COLEAD

GOOD PRACTICE GUIDE

AVOCADO VALUE CHAIN

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FOREWORD

Through the process of data collection in collaboration with the industry stakeholders, a set of information that is a true reflection of what is happening in the industry has been collected, analyzed and compared with what should be happening in the industry to develop a self-assessment guide for Avocado for the sector.

There are many choices that can be made in the handling of protocols of Avocado, as well as numerous steps in the supply chain. The layout of the guide is based on each step in the supply chain, so operators within each step can easily access suggested protocols.

Against the recent market notifications which could lead to a complete ban of Avocados from Kenya, the purpose of the guide is to flag and emphasize on issues of particular importance to the maintenance of quality and compliance with sanitary and phytosanitary requirements through the entire distribution chain, so that operators can include critical aspects in their own detailed operations protocols.

In order to protect this sector and safeguard Kenya's market share in the international market, a code of practice that is in compliance with standards and regulatory requirements must be put in place.

The main objective is therefore to develop a sectoral Good Practice Guide for Avocado, based on the results of the analysis of the sanitary and phytosanitary risks and problems related to commercial quality/post-harvest losses caried out on all production operations (entire value chain), and thereafter submitted for validation by stakeholders.

The GPG has been developed by the National Horticulture Taskforce and will be subjected to a review from time to time to make it compliant with changes in the market as they emerge. Much as it has been done with support from COLEAD, the document belongs to the industry and therefore professionals from the sector should disseminate and help in its implementation and also ensure it is updated regularly.

1

INTRODUCTION

1.1. PURPOSE AND SCOPE OF APPLICATION

The Good Practice Guides (GPG) are considered by both the Codex Alimentarius and the European Commission (Regulation on Official Controls (EU) 2017/625 - official controls throughout the food chain[1] Hazard Analysis Critical Control Points (HACCP) principles) and thus to prevent and control SPS risks.

The Guide of Good Practices that has been elaborated for the Avocado sector is based not only on the usual recommendations of Good Hygiene Practices, but also on a systematic analysis approach of the "HACCP" type (analysis of the different stages of production, identification of hazards and evaluation of the level of risk) that has been applied, both to sanitary and phytosanitary risks, within the Avocado sector. This guide will allow:

1. To facilitate the compliance of practices and products: to help professionals in the Avocado sector to control the commercial quality and sanitary and phytosanitary safety of products so that they meet the requirements of the destination market (national, regional or export).
2. To facilitate the recognition of compliance with standards and regulatory requirements by professionals: to obtain recognition of the capacity of operators in the sector by the local Competent Authorities (C.A.) and those of the destination market, it is a question of: (i) demonstrating their capacity to effectively control SPS risks; (ii) obtaining a more favourable "risk profile" that can reduce the burden of official control; (iii) facilitating sanitary and phytosanitary inspections by communicating their "Integrated Control Plan" indicating the critical control points (CCP) in the processes and the control measures implemented; (iv) more easily obtaining certification of their Sanitary and Phytosanitary Quality Management System (SPSQMS) as well as export certification for their products (issuing Phytosanitary Certificates).
3. To facilitate dialogue and the exchange of practices in the sector: to establish an open and permanent dialogue between private and public sector stakeholders in order to agree on control methods as well as on the internal controls that will have to be set up within companies, from the plot of land to the shipment of the finished product.
4. To be a pedagogical tool: the GPG was written to be a practical tool, facilitating the understanding of objectives, content, and methods (e.g., HACCP) by professionals. A user manual explains how to implement the GPG recommendations, step by step, to be easily understood by those in charge of the Avocado sector and to be used by company managers, by production or packaging station managers, by quality and traceability managers or by inspectors in charge of official controls in the sector.

1 The Official Controls Regulation (EU) 2017/625 deals with official controls and other official activities carried out to ensure the enforcement of food and feed law, animal health and welfare, plant health and plant protection product rules (Official Controls Regulation - OCR). The Regulation establishes a control system based on risk assessment to ensure that responsible authorities at national level carry out official controls where they are most needed. In Article 14, the Regulation states: *"Methods and techniques for official controls shall include the following activities: (a) an examination of the controls put in place by operators and of the results obtained;"*.

1.2. GROUP AND WORKING METHOD

1.2.1. WORKING GROUP (COMPOSITION, REPRESENTATION OF THE AVOCADO SECTOR)

The design and drafting of this Guide were carried out by a Technical Working Group (TWG), supported by a Steering Committee (SC), with the collaboration of apex export and producer associations, company managers, experts and with the support of scientific and technical experts from research institutions and COLEAD. Refer to Tables 1, 2 and 3 for SC, TWG and Co-opted members composition.

Table 1 — Composition of the Steering Committee

LAST NAME, FIRST NAME	ORGANIZATION	FUNCTION	MANDATE IN THE STEERING COMMITTEE
1. Mr. Benjamin Tito	AFA- HCD	MD	Chair
2. Mr. Ernest Muthomi	ASOK	CEO	Co-Chair
3. Ms. Deborah Shituvi	KEPHIS	Plant Inspector	Secretary
4. Dr. Kimaru Stanley	KU	Senior Lecturer	Co-Secretary
5. Mr. Hosea Machuki	FPEAK	CEO	Member
6. Mr. Okisegere Ojepat	FPC	CEO	Member
7. Dr. Kimani Esther	PCPB	CEO	Member
8. Dr. Lusike Wasilwa	KALRO	Director Crop Systems	Member
9. Mr. Amos Ndalutt	MoALFC	Agricultural Officer	Member
10. Mr. Richard Ndungu	Kenya Chamber of Commerce	Vice Chairman KNCCI Kiambu County	Member
11. Mr. Philip Mutooni	Avocado Exporters Association	CEO	Member

Table 2 — Composition of the Technical Working Group

LAST NAME, FIRST NAME	ORGANIZATION	FUNCTION	MANDATE IN THE WORKING GROUP
1. Mr. Richard Collins	Kakuzi PLC	Regional New Crops Development Manager	Chair
2. Grace Kyalo	Agriculture and Food Authority -Horticultural Crop Directorate (HCD)	Head, Technical and Advisory Services	Secretary
3. Dr. Lusike Wasilwa	Kenya Agricultural Livestock Research Organization (KALRO)	Director Crop Systems	Representative Steering Committee
4. Dr. Joseph Kori Njuguna	Kenya Agricultural Livestock Research Organization (KALRO)-Horticultural Crops Institute (HRI)	Senior Research Scientist	Member
5. Mr. Richard Ndugu	Kenya Chamber of Commerce	Vice Chairman KNCCI Kiambu County	Member
6. Mr. Ernest Muthomi	Avocado Society of Kenya (ASoK)	CEO	Member
7. Mr. Raphael Wafula	Fresh Produce Consortium (FPC)	Technical and Compliance Officer	Member
8. Mr. Philip Mutooni	Avocado Exporters Association	CEO	Member
9. Dr. Githaiga Wagate	Pest Control Products Board (PCPB)	Registrations Officer	Member
10. Nicholas Muendo	Pest Control Products Board (PCPB)	Pesticide Inspector	
11. Moraa Sylvia	Pest Control Products Board (PCPB)	Pesticide Inspector	
12. Mr. Amos Melly Ndalutt	Ministry of Agriculture Livestock, Fisheries and Cooperatives- State department of Crop Development and Research	Agricultural Officer	Member
13. Ms Jackline Chege	Ministry of Agriculture Livestock, Fisheries and Cooperatives- State department of Crop Development and Research	Agricultural Officer	Member
14. Ms. Deborah Shituvi	Kenya Plant Health Inspectorate Services (KEPHIS)	Plant Inspector	Member
15. Mr Josiah Syanda	Kenya Plant Health Inspectorate Services (KEPHIS)	Senior inspector and Phytosanitary expert	Member
16. Mr Paul Peter Muthanga	Fresh Produce Exporters Association of Kenya (FPEAK)	Technical & Standards Officer	Member
17. Ms Rosemary Muita	Great Global Growers (Representing Farmers)	CEO	Member

LAST NAME, FIRST NAME	ORGANIZATION	FUNCTION	MANDATE IN THE WORKING GROUP
18. Dr. Stephen Tarmogin	Farmtrack Consulting	Plant Health Expert	COLEAD Consultant
19. Beatrice Opiyo	Direne Packaging & Business Advisory Services	Food Safety and Quality Expert	COLEAD Consultant
20. Dr. MaryLucy Oronje	CABI	Scientist, SPS	COLEAD Consultant

Table 3 — Co-opted TWG Members

LAST NAME, FIRST NAME	ORGANIZATION	SPECIAL SKILLS	ACTIVITIES CARRIED OUT
Ruth Vaughan	Crop Nutritions Ltd	Co- Opted member	Crop Nutrition requirements
Brian Gesimba	Amiran	Co- Opted member	Land cultivation and irrigation requirements
Bob Weyn/ Yannick Weyn	Gateway Marine Services Ltd	Co- Opted member	Shipping requirements

1.2.2. WORKING METHODOLOGY FOLLOWED

The drafting of this Guide for the Avocado sector has been carried out according to the recommendations of COLEAD's "**Manual for the drafting of Good Practice Guides**", by implementing the actions planned in the 4 stages:

STEP 1: ORGANIZATION AND LAUNCH OF THE PROJECT

- Organization of a Launch Workshop
- Setting up the Steering Committee
- Creation of a "Working Group" and appointment of the Project Manager

STEP 2: FIELD SURVEYS (IN COMPANIES IN THE SECTOR AND/OR THE MAIN PRODUCTION AREAS) AND INVENTORY OF RELEVANT SPS REGULATIONS AND STANDARDS FOR THE SECTOR

- Carrying out a field survey of the sector
- Inventory of analytical and diagnostic laboratory capacities
- Inventory of national and regional SPS legislation and applicable standards
- Drafting of a summary submitted to the Steering Committee

STEP 3: DRAW UP A DRAFT GOOD PRACTICES GUIDE, AFTER ANALYZING THE HAZARDS AND IDENTIFYING THE CONTROL MEASURES TO BE RECOMMENDED

- Plant health assessment looked at all potential pests affecting avocado during its active growth considering market requirements of the final exported product
- Quarantine pests for key exports markets were categorized and monitoring and management practices proposed
- Phytosanitary measures for the quarantine pests are included for key markets; EU, China, India and South Africa
- Analysis of practices with the 5M method and proposal of general hygiene recommendations (or PRP, Programme Requirements Prerequisites).
- Assessing the level of risk and identifying IPs (points of attention) and CCPs on the process
- Proposal of control measures to be implemented in the sector
- Proposal of the checks to be set up in the sector
- Drafting of a complete draft Good Practice Guide

STEP 4: FINALIZE AND DISSEMINATE THE GOOD PRACTICE GUIDE

- Finalization of the Good Practice Guide
- Organization of a workshop to restitute and validate the guide
- Preparation of an “action plan”.

1.3. RESOURCES AND SKILLS MOBILIZED FOR THE DRAFTING OF THE GUIDE

The resources and skills mobilized for the drafting of the guide consisted of:

1. A CONSULTATION OF STAKEHOLDERS IN THE SECTOR IN THE DIFFERENT PRODUCTION BASINS

On the basis of semi-structured questionnaires, elaborated from the diagrams of the production process, the meetings of the different stakeholders made it possible:

- To collect technical information on the implementation of their activities, in order to determine: (a) the operations carried out at this stage of the process; (b) the practices and conditions under which they take place; and (c) the potential risks associated with each stage of production;
- To update and validate the flow-chart on the entire value chain, detailing all the stages of production, from the nursery to the final marketing of all the products made by the actors in the Avocado sector (Farmers, aggregators, packhouses, transporters, shipping companies).

2. A DOCUMENTARY REVIEW

A set of reference documents was consulted, and the literature review was supplemented by Internet searches in order to gather relevant agronomic information, regulations and standards related to sanitary and phytosanitary risks, as well as trade standards applicable to the Avocado sector both at national and international level. Bibliographical references and URL indications (addresses of websites consulted) are given in Part C of the Guide.

3. THE MOBILIZATION OF SCIENTIFIC AND TECHNICAL EXPERTISE FOR THE DRAFTING OF THE GUIDE

The drafting of this Guide required the contribution of local and external expertise, composed of three national consultants with complementary profiles and a good knowledge of the avocado sector and an external expert in charge of the scientific validation of the risk assessment and the general revision of the Guide's drafting.

1.4. HOW TO USE AND DISTRIBUTE THE GPG

WHO CAN USE THE GPG

This guide is intended for use by any actor in the Avocado sector whose activities or operations may have an impact on the safety and/or quality of the products. Such activities or operations may involve performing one (or several) of the following roles:

- **Producer/Farmer** – produces and harvests but may also carry out the packaging, shipment, and export of Avocado.
- **Agent/Aggregator** – from small-scale farmers e.g., agents who may also transport the produce and deliver it to exporters/place it on the local market for sale to consumers
- **Transport operator** – transports the produce right through the supply chain
- **Packer and exporter** – receives the Avocado from various suppliers, carries out sorting and grading of the produce and then packages it at logistics units (pack houses) and/or at consumer units (supermarkets) or in containers with the aim of placing it on the market
- **Production manager, quality manager, internal auditor, inspector and certifier** for the self-assessment system.

The GPG offers players in the Avocado sector (professionals, producers, aggregators and exporters) the criteria of risk profiles and guidance on actions to enable mitigation of food safety risks and non-conformance with safety and quality standards from the production and harvesting stage through to placement of the produce on the market. The GPG gives guidelines on production of Avocado transported by road, sea, rail or air with the intention to be marketed locally, regionally and internationally, with particular relevance to Kenya and the EU.

HOW TO USE THE GPG

This Guide provides professionals, nursery operators, producers, processors and distributors in the Avocado sector with the **means and methods to control the sanitary, phytosanitary and commercial quality of** products, from the field production stage to dispatch.

Compliance with the requirements and practices proposed in this Guide ensures that all operators in the Avocado chain that the operations carried out and the hygiene measures implemented in each production unit are suitable for ensuring the safe consumption of the products and that they are subject to constant and appropriate monitoring.

THE GPG IS VOLUNTARY

Each operator in the sector can take inspiration from the "**practical sheets**" and "**check lists**" proposed, but it is advisable to adapt them to his situation.

On the basis of an **analysis of the different stages of the production process**, an assessment of the SPS risks in the value chain and traceability requirements, the Good Practice Guide informs operators, internal or external inspectors/auditors about;

1. **What you need to know**: At this level, the **main hazards or dangers** that may arise during operations and result in a risk of non-compliance with applicable regulatory or commercial requirements must be identified and then addressed by appropriate control measures and controls. Hazards may be of a (micro) biological, including pests, chemical or physical nature or result from the non-control of a process which may have an impact on commercial quality criteria (taste, colouring, maturity, etc.).
2. **What needs to be done:** these are the **preventive or control measures (including ISPMs) whose implementation is recommended, and which have been identified as relevant and effective by a hazard analysis** (using the HACCP approach). Each operator is free to adapt the proposed pest management and hazard control recommendations and provisions of the Guide according to his needs and means, but the control measures proposed for the sector in this Guide aim to guarantee operators the sanitary and phytosanitary safety of their products.

   Depending on the key pest population level and **level of risk identified, i.e., the** probability of the hazard appearing and the severity of its impact, a **rating for the** prevention or control measure is defined in the "control plan" for pest management section and for sanitary and phytosanitary and quality section. According to the rating system adopted in the Guide, **the requirements** sanitary and phytosanitary and quality **are divided into 3 levels according to the estimated risk**:

MAJOR REQUIREMENTS

They relate to preventive or control measures whose failure to implement them may lead to non-compliance with a high probability of non-compliance, the impact of which may be serious on the commercial quality of the product or the health of the consumer. For example, poor conditions for handling, storing and application of pesticides can lead to the presence of residues in avocado. Poor handling practices during harvesting, transport and packaging can result in contamination with highly toxic substances and pathogenic microorganisms such as *E. coli* and *Salmonella spp*. The absence or break in the traceability of batches, from production to export, is also a major requirement. In this GPG, quality aspects affecting avocados that can result in market rejection has also been considered as major requirements. For example, fruit maturity/low dry matter content and size.

MINOR REQUIREMENTS

They relate to preventive or control measures whose non-implementation may lead to non-conformity, whose impact is real on the commercial quality of the product or on the sanitary quality but without causing serious and/or irreversible harmful effects (e.g., lack of training of personnel and its repercussions on the handling of the product).

RECOMMENDATIONS

They relate to control measures whose non-implementation does not have a significant detrimental impact on the sanitary, phytosanitary or commercial quality of the product.

3. **What to record:** the main data to be recorded

   Traceability is a regulatory requirement for all food products. Traceability must make it possible to trace a batch of products and to isolate it if necessary (e.g. detection of non-conformity). Compliance with traceability requirements is one of the objectives of this Good Practice Guide. All data or information that must be recorded or documented are defined in this Guide.

4. **Useful appendices**: examples of "Practical Sheets" (procedures), models of "self-checklists" that can be used to implement the self-checking system; as well as documentation, models of teaching aids, etc.

5. **The educational tools to be used:** to raise awareness among the players in the sector about the Good Practices to be implemented.

1.5. DISSEMINATION (MANAGEMENT, UPDATING AND CONDITIONS OF ACCESS TO THE GUIDE)

Distribution of the Guide is restricted to operators in the Avocado sector. Online access of the guide will be through a link provided by GPG Secretariat (HCD). The printed version of the GPG may be subject to a charge and can also be obtained from HCD (Nairobi Horticultural Centre next to JKIA, P.O. Box 42601 - 00100; Telephone: 020-2088469; Email: directorhcd@afa.go.ke; Website: www.afa.go.ke).

This GPG for the avocado sector is regularly updated. The version number and the date of entry into force are mentioned at the beginning of the Guide.

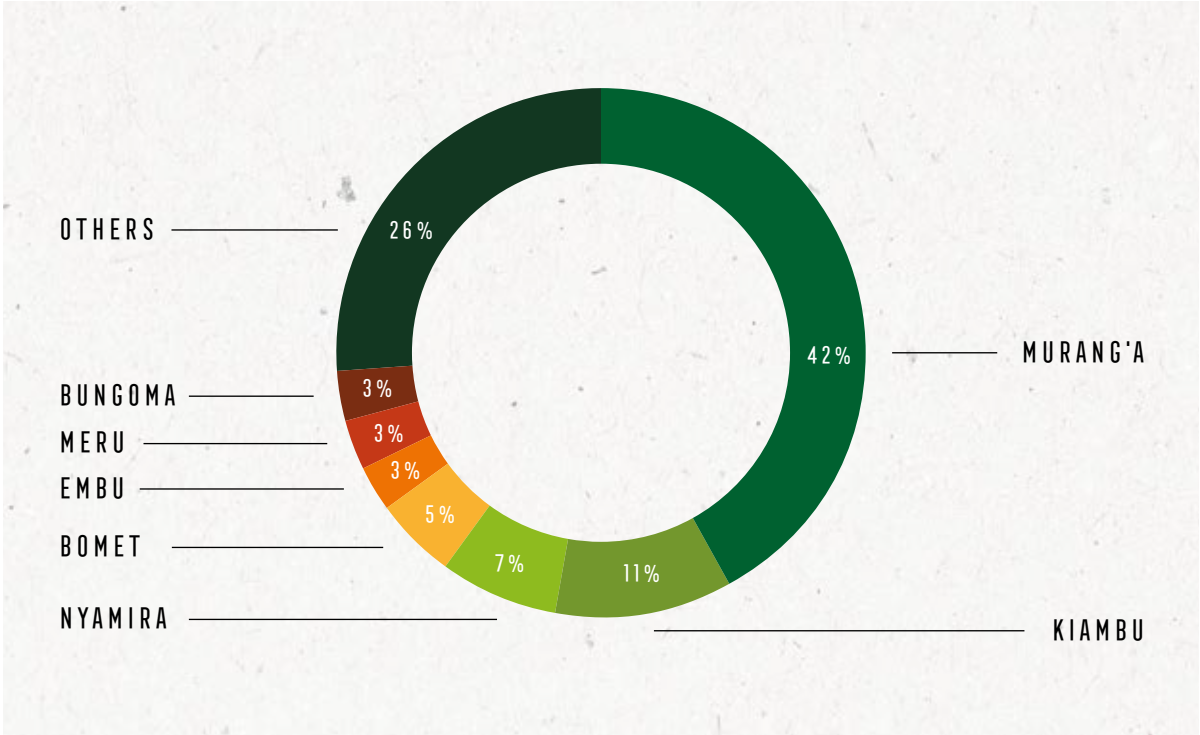
2

ECONOMIC AND SOCIAL STRUCTURE OF THE INDUSTRY OR SECTOR

Kenya is the world's third largest producer of avocados producing an estimated 420,430 tonnes of avocado in 2019 over an acreage of 20,240 Ha (HCD, 2020). About 70% of the avocado is grown by small-scale farmers for subsistence, for the local markets, and for export. Most of the avocado produced in Kenya (about 85%) is domestically consumed and only about 15% is exported. Avocado is also Kenya's leading fruit export, contributing 80.62% of the total fruit export value. Similarly, avocado constitutes about 17% of the total horticultural exports from Kenya to the European Union. As of 2017, Kenya was classified as the largest exporter of avocados in Africa according to statistics by the International Trade Center (ITC), exporting approximately 51,507 tonnes of the fruit. The country grows over 40 varieties of avocado, with Hass variety being the main export variety because of its higher fat content than other varieties which gives it a richer taste while Fuerte is preferred for processing.

Most of the avocado produced in Kenya is grown by small scale farmers spread across counties in Central, Western and Eastern parts of the country including Murang'a (42.0%), Kiambu (10.1%), Kisii (10.9%), Nyamira (9.9%), Meru (5.3%) and Embu (4.6%). Most of these avocado growing regions are in the highlands with an altitude range between 1,200 and 1,800 m a.s.l. Other avocado growing regions include Kirinyaga, Bungoma, Machakos, Migori, Elgeyo Marakwet, Nyeri, Bomet, Homabay and Kericho (HCD, 2018) (Fig 1 and 2).

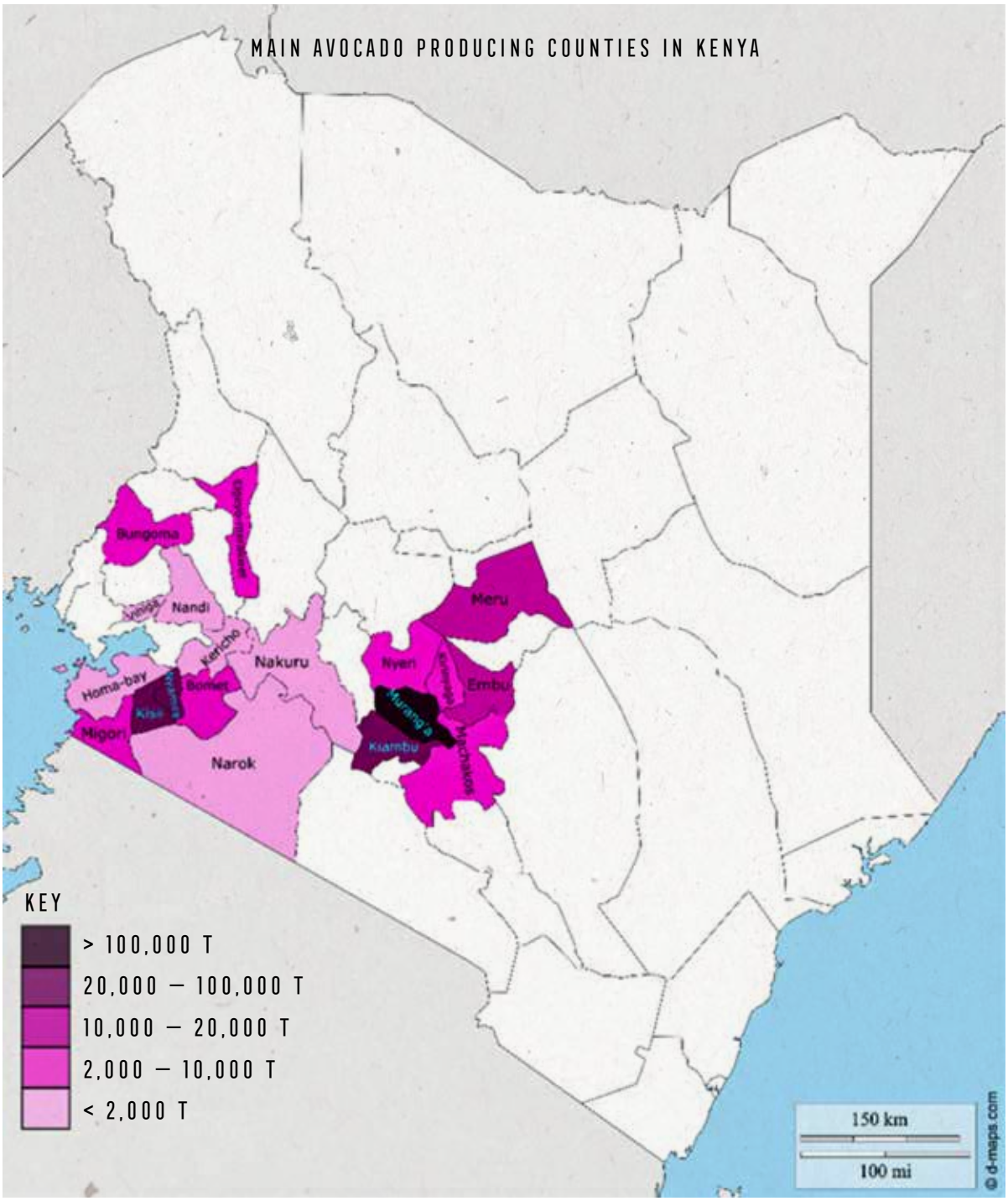
Figure 1 — Top Avocado producing counties by % share in 2018 (HCD, 2018)



Whereas Kenya ranks top in production, it exports only about 15% of its total avocado production compared to other top producers like South Africa exporting about 60% of its avocado production; and Chile, 55%. The difficulty of increasing the export share is often attributed to poor quality; high regulatory standards in export markets; the weak institutional capacity of small-scale producers; and inadequate capacity for,

and coordination of, fruit exportation (Amare et al. 2019). The poor quality of Kenyan avocados is mainly due to the inadequate knowledge of modern production practices on the part of small-scale producers, who have traditionally grown their trees for domestic markets or for noncommercial purposes, and to the limited dissemination of market-preferred varieties. Given the weak organization of avocado markets, most smallholder growers market their produce through middlemen, who may be legally certified agents or unofficial brokers (Amare et al. 2019).

Figure 2 — Map of Kenya showing the major avocado producing regions (HCD, 2019)



The avocado export market in Kenya is dominated by exporters including Kakuzi PLC, Keitt Exporters ltd, Vegpro Kenya ltd, Sunripe ltd, Kenya Horticultural Exporters ltd, East African Growers ltd, Mofarm fresh fruits exporters ltd, Afrex Gold ltd and Fair farm exporters ltd among others mostly exporting Hass and Fuerte varieties. These companies are the main stakeholders in the export of the product and source their avocados primarily from smallholder farmers, although some firms also source from larger growers or own plantations.

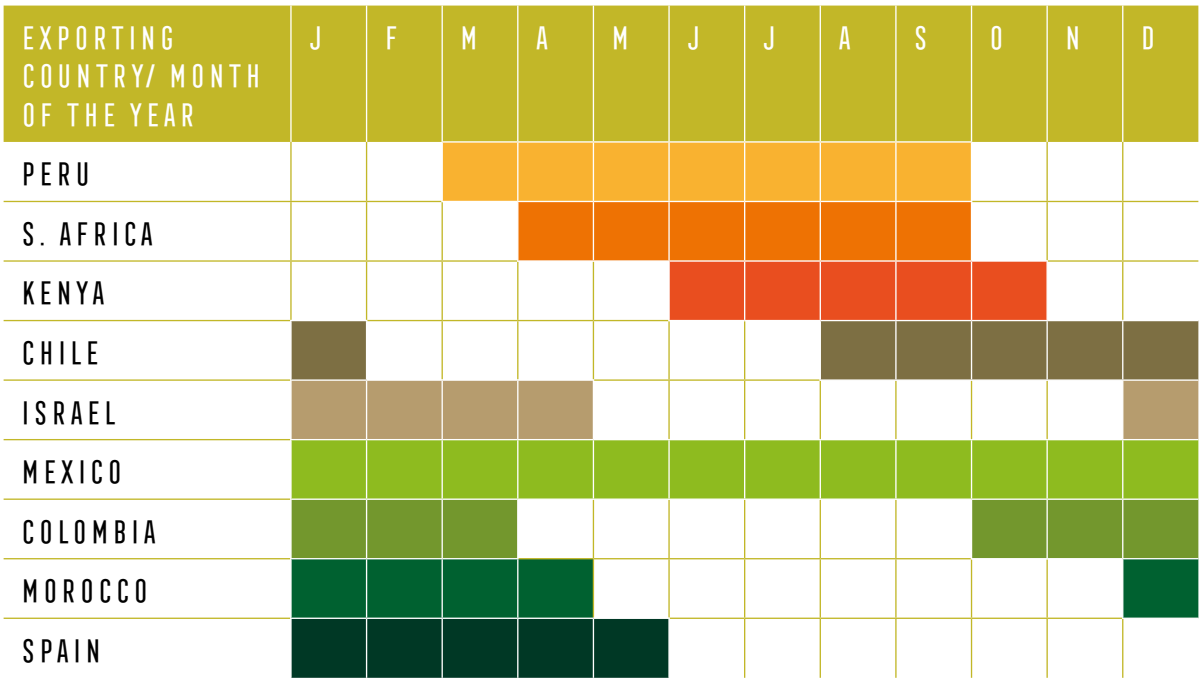
The stakeholders among the regulatory bodies in the avocado sector include Kenya Plant Health Inspectorate Service (KEPHIS), Horticultural Crop Directorate (HCD), Ministry of Agriculture Livestock and Fisheries, Pest Control and Products Board (PCPB), Kenya Agricultural Livestock Research Organization (KALRO), National Public Health Laboratory Services, Ministry of Trade, Kenya Bureau of standards (KEBS), and the different county Governments (Council of Governors). KEPHIS are actively involved in monitoring as well as educating farmers and exporters.

Other stakeholders are Fresh Produce Exporters Association of Kenya (FPEAK), Society of Crop Agribusiness Advisors, Agrochemical Association of Kenya, Learning and research institutions like universities. Fresh Produce Consortium of Kenya (FPC Kenya), Avocado Society of Kenya (ASoK), Avocado Exporters Association of Kenya (AEAK) who are providing advocacy and capacity building to their members on available markets and the required standards. There are different Farmer Cooperatives e.g., Mathioya Avocado Farmers' Co-operative Society and also stakeholder forums that are formed from time to time, e.g. Miranda County Avocado stakeholder's forum, Meru County Avocado stakeholders' forum.

2.1. PARTICULARITIES OF THE MARKET(S) CONCERNED

The Kenyan avocado industry is export-orientated and among the fastest-growing exports in the world. In 2018, total fresh and frozen avocado export was valued at $ 119 million with main markets namely, Netherlands (37.2%), France (20.7%), and Russia (10.9%) for fresh avocado. Kenya's exports to the African region were estimated at $ 0.3 million and accounted for 15% of the region's imports. The main exporters of fresh avocado include Peru, South Africa, Kenya, Chile. Main export months for fresh avocado are from June to October every year (see table 4 below).

Table 4 — European major exporters' indicative supply calendar for avocados (Hass avocado)



Source: ICI Business (http://www.icibusiness.com/)

As per the Vision Data, of 2018 the actual marketed avocado fruits in Kenya were 287,868 tonnes. Out of this, 64,477tonnes was exported to international markets, 15,904 tonnes were consumed on-farm while 223,391 tonnes were sold through informal traders in the local market. In the same period, there were 156 registered exporters although only 94 were active according to the National Avocado Promotion Strategy (MoALFC, 2020.).

Most exports of fresh avocado are to EU markets, Middle East, and until recently, China and South Africa. The total export volume and value has been increasing steadily from 2017 to 2018 with a slight decrease in 2019 (Table 5).

Table 5 — Exports of fresh avocado fruits from Kenya (USD'000)

MARKETS/YEAR	2017		2018		2019	
	QUANTITY (TONS)	USD ('000)	QUANTITY (TONS)	USD ('000)	QUANTITY (TONS)	USD ('000)
EU	26,274	41,866	42,954	77,086	35,788	61,911
MIDDLE EAST	19,044	26,271	20,473	28,108	21,553	31,170
COMESA	1,248	1,226	1,440	1,365	1,986	1,789
CHINA	25	38	0	0	10	34
SADC	0	1	27	21	29	107
ECOWAS	0	0	3	7	0	0
TOTAL EXPORTS	51,507	77,997	71,879	118,303	63,356	102,573

Adapted from HCD, 2019

NOTIFICATIONS ON AVOCADO

The number and type of notifications (RASFF, EUROPHYT or others) received for these products should be clearly indicated.

— EUROPHYT interception in 2018 due to presence of quarantine insect pests indicated as lepidopteran observed on exported avocado fruits to the EU (EUROPHYT, 2019).

— In 2020, there were 3 interceptions due to documentation issues. Phytosanitary certificates accompanying exported fresh avocado fruits were missing appropriate additional declarations; plant name not indicated or incomplete in the phytosanitary certificates (EUROPHYT, 2020).

The RASFF database provides for access to noncompliant notifications issued by the EU countries on the exported food and feed.

— In 2018, Kenya received 1 (one) interception notification on avocado including unauthorized use of substance carbofuran (0.015 mg/kg) in organic avocado exported through the Netherlands, the avocado fruits were packaged in Denmark. This serious non-compliance was detected during the importing company checks and the product distributors were notified (RASFF, 2018).

2.2. SIZE AND CHARACTERISTICS OF THE COMPANIES IN THE AVOCADO SECTOR

There are several companies in Kenya who export avocado including: Keitt, Kakuzi, Vegpro, Sunripe, Olivado, Biofarms, Mofarms, Kenya Horticultural Exporters, and East African Growers among others who mostly export the Hass and Fuerte varieties. These companies are the main stakeholders in the export of the product and source their avocados primarily from smallholder farmers, although some firms also source from larger growers or own plantations. Additionally, some companies produce other avocado products such as oil, puree for both local and export markets.

Kenya has witnessed a sharp increase in the number of countries interested in its avocados, including Russia, Hong Kong, Singapore, Belgium, Germany, Netherlands, France, Spain, Iran, Libya, and Egypt among others. Kenya currently exports mainly to the European Union, United Arab Emirates, Saudi Arabia, Russia, Singapore, Egypt, Malaysia, Oman, Hong Kong, Qatar, Kuwait, Morocco, South Africa and Ghana.

The European Union is the leading importer of avocado from Kenya followed by the United Arab Emirates. Kenya exported 64,477 tonnes of avocados in 2018 and 59,331 tonnes in 2019. From January to June 2020, the County exported 58,426 tonnes valued at Kshs. 8 billion.

2.3. CHARACTERISTICS OF THE SITES AND FACILITIES, THE ENVIRONMENT

An estimated 70% of Kenyan avocados are produced by smallholder farmers. Most of them own less than 2 acres of land. The avocado smallholder on average has 10-20 trees per homestead and constitutes a greater percentage of the estimated 136,623 known avocado farmers. Of these 130,424 are smallholders, 6,114 are medium holders and 85 are large scale. When not linked to exporters through an out-grower scheme, farmers market their avocados through middlemen, either legally government-certified agents or unofficial brokers. These middlemen typically harvest avocados themselves and organize transport to Nairobi packhouses. This initial leg of transport from farm to packhouse is usually done with small open trucks and pickup trucks. This transport mode triggers approximately 5% food loss, mainly due to sun exposure on the top layer of fruit, but also due to spillage.

Once at the factory, avocados are quality-checked, sorted, washed, waxed, pre-cooled and packed in cartons. Once packed, exporters stuff the cartons into refrigerated containers ("reefers") outside the processing gate, and shipping companies then transport the reefers to the Mombasa port. Mombasa is the pivotal port for East African countries and is accessed via the main corridor, the Nairobi-Mombasa highway. Once in Mombasa, the reefers, which are controlled-atmosphere-treated, are loaded onto a ship and later trans-shipped in Salalah, Oman. Finally, the reefer containers are unloaded in Europe and delivered to importers.

In addition to overland transport challenges, Kenyan exporters face a strong competitive disadvantage versus exporters in Peru and South Africa due to trans-shipping at the Salalah port in Oman. Peruvian and South African avocados are shipped directly to Europe ships from Kenya, however, have to steer wide of the Somalian coast for piracy reasons, making the trip longer and more expensive due to insurance coverage. Vessels sometimes miss the trans-shipment in Oman and must wait for a week in Salalah's port. This leads to a significant impact on operations. Another contributing factor is that the peak period for Kenyan avocados occurs during the Khareef, or monsoon season, in Oman; the severe weather significantly affects operational efficiency at Salalah's port.

Most often vertically integrated with exporters, packers procure and package a 4-kilogram (kg) carton of avocados at a cost of about US$ 4.10. An additional US$ 1.60/carton is required for shipping to Europe by sea in a reefer. Despite the import price fluctuating around US$ 7-8/carton, the supply chain overally is profitable.

2.4. USE OF INPUTS IN THE SECTOR

WATER

Most avocado growers in Kenya rely on rainfall for production. A well distributed annual rainfall of between 1000-1200mm rainfall is adequate for proper crop development with up to 1600 mm optimal for good production. Climatic conditions with alternating dry and rainy seasons encourage flowering and fruit development. High rainfall may result into flower abortion, high occurrence of fungal diseases and reduced yields. The avocado tree requires high relative humidity at flowering, about 70-80 %, then moderate levels during the fruit swelling stage. Too much humidity encourages the proliferation of pests and diseases such as scales, scab and anthracnose among others.

In drier areas, irrigation water is used to supplement rainfall and should be at least 25mm per week. This may be from a stream/river source or harvested rainfall water stored in open water pans, underground tanks, etc. Irrigation water should be tested to determine levels of PH and salinity. It is important to undertake irrigation water risk analysis for salts, heavy metals, pesticides residues and presence of waterborne disease-causing pathogens

SOIL FERTILIZERS AND IMPROVERS

In most growing areas, avocado growers use limited or no fertilizers in their orchards. In some instances, fertilizer and manure are applied at planting time with limited or no further application during the active growth, flowering, and fruiting of the trees. Basal fertilizers such as DAP, CAN NPK, Urea and foliar fertilizers for both macro and micronutrients are applied. Compost manure is used to apply to the base of trees to improve nutrition and soil organic matter. Most farmers do not undertake soil or leaf nutrient analysis before application of fertilizers or manures.

POST-HARVEST PRODUCTS

Post-harvest products include 1-Methylcyclopropene 6.3g/L e.g. SMARTFRESH as an ethylene inhibitor to be control related disorders and protects from the various adverse effects of ethylene and deterioration of quality due to early ripening during shipment to market destination. Other post-harvest products used are food grade wax, fungicide.

PESTICIDES

Most avocados produced in Kenya have minimal use of pesticides for the management of key pests (anthracnose, stem end rot, fruit flies, false codling moth). Pest Control Products Board (PCPB) of Kenya has registered and approved conventional active ingredient and biopesticides and post-harvest products for use on avocado (see table 6

and link below). For some pests and diseases, there are no registered/approved pest control products presenting a potential gap for unauthorized use of other approved or unauthorized molecules. Approved pesticides commonly used for field pest and post-harvest management in avocado production are listed in table 6 below.

Table 6 — Approved pesticides for field pest and post-harvest management in the sector

TRADE NAME	ACTIVE SUBSTANCE (S) AND CONCENTRATION (S)	FORMULATION (CODE)	TYPE OF ACTION	TARGETED PESTS	APPLICATION RATE	PRE- ENTRY INTERVAL	WHO CLASSIFICATION	ACCEPTABLE MRL (EU)
CONVENTIONAL PESTICIDES								
SMARTFRESH	1-Methylcyclopropene 6.3g/L		Post-harvest treatment in sealable containers to maintain condition and quality of Avocados.	controls the development of ethylene-related disorders and protects from the various adverse effects of ethylene	1 pink Pro Pack per 270 -360cubic ft	-	-	0.01mg/kg
TECTO 500 SC	Thiabendazole 500g/L	Suspension Concentrate	Systemic with protective and curative action for post-harvest disease	Anthracnose	465ml/100liters of water	12 hours	*Class III*, Unlikely to present hazard in normal use Green color band.	20mg/kg
TOPSIN M LIQUID	Thiophanate-Methyl 500g/L	Wettable Powder	Systemic preventive and curative fungicide	Powdery mildew	100g /100 litres of water	12 hours		0.1mg/kg

ISOMATE-FCM DISPENSER	CRYPTEX	CERATITIS – BLOCK BLOCK	LIBERATE	BACTROCERA BLOCK BLOCK
E-8-dodecen-1-yl acetate 166.8 mg + Z-8-dodecen-1-yl acetate 70.8 mg + E-8-dodecen-1-ol 2.4 mg	Cryptophlebia leucotreta granulovirus CrleGV 2*1010 occlusion bodies/mL	Enriched ginger root oil 13.5 % + Malathion 50 %	Methyl Eugenol 99 % + Malathion 50 % (w/w)	Methyl Eugenol 99 % + Malathion 50 % (w/w)
	Suspension concentrate			
	Biological insecticide for control	Attractant	A wooden block impregnated with an attractant and an insecticide	A wooden block impregnated with an attractant and an insecticide
False Codling Moth (*Thaumatotibia leucotreta*)	False Codling Moth (*Thaumatotibia leucotreta*)	of Fruit flies (*Ceratitis capitata*)	Control of fruit flies (*Bactrocera dorsalis*)	Fruit flies (*Bactrocera dorsalis*)
Class U Unlikely to present hazard in normal use Green Color Band	WHO Classification not applicable for microbial pesticides	*Class II* Moderately hazardous Yellow Color Band	*Class II* Moderately hazardous Yellow Color Band	*Class II* Moderately hazardous Yellow Color Band
-	-	Malathion 0.02 mg/kg	Malathion 0.02 mg/kg	Malathion 0.02 mg/kg

BIOPESTICIDES

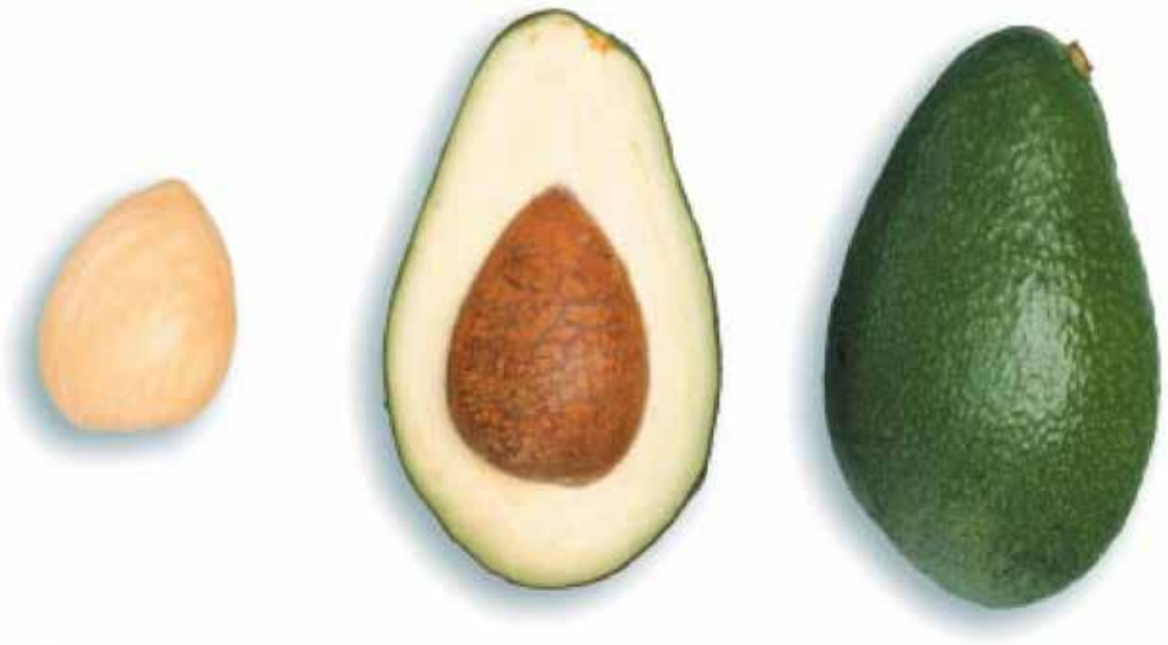
To access the most recent information on approved pest control products for avocado, use the following links: https://www.pcpb.go.ke/crops/ and https://www.pcpb.go.ke/biopesticides-on-crops/

2.5. DEFINITION OF THE PRODUCTS

This Good Practice Guide applies to all varieties of avocados (*Persea americana* Mill) of the family Lauraceae to be supplied fresh or frozen to the consumer after preparation and packaging. Table 7 below describes the different avocado varieties and their characteristics.

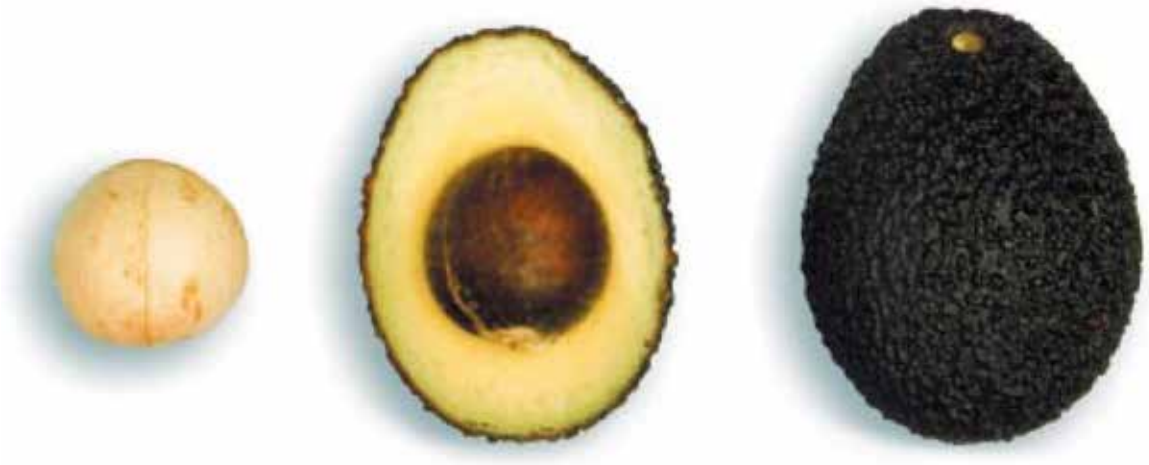
Table 7 — Different Avocado varieties and their characteristics

CULTIVAR (VARIETIES)	PRODUCTION	FURTHER PRODUCT INFORMATION
Fuerte – (A hybrid between *Guatemalan* and *Mexican races*)	Fruit matures 6-8 months after flowering.	One of the most popular cultivars for export in many parts of the world. It has flower Group B. Fruits are green, slightly pebbled with good flavour. Skin is thin and the seed is medium and conical.



Fuerte avocado (Photo: Newett et al., 2001)

CULTIVAR (VARIETIES)	PRODUCTION	FURTHER PRODUCT INFORMATION
Hass (*Guatemalan race*)	It matures 8-9 months after blossoming.	Very popular for the export market. A vigorous upright tree and is a consistent bearer, flower Group A. The fruit is green at early stages and then brown on maturity. Very slightly pebbled, pear-shaped. Skin is thin and leathery.



Hass avocado (Photo: Newett et al., 2001)

Nabal (*Guatemalan race*)	It matures 8-9 months after blossoming.	Fruit is green, smooth, almost spherical or slightly oval. Flavor is good. Bears in alternate years. Flower Group B

Nabal avocado, Source: Specialty Produce, 2022
Source: https://specialtyproduce.com/produce/avocados/nabal_11226.php

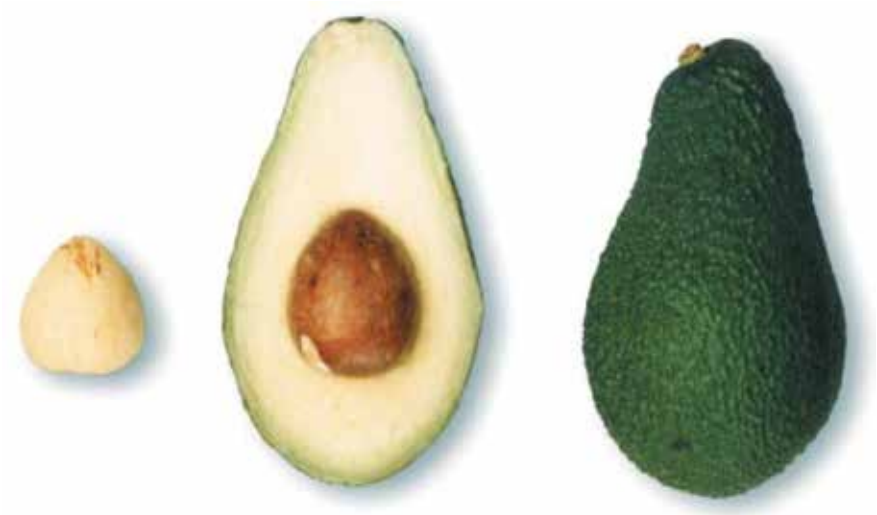
CULTIVAR (VARIETIES)	PRODUCTION	FURTHER PRODUCT INFORMATION
Puebla (*Mexican race*)	It matures 5-7 months after blossoming	A spreading, dark green tree. Fruit is deep maroon, purple, smooth, glossy and roundish. Seed is medium sized and somewhat conical. Flavor is good. In Kenya, Puebla fruits are sold locally, and seeds are used as rootstocks for most cultivars.

Puebla Avocado, Source: Specialty Produce, 2022
Source: https://www.specialtyproduce.com/produce/Puebla_Acvocadoes_10594.php

CULTIVAR (VARIETIES)	PRODUCTION	FURTHER PRODUCT INFORMATION
Bacon (Mexican x Guatemalan hybrid)	It matures 5-7 months after blossoming	Trees tall with pointed crowns, leaves have aniseed smell when crushed, red flecking on wood of new shoots; flower Group B; fruit ovate, medium to large size weighing 170–510 g; skin thin, green and glossy with leathery texture; seed size is large; early maturing with very pale yellow-green flesh. Cold tolerance is widely reported in many areas; frost tolerance is down to -4.4°C, thus production is suited to colder regions. Susceptible to insect attack, extremely susceptible to anthracnose, unsuitable for humid subtropical areas; skin is susceptible to wind scarring, in severe cases fruit splits exposing seed. 'Bacon' is a successful pollinator for 'Hass' (Newett et al. 2002).

Bacon avocado, Source: Specialty Produce, 2022
Source: https://specialtyproduce.com/produce/avocados/bacon_6658.php

CULTIVAR (VARIETIES)	PRODUCTION	FURTHER PRODUCT INFORMATION
Pinkerton *(Guatemalan hybrid)*		A semi-dwarf, moderately spreading tree with a growth rate similar to 'Hass'; flower Group A; pear shaped but can be excessively 'necky' in cooler areas. Fruits can be very variable in shape presenting a difficulty during packaging. Fruits are medium size weighing 230–425 g, fruit remains dark green when ripe. Fruit skin is of medium thickness, prominently pebbled, leathery and tough, easy to peel; seed size is relatively small. It is early bearing with mid-season maturity. Relatively resistant to anthracnose, can have high percentage of internal fruit disorders including uneven ripening.



Pinkerton avocado (Photo: Newett et al., 2001)

Reed *(Guatemalan race)*		Upright growing with medium vigour with flower Group A; fruits are round shaped and weigh about 400–500 g, dark green when ripe. It has medium skin thickness with smooth fruit surface. Wide range of climatic adaptability and relatively resistant to anthracnose, can have a high percentage of internal fruit disorders including uneven ripening. Late maturity compared to Hass.

Reed avocado (Photo: Newett et al., 2001)

2.6. QUALITY REQUIREMENTS

2.6.1. MINIMUM REQUIREMENTS

All classes of avocado fruits for fresh supply or processed must meet the following minimum requirements:

- intact/whole
- sound
- clean, practically free from any visible foreign matter,
- free from damage caused by low and/or high temperatures,
- free from stalk longer than 10mm
- free from external moisture
- free from any foreign smell and /or taste
- free from pests and pest damage
- firm and carefully picked
- the fruit condition should be able to withstand transport and handling and be able to arrive in satisfactory condition at the place of destination

2.6.2. PRODUCT MATURITY CRITERIA

Maturity requirements for avocado classes are based on UNECE Standard FFV-42 and Codex Standards (UNECE, 2017). The following product maturity criteria must be met:

- the development and state of maturity of the avocados must be such as to enable them to continue their ripening process and to reach a satisfactory degree of ripeness,
- free from bitterness
- the fruit should have a minimum dry matter content to be determined by drying to constant weight;
    - 21 % for the variety Hass
    - 20 % for the varieties Fuerte, Ettinger, Pinkerton, Ryan, Reed and Edranol
    - 19 % for the other varieties

The following are recommended maximum and minimum maturity level for export of avocados by HCD:

Fuerte: Minimum maturity = 76 % moisture content i.e., 24 % dry matter content
Maximum maturity = 76 % moisture content i.e., 24 % dry matter content

Hass: Minimum maturity = 76 % moisture content i.e., 24 % dry matter content
Maximum maturity = 76 % moisture content i.e., 24 % dry matter content

2.6.3. CLASSIFICATION OF PRODUCTS

There are three classes of avocados, namely "Extra Class", "Class 1" and "Class 2"

1. ''EXTRA CLASS"

The Avocado in this class must be of superior quality. They are characteristic of the cultivar/variety with regard to shape and colour. They should comply with the quality standards for Extra Class. They must be free from defects with the exception of very slight superficial defects provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

2. CLASS 1

The Avocado in this class must be of good quality. They must be characteristic of the cultivar/variety with regard to shape and colour. They must be of a cultivar specified for export by the industry:

They should comply with the quality standards for Class 1 set out in Table 1 below.

The following slight defects, however, may be allowed, provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package (package, sales package and prepacking):

- A slight defect in shape;
- Slight defects in colouring;
- Slight skin defects and sunburn.

The defects must not in any case affect the flesh of the fruit.

The stalk if present may be slightly damaged.

3. CLASS II

This category includes avocados which do not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified above. They must be sound, attractive, clean, fresh, intact and true to cultivar.

The following defects may be allowed, provided the fruit retain their essential characteristics as regards the quality, the keeping quality and presentation:

- Defects in shape
- Colour defects
- Defects of the epidermis/skin and sunburn.

The defects must not in any case affect the flesh of the fruit.

The stalk if present may be slightly damaged.

2.6.4. SIZE OF THE PRODUCTS

Size of avocado is determined by weight and by count. The following table (Table 8) shows how avocado is sized by weight:

Table 8 — Size categories of Avocado by weight

SIZE CODE	WEIGHT (IN GRAMS PER FRUIT)
2	> 1220
4	781-1220
6	576-780
8	456-576
10	364-462
12	300-371
14	258-313
16	227-274
18	203-243
20	184-217
22	165-196
24	151-175
26	144-157
28	134-147
30	123-137
32	80-123 (Only Hass type)

Sizing by count: In order to ensure uniformity of size, the size range for produce in the same package must not exceed 25% i.e., the weight of the smallest fruit shall be not less than 75% of the weight of the largest fruit in the same package.

2.6.5. QUALITY AND SIZE TOLERANCES

Tolerances in respect of quality and size shall be allowed in each lot for produce not satisfying the requirements of the class indicated.

QUALITY TOLERANCES

i. **"Extra Class" category**

A total tolerance of 5 %, by number or weight, of Avocados not satisfying the requirements of the class but meeting those of Class I is allowed. Within this tolerance not more than 0.5 % of the produce may consist of produce satisfying the requirements of Class II quality.

ii. **Class I**

A total tolerance of 10 %, by number or weight, of Avocados not satisfying the requirements of the class but meeting those of Class II is allowed. Within this tolerance not more than 1 % of the produce may consist of produce not satisfying the requirements of Class II quality or the minimum requirements or may be damaged.

iii. **Class II**

A total tolerance of 10 %, by number or weight, of Avocados *satisfying* neither the requirements of the class nor the minimum requirements is allowed. Within this tolerance not more than 2 % of the produce may be damaged.

SIZE TOLERANCES

For all classes: a total tolerance of 10 %, by number or weight, of Avocados *not* satisfying the requirements as regards sizing is allowed.

HOMOGENEITY OF PRODUCTS

The contents of each package *(or lot for produce presented in bulk in a transport vehicle)* must be uniform and contain only avocados of the same origin, variety, colouring of fruits at point of dispatch quality and size.

However, a mixture of avocado whose species, varieties, commercial types, colours, are markedly different may be packed in a packaging, sales packaging, provided that the products are homogeneous as regards their quality and, for each species, variety, commercial type, colour considered, as regards their origin. In such a case, however, uniformity in size is not required.

If special features, including net weight limits for sales packages, are required, they may be added in the individual standards.

The visible part of the contents of the package *(or of the lot in the case of presentation of the product in bulk in a transport vehicle)* must be representative of the whole.

2.7. PACKAGING

The avocados must be packaged in such a way as to ensure adequate protection of the product during transport and handling including compression from overhead weight of stacked materials, impact and vibration during transportation, loading and unloading. The materials used inside the package must be clean and of a quality such as to avoid causing any external or internal damage to the product. The use of materials, particularly of paper or stamps bearing trade specifications is allowed provided the printing or labelling has been done with non-toxic ink or glue.

Stickers individually affixed to the products must be such that they do not leave any visible traces of glue or damage the skin when removed. Laser printing on individually presented fruit must not cause defects to the flesh or skin.

Packages or batches, crates in the case of presentation of the product in bulk in a transport vehicle *(or batches in the case of presentation of the product in bulk in a transport vehicle)* must be free of all foreign matter. Transport vehicles, crates (wooden/plastic), boxes must be clean, in good condition, well ventilated and free of foreign matter and smell. A visible lack of cleanliness in the packaging materials, crates, or transport vehicles could result in rejection at the point of product receipt.

2.8. LABELING/MARKING OF PRODUCTS

Each package must bear the following particulars, in letters grouped on the same side, legibly and indelibly *marked*, and visible from the outside *(these marking provisions do not apply to sales packages presented in packages). (These marking provisions do not apply to sales packages presented in packages, but do apply to sales packages (pre-packages) packed individually*:

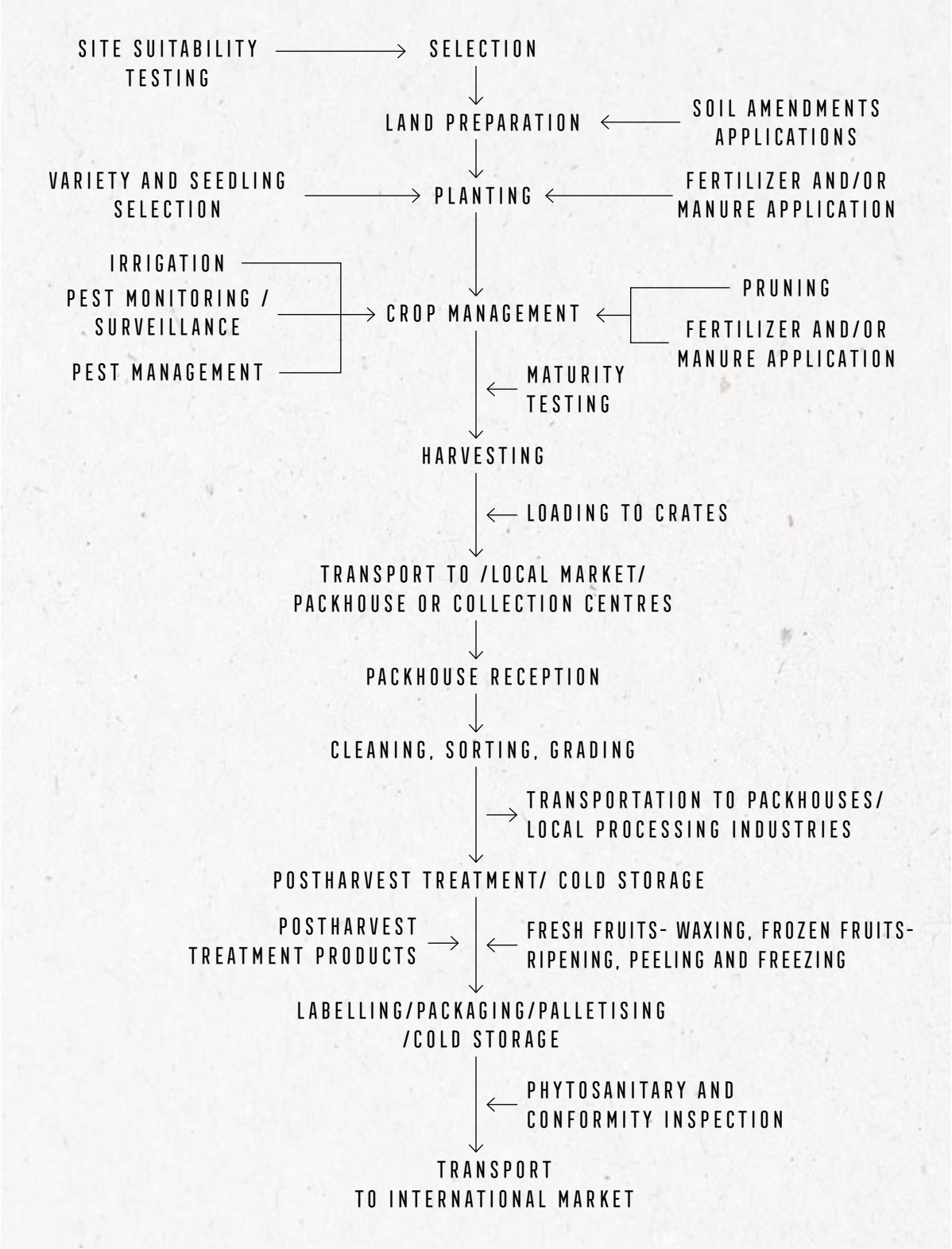
- Packer and/or shipper/exporter:
- Name and address (e.g., street/city/region/postal code, and country if different from the country of origin)
- Name of the product if the contents are not visible from the outside.
- Name of the variety *(may be replaced by a synonym). A brand name may only be indicated in addition to the variety or a synonym). In the case of a mixture of distinctly different varieties or species, names of the different varieties or species. Indicate: «Mixture of .....». If the produce is not visible from the outside, the commercial types and/or colours and the quantity of each product contained in the package must be indicated).*
- Country or area of origin
- Class
- Calibre
- Official control mark (optional)

For avocados transported in bulk (direct loading into a transport vehicle), these particulars must appear on a document accompanying the goods, affixed visibly inside the vehicle

2.9. MAIN PRODUCTION PROCESSES

The production process can be summarized in the following process flow chart below, from the field/orchard to the shipment of the products after packaging.

Figure 3 — Avocado processing flow diagram for Kenya



3

SANITARY AND PHYTOSANITARY REQUIREMENTS OF THE MARKET(S) CONCERNED

3.1. REGULATORY REQUIREMENTS

The avocado industry in Kenya is regulated directly by HCD, KEPHIS and AFA at the national level and County governments. Other institutions that influence the development and promotion of the sector include KALRO, KEBS, PCPB, KEPROBA among others. The national government institutions are established under various statutes and have a national mandate on various regulatory aspects with a view to improving service delivery. The government has designated a competent horticultural authority structure to coordinate the horticulture industry consisting of AFA, HCD, KEPHIS, KALRO and PCPB. There are other legal and regulatory frameworks that influence the operations and governance of the industry. These include international standards, protocols, conventions, treaties and agreements at the multilateral and bilateral level and codes of practice for industry associations at the local level.

In the new requirements for avocado:

- Fruits for export to other countries shall originate from production sites, packhouses and storage facilities approved and registered annually by KEPHIS.
- Pest monitoring shall be conducted by KEPHIS regularly in the production sites destined for export to other countries.
- Fruit fly monitoring shall be initiated three months before harvesting or when the crop for export starts to flower and this shall continue through the completion of harvest.
- The owner of the production site will be required to maintain the data and submit a copy to KEPHIS on quarterly basis
- Farmers are advised that culled and fallen fruits are supposed to be buried, destroyed or removed away from the production sites at least twice a week.
- Registered packhouses and storage facilities shall be maintained clean free from pests, soil and plant debris safeguarded and equipped to avoid fruit contamination.
- KEPHIS shall also ensure that the packhouses have a defined traceability system to approve forms for export to other countries by maintaining integrity lots.
- Exporters are to apply for other country's import permits before export.
- Normal port of exit inspections to be undertaken by KEPHIS for every consignment before export.

3.2. NATIONAL SPS REQUIREMENTS

In Kenya, the requisite regulations for standardization and certification are supported by a number of laws and regulations. A number of national institutions are responsible with some cases of overlapping mandates these include; Kenya Plant Health Inspectorate Service (KEPHIS), Ministry of Health- Department of Public Health, Kenya Bureau of Standards (KEBS), Horticultural Crops Directorate (HCD), Pest Control Products Board (PCPB). The list below shows the relevant national regulations and standards relevant to avocado production and marketing (domestic and international markets). The sub-sector is regulated by a total of 15 laws including The Agricultural Produce Export Act: CAP 319, The Public Health Act Cap 242, Pest Control Products Act CAP 346, Imports, Exports and Essential Supplies Act: CAP 502, The Seeds and Plant Varieties Act: CAP 326, The Standards Act: CAP 496, The Food, Drugs and Chemical Substances Act: CAP 254, Agriculture Act: CAP 318, KEPHIS Act No. 54, The Public Fees Act: CAP 424, The Fertilizer and Animal Feedstuff act Cap 345, Use of Poisonous Substances Act, Cap 247, Agriculture and Food Authority (AFA) Act No.13 of 201, Crops Act 2013 and The Horticultural Crops Regulations, 2019.

Relevant standards that are directly linked to the Avocado sector include:

1. KS 1559:1999 - Vocabulary in fresh fruit and vegetables
2. KS 1551-1 to 3:2001 - Code of practice for handling and distribution of fresh fruits and fresh fruit products
3. KS ISO 2169:1999 - Fruits and vegetables - Physical conditions in cold stores - Definitions and Measurements
4. KS 220-parts 1-8:1979 (Confirmed, 1999) - Methods for the microbiological examination of foods - Part 1: General procedures and techniques
5. KS 140:1980 (Confirmed, 1999) - Methods of test for processed fruits and vegetables
6. KS CAC/RCP 8:1976 - Recommended code of practice for the processing and handling of quick-frozen foods
7. KS ISO 6661:1999 - Fresh fruit and vegetable - Arrangement of parallelepipec packages in land transport vehicles
8. KS 05-40:1990 - Labelling of pre-packaged foods (First Revision)
9. KS 1758-2: 2016: Horticulture Industry Code of practice-Fruits and Vegetables

3.3. INTERNATIONAL SPS REQUIREMENTS RELEVANT TO AVOCADO SECTOR IN KENYA

3.3.1. INTERNATIONAL STANDARDS ON PHYTOSANITARY MEASURES (ISPMS) OF THE IPPC

The relevant IPPC ISPMs applicable in the chain define measures to prevent the spread and introduction of pests of plants and plant products, and to promote appropriate measures for their control, with minimum disruption to trade.

3.3.2. CODEX ALIMENTARIUS COMMISSION STANDARDS

Codex Alimentarius Commission (Codex) standards on avocado. Relevant Codex standards include:

CODEX STAN 197-1995: Standards for avocado provides guidance on maturity requirements, minimum requirements, and quality classes such "extra", "class I" and "class II"; sizing, uniformity, packaging and labeling. The Standard applies to commercial varieties of avocados grown from *Persea americana* Mill., of the Lauraceae family, to be supplied fresh to the consumer, after preparation and packaging. Parthenocarpic fruit and avocados for industrial processing are excluded (CODEX,KA 2013).

CODEX STAN 193-1995: Codex Standard for Contaminants and Toxins in Food and Feed gives provisions for maximum residue limits for pesticides as established by the Codex Alimentarius Commission.

CAC/RCP 1-1969, REV, 5 (2020): "Recommended International Code of Practice - General Principles of Food Hygiene" These requirements are applicable to all WTO countries that have signed the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

CAC/RCP 53-2003: Code of Hygienic Practice for Fresh Fruits and Vegetables

CAC/GL 21-1997: Principles for the Establishment and Application of Microbiological Criteria for Foods (implementation of quality standards, lists, recommended methods for sampling of produce; analysis and determination of pesticide residues.

CAC/RCP 44-1995: Code of Practice for the Packaging and Transport of Fresh Fruits and Vegetables

CODEX STAN 1-1985: General Standard for the Labelling of Pre-packaged Foods

CAC/RCP 20-1979: The Code of Ethics for International Trade in Foodstuffs

3.3.3. EU REGULATIONS AND DIRECTIVES ON FOOD SAFETY AND PLANT HEALTH

1. Commission Delegated Regulation (EU) 2019/1702 - establishing the list of priority pests. including *Thaumatotibia leucotreta*, *Bactrocera dorsalis* and *Bactrocera zonata.*
2. Regulation (EC) No 2016/2031 on protective measures against pests of plants that establishes the control of the introduction and spread of non-indigenous organisms harmful to plants or plant products
3. Regulation (EC) No 2017/625 on official controls and other official activities to ensure compliance with food and feed law, animal health and welfare, plant health and plant protection product rules
4. Regulation (EC) No 852/2004 on the hygiene of foodstuffs, which stipulates the widespread application of procedures based on the HACCP principles, combined with the implementation of good hygiene practices and the establishment of Good Practice Guides. This regulation covers general hygiene provisions applicable to primary production and to related operations such as transport, warehousing and handling.
5. Regulation (EC) No 178/2002 laying down procedures in matters of food safety: the traceability of food must be established at all stages of production, processing and distribution (cf. Chapter II - Section 4 - Article 18 of the Regulation).
6. Regulation (EC) No 2073/2005 - on microbiological criteria for foodstuff and describes rules for sampling and preparation of test samples.
7. Regulation (EC) 396/2005 - establishes the EC Maximum Residue Level (MRL) Harmonisation programme. It establishes the MRLs applicable to pesticide residues.
8. Commission Implementing Directive (EU) 2019/523 - amending Annexes I to V to Council Directive 2000/29/EC on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community.
9. Directive 93/43/EEC of 14 June 1993 on the hygiene of foodstuffs.
10. Directive No. 2002/63/EC referring to sampling methods for the official control of residues of plant protection products in and on products of plant origin.
11. Regulations (EC) No. 1107/2009 and No. 396/2005 governing respectively the marketing authorisation of plant protection products and the setting of Maximum Residue Limits for Pesticide Residues in the EU.
12. EU Official Control Rules (OCR). This regulation includes phytosanitary controls. The OCR replaces Regulation (EC) No 882/2004 on official controls throughout the agri-food chain. The European regulatory basis for official controls (food safety and others) are included in the OCR.

13. Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007
14. Regulation (EU) No 543/2011 lays down detailed rules for the implementation of Council Regulation (EC) No. 1234/2007 as regards the vegetable and processed fruit and vegetable sectors. These Regulations set out rules on classification of products, checks on conformity to marketing standards and methods of inspection. Specific articles concern producers' organizations and their recognition.

3.3.4. EPPO STANDARDS

1. EPPO Standard PM 1/002 (29) - presents and explains the EPPO A1 and A2 Lists of pests recommended for regulation as quarantine pests including *Bactrocera dorsalis* A1/233, *Bactrocera zonata* A2/302, *Thaumatotibia leucotreta* A2/377.
2. EPPO Standard PM 1/001 - This standard gives guidance to EPPO Member Governments on the definition in their phytosanitary regulation of requirements for phytosanitary certificates to accompany imported consignments of plants, plant products and other commodities.

3.3.5. UNITED NATIONS ECONOMICAL COMMISSION FOR EUROPE (UNECE) STANDARDS ON AVOCADO

UNECE STANDARD FFV-42 concerning the marketing and commercial quality control of AVOCADOS exported to EU defines avocado produce and give guidance on quality, maturity requirements, sizing and classification and acceptable tolerances including requirements for packaging and labelling of produce (UNECE, 2017; OECD, 2004).

3.3.6. ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT (OECD) STANDARDS ON AVOCADO

OECD International Standardization for fruit and vegetables; Avocados provisions include avocado fruit quality, maturity requirements and classification, sizing uniformity, packaging, labelling and defines tolerances. The OECD standard on avocado is similar to the UNECE standard FFV-42. Kenya is a member of the OECD FFV scheme codex for the application of international standards for fruit and vegetables since February 2009.

3.3.7. ISO STANDARDS

1. ISO 22000: Food safety management systems that integrates HACCP into ISO 9001.
2. ISO/TS 22002 Part 1: Prerequisite programmes on food safety - Food manufacturing
3. ISO/TS 22002 Part 3: Prerequisite programmes on food safety – Farming
4. ISO 9001: Quality Management System

3.3.8. OTHER PRIVATE/MARKET REQUIREMENTS

To respect the concerns of their clients (export) in terms of product health and safety, as well as the social and environmental conditions of the product production chain on the one hand, and also to conquer new markets, several players in the sector have been engaged for some time in a process of private certification in order to comply with these requirements.

The most prominent private standards are:

GLOBALG.A.P. is a reference system of Good *Agricultural Practices (GAP*) recognized and applicable throughout the world. It is based on an equal partnership of agricultural producers and retailers who wish to establish effective standards and certification procedures. This certification aims to respond to consumer concerns about food safety, environmental protection, health, safety and social protection of workers and animal welfare.

Organic Agriculture: it is defined by an agricultural management and production system that combines a high level of biodiversity with environmental practices that preserve natural resources. It also incorporates high standards of animal welfare. It responds to a growing consumer demand for natural products, while contributing to the preservation of the environment in the context of sustainable rural development.

Fair Trade is (i) changing the conventional trading system so that small-scale producers in the South can reap the benefits, and (ii) increasing their access to markets. The objective of the Fairtrade International Generic Fairtrade Standard for Small Producer Organizations, which is one of the best-known Fairtrade standards, is to set the criteria for participation in this marketing system. This criteria aims to promote sustainable development and reduce poverty. Fairtrade certification leads to improvements in the social and economic well-being of small producers, as well as their empowerment and environmental sustainability, leading to improved quality, market access and fair and equitable incomes. Other Fairtrade standards are also developing in the international market, including FFL (Fair For Life) and SPP (the Farmers' Producers' Symbol).

Rainforest Alliance for promotion of collective action for people and nature. It amplifies and reinforces the beneficial impacts of responsible choices, from farms and forests all the way to the supermarket check-out.

Others include; **GLOBALG.A.P. Risk Assessment on Social Practice** (GRASP) a voluntary, ready-to-use module developed to assess social practices on the farm, such as specific aspects of workers' health, safety, and welfare and **Sedex Members Ethical Trade Audit** (SMETA) a social audit of businesses.

PART A

DESCRIPTION OF PROCESSES AND ACTIVITIES, HAZARD ANALYSIS AND RECOMMENDED CONTROL MEASURES

A1

AVOCADO NURSERY ESTABLISHMENT

Healthy vigorous plants are the key to establishing a successful avocado orchard. It is recommended to plant only selected vigorous, healthy plants from a registered avocado nursery. All nurseries should have a License issued by HCD and at all times have a valid Phytosanitary inspection Certificate at hand issued by KEPHIS (Annex 1). Records should be kept and maintained at every stage of the nursery management to ensure traceability e.g., date of planting, variety, source of scions and rootstock and pesticides used among others. Refer to Record Sheets 1 to 16 for examples of templates for record keeping.

The nursery site selection and establish should;

- on sites with no disease history and also treat the potting media through steaming, and solarization etc.
- Control access to the nursery facility and use of foot baths by workers and visitors
- Use of resistant varieties, treated or certified rootstock seeds, scions and seedlings should be done to avoid introducing pathogens to the field.
- Ensure there is proper drainage to avoid root rot diseases
- Irrigation water should be tested and treated before use
- Proper nursery waste disposal established (see Practical sheet 9)

1.1. THE NURSERY STRUCTURE

1. Nursery structure should consist of soil/potting mix preparation and a storage zone, nursery equipment store, seedling grafting area and the seedling growth area.
2. Propagation structures are covered with plastic or shade netting to protect the seedlings and maintain temperatures between 16^0C to 32^0C.
3. The nursery should be fenced and have restricted entry.
4. Strict sanitary measures should be practiced to prevent introduction and establishment of pests and disease.
5. Foot baths should be installed to allow visitors and workers to disinfect footwear /gumboots. Use chlorine or any approved disinfectant e.g., copper fungicides (Figure 2 & 3).
6. Raised seed beds should be used to raise the young plants off the ground, improve drainage and reduce contamination. Raised bed can be of quarry stone, fine gravel or raised benches to approximately 5cm above the soil level (Figure 4 & 5).
7. Nursery side walls should be protected from rainfall run-off and rain-splashed by a solid wall or napier grass to intercept the run-off or rain-splash. The barrier should be at least 1 meter away from the first row of plants in the nursery.
8. Irrigation may be done manually using watering pipes/cans or through an automated controlled system using a microtube system. Overhead irrigation is effective and more versatile to the movement of seedlings as they are continually sorted and moved around the nursery structure.

9. Humidity of 75% should be maintained in the nursery facility e.g., by use of misting systems.
10. Fertilizer and other micro elements can be applied manually or through the irrigation water.

Figure 4 — Practices in the avocado Nursery

A: Footbath with disinfectant:
Picture by MaryLucy Oronje courtesy Soloplants nurseries
(good practice)

B: Napier grass rain-off/splash
protective barrier: courtesy
Olivado nurseries (good practice)

C: Grafted avocado seedlings in nursery raised bed
Picture by Richard Collins, Kakuzi PLC
(good practice)

D: Grafted avocado seedlings
in nursery directly put on the ground
Picture by Lusike Wasilwa KALRO (bad practice).

1.2. GROWTH MEDIA

Various potting mix/growing media products can be used for avocado plant production depending on availability and affordability. It is recommended that:

1. The media must be of good moisture holding capacity, well drained, and friable to allow for good plant support and root development. Growth media that are not well drained will result in poor root development and higher likelihood of disease infections like root rots.
2. Growth media pH should be between 5.5-6.5.
3. The soil should be collected from a site that has previously not been used for growing avocado or other tree crops (preferably grazing land).
4. If organic manure is used it should be free of lumps and added to the soil / pumice mix prior to being pasteurised.
5. The growing media should be sterilized to prevent soil borne pathogens, insects and weeds.
6. Potting mix/ growing media consisting of organic matter, soil and sand can be used in the ratio of 3:2:1, respectively. Other mixes can be 2 parts perlite to 3 parts of peat moss or 1/3 vermiculite, 1/3 peat and 1/3 perlite can be used.
7. Where coco peat is used, it is recommended to treat the media by washing to reduce pH
8. The growth media should have enough nutrients to support the growth of the seedlings. It is advisable to do a soil test to determine the nutrient levels on your medium.
9. If one is importing the growing media, they must obtain an import permit from KEPHIS.

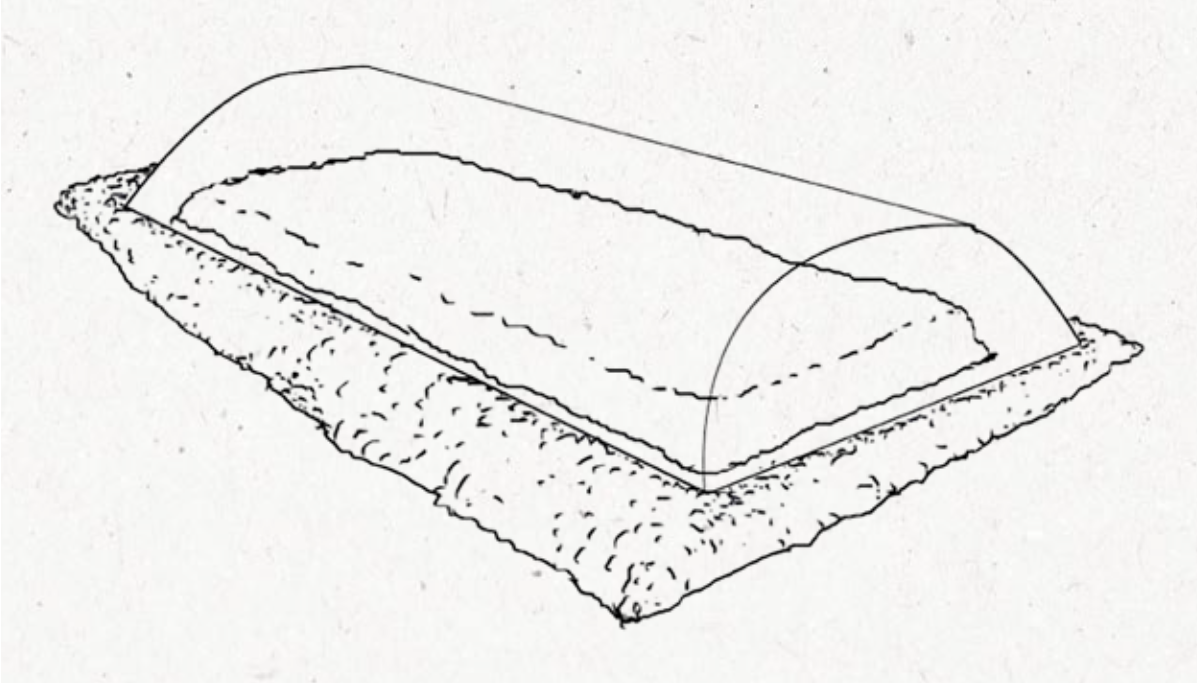
It is recommended to treat the mixed growth media by solarization, steam or electric sterilizers to reduce soil borne pathogens, insect pests and weed seeds.

1.2.1. SOLARIZATION OF POTTING MIX

1. Use a large black paper sheet to cover the ground where the solarization will be established. The area must be exposed to direct sunlight
2. Pour the potting mix onto the black polythene sheet
3. Level the soil and cover with another piece of black polythene sheet
4. Sprinkle water onto the soil to increase soil moisture. The soil moisture will vapourize during solarization killing the soil pathogens, insect pests and weed seeds
5. Cover the edges of the polythene sheet with soils to create a seal
6. Expose to the direct sun for 2-3 weeks
7. Uncover the treated soil and fill in the planting bags with desired amounts of potting mix
8. Ensure good hygiene practice to reduce contamination.

As the temperatures rise under the polythene sheet, the soilborne pathogens, insects and weed seeds are destroyed. See figure 5 below.

Figure 5 — Illustration showing solarization of planting soil/potting mix



adapted from Latia, 2018

1.2.2. STEAM PASTEURISATION OF POTTING MIX

Heat the potting mix to at least 70° C for at least 30 minutes. Higher temperatures and longer times will not harm the mix.

The mix is heated by steam. This can be produced by a fuel fired steam generator or a wood fired drum boiler discharging steam through a pipe into a drum of potting mix. Refer to Figure 6 below.

It is important to ensure that all the mix reaches the target temperature for the required time.

Ensure separation of pasteurised and unpasteurised mix or soil that may reintroduce *Phytophthora.*

Figure 6 — A locally assembled steam sterilization unit

Photo courtesy of Olivado

1.3. POTTING BAGS

Biodegradable potting bags are recommended for planting avocado seedlings. It is recommended that:

1. Potting bags should have a minimum height of about 25 cm (10 inches) with a diameter of at least 15cm (6 inches). This is to allow for good seedling root development. However, the potting bags should not be too wide as this will result in the use of a higher volume of planting/potting media. See Figure 7.
2. The bags should have sufficient drainage if not use paper punch to punch holes at the bottom of the potting bags and along the sides to allow for water drainage and prevent waterlogging.
3. Potting bags should be placed on raised beds. This ensures excess water drains off and roots cannot grow through a drainage hole of the potting bag into the soil below.
4. In case the bags do not have a gusset bottom, cut off 2cm off the corner pieces.
5. The bags should be filled with treated potting mix leaving 5cm from the top.

Figure 7 — Filling of potting bags

Photo by Lusike Wasilwa, KALRO

1.4. ROOTSTOCKS

Avocado tree development, health and productivity are dependent on the type of rootstock used Rootstocks are selected based on their horticultural value and ease of propagation. Examples of cultivars whose seed make suitable rootstocks are:

- Edranol
- Zutano
- Velvick
- Reed-Relatively resistant to anthracnose
- Puebla
- Fuerte

Where importation of rootstock may be desired, Plant Import Permit must be obtained from KEPHIS (Refer to Annex 2).

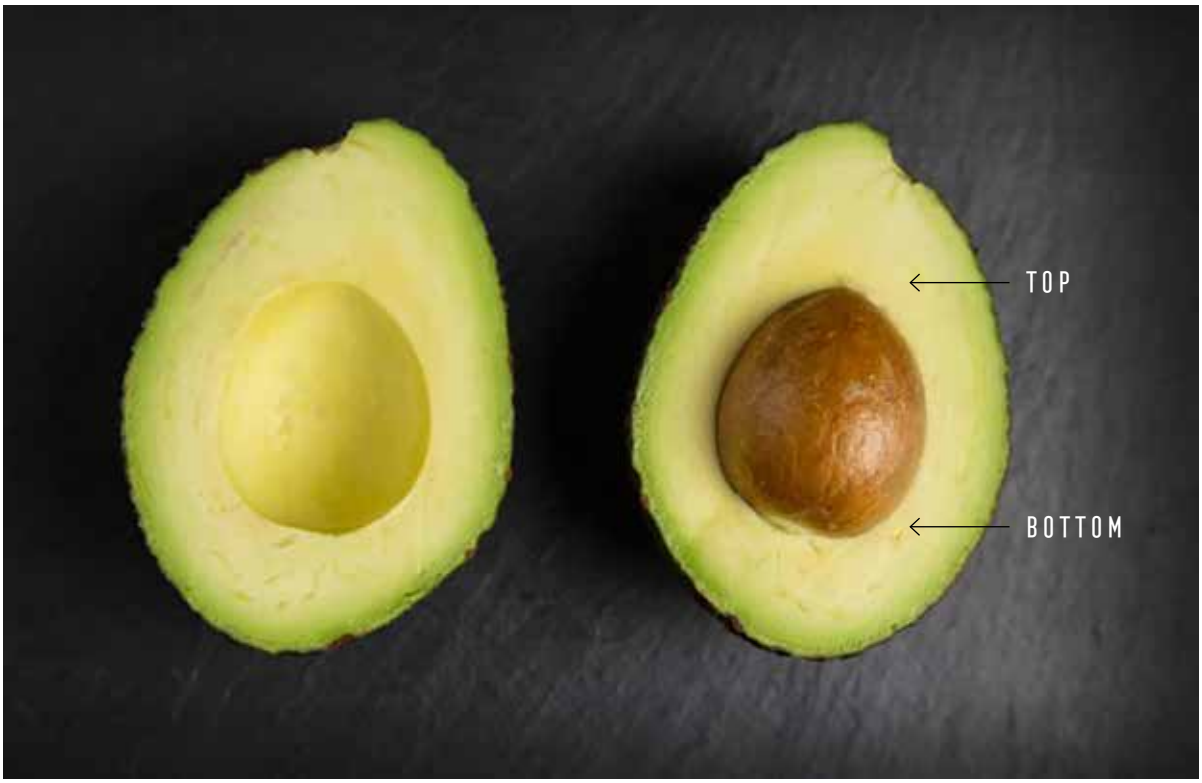
1.4.1. SEEDLINGS ROOTSTOCKS PRODUCTION

Seed preparation

- Select healthy fruits from vibrant trees in the mother block. Extract seeds from these fruits once ripe. Large seeds in general will have good vigour. See Figure 8 below.
- Mother plants where seeds are selected should be free of Avocado Sunblotch Viroid disease.
- Collect seed from reliable source to ensure it is true to variety
- Fuerte and Puebla seed give the strongest seedlings for grafting
- Avoid seeds from seedling trees (non-grafted avocado trees), due to possible variability in vigour in the orchard
- Collect fruit only from the trees – do not collect from the ground to avoid infestation by avocado seed moth.
- Ripen fruit and remove seed and store the seeds in a cool place
- Wash seed of adhering pulp and allow to dry
- Dry seed can be stored in plastic bags, crates or bins

All records of sources of avocado propagation materials need to be kept (refer to Record Sheet 1).

Figure 8 — Avocado seed



(AGS, 2021)

Planting and maintenance

- Before planting cut or grate approximately 5-10 mm from the top of the seed. This will break the dormancy and encourage rapid and even germination
- Treat seed with a copper-based fungicide before planting
- Seed may be pre-germinated in a seed bed then transplanted to growth media or planted straight into the potting bag
- The seed is planted on the potting mix with the apical end facing downwards and covered to reduce drying. See Figure 9 (a) below
- Plant one seed per planter bag and cover the bags with mulch. See Figure 9 (b) below.
- Inspect regularly as seeds germinate. See Figure 9 (c) below.
- Rearrange planter bags as seedlings emerge and remove plant bags where germination failed. The potting mix from those bags can be returned to the soil preparation area, added to fresh mix, sterilised and used again.
- Ensure that all planter bags are receiving water - maintained moist but not saturated
- Ensure the even distribution of irrigation across all planter bags

— Planter bags can be rearranged during the germination and early growth stage to keep plants of the same size together. This will facilitate grafting.

— Watering of the planted seeds should continue to maintain the required moisture content.

— The seeds take 3-4 weeks to germinate. Any seed that does not germinate within 3 months should be discarded. See Figure 9 (d) below.

— The seedling rootstock is ready for grafting when it attains pencil thickness (usually in about 6 months)

Figure 9 — Planting of avocado rootstock

(a) Planting of seeds

(b) mulching of planted seeds

(c) Germinated rootstock seeds

(d) Germinated rootstock seeds in polyethene bags

Photo by Lusike Wasilwa, KALRO

Nutrition

- If animal manure is used in the potting mix the plants will normally have adequate nutrients for at least the first month. Additional fertiliser may be needed after that time to keep the grafted plants growing vigorously. The manure should be well decomposed.
- If animal manure is not used chemical fertilisers must be applied
- No chemical fertiliser should be added to the pots until the seeds have germinated
- When rootstocks are between emergence and 10 cm high each pot should be fertilised with N:P:K 17:17:17 at 3 gm per planter bag: Use an accurate measuring container for convenient and speedy fertilising.
- The fertiliser should be sprinkled evenly over the whole surface of the pot and care taken to prevent fertiliser pellets touching the shoot or stem to prevent burning the young growth.
- Fertiliser must NOT be put in one heap or buried in a hole in the soil. The nutrients must be able to move evenly down into the mix with water.
- Apply 3 gm 17:17:17 per planter bag monthly or more often if required judged by plant colour and vigour
- High health plants intended for organic orchards can have chemical fertilisers added as it will be three years before fruit from those trees will be harvested, by which time they will have qualified for organic status.
- Similarly, pesticides can be used in the nursery to protect them from pests and disease
- Seedlings destined for organic compliance will commence their process towards Organic Certification status from the time of planting in the field (3 years).

Records of types of fertilizer and manure used, amounts applied, date of application, by whom and other related information must be kept (refer to Record Sheets 2 and 3).

Pruning rootstocks

- As the seed germinates a single and strong stem should be selected for grafting
- All other nucellar shoots should be removed
- Maintain the germinated seedlings to a single straight vigorous stem for grafting. All other shoots should be removed.

1.4.2. CLONAL ROOTSTOCKS

Currently production of clonal rootstocks is not practiced in Kenya. They can be imported through the approved process by KEPHIS. Clonal rootstocks are resistant or tolerant to root rot (*Phytophthora cinnamoni*), salt tolerance, high vigour, early flowering and fruiting and high production. To ensure true to type, any clonal must be vegetative propagated. See Table 9 for recommended rootstock and their characteristics.

Table 9 — Table of recommended rootstock and their characteristics

AVOCADO RACE TYPE	ROOTSTOCK	CHARACTERISTICS
GUATEMALAN	Nabal Velvick Edranol Reed	— Good uptake of boron and calcium — Poor uptake of potassium — Velvick is tolerant to phytophthora root rot disease — Nabal and Reed give a uniform tree when grafted with Hass
MEXICAN	Duke 7 Puebla Zutano Fuerte	— Poor uptake of boron and calcium — Good uptake of potassium — Susceptible to saline water and soils — Duke 7 is tolerant to phytophthora root rot disease but high susceptible to anthracnose disease — Zutano is tolerant to salinity

Other promising rootstocks are Dusa and Bounty

1.4.3. SCION

Scions should come from mother blocks that are "phytosanitary" certified and have the Phytosanitary Inspection Certificate. The trees where the Scions are sourced must be screened against the Sunblotch virus.

Preferred scion cultivars must be true to type, free from diseases such as Avocado sunblotch viroid (ASBVd) and with high growth vigour. See Figure 10 below. The selected scion is the source of the budwood for grafting onto the rootstock.

In Kenya, most varieties planted are Hass and Fuerte. Other new varieties are Maluma and Lamb Hass. Maluma is now commercialized in South Africa.

The scions should be;

- True to type (variety)
- Taken from high yielding healthy trees
- Selected for size to closely match rootstock sizes
- Have leaves removed after cutting to prevent dehydration
- Kept cool and out of direct sunlight.
- Scions should be collected early in the day and grafted the same day if possible
- They should be transported in ice boxes with cool packs and clearly labeled with the variety name.
- The scions should be kept cool in ice boxes during the grafting process.
- Any unused scions from the first day can be kept in cool storage and used the following day.
- If they are not used the second day they should be discarded.
- Scions more than two days old will not take well after grafting

Figure 10 — Hass variety scions ready for grafting

Picture by Dr. Lusike Wasilwa, KALRO

1.5. GRAFTING

Grafting facility/room must be well lit and with a clean working area. Grafting is recommended to be above 30 cm height of the selected rootstock. This allows for future top working if necessary. Grafted avocado seedlings have the following advantages:

— Come into bearing 3 years earlier than un-grafted ones

— Maintain the desirable characteristics of the mother plant e.g. variety

Grafting tools include sharp knife, scarpel, grafting tape, grafting scissors/ shears. Grafting tools must be cleaned and disinfected regularly to reduce cross contamination. Many methods including cleft or side wedge grafting, whip and tongue can be used but the top wedge-grafting method is the most successful. Grafting should be done at the point where the rootstock is soft and tender. The scion should be dormant at the time of grafting and should match the size of the stock. Wrap firmly with a grafting tape or biodegradable tape to exclude water and air from the graft union.

1.5.1. GRAFTING METHODS

1. TOP WEDGE OR CLEFT GRAFTING

— Make a 3 cm wedge cut into the scion

— Cut off the top of rootstock

— Make a 3 cm cut into the rootstock. Ensure that all cut surfaces are smooth.

— Fit the scion and rootstock and align scion and rootstock cambium (Figure 11)

— Tie and wrap the graft union with plastic wrap. A clothing peg can be used to reinforce the graft union (Figure 12). A plastic bag may be used to cover the scion and graft to prevent desiccation (Figure 13).

— Keep the grafted material in the shade.

— Provide a label detailing the rootstock name and planting date, scion variety name and source, grafting date and nursery block number

Figure 11 — Grafting avocado

(a) making a wedge cut on the selected scion; (b) making a cut into the root stock
(c) inserting the wedge scion onto the rootstock; (d) and (e) securing the graft union
and (f) bind the graft with grafting tape;
Photos: Lusike Wasilwa, KALRO.

Figure 12 — Clothing peg used to hold the graft union tight

Photo by MaryLucy Oronje

Figure 13 — A plastic bag used to cover the scion and graft to prevent desiccation

2. SIDE WEDGE GRAFT

- Make a 5 cm sloping cut on one side of the scion (see Figure 10 a)
- Make a 5 cm cut into the rootstock exposing the cambium
- Fit scion and rootstock
- Tie the union tightly with a grafting tape
- Keep the grafted material under shade

NB: All the grafted seedlings must be labeled in the nursery.

1.6. NURSERY STOCK AND PEST MANAGEMENT

Inspection

- The whole facility should be inspected at least weekly to ensure high health requirements are being met and to identify any cleanliness, pest, disease, nutritional, weed or irrigation issues which need to be addressed (refer to Record Sheet 4)
- Any problems should be documented on the weekly record sheet 4 and 5 and corrective actions taken promptly (refer to Record Sheet 6).

Plant management

- If plastic tape is used it should be removed no later than 4 weeks after grafting. The graft will be strongly bonded by that time.
- Failure to do so will cause constriction of the stem as it enlarges and plants may break off when handled
- As the scion grows, remove side shoots to leave a single strong leader. Commence this early to promote the growth of the leader. See Figure 14.
- Remove any shoots developing from the rootstock and any nucellar seedling shoots emerging
- Maintain free of weeds at all times
- Fully grown seedlings should be protected from pests and adverse weather by use of a netting. See Figure 15

Figure 14 — Early pruning of the growing scion to develop a strong leader

Photo by Bridget Mwangi, Olivado Nurseries

Figure 15 — Fully grown avocado seedlings in a nursery

(Notice the protective netting).

Irrigation

- Plants should be inspected daily to ensure the potting mix is maintained damp but not saturated
- Irrigation timing should be adjusted according to the weather to avoid over-wetting or drying out.

Nutrition

- Grafted plants should receive 3 gm 17:17:17 at least monthly to promote strong vigorous growth. The frequency can be changed according to observed plant vigour.
- All fertilizer applications must be recorded in the nursery diary.

Pest management

Pest management methods aim at preventing introduction and spread of pests and diseases in avocado nurseries. Integrated pest management methods can be used to reduce the effect of insect pests and diseases on the avocado graft seedlings. Growing healthy, marketable plants is the primary objective of nursery growers and one of the key challenges for each crop is nursery sanitation and effective management of pests and diseases. The following is recommended:

- Select sites with no disease history and also treat potting media through steaming, and solarization etc
- Control access to the nursery facility and use of foot baths by workers and visitors
- Use of resistant varieties, treated or certified rootstock seeds, scions and seedlings should be done to avoid introducing pathogens to the field.

- Ensure there is proper drainage to avoid root rot diseases
- Proper handling of grafting material, tools, growing media
- Irrigation water should be tested and treated before use
- Proper nursery waste disposal
- Raise the nursery floor and have the floor covered with material such as gravel.
- Avoid overwatering to prevent disease build up.
- Consistent monitoring/scouting of the growing seedlings to allow timely response to symptoms of pests and diseases.
- Practice Integrated Pest Management (IPM)
- Ensure you separate the sanitized materials in the nursery from the unsanitized ones
- Use of safe and approved pest control products for pest control and disease management
- All pest control products used and their applications must be recorded in the nursery diary.

Refer to Practical Sheet 1 for safe use of Pesticides

Foliage Diseases

These are common plant diseases in the nursery. Although they are considered to be more aesthetic than life-threatening problems, they can significantly reduce the marketability of the seedlings.

Root diseases

Root rot disease caused by *Phytophthora cinnamoni* are common in the nursery

Testing for Phytophthora

- Tests of potting mix should be made at random (monthly or bi-monthly) intervals to ensure that the pasteurisation system is delivering Phytophthora free mix.
- At the same time random pots in the nursery should be sampled to ensure freedom from Phytophthora.
- If Phytophthora contamination is detected, more extensive sampling of the nursery should be carried out to determine the extent of the contamination and corrective actions needed.
- An intensive inspection and audit of the nursery operation will be made to determine the source of contamination and corrective actions taken.
- Foliar spray with phosphite prior to dispatch is recommended to protect against early infection by Phytophthora or Pythium in the field after transplanting.

Samples can be submitted to the laboratory for diagnosis (refer to Annex 3 for list of Laboratories).

Avocado Sunblotch Viroid (ASBV)

Every effort must be made to ensure that neither seed source plants and or scion material are free of ASBV. The disease symptoms can manifest itself as low spreading growth habit, depressed sunburn looking streaks on stems and fruit can be misshapen with depressed white to yellow streaks on fruit. These symptoms can only be noticed in growing trees. Sampling and diagnosis of suspected plants may be necessary in accredited laboratories (refer to Annex 3 for list of Laboratories). Seedlings for commercial sale must be free from Avocado Sunblotch Viroid (ASBV).

1.7. AVOCADO NURSERY INSPECTION AND CERTIFICATION

All commercial avocado nurseries must be registered by HCD and issued with a valid License. Avocado seedlings intended for commercial purposes must be inspected and certified to be disease free, true to type (confirm the identity of the variety (mother plants/scion source) and general phytosanitary conditions. Phytosanitary Inspections are undertaken by KEPHIS. Using a checklist for avocado nursery for compliance to phytosanitary inspection, KEPHIS undertakes regular system audits (nursery organizational structure, procedures, processes and resources). KEPHIS carries out surveillance inspections of all nurseries that are registered by HCD. During inspections, plant or pest samples may be collected for further diagnosis and advice. Only compliant nurseries are issued with Phytosanitary Inspection certificates which are valid for one year. (See Checklist 1 for avocado nursery phytosanitary inspection checklist). In case of non-compliance, a Nursery Stock Notice is issued and a Report of Nursery given to the nursery operator. Nursery stock to which "warning" tags have been affixed shall not be sold to farmers. The report that the Non-compliant nurseries get contains recommendations for improvement and a schedule for re-inspection. Upon completion of re-inspection, re-inspection summary is reviewed and a compliance report and certificate are issued. In case of non-compliance, a new Notice of Non-compliance report is issued.

1.7.1. IMPORTANCE OF PHYTOSANITARY NURSERY CERTIFICATION

- Enable farmers access healthy varieties as they become available
- To prevent the introduction of pests /Diseases into areas where they were not present
- Ensure right seedlings are offered to the farming community
- To facilitate safe trade in plant and plant products.
- Plant health inspection and Certification help protect the growers against major crop losses associated with pests
- If seedlings are not all sold within six months, a re-inspection of the old stock is done.

1.7.2. EXPORT NURSERY STOCK INSPECTION

General phytosanitary requirements:

- The exporter must have an Export Licence
- Valid plant import permit from the importing country
- Freedom from all regulated pests to importing country
- Practical freedom from non-regulated plant pests specified by the importing country
- Compliance with any pest-specific or commodity specific phytosanitary requirements of the importing country
- Valid phytosanitary certificate from Kenya

A2

ORCHARD ESTABLISHMENT AND MANAGEMENT

2.1. SITE SELECTION

Proper consideration must be made when selecting a field for avocado orchard establishment.

2.1.1. CLIMATIC FACTORS

1. **Rainfall and Humidity**: Avocados require a well distributed annual rainfall of up to 1600 mm for optimum growth and production. Climatic conditions with alternating dry and rainy seasons are best for avocados. Irrigation is essential where rainfall is not adequate. Where supplementary water is through irrigation, it should be light and frequent and not more than 50mm at a time. High rainfall during flowering causes flower abortion resulting in significant reduction in production. Fungal diseases are also problematic in very wet weather. A short period of dry weather of up to two months usually triggers flowering especially in tropical climates not subject to marked falls in temperature. The avocado tree requires high relative humidity at flowering, about 70-80%, then moderate levels during the fruit swelling stage. High moisture content and light showers at the time of flowering and fruit set will ensure good yields. Too much humidity encourages the proliferation of pests and diseases such as scales, scab and anthracnose among others (Biovision, 2020). The avocado's various development stages e.g. vegetative growth, flushing, flowering and fruit set and enlargement have varying water requirements through the year.
2. **Temperature:** Optimum temperatures are between 16°C to 24°C. Fruits and trees can be damaged at high temperatures e.g 33°C above. This will result in the plant experiencing water deficit and reduced growth due to high temperature. Under high humidity, avocado plants can tolerate a slightly higher temperature before shutting down. High temperatures and direct sunshine can cause sunburn damage to exposed fruits, low temperature affects the tree vigour growth and fruit quality. Temperatures below 12°C for 2 weeks are necessary to initiate flowering.
3. **Frost**: must ensure that any area targeted for Avocado production is not subject to frost or even periodic frost. If frost is severe, they can kill trees. While even a mild frost will have an impact on fruit quality. Hass is considered susceptible to frost.
4. **Wind**: if severe winds occur, then windbreaks must be established between blocks.
5. **Hail**: certain areas in the country are prone to hail. Hail can be very damaging to trees and injure fruits making marks on fruit skin that make them unsuitable for export. Although hail may not occur every year in such areas, note has to be taken that it can happen. With climatic change a reality frequency and or intensity of such events may become more frequent

2.1.2. ALTITUDE

Avocados can grow well in altitudes with ranges of 0-2500m asl. For commercial production, Hass variety requires altitudes between 800-2100m asl while Fuerte grows well between 1500-2100m asl. (Biovision, 2020).

2.1.3. SITE HISTORY

Previous use of the land under consideration must be established. This is critical to reduce the possible contamination of the sites from heavy metals and other hazards, enabling plans for the appropriate land preparation and fertility management regime. Thus, posing a risk to the final fruit harvested. Sites previously used for commercial cropping e.g. wheat, sugarcane etc. must be properly cultivated to break hardpans built by machinery over time. Avoid sites that were previously used for heavy industrial processing and mining.

2.1.4. TOPOGRAPHY

The slope of the land is steep; it will make crop husbandry activities difficult. No production should be undertaken with slopes >35%.

2.1.5. SOIL

For optimum growth, avocado requires well drained, deep soils with good water holding capacity and a pH of 5.5-6.5. Avocado trees are sensitive to excessive soil moisture and high salinity (Biovision, 2020). High clay content soils will be more prone to water retention and water logging. Ridging can be considered for heavier clay soils to improve water drainage. Waterlogged soils favor the development of root-rot caused by the fungus *Phytophthora cinnamomi*. Soils that dry out too fast or crack also encourage root damage and disease. It is advisable to carry out soil suitability assessment to determine both physical and chemical status of the soil before land preparation is undertaken. See Annex 3 for laboratory service providers.

a. Soil suitability testing

Soil suitability assessments are important to confirm the suitability of the land for growing avocados, identify areas of the farm that are more suitable for avocados and areas which would be better planted with other crops. In some cases, soil suitability assessment forms part of this risk assessment for credit financial support.

Topsoil (0-20cm) and subsoil (20cm–1m) should be collected and sent to an accredited laboratory for chemical and soil texture analysis. A complete soil analysis will pick up any hazards in the soils and give you the correct, scientifically calculated rates and types of soil amendments to bring up soil fertility. Soil tests should be done in good time, to correct the soil fertility before planting.

b. Soil pH

The optimum soil pH for avocados is pH of 5.5-6.5 but they can grow in soils from pH 5-7. Calcitic and dolomitic lime can be added to acidic soils to bring the pH up. High pH soils cause nutrient lock up, leaf yellowing and tree decline. pH can be brought down by applying sulphur, which needs 6-12 months in a moist soil to react. To test for soil PH, See Annex 3 for laboratory service providers.

c. Soil nutrient

Calcium is a critical avocado nutrient important for soil structure, disease suppression and fruit quality. This should be balanced before planting with lime or gypsum. The Calcium:Magnesium ratio determines the softness and water infiltration rate of the soil. Soil with high Magnesium and low Calcium can become compact and concreted resulting in waterlogging and root rot diseases. Soils with high Sodium and/or Potassium % become dispersed which can cause soil capping, water puddling and diseases.

Phosphorus is a major plant nutrient that does not move through the soil profile and the correct type and amount should be mixed into the soil profile before planting. The soil phosphorus should be enough to support the long-term growth of the trees, with only small annual top ups. Low phosphorus causes tree decline and encourages *Phytophthora*.

Avocados are very sensitive to high Sodium and high salts in the soil. These affect soil structure, water uptake and they can also burn the roots. High levels of certain elements are toxic to avocados (for e.g Boron, Sodium, Chloride, Aluminium). To test for soil nutrient content, see Annex 3 for laboratory service providers.

d. Soil texture and structure

Avocado roots are very fragile and grow in the top 20cm. The soil should be well drained, deep soils with good water holding capacity. Soil structure plays a big role inproduction and root health. Strongly developed block structures, soils that break into hard clods, soils that expand and contract, and soils that have large cracks when dry are unsuitable for planting avocado trees. Soil texture is a property that cannot be changed; however, soil structure can be improved on by balancing the cations, increasing organic matter content and proper land preparation.

Avocados do best in soils with 20-40 % clay. Soils with <20 % clay have a reduced water holding capacity and require more frequent, smaller irrigations and there is a risk the roots will suffer a temporary drought and die. Clays >40 % are heavy with a much higher water retention and lower infiltration rate; they become waterlogged during heavy rains or irrigation and promote root rot. Clay content should be tested accurately in a laboratory. To test for soil texture and structure, see Annex 3 for laboratory service providers.

e. Soil profiles and rooting depth

A healthy avocado tree requires 1-1.5m of friable free-draining soil. Deep profile pits should be dug around the land, a minimum of 1 per ha and more in hilly / variable land. The soil profile should be inspected to a depth of at least 1.5 m. Check for soil colour, soil texture, hard pans, concretions, gravel, stones, changes in structure, patches and gleys. Hardpans and cemented layers from previous land use should be identified and the depth noted so they can be broken up by ripping. Areas of shallow soils, waterlogged, or anaerobic soils and ground water should be noted as these are hidden hazards for avocado production.

Red/brown soils are preferable. Yellow/grey/light brown soils often indicate temporary or permanent waterlogging. Black soils can be very heavy and become very acidic which can result in aluminum toxicity. On sampled areas of the farm, dig a profile of 1.5m deep. Inspect and check the soil colour, texture, hard pans, concretion, gravel, stones, and water. See Figure 16.

Figure 16 — Soil profile

Photo by Ruth Vaughan, Crop Nutrition Laboratory Services Ltd.

f. Drainage and Erosion

Steep slopes are easily eroded, washing the surface soil off the fragile, shallow feeder roots. Look around for signs of soil erosion and where the water moves when it rains. Water flows down the slope, so low-lying land can get seasonally flooded. Drainage needs to be planned according to the contours of the land.

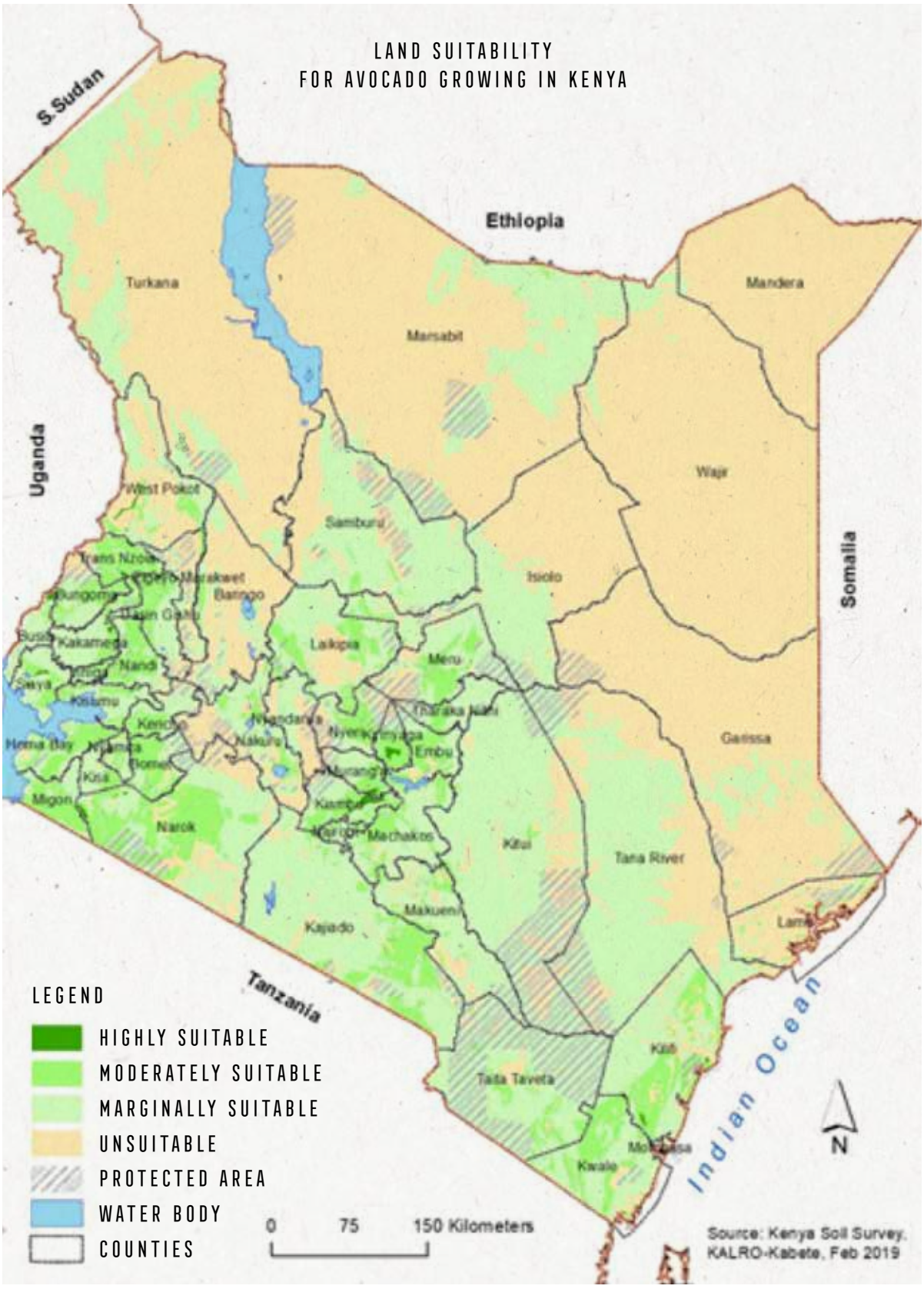
g. Heavy metal and pesticide analysis

Some soils present hidden or dormant risks that become a problem further down the line. Soils can become contaminated with heavy metals and pesticide residues, which can affect the marketability of the fruit further down the line. These can be tested for in an accredited laboratory. See Annex 3 for laboratory service providers.

h. Soil Suitability Survey Mapping

For large scale projects we recommend farmers and investors to do a professional soil suitability survey to look at the full soil picture and assess the risks involved, identify the types of soil amendments required and the quantities to add and where to apply them. National Avocado land suitability maps are available for avocado production in Kenya (See Figure 17 below). See Annex 3 for laboratory service providers.

Figure 17 — National land suitability map for growing avocado in Kenya



Source: Kenya Soil Survey KALRO, 2019

Areas with moderate suitability and marginal suitability, irrigation is highly recommended.

Soil surveys are performed by deep soil augering at set points, with descriptions of the soils texture and classification down the profile. Topsoil, subsoil and irrigation water samples are collected and analyzed. The data is geostatistically analyzed to generate maps, on suitability, risks and soil amendment requirements. See Figure 18 for recommended soil survey points.

Figure 18 — Soil survey points

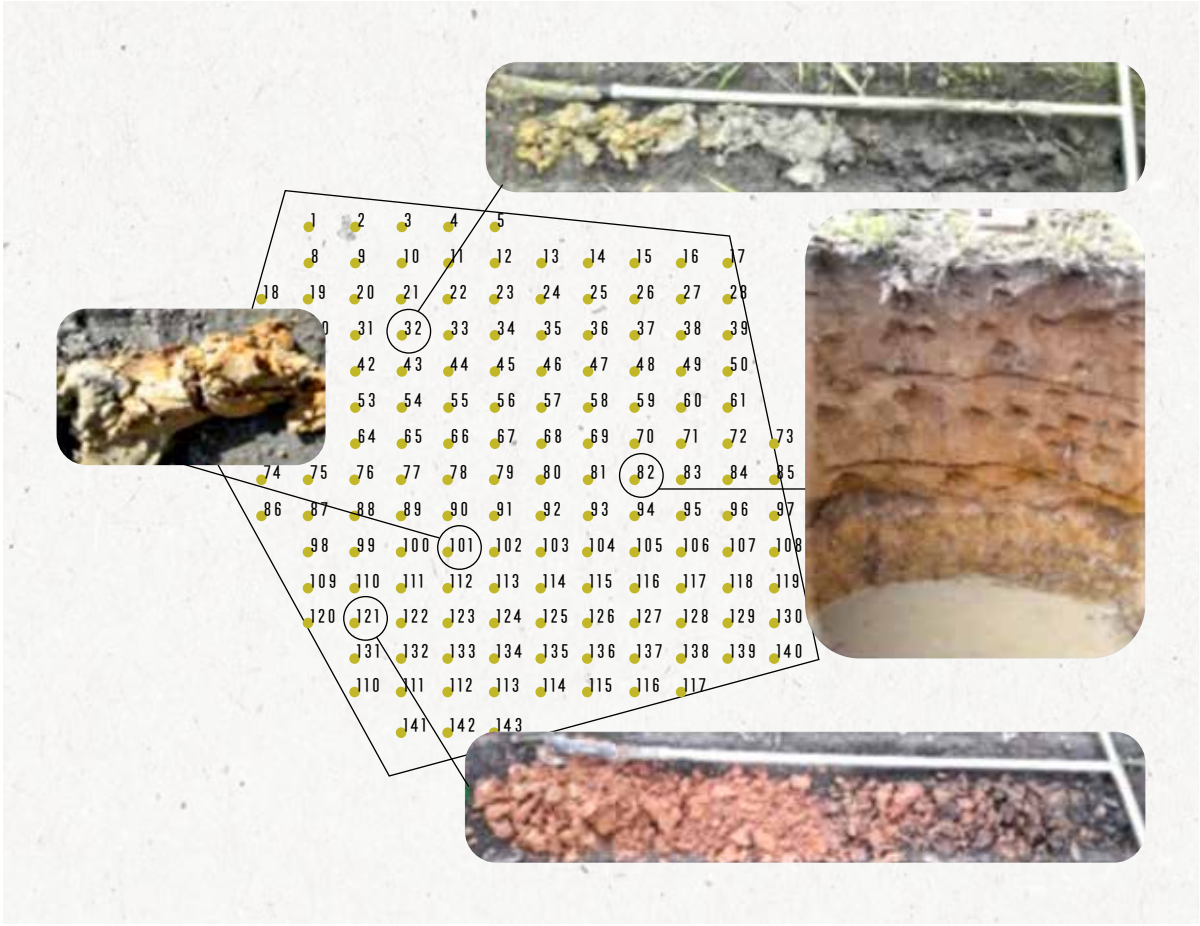


Photo by Ruth Vaughan, Crop Nutrition Laboratory Services Ltd.

2.1.6. WATER

Irrigation Water Quality

Rain fed avocados need >1000 mm rainfall a year, spread throughout the year, with a two-month drier season prior to flowering. The trees require roughly 25mm per week. For high yields and good fruit quality, avocados need to be irrigated. Irrigation water should be tested in a laboratory to check its long-term suitability for irrigating avocado. Water quality is assessed for high salinity, high alkalinity, and toxic ions.

Some elements, like sodium, chloride and boron are plant toxic and can affect / kill the crop. These also burn the leaves when applied as overhead irrigation. Water with high sodium and a high SAR (sodium adsorption ratio) will cause soil dispersion and reduced water infiltration and diseases. Water with a high EC (Salinity) will increase the EC in the soil and can burn the shallow feeder roots and leaves. High magnesium water can cause soil to turn to concrete.

Surface water can contain soil borne pathogens and should be tested for risk before use for irrigation, see Annex 3 for laboratory service providers.

2.1.7. WINDBREAK

A windbreak should be established a year before planting the trees to protect the plants from the wind. The windbreak protects the plants from leaning over to one side and also from the wind damage such as shedding the leaves, fruit drop and bruising of fruits. Some examples of trees to be planted along the orchard fence to consider include, Cypress, Grevillea, Casuarina, Cedar, Spruce, Honey locust, and indigenous trees e.g neem etc. Tree bearing edible fruits and are suitable may be preferred as these could provide an extra source of income to the farmer e.g. jackfruit, Mulberry, Jamun, Karonda, Babool etc. However, selected trees for use as windbreak should not harbor insect pests and disease that will affect the avocado trees and fruits. See Figure 19. It is not recommended to plant eucalyptus trees as windbreaks in the orchards as they deplete water.

Figure 19 — Natural windbreak

Photo by COLEAD.

2.2. LAND PREPARATION

Previous land usage must be considered to understand the type of land preparation required and potential risks and hazards that may be of challenge for avocado fruit production.

The land should be cleared of perennial weeds either through deep ploughing and harrowing or use of herbicides. Zero tillage is possible so long as the area around the tree is cleared of the weeds. Records of land preparation, soil amendments, as well as other agronomic practices should be kept as part of the farm records, see record sheet 7.

2.2.1. DEEP RIPPING

If possible, deep cross ripping with a D7 or similar will break up any hard pans in the soil. This is particularly important for soils that have had years of arable farming or have been fallow for years. Deep ripping should be:

- Undertaken when the soils are dry. Drier soils shatter better, wet soils form lumps.
- Rip in one direction, separating passes about 1m from each other and then to cross rip again (in diagonal 45 degrees). See Figure 20 below.
- Directed towards the main drainage system of the block.

Figure 20 — Deep cross ripping of virgin land

Photo by Richard Collins, Kakuzi PLC

2.2.2. SOIL AMENDMENT

Depending on the soil analysis results, amending the soil with organic matter, gypsum or lime may be undertaken during land preparation. Only well decomposed organic matter and approved gypsum and lime can be used for soil amendment. Cover crops such as legumes (e.g. mucuna, desmodium or velvet bean) can be planted a year before the orchard is established to increase the organic matter content and to minimize soil erosion and root rot. See Figure 21.

Figure 21 — Application of lime during land preparation

Photo by Kakuzi PLC

2.2.3. CULTIVATION

The soil should be evenly cultivated; this will reduce compaction of the topsoil by the heavy machinery used during ripping. Cultivation should not be done in the direction of the high slope and should be avoided to reduce erosion. The cultivated land should be left for 3-4 weeks to settle before ridging can be done.

2.2.4. RIDGING

To enhance water drainage, encourage fast root growth of avocado seedlings and reduce root rot diseases on avocado trees, ridging is recommended for sites with high clay content. Due to the associated high costs of ridging, the prevailing soil conditions, rainfall intensity should be considered before a decision can be made. Where ridging is not done, planting must be done on a raised planting station. Avoid planting on sunken basin as it will encourage water lodging and development of root rot diseases. Ridging is done by accumulating the topsoil in the marked planting

rows. Row spacing should be sufficient to allow for smooth movement of tractors, spray carts and other agricultural machinery to drive through freely without damaging trees/roots or compacting soil. They must be flat in the upper surface (top) to support the irrigation system and direct water into the roots of the tree. Spacing of the ridges must ensure that adequate space is left for access orchard management and movement of machines for operations such as spray operations and harvesting. See Figure 22 below.

Figure 22 — Prepared ridges for planting avocado seedlings

Brian Gesimba, Amiran Kenya Ltd

2.3. PLANTING

2.3.1. SPACING

Spacing of trees depends on the variety vigour, type of soil, climatic conditions and farm operations such as spraying, crop management activities e.g., pruning. Table 10 below is the recommended spacing for commonly planted varieties. The higher the plant density that is planted, the higher the competition between the plants for nutrients and the greater the need for canopy management because of pruning.

Table 10 — Recommended tree spacing

VARIETY	GROWTH HABIT	SPACING (BETWEEN X IN-ROW SPACING)	NO. OF TREES PER HA
FUERTE	Vigorous growth	9 x 9 meters	123 trees per hectare
HASS	Upright growth with high vigour	7 x 6 meters	238 trees per hectare
BACON	Upright growth	8 x 6 meters	208 trees per hectare
PINKERTON	Semi dwarf	6 x 4 meters	416 trees per hectare

2.3.2. PLANTING HOLE

Holes should be dug after the avocado tree spacing has been marked out and the irrigation system installed. Dig holes that are 60cm x 60cm x 60cm (length x width x depth) one month before planting, see Figure 23. The holes should be slightly deeper and wider than the tree bag. The width of the hole should be about 2-3 times the diameter of the pot or sleeve. The hole can be dug manually with a shovel or mechanically with an excavator. At planting mix topsoil, 15 kg of decomposed manure and 120g of TSP fertilizer per hole.

Figure 23 — Digging of avocado planting holes

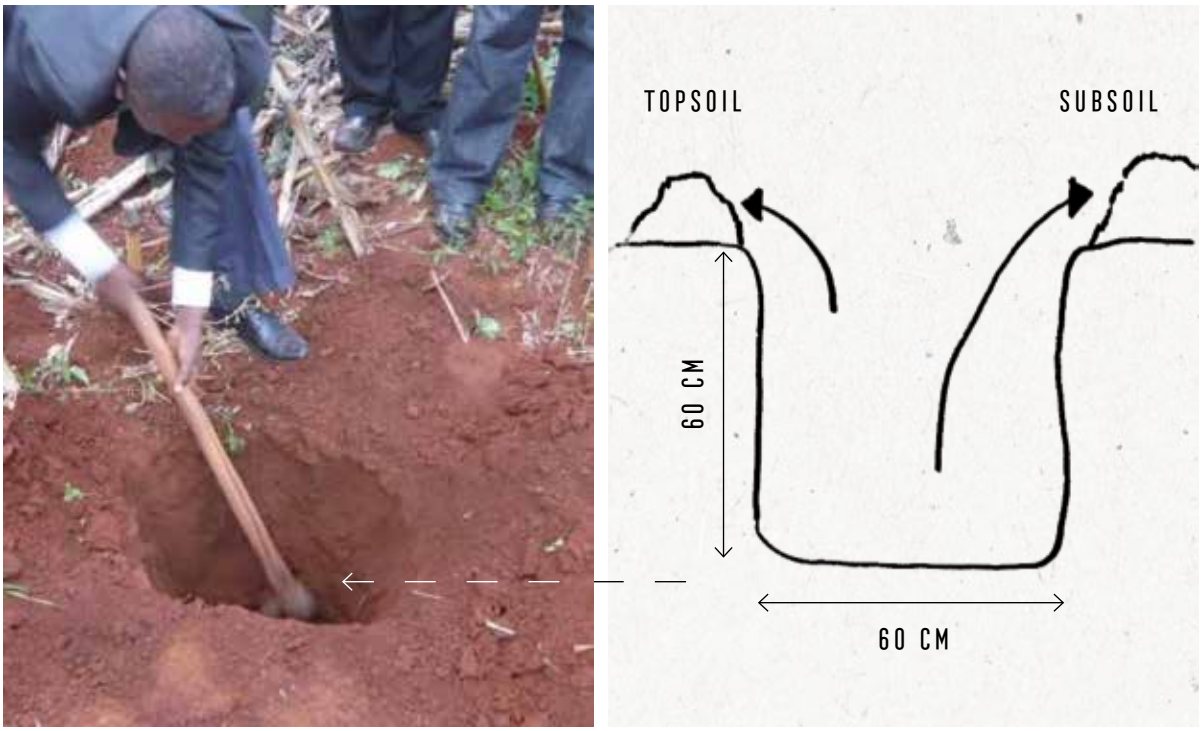


Photo by SHEP PLUS project

2.3.3. SEEDLING SOURCING

Only certified disease-free seedlings from approved nurseries are recommended for planting. The seedlings should be at least 15 months old at the time of transplanting (Refer to the annex for certified avocado seedling nurseries). Ensure the seedlings are true to type as per your desired variety. Seedlings need to be hardened off before planting.

2.3.4. PLANTING

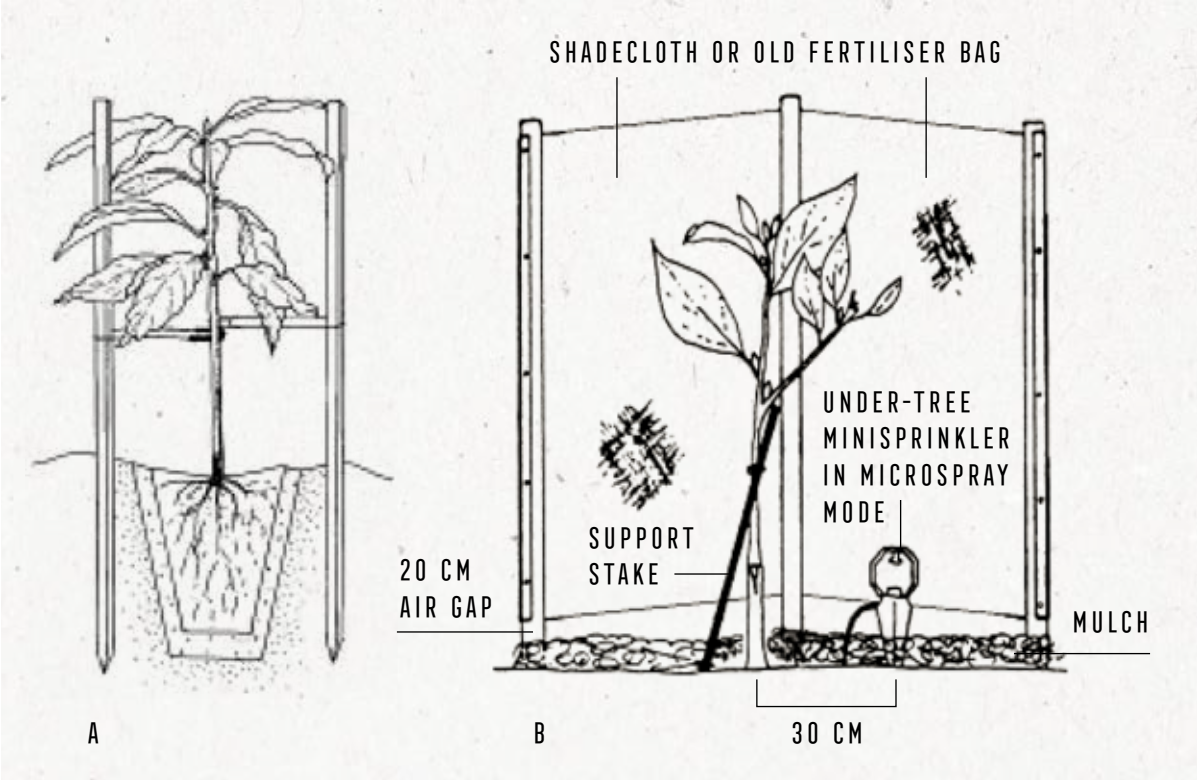
It is recommended that planting is done after land preparations have been made. Irrigation should be done a day or two prior to planting, to ensure enough soil moisture content to support the growth of the avocado seedlings. Carry seedlings to the planting site, putting each seedling beside the prepared planting hole. Care should be taken not to break the scion off at the graft union. Wet the potting mix with water dipping the whole seedling bag into water until no more bubbles rise from the potting mix to the surface. Ensure that the hole is weed free, well moist, deep enough to contain the whole root area of the tree.

Carefully remove the plant from the polythene with the soil intact and place it at the center of the hole. Water the plant immediately after planting. Records of planting dates should be kept as part of the farm records, see record sheet 7.

2.3.5. STAKING OF PLANTED SEEDLINGS

Avocado seedlings are very brittle and can break off easily during the early planting and establishment phase. On windy sites, staking of trees is encouraged to prevent breakage or bending of the seedlings as they grow, see Figures 24(a) and 25(a). To protect from sunburn damage to the stem and herbicide spray damage, protective sleeves can be put on around the stem using shade cloth or old fertilizer bag, see Figures 24(b) and 25(b). Application with water-based paint or white wash to prevent sunburn damage to the young stems is recommended.

Figure 24 — Staking and protecting young avocado plants



(a) Illustration of staking of newly planted seedling (b) tree guarding;
Source: Agrilinks, 2001

Figure 25 — Staking avocado seedlings and positioning of protector sleeves

(a) Staking of a newly planted seedling, Photo by Richard Collins, Kakuzi PLC
(b) a young Hass tree with a protector sleeve around the trunk. Photo by AGFACT, 2003.

2.3.6. MULCHING

Natural/artificial Mulching is recommended for young, planted seedlings especially where the slope, soil type or rainfall may increase soil erosion risk. Living/green mulch can be planted between the tree rows. The selected mulch should be low growing, non-climbing and tolerant shade and be able to smother weeds. Where grass is used as green mulch between the tree rows, it should be routinely cut and used as mulch under the avocado trees. Keep away the mulch from the tree trunk. See Figure 26.

Figure 26 — Dry grass mulch on young avocado trees

Photo by Simon Newett, Dept of Agriculture, Fisheries and Forestry, Queensland

2.4. CROP MANAGEMENT

2.4.1. FERTILIZATION

For optimum growth and production of avocado trees, use of fertilizers and manures is highly recommended. Specific levels of macro and micronutrients may be required depending on the development stage of the avocado tree (see the general nutrient requirement for avocado at different stages in Figure 27 below). Also, refer to Practical sheet 2 for General Avocado Management plan. Animal manure should be used with caution because of high salt, nitrogen and phosphate content. It should also be noted that some manures, such as chicken manure, generally have very high phosphate and nitrate contents, which can lead to nutrient imbalances in orchards.

Figure 27 — General nutrient requirement at different growth stages

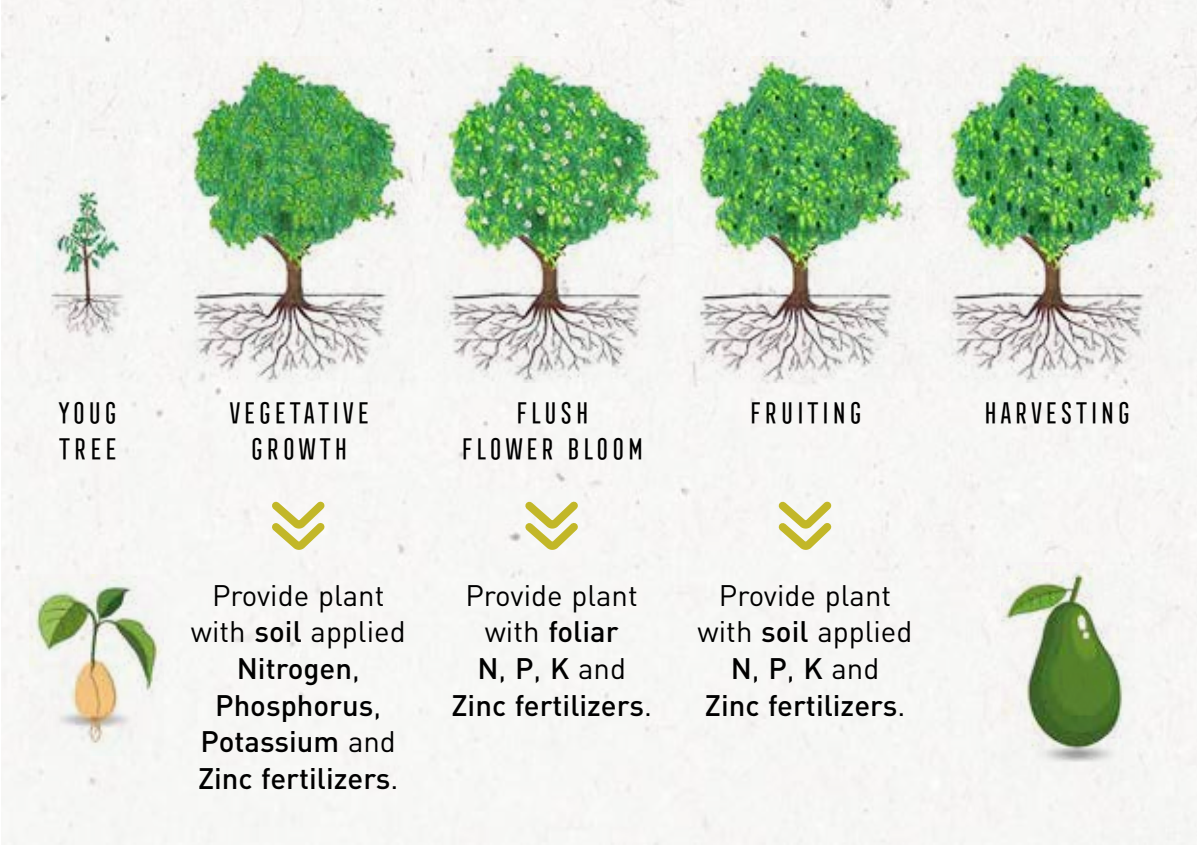


Photo by Ruth Vaughan, Crop Nutrition Ltd, Kenya.

Before planting an orchard, it is recommended to undertake soil analysis and establish the soil nutrient levels. At planting mix topsoil, 15 kg of manure and 120g of TSP fertilizer per hole. At the onset of each long and each short rain, place the fertilizer on the soil around the tree and replace the mulch as necessary. It is critical that soil nutrients will need to be replaced as the avocado trees start to fruit. For every metric tonne (1MT) of harvested avocado fruits, 7.5Kg of Nitrogen,

2.5kg of Phosphate and 10.2 kg of Potassium is depleted from the soil. To replenish these nutrients, fertilizer application during the growth, flowering, fruiting stages should be advised by the soil nutrient analysis, avocado leaf analysis results and the development stage of the avocado tree. Table 11 is an example of avocado nutrients requirements that a grower may use as guide.

Table 11 — General fertilizer requirements of avocado per year per avocado tree

AGE IN YEARS	CAN (G)	TRIPLE SUPER PHOSPHATE	MURIATE OF POTASH	MANURE (KG)
1-3	125	225	-	15
4-5	225	450	-	15
6-7	450	650	225	30
8-9	650	650	450	30
10-14	900	1000	635	60
15+	1300	1200	650	60

Split application of fertilizer is highly recommended. Tables 12 and 13 below indicates recommended amounts of each fertilizer for split application. Deficiency of the macro- and micro-elements due to improper fertilization can lead to various defects as shown in Table 14.

Table 12 — Split fertilizer application recommendation

AGE OF TREE IN YEARS	RECOMMENDED RATES FOR CAN	RECOMMENDED RATES FOR TSP
1	25-50g Monthly	50g, 4 times per year
2	50-75g Monthly	75g, 4 times per year
3	125-175g Monthly	125g, 4 times per year
4	Leaf and Soil Analysis Norms	Leaf and Soil Analysis Norms

Table 13 — Nutritional Calendar by Avocado plant growth stage as % of each Nutrient/Growth stage

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	REMARKS
GROWTH STAGE	FLOWER-ING		FRUIT GROWTH						HARVEST				
Nitrogen		20 %			40 %		40 %						From soil analysis every 1 % organic matter will provide 25 kg N/Yr.
Phosphate								100 %					Apply in rains
Potassium		20 %			40 %		40 %						
Liming products, Calcitic Lime, Dolomitic Lime or Gypsum								100 %					Apply in rains
Boron	25 %			25 %			25 %			25 %			
Zinc		50 %					50 %						Apply with Potassium. Zinc to be applied in 3 to 4 lumps in the drip zone
Foliar Spray: Boron, Zinc & Molybdenum	50 %	50 %											

All records on types of fertilizer used, amounts applied should be kept as part of the farm records, see record sheets, 2,3, and 7. Input supplier audit must be undertaken and records kept to ensure quality of inputs used at the farm and future traceability in case of any quality issue have been identified, see record sheet 8.

Table 14 — Some macro- and micro-elements of importance in avocados and their deficiency symptoms

DEFICIENCY	SYMPTOMS	CORRECTION
NITROGEN		
— Reduced chlorophyll on avocado leaf due to Nitrogen deficiency leading to loss of colour.  Photo: Just Avocados ltd, 2018 — Yellowing veins due to lack of N.  Photo by Ruth Vaughan, CropNutrition — Pulp greying due to high Nitrogen  Photo by Richard Collins, Kakuzi PLC	Shoot growth is restricted by nitrogen deficiency, which manifests itself in small pale leaves and premature leaf shedding. Leaf veins turn yellow in cases of acute N deficiency. The leaves are also often slightly rolled inwards as a result of nitrogen deficiency. Reduced chlorophyll on avocado leaf due to Nitrogen deficiency leading to loss of colour. There is slight fading of normal colour at the onset and later stages show uniform loss of colour. There is also retardation in shoot elongation **Too high nitrogen** Avocado Grey pulp. This is associated with too high Nitrogen levels. Other factors and in combination with each other can also impact grey pulp and include advanced maturity and long transit time being over 35 days.	Apply nitrate fertilizers or organic manures high in nitrogen. Nitrates are easily leached, ammonium is bound to the soil particles and not leached so easily but can cause soil acidification. Over application of nitrogen can stimulate excess vegetative growth, at the expense of flowering and fruit yields.

PHOSPHORUS

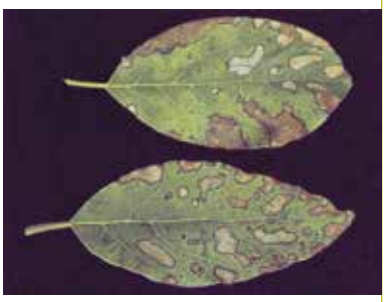
Phosphate – root development

Phosphorus deficiency symptoms are uncommon in avocado orchards. Some symptoms include decreased vegetative development, burnt leaves/necrotic spots, early leaf shedding, poor fruit development and branch dieback in avocado trees. There isn't a lot of knowledge about the direct impact of P on avocado yield.

Phosphorous is most available at pH 6.5-7.5. Check soil pH and soil phosphorus levels. Apply lime to increase pH of acidic soils. MAP, TSP, SSP or rock phosphate can be applied to increase soil P levels, the preferred phosphorus form depends on soil pH.

POTASSIUM

— Brownish-red necrotic spots on leaves due to Potassium deficiency



— Marginal burn on avocado leaf due to severe Potassium deficiency

Potassium – critical and rapid fruit expansion and together with calcium important in cells development. If cell development is good this ensures less post-harvest quality issues.

Tiny, thin leaves with brownish-red necrotic spots that grow on older leaves and then coalesce over the entire leaf blade between the main veins are typical K deficiency symptoms. Twigs on highly deficient trees are very small, and there is some dieback or marginal burn. However, K shortage in avocados can be difficult to detect since it manifests as tip and marginal chlorosis and necrosis on older leaves, which is sometimes hidden by chloride toxicity-induced tip burn. Slow growth, weak stems, and undersized fruit are other signs of K insufficiency. Potassium deficiency can cause blackening of the veins in the fruit. Potassium regulates the fruit acidity, size and increases the oil content of the fruit.

Test soils and apply potassium nitrate, potassium sulphate or high K NPK's according to soil analysis, age of trees and yields, spray potassium foliar feeds.

ZINC

— abnormally rounded avocado fruit vs (b) normal oval shape in Hass variety.

Photo by Richard Collins, Kakuzi PLC

Zinc deficiency causes mottled leaves with light yellow areas between the veins and abnormal development of growing shoots. In a more severe stage, stunted and deformed leaves and twigs are observed. At this stage tree growth, may be retarded and fruit production reduced. In Fuerte and Hass for instance, fruits may become round rather than the normal pear shape.

Test the soil, apply zinc sulphate to low zinc soils, and zinc foliar feeds. Zinc deficiencies are common in high alkaline soils and soils with high phosphorus due to over application of P fertilisers or manures.

The deficiency may be corrected either with 0.5% Zinc Sulphate ($ZnSO_4$) plus 0.25% Hydrated lime (Ca (OH)) or 0.2% Zinc oxide or by application of 250g Zinc sulphate for each year of age, upto maximum of 4.5kg. The application should be done in a 60cm strip around the drip of the tree.

MANGANESE

Leaves have light-coloured spots that sometimes become necrotic. Areas between the smallest veins turn chlorotic and in advanced stages only the larger veins remain green.

Manganese deficiency is controlled by foliar spray of manganese sulphate. As with the Zinc, spray when the leaves are young.

IRON

Iron deficiency causes chlorosis of the leaves.

Iron deficiency is corrected by application of Iron Sulphate at the rate of 250g per 10 litres of water. In acid soils Iron-Chelate at the rate of 360g per tree will correct iron-deficiency.

BORON

Photo by Richard Collins, Kakuzi PLC

— Avocado leaf displaying symptoms of boron toxicity

Boron leaches easily and deficiencies are common, more so in sandy soils.

plants with Boron deficiency show Interveinal crinkling of leaves, misshapen leaf margins, shot-hole of leaves, nodal swelling of the shoots, loss of apical dominance of shoots and flower panicle, splitting of stems, poor fruit set due to short pollen viability.

The fruit are misshapen, sickle shaped, with bumpy skin and sunken corky lesions. In severe cases of boron deficiencies necrotic lesions develop on the branches and trunk.

High uptake of boron from the soil could lead to Boron toxicity. Affected trees have leaves that display a burn margin with a clearly defined edge. There are pale yellow areas within the burnt area with a variety of tiny dark spots

Applications of soil fertilizers and foliar fertilizers rich in Boron. Apply boron foliar feeds or fertilisers containing boron evenly to plants or soil. Boron is a sensitive element and over application or uneven application can result in boron toxicity.

CALCIUM		
	Calcium is a critical structural component of plant cells walls. It is immobile in the plant and therefore a continuous calcium supply is required in the soil to support new growth. Calcium is important for disease resistance and fruit quality. Calcium deficiency results in deformed leaves. Severe deficiency results in the death of the growing tips in the shoots and roots. Calcium deficiency affects fruit texture and shelf-life, and fruits are often rubbery inside, take longer to ripen, have a bitter pit, crack or get water soaked and go rotten quickly when picked.	Spray calcium foliar feeds in the short term and address low calcium levels in the soil by applying calcium nitrate, CAN, gypsum or lime. In highly leached acid soils apply lime to increase pH and calcium. In alkaline calcium may become locked up and supplemental calcium application is required. Highest plant demand for calcium is during early fruit development.
CHLORINE		
 Photo by Ernest Muthomi, ASOK 	Avocados are very sensitive to chloride and high salinity (*there is a yield loss of about 12 % for every 35ppm chloride in the water*). High concentrations of chlorides in the soil may cause scotching of the leaf (leaf-tip-burn). The roots are also damaged by high concentrations of chlorides.	Avoid high chlorinated water Measure the chlorides and salinity of the water, do not over apply fertiliser, apply fertiliser in the rainy season, leach saline soils to reduce salt content.

Avocado Fruit abortion

Avocado trees shed both flowers and immature fruits naturally due to many reasons. Limited water and nutrients have been linked to heavy flower and fruit abortion especially in Avocado. To avoid heavy fruit drop, farmers are advised to apply well decomposed manure and appropriate fertilizers as indicated in figure 27 and table 11.

2.4.2. SOIL NUTRIENT MANAGEMENT PLAN

An annual soil health and nutrient management plan aims to take soil, leaf, and water samples at strategic times in the growth cycle so as to apply the correct soil amendments and to fine tune the fertilizer and foliar feed applications and water treatment procedures. The soil and leaf analysis results and target yields are considered important for planning optimum NPK and micronutrients to add to the soil, and when to apply appropriate foliar feeds, liming and manure to maintain optimum soil fertility.

A well-balanced healthy soil will have better fertilizer efficiency and be regenerative and disease suppressant.

The soil analysis should be done every 3 years and leaf analysis should be done annually especially at the start of the spring flush.

Records of types of fertilizer and manure used, amounts applied, date of application, by whom and other related information must be kept (refer to Record Sheets 2 and 3).

2.4.3. SOIL AND LEAF SAMPLE COLLECTION PROCEDURE

a. **Soil sampling for nutrient analysis**

- Soil should be taken from the 'drip zone' under the tree canopy of these trees, not too close to the base of the tree,
- Mix up to form a representative, composite sample of the field.
- Immediately transport the sampled soil in Khaki bags to the preferred soil analysis laboratory
- Soil analysis should be done every 3 years. Table 15 shows the optimum values for soil test for Hass avocado.

Table 15 — Optimum Soil pH and Nutrient analysis readings for Hass avocado

NUTRIENT	OPTIMUM RANGE
Soil pH	6.0-6.8
EC Salts	<800
Phosphate(ppm)	50-100
Potassium (ppm)	120
Calcium (ppm)	1,120-1,310
Magnesium (Mg)(ppm)	112-202
Zinc (ppm Zn) (ppm)	2-20
Copper (ppm Cu) (ppm)	2.00-10

Sulphur (ppm)	20-200
Sodium (ppm)	<108
Iron (ppm)	50-300
Manganese (ppm Mn)	30-250
% Organic matter	2.50-3.50

b. **Leaf sampling for nutrient analysis**

- Mark 10-20 trees / ha in an orchard, that are not at the edges, and whose growth is representative of the majority of the trees
- Sampling of leaves should be done on same trees
- Pick 7–8-month-old leaves from non-fruiting branches which are not showing signs of new flush
- From the same tree, pick recently expanded, mature, healthy terminal leaves.
- Leaf analysis should be done annually before fertilizer application.
- See Table 16 below.

Table 16 — Optimum Leaf Nutrient analysis readings for Hass avocado

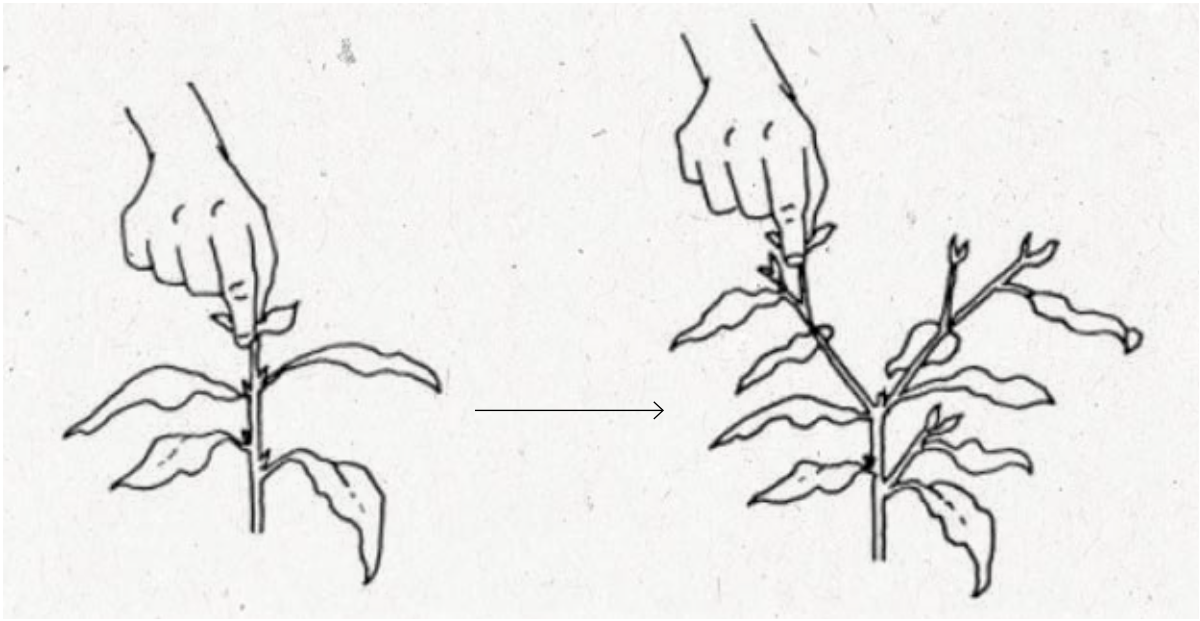
NUTRIENT	OPTIMUM RANGE
Nitrogen (% N)	1.80-2.60
Phosphorus (% P)	0.08-0.30
Potassium (% K)	0.74-20
Calcium (% Ca)	0.9-2.0
Magnesium (% Mg)	0.15-0.80
Zinc (ppm Zn)	29-50
Copper (ppm Cu)	4.00-15.0
Sulphur (% S)	0.19-0.60
Sodium (ppm Na)	<3,000
Iron (ppm Fe)	49-200
Boron (ppm B)	40-100
Manganese (ppm Mn)	29-500
Molybdenum (% Mo)	0.20-1.00

2.4.4. PRUNING, ROGUING, TOPWORKING

Tree shaping

Avocados should be allowed to continue increasing in size to be more productive. Formative pruning is needed in avocados to train and shape the tree. Pruning helps to establish a good height that would enable ease of movement and access for other orchard management activities including pest control and improve light penetration. For the first two years, pinch out the strong growing points/tips to promote a more side shoot growth and more compact tree. See Figure 28.

Figure 28 — Illustration of tip pruning to encourage side branching



Agrilinks, 2001

Remove any branches growing below the graft union or divided trunks/stems. Keep trees pruned to maximum height of 5.5 metres for better sunlight penetration and aeration. For optimum light penetration, the tree height must not exceed 70% of the row width. Avocado trees are very susceptible to sunburn and therefore severe pruning is not recommended. However, if there are severe pruning branches must be painted with whitewash to help protect against sunburn. The types of pruning that can be carried out in the orchard include:

1. **Selective branch removal**

Lower branches that are overlapping or growing up the centre of the tree or interfering with farm management activity and equipment such as tractor movement, irrigation or general field hygiene are removed. Remove low branches where fruits may contact the ground. Internal branches and dead twigs should also be removed. In cases of severe pruning, branches must be painted with whitewash to help protect against sunburn. See Figure 29 below.

Figure 29 — Selective pruning of avocado

(a) some tools used in pruning (b) and (c) selective cutting of branches and parts of tree stems.
Photo by Ernest Muthomi, ASoK

2. Staghorning

This is a heavy pruning and it is only used to reduce the size of the tree after many years (>15 years) of growth. The tree branches are pruned back to a stump, above the graft. This allows even light infiltration for regrowth and better control of irrigation, fertilizer rates and timings. It is recommended to staghorn all trees in a block at the same time. Application of paint to the cut exposed branches with white plastic paint is recommended to reduce sensitivity to sunburn and disease infection. The pruned trees in this case are out of production for a couple of years. See Figure 30 below.

Figure 30 — Staghorning avocado

(a) An illustration of a staghorned tree, adapted from Agrilinks 2001;
(b) a staghorned avocado tree covered with white wash to protect
it from disease causing pathogens and sunburn,
(c) staghorned tree with whitewash and dead branches for protection,
(d) regrowth 1-yr after staghorning.
Photos from Richard Collins, Kakuzi PLC.

3. Tree removal /rogueing

Tree removal/roguing of trees may be done due to declining production or disease infection such as root rots. Whole tree or part of the infected tree is removed, application of paint to the cut exposed branches with white water-based paint is recommended to reduce sensitivity to sunburn and entry of pathogens causing diseases. In cases of disease infection, spot treatment is recommended with approved products.

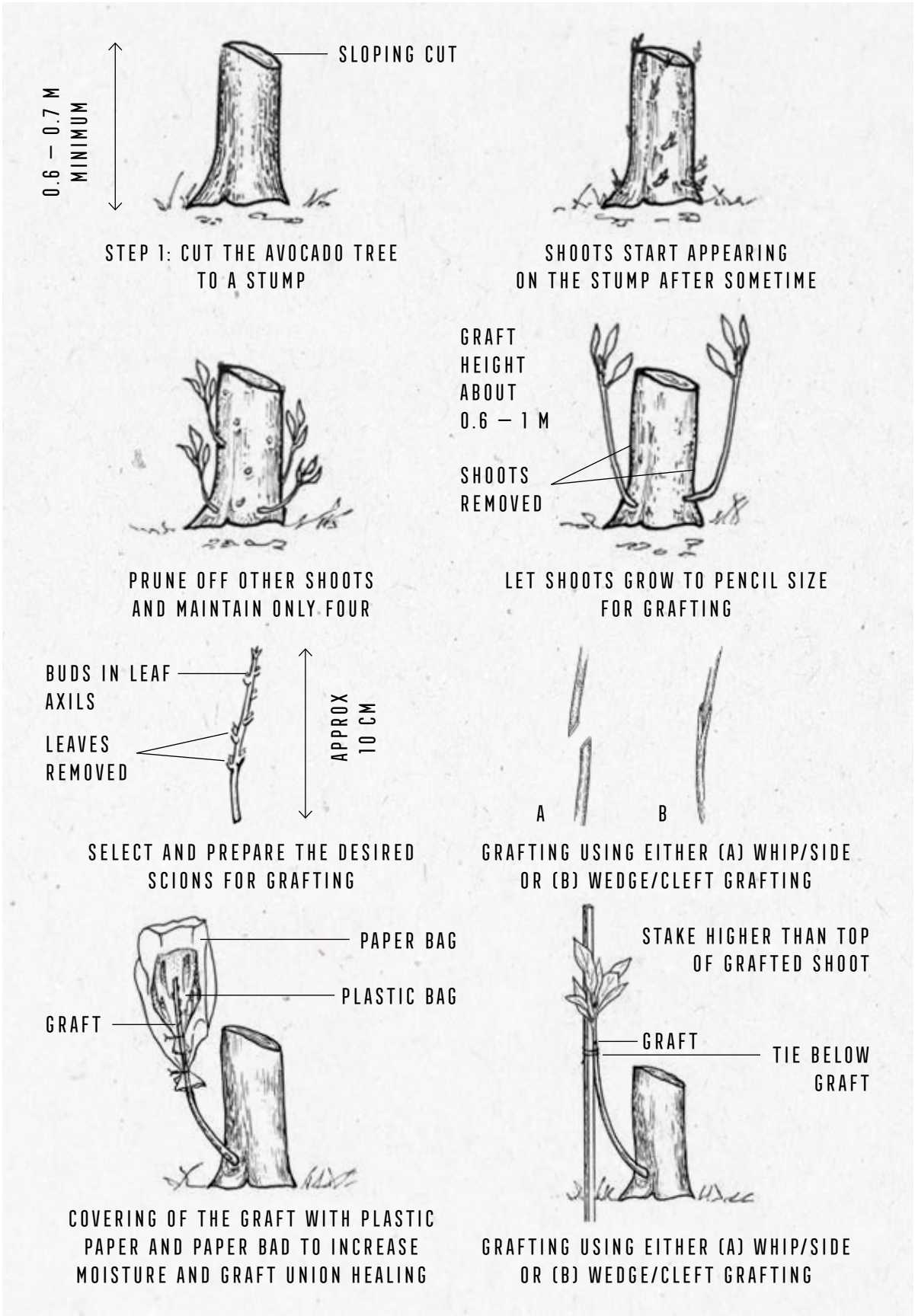
4. Topworking of orchard

Over time, avocado varieties demanded by consumers may change or new varieties with high yielding or pest resistance may be available for production. Replanting or topworking may provide an opportunity to re-establish the orchard and adapt to these changes. Topworking provides the best option as the desired varieties will fruit within a shorter time than planting a new orchard. the following steps should be followed when topworking the orchard:

- Topworking should be done after harvest on health trees
- Use a chainsaw to cut off the existing canopy leaving a stump of 60-70cm high. Ensure the previous graft is removed. ensure the cut is slopping to drain off water from the new wound
- Do not cut below 60cm as the stump may not shoot new growth
- Seal off the cut wound with white water-based paint to prevent fungal disease growth and sunburn
- Continue watering the cut stumps to ensure shooting. Do not overwater the stumps
- As shoots start to appear, select four vigorous shoots emerging near the base of the stump
- When shoots attain pencil thickness, graft two of the vigorous shoots with desired scions. Thin off the other two shoots.
- Either whip/side or top wedge/cleft grafting can be used
- Bind the graft with grafting tape ensuring no air of open spaces
- Cover the new grafts with paper bag and polythene bag to increase moisture levels and protect the graft from heat and drying out and pathogens
- Stake the grafted shoots to reduce breakage by wind.
- Continue to remove any additional shoots growing from the stump and maintain only the desired variety grafted.

The steps for topworking are illustrated in Figure 31 below.

Figure 31 — Steps involved in topworking Avocado



(Agrilinks, 2001)

2.4.5. IRRIGATION

Irrigation systems can be manual or automated depending on the availability of water and affordability. Recommended irrigation systems would be either drip or micro-sprinklers. Basin irrigation systems can be used where water is available in plenty, however the soil should be free draining due root rot diseases. The irrigation pipes' laterals should go with the slope (across the contours, not along the contours). This will allow for good drainage and avoid water logging. See Figure 32 below.

Figure 32 — Ridged planting beds with (a) micro sprinklers, (b) drip lines

Photo by Richard Collins, Kakuzi PLC

The amount and frequency of irrigation is determined by the soil type, weather condition and growth stage e.g., during flowering, fruit set and fruit development. After transplanting, irrigation should be more frequent for about 4-5 days to support the fast development and spread of roots. Through the growth cycle of avocados, it is important to make use of weather data to make decisions for irrigation. Factors such as rainfall, degree of wind will also impact the rate of evaporation and transpiration. Continuous monitoring of soil moisture all year using soil moisture monitoring tools such as tension meters is recommended. Tensiometer stations can be installed across the blocks to help make informed decisions about when and how much to irrigate. Generally, within the first year of transplanting the tensiometer reading should be between 10 to 20 centi-bars. Table 17 indicates water demand by the growth stage.

Table 17 — Monthly water demand by avocado trees at different growth stage

WATER DEMAND OF STAGE OF GROWTH	1	2	3	4	5	6	7	8	9	10	11	12
Flower & Fruit Set	High											
Fruit Expansion & Growth		High										
Harvest									Medium			
Water Stress prior to next Flowering											Low	

Any moisture stress through the flowering and fruit expansion phase will result in a higher proportion of fruit drop, high % of small fruits, ring-necking of fruit, skin cracking, salt burn on leaves and drying out of the feeder roots. Controlling moisture levels through the harvesting can help to reduce lenticel damage. Turgid fruits (during high water level) are more sensitive to lenticel damage.

2.4.6. FLOWER INDUCTION

By being able to stress the plants after harvest until flowering, can help to ensure the flowering period is concentrated. Flowering can take up to 6 weeks and may result in lack of uniformity in fruit maturity thus presenting a challenge during harvesting. However, this anomaly reduces over the years with tree development.

2.4.7. POLLINATION

Generally avocado flowers are capable of self-pollination. However, to reduce likelihood of self- pollination, on the first day of opening, flowers are functionally female and become functionally male on the second day after flower opening. On a single tree, all the open flowers will be synchronized and only last about half a day. Under temperatures of maximum 25°C and minimum 20°C, some avocado varieties will open first in the morning as functionally female, close and then reopen the next afternoon as functionally male (type A flowering sequence). Other varieties will open first in the afternoon as functionally female, close and then reopen the next morning as functionally male (type B flowering sequence) (McCauley, 2021). In an orchard of single varieties, flowering will be synchronized as a single tree i.e., same flowering behavior. See Figure 33 below.

Figure 33 — Hass avocado flowering stages

(a) the functionally female stage, the first opening stage and
(b) functionally male stage, after dehiscence, the second opening stage
(©2021 DPIRD)

To reduce risk of poor pollination and fruit set, it is recommended to inter-planting with complementary varieties. In Kenya, the tropical climate enables the pollen to stay viable for longer hence good pollination without use of any complementary flowering cultivars. However, where necessary, orchard growers may consider mixing a type B flowering variety like Fuerte trees planted in Hass orchard (type A). Considerations must be made on the marketability of the pollinizer variety. Refer to the table below (Table 18) for more examples of varieties and flowering types. It is important to ensure Boron levels are optimum as Boron is important to maintain pollen viability.

Table 18 — Avocado flower opening sequence and flowering classification of common avocado varieties under warm temperatures

FLOWER TYPE	DAY 1 MORNING	DAY 1 AFTERNOON	DAY 2 MORNING	DAY 2 AFTERNOON	EXAMPLES OF VARIETIES
A	female	closed	closed	male	Hass, Lamb Hass, Pinkerton, Reed
B	closed	female	male	closed	Bacon, Edranol, Ettinger, Fuerte, Llanos Hass, Nabal

Adapted from McCauley, 2021

A number of insects including bees are common flower visitors to avocado flowers, see Figure 34. Honeybees are the best avocado pollinators in pure stand avocado orchards/monoculture. Having beehives in the orchard during flowering is highly encouraged. At flowering, we recommend 2 to 10 active hives per hectare of trees to help pollinate avocado flowers. Introduce hives early enough when about 10% of the flowers have opened.

Figure 34 — Pollinators of Avocado

(a) Honey bee pollinating avocado flowers, (b) houseflies pollinating avocado flowers
Photos by Dino Martins

2.4.8. ENVIRONMENTAL SUSTAINABILITY

Due to the intensive investment in the production of avocado, it is recommended that farmers ensure that they undertake sustainable production that would sustain the environment and support a healthy biodiversity. Successful integrated pest management system will enhance ecosystem services such as pollination, and nutrient recycling services within the orchard. Harvesting of rainfall water and efficient use of water and use of solar energy will enable farmers/ processing agents to ensure efficient use of natural resources. Management of fruit rejects for oil production will ensure a source of income to producers. Others include waste management and beekeeping and conservation of green areas within the avocado orchards that support alternative nectar and pollen resources to pollinators (see practical sheet 8).

2.4.9. CROP PROTECTION

AVOCADO PEST AND DISEASE SCOUTING

Before any spray decision is made for any pest or disease, scouting should be done. The procedure must be completed. Scouting can be done by use of pest specific pheromones, visual observation, observation of damage on the vegetative flush and fruit or for fungus infection climatic predictive models. See record sheet 4 for pest traps and 5 for pest and disease monitoring record sheet. Table 19 describes the different pests that attack avocado during its active growth, their symptoms, detailed description of the type of damage they cause and their stage of crop/ fruit sensitivity, regulation status to importing country and the monitoring and management of each pest. Insect pest and disease identification services can be obtained form various laboratories spread across the country. See Annex 3 for list of laboratories to support diagnosis where necessary.

SCOUTING

Scouting by visual observation

This method of scouting can be used to target pests such as thrips, mealybugs, scales, mites, mosquito bugs etc.

1. Plants are to be selected randomly throughout the block. Ensure it is representative for the block
2. Blocks up to 2ha-25 trees, 2.1–4.0ha - 50 trees, and 4.1ha plus 100 trees to be sampled.
3. Scouting for each orchard should be carried out once per week for the entire season. Each tree sampled to be scouted on four sides of the tree; north, south, east and west. Record these results. From these records over time trends will become evident. Also, hot spot areas for a particular pest or disease will become evident.
4. Do not scout guard row trees as they will not necessarily be representative of the production area.

Scouting by pheromone traps

This method of scouting can be used to target pests such as fruitflies (all species), False codling moth and other caterpillars.

1. Place a pest specific pheromone and trap for the target pest, see Figure 35.
2. Place traps at 1.5m in the tree
3. For scouting place 1 trap per Ha or less.
4. Traps should be placed on the windward side of the respective block it is in. This is to allow maximum penetration of the pheromone into the field and thus give the best indications of the populations inside the block.
5. Take into consideration the predominant wind direction, to ensure you have adequate traps in that area. Generally, these insects move distances using the wind.

6. Trap must be at least 20m from the edge of the block.
7. Also consider extra traps where the production area borders bush which can act as an over wintering area for target pests.
8. Ensure the trap is free from obstructions.
9. Follow the instructions from the Supplier for time for the replacement of pheromones.
10. Trap placement should be clearly marked on the map.
11. Any broken or damaged traps must be reported and replaced as soon as possible.
12. Once trap positions have been established and mapped out, the trap placement should not be changed.
13. Monitor results in tracking the pest cycles. From pest cycles decision for control options are made

Figure 35 — Pheromone trap installed on avocado tree to monitor pests

(a) and (b) false codling moth (c) fruit fly adult populations

WEEDS AND THEIR MANAGEMENT

1. Interrow grass or green mulch must be free of weeds.
2. Weeds can be handpicked or uprooted and destroyed.
3. Herbicides may be used for weed management. However, use of herbicides must be kept at the minimum.
4. Apply herbicides when the weeds are actively growing.
5. Avoid herbicide contact with growing avocado tree leaves, steam and branches
6. To avoid contamination of fruits, avoid herbicide application during fruiting.
7. Use only approved herbicides and follow recommendations on safe application of herbicides.

Table 19 — Signs and Symptoms of common Pests of avocado and their management

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
Fruit fly: *Ceratitis capitata* *Ceratitis rosa* *Ceratitis cosyra* 	The *Ceratitis* sp. of fruit fly are highly mobile and can travel long distances. Avocado fruit becomes more susceptible to infestation of fruit fly the more mature the fruit gets. Fruit flies cannot lay eggs into green hard fruit. However, if there is a lesion on the fruit caused by either mechanical damage of another insect such as FCM or mosquito bugs, then eggs may be laid in these lesions. These eggs may not always hatch when fruit is still immature, being green and hard. The fruit may encapsulate the eggs. If in an area the *Ceratitis* sp. fruit is a prevalent species it is highly unlikely that the *Bactocera* sp. will be evident. The *Ceratitis* fruit fly pupates in the soil. 	Yes *Ceratitis capitata* is an A2 pest in East Africa, Egypt and South Africa, Argentina, Bahrain, Turkey, APPPC, EAEU, EPPO, OIRSA, PPPO. A1 pest in: China, Kazakhstan, India, Uzbekistan, Russia, Ukraine. *Ceratitis rosa* is an A 1 pest in EPPO region	Monitor and record weekly catches by using pheromone traps. Track the trend to develop a pest calendar for the production area. i. Trap to be used: McPhail Trap ii. Pheromone: Contact Suppliers for specific Pheromone for Ceratitis sp. Fruit Fly iii. No' of Ha / Trap: 1 trap to Ha iv. Tolerance: 0 Control Measures: Refer to approved Chemical list. Controls can include: 1. Orchard Sanitation: Collect and bury all fallen fruits 2. Use of low volume protein hydrolate bait sprays 3. Pheromone bait blocks
Fruit fly *Bactrocera dorsalis* 	The *Bactocera* sp. of fruit fly are highly mobile and can travel long distances. Infect fruit in the same way as *Ceratitis* fruit fly. They cannot lay eggs into green hard fruit. However, if there is a lesion on the fruit caused by either mechanical damage of another insect such as FCM or mosquito bugs then eggs may be laid in these lesions. These eggs may not always hatch when fruit is still immature, being green and hard. The fruit may encapsulate the eggs. If in an area the *Bactocera* sp. fruit is prevalent it is highly unlikely that the *Ceratitis* sp. will be evident. The *Bactocera* fruit fly pupates in the soil.	Yes *Bactrocera dorsalis* is an A1 quarantine pest in the EU	Monitor and record weekly catches by using pheromone traps. Track the trend to develop a pest calendar for the production area. Control Measures: Refer to approved Chemical list. Controls can include: i. Orchard Sanitation ii. Use of low volume protein hydrolate bait sprays iii. Pheromone bait blocks

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
False Codling Moth *Thaumatotibia leucotreta*   Photos of FCM infestation on Avocado Fruits- Courtesy of Deborah Shituvi from KEPHIS	FCM moths are active at night. They are not the best flyers and do not cover as great a distance as that of fruit fly. The female lays her egg on the fruit and from the egg hatching the larva very quickly burrows into the flesh of the fruit, this happens within minutes. The larvae are then protected by the skin of the fruit. Fruit is susceptible to FCM infection for a long period with the risk of infection increasing as fruit matures. It is also noticeable that Pinkerton is more susceptible to FCM than other cultivars. FCM pupate in the soil under the tree.   Photos of FCM infestation on Avocado Fruits- Courtesy of Deborah Shituvi from KEPHIS	Yes *Thaumatotibia leucotreta* is an A2- pest recommended for regulation as quarantine pest in the EU according to Regulation (EU) 2016/2031	Monitor and record weekly catches by using pheromone traps. Track the trend to develop a pest calendar for the production area. Control Measures: Refer to approved Chemical list. Controls can include: i. Orchard Sanitation ii. Mating disruption iii. Antagonistic viruses or fungi iv. Attract & Kill using pheromones and knockdown chemical v. Cover sprays.

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
Mosquito bugs *Helopeltis schoutedeni*  	This is one of the most important pests on avocados. Accurate and diligent reporting on this pest is critical. Mosquito bugs prefer to feed on young vegetative flush then as this hardens off they move onto fruit. They can feed on all stages of fruit. Critical periods to monitor are from flowering through the fruit set, on then on every subsequent vegetative flush. In general, they do not favour hot weather. a. Adults: On a weekly basis the number of adult mosquito bugs is to be counted. Scouting must be carried out during the early morning and before it gets too hot. Care must be taken to ensure that certain blocks are not always scouted late, as this could give a false impression. The adults have black wings and are bright orange. To detect the mosquito bug, you are to ensure you look on the underside of leaves as well as the top and on fruit. The warmer the temperature gets the more difficult they are to find.	No	Monitor and record weekly catches by using pheromone traps. Track the trend to develop a pest calendar for the production area. Control Measures: Refer to approved Chemical list. Control can include: i. Cover sprays. Ensure that following the 1st application which would most likely be based on the result of the adult no' scouted, that a follow up spray should follow within 10 to 14 days. In this way it will ensure that any egg hatches following the first spray that form nymphs will be controlled before they are mature and can reproduce. When nymphs are detected, it is critical to respond to control immediately.

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
	b. Fruit damage: Weekly 100 fruits/ha are to be randomly selected from each block and monitored (without removing the fruit) for mosquito bug damage. The % infection is to be recorded.  		
Caterpillars/ Leaf Rollers/ Loopers	Infection by any form of caterpillars can happen throughout the season. Depending on the area and the surrounding agriculture the pressure by caterpillar damage will vary. Tolerance: 5/Ha	No	Visual monitoring for caterpillars and fruit damage Careful observation of mature leaves on the lower ¼ of the tree and of young fruit Refer to the approved Chemical list. Control can include: i. Cover sprays.

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
Mites *Polyphago-tarsonemus latus* (Broad Mite)	More often than note these insects are as a result of other agricultural practices on Avocado. The most common reason for their infection is as a repercussion related to some other chemical control that has been used on the Avocado which knocks out the predators and parasites normally controlling them.	No	Visual scouting is recommended Control can include: i. Spot sprays. ii. Severe cases cover sprays
Scales Red Scale (*Aonidiella* spp) Soft brown scale	These suck the plant sap and in severe infestation cause complete distortion of the leaves with consequent drying and dropping off. More often than note these insects are as a result of other agricultural practices on Avocado. Particularly scale insects can be associated with areas next to roadways and are prone to dust. The dust interferes with natural predators & parasites which would normally keep them under control. The most common reason for their infection is as a repercussion related to some other chemical control that has been used on the Avocado which knocks out the predators and parasites normally controlling them.	No	Visual scouting is recommended Control can include: i. Spot sprays. ii. Severe cases cover sprays DC – Tron Plus (Caltex oil)
Mealy bugs	More often than note these insects are as a result of other agricultural practices on Avocado. Particularly mealy bugs can be associated with areas next to roadways and are prone to dust. The dust interferes with natural predators & parasites which would normally keep them under control. The most common reason for their infection is as a repercussion related to some other chemical control that has been used on the Avocado which knocks out the predators and parasites normally controlling them.	Yes	Visual scouting is recommended Control can include: i. Spot sprays. ii. Severe cases cover sprays

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
Systates weevils *Systates pollinosus*	This is a black insect that feeds on the leaves especially when the plants are young leaving characteristic indentations on the edge of the leaves. Problems in areas that have been followed or under grasses for a long time. It feeds only at night and rests under the mulch or loose soil at the ground level in the daytime.		Hand pick and destroy the insect If the problem persists chemical control can be practiced using drench sprays to be carried out using knapsacks in the late afternoon prior to sunset. The stem of plants and soil surrounding the stem to be drenched/ sprayed Use Deltamethrin as recommended on the label
Root Rot  Photo by Ernest Muthomi, ASoK	**Description:** This disease is caused by the fungus *Phytopthora cinnamomi* Rarels. Infections can come from infected plants, infected soil or introduced via irrigation water and under waterlogged (anaerobic) conditions in the field. Seed infection may occur if the fruit is allowed to remain for several days on soil infested with the fungus. Spread to new areas is infected seed, infected soil and seedlings. These fungal infections can thrive under conditions with low pH. The host range of the fungus includes Acacia, Eucalyptus andGrevillea. **Symptoms:** Trees of any size from nursery trees to large, out trees may be affected. Longitudinal, distinctly sunken strips, of yellow or sometimes reddish colour appear on smaller stems and on fruits. The dead brown leaves hang for a long time and the affected tree may suddenly collapse. More commonly, the tree yield gradually decline; leaves become smaller, and paler yellow-green, then drop. The twigs and branches die back. Feeder roots are necrotic, black and brittle.	No	• Improve soil drainage to avoid excessive moisture in the soils • Improving the pH closer to 5.8 to 6.5 will help mitigate the conditions suitable for the fungus • Remove and destroy all infected trees • Prevent movement of soil from diseased to non-infested areas • Use cultivation equipment in disease free areas before the diseased areas • Carefully select ornamental crops to avoid alternative hosts • Seeds picked from the soil should be treated in hot water (500C for 20 min). • Use a resistant variety as rootstock. There are clonal rootstocks that are tolerant of these root rots.

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
Fig. Injecting trees with fungicides.  Photo by Ernest Muthomi			**Chemical** i. Following harvest, tree injections. ii. ii. Stem paints iii. iii. TLC program by applying up to 5Kg of Calcitic lime to the plant dependent on tree sizes. iv. iv. In severe cases trees can be stag horned, then follow with fungicide stem paints and Calcitic lime which should regenerate the plant. • Used Metalaxyl (Ridomil) at the rate of 20-35g per m^2 of canopy area as a soil drench at monthly intervals in newly infected trees
Fruit Spots and rots Scab (*Sphaceloma perseae* Jenkins) Cercospora spot (*Cercospora purpurea* Cke) and Anthracnose (*Colletotrichum gloeosporioides* Peenz).	Although all these tree diseases also attack the leaves their prime importance lies in the damage done to fruits. Fruits are only susceptible to scab from flowering until about half size development. The fungus requires moist conditions for sporulation and infection, so the fruits may escape infection when the conditions at fruit setting are dry and warm. *Cercospora* spot occurs under very humid conditions and when the temperatures are high humidity exists. Spores are essentially splash-dispersed through under wet conditions they can wind-borne. Infection is through lenticels; mature fruits are resistant. Symptoms are slow in appearing, often as much as three weeks after infection.	No	There is a predictive model that has been developed to determine when conditions are ideal for spore release. This model makes use of temperature & rainfall data collection. Important that on the farm a weather station should be set up to monitor this data. There are simple instruments that can do this or through more technical weather stations that record data automatically. **z = –58.99–3.22x+0.18y:** Where: Z = conidia number, X = mean weekly air temperature using daily (min+max)/2, Y = total weekly rainfall (mm)

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
	The anthracnose fungus lives saprophytically on twigs, rotten fallen fruits and dead or drying leaves but is generally unable to infect undamaged fruits. During wet weather when the fungus sporulates, the spores are spread by splash and infect only damaged fruits. Fruit rot begins as small, dark discoloration and slightly sunken spots. The disease rapidly spreads into the flesh. On Hass the symptoms will be seen as a bronzing, similar to mite damage on other crops, but has a small lesion and is described as "Pepper Spot". Fruits bigger than pigeon egg size are susceptible to infection at any time under favorable climatic conditions for the fungus.		According to this formula, spore release occurs when Z > 0. Cercospora infection takes place when Z value is ⩾15 and fruits are larger than pigeon egg size. The first copper spray should be applied when fruits are bigger than pigeon egg size and the Z value >5. The potential for *Cercospora* spot infection is high when Z > 20. Use copper-based fungicides e.g. Copper oxychloride and Kocide DF during fruit development.
Avocado sunblotch viroid.  Photo by MaryLucy Oronje, CABI	Symptoms of Avocado Sunblocth Viroid (ASBV) are seen on fruit causing a white to yellow lesion on fruit. The growth habit of ASBV trees can be inclined to growing flat and low. In more severe cases lesions similar to that as on fruit can be seen on branches. Trees used as seed sources and or trees used for budwood can appear symptomless, but on using seed as rootstock and budwood for scion material the symptoms can develop on that next generation of plants. At the ITSC, Nelspruit, South Africa there is a serological test that can be done to certify plants ASBV free. This would be a good practice for screening all trees to be used for propagation of plants. ASBV is transmitted by using infected budwood or seed for rootstocks. Limited transmission can take place from plant sap on from picking clippers and pruning equipment. Very rates of transmission have been reported from pollen.	Yes	Remove trees showing fruit with symptoms and also any trees growing flat and low and not in the normal upright growth habit.

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
Cucumis dipsaceus.  Photo by MaryLucy Oronje	Arabian cucumber (*Cucumis dipsaceus*) is an annual climbing herb. They intertwin on the growing points of avocado trees and result in stunted growth due to competition for nutrients, water and light. In the orchard, they act as alternative hosts for pests and diseases that affect avocado. They also present challenges to orchard management practices such as spraying, irrigation, pruning and fruit harvesting.	No	Scouting for weeds in the nursery and hand pulling of germinated seeds Burn uprooted weed growing parts and fruits should be burned Frequent manual weeding to reduce growing weeds
Dandelion (*Taraxacum officinale* complex) 	Dandelion (*Taraxacum officinale* complex) is an important weed in avocado nursery and orchards. The weed spreads easily through the nursery and orchard through movement of viable seeds through wind, contaminating field equipment and personal clothing. Presence of dandelion may result in stunted growth of seedlings due to competition for nutrients, water and light. In the orchard, they act as alternative hosts for pests and diseases that affect avocado. They also present challenge to orchard management practices such as spraying, irrigation, pruning and fruit harvesting	No	Scouting for weeds in the nursery and hand pulling of germinated seeds Frequent mowing/ slashing of dandelion seedlings when they start to flower is the most effective method to manage this weed. Frequent manual weeding to reduce growing weeds Use of approved herbicides for weed management

INSECT PESTS	DESCRIPTION, SYMPTOMS/ DAMAGE AND STAGE OF SENSITIVITY	REGULATED BODY (YES/NO)	MONITORING/ MANAGEMENT
Selected Grass weeds Couch Grass, *Cynodon dactylon*  Picture by CropNuts Couch grass  Photo Massey University *Eleusine indica*  Photo by CropNuts Ltd	While grasses can be used as a green mulch between the avocado trees, they can be important weeds if not managed appropriately. Common grass weeds include couch grass, star grass etc. Grass weeds are difficult to control and can spread fast through the nursery and orchard. Grass weeds will result in stunted growth of seedlings due to competition for nutrients, water and light. In the orchard, they act as alternative hosts for pests and diseases that affect avocado. They also present challenges to orchard management practices such as spraying, irrigation, pruning and fruit harvesting.	No	Hand weeding around the avocado tree crown preferably before the grass weeds flower and set seeds. Slashing of weeds and use as dry much or animal feed may be helpful to manage the grass weeds. Use of post emergence herbicides during orchard establishment. Use of herbicides should be considered as the last option and must be kept to the minimum. Only use approved herbicides and observe safe use of herbicides. Do not graze livestock in the orchard.

APPROVED PEST CONTROL PRODUCTS

The following end-use products in Table 20 are permitted on the avocado provided that they meet the GAP requirements on the label. Approved pest control products must be used according to the safe use guidelines in Practical sheet 1. All applied pesticides must be recorded in the pesticide application record, see Record Sheet 6.

Table 20 — Plant protection products registered for use on Avocado in Kenya (as in August 2022)

PESTS, DISEASES ADVENTICES (WEEDS), OTHERS	AREA OF USE	TRADE NAME OF THE PRODUCT (REGISTRATION NUMBER)	ACTIVE SUBSTANCES (N.A)	WHO CLASSIFICATION	RECOMMENDED CONDITIONS OF USE (RATE: G A.S./HA; MAXIMUM NUMBER OF APPLICATIONS; PHI)
Anthracnose	Post-harvest	Tecto 500 SC (PCPB(CR)0914)	Thiabendazole 500g/L	Class III	recommended at the rate of 46.5ml/10L (465ml/100L) = 232.5 gai/100ml Deep fruit for 5 minutes.
Anthracnose and Cercospora fruit spots	Field	Vitra 40 WG (PCPB(CR)1198)	Copper hydroxide 66.7 % w/w	Class II	Recommended at 5kg/ha (32g/20L) Foliar application Pre-harvest interval: 3 days.
Fruit flies *Bactrocera dorsalis*	Field	BACTROCERA BLOCK (PCPB(CR)1696)	Methyl Eugenol 99 % + Malathion 50 % (w/w)	Class U Malathion -Class III	Recommended at 10 blocks/ha to be placed from flowering and early fruit development stages. Bait should be replaced after 6 weeks. No pre-harvest interval required.
Fruit flies *Bactrocera dorsalis*	Field	LIBERATE (PCPB(CR)1696-P(i))	Methyl Eugenol 99 % + Malathion 50 % (w/w)	Class U Malathion -Class III	Recommended at 10 blocks/ha to be placed from flowering and early fruit development stages. Bait should be replaced after 6 weeks. No pre-harvest interval required.
Fruit flies *Ceratitis* sp. (*C. capitata*, *C. cosyra*, *C.*)	Field	CERATITIS (PCPB(CR)2089)	Enriched ginger root oil 13.5 % + Malathion 50 %	Class U Malathion -Class III	Recommended at 10 traps/ha Hang traps at-least 1.5 m high above ground on shady side of tree inside the orchard Replace the block inside the traps after every 6 weeks Traps to be installed at flowering stage No pre-harvest interval required.

PESTS, DISEASES ADVENTICES (WEEDS), OTHERS	AREA OF USE	TRADE NAME OF THE PRODUCT (REGISTRATION NUMBER)	ACTIVE SUBSTANCES (N.A)	WHO CLASSIFICATION	RECOMMENDED CONDITIONS OF USE (RATE: G A.S.A/HA; MAXIMUM NUMBER OF APPLICATIONS; PHI)
False Codling Moth	Field	ISOMATE-FCM Dispenser (PCPB(CR)2090)	E-8-dodecen-1-yl acetate 166.8 mg + Z-8-dodecen-1-yl acetate 70.8 mg + E-8-dodecen-1-ol 2.4 mg	Class U	*Recommended rate 750 dispensers@ Ha or 2,250 dispensers for 3 Ha* No pre-harvest interval required.
False Codling Moth	Field	CRYPTEX (PCPB(CR)1969)	*Cryptophlebia leocotreta* granulovirus CrleGV 2*1010 occlusion bodies/mL	Class U	Recommended at 300ml/ha. Applied early in the season to coincide with egg-laying and larvae hatching stage of FCM. No pre-harvest interval required.

Source: PCPB (https://www.pcpb.go.ke/on-crops/) and https://www.pcpb.go.ke/biopesticides-on-crops/

2.5. FRUIT HARVESTING

For grafted varieties, harvesting starts 3-4 years after planting. Avocado fruits must be harvested at the right maturity stage to meet the export market quality requirements. The fruits need to be harvested when physiologically mature to ensure that the final taste and experience meets the consumers preferences/expectations. fruit physical appearance, color can be used to know if fruits are mature for harvesting. Dry matter content is more precise in determining fruit maturity. A general reference of 22% dry matter for fresh fruits and 30% for fruits meant for oil processing as being the minimum specification, however this varies according to variety. Oil content can also be used to determine fruit quality with a minimum of 11.2% oil content being considered necessary to declare a fruit mature. The higher the oil content, the better the fruit tastes.

Before harvesting, it is highly recommended to assess fruit maturity by testing for dry matter content of the fruits at their orchard. The following Horticulture Regulation of 2020 must be met before harvesting;

- Horticultural produce shall be harvested at the right stage of maturity for the intended use.
- Harvested produce shall be handled by personnel with skills and knowledge on food safety.
- Harvested produce shall be protected from dust and other contaminants
- Horticultural produce shall be harvested using clean crates or clean buckets. A collection shed shall be constructed for receiving produce at the field level and meet all the conditions set out in the Horticulture Regulation of 2020

2.5.1. AVOCADO MATURITY DETERMINATION

DRY MATTER

Dry matter content increases as the fruit matures. It is highly dependent on the variety, season, and region where the avocado is cultivated. It is used as a reliable indicator of flavor and consumer satisfaction with fruit quality.

HCD uses "**Time to harvest**" tool to estimate the maturity periods for both Hass and Fuerte in various regions of the country. They then carry out avocado maturity surveillance and provide guidance to growers and exporters on the harvesting and exporting seasons for Hass and Fuerte. Notices are published at the start of each harvesting season in the media to inform growers and exporters.

The following are recommended maximum and minimum maturity level for export of avocados by HCD;

Fuerte: Minimum maturity = 76% moisture content i.e., 24% dry matter content
Maximum maturity = 76% moisture content i.e., 24% dry matter content

Hass: Minimum maturity = 76% moisture content i.e., 24% dry matter content
Maximum maturity = 76% moisture content i.e., 24% dry matter content

Sampling for dry matter testing

- Sample fruits in the morning, since fruit is most hydrated at this time of the day.
- If using Near Infrared (NIR) Spectroscopy instruments such as Felix instrument, conduct the sampling in the morning.
- Take fruit samples from shady parts of the tree and select the least mature/ripe-looking fruits.
- Samples should be taken from several avocado trees; a single test is not enough
- Samples should be wrapped in plastic to prevent moisture loss
- Dry matter should be measured at the midpoint (widest diameter). Measurements should be taken from the same place on ALL fruit
- Dry matter is checked not only at the time of harvest, but also when it is packed and in storage.

See the list of Annex 3 for laboratories that undertake dry matter testing.

DRY MATTER TESTING METHODS

There are various methods to determine the dry matter and moisture content.

a. **Non-destructive prediction of avocado dry matter**

   i. **No. of days of fruit to ripen**

   Fruit samples collected as specified above, are ripened at ambient/room temperature, between 18°C and 20°C. Fruits must not be placed with other fruits that may generate ethylene like ripened avocado, mangoes and bananas which could influence the rate of ripening. If the fruit takes 7-10 days to ripen without shriveling, then the fruits are mature and can be harvested. In case it takes more than 10 days to ripen, it is immature and should not be harvested.

   ii. **Near InfraRed spectroscopy**

   It uses Felix Instruments Dry Matter Reader instrument to measure the dry matter. See Figure 36. The machine is however expensive. This is one of the methods that is recommended by the HCD.

Figure 36 — Photo of Felix Instruments Dry Matter Reader

Photo by Grace Kithusi, HCD

b. **Destructive methods**

i. **Microwave/oven method**

The method follows the procedure below:

- Fruits are first cut in half (through the seed). Next, lay the flat side down and cut a wedge out of the middle (approximately 1/8th of the fruit). Do this for the other half of the fruit. Use these wedges for sampling.
- Using the potato peeler or knife, remove the skin down to flesh. Remove the seed and all traces of the seed coat.
- Cut these wedges into smaller pieces and place into the food processor with a chopping blade. Run the food processor until the avocado has been chopped into fine pieces (starts to stick to the side of the food processor container).
- Reserve several tablespoons of sample in a plastic bag in case the sample needs to be rerun.
- Weigh an empty dish and record its weight; this is the **TARE WEIGHT**.
- Place the empty dish on the scale and add avocado samples until you have added 5 grams. Record this weight on the data sheet. (Does not have to be exactly 5 grams, but within 0.3 on either side… just remember to record the exact weight); this is the **WET WEIGHT**.
- Place the dish containing the finely chopped avocado into the microwave oven.

— Since microwave ovens vary, it is critical to start at a low power setting and gradually work up to higher settings to prevent scorching. Suggested setting might be 40% power for 15 minutes. After weighing, microwave the sample again for 3 minutes at 40% power then reweigh. This process is repeated at one-minute intervals until no further weight loss is observed (after several times of doing this, you can determine the proper power setting and approximate time. Do not burn the sample.

— After no further weight loss, remove the sample and weigh; this is the **DRY WEIGHT**

% Dry Matter = ((Dry Weight-Tare weight)/ (Wet Weight-Tare weight)) * 100.

Other tools that are used in QC laboratories and by Receiving Agents overseas are the following:

PENETROMETER

It is used extensively by receiving agents to determine the firmness of the fruit. See Figure 37. Expected reading specifications are:

— Hard firm: 13+

— Triggered: 9-12

— Turning: 4-8

— Ready to Eat: 1-3

— Soft: <1

Figure 37 — Photo of Penetrometer

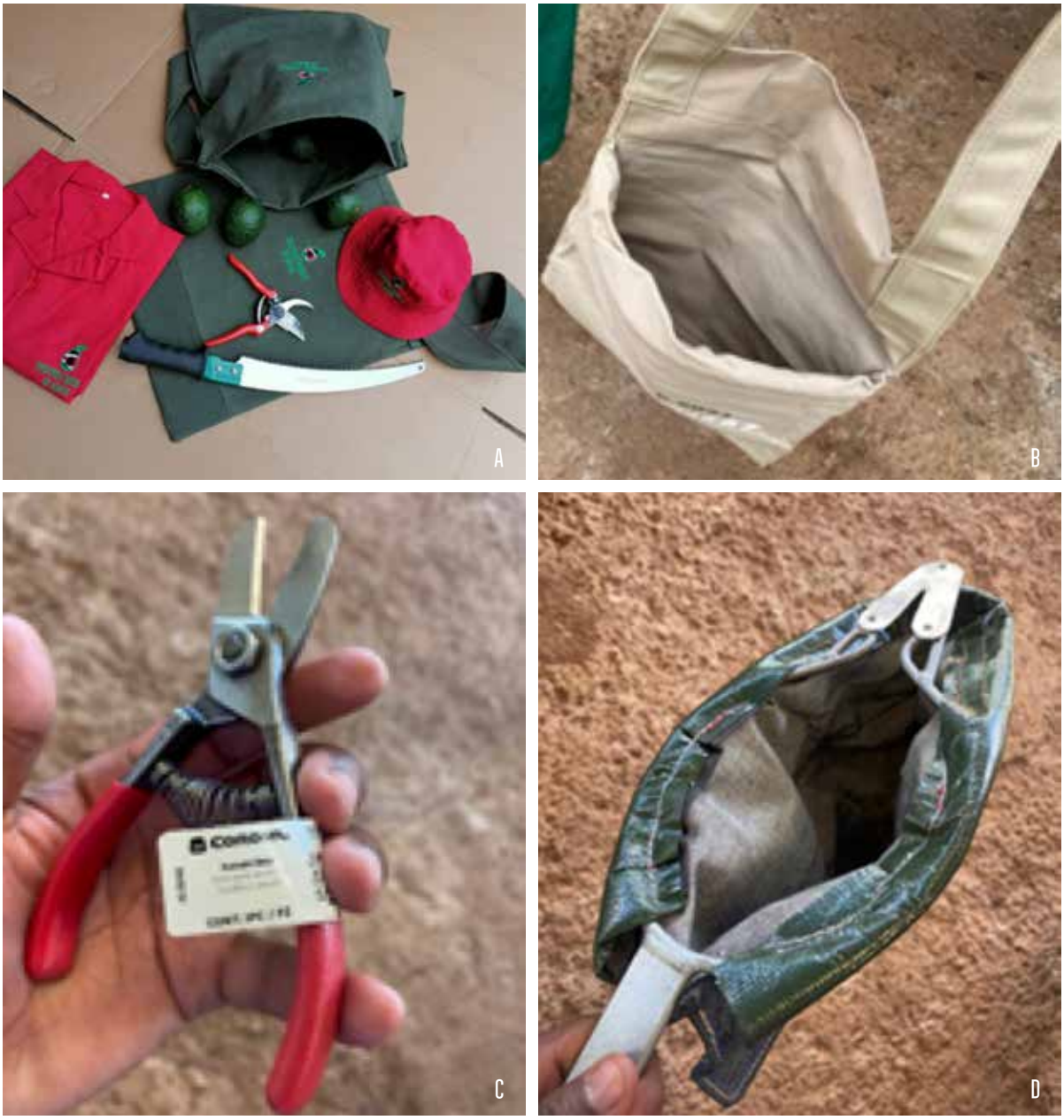
Photo by Richard Collins, Kakuzi PLC, Kenya

2.5.2. HARVESTING

The following are good practices during harvesting of avocado fruits:

- Harvesting personnel must be trained and must observe personnel hygiene requirement at the farm, see Practical Sheet 3.
- Do not harvest fruit when wet, e.g. during or after rains. Also, do not harvest when weather is hot if fruit cooling facilities are not available
- Use of harvesting equipment picking poles or ladders are used for fruit that cannot be reached by hand from the ground. Picking poles must have a clipper to the end, with a collection bag made of cloth. The use of clippers is suitable for removing fruits from trees. See Figure 38 below.
- 1 cm of the pedicel must be left attached to the fruit.
- Harvested fruits should be carefully transferred into a soft picking bag attached to a harvesting pole or directly into a plastic crate to prevent mechanical injuries, especially bruising to the fruits
- Keep harvested fruits on raised clean harvesting trays or bags. See Figure 39 (a). The fruits should not be placed on the ground so as to avoid any contact with the soil. This will help to prevent contamination by food borne pathogens that can survive in the soil.
- Do not wrap harvested fruits using banana leaves both at the orchard and during transportation.
- Harvesting records must be kept as part of farm records, see Record Sheet 9

Figure 38 — Recommended harvesting equipment



(a) Assorted harvesting equipment - Photo by Ernest Muthomi ASoK.
(b) Harvesting Bag (c) Avocado picking clippers (d) Pole picker.
Photos by Richard Collins; Kakuzi PLC

PRE COOLING AT THE FIELD

Pre- cooling is very important especially when the field temperatures are more than 25°C.

- It is advisable that harvested fruits are precooled within 6 hours after harvesting as this ensures the possibility of long-term storage.
- Keep harvested fruits in a cool area preferably under a protected clean shade. See Figure 39 (b).
- Fruits should not be exposed to direct sun as exposure to the sun will tend to increase the pulp temperature, which accelerates ripening and shortens the shelf life of the fruit.
- Harvested fruits should be cooled as soon as possible after harvesting in order to delay ripening and related softening.
- At aggregation centers fruits should be held in crates.

Figure 39 — Good harvesting practices

(a) harvesting crates (b) harvested fruits in crates under a cool shaded tree at the orchard - Photo by Ernest Muthomi, ASoK

2.5.3. SORTING

Harvested fruits should be sorted and graded according to sizes, skin colour and the absence of cuts or wounds, blemishes, insect damage and spray residue if any spraying is done. It is recommended to have a Quality Defect Chart for sorting fruits at the orchard. See Practical Sheet 4 and 5 for avocado fruit quality defects and abnormalities respectively.

2.5.4. TRANSPORTATION TO AGGREGATION CENTERS AND PACKHOUSE FACILITY

Mechanical injuries that occur during harvesting, field handling and transportation are the major causes of postharvest quality losses. Other important causes of these losses include desiccated and over-ripe fruit, infection by postharvest diseases like anthracnose and stem-end rots, physiological disorders, unfavorable storage temperatures and pest damage.

The following considerations should be put in place during transportation of fruit to the packhouse:

- The filled labelled avocado crates are loaded onto pick-up vehicles or lorries for transportation to the packhouse. Labelling is important for traceability.
- The fruits should not be exposed to the sun in the transportation vehicles hence covering with 80% shade-cloth or a fabric tarpaulin / canvas is recommended for vehicles without a roof.
- Refrigerated vehicles are recommended for transportation of avocado to the packing station.
- Plastic sheets should not be used because they create a warm and humid environment that accelerates ripening and sometimes fungal infections.
- Avoid the use of banana leaves to cover the crates for they produce ethylene gas which accelerates avocado ripening and thereby reduces shelf-life.
- The harvested fruits should be transferred to the packhouse within six hours of harvest.
- The trucks/pickups carrying the produce should be driven carefully on rough roads to minimize damage during transportation to the packhouse.
- The avocado shall not be transported together with other produce – avoid contaminants that affect their quality.
- Covered vehicles should be used preferably to minimize damage to fruit during transport.
- Fruits should be transported to cooling and aggregation centers to remove field heat.
- From aggregation centers, fruits should be transported in closed trucks preferably cooled trucks to pack houses.
- On arrival at the packing station the fruits must be pre-cooled to about 16°C in order to remove the field heat.
- The risk of post-harvest losses increases if the produce takes more than 35 days to get to the customer's warehouse.

2.5.5. TRACEABILITY

The traceability system should allow getting information on the avocado fruits from beginning of growing to harvesting and transportation to the packhouse.

The following list is the minimum data that should be kept by the farmer for traceability purpose;

- Field where harvested (Farming block)
- Processor details (Company name, company logo, barcode/QR)
- Pallet number
- Supplier details/reference
- Purchase order, invoice
- Customer reference
- Quality control results

The avocado boxes from the farm are to be marked with the following information for easy identification.

- Farm/farmer name or code
- Variety name
- Planting date,
- Block name/Block number/ size
- Weight of fruit harvested
- Harvesting date

The following Quality records should be kept by the orchard management

- Pest control records including name of product(s) used, date of application etc (see record sheet 6),
- scouting records including dates and results (see record sheets 4 and 5),
- fertilizer application records including type of fertilizer, date of application and amounts applied (see record sheet 2),
- irrigation water quality records that encompass the laboratory test results and sampling dates,
- soil test records consisting of the laboratory test results on nutrients or pollutants,
- Fruit sampling records including sampling dates, blocks sampled, number of samples collected etc.

Check provided checklists, and record sheets for the detailed information on the data that should be recorded.

2.6. POST HARVEST AND PROCESSING OPERATIONS

2.6.1. PACKHOUSE FACILITIES

Produce handling facilities and personnel shall:

- Be free of waste materials,
- Personnel shall wear protective clothing,
- Hand used equipment or grading table shall be rust proof,
- Floor layout should allow for smooth flow of produce,
- Floors, doors shall be made of impervious material which is easy to clean,
- Facility shall not allow entry of dust and unwanted animals,
- No persons shall smoke or eat in the facility,
- Appropriate signage shall be displayed,
- Packaging material shall be kept off the floor,
- Traceability of produce shall be documented
- Have a Quality Defect Chart for sorting fruits
- All food handling personnel should be trained on basic hygiene including HACCP.
- All personnel handling food should be of sound health to avoid contamination.

See Practical sheets, record sheets where appropriate

2.6.2. FRUIT RECEPTION, SORTING AND GRADING

At packhouse reception:

- The fruit is unloaded from the trucks, received and weighed
- Upon delivery to the packhouse, the crates should be transferred immediately to a cool, shaded area inside the packhouse. See Figure 40 (a) below.
- Packhouse reception staff should verify the number of crates and the condition of the fruits received. Initial assessment of fruit quality on arrival is important for subsequent steps.
- The staff should confirm that the delivered fruits are of the same variety and they are not mixed. And that only fruits of the same cultivar have been delivered.
- Packhouse reception staff should control the presence, severity and percentage incidence of:
    - insect or pest-damaged fruits.
    - diseased fruits (anthracnose, stem-end rot, etc.).
    - fruit injuries caused by rough handling during harvest or transport (e.g. cuts or gashes to fruits, fingernail scratches).

- fruits without pedicels ("snap-picked" fruits).
- lenticel damage

See Practical Sheet 4 and 5 for avocado fruit quality defects and abnormalities respectively.

2.6.3. WASHING/CLEANING

Fruits should be cleaned with clean water to remove field dust, plant parts such as leaves pests etc. Cleaning of fruits can be achieved in different ways depending on the sophistication of the available equipment. See Figure 40 (b) below. The fruits are dipped in chlorinated water and cleaned with soft rotating brushes. Avoid use of stiff/hard bristles that may cause mechanical damage to the fruits.

Water used for cleaning fruit should be clean (potable) and must be replaced regularly (possibly every 8 hours or less depending on quantity of produce processed) to prevent buildup of microorganisms.

Figure 40 — Packhouse fruit reception practices

(a) Crates loaded with fruits at reception in the packhouse and
(b) fruits being conveyed using water
Photo courtesy of BioFarms Ltd and Kakuzi PLC

2.6.4. POST-HARVEST TREATMENT

Post-harvest treatment should be done within 24 hrs of fruit delivery to the packhouse.

Fungicide application

- Preferably, mix fungicide with the cleaning water.
- Fruits can also be sprayed with a spray, Tecto (Thiabendazole) or Sportak (prochloraz), for the control (prevention and management) of anthracnose and stem-end rot.
- The fruits can also be treated with Ozone.
- When conducting post-harvest treatment using any product, it is important to read the labels and follow the recommended doses.

Waxing

- Waxing should be done after fruit is treated with a fungicide
- Waxing of treated fruits is beneficial in that the wax coating prevents loss of moisture and consequently the weight of the fruits.

2.6.5. SORTING AND GRADING

Fruit from the orchard is sorted and graded at the packhouse according to the following quality criteria: size, skin color, and the absence of cuts or wounds, blemishes, insect damage, and spray residue. The fruit must also be free of infections (anthracnose and end rot), physiological problems (grey pulp, vascular browning), and bruising after ripening. Fruit quality is determined by its lack of insect, wind, or hail damage, so any fruits with these signs are discarded. See Figure 41

The fruit is sorted manually or with the assistance of machinery, considering its shape, size, and sanitary qualities, as well as any defects caused by insects, rodents, mechanical abuse, or disease (viruses, bacteria and fungi). The parameters for selection are also influenced by the fruit's final destination. A Quality Defect Chart should be provided to the packhouse personnel to aid in sorting fruits. See Practical Sheet 4 and 5 for example of Quality Defects and abnormalities on fresh avocado.

Figure 41 — Sorting of Avocado along the grading line in a packhouse

2.6.6. PACKAGING, LABELLING AND PALLETISING

PACKAGING

Different destination markets requirements include open or closed boxes.

For export market, avocados must be packed in 4 kilograms cartons in a single layer. The following information must be put on the packaging box label;

— The packaging material for horticultural produce shall be designed to suit the transport handling system and shall meet market requirements.

— The package weight of avocado shall be 4kg or 10kg depending on client specifications.

LABELLING

— Every packaging material for horticultural produce for the export market shall be branded as "Produce of Kenya" using the national logo prescribed by Kenya Export Promotion and Branding Agency (KEPROBA; the national institution responsible for branding.

— In order to comply with the Codex General Standard for the Labelling of Prepackaged Foods (CODEX STAN 1-1985) the following additional information may be added to the labels:

- Product name
- Categories of fruit
- Size of fruit
- Variety name

- Packing date
- Country of origin
- Destination country
- Name and address of customer/Client
- Name and address of the exporter
- Storage or conservation conditions
- Nutritional value (composition, energy value)
- Instructions for use

PALLETIZING

Wooden pallets are commonly used for stacking of packed avocado boxes. Wooden pallets must be heat treated at a Heat Treatment facility approved by KEPHIS. Ensure the wooden pallets are placed on a secure surface off the packhouse floor.

Strapping at the bottom, middle and top of staked boxes is recommended to reduce collapsing of the pallet and packed avocado fruits injury. See fig below for well stacked and secured pallet ready for pre-cooling and loading into a reefer. See Figure 42 below.

Figure 42 — Recommended avocado palletizing

(a) Packed avocado fruits on approved heat-treated wood pallet,
(b) and (c) properly staked and reinforced ready for loading into a reefer.
Temperature and humidity data logger monitoring gadgets installed.
Photo by MaryLucy Oronje, CABI courtesy of Kakuzi PLC and BioFarms Ltd.

2.6.7. COLD STORAGE

THE COLD STORAGE FACILITY

— Before the season starts, clean and sanitize walls and floors.

— Keep walls and floors as dry as possible

— Condensation from cooling units should drain directly into the drain and not onto the floor.

— Clean and sanitize drain pans before start of the season. Add a slow-release disinfectant to the pan to keep microbial growth at a minimum and prevent drainage lines from clogging and overflowing onto boxes of produce.

— A daily temperature log of fruits in the cold room should always be maintained. See Record sheet 10 for Daily temperature log

FRUIT COOLING

Fruit cooling is perhaps the most significant operation in the logistics chain, as it establishes the parameters for fruit quality by controlling physiological changes in the fruit from harvest to sale. This will, in turn, affect the rate of ripening and shelf life, as well as the possibility of post-harvest problems. The cooling parameters chosen during packing, as well as the extent to which they have been efficiently applied, are important to the cold chain's overall success.

— The optimal temperature to which fruits should be cooled for longer storage ranges from 4-8ºC depending on the cultivar, maturity (dry matter) at the time of harvest, distance to destination and potential storage requirement.

  • For fruits with low dry matter (<23%) temperatures should not be adjusted lower than 7 ºC, as chilling damage may occur in fruit stored for longer than 2 weeks.

— Without proper cooling of fruits, the molecular interactions inside the fruits cannot be kept at minimum. The fruit respire more and consequently ripening starts off earlier than required. Early ripening of fruits while still in transit leads to other problems such as internal browning, tissue softening, progression of infections (if any) and decay.

REMOVAL OF FIELD HEAT ON ARRIVAL AT PACKHOUSE

It is critical to keep the time between fruit arrival at the packhouse and ultimate cooling as brief as possible. The faster field heat can be removed, the longer the shelf life can be extended and quality deterioration can be delayed.

Temperature control can be achieved at the packhouse through various means including:

- Crates or bins are offloaded into a shaded holding area. In this situation, field heat is not substantially removed fruits should be moved into final packing within 24 hours.
- Crates or bins can be offloaded into a cooled holding area usually with temperatures regulated at between 13 -15 °C.
- Hydro cooling of fruits upon arrival at the pack house to temperatures of 13 -15 °C. It is advisable that fruits are packed as soon as possible after hydro cooling or held in a temperature-controlled area at approximately the same temperature (13 -15 °C).

NB: Fruit should not be held for more than 24 hours in any system before final cooling.

If you don't check on the temperature when receiving fruits at the packhouse, you will compromise on the quality

FORCED AIR COOLING AFTER PACKING AND PALLETIZATION

This is the second point of cooling and it takes place after packing and palletization. Cooling at this point serves to bring the fruit to the temperature of shipping.

If cooling is not done correctly, it may cause chilling injuries and or loss of water by the fruits; resulting in overall deterioration of quality. Below are factors to consider when cooling:

- Gradual cooling of fruits is key to avoid chill injury. Depending on the harvesting temperature, ideally avocados can be cooled within 24 to 36 hours. The below parameters can be used:
    1. Hass: 4-5 degrees Celsius
        - Temp. reduction at 12hr intervals: 30-15°C // 15-7.5°C // 7.5-4.5°C
    2. Other Varieties: 6-8°C
        - Temp. reduction at 12hr intervals: 30-15°C // 15-7°C
- Forced air cooling system is important since it is efficient in ensuring that fruits in the middle and bottom boxes in a pallet attain the set temperature. This system causes an osmotic gradient leading to loss of moisture.
- Monitor humidity in the room and ensure it is within range (85% to 90%).
- The system must also be switched off once the set temperature has been attained.

— Frequent monitoring is required – both room and fruit temperature should be checked as per below guide:

Room Temperature

14:00 to make sure that the room is keeping cold during the hottest hours of the day

17:00 to make sure that as you leave for home the system is in order

Fruit Temperature

08:00 to make sure that overnight the fruit was cooling appropriately and nothing happened

16:00 to make sure the cooling level was maintained during the hottest hours of the day

— Ensure that there is enough ventilation between the packages to enable cooling efficiency.

— Do not overload the pallets.

— Use of thermal coupler is recommended for temperature maintenance

See Practical sheet 8 for cold room temperature measurement protocol.

HUMIDITY

Humidity is an important aspect to consider and monitor as Low humidity encourages loss of moisture by the fruits while too much water enables fungus and other pathogens to thrive.

The optimum humidity (85% to 90%) for avocados should be maintained in the cold rooms. Industrial humidifiers with a monitoring system should be installed for efficient control of humidity.

ETHYLENE CONTROL

Most pack-houses do not have systems in place to control ethylene at the processing area and in the cold-rooms.

The build-up of ethylene triggers the formation of ethylene receptors in the fruits. Such fruits will ripen faster and may suffer advanced effects of ethylene before they can reach the consumer. Such effects include:

— Softening and loss of firmness.

— Over- ripening and ageing.

— Higher risk of scalding.

— Higher risk of internal browning.

— Higher incidence of rot.

— Shriveling; and

— Weight loss.

There are ethylene scrubbing applications (such as EthylClean and Bioturbo Machines) that can be used in the cold-rooms to get rid or control ethylene levels. This will contribute to increasing the longevity of fruits during processing and storage.

Storage after cooling

- Fruit will need to be stored after cooling until shipment.
- The cold rooms used for storage should be set at the intended shipping temperature.
- Fruits should be stored for the shortest time possible before shipping, taking into account logistics and marketing considerations.
- This holding room cold area is not suitable as a fruit cooling zone, and fruit needs to be adequately cooled in forced air cooling tunnels before being placed in the cold storage chambers.
- The cooling in this area is static cooling, and there is a possibility that fruit on the inside of pallets will not be adequately cooled if not already cooled when placed in the holding room.
- In an ideal holding room, there should be a pre-installed stacking system that allows pallets to be stacked and adequately spaced to allow air flow between them. If this is not the case, pallets should be put in the cold room with enough airflow around them. Pallets should be spaced apart by at least 4 inches.
- Air delivery in the holding room should not be set at more than 1°C below the target fruit pulp temperature. This is particularly important when the cold room contains fruit awaiting shipment which is less mature and was cooled to a temperature higher than new fruit coming into the room.

Air temperature should be checked on a daily basis, and fruit temperatures checked on a random basis to ensure target temperatures are being maintained.

2.6.8. PRE-CARRIAGE FROM PACK-HOUSE TO PORT OF EXIT

It is important to maintain the cold chain at this point of the supply chain to ensure good quality of fruit on arrival at the destination market.

- Avocados should be stuffed in a reefer container and transported from pack-house to port of exit under active cooling.
- A genset should be used to supply power to the container.
- While some exporters may opt to have fruits transported without active cooling to save on genset cost, this practice should be avoided at all costs.
- Without active cooling, cargo temperature increases making the fruits respire more thus, the fruits are bound to ripen faster. The increase in temperature also encourages moisture loss leading to weight loss.

- The reefer containers used for export of avocados to Europe should be equipped with controlled atmosphere (CA). This is to ensure that oxygen (O_2) and carbon (IV) oxide (CO_2) levels in the container are kept in check to minimize fruit respiration. Various CA's have different O_2 and CO_2 set points depending on how they function.
- If O_2 level in the container goes below 2%, fruits suffocate and with time the fruit skin turns brown. When CO_2 level is above 11% it becomes difficult to maintain temperature due to green-house effect.
- It is essential to contract a freight forwarder and or trucking company experienced in reefer transport logistics, cold chain maintenance and with functional knowledge on controlled atmosphere technologies used.
- It is recommended that a checklist is followed during loading to ensure that all required shipping conditions are met before dispatch of the loaded reefer from your packhouse. See checklist 2.

2.6.9. SEA-CARRIAGE TO PORT OF DISCHARGE

Once the full reefer containers are loaded and shipped on board, it is key that they get power and that the Controlled Atmosphere functions throughout the voyage.

Sometimes problems may occur – a reefer container may fail to work as it should; compromising the cold chain. Controlled Atmosphere may also malfunction leading to suffocation of fruits.

The vessel crew should carry out occasional physical checks of the containers on board to ascertain that all are running okay.

Shipping Lines should also share cargo data (temperature, O_2 and CO_2) with the parties involved in respective shipments so that it is quick to establish when something goes wrong and take corrective measures to save cargo from deteriorating.

The transit time is also an important aspect to consider when exporting avocados. Prolonged transit time would lead to fruits arriving soft and ripe and may also be overly ripe (way past storage life).

The timing for stuffing of fruits should be well coordinated in relation to available vessels and their sailing dates to minimize the dwell time at the port of loading.

2.6.10. SHIPMENT OF FRESH AVOCADO BY AIRFREIGHT

Avocado is mainly shipped from Kenya through sea freight; however, a small portion is shipped through airfreight but mainly to EU market. Shipment by air is mainly done through airline cargo services like Kenya airways (KQ), Qatar Airlines and KLM among others.

- The transport logistics supplier should ensure the transport cools chain is observed including the temperature checks of the packed fresh avocado boxes to the airport packhouse
- All fresh avocados to be exported must be inspected for quality and phytosanitary compliance as per the destination market requirements
- It is recommended to have a temperature log to monitor inflight temperatures
- Consignment must be booked for flight confirmation through agent
- Consignment must be verified by the Border control officer
- Consignment must be palletized ad netting done to hold the boxes in place during flight
- Airway bill is produced and must accompany the consignment to final destination
- The exporter must ensure the following documents accompany the consignment before loading to the aircraft;
    - Certificate of Conformity
    - Phytosanitary certificate
    - Commercial invoice
    - Certificate of Origin
    - European movement Certificate (EURO 1 Form)
    - Generalized System of Preference (GSP)
    - Airway bill

Figure 43 — Packaging avocado for air freight

(a) fresh avocado packed in boxes shipped through Qatar cargo,
(b) temperature log for monitoring temperature during flight
(c) palletized and netted fresh avocado boxes shipped through KQ cargo
Picture courtesy Wilberforce Juma

2.6.11. TRACEABILITY OF BATCHES

The traceability system should allow getting information on the avocado fruits with the details of the orchard, location, field variety, harvest date and should be applicable to all stages of the avocado value chain, from nursery to sale. The traceability system should provide associated quality control test results.

The following list is the minimum data that should be available to the packhouse from the orchard for traceability purpose

- Farm details (name of the farm, location)
- Field where harvested (Farming block)
- Variety name
- Harvested weight
- Pallet number
- Supplier details/reference (where applicable)
- Purchase order, invoice
- Quality control results

The products from the packhouse are to be marked with the following information for easy identification.

- Variety name
- Source of the avocado/land of origin
- Weight
- Packing date
- Pallet number/ Pallet creation date
- Batch number/ batch pack date
- Country of origin
- Shipping date
- Customer reference
- Transport company

2.6.12. AVOCADO FIELD INSPECTION AND PACKHOUSE CERTIFICATION FOR EXPORT MARKET

Inspection and certification are undertaken based on the general and specific export market requirements. Inspection is undertaken by HCD and KEPHIS before approval for export.

FIELD INSPECTION AND CERTIFICATION

KEPHIS does certification of avocados in the field based on specific market requirements. During production field inspections, phytosanitary checks are done to assess whether they comply with the various market requirements. Various markets have different market requirements. Exporters are advised on pest management practices, surveillance and monitoring through scouting. They are advised to do scouting using appropriate scouting methods which ensures that the entire orchard is covered. Key parameters checked during inspections include:

- The number of scouts in the field, the tools they have, and scouting regime and data available
- General sanitation of the orchards
- Use of clean/certified planting material
- Use of insect traps especially for False Codling Moth (FCM) and Fruit flies
- Presence of pests and diseases
- Pest and disease control regime at the orchard
- Knowledge and awareness of the destination export market requirements

PACKHOUSE FRESH AVOCADO QUALITY INSPECTIONS

The exporter must ensure avocado fruits conform to the quality requirements as listed by the regulator and those by the importing country regulatory agencies and their customer.

Exporter packhouses are audited by HCD pre-authorized to carry out basic quality tests for % dry matter (DM), and oil content.

Samples are randomly picked from lots for every size (e.g size 14, 16,18,20, 22, 24) and submitted to HCD confirmatory quality test laboratory for % dry matter (DM) and, oil content as well as other quality parameters.

HCD Inspectors visit fields and pack houses with Avocado potable quality meters for non-destructive real time DM and oil content determination.

The inspector HCD forwards fills a fruit Quality Inspection checklist/report in case the fruits conform to quality requirements, forwards to the director for a clearance letter to the exporter or rejects the entire lot if it doesn't conform.

KEPHIS issues Conformity Certificate for fresh avocado exports to the EU (see Conformity Certificate – Annex 7). For airfreight, the KEPHIS inspector randomly samples at the clearing agent facility, undertakes the basic tests for dry matter, and approves or declines the export requests.

During the packhouse processing, samples should be picked throughout the packing with a minimum of 4 cartons per hr (4 cartons/hr).

Recommended data to be collected in relation to quality conformity checks include:

- % Dry matter content
- Cartons net weight
- Number of fruits as per count label-size
- Individual fruit weights against set min/max weight
- Blemishes and or any skin damage
- Colour uniformity

It is recommended to retain samples of shipped avocado fruits to ripen at ambient temperature and in the cold room to 'simulate' shipping. These should be monitored for post-harvest disorders and 'days taken to ripen' 'to mirror' potential feedback from the importing customers. Checklist 3 below is the proposed Packhouse fresh avocado quality checklist.

VOLUNTARY QUALITY PACKHOUSE INSPECTION

Importers of fresh avocado have contracted service providers such as Pollucon Laboratories Pvt. Ltd, SGS Kenya, and Bureau Veritas Kenya for quality assurance of exported produce via Sea freight. The service providers, sample, test and provide additional services such as reefer avocado post-harvest treatment and handling and monitoring services on reefer while on transit on behalf of the client.

PHYTOSANITARY INSPECTION FOR FRESH AVOCADO

Inspections are undertaken at the packhouse and points of exit (airports and shipping sites) by KEPHIS inspectors. Inspections are guided by the UNECE STANDARD FFV-42 concerning the marketing and commercial quality control of AVOCADOS 2017 EDITION. This is a brochure developed by the OECD FFV Scheme.

a. **At the Packhouse**

- The exporter must ensure avocado fruits in the packhouse are protected from re-infestation by insect pests and diseases.
- KEPHIS inspects all fresh and frozen avocados for all export destination main markets to ensure freedom from all pests.
- KEPHIS audits approved packhouse facilities that exports to China and EU destination markets.

b. **At points of exit**

— For sea freight exports, KEPHIS' Phytosanitary inspection is undertaken according to ISPM 31 and as guided by the specific destination market India, South Africa, and the EU regulatory requirements.

— For airfreight, the KEPHIS inspector randomly samples packed boxes at the clearing agent facility, undertakes inspection of products prior to ensure freedom from pests, and approves or declines the export requests. Checklist 4 below is the proposed Packhouse fresh avocado phytosanitary inspection checklist.

Phytosanitary requirements and inspections

— Exporter must have a HCD export License and must be registered in the KEPHIS ECS System.

— Exporter must apply for inspection through the KEPHIS Electronic Certification System (ESC)

— Export lots are processed and packed at an approved packhouse by HCD and KEPHIS

— Approved letter of authorization specifying the allowed export quantity and a laboratory test report specifying the quality (dry matter/oil content) from HCD. Oil content must be above 11%.

- Lots are sampled and inspected for presence of insect pests and diseases as well as quality checks. Quality checks are done by cutting some fruits to assess for fruit maturity through the colour of the fruit pulp and colour of the seed skin and how easily the seed separates from the skin. See Figure 44 (a). During inspection, inspectors ensure the following minimum quality requirements;
    - They must be intact, not broken
    - They must be clean
    - They must be practically free from insect pests and diseases
    - They must be free from damage caused by insect pests and diseases affecting the flesh.
    - Free of foreign smell or taste,
    - The produce must also be graded into 3 quality classes (Extra class, Class I and Class II)
    - The produce must be well labeled (name and address of the packer/ dispatcher, nature of produce, quality class, country of origin, size)
    - Wood used for palletizing, must be heated-treated according to ISPM 15 requirements. The wood pallet must bear the symbol for heat treatment.

— Inspected and approved consignment (See Figure 44 (b)) is issued with a Phytosanitary Certificate accessible through the KEPHIS Electronic Certification System (ECS). For the consignments destined for the EU market, a Certificate of conformity (COC) is also issued by KEPHIS to confirm that quality checks have been done. Non-compliant consignments are issued with a Rejection Notice through the KEPHIS Electronic Certification System (ECS).

Figure 44 — Fruit inspection

(a) cut fruits for inspection to check for maturity,
(b) well packed and uniform avocado fruits in a box
Photo by Debora Shituvi, KEPHIS.

Sanitary and Phytosanitary requirements for fresh avocado exports to South Africa

- Only three avocado cultivars (Pinkerton, Fuerte and Hass) are approved for export to South Africa
- Fruits must originate from production sites, pack houses and storage facilities approved and registered annually by KEPHIS.
- Pests monitoring is conducted by KEPHIS inspectors regularly in the production sites destined for export to South Africa.
- Management strategy for fruit fly; implementing a fruit fly (*Bactrocera dorsalis* and *B. cucurbitae*) and False codling moth Integrated Pest Management (IPM) programme. Fruit fly monitoring is initiated at least three months before harvesting. Fruit fly monitoring data must be maintained and submitted to KEPHIS on a quarterly basis.
- Culled and fallen fruits are supposed to be buried, destroyed or removed away from the production sites at least twice a week.
- Facilities for storage, pack houses must be registered with KEPHIS
- Facilities for storage and packhouses must be clean, free from pests, soil and plant debris, safeguarded and equipped to avoid fruit contamination.
- Packhouses must have a defined traceability system for own farms and outgrowers
- Valid South African import permit before export
- Inspections by KEPHIS for every consignment before export.

Sanitary and Phytosanitary requirements for fresh avocado exports to India

- Registration of avocado orchards to supply to the Indian market, which should have linkages with the approved pack houses,
- KEPHIS inspection of produce prior to shipment and ensure freedom from pests in the Indian quarantine list namely, Mediterranean fruit fly (*Ceratitis capitata*), Marula fruit fly (*Ceratitis cosyra* Walke), Natal fruit fly (*Ceratitis rosa* Karsch), False Codling Moth (*Cryptophlebia leucotreta*), white wax scale (*Ceroplastes destructor* Newstead (1917), Indian red scale (*Selenaspidus articulates* (West), coconut bug (*Pseudotheraptus wayi*) and cotton leafworm (*Spodoptera littoralis)*
- Evidence of management of the quarantine pests listed above during the farm inspections.
- Approval of pack houses to be used for post-harvest processing of fruits,
- Ensure use of closed trucks to move harvested fruits from orchards to the designated pack houses,
- Ensure sorting, grading and culling done in the approved pack houses and fruits meant for export to India separately stored from fruits destined for other market destinations,
- Methyl bromide fumigation @ 32g/m^3 for 2 hours at 21.1^{0}C or equivalent thereof against *Ceratitis capitata* (Mediterranean fruit fly);-KEPHIS to witness the fumigation
- OR
- Pre-shipment cold treatment at 0^{0}C or below for 10 days/0.55^{0}C or below for 11 days/ 1.1^{0}C or below for 12 days;
- Note only apply either Fumigation or cold treatments to fresh avocados BUT not both.
- Pre-shipment cold treatment or fumigation treatment for every consignment to be inspected and witnessed and approved by KEPHIS.

Sanitary and Phytosanitary requirements for fresh avocado exports to China

- All orchards, packhouses and fumigation treatment facilities exporting fresh avocado to China must be registered with KEPHIS and approved by KEPHIS and GACC.
- All registered orchard must keep monitoring records of quarantine pests, chemical and biological control programs implemented for Fruit flies (*Ceratitis capitata*, *C. cosyra* and *C. rosa)* and False codling moth (*Cryptophlebia leucotreta),* scales and other quarantine pests including *Pseudocercospora purpurea*
- Processing, packaging, storage and transportation must be supervised by KEPHIS officials
- Wood packing materials must comply with international standards for phytosanitary measure 15 (ISPM 15).

— All fresh avocados exported to China must be treated with Methyl bromide fumigation to eliminate the three fruit flies and false codling moth before shipment. The treatment parameters are as follows:

— 32g/m^3 Methyl Bromide for 2 hours at 21.1^{0}C or above.

Sanitary and Phytosanitary requirements of export of frozen avocados to China

Frozen avocados are ripe avocado fruits that have been frozen at -30^{0}C or below, for at least 30 minutes, after the removal of non-edible peels and stones/ seeds and subsequently packed and transported at -18^{0}C or below. See Figure 45 below. Currently, only frozen avocados are allowed to be exported to China.

Figure 45 — Frozen avocado for export

(a) Peeling of skin of ripe avocado, (b) frozen avocado halves
Photo by George Momanyi, KEPHIS

REQUIREMENTS FOR EXPORT OF FROZEN AVOCADO

Export companies allowed to export frozen avocado meet the following conditions;

Source of fruits

- Export companies and farmers whose farms and processing facilities/pack houses have been inspected and approved by KEPHIS
- Fruits must be sources from farms that are registered, approved and monitored by KEPHIS or authorized agent
- Implement a traceability system approved by KEPHIS
- Use only the approved list of chemicals.
- Implement Good Agricultural Practice (GAP) and Integrated Pest Management (IPM) to minimize or avoid the occurrence of pests.

Packhouse facility for fruit processing frozen avocado

KEPHIS inspects and approves packhouse facilities and shares the list of approved facilities with the General Administration of Customs People's Republic of China (GACC), who in turn review, approve and publish the list on their official website prior to the beginning of each export season. The packhouse processing facility must be:

- Registered, approved and regularly monitored by KEPHIS, or its authorized agent.
- Implement Good Manufacturing Practice (GMP) and Sanitation Standard Operating Procedure (SSOP) and establish a Quality Management System based on the principle of hazard analysis and critical control point (HACCP).

Ripening, freezing requirements

- Ripened avocados are peeled and non-edible peels and stones/ seeds are removed
- Peeled ripened fruits are frozen at -30 °C or below, for at least 30 minutes,
- The frozen avocado should be store, packed and transported at -18 °C or below
- Regular tests on frozen fruit consignments destined for China for pesticide residues, heavy metals and microbial pathogens to ensure compliance with the requirements of China

Packaging, labeling and shipment requirements

1. Each product should be packed in new and clean packaging materials
2. Package labeling must include the following information in English/Chinese: Name of goods, place of production, country of origin, name and address of processing plants and exporter, date of packaging, shelf life, net weight
3. Every pallet (or packaging box for air cargo) should be marked in Chinese/English "Exported to the People's Republic of China".
4. If wooden pallets are used, they should comply with the international requirements for wood packaging material (ISPM 15).

Phytosanitary inspection for frozen avocado

Before export, KEPHIS must inspect each shipment of frozen avocado.

1. Sampling of 1 percent of total consignment prior to export.
2. If compliant with the requirements, a phytosanitary certificate with the following additional declaration: "*The consignment is in compliance with the requirements described in the protocol of sanitary and phytosanitary requirements for the export of frozen avocado fruits from Kenya to China*"
3. Consignment is rejected if:
    a. fruits are sourced from unauthorized processing plants,
    b. quarantine pests (and diseases) are found, or if non -compliance with the sanitary standards is found,

2.6.13. DOCUMENTATION REQUIREMENTS

Local documentations

- HCD registration certificate
- KEPHIS Phytosanitary Inspection certificate
- Kenya Revenue Authority Certificates

Export market documentation requirements

- Plant Import Permit (PIP)- see Annex 2
- Phytosanitary Certificates- see Annex 5
- Conformity certificate -see Annex 6
- Certificate of Origin- see Annex 7
- Certified commercial invoice
- Bill of Lading (sea freight transport) – see Annex 8
- Airway Bill (air freight transport)
- Insurance Policy Certificate
- Cargo Insurance
- Packing List
- EURO 1 Form (European movement Certificate)
- GSP (Generalized System of Preference)

A3

DETERMINATION OF RISK LEVELS AND PROPOSALS FOR APPROPRIATE CONTROL MEASURES

This analysis of **the level of risk**, of each hazard recognized as relevant in the Avocado value chain, follows the analysis of the hazards identified in the diagrams for the stages at which they may appear and cause more or less serious harm, whether or not avoidable. This hazard analysis will be revised when one of the elements that have been considered is modified (regulatory evolution, change in production practices, etc).

Hazard / Risk Ranking (Threat) Matrix (*Risk characterization matrix for Food safety parameters)*

	RANKING SCORER	1 VERY UNLIKELY	2 LIKELY	3 VERY LIKELY
SEVERITY (S)	3 *Major*	3	6	9
	2 *Moderate*	2	4	6
	1 *Minor*	1	2	3

Likelihood (L)

Risk Ranking (Threat) Matrix (*Risk characterization matrix for Quality parameters)*

	RANKING SCORER	1 VERY UNLIKELY	2 LIKELY	3 VERY LIKELY
IMPACT (I)	3 *High*	3	6	9
	2 *Medium*	2	4	6
	1 *Low*	1	2	3

Likelihood (L)

Key: Hazard / Risk Tolerance - Levels of risk characterization:

- **Score < 4: low risk = Good Working Practices programmes (GWP) required prerequisite:** maintain compliance with all "Good Practices" (e.g. GHP, GAP, as appropriate).
- **Score of 4: moderate risk = Point of Attention (PA):** for tolerable: - preventive measures and regular monitoring (checks) will have to be put in place OR **Control Point (CP)** for intolerable
- **Score > 4: high risk = Control Point (CP) or Critical Control Point (CCP):** control measures accompanied by checks will be essential and emergency action must be provided for in the event of non-compliance detected (e.g., exceeding the MRL).

1 - 3 = **Low Risk**	GREEN	**RECOMMENDATION** Insignificant hazard – Tolerable - No action	Controlled by PRP (GAP or GHP)
4 = **Medium risk**	YELLOW	**MINOR** Tolerable- Controlled by PRP's if chemical or physical hazard or quality related issue Intolerable- Controlled in SPS Control plan if biological hazard or quality related issue	Controlled by PA for tolerable and CP for intolerable
6 – 9 = **High Risk**	RED	**MAJOR for Food safety** Intolerable - Controlled in SPS Control plan	Controlled by CCP
	BLUE	**MAJOR for Quality** Intolerable - Controlled in SPS Control plan	Controlled by CP

When, for this high risk for food safety parameter, a **CCP** (Critical Control Point) is determined, **a control measure accompanied by a specific self-check are mandatory**.

Determination of risk levels for each hazard according to the stages (general production, processing and packaging scheme).

A-1

DIAGRAMS OF THE PROCESSES ADOPTED IN THE CHAIN, DESCRIPTION OF THE UNIT OPERATIONS AND IDENTIFICATION OF THE DANGERS LINKED TO THE PRACTICES OBSERVED AND THE POSSIBLE PREVENTIVE CONTROLS

4.1. PRODUCTION OPERATIONS AND HAZARD ANALYSIS AT THE NURSERY

4.1.1. HAZARD ANALYSIS - NURSERY

The following table (Table 21) describes for each operation step at the nursery, the analysis and categorization of potential quality dangers, plant health and food safety hazards that can affect avocado, including recommended control measures at each step.

Table 21 — Hazard analysis work sheet for nursery operations

(1) STEP	HAZARD DESCRIPTION		HAZARD EVALUATION				CONTROL MEASURES	
	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	(4) SEVERITY/ IMPACT OF EFFECT	(5) LIKELIHOOD OF OCCURRENCE	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	(7) JUSTIFY DECISION FOR COLUMN (6)	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	(9) PRP, *PA, CP, OR CCP*
SITE SELECTION	• Heavy metals (Lead, mercury, cadmium)	**Environmental hazard** • Industrial waste • Previous usage of pest control products and inputs	2	1	Recommendation	Possible contamination of the soil with heavy metals from industrial wastes, flooding and previous usage of pest control products	• Establish history of the soil • Carry out a systematic analysis of the sanitary quality of the soil (volcanic soil) • Soil testing for heavy metals.	GAP
SELECTION OF SEEDS	• Poor quality fruits due to use of unidentified or unknown or weak / diseased seeds for the rootstock with Poor vigor	**Hazards related to the raw material:** • True to type of avocado seed varieties – no link to variety demands from market, • uncertified sources and unknown weak/ diseased seeds used for rootstock	2	3	Major	Possible use of weak diseased and unidentified seeds for rootstock either because they are cheaper and readily available, or personnel are not well trained on the right seeds to be used for rootstock	• Source seeds that are identified/classified from certified mother blocks • Training of person on good quality seeds and avocado diseases and how to control them • Use of disease-free rootstock	CP

POTTING MIX PREPARATION		(1) STEP	
• Plant pathogens	• Chemical hazards	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Raw material hazards • Soil borne pathogens in soil used for potting • Use of unsterilized potting mix	**Materials hazards** • Presence of heavy metals in fertilizers and manure	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
2	1	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2	1	(5) LIKELIHOOD OF OCCURRENCE	
Minor	Recommendation	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Soil borne pathogens for Phytophthora and Pythium are endemic in most soils	Possibility of using soil amendment products that are not approved	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Use virgin soil from previously uncultivated areas • Testing of soil to determine if the pathogens are present or absent. If present, use the recommended soil treatment product (see table 20). • Soil sterilization	• Use of approved soil amendment products	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
PA	GAP	(9) PRP, *PA, CP, OR CCP*	

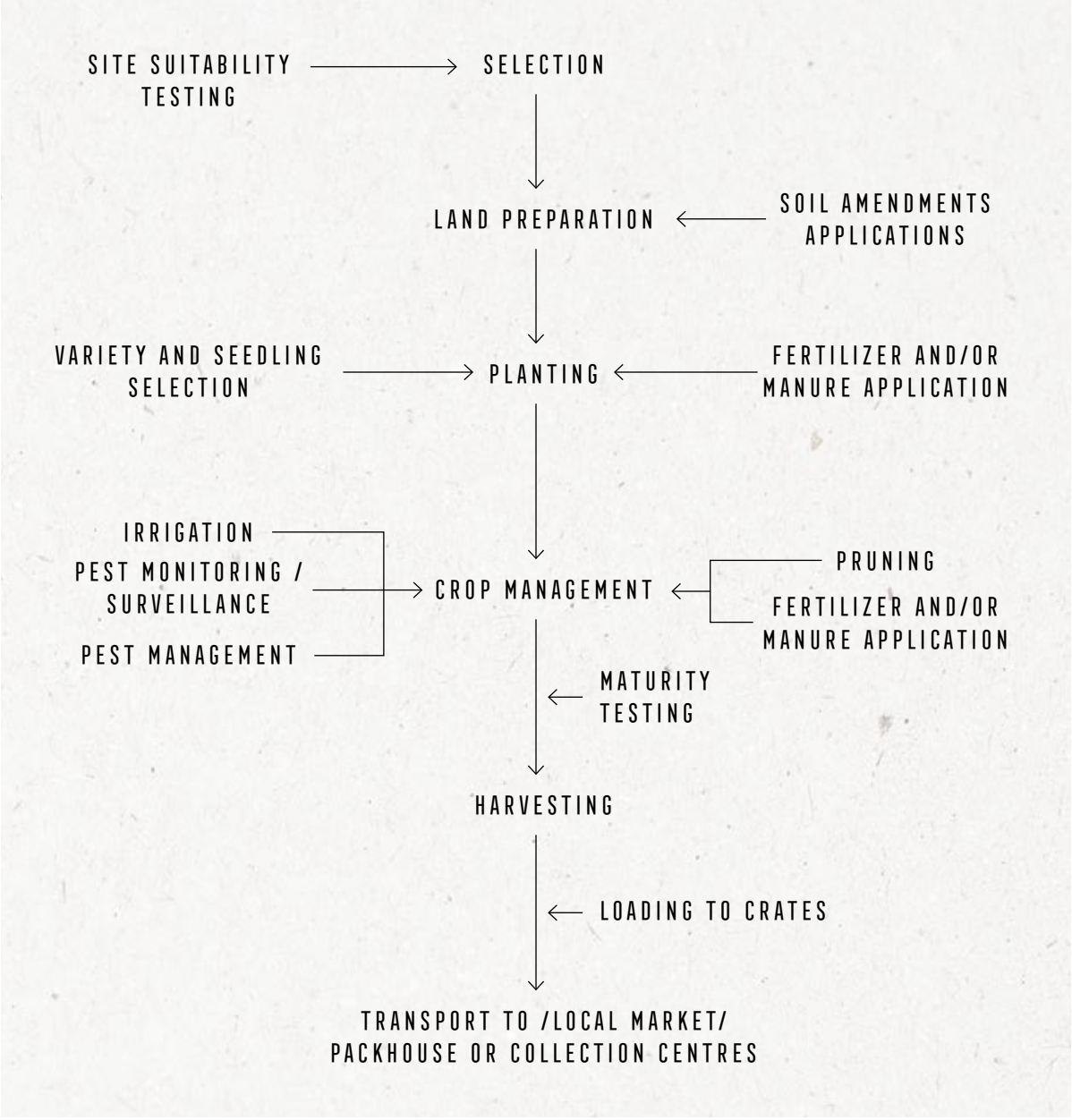
CROP MANAGEMENT		GRAFTING	(1) STEP	
Mixed variety fruits and loss (breakup) of traceability	Poor quality fruits	Poor quality fruits resulting from poor quality rootstock and scion Mixed varieties of avocado that are not properly identified	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Poor identification and traceability of seedling resulting in mixing of variety	Poor management of seedling rootstock to remove off-shots	**Raw material hazards**: • Use of unidentified variety for scion • Weak rootstock and /or scion that has poor vigor • Poor grafting method/technique - scion does not take off • Use of diseased rootstock /scion	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
2	2	2	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
3	3	3	(5) LIKELIHOOD OF OCCURRENCE	
Major	Major	Major	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
There have been cases of mixed variety in orchards due to lack of traceability	Lack of appropriate agronomic practices such as weeding, watering, fertilizer application and pest control. Poor nursery management resulting in poor seedlings	Possible sourcing of rootstock and scion from unknown and noncertified centers. Workers not well trained on proper drafting methods and luck of proper grafting tools	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Proper labeling and traceability of varieties / seedlings	• Training staff on good nursery management practices and on avocado diseases and how to control them	• Source of known recommended seed and scion • Train grafting staff on good grafting techniques and the right tools for grafting • Training of person on Avocado diseases and their control • Use of disease-free rootstock /scion	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CP	CP	CP	(9) PRP, *PA, CP, OR CCP*	

4.2. PROCESS FLOW DIAGRAM AND HAZARD ANALYSIS – CROP HUSBANDRY (ORCHARD)

4.2.1. FLOW DIAGRAM OF THE OPERATIONS

The following steps (Figure 46) make up the diagram of primary production in the avocado sector.

Figure 46 — Production steps of avocado at the orchard



4.2.2. HAZARD ANALYSIS - ORCHARD

The following table (Table 22) describes for each step, the essential unit operations to grow avocados, the associated potential hazards and control/preventive measures:

Table 22 — Hazard analysis work sheet for orchard operations

(1) STEP	HAZARD DESCRIPTION		HAZARD EVALUATION				CONTROL MEASURES	
	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	(4) SEVERITY/ IMPACT OF EFFECT	(5) LIKELIHOOD OF OCCURRENCE	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	(7) JUSTIFY DECISION FOR COLUMN (6)	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	(9) *PRP, PA, CP, OR CCP*
SITE SELECTION	• Heavy metals (Lead, mercury, cadmium)	**Environmental hazard** • Industrial waste • Previous usage of pest control products and inputs • flooding	3	1	Recommendation	Possible contamination of the soil with heavy metals from industrial wastes, flooding and previous usage of pest control products	• Establish history of orchards • Carry out a systematic analysis of the sanitary quality of the soil (volcanic soil) • - Ensure soil type depth and profile are right • - Soil testing for heavy metals before land use, if higher than the following values; Cadmium – 0.8mg/kg, Chromium – 100mg/kg, Copper – 36mg/kg, Lead – 85mg/kg and Nickel 35mg/kg, abandon the field.	GAP
• Toxic chemicals and particles residues like smoke or dust on fruit	• Contamination from the surrounding areas with dust, smoke or other contaminants	2	1	Recommendation	Most orchards are located away from industrial contaminated areas	• Proper hygiene on planting sites in buildings and premises • Proper Site selection	GAP	

SITE SELECTION			(1) STEP	
• Fruit bruising	• Soil type	• Plant pathogens	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
• Fruit bruising caused by strong wind and hailstorm	• Waterlogging and salinity	• Soil borne pathogens	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	3	2	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2	3	2	(5) LIKELIHOOD OF OCCURRENCE	
Major	Major	Minor	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
There are areas with very strong wind	Avocado is sensitive to water logging and saline soils	Soil borne pathogens for Phytophthora and Pythium are endemic in most soils	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Select sites that are not prone to strong wind that would lead to fruits knocking on each other hence fruit bruising • Use of wind breaks – Erect or plant trees along the fence to reduce the strength of wind.	• Soil suitability testing. • Do not plant in soils with pH values above 6.5 and below 5.5 • Use of soil amendment products such as lime (soil liming)	• Testing of soil to determine if the pathogens are present or absent. If present, use the recommended soil treatment product (see table 20).	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CP	CP	PA	(9) *PRP, PA, CP, OR CCP*	

LAND PREPARATION		SITE SELECTION		(1) STEP	
Heavy metals (Cadmium, lead, mercury)	Chemical contaminants (Oil, lubricants, Pesticide residues)	• Frosting damage and hailstone	• Sunburn	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Hazards related to the raw material • Presence of heavy metals in certain mineral materials	**Materials hazards** Oil and lubricants from field equipment like tractors, use of herbicides	• Frosting damage as a result of very cold temperatures and hailstone of fruits on the tree	• Sunburn of fruits caused strong sun	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	2	3	2	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
1	1	1	3	(5) LIKELIHOOD OF OCCURRENCE	
Recommendation	Recommendation	Recommendation	Major	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Lime used in soil amendments and other soil amendment products that contain heavy metals	Most field equipment is well maintained Indiscriminate use of herbicides for clearing land	Few farms are located in areas with very cold weather especially during the night	Most farms are located in areas with very strong sun	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Use approved/registered lime, organic materials, fertilizer, and pest control products • Ensure there is no high weed pressure in orchards that encourages intensive use of herbicides at planting	• Maintenance of field equipment • Integrated weed management • Use of approved/ registered herbicides in clearing the land	• voidance of fields prone to frost damage and hailstone	• Application of white plastic paint on expos-ed stems, branches • Planting heat tolerant varieties in areas that are more prone to sunburn • Avoid fields in hot areas with high temperature that could lead to sunburn	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
GAP	GAP	GAP	CP	(9) *PRP, PA, CP, OR CCP*	

PLANTING			(1) STEP	
Heavy metals (Arsenic, lead, mercury)	Variety	Biological hazards (Pathogenic microbes)	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Materials hazards • Presence of heavy metals in certain fertilizers and manure	**Hazards related to the raw material:** • True to type of avocado seedling varieties – no link to variety demands from market, uncertified sources, own production of avocado seedlings	**Materials hazards** Pathogens in raw manure **Labour-related hazards** Personnel used for planting	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	3	1	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
1	3	3	(5) LIKELIHOOD OF OCCURRENCE	
Recommendation	Major	Recommendation	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
• Few farmers use chemicals during planting • Possible exceeding of the maximum MRL levels • Lime used in soil amendments not tested or confirmed for quality safety	Use of certified nurseries, prior knowledge of market requirements	Some farmers use farm manure that is not well composed Some farmers do not provide toilet facilities for their workers	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Use of approved or registered products • Use approved/registered lime, organic materials, fertilizer, and pest control products • GAP	• Purchase of certified planting materials from certified Nursery (see Annex 4)	• Use of decomposed manure • Providing toilets at the farm for workers • Fencing • Compliance with GAPs	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
GAP	CP	GAP	(9) *PRP, PA, CP, OR CCP*	

IRRIGATION	PLANTING		(1) STEP	
Poor quality fruits • Small fruits • Ring-necking and skin cracking	Poor quality fruits	Pesticide residues	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Materials hazards • Small fruits, ring-necking and skin cracking caused by water stress	**Materials hazards** • Poor plant growth that would result in poor quality fruits • Poor quality manure	**Materials hazards** Use of pest control products at planting	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
2	2	1	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
3	2	1	(5) LIKELIHOOD OF OCCURRENCE	
Major	Minor	Recommendation	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
• Most farmers do not irrigate their orchard resulting in water stress especially in areas with low rainfall	Some farmers use poor quality/ undecomposed manure that does not provide proper nutrition to the avocado tree	• Possible residues may not exceed the max. MRL levels	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Controlled irrigation using moisture monitoring equipment (Tensiometers)	• Use of well decomposed manure • Proper application of the manure in the right quantities following soil nutrient test • Certification of planting materials by the competent authority • Farmers to use certified materials for planting	• Use of approved/ registered products (see table 6) • GAP	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CP	CP	GAP	(9) *PRP, PA, CP, OR CCP*	

IRRIGATION		(1) STEP	
Rotting fruits	Pathogenic microbes	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
• Wetting of fruits during harvesting that could lead to rotting over irrigation during harvesting • Irrigation being done during harvesting	**Labour-related hazards** Personnel used for irrigation Hazards related to the raw material: From contaminated water	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
2	2	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
1	1	(5) LIKELIHOOD OF OCCURRENCE	
Recommendation	Recommendation	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
High moisture content leading to rotting, pathogen growth or pedicel damage	• Lack of toilet facilities for workers in some farms • No systematic analysis of irrigation water, lack of proper hygiene in the water storage facilities, lack of quality control of irrigation water • Irrigation occurs throughout the crop cycle including harvesting period hence would be a possible problem of cross-contamination during harvesting period	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Recommend drip irrigation or micro sprinklers • Avoid irrigation during harvesting	• Training of personnel on proper health and hygiene practices • Proper hygiene in the water storage facilities • Periodic water testing (Water quality checks) • Covering / fencing of the water source /catchment area • Preference of drip irrigation over overhead irrigation • Providing toilets at the farm for workers • Fencing	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
GAP	GAP	(9) *PRP, PA, CP, OR CCP*	

FERTILIZER AND MANURE APPLICATION		(1) STEP	
Poor quality fruits • Small fruits • Deformed fruit shape due to Zinc deficiency • Fruit abortion	Heavy metals from contaminated fertilizer and manure	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Lack of nutrients especially Zinc	**Hazards related to the raw material** • Lack of systematic analysis or manure of the of fertilizers used • Lack of quality control of fertilizer and manure used • Improper fertilization	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	3	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2	1	(5) LIKELIHOOD OF OCCURRENCE	
Major	Recommendation	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Most farmers do not test soil to know the right fertilizers to apply in the right quantities Farmers generally do not apply fertilizers and manures	Most fertilizers used are approved for quality and checked for any contamination by Competent Authorities	(7) JUSTIFY DECISION FOR COLUMN (6)	
Soil testing / leaf analysis and right fertilizer and manure application including testing the manure to know what quality it is before application	Good agricultural practices	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CP	GAP	(9) *PRP, PA, CP, OR CCP*	

SCOUTING FOR PESTS AND DISEASES	FERTILIZER AND MANURE APPLICATION	(1) STEP	
• Plant pathogens e.g. Avocado sun blotch viroid • Presence of pests in fruits	Pathogens	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Labour-related hazards • Scouting not done properly or early enough to identify pests and diseases in good time • *Lack of knowledge on pests and diseases* **Dangers related to working methods** Scouting materials such as hand lenses, scissors • *Lack of proper management or use of scouting equipment*	**Dangers related to working methods:** From raw manure Risky phytosanitary practices: practice of use of undecomposed manure near harvesting period	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	2	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2	2	(5) LIKELIHOOD OF OCCURRENCE	
Major	Minor	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
• Plant pathogens resulting into fruit rot • Scouting personnel not trained on pest diagnostic • Scouting not done correctly to identify pests and diseases of concern • Spreading of plant pathogens and virus when equipment is not disinfected	Some farmers use undecomposed manure	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Proper scouting regime • Training of personnel • Maintenance of field equipment	• Use of well decomposed manure • GAP	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CCP	PA	(9) *PRP, PA, CP, OR CCP*	

CROP PROTECTION TREATMENT				(1) STEP	
Pesticide residues > MRL				(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Labour-related hazards • Over application of PPPs *–Un even distribution of PPPs during spraying, intercropping with other crops*	**Hazards related to the raw material**: • Use of unapproved chemical *– No systematic analysis of the of fertilizers used, - Lack of quality control of the fertilizer and manure used*	**Dangers related to working methods** • Use of unapproved chemical – *Due to pest pressure, farmers are likely to apply more chemicals than required*	• Over application and spray drift -*inadvertent use of pesticides* • Use of unapproved chemical • Not observing preharvest interval	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3				(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2				(5) LIKELIHOOD OF OCCURRENCE	
Major				(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
• Farmers tend to overuse or improperly use /apply PPPs (Over-application of pest control products) • Some farmers use pest control products that are not approved or not checked for quality by Competent Authorities • Improper pruning practices that result in dense canopy		• Intercropping with other Crops that may require intensive use of PPPs • Some farmers use pest control products that are not approved. • Lack of observation of pre-harvest interval		(7) JUSTIFY DECISION FOR COLUMN (6)	
• Training of personnel on proper application of PPPs and adherence of PPPs application guidelines • Training on personnel on proper pruning practices and use of pruning guides (Orchard management practices) • No intercropping • Use of only approved or recommended pest control products. • GAP				(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CCP				(9) *PRP, PA, CP, OR CCP*	

PRUNING		CROP PROTECTION TREATMENT	(1) STEP	
Uncontrolled tree growth resulting in dense Canopy and a high tree	Pests and diseases on fruits and foliage	Presence of pests on fruit	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Dangers related to working methods Poor orchard management activities, e.g., lack of pruning • *Unpruned trees*	**Materials hazards** Unsanitized equipment *Use of – unsanitized equipment*	Poor control of target pests • *Un even distribution of Plant Protection Products (PPPs) during spraying*	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	3	3	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
1	2	2	(5) LIKELIHOOD OF OCCURRENCE	
Recommendation	Major	Major	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Lack of Pruning would hamper orchard management practices like pest scouting, light penetration, application of PPPs and harvesting	Possibility of cross contamination resulting in Sunblotch viroid and other pests/diseases	Due to improper application of PPPs resulting in high pest population	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Proper pruning of trees • Good agricultural Practices	• Disinfecting and sanitizing of pruning materials • Use of the appropriate pruning equipment	• Discard affected fruit if presence of pests is observed • Training of personnel on proper safe use of pesticides • Adoption of IPM practices for management of pests (see table 19 for signs and symptoms of common pests of Avocado and their management • Proper application of approved PPPs • GAPs	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
GAP	CP	CP	(9) *PRP, PA, CP, OR CCP*	

HARVESTING	PRUNING	(1) STEP	
Pesticide residues > MRL	Injury of the tree that could result in death of plant	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Labour-related hazards • Non-observation of PHI at harvesting • Spray drift from application of pesticides for other crop nearby the orchard	**Materials hazards** Use of inappropriate pruning equipment – *Lack of proper equipment* **Dangers related to working methods** Poor pruning practices e.g., not covering the wound resulting in infection of the tree – *Improper pruning*	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	2	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2	2	(5) LIKELIHOOD OF OCCURRENCE	
Major	Minor	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Lack of observation of pre-harvest interval Intercropping with other Crops that may require intensive use of PPPs	Wrong pruning equipment that could result in damage of the tree or stem Poor pruning practices e.g., not covering the wound resulting in infection of the tree	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Observation of PHI • Training of personnel on proper application of PPPs and adherence of PPPs application guidelines • Training on harvesters on good harvesting practices • No intercropping in avocado orchards • GAP	• Use of appropriate tools that are well maintained e.g. in terms of sharpness • Painting of the pruned section with Polyvinyl-acetate (PVA) paint • Training of personnel on proper pruning practices	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CCP	CP	(9) *PRP, PA, CP, OR CCP*	

HARVESTING		(1) STEP	
Pathogenic microorganisms such as E. Coli, Salmonella		(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Labour-related and material hazards • Harvesting Personnel used – *Lack of compliance with GHP, Lack of control over health status, Lack of clean water for hand washing* • Unclean harvesting equipment and materials (creates, harvesting containers)	**Dangers related to working methods** • Poor fruit handling practices and lack of harvesting tools and equipment • *Lack of knowledge of harvesting method* • *Placing fruits on the ground or soil* • *Harvesting at height*	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3		(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
1		(5) LIKELIHOOD OF OCCURRENCE	
Recommendation		(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Poor hygiene practices by personnel used in harvesting Spreading of pathogens when unclean equipment that are not disinfected are used during harvesting Placing of fruits on contaminated soil A number of farmers do not have proper or adequate harvesting tools and equipment		(7) JUSTIFY DECISION FOR COLUMN (6)	
• Providing toilets at the farm for workers and hand washing stations in the farm. • Proper cleaning and disinfection of harvesting equipment, creates and containers • Using the right equipment and tools for harvesting to avoid fruit touching the ground, e.g., use of crates, buckets and motorized equipment • Training of personnel on proper health and hygiene practices to ensure compliance with GAP/GHP. • Training of harvesters on proper practices of handling and harvesting • Fencing		(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
GAP/GHP		(9) *PRP, PA, CP, OR CCP*	

HARVESTING		(1) STEP	
Poor quality fruits (Immature fruits /low dry matter/high dry matter, Bruised and internal injury of fruits • Damaged/ missing pedicel • Physical hazards like sand)	Chemical contamination with oil, lubricants, fertilizers and pesticides	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Harvesting before the fruits matures Poor harvesting techniques Placing of fruits on the soil during harvesting	**Materials hazards** • Oil and lubricants from moving parts of machines • Use of unclean fertilizer bags and containers *Non-disinfected fruit cutting equipment*	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	3	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
3	2	(5) LIKELIHOOD OF OCCURRENCE	
Major	Major	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Many farmers do not test the maturity of their fruits before harvesting and only use size as an indicator Many farmers/fruit harvesters not aware of proper fruit harvesting requirements Placing of fruit on soil/ground	Some farmers use sacks or containers that previously were used for fertilizer, pesticides or paints etc. Field equipment may not be in good state of repair	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Testing of the dry matter of the fruit before harvesting • Training of Staff on good harvesting techniques • Training of Staff on good harvesting techniques • Placing of fruit in recommended containers	• Use of clean recommended containers, fruit cutting equipment and crates • GAPs	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CP	CCP	(9) *PRP, PA, CP, OR CCP*	

TRANSPORTATION TO PACKHOUSE OR COLLECTION CENTERS	(1) STEP	
Chemical contamination with oil, lubricants and other chemicals from the vehicles Toxic chemicals and particles residues like smoke or dust from the vehicles	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Environmental Hazards Contamination from dirty surfaces in the vehicles and the exhaust fumes – *Dirty transportation vehicles* • *Not well-maintained vehicles* **Materials hazards** • Use of dirty vehicles • *General lack of equipment maintenance* • *Non-disinfected fruit cutting equipment*	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	HAZARD DESCRIPTION
2	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2	(5) LIKELIHOOD OF OCCURRENCE	HAZARD EVALUATION
Minor	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	HAZARD EVALUATION
Most vehicles used for transportation are not in a good state Some farmers use dirty sacks and containers in dirty vehicles that previously were used for transportation of other materials that could be contaminants e.g. fertilizer or pesticides etc.	(7) JUSTIFY DECISION FOR COLUMN (6)	HAZARD EVALUATION
• Use of clean sanitized surfaces in transport vehicles, • Vehicles covered and avoid use of banana leaves • Use of crates for holding fruit • Use of clean recommended containers and crates • Use of clean vehicles that are in good state of repair and that are closed • GAPs	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
PA	(9) *PRP, PA, CP, OR CCP*	CONTROL MEASURES

TRANSPORTATION TO PACKHOUSE OR COLLECTION CENTERS			(1) STEP	
Pathogenic microorganisms such as E. Coli, Salmonella			(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Material hazards and dangers related to working methods Unclean sacks, crates and containers, unclean vehicles Placing of fruits on the floor of the vehicle or using dirty container If vehicle was used for transportation uncleaned materials prior to loading fruit.	• *Due to poor transportation practices* • *Bulk transporting* • *Delay in transport to the packhouse* • *Long distance transport from within EAC countries*	**Labour-related hazards** Personnel handling fruit/crates with dirty hands – *Lack of compliance with GHP by staff, Lack of control over health status, Lack of water for hand washing or cleaning of crates*	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
2			(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
2			(5) LIKELIHOOD OF OCCURRENCE	
Minor			(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
Spreading of pathogens when unclean equipment that are not disinfected are used during transportation Contaminated product contact surfaces (vehicle or containers) Poor hygiene practices by personnel used in Transportation			(7) JUSTIFY DECISION FOR COLUMN (6)	
• Proper cleaning and disinfection of crates and containers used during transportation, and clean vehicles • Proper sanitation of product contact surfaces • Providing hand washing facility • Have a cleaning programme for fruit holding containers • GAPs			(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
PA			(9) *PRP, PA, CP, OR CCP*	

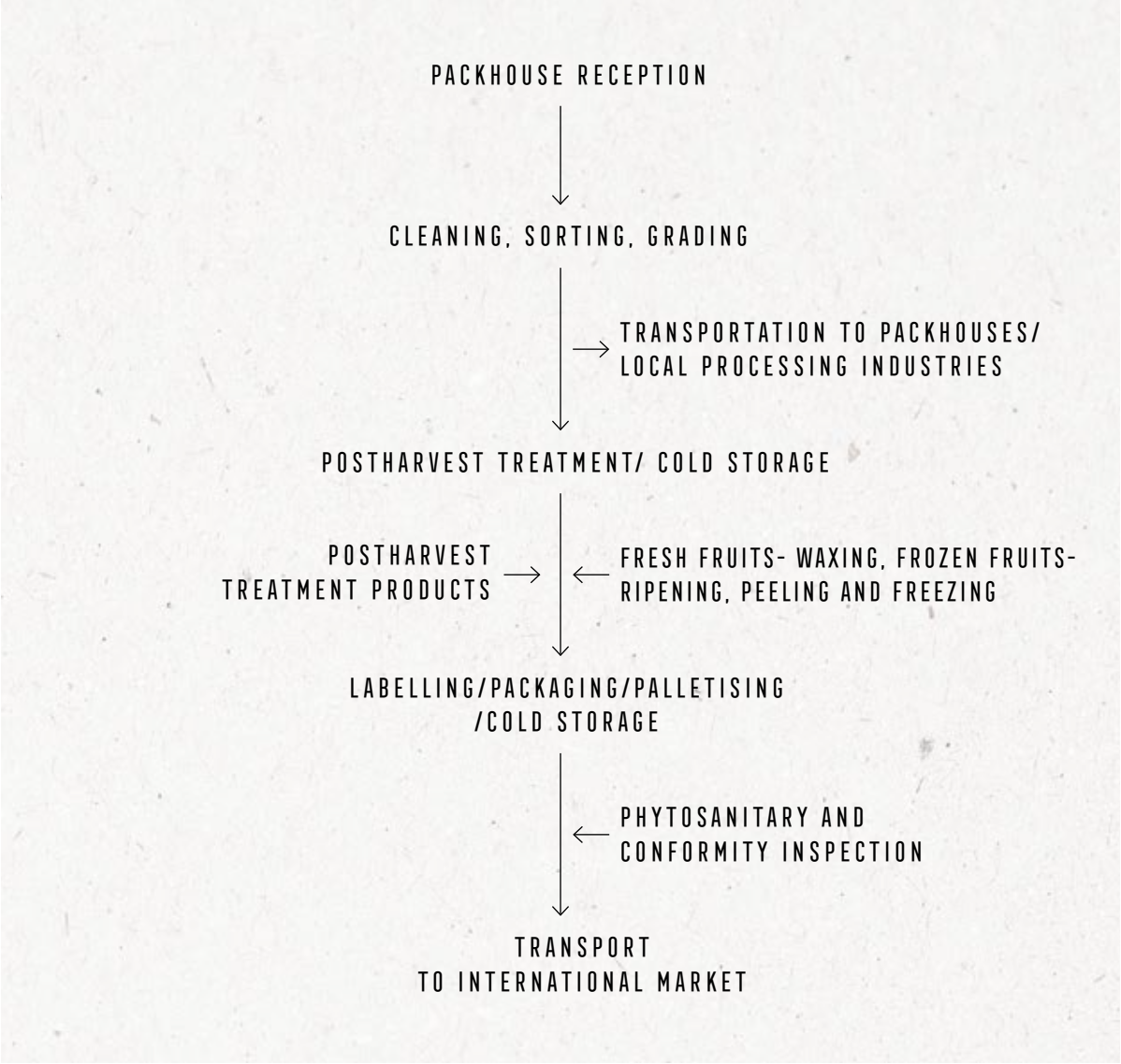
TRANSPORTATION TO PACKHOUSE OR COLLECTION CENTERS	(1) STEP	
Poor quality fruits due to physical damage to fruit	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP	HAZARD DESCRIPTION
Dangers related to working methods • Heat buildup • Piling of fruits • Delayed transportation • Premature ripening – *Transportation in open tracks with bananas leaves*	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER (ACCORDING TO THE 5M METHOD)	
3	(4) SEVERITY/ IMPACT OF EFFECT	HAZARD EVALUATION
3	(5) LIKELIHOOD OF OCCURRENCE	
Major	(6) RECOMM- ENDED LEVEL OF REQUIREMENT	
• Heat buildup due to piling. Piling also results in internal damage of fruits at the bottom • Bruises caused by fruits rubbing against each other • Onset of physiological process leading to ripening due to delay to transport and fruit staying in unfavorable conditions for long	(7) JUSTIFY DECISION FOR COLUMN (6)	
• Transportation of fruits within 6hours from harvesting • Transportation in crates for bulk transport • Use of cooling during transportation for long distances	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD	CONTROL MEASURES
CP	(9) *PRP, PA, CP, OR CCP*	

4.3. PROCESS FLOW CHART AND HAZARD ANALYSIS – PACKHOUSE OPERATIONS

4.3.1. FLOW DIAGRAM OF THE OPERATIONS

The following steps (Figure 47) make up the diagram of primary production at the Packhouse:

Figure 47 — Production steps of avocado at the packhouse



4.3.2. HAZARD ANALYSIS - PACKHOUSE

The following table (Table 23) describes for each process step, the essential unit operations to package the products, the associated potential hazards and the preventive controls.

Table 23 — Hazard analysis work sheet for packhouse operations

(1) DIENT/ PROCESSING STEP	HAZARD DESCRIPTION		HAZARD EVALUATION				PREVENTIVE CONTROL(S)	
	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	(4) SEVERITY / IMPACT OF EFFECT	(5) LIKELIHOOD OF OCCURRENCE	(6) RECOMMENDED LEVEL OF REQUIREMENT	(7) JUSTIFY DECISION FOR COLUMN (7)	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	(9) *PRPS, PA, CP, OR CCP*
FRUIT RECEPTION, WEIGHING AND VISUAL INSPECTION	Pathogenic microorganisms such as E. Coli, Listeria, Salmonella	**Dangers related to working methods** • Placing of fruits on the floor during unloading and using dirty container – Due to poor handling practices or too long time to deliver **Labour-related hazards** • No respect of basic hygiene rules by personnel • Lack of hand-washing stations **Materials hazards** • Unclean containers such as crates • Non-disinfected fruit holding containers like crates	3	1	Recommendation	Poor hygiene practices by personnel used Spreading of pathogens when unclean containers that are not disinfected are used for holding fruits Contaminated product contact surfaces (e.g., containers)	• Providing toilets at the Packhouse for workers and hand washing stations • Personnel health checks • Visitor control and declaration (see Record sheet 13) • Proper cleaning and disinfection of Containers used for holding fruits • Proper sanitation of product contact surfaces • Place fruit in crates on pallets raised off the floor • GHP	GHP

FRUIT RECEPTION, WEIGHING AND VISUAL INSPECTION		(1) DIENT/ PROCESSING STEP	
Mixed fruit types or those from different farms	Chemical contamination with oil, lubricants	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Hazards related to the raw materials Different farmers or different exporters using same facility	**Materials hazards** • Oil and lubricants from moving parts of forklifts or machines • -Use of unclean containers • General lack of equipment maintenance • Placing fruits on dirty floor which may contain chemicals	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
3	2	(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
2	2	(5) LIKELIHOOD OF OCCURRENCE	
Major	Minor	(6) RECOMMENDED LEVEL OF REQUIREMENT	
Some Exporters do not have own facility for processing so different exporters using same facility with potential for mixing fruit	Dirty containers used for holding fruit Contaminated product contact surfaces (e.g., floor or containers)	(7) JUSTIFY DECISION FOR COLUMN (7)	
• Cultivar/varieties segregation • Ensure traceability e.g., color coding • Training for packhouse personnel	• Use of clean recommended containers and crates • Place fruit in crates on pallets raised off the floor • Proper sanitation of product contact surfaces	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
CP	GHP	(9) *PRPS, PA, CP, OR CCP*	

TEMPORARY STORAGE			(1) DIENT/ PROCESSING STEP	
Pathogenic microorganisms such as E. Coli, Listeria, Salmonella		Physical damage to fruit	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Labour-related hazards • No respect for hygiene rules by Personnel • Lack of hand washing stations **Materials hazards** • Unclean containers such as creates -Non-disinfected fruit holding containers like crates	**Dangers related to working methods** • Holding of fruits for long period leading to multiplication of pathogens, use of dirty containers – Due to poor handling practices • Delays before processing	**Environmental Hazards** • Heat buildup • Piling of fruits • Delayed before processing • Premature ripening	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
3		3	(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
1		1	(5) LIKELIHOOD OF OCCURRENCE	
Recommendation		Recommendation	(6) RECOMMENDED LEVEL OF REQUIREMENT	
Poor hygiene practices by personnel Spreading of pathogens when unclean containers that are not disinfected are used for holding fruits Contaminated product contact surfaces (e.g., containers)		Fruits stored in warm temperatures may exacerbate rotting	(7) JUSTIFY DECISION FOR COLUMN (7)	
• Proper sanitation of product contact surfaces • Not holding fruit for long before processing and holding the fruits in cool clean storage areas • Providing toilets at the Packhouse for workers and hand washing stations • Proper cleaning and disinfection of Containers used for holding fruits		Monitor receiving temperature Store in a cool area before processing to remove the field heat Pack fruits as soon as possible	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
GHP		GHP	(9) *PRPS, PA, CP, OR CCP*	

WASHING AND TREATMENT			TEMPORARY STORAGE	(1) DIENT/ PROCESSING STEP	
Pathogenic microorganisms such as E. Coli, Listeria, Salmonella		Harmful chemicals	Chemical hazards -Chemical contamination with oil, lubricants	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Environmental Hazards • Dirty or untreated water used in the packhouse	**Materials hazards** • Unsanitized brushes used in cleaning of fruit and conveyor belts and other fruit contact surfaces – Poor maintenance of cleaning brushes	**Hazards related to the raw material** • Contaminated water – Dirty washing facility **Dangers related to working methods** • Not changing water frequently	**Environmental Hazards** • Dirty or untreated water used in the packhouse	**Materials hazards** • Use of unclean containers • Dirty floor which may contain chemicals	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER
3			3	2	(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
2			1	1	(5) LIKELIHOOD OF OCCURRENCE
Major			Recommendation	Recommendation	(6) RECOMMENDED LEVEL OF REQUIREMENT
Poor hygiene practices by personnel used Dirty brushed that are not well maintained Use of untreated water	Prolonged use of washing water Not changing water frequently as required		Packhouse use potable water, but some packhouses may use borehole	Contaminated product contact surfaces (e.g., floor or containers)	(7) JUSTIFY DECISION FOR COLUMN (7)
• Providing toilets at the Packhouse for workers and hand washing stations • Cleaning and good maintenance of cleaning brushes • Use of portable water Change of water after every shift Change of water after every shift GHP			• Use potable water, tests for water quality • If treated use approved products	• Use of clean recommended containers and crates • Proper sanitation of product contact surfaces	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
CCP			GHP	GHP	(9) *PRPS, PA, CP, OR CCP*	

DRYING, SORTING AND GRADING		WASHING AND TREATMENT	(1) DIENT/ PROCESSING STEP	
Inconsistency in fruit quality	Pathogenic microorganisms such as E. Coli, Salmonella	Chemical hazards	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Dangers related to working methods Fruit quality defects - Manual packaging and handling	**Labour-related hazards** • Lack of compliance with GHP by food handlers • Lack of control over health status • Lack of or non-proper use of hand-washing stations **Materials hazards** Unsanitized food contact surfaces • Poor maintenance of the machines • Dirty washing brushes, prolonged use of brushes without washing them	**Hazards related to the raw material** • Residue of PPPs used to control fungi and bacterial diseases, Overuse of chemicals or use of wrong chemicals • Use of chemicals to control fungi and bacterial diseases	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
2	3	3	(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
2	2	2	(5) LIKELIHOOD OF OCCURRENCE	
Minor	Major	Major	(6) RECOMMENDED LEVEL OF REQUIREMENT	
Sorting not properly done	Poor hygiene practices by personnel used considering that the fruit will not be cleaned further Dirty surfaces used for conveying fruits during drying	Possible overuse of chemicals during washing or wrong chemicals used	(7) JUSTIFY DECISION FOR COLUMN (7)	
Training of packhouse Provide quality charts Discourage manual packaging	• Providing hand washing stations at convenient locations • Personnel health checks • Protective clothing provided • GHPs • Cleaning and good maintenance of food contact surfaces, machinery and cleaning brushes	• Use the recommended chemical additives at the recommended rate • Calibration of equipment	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
PA	CCP	CCP	(9) *PRPS, PA, CP, OR CCP*	

WEIGHING, PACKING INTO CARTONS AND PALLETIZING			(1) DIENT/ PROCESSING STEP	
Chemical contamination with oil, lubricants	Pathogenic microorganisms such as E. Coli, Salmonella		(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Materials hazards Oil and lubricants from moving parts of fort-lifts or machines Use of unclean cartons • Poor maintenance of the machines • General lack of equipment maintenance	**Labour-related hazards** • Lack of compliance with GHP by food handlers • Lack of control over health status • Lack of hand-water stations	**Materials hazards** • Unsanitized food contact surfaces • Use of unclean cartons **Dangers related to working methods** • Contamination from poor handling places e.g., placing on dirty floor	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
2	3		(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
1	2		(5) LIKELIHOOD OF OCCURRENCE	
Recommendation	Major		(6) RECOMMENDED LEVEL OF REQUIREMENT	
• Poor maintenance of machinery • Use of dirty or contaminated cartons	Poor hygiene practices by personnel used considering that the fruit will not be cleaned further Dirty surfaces used for conveying fruits during drying Contamination from poor handling places e.g., placing on dirty floor		(7) JUSTIFY DECISION FOR COLUMN (7)	
• Use of clean recommended cartons • Proper maintenance of machinery • GMPs	• Providing hand washing stations at convenient locations • Good Hygiene practices • Cleaning and good maintenance of food contact surfaces and cartons • Good handling practices • Weigh cartons		(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
GWP	CCP		(9) *PRPS, PA, CP, OR CCP*	

STORAGE	WEIGHING, PACKING INTO CARTONS AND PALLETIZING		(1) DIENT/ PROCESSING STEP	
Fruit Quality	Quality defect (Mixed fruit sizes)	Damaged fruits	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Dangers related to working methods • Poor pulp temperature of the core pulp • Placing of products on floor • Poor temperature control of pulp	**Dangers related to working methods** • Poor workmanship • Poor handling of cartons or products • Lack of uniformity in weight of packed cartons • Lack of calibration of machines	**Hazards related to the raw material** Weak boxes or straps that could result in collapsing of the pallet and spillage of fruits hence damages • Quality of boxes and strapping and poor strapping	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
3	3	3	(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
3	2	1	(5) LIKELIHOOD OF OCCURRENCE	
Major	Major	Recommendation	(6) RECOMMENDED LEVEL OF REQUIREMENT	
High pulp temperatures	Improper	Most exporters use good quality boxes, pallets and straps that meet required standards	(7) JUSTIFY DECISION FOR COLUMN (7)	
• Control pallet temperature	• Calibration of equipment and servicing be carried every quarter or as often as may be required • Training of personnel • Self-manual checks throughout the day and reports available	• Use of boxes that meet the minimum strength requirements • Training of staff on proper strapping methodology	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
CP	CP	GWP	(9) *PRPS, PA, CP, OR CCP*	

STORAGE			(1) DIENT/ PROCESSING STEP	
Pathogenic microorganisms such as E. Coli, Salmonella and fungi			(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Labour-related hazards • Lack of compliance with GHP by food handlers and lack of control over health status	**Materials hazards** • Moisture build-up and molding due to poor conditions in the storage facility or temperature abuse • *Poor maintenance of the cold storage facility*	**Dangers related to working methods** Contamination from poor handling places e.g., placing on dirty floor in the cold room	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
2			(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
2			(5) LIKELIHOOD OF OCCURRENCE	
Minor			(6) RECOMMENDED LEVEL OF REQUIREMENT	
Poor hygiene practices by personnel Frequent/uncontrolled opening and closing of the cold facility		Poor maintenance Contamination from poor handling places e.g., placing on dirty floor	(7) JUSTIFY DECISION FOR COLUMN (7)	
• Providing hand washing stations at convenient locations • Cleaning and good maintenance of food storage facility • Palletizing of all materials kept in the cold store • Good handling practices and good hygiene practices			(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
PA			(9) *PRPS, PA, CP, OR CCP*	

LOADING INTO TRANSPORT CONTAINERS OR THE REEFERS AND TRANSPORTATION				(1) DIENT/ PROCESSING STEP	
Chemical substances	Pathogenic microorganisms such as E. Coli, Salmonella, Listeria			(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Materials hazards • Contaminated transport containers or reefers • Poor hygiene of the transport containers and reefers	**Labour-related hazards** • Lack of compliance with GHP by food handlers • Lack of control over health status	**Materials hazards** • Contaminated transport containers or reefers	**Dangers related to working methods** • Possible growth of microbes due to temperature abuse • Improper temperature controls	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
2	3			(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
1	1			(5) LIKELIHOOD OF OCCURRENCE	
Recommendation	Recommendation			(6) RECOMMENDED LEVEL OF REQUIREMENT	
Dirty and unsanitized transport containers and reefers	Poor hygiene practices by personnel Possible growth of microbes due to temperature abuse			(7) JUSTIFY DECISION FOR COLUMN (7)	
• Proper cleaning and sanitation of transport containers and reefers before loading	• Providing hand washing stations at convenient locations • Proper control of temperature • Good handling practices • GHP • Constant checking the reefer			(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
GWP	GHP			(9) *PRPS, PA, CP, OR CCP*	

LOADING ONTO A SHIP, TRANSPORTATION		(1) DIENT/ PROCESSING STEP	
Chemical hazard – High MRL	Pathogens and fungi	(2) HAZARDS/DANGERS INTRODUCED, PRESENT OR ENHANCED AT THIS STEP (ACCORDING TO THE 5 M METHOD)	HAZARD DESCRIPTION
Materials hazards • overapplication of 1-Methylcyclopropene 6.3g/L	**Materials hazards** Possible growth of microbes due to temperature abuse • Improper temperature controls • Poor maintenance of the cold storage facility	(3) ORIGIN OR SOURCE OF THE HAZARD OR DANGER	
3	2	(4) SEVERITY / IMPACT OF EFFECT	HAZARD EVALUATION
1	1	(5) LIKELIHOOD OF OCCURRENCE	
Recommendation	Recommendation	(6) RECOMMENDED LEVEL OF REQUIREMENT	
Lack of training on proper use and application of the chemical	Malfunctioning cold facility Poor maintenance	(7) JUSTIFY DECISION FOR COLUMN (7)	
Training of persons on proper use of the chemical	Good maintenance of food storage facility	(8) CONTROL MEASURE(S) APPLIED TO SIGNIFICANTLY MINIMIZE OR PREVENT THE HAZARD OR DANGER	PREVENTIVE CONTROL(S)
PA	GHP	(9) *PRPS, PA, CP, OR CCP*	

A5

DETERMINATION OF RISK LEVELS AND PROPOSAL OF APPROPRIATE CONTROL MEASURES: SPS CONTROL PLAN

The following table lists **the checks to be carried out** on the production, processing and packaging process **(self-checks)**: documentary checks, visual checks, measurements, product inspections, sampling for the analysis of biological or chemical contaminants, sampling for phytosanitary diagnosis**.** This table is intended for:

- Facilitate the development by industry professionals of a "Check List" for conducting valid internal audits (Part B of the Guide).
- Facilitating external controls (third party certification inspections and official controls): "control points", which should be the focus of inspectors' attention, are thus identified – with their minor and major requirements.

The **periodicity and nature of the verifications** (technical aspects to be checked by the auditors and internal auditors), as well as the records to be made are indicated in the table which can therefore be considered as the "**SPS Control Plan**".

Among the various checks to be indicated in the table are the following:

Plan of the checks to be implemented in the Avocado sector.

5.1. SPS PLAN FOR THE NURSERY MANAGEMENT

Table 24 — SPS Plan for the Nursery management

S.N	PROCESS STEP	NATURE AND SOURCE OF DANGER TO BE CONTROLLED	RECOMMENDED LEVEL OF REQUIREMENT	RECOMMENDED CONTROL MEASURES	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)	CORRECTION/ CORRECTIVE ACTION
1	**Selection of seeds**	• Poor quality fruits due to use of unidentified or unknown or weak /diseased seeds for the rootstock with Poor vigor	Major	• Source seeds that are identified /classified from certified mother blocks • Training of person on Avocado diseases and seed quality requirements • Use of disease-free rootstock	**Documentary control** • Verification of the records of certification to check for compliance; see record sheet 1 **Phytosanitary diagnostic tests** • Determination of pests or diseases to ensure disease-free seeds **Internal inspections** • Inspection of the process of seed selection, treatment and related operations **Visual checks** • Visual checks of the seeds to be used for rootstock to ensure they meet requirements	• Training of person on Avocado diseases and seed quality requirements • Rogueing (Selective removal of diseased rootstock)

4	3	2	S.N
Crop management		**Grafting**	PROCESS STEP
Mixed variety fruits and loss (breakup) of traceability due to poor identification and traceability of seedling resulting in mixing of variety	• Poor quality fruits due to poor management of seedling rootstock to remove off-shots	• Use of unidentified variety for scion • Weak rootstock and /or scion that has poor vigor • Poor grafting method where the Scion does not take off • Use of diseased rootstock /scion	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Major	Major	RECOMMENDED LEVEL OF REQUIREMENT
• Proper labelling and traceability of varieties/ seedlings	• Training staff on nursery management good practices • Scouting for pests and diseases	• Source of known recommended seed and scion • Train the grafting staff on good grafting techniques • Training of person on Avocado diseases • Use of disease-free rootstock/scion	RECOMMENDED CONTROL MEASURES
Documentary control • Confirmation that proper records are kept ensuring traceability, see relevant record sheets 2-8. **Internal inspections** • Inspection of the seedlings (scouting to check seedling conditions e.g. labelling, pruning of extra shoots, arrangement etc)	**Documentary control** • Confirmation that proper records are kept ensuring traceability, see relevant record sheets 2-8. **Phytosanitary diagnostic tests** • Determination of pests or diseases to ensure disease-free seedlings	**Documentary control** • Verification of the records of certification to check for compliance; see record sheet 1 **Phytosanitary diagnostic tests** • Run samples to check for diseases – confirm disease free before use for grafting **Internal inspections** • Supervision of the process grafting operations • Inspection of the grafts (scouting to check seedling conditions e.g. labelling, pruning of extra shoots, arrangement etc)	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
• Correct labelling of seedling to proper identification of variety • Sorting and proper grouping/arrangement/ demarcation of seedlings according to their variety	• Training staff on nursery management good practices and identification of pests and diseases	• Rogueing (Selective removal of seedlings that are poorly grafted or have unidentified scions that are exhibiting varied characteristics) • Training staff on good grafting techniques and identification of pests and diseases	CORRECTION/ CORRECTIVE ACTION

Table 25 — SPS Plan for the Orchard management

2	1				S.N
Planting	**Site selection**				PROCESS STEP
Variety	Sunburn	Fruit bruising	Soil Type	Plant pathogens	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Major	Major	Major	Minor	RECOMMENDED LEVEL OF REQUIREMENT
Farmers to use certified materials for planting	Soil testing for presence of plant pathogens (e.g. fungi) and to know the soil type before land use				RECOMMENDED CONTROL MEASURES
Documentary control Confirmation that seedlings are from a certified nursery (see Annex 4)	**Contaminant analyses control** • Sampling for analysis (soil testing) at the beginning to check the soil quality and suitability (check for salinity, depth, type e.t.c.) in an accredited laboratory (see Annex 3) **Documentary control** • Verification of the lab reports against requirements to check for compliance				CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
• Certification of planting materials by the competent authority	• Abandon contaminated fields or apply treatment before land by use of excavation and removal of soil in affected areas, in-situ fixation or Phyto-extraction method) • Application of white plastic paint on exposed stems and branches • Use of wind Breaks • Planting heat tolerant varieties in areas that are more prone to sunburn				CORRECTION/ CORRECTIVE ACTION

3	2	S.N
Irrigation	**Planting**	PROCESS STEP
Poor Quality fruits (Small fruits, Ring-necking and skin cracking)	Poor quality fruits due to poor plant growth	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Minor	RECOMMENDED LEVEL OF REQUIREMENT
• Ensuring the water requirements of every tree are met especially at flowering	• Use of well decomposed manure • Proper application of manure in the right quantities following soil nutrient test • Certification of planting materials by the competent authority • Farmers to use certified materials for planting	RECOMMENDED CONTROL MEASURES
Measurement control Controlled irrigation using moisture monitoring equipment (Tensiometers)	**Internal inspections** Confirm the quality of Manure to be used by checking the temperature, consistency,	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Monitor water requirements in the orchard and put in place-controlled irrigation using moisture monitoring equipment (e.g., Tensiometers)	• Use of well decomposed manure • Proper application of the manure in the right quantities following soil nutrient test. GAP	CORRECTION/ CORRECTIVE ACTION

5	4	S.N
Scouting for pests and diseases	**Fertilizer and manure application**	PROCESS STEP
• Plant pathogens and virus resulting into fruit rot and presence of pests in fruits	Poor Quality fruits (Small fruits, Deformed fruit shape due to Zinc deficiency - Fruit abortion)	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Minor	RECOMMENDED LEVEL OF REQUIREMENT
• Proper scouting regime • Training of personnel on proper scouting practices • Maintenance of field equipment	• Use of well decomposed manure • Use of only certified/approved fertilizers • GAP e.g., applying fertilizers and manure at the right time (*See Practical sheet 2*)	RECOMMENDED CONTROL MEASURES
Visual checks Visual checks to ensure workers wash hands before scouting activities (see Practical sheet 3) **Documentary control** Checking the frequency of scouting and management of the pests. (see record sheet 5 and 6.) **Internal inspections** Supervisor to ensure personnel are well trained and that they are carrying out the scouting activities in the right manner **Phytosanitary *diagnostic tests*** New/unknown pests detected at the orchard must be reported for identification in order to establish the proper management action(s) **Monitoring/scouting** Use of traps to monitor key pests	**Documentary checks** • Confirm that the fertilizers to be used is certified/approved. See record sheet 2 • Confirming from the records the age of the manure before application *(should be at least 6 months)* **Monitoring/Scouting** • Routine monitoring for nutrient deficiency symptoms on the plant and fruits **Measurement control** • Soil fertility tests to be done periodically (annually)	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Training of personnel on scouting and pest management and good hygiene practices Use of data to develop IPM and economic thresholds for pest management decisions (see Table 19 for signs and symptoms of common pests of Avocado and their management)	Soil testing / leaf analysis and right fertilizer and manure application including testing the manure to know what quality it is before application	CORRECTION/ CORRECTIVE ACTION

6	S.N
Crop protection treatment	PROCESS STEP
• Pesticides residue > MRL • Pesticide residues from use of unapproved products, wrong use of products or not observing pre-harvest interval	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	RECOMMENDED LEVEL OF REQUIREMENT
• Use of only recommended pest control products. • Observe pre-harvest interval • Use products as per the instructions for use • Training of personnel on proper application of PPPs and adherence • of PPPs application guidelines • Training on personnel on proper pruning practices and use of pruning guides (Orchard management practices) • No inter-cropping and GAPs	RECOMMENDED CONTROL MEASURES
Documentary control • Checking the list of authorized PPPs on the crop Checking the list at every use • Verification of the recording of the phytosanitary treatments carried out during cultivation: sheet to record activities of crop protection treatment (see record sheet 6). **Internal inspections:** • Verification of the application of Crop protection treatment procedures	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Discard affected fruit if unauthorized PPPs are used or preharvest interval not observed Training of personnel on proper safe use of pesticides Adoption of IPM practices for management of pests (see table 19 for signs and symptoms of common pests of Avocado and their management)	CORRECTION/ CORRECTIVE ACTION

7		6	S.N
Pruning		**Crop protection treatment**	PROCESS STEP
Injury of the tree (Use of inappropriate pruning equipment	Pests and diseases in fruits (Unsensitized equipment)	Presence of pests on fruits	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Minor	Major	Major	RECOMMENDED LEVEL OF REQUIREMENT
• Use of appropriate tools that are well maintained e.g. in terms of sharpness • Painting of the pruned section with Polyvinyl-acetate (PVA) paint	• Disinfecting and sanitizing of pruning materials • Use of appropriate pruning equipment	• *Even distribution of PPPs* • Proper application of PPPs	RECOMMENDED CONTROL MEASURES
Internal inspections • Supervision of the use of appropriate pruning equipment and sanitization before/after use **Documentary control** • Confirmation and recording of type and concentration of disinfectants used **Visual checks** • Visual checks to ensure pruning is done correctly		**Internal inspections** • Supervision of use of the PPPS **Documentary control** • Checking the scouting record (see record sheet 4 and 5) • Verification of the recording of the phytosanitary treatments carried out during crop management: sheet to record activities of crop protection treatment (see record sheet 6).	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Training of personnel on proper pruning techniques and practices		Discard affected fruit if presence of pests is observed Training of personnel on proper safe use of pesticides Adoption of IPM practices for management of pests (see table 19 for signs and symptoms of common pests of Avocado and their management)	CORRECTION/ CORRECTIVE ACTION

8	S.N
Harvesting	PROCESS STEP
Chemical hazards such as pesticide residues > MRL, oil, lubricants, fertilizers from dirty equipment and packaging/holding materials, oil and lubricant leaks from oil equipment	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	RECOMMENDED LEVEL OF REQUIREMENT
• Avoid application of pesticides near harvesting • Observe recommended PHIs • Use of clean recommended containers and crates for holding fruits • Proper machine maintenance • GAPs/ GHPs	RECOMMENDED CONTROL MEASURES
Internal inspections • Supervision to ensure equipment and containers used during harvesting meet minimum requirements **Documentary control** • Confirmation and recording of applications of PPPs	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Training of personnel on proper safe use of pesticides - Adoption of IPM practices for management of pests (see table 19 for signs and symptoms of common pests of Avocado and their management) Discard fruit if PHI not observed Period testing of fruit (see Table 6) Maintenance of the equipment Cleaning and disinfection of containers before use	CORRECTION/ CORRECTIVE ACTION

9	8		S.N
Transportation to Packhouse or collection centers	**Harvesting**		PROCESS STEP
Poor quality fruit due to physical damage to fruit	Poor fruit quality (Immature fruits /low dry matter /high dry matter, Bruised and internal injury of fruits, Damaged/ missing pedicel)		NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Major		RECOMMENDED LEVEL OF REQUIREMENT
• Transportation of fruits within 6hours from harvesting • Transportation in crates for bulk transport • Use of cooling during transportation for long distances	• Testing of dry matter • Training of harvesting personnel • Temperature control	• No use of banana leaves and other ethylene producing packaging • No harvesting during rainfall, don't irrigate 2 days before harvesting	RECOMMENDED CONTROL MEASURES
Visual Inspection Ensure vehicles are covered and avoid use of banana leaves **Documentary control** Keeping Temperature logs for controlled temperature transportation	**Visual checks** Checks to confirm that the fruits have reached the right physiological maturity before harvesting. **Measurements** Measure the dry matter to ensure it falls within the specified ranged based on variety *(See Part A Section 2.5.1)*		CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Training on proper handling of fruits and monitoring tools	Use of immature avocadoes for oil production Training of Staff on good harvesting techniques		CORRECTION/ CORRECTIVE ACTION

Table 26 — SPS Plan for the Packhouse operations

2	1	S/N
Washing and treatment of fruit	**Fruit reception, Weighing and visual inspection**	PROCESS STEP
• Pathogens from poor maintenance of cleaning brushes, dirty washing facility	• Mixing of fruit types or those from different farms	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Major	RECOMMENDED LEVEL OF REQUIREMENT
• Cleaning and good maintenance of cleaning brushes • Use of portable water • Change of water frequently or after every shift	• Cultivar/varieties segregation • Establish a traceability system e.g., color coding of crates at delivery	RECOMMENDED CONTROL MEASURES
Visual checks • Visual checks to ensure brushes are in good condition (see Practical sheet 6 and Record sheet 11) **Contaminant analyses** • Periodic sampling of potable water analysis to check the Water quality (every three months **Documentary control** • Ensure proper record keeping and review of records of the washing operations (see Practical sheet 6 and Record sheet 11) • Verification of the water analysis lab reports against requirements to check compliance • Logging of information on water change **Internal inspections** • Supervisor verification of logs/records of water change • Supervisor to ensure proper handling and hygiene practices	**Documentary control** • Records of fruit deliver (Farmers or source of fruit)	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Clean or replace brushes that are worn out or dirty Treatment of water or replacement of dirty water with clean water Reclean fruits using clean water Training of personnel (see Record sheet 12)	Sorting Training packhouse personnel	CORRECTION/ CORRECTIVE ACTION

4	3	S/N
Drying, Sorting and grading	**Washing and treatment of fruit**	PROCESS STEP
• Pathogens such as E. Coli, Salmonella, Listeria due to poor hygiene practices by personnel and/or dirty surfaces used for conveying fruits	• Residue of PPPs used to control fungi and bacterial diseases during washing > MRL	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Major	RECOMMENDED LEVEL OF REQUIREMENT
• Providing hand washing stations at convenient locations • Cleaning and good maintenance of food contact surfaces, machinery and cleaning brushes and GHPs	• Use recommended plant protection products at the recommended rate • Calibration of equipment	RECOMMENDED CONTROL MEASURES
Documentary control Ensure proper record keeping and review of records of the GHPs **Internal inspections** Supervisor to ensure good hygiene practices are adhered with	**Documentary control** • Checking the list of authorized PPPs for use in postharvest treatment • Ensure proper record keeping and review of records of the washing operations **Internal inspections** • Supervisor to ensure proper handling and use of PPPs	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Training of personnel on GHP	Calibration of equipment Training of personnel on PPP use Discard affected products	CORRECTION/ CORRECTIVE ACTION

7	6	5	S/N
Storage in the cold	**Weighing, packing into cartons and palletizing**		PROCESS STEP
Quality defects e.g., brown pulp	Quality defects (e.g., mixed fruits with different weights)	Pathogens such as E. Coli, Salmonella. Listeria due to poor hygiene practices, lack of control over health status, unsanitized food contact surfaces, use of unclean cartons	NATURE AND SOURCE OF DANGER TO BE CONTROLLED
Major	Major	Major	RECOMMENDED LEVEL OF REQUIREMENT
Control pallet temperature	• Weight controlled according to market requirements • Calibration of machines	• Providing hand washing stations at convenient locations • Cleaning and good maintenance of food contact surfaces • Good handling practices • GHPs	RECOMMENDED CONTROL MEASURES
Measurement Checks of temperature and humidity and ensure it is between 4 – 6°C and 80 – 90 % respectively **Documentary control** Ensure proper record keeping and review of records of the fruits in storage (see Record sheet 10) **Internal inspections** Fruit inspection (see Practical sheets 4 and 5)	***Documentary control:*** Calibration records of the weighing machines **Measurement** Sampling of packed cartons and verifying weights at a specified interval **Internal inspections** Supervision of hand-packing operations	**Documentary control** Ensure proper record keeping and review of records of the GHPs **Internal inspections** Supervisor to ensure good hygiene practices are adhered with	CHECKS AND REGISTRATIONS (MONITORING: SELF-CHECK)
Calibration of the measuring equipment Training of personnel	Re-sorting and repacking Training of personnel Calibration of the measuring equipment	Training of personnel	CORRECTION/ CORRECTIVE ACTION

PART B

FACTSHEETS, REGISTRATION FORMS AND CHECKLISTS

This part of the guide contains a series of documents useful for operators to demonstrate their good control of SPS risks:

B1

PRACTICAL SHEETS (OPERATING PROCEDURES)

A. STORAGE

Proper pesticide storage is important to protect people, animals, the environment and the pesticide itself. Keep these tips in mind when storing pesticides:

B. CONTAINER

— Pesticides should be stored in their original containers. The original container is designed to protect the product and it's made of materials that will withstand the chemicals in the product

— Store containers with their original labeling which includes application and disposal directions, ingredient names and emergency information.

— The original container also has the appropriate lid/cap to protect leakage.

C. TEMPERATURE

— Extremes in temperature can change the chemistry of some pesticides inside the container.

— Extremes in temperature can also damage containers.

— Always read the label for storage instructions. As a general rule, pesticides are best stored between 4°C to 32°C.

D. LOCATION

— Designate a place that is only used for pesticide storage.

— Pick a well-ventilated location that children and pets cannot access, preferably with a lock.

— Keep pesticides away from food, feed and flames.

— Choose a location away from ponds, streams and drinking water wells.

E. SAFETY

— Practice Integrated Pest Management (IPM) to reduce the need for pesticides.

— Try to keep your pesticide inventory as low as possible. Buy only what you need this season; mix only what you need today.

— Dispose of unwanted pesticides properly rather than storing them.

— Never store pesticides in food or drink containers.

— Consider storing bottles inside a larger container that could contain liquids in the event of a leak or spill. Keep sawdust or sand for spillage management.

F. DISPOSAL OF PESTICIDES.

Pesticides need to be disposed of properly to prevent accidents and to protect the environment. Unwanted pesticide products (waste) should be stored safely and disposed of as soon as possible.

- Dispose of pesticides as instructed on the product label. Look for the "Storage and Disposal" statement on your pesticide label.
- If any product remains in the container it must be disposed of as hazardous waste.
- Pesticides waste should be taken to county or national collection center or licensed disposal facility.
- After emptying a pesticide container rinse it properly for disposal or recycling. Never reuse a pesticide container for any purpose!
- Be sure to wear protective clothing when rinsing pesticide containers, such as chemical resistant gloves and eye protection.
- Do not pour rinse water into any drain or on any site not listed on the product label; it could contaminate the environment.
- If you mixed or diluted a pesticide and you have a little too much left over, try to use it up while following the label.

Tips for transporting pesticides for disposal:

- Keep the pesticides in their original containers with the labels attached.
- Place containers so they won't shift and/or spill.
- Line the transport area in your vehicle or place pesticides in a plastic bin to contain any spills in case of an accident.
- If pesticides are carried in the back of an open vehicle, secure and cover the load.
- Don't put pesticides in the passenger compartment of a vehicle.
- Keep pesticides away from groceries, including food for animals.
- Go straight to the collection site once you have loaded your vehicle. Drive carefully!

Training for safe and effective of use of Pesticides

This includes the following but not limited to

- Pesticide purchase, transportation and storage
- Pesticide application (before and during) – considerations, Mixing and disposal of wastes
- Personal Protective Equipment (PPE) and Spraying (theory and practical)
- Classification and toxicity of pesticides
- PHIs, Residual levels, post-spray management and safety standards
- Pesticide's exposure and First aid measures
- The pesticides law - PCP Act, Cap 346
- Illegal/counterfeit pesticides and mitigation measures
- Pesticides label interpretation

PRACTICAL SHEET 2 — GENERAL AVOCADO MANAGEMENT PLAN: AVOCADO MANAGEMENT CHART

	DETAILS	JUSTIFICATION / REASON		AUG	SEP	OCT	NOV	DEC	JAN	FEV	MAR	APR	MAY	JUN	JUL
PHENOLOGY	Note that timing of phenological events eg. Flowering/flush differs between areas, cultivars and seasons. Management should be according to phenological events and not calendar month.														
FOLIAR SPRAY	Baron	Solubor / Borax	Only if B leaf levels < 30 mg/kg		Cauliflower stage										
	Baron + Zinc + Calcium	Sloubor / Borax, Zinctrac $ZnNO_3$ & Calcimax	Only if B leaf levels < 4.5 mg/kg, and/or Zn levels < 30 mg/kg, Ca levels < 1.0 mg/kg		During full bloom & fruit set										
	Zinc + Calcium	$ZnNO_3$ & Calcimax / $CaNO_3$	Only if ZN leaf levels < 4.5 mg/kg, and/or Ca levels < 1.5 mg/kg			Start of fruit development									
SOIL APPLIED FERTILIZERS	Lime	Calcitric / Dolomitic	Dolommitic lime can also be used if Mg deficiencies exist												
	Phosphate	TSP @10 g / Tree drip area	P leaf < 0.15 mg/kg, and/or soil < 40 mg/kg												
	Baron	Solubor 21% @ 1 g / tree drip area x 3 rounds	Only if B leaf < 40 mg/kg												
		Borax 11% @ 3 g / Tree drip area	B leaf < 55 mg/kg & B level maintenance												
	Zinc	Zn sulphate 13% & 4 g / Tree drip area	Zn levels < 30 mg/kg												
	Gypsum	30 g / Tree drip area	Only if fruit & leaf levels are low (Fruit < 0.5 mg/kg and/ or leaves < 1.5 mg/kg												
	Nitrogen	CAN @ 12.5 g / m^2 Tree drip area	Only if N leaf levels < 1.5 mg/kg N supplied by nitrate / MAP / Organic matter												
	Potassium	K_2SO_4 @ 12.5 g / m^2 Tree drip area	Only if N leaf & soil levels are low (Leaf < 0.8 mg/kg, and/ or soil < 150 mg/kg								Only use KNO_3 if leaf N level are low				
	Leaf & soil samples	Soil sample every 2 - 3 years Leaf sample annually	To determine nutrient levels	Soil samples						Leaf samples			Fruit samples		
DISEASE CONTROL	Copper sprays	Hass	Under wet humid conditions with > 0°C						4-6 wks after 1st spray		4-6 wks after 2nd spray				
	Tree Injections	POTPHOS - After vegetative flushes hardened off/beginning of root flushes @ 60 mg / Tree	To limit P. innamomi infection W			Only weak and sick trees									
INSECT CONTROL	Fruit Fly	Monitoring	Control if thresholds levels (0/ha) are exceeded / Contact extension officers												
	False Codling Moth (FCM)	Scouting - for eggs / damage	Control wit bait blocks / Contact extension officers												
	Stainers	Monitoring - early morning	Control if thresholds levels (0/ha) are exceeded / Contact extension officers												
	Loopers/Hairy caterpillars	Monitoring - early morning	Control if thresholds levels (0/ha) are exceeded / Contact extension officers												
OTHER	Bees	Min 3 hivers / ha + remove before insect spry start	Target: 4 beets / m^2 of flowering canopy												
	Irrigation	If available contact extension officers													
	Tree Management	Pruning	Light penetration / tree height control of canopy management of vegetative flushes												
	General	Mulch	Improve water infiltration and tree health, limit root rot												
				Establish cover crops				Plant velvet bean (after first 25mm rain) & spray weeds with 1 - 3% Glyphosate beans ernerge			1 - 3 Glyphosate spray to control weeds if necessary				

Directly after harvest

Manage watershoots

watershoot management

AVOCADO GROWING STAGES

ROOT FLUSH | LEAF FLUSH | CAULIFLOWER STAGE | PIN HEAD SIZE STAGE | PEA HEAD SIZE STAGE | GOLFBALL SIZE STAGE | MATURITY STAGE

Courtesy Kakuzi PLC

HYGIENE RULES AT THE FARM/ORCHARD

Personal hygiene requirements for Workers, Sub-contractors and Visitors

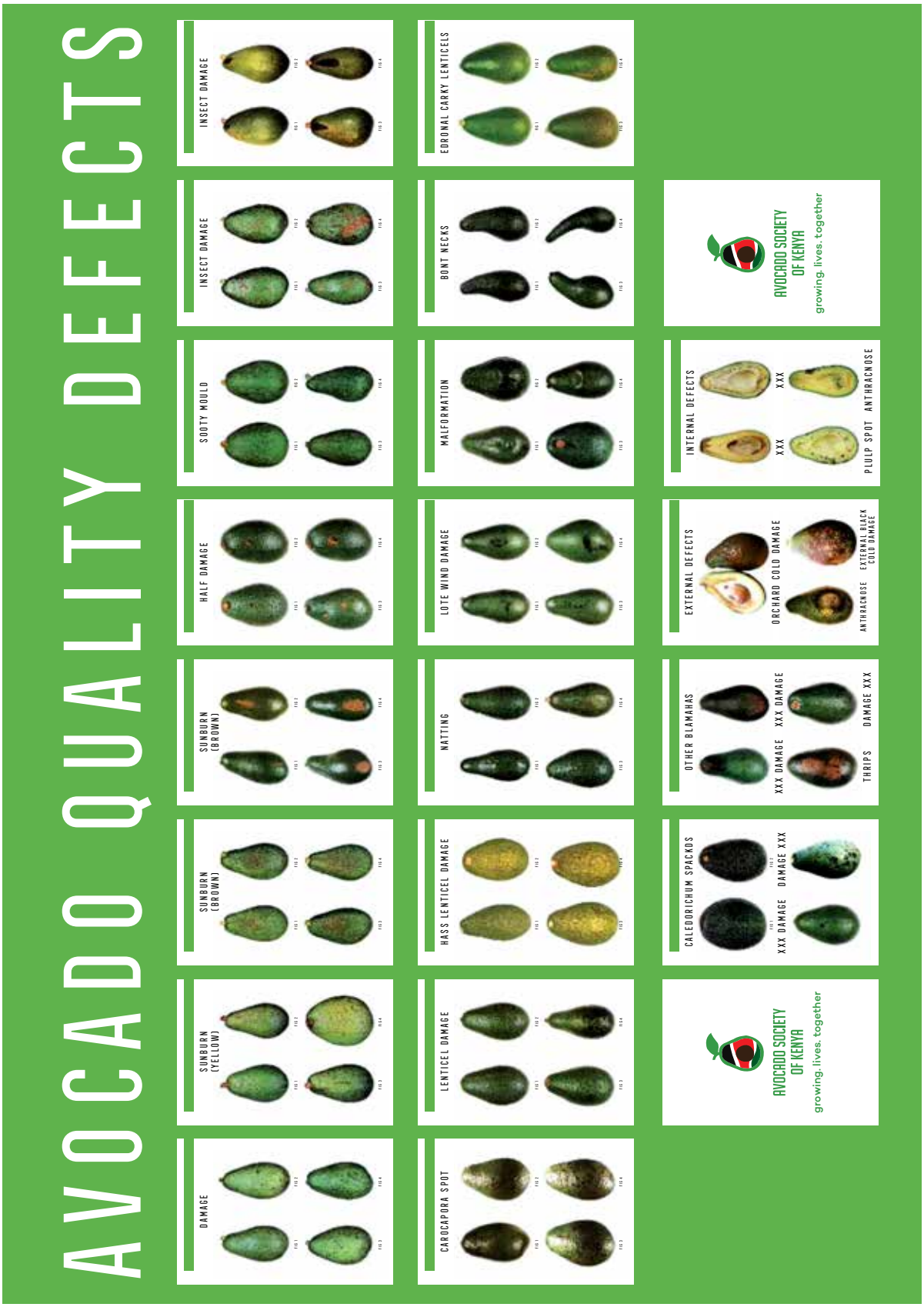
The following hygiene rules shall apply to workers, sub-contractors, and visitors on the farm who are likely to come close to the edible portion of the crop and especially those in harvesting and at the produce sheds.

1. Hands must be washed prior to commencing work and after every visit to the toilets and all breaks
2. Sprayed fields shall be marked with red or yellow flags. Do not harvest in those blocks.
3. Hair must be covered when one is harvesting, transporting produce, and while at the produce sheds. Those without hair are not required to wear headgear.
4. Nails must be kept short and clean at all times. No nails vanish should be worn.
5. You should always be in the right work clothes and where applicable, the right personal protective clothing.
6. You should not allow foreign matter to come into contact with harvested food product.
7. No food and/or drinks should be brought or consumed within the harvesting environment.
8. Smoking is not permitted in any area on the farm except in the designated area.
9. Report illness, cuts, lesions and bleeding immediately to your immediate supervisor or farm in-charge. Report accidents to the first aider on duty.
10. Anyone suffering from gastro-intestinal illness, sores, or boils to the hands and face, skin infections and heavy colds shall be excluded from crop handling areas immediately and if possible allocated other duties.
11. Any open wound must be covered by a suitable plaster. One with a plastered wound on the hand can only handle product while wearing surgical gloves.
12. Harvest containers shall be exclusively used for harvesting. Glass and clear hard plastics shall not be taken into the cropping blocks.
13. Ensure that the harvest equipment and transport vehicle/vessels is clean before use. During use, sanitize them regularly with non-perfumed food grade sanitizer.
14. All the harvesting equipment and on farm transport e.g., picking buckets, pickups, shall be cleaned and sanitized at the end of each working day.
15. After harvesting, all picking equipment, produce roadside sheds, shall be cleaned hygienically and rubbish collected.
16. Sufficient waste bins/ waste disposal pits shall be provided at strategic locations within the farm to have all litter collected/dropped in. Dropping of litter anyhow and anywhere is not allowed.
17. Follow hand washing and sanitizing instructions.
18. Personal hygiene inspection shall be done by the hygiene supervisor before you are allowed to come into contact with produce.

Declaration

I have read/ I have been trained, I have understood the above hygiene requirements, and will comply with these conditions always while on the farm.

Name ..... *Signature* ..... *Date* .....


AVOCADO QUALITY DEFECTS
DAMAGE
SUNBURN (YELLOW)
SUNBURN (BROWN)
SUNBURN (BROWN)
HALF DAMAGE
SOOTY MOULD
INSECT DAMAGE
INSECT DAMAGE
EDRONAL CARKY LENTICELS
CAROCAPORA SPOT
LENTICEL DAMAGE
HASS LENTICEL DAMAGE
NATTING
LOTE WIND DAMAGE
MALFORMATION
BONT NECKS
CALEDORICHUM SPACKOS
XXX DAMAGE
DAMAGE XXX
OTHER BLAMAHAS
XXX DAMAGE
XXX DAMAGE
THRIPS
DAMAGE XXX
EXTERNAL DEFECTS
ANTHRACNOSE
ORCHARD COLD DAMAGE
EXTERNAL BLACK COLD DAMAGE
INTERNAL DEFECTS
XXX
XXX
PLULP SPOT
ANTHRACNOSE
AVOCADO SOCIETY OF KENYA
growing. lives. together
AVOCADO SOCIETY OF KENYA
growing. lives. together

AVOCADO SOCIETY OF KENYA
growing. lives. together

ABNORMALITIES & DEFECTS

AVOCADO SOCIETY OF KENYA
growing. lives. together

Figure 1: Examples of "cukes" or parthenocarpic 'Hass' fruit. A. Exterior view of fruit (left, single seeded fruit; right, double ovary fruit). B. Internal view of fruit. Note the "sheath" from the empty ovule. Fruit on right is the double fruit.

Figure 4: A. 'Hass' avocado fruit with a longitudinal ridge which C. Schroeder theorized was a result of incomplete closure of the carpel. Such fruit are often scarred on the ridge. B. A "woody" avocado 'Hass' avocado fruit.

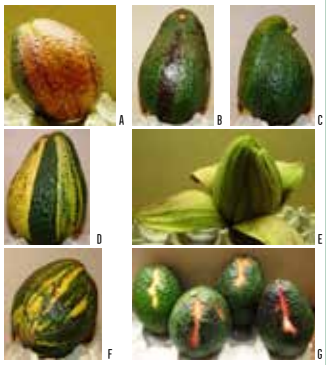


Figure 5: A. Sectorial chimera showing red coloration. B. Sectorial chimera showing dark coloration. C. A raised sectorial chimera. D. Mulltiple sectorial chimeras. E. Fruit peeled that had multiple sectorial chimeras similar to D. Note the difference in coloration extends into the flesh of the fruit. F. A sectorial chimera which could be confused with sunblotch viroid. G. Fruit infected with the sunblotch viroid. Note that the affected areas do not extend the length of the fruit and are depressed.

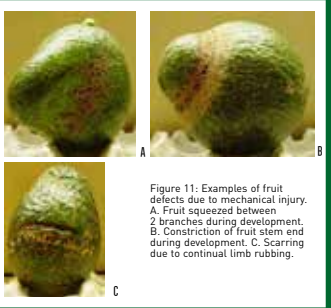


Figure 11: Examples of fruit defects due to mechanical injury. A. Fruit squeezed between 2 branches during development. B. Constriction of fruit stem end during development. C. Scarring due to continual limb rubbing.

Figure 13: Examples of side cracking or random splitting in 'Hass'.

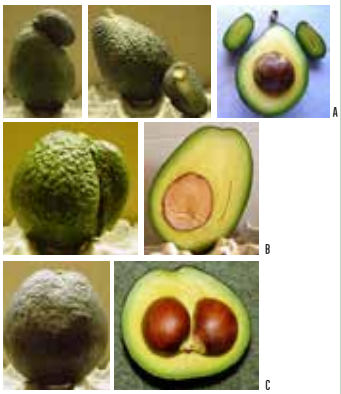


Figure 2: A. Double fruit resulting from the fusion of 2 carpels. The two separate fruit are only joined at the stem end. The "top fruit" is parthenocarpic (seedless) with only a sheath where seed would normally be (see right). B. Double fruit resulting from the presence of 2 ovaries. This fruit has 1 normal seed and one "sheath" containing a degenerated ovule. C. Double fruit which contains 2 fully developed seeds resulting from a flower which contained 2 ovaries.

Figure 6: Crook neck, another type of sectorial chimera.

Figure 9: Examples of sunburned avocados. A. Sunburn that occurred when the fruit was on the tree. B. Sunburn that occurred after harvest, typically from the top of an uncovered bin. C. Severe sunburn (left) and a cut-away of fruit damaged to the seed due to sunburning.

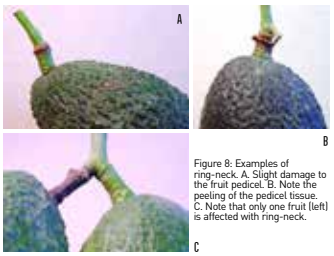


Figure 8: Examples of ring-neck. A. Slight damage to the fruit pedicel. B. Note the peeling of the pedicel tissue. C. Note that only one fruit (left) is affected with ring-neck.

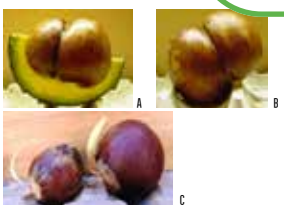


Figure 3: A. 'Hass' avocado fruit with 2 fully developed seeds. B. The same seeds in (A) but showing attachment at base of the seeds. C. Two examples of seeds from a double ovary flower, except in this case, one seed developed normally whereas in the other ovary, the ovule failed to develop normally giving rise to the type of fruit depicted in Figure 2B.

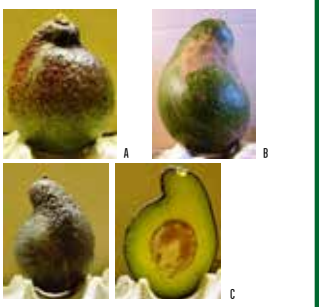


Figure 7: Examples of crick-side. A. Crick-side due to heat damage. B. Crick-side due to limb or insect feeding. C. A crick-side fruit due to an unknown cause, external and internal view of fruit cut longitudinally. Note the compressed nature of the flesh tissue in the portion of the "crick".

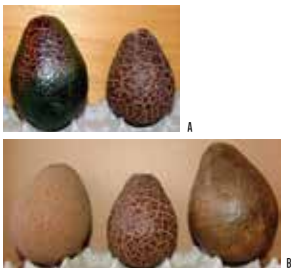


Figure 10: A. Examples of varying degree of carapace damage. B. A comparison of avocado thrips damage (left), carapace (middle) and greenhouse thrips damage (right).

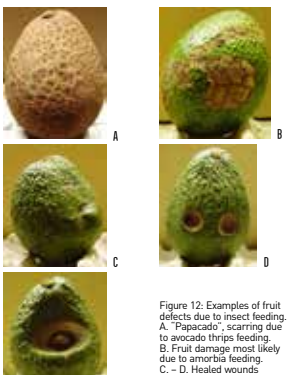


Figure 12: Examples of fruit defects due to insect feeding. A. "Papacado", scarring due to avocado thrips feeding. B. Fruit damage most likely due to amorbia feeding. C. – D. Healed wounds on mature fruit. E.

Important: Train employees involved in packaging, as well as those responsible for cleaning, washing and sanitizing food contact surfaces. Make sure workers have washed their hands before starting work, after breaks, and after using the restroom. Ensure workers wear PPEs (At minimum, wear disposable outwear e.g. overalls, boots, hat, and gloves).

1. FOOD CONTACT MATERIALS/EQUIPMENT/WASH TANKS AND SURFACES

Precaution: Ensure surfaces that contact food are smooth, do not absorb water, drain easily, resist corrosion, and are easy to clean and sanitize

Wash, rinse, sanitize, and air-dry all food-contact surfaces, equipment, and utensils that will be in contact with produce (e.g. containers or crates used for transfer or storage of fruit).

If and when necessary, use brushes to scrub all contaminated surfaces with water and detergent in accordance with the site-specific plan, ensuring that cleaned areas are free of dirt and debris

Wash, rinse, and sanitize food contact surfaces of sinks, tables, chopping boards, equipment, utensils, and equipment:

- Before each use
- Any time contamination occurs or is suspected
- After each use

Wash, rinse, and sanitize food contact surfaces of sinks, tables, chopping boards, equipment, utensils, and equipment using the following procedure:

- Wash surface with detergent solution.
- Rinse surface with clean water
- Sanitize surface using a sanitizing solution mixed at a concentration specified on manufacturer's label e.g. 20g sodium metabisulphite:20l water
- Soak items in sanitizing solution for 10 minutes
- Place wet items in a manner to allow air drying.
- Spray tables with sanitizing solution and allow to air dry
- Clean basins for washing fresh produce with cleaning detergent
- Rinse basins with sanitizing solution

2. NAPKINS/TOWELS USED FOR CLEANING

Wash, rinse and sanitize all new napkins before first use.

Frequency: Wash, rinse, and sanitize napkins:

- After each use
- Any time contamination occurs or is suspected

Wash, rinse, and sanitize napkins using the following procedure:

- Wash with detergent solution.
- Rinse with clean water.
- Sanitize using a sanitizing solution mixed at a concentration specified on the manufacturer's label e.g. 50g chlorine: 50 litres water)
- Soak in sanitizing solution for five (5) minutes.
- Place napkins in a manner to allow air drying.
- Store in designated containers for safe keeping till next use.

3. PROCESSING TOOLS INCLUDING KNIVES, AND OTHER UTENSILS USED FOR PRODUCE PACKING

Wash, rinse, and sanitize processing tools:

- After each use
- Any time contamination occurs or is suspected

Wash, rinse, and sanitize processing tools using the following procedure:

- Wash with detergent solution and designated sponge.
- Rinse in clean running tap water till no trace of soap/detergent is present.
- Sanitize using a sanitizing solution mixed at a concentration specified on the manufacturer's label e.g. 50g sodium metabisulphite: 50 litres water.
- Soak in solution for 5-10 minutes
- Place processing tools on designated table to allow air drying.
- Store in designated area for safe keeping till next use.

4. CLEANING/SANITIZATION CHEMICALS

- Follow manufacturer's instructions for proper use of chemicals
- Ensure Chemicals are clearly labelled and stored in designated areas

5. THE PACKING SHED INCLUDING FLOORS, WALLS, DRAINS, DOOR AND WINDOW SCREENS

- Remove loose rust, flaking paint, dust, cobwebs, or mold on overhead areas, or dirt on part of equipment that may come in contact with or contaminate the product while it is vulnerable.
- Floors are cleaned daily using recommended detergents
- Drainage: Water should drain away
- Overhead structures: Look for overhead places where birds can perch. Prevent perching with methods such as covering rafters, installing bird spikes, or installing steep-sided pyramids on beams

6 WATER USED FOR CLEANING

- Water used for washing and cleaning equipment that comes into direct contact with fruit should, be of a high microbiological quality.
- Water used for washing and cleaning the pack house and non-fruit contact equipment should also be of high microbiological quality
- Water used for handwashing should be of potable quality
- Delivery lines (hoses, pipes, etc.) and points of application, such as spray nozzles should be kept clean and tidy and off the ground to minimise contamination
- Water tanks to be completely emptied and cleaned before refilling at regular intervals

7. PEST/VERMIN CONTROL

- Have a regular schedule of pest control by a licensed pest control operator
- Pest control program should incorporate the use of appropriate baits and traps for insects and rodents
- Allow sufficient space between equipment and interior walls to make inspecting for pests easier.
- Keep pests out: As much as is practically possible, refit doors or use rubber stripping to seal up cracks and holes

8. GARBAGE STORAGE AND DISPOSAL

- Indoor garbage cans are cleaned and sanitized daily
- Garbage bins are emptied as necessary
- Clean up any spillages as they occur
- Put all waste into designated bins
- Boxes and containers are removed from site

9. SURROUNDING ENVIRONMENT

- Areas outside of the packing buildings should be cleared of tall grass, weeds, and idle equipment that can provide hiding places for rodents
- Walk the perimeter of your packing building. Check for damage to the roof and cracks or holes in exterior walls that could allow pests to enter. Repair these areas before the season begins
- Trees provide cool shade but are perching sites for birds. Consider ways to lower the risk from these birds

10. COLD STORAGE FACILITY

- Before the season starts, clean and sanitize walls and floors.
- Keep walls and floors as dry as possible
- Condensation from cooling units should drain directly into the drain and not onto the floor.
- Clean and sanitize drain pans before start of the season. Add a slow-release disinfectant to the pan to keep microbial growth at a minimum and prevent drainage lines from clogging and overflowing onto boxes of produce

11. PACKING MATERIALS

- Store packing materials on pallets. This provides better visibility and protects the products from dirt and contaminants on the surface of the floor
- Cover packing materials to prevent contamination
- Containers and packaging should be used only for their intended purposes. Colour coding can be useful in maintaining control over usage.

NB: Cleaning and sanitizing are two distinct procedures: Cleaning is undertaken with detergents that act to dissolve and remove soil and dirt from a surface. Sanitizing follows the cleaning process. Sanitizers are designed to significantly reduce the numbers of remaining viable microorganisms and so render the surface safe.

PACKHOUSE HYGIENE RULES

Personal hygiene requirements for food handlers, Sub-contractors and Visitors

Hygiene and health requirements should be followed to ensure that personnel who come directly into contact with fresh fruits are not likely to contaminate them. Bacteria that cause food poisoning can be on everyone – even healthy people who can spread bacteria to the produce if they touch their nose, mouth, hair or clothes, and then touch produce. Personnel handling food, food materials, and equipment must receive adequate and continued training in the hygienic handling of food and in personal hygiene.

Personal cleanliness

Food handlers who have direct contact with fruits should maintain a high degree of personal cleanliness and, where appropriate, wear suitable protective clothing and footwear. Cuts and wounds should be covered by suitable waterproof dressings when personnel are permitted to continue working.

Food handlers – personal hygiene requirements

Tips to prevent contamination using good personal hygiene (**DO's**):

- wash and dry your hands thoroughly before handling food, and wash and dry them again frequently during work whenever you touch an item other than the fruits being handled or leave the workstation and you are returning to your workstation
- dry your hands with a clean towel, disposable paper towel or under an air dryer, hands are not wiped on uniforms
- wear clean protective clothing that are in good repair, such as an apron. If uniforms are expected to become soiled rapidly, disposable aprons are worn over the uniform.
- uniforms use zippers\ press studs, not buttons. Uniforms don't have pockets above the waist.
- only leather\ vinyl shoes are worn. The toes on these shoes are enclosed. Shoes are clean, neat, and in good repair
- keep your spare clothes and other personal items (*including mobile phones*) away from where fruits are being handled or stored
- tie back or cover long hair. Head coverings are worn, and they cover all of the hair. Men with beards and mustaches wear a face snood.
- Hair pins, clips, etc are not used to keep head \beard coverings in place.
- keep fingernails short so they are easy to clean, and don't wear nail polish because it can chip into the food, false fingernails, and false eyelashes are not worn.

- completely cover all cuts and wounds with a wound strip or bandage (*brightly coloured waterproof bandages are recommended*)
- wear disposable gloves over the top of the wound strip if you have wounds on your hands
- change disposable gloves regularly
- advise your supervisor if you feel unwell, and don't handle food.
- Practice good hygiene, including bathing and showering

Tips to prevent contamination using good personal hygiene (**DONT's**):

- never smoke, chew gum, spit or eat in a food handling or food storage area
- never cough or sneeze directly over food, or where food is being prepared or stored
- avoid wearing jewelry including watches, earrings, necklaces, bracelets, tie pins etc..., or only wear plain-banded rings and sleeper earrings (Ethnic jewelry can be worn, but ONLY with the consent of the Quality/Technical Management)
- Do not allow work clothes to become excessively dirty. Filthy work clothes can become a source of contamination.

Personnel hygiene and sanitary facilities

Hygienic and sanitary facilities should be available to ensure that an appropriate degree of personal hygiene can be maintained. As appropriate, such facilities should:

- Be located in close proximity, and in sufficient number to accommodate personnel.
- Be of appropriate design to ensure hygienic removal of wastes and avoid contamination of packhouse and the fruits.
- Have adequate means of hygienically washing and drying hands.
- Be maintained under sanitary conditions and good repair.

Food handlers – handwashing

Thoroughly washing hands reduces the chance of contaminating fruits with bacteria from Food handlers. Food handlers to wash their hands with soap and water (*preferred warm*), and not forget the backs of hands, wrists, between fingers and under fingernails.

They should dry hands immediately after washing them with a clean towel, disposable paper towel or under an air dryer until they are completely dry.

Wash hands **before**:

- starting work involving the handling of fruits
- handling fruits
- putting on hand gloves

Wash hands **after**:

- using the toilet
- handling unwashed fruits
- blowing your nose, blocking a cough or sneeze with the hand
- handling garbage or any contaminated material where this could result in contamination of fresh fruits
- touching your ears, nose, mouth, hair or other parts of the body
- using a handkerchief or tissue
- smoking
- every break from work, each time they return to handling areas after a break
- eating and drinking
- cleaning
- handling animals.

If food handlers are wearing disposable gloves, change them regularly – at the same times you would normally wash your hands if you weren't wearing gloves.

Wash basins are supplied with soap or detergent and hand drying equipment. The wash basins are in good repair and effectively cleaned. The wash basins are only used for washing hands, not equipment.

If gloves are used to handle food, they are disposed of between tasks so as to avoid the contamination of food. Gloves are made of impermeable materials. Personnel wearing gloves still wash their hands at regular intervals.

Food handler's health

Personal prior to employment should have had a medical examination to determine their fitness to work in a food processing environment. Personnel working in a pack house for edible produce shall have full medical check-ups once every six months and the records of the examination shall be well documented.

Food handlers who are ill may contaminate fruits. Food handlers known, or suspected, to be suffering from, or to be a carrier of a disease or illness likely to be transmitted through fresh fruits, should not be allowed to enter any food handling area if there is a likelihood of their contaminating the produce.

Ensure no illness is passed on by those handling produce.

- No food handlers to work at the packhouse if they are vomiting or have diarrhea.
- They should not return to work until their symptoms have stopped for 48 hours. If unsure, contact your doctor for advice.
- Food handlers to immediately report illness or symptoms of illness to their supervisors if they are feeling unwell, including when suffering from a cold, flu, and sties and other eye infections. Anytime the following symptoms occur, workers who contact produce should report them to their supervisor:

- Vomiting
- Diarrhea
- Jaundice (a sudden yellowing of eyes or skin)
- Sore throat with a fever, a severe cold
- gastroenteritis, cough, influenza
- visibly infected skin lesions (boils, cuts, etc.)
- discharges from the ear, eye or nose

— Staff should not return to work until they have been free of vomiting/diarrhea for 48 hours. Staff who have been taking anti-diarrheal medication should not return to work until they have been symptom-free for at least 48 hours after stopping the use of the medication.

All cuts and wounds should be covered by a waterproof blue Band-Aid containing a metallized thread. There should be adequate first-aid facilities stocked with approved band-aids. People with bandaged hands who handle exposed product, packaging materials, and equipment coming into contact with exposed products must wear gloves.

Food handlers dressing

— All staff handling food must wear appropriate, clean clothing, which should be changed, laundered regularly and in good condition (e.g., free from rips, tears or fraying material and have no buttons but other fastenings).

— Hair should be tied back and preferably covered.

— Jewelry should be kept to a minimum when preparing and handling fruits – for example, to prevent the physical contamination. Only plain wedding rings (no stones) and sleeper earrings (maximum diameter 2cm). Wrist watches are not worn.

— Cuts and sores should be covered with a waterproof (preferably highly visible) dressing

— Work wear shall provide adequate coverage to ensure that hair, perspiration, etc. cannot contaminate the product.

— Hair, beards, and moustaches shall be protected (i.e. completely enclosed) by restraints

— Shoes shall be fully enclosed and made from non-absorbent materials.

Food handlers' skills and knowledge

Food handlers need to know how their actions can affect the safety of the produce they handle. They need to know:

- how to locate and follow workplace information
- about their own food handling operations
- how to identify and correct (or report) situations or procedures that do not meet the business' food safety obligations
- who to report food safety issues to within the packhouse (see Record sheet 14)
- their responsibilities in relation to health and hygiene requirements.

Visitors

Access to produce handling areas shall be restricted.

- No unauthorized person shall be allowed access to the packhouse.
- Visitors to declare health status before being allowed into the premises.
- Authorized visitors entering the packhouse shall only be allowed in after briefing on the importance of hygiene
- Visitors to produce processing or handling areas should, where appropriate, shall wear appropriate protective clothing and adhere to the established personal hygiene provisions.
- A record of visitors to the packhouse shall be maintained.

Records

- Medical certificates and treatment records
- Personnel inspection records
- Visitor records

PRACTICAL SHEET 8 – COLD ROOM TEMPERATURE MEASUREMENT PROTOCOL

Frequent monitoring of temperature in the cold rooms is required to ensure that quality of fruit is maintained. The following criteria should be used in monitoring cold room temperatures:

1. Both room and fruit temperatures should be checked at least twice in a day
2. The timing for temperature checks should be as follows:

ITEM	FREQUENCY	TIME 1	TIME 2
ROOM TEMPERATURE	Twice a day	14:00	17:00
FRUIT TEMPERATURE	Twice a day	8:00	16:00

These timings are appropriate because:

Room Temp.

14:00 to make sure that the room is keeping cold during the hottest hours of the day

17:00 to make sure that as you leave for home the system is in order

Fruit Temp.

08:00 to make sure that overnight the fruit was cooling appropriately and nothing happened

16:00 to make sure the cooling level was maintained during the hottest hours of the day

3. The room temperature monitors should be accurately read and recorded/ logged in a temperature log form clearly printed with the date, time and name of the person doing the reading.
4. Any deviations from the normal room temperature readings, should be immediately reported to the relevant personnel (provide a range of deviation).
5. If the fruit temperature is higher than 7ºC, report to the relevant personnel

NO.	WASTE OR POLLUTANT	CLASSIFICATION	SOURCES.	MANAGEMENT PLAN AND DISPOSAL PROCEDURE
1	Crop residues	Biodegradable	Reject products and uprooted crops. Slashed grass, cleared vegetation.	Fed to livestock. Burned if diseased.
2	Domestic animal waste	Biodegradable	Poultry unit	Sold out
3	Organic manure	Biodegradable	Domestic animals sheds	Composted and applied as fertilizer on selected crops after risk analysis
4	Waste water	Biodegradable	Domestic, cleaning, Irrigation effluents, excess rains	Rainwater is collected in tanks, Implementation of water management plan, Drainage of wastewater to control soil erosion
5	Food remains	Biodegradable	Living Houses	Fed to domestic animals
6	Cloth	Non biodegradable	Farm staff, living quarters	Recycled
7	Polythene paper	Non biodegradable	Farm inputs, food packaging, staff quarters	Recycled, disposed through waste collection company
8	Plastics	Non biodegradable	Broken crates, buckets, trays, packaging materials	Recycled
9	Wire	Non biodegradable	Construction material	Recycled
10	Wood	Biodegradable	Construction material	Recycled, sold as firewood
11	Hard plastics	Non biodegradable	Pens, construction material	Recycled
12	Tyre and rubber	Non biodegradable	Worn out vehicle tyres	Recycled

13	Metal	Non biodegradable	Tins, Farm equipment and implements, iron sheet pieces, building materials	Recycled
14	Biodegradable paper	Biodegradable	Office, paper packaging	Recycled, disposed in compost pit
15	Solid hazardous waste	Non biodegradable	Obsolete pesticide, spillage sand, worn out PPE, spray equipment and pesticide containers	Accumulated in a container in the secured pesticide store. Disposed through official company approved by the National Environmental Management Authority
16	Wash out water	Biodegradable	General cleaning, Bathrooms, facilities, tools and equipment cleaning, pesticide equipment tank, PPE and containers wash outs	Based on risk assessment, Disposed or Directed into designated drainage area taking care to minimize soil and water sources pollution
17	Other synthetic materials	Non biodegradable	Fertilizer, animal feed bags, nylon straps, manila straps etc	Recycled
18	Batteries	Non biodegradable	From Torch, motor bikes and vehicles	Disposed through authorized hazardous waste dealers
19	Glass	Non biodegradable	Homestead	Disposed in the pit toilet
20	Human waste	Biodegradable	Farm staff	Disposed in the toilet
21	Smoke	Biodegradable	Staff Kitchen, burnt crop remains (Minimum burning)	Escapes to the atmosphere and is purified by trees in the environment
22	Bones	Biodegradable	Dead animals	Disposed in the compost pit

Notes: *Non-recyclable non-biodegradable waste shall be stored cumulatively and disposed through waste collection dealers*

B2

RECORD SHEETS (FOR THE TRACEABILITY OF OPERATIONS)

Recording sheets to help operators to identify the data to be kept. They can be used as models or even printed and used as they are:

RECORD SHEET 1 — AVOCADO NURSERY STOCK SPECIFICATION PROPAGATION MATERIAL RECORD

Accredited Business name:

....

COLLECTION DETAILS						
COLLECTION DATE	SITE ADDRESS (GPS COORDINATES WHERE POSSIBLE)	BLOCK NAME/CODE	VIROID TESTED MULTIPLICATION BLOCK?	TYPE OF MATERIAL COLLECTED	CULTIVAR	MATERIAL AMOUNT AND BATCH CODE
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		
			○ Yes **OR** ○ No	○ Seed **OR** ○ Budwood/scion		

RECORD SHEET 2 – FERTILIZER/ MANURE APPLICATION RECORD

FARM NAME .....

Location: .....

Block No .....

Area (Ha) ..... CROP .....

Variety Planting date .....

SUMMARY OF SOIL FERTILIZER/MANURE APPLICATION

DATE OF APPLICATION	TRADE NAME (TYPE) OF FERTILIZER/ MANURE	FERTILIZER COMPOSITION	RATE PER HECTARE	QUANTITY APPLIED	MODE OF APPLICATION	MACHINERY USED	OPERATOR'S NAME (S)	ADVISED BY NAME/ SIGN

NOTE .....

RECORD SHEET 3 — FERTILIZER STOCK INVENTORY

Farm .....

FERTILIZER NAME UNITS							
FERTILIZER COMPOSITION							
DATE	RECEIPT OR DELIVERY NOTE RECEIVED?	SUPPLIER NAME	ISSUED TO BLOCK REF.	QUANTITY IN	QUANTITY OUT	BALANCE IN STOCK	NAME INITIALS

RECORD SHEET 4 – MONITORING RECORD FOR IPM PEST TRAPS

FARM/FARMER NAME .....

Block Number ..... Crop .....

Variety ..... Pest .....

DATE	STATION REF	FINDING/ INSECT POPULATION	LIFE STAGE	DEAD/ALIVE	ACTION/ REMARKS	SCOUT NAME

RECORD SHEET 5 — PEST AND DISEASE MONITORING RECORD

FARM: ..... BLOCK REF .....

Scouting ref. no. ..... SIZE ..... Ha PLANTING .....

CROP ..... VARIETY ..... AGE .....

PEST & DISEASES	APHIDS	BEAN FLY	BOLLWORM/ CATERPILLARS	FRUIT FLY	LEAF MINERS	FALSE CODLING MOTH	THRIPS	WHITE FLIES	ANTHRACNOSE	ASCHOCHYTA	BACTERIAL INFECTIONS	BLIGHT	MILDEWS	RUST	LEAF SPOTS	OTHERS
Threshold levels (out of 10)	3	1	1	1	1	1	2	1	2	2	1	2	2	1	2	3

Number of Plants affected (out of 10) per each scouting station

PEST, DISEASE, BENEFICIAL INSECTS	1	2	3	4	5	6	7	8	9	10	AVERAGE/10	COMMENTS

Signed by Scout: ..... Date: .....

RECORD SHEET 6 — PESTICIDE APPLICATION RECORD

FARM NAME ..... Location: .....

Block No ..... CROP STAGE .....

Variety ..... Planting date .....

Summary of Pesticide Application

DATE OF APPLICATION	TRADE NAME (TYPE) OF PESTICIDE	ACTIVE INGREDIENT	RATE PER HECTARE	QUANTITY APPLIED (L/HA)	MODE OF APPLICATION	OPERATOR'S NAME (S)	ADVISED BY NAME/ SIGN

NOTES .....

RECORD SHEET 7 — AGRONOMIC ACTIVITIES RECORD (E.G. WEEDING, LAND PREPARATION)

FARM/Block

ACTIVITY	DATE	REMARKS
LAND PREPARATION		
PLANTING		
FERTILIZER/MANURE APPLICATION		
PRUNING		
IRRIGATION		
SCOUTING AND PEST SURVEILLANCE		
PEST MANAGEMENT		
MATURITY TESTING		
HARVESTING		

RECORD SHEET 8 – INPUT'S SUPPLIER AUDIT CHECKLIST

Type of Farm Input .....

Input Description .....

Supplier name .....

Supplier Address .....

Supplier location .....

Contact Person ..... Mobile contact .....

CRITERIA		YES/ NO	ACTION (WHERE APPLICABLE)	REMARKS
1	Good reputation			
2	Valid dealers license by government appointed authority			
3	Legal input manufacturer and technical capability			
4	Quality of the input acceptable			
5	Good packaging and presentation			
6	Product labeling (Traceability details, product description)			
7	Relevant documents accompanying sold input			
8	Upkeep of input supplier storage premises			
9	Input quality assurance (Guarantee)			
10	Input transportation that meets food safety requirements			

Supplier Approved? .....

Name of inspector ..... **Signature** ..... **Date** .....

RECORD SHEET 9 — FARM HARVEST RECORD

FARM NAME/CODE .....

NO	DATE	VARIETY	HARVESTED BLOCK(S) CODE	PRODUCE COLLECTION NOTE NO.	DISPATCHED (KG)	PRODUCE/ GRADE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Notes where applicable .....

Customer Vehicle Registration No. ..... Grader .....

Group Harvest Supervisor ..... Signature .....

RECORD SHEET 10 – CORPORATIVE/FARMER GROUP HARVEST RECORD

SUB STATION/PRODUCE SHED .....

Harvest date ..... Avocado Variety .....

NO	NAME OF FARMER	FARMER CODE	HARVESTED BLOCK(S) CODE	PRODUCE COLLECTION NOTE NO.	DISPATCHED (KG)	PRODUCE/ GRADE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Notes where applicable .....

Customer Vehicle Registration No. ..... Grader .....

Group Harvest Supervisor ..... Signature .....

RECORD SHEET 11 – DAILY TEMPERATURE LOG

Month of ..... Cold Room #.....

Cold room number/name..... Type of fruit (Variety) .....

Please use this form to record the daily temperature readings of all the cold storage facilities

DATE	TIME 1 OF DAY	TEMP.	CHECKED BY	TIME 2 OF DAY	TEMP.	CHECKED BY
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Recommended Temperature guides
Cold room temperature (3 to 5°C)
Fruit temperature (5 to 7°C)

RECORD SHEET 12 — CLEANING RECORD

FARM/HARVEST STATION .....

DATE	EQUIPMENT/ TOOL/ FACILITY	NUMBER	CLEANED BY	DATE	EQUIPMENT/ TOOL/ FACILITY	NUMBER	CLEANED BY

TRAINING RECORD Form ..... of .....

GROUP/FARM			
NAME OF TRAINING ORGANIZATION		TRAINING DATE	
TRAINING VENUE			
COURSE TITLE			
COURSE CONTENTS			

NO.	TRAINEE FULL NAME	SIGNATURE

Trainer(s):

1. Name ..... Signature ..... Date .....

2. Name ..... Signature ..... Date .....

RECORD SHEET 13 – VISITOR HEALTH DECLARATION FORM

To be completed by groups of visitors Intending to go Into Food Production/Handling Areas or visit the farm We request that you take a few moments to complete this questionnaire.

Name ..... Date .....

Purpose for visit .....

Please tick the appropriate box

	HAVE YOU EVER SUFFERED WITH	YES	NO
1	During the last 48 hours, have you suffered from nausea, vomiting or diarrhea or taken antidiarrheal drugs?		
2	Enteric fever (typhoid or paratyphoid)?		
3	Hepatitis or Jaundice?		
	ARE YOU CURRENTLY SUFFERING FROM OR HAVE YOU SUFFERED FROM IN THE LAST 14 DAYS?	**YES**	**NO**
1	Cold or flu-like symptoms (to include fever, persistent or productive cough and / or sneezing, sore throat, respiratory illness, difficulty breathing)		
2	Acne, boils, skin infections, septic cuts or sores?		
3	Discharge from eye, ear, nose, gums or mouth/throat?		
4	Scaling condition of the hands, forearms or face?		
5	Hepatitis or jaundice?		
6	Have you been outside the country within the last 4 weeks - please state where		
	Have you suffered from any illness since?		
7	Have you had close contact with or cared for someone diagnosed with COVID-19?		

If you answered YES to any of the above questions, please provide in the space above any further details which may assist in determining your suitability or not to enter food handling areas.

Comment .....

I declare that the answers given above and any additional information supplied are accurate to the best of my knowledge. I agree to report Immediately to a visit guide if I should suffer from any of the above whilst on site.

Signed ..... Date .....

OFFICIAL USE

I declare that I have reviewed the responses above and determined that the visitor is (as applicable):

○ **Approved** to enter food handling areas ○ **NOT approved** to enter food handling areas

Signed ..... Date. .....

Information to the visitors

1. All visitors must wash their hands with soap and water, or sanitize their hands upon arrival
2. Visitors with mobile phones and laptops should sanitize them before and after using them at our premises
3. Visitors should leave their personal effects at the place directed by the management
4. Visitors shall be accompanied by key staff and shall wear a mask or cloth nose /mouth covering at all times
5. No entry into areas with red flags and no unauthorized entry into the restricted areas (e.g., stores, produce sheds, e.t.c.). Visitors can enter restricted areas if accompanied by management.
6. Wearing jewelry and heavy perfume is not permitted in harvesting areas, produce sheds or packhouse.
7. After visiting the toilet, wash your hands with clean water and soap provided.
8. Smoking, chewing of khart, or tobacco, eating and drinking is strictly not allowed in the premises except in the designated areas.
9. Unauthorized planting materials and agricultural pesticides are not allowed into the farm without prior arrangement with management
10. We respectfully ask you not to handle fruits or surfaces where fruits are being prepared or transferred, unless given permission to do so. No handling of fruits, tools, equipment unless authorized.

RECORD SHEET 14 — FOOD SAFETY & QUALITY INCIDENTS RECORD

FARM .....

NO	DATE	CONTAMINANT	INCIDENT DETAILS	ROOT CAUSE	CORRECTIVE ACTION	PREVENTIVE ACTION	ACTION VERIFIED	DATE OF VERIFICATION	CHECKED BY
1									
2									
3									
4									
5									
6									
7									
8									

RECORD SHEET 15 – PRODUCT RECALL, WITHDRAWAL AND RECONCILIATION (MASS BALANCE) RECORD

1. Product recall details *(To be completed by pack house/Quality Assurance manager)*

DATE AND TIME INFORMATION IS RECEIVED	PARTICULARS OF THE PRODUCT AND REASON FOR WITHDRAWAL	QUANTITY (NO OF CRATES, KG)	TRACEABILITY DETAILS

2. Stock reconciliation (mass balance) *(To be completed by Pack house Quality Supervisor)*

DATE AND TIME OF RECEIVING INFORMATION	QUANTITY RECEIVED (NO OF CRATES, KG)	QUANTITY RECALLED (NO OF CRATES, KG)	ACTION TAKEN	QUANTITY TO BE ACCEPTED (NO OF CRATES, KG)	QUANTITY ACCEPTED DATE AND TIME	QUALITY CONTROLLER NAME

Comment by Pack house .....

Pack house Manager ..... Sign ..... Date .....

Comment by Technical Advisor .....

Technical advisor name ..... Sign ..... Date .....

RECORD SHEET 16 – ENERGY USE MONITORING RECORD

FARM .....

Type of Energy ..... Machinery/ Equipment/e.t.c .....

Normal consumption Rate ..... YEAR .....

MONTH	AMOUNT OF ENERGY CONSUMED	DEVIATION FROM NORM?	% DEVIATION FROM THE NORM	REASON FOR INCREASE OR DECREASE	ACTION	SIGNATURE
JAN						
FEB						
MARCH						
APRIL						
MAY						
JUNE						
JULY						
AUG						
SEPT						
OCT						
DEC						

Conclusions .....

Competed by ..... **DATE** .....

B3

CHECKLISTS

To be used by operators and inspectors.

CHECKLIST 1: CHECKLIST FOR AVOCADO NURSERY PHYTOSANITARY INSPECTION

Nursery Name:	**Date:**
Location:	**Conducted by**
Area Size/Plot No:	**Signature:**
Avocado variety:	

Q #	COMPLIANCE CRITERIA	LEVEL	REMARKS
1.0	GENERAL INFORMATION		
1.1	Is there a good understanding of nursery operations and phytosanitary requirements?	Major Must	
1.2	Is status of the surrounding environment indicative of sustainable practices	Minor Must	
1.3	Is the condition and status of the production facility insect free? Well drained and free from weeds?	Major Must	
1.4	Are nursery operations well documented and records available?	Major Must	
1.5	Is the nursery stock traceable to the block or production site?	Major Must	
2.0	PRODUCTION/TECHNICAL		
2.1	If source of mother plants are from outside the country, is there evidence that the seeds are certified (rootstock and scions)?	Major Must	
2.2	If source of mother plants are sourced from within the country, is there evidence that the seeds are certified (rootstock and scions)?	Major Must	
2.3	Is there evidence of irrigation water laboratory tests indicating freedom from pathogens?	Major Must	
2.4	Is the growing media tested or treated? Is evidence available?	Major Must	
2.5	Are there tests for *Phytophthora cinnamomi* done? Is evidence available?	Major Must	
2.6	Are the seedling polythene sleeves >30cm in depth to allow for root development	Major Must	

3.0	PEST MANAGEMENT		
3.1	Is the pest management protocols or procedures adequate and documentation is available on request?	Major Must	
3.2	Are the nursery workers aware of pests of concerns in the nursery?	Major Must	
3.3	Have pest monitoring systems in place e.g. traps, and scouting data available?	Major Must	
3.4	Is there a pest reporting system (Any records Available)	Major must	
3.5	Are the pest management practices effective against the pests targeted?	Major Must	
3.6	Have the nursery workers and management undergone any pest identification training	Minor Must	
3.7	Where samples are taken for laboratory analysis, are there records confirming test results and action taken?	Minor Must	
4.0	NURSERY ACTIVITIES		
4.1	Are seedling grafting and handling procedures documented and clear to all the workers?	Major Must	
4.2	Are appropriate PPE worn by workers in the nursery?	Major Must	
4.3	Are collection points in the field clean and in hygienic conditions?	Major Must	
4.4	Are results from previous seedling batches recorded and available for reference?	Major Must	
4.5	Are temperature and humidity controls maintained and documented in the nursery?	Minor Must	
4.6	Are seedlings protected from physical, chemical and microbiological contaminants in the nursery?	Major Must	
5.0	WORKER HEALTH/SAFETY, HYGIENE AND TRAINING		
5.1	Are there documented hygiene procedure for the nursery?	Minor Must	
5.2	Have workers been trained on personal hygiene?	Minor Must	
5.3	Are there records for personal hygiene trainings and attendees?	Minor Must	
5.4	Are First Aid Kits accessible to workers?	Minor Must	
5.5	Attendant facilities exist; toilets, flowing clean water,	Minor Must	

OVERALL ASSESSMENT	INSPECTION RATING
GENERAL NURSERY STATUS	
All Major Musts and Minor Musts met	Excellent
Above 70 % of Major Must and Minor Musts Met	Good
Only 50 % of Major Must and Minor Musts Met	Poor
PRODUCTION/TECHNICAL	
All Major Musts and Minor Musts met	Excellent
Above 70 % of Major Must and Minor Musts Met	Good
Only 50 % of Major Must and Minor Musts Met	Poor
PEST MANAGEMENT	
All Major Musts and Minor Musts met	Excellent
Above 70 % of Major Must and Minor Musts Met	Good
Only 50 % of Major Must and Minor Musts Met	Poor
NURSERY ACTIVITIES	
All Major Musts and Minor Musts met	Excellent
Above 70 % of Major Must and Minor Musts Met	Good
Only 50 % of Major Must and Minor Musts Met	Poor
WORKERS HEALTH/SAFETY, HYGIENE AND TRAINING	
All Major Musts and Minor Musts met	Excellent
Above 70 % of Major Must and Minor Musts Met	Good
Only 50 % of Major Must and Minor Musts Met	Poor
RECOMMENDATIONS	
Nursery approved	
Nursery not approved (reasons)	
Any other observations	

CHECKLIST 2: SHIPPING CONTAINER DISPATCH CHECKLIST FOR AVOCADO

Company Name	Dispatch Checklist Form.	**Effective Date:**
Issued by:	Revision Number:	**Revised Date:**
Vehicle Reg:	**Date of shipping:**	

	YES - √ / NO - X	REMARKS
Container No.		
Type of Container		
Incoming Seal No.		
Container Cleaned		
Container Condition		
Container refrigeration unit working		
Genset Status and Condition		
Plugs placed		
Approved CA Curtains availed		
Ethylene Scrubbers in place		
Cable Ties available		
Outgoing Seals available		
Pallets.		
Pallets treated and stamped.		
Neatly packed. (Not collapsing)		
Box Locks are correct.		
Strapping is correct.		
Strapping tensioned and seal holding.		
Cartons not damaged. (Pests/rodents)		

Labeling:			
Cartons type			
All Cartons correctly Date coded			
4 Pallet labels on each Pallet & Numbered			
Pulp Temps taken / pallet.			
Temp tools placed in cartons			
QC Label Attached			
PHF 16 completed.			
Carton Count Labels in place			
Smartfresh:			
Treatment, Static / Shipping / None			
Smartfresh Container secured.			
Tablets placed.			
Door closed within 2 minutes.			
Instructions given to shipper			
Container.			
Set Temperatures.			
Step Down			
Oxygen Settings			
Carbon dioxide Settings	0 %		
		Sign	Time

Checked by dispatch Supervisor and if there is any problem report to the manager	Dispatch Supervisor
Returned to the PM at the end of the week	Duty Manager:

Company Name:	Approved by:	Status of Document
Issued by: Technical & Packing.	General Manager	Controlled Document

CHECKLIST 3: PROPOSED PACKHOUSE FRESH AVOCADO QUALITY CHECKLIST

KEY AREAS OF QUALITY INSPECTION	STATUS PRESENT (✔), ABSENT (✘)	REMARKS
Availability and ability of QC to identify and differentiate non-compliances in size, maturity, defects and deformities chart the packhouse produce intake and sorting stations		
Availability of Quality charts in the packhouse to guide during sorting and grading		
Availability and ability of QC to identify and differentiate non-compliances in size, maturity, defects and deformities at the produce intake stage		
Sampling at intake stage procedure and sample size verification of quality aspects size, maturity		
Availability and ability of QC to identify and differentiate non-compliances in size, maturity, defects, and deformities at the processing/grading stage		
Ability of QC staff to detect nonconformity in size, maturity, defects, deformities, produce labelling at produce dispatch stage		
Evidence of training of QCs and Graders on pest identification e.g training record sheet		
Quality assurance personnel familiar with post- harvest treatments/challenges		
Produce handling procedures to ensure temperatures are maintained throughout the shipping period		
Documentation of quality defects recorded and reports of actions available		
Quality management procedures/protocol in place for documentation such as Conformity checks		

Name of the Farm manager ..... Date .....

Signature of the manager .....

CHECKLIST 4: PROPOSED PACKHOUSE FRESH AVOCADO PHYTOSANITARY INSPECTION CHECKLIST

KEY AREAS OF PHYTOSANITARY INSPECTION	STATUS PRESENT (✔), ABSENT (✘)	REMARKS
General packhouse management of infrastructure prevents entry of pests		
Quality management procedures/protocol in place		
Availability of FCM and other pest cards at the packhouse at sorting stations		
Ability of QC staff to detect FCM, fruit flies, scales and other pests at the produce intake stage		
Ability of QC staff to detect FCM, fruit flies, scales and other pest at the produce processing/grading stage		
Ability of QC staff to detect FCM pests at produce dispatch stage		
Evidence of training of QCs and Graders on pest identification e.g training record sheet		
Produce handling procedures to ensure consignment integrity and prevent pests re-infestation		
Quality assurance personnel familiar with post-harvest treatments as per destination market requirements e.g China Methyl bromide treatment		
QC ability and experience to detect and identify FCM and other quarantine pests at different life stages and symptoms		
Documentation of pest detection incidences and actions available		
QP inspection with appropriate sampling methodology (ISPM31) at the point of exit from the packhouse for listed quarantine pests		
Sampling of wood packing material for compliance to ISPM 15 for Wood treatment		
Quality management procedures/protocol in place for documentation such as Conformity Certificates and Phytosanitary Certificate		

Name of the Farm manager ..... Date .....

Signature of the manager .....

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THE AVAILABLE TEACHING TOOLS

1. Guide to good crop protection practices

   https://eservices.coleacp.org/en/e-bibliotheque/organic-avocado-0

2. Handout for introduction of organic certification to outgrowers:
   A guide for extension staff of avocado exporting companies:

   https://eservices.coleacp.org/en/e-bibliotheque/a-guideline-for-extension-staff-of-avocado-exporting-companies

3. Crop production protocol: Avocado (*Persea americana*)

   https://eservices.coleacp.org/en/e-bibliotheque/avocado-0

4. Safe use of pesticides

   https://eservices.coleacp.org/en/e-bibliotheque/use-safe-pesticides

   https://eservices.coleacp.org/en/e-bibliotheque/usage-securise-pesticides-consignes-pendant-application-34-kiswahili

5. Protection equipment

   https://eservices.coleacp.org/en/e-bibliotheque/protection-equipment

6. Managing empty packaging

   https://eservices.coleacp.org/en/e-bibliotheque/managing-empty-packaging

7. Storing plant protection products safely

   https://eservices.coleacp.org/en/e-bibliotheque/storing-plant-protection-products-safely

8. Instructions for planning and calibration

   https://eservices.coleacp.org/en/e-bibliotheque/instructions-for-planning-and-calibration

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AVAILABLE TRAINING COURSES

1. Avocado good harvest and post-harvest practices, Commercial fruit quality
   https://training.coleacp.org/enrol/index.php?id=868

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ANNEXES

REPUBLIC OF KENYA

KENYA PLANT HEALTH INSPECTORATE SERVICE (KEPHIS)

Plant Protection Act (Cap 324)

NURSERY PHYTOSANITARY INSPECTION CERTIFICATE

This is to certify that (Name of NURSERY)

Producing Avocado seedlings was inspected in accordance with the provisions of Plant Protection Act; Cap 324 of the Laws of Kenya and found to be virtually free from injurious pests and diseases at the time of inspection.

This certificate is valid for a period of *ONE YEAR*

Commencing on (DATE)

Certificate No *KEPHIS/ PH/NUSR*

Inspector/s:

Date of Issue:

.....

MANAGING DIRECTOR

** Renewal is subject to re-inspection by KEPHIS and Conformity to the terms of approved measure(s) is mandatory*

PERMIT No. KEPHIS/22198/2021

REPUBLIC OF KENYA

MINISTRY OF AGRICULTURE & RURAL DEVELOPMENT

KENYA PLANT HEALTH INSPECTORATE SERVICE (KEPHIS)

PLANT IMPORTATION PERMIT

(Plant Protection Act Cap 324) Date 2 July, 2021

The importer must furnish the supplier with a copy of this import permit before plant material is despatched.

*Permission is hereby granted to ·(IMPORTER DETAILS).....

of .....

to import from (EXPORTER DETAILS).....

.....

the following Seedlings

100 Kgs Persea spp

subject to the following conditions

1) All **Seedlings** ..... to be the produce of and grown in . ISRAEL

2) The consignment to be inspected on arrival and the importing authority reserves the right to treat, destroy or refuse the importation.

3) Plants or plantparts must be entirely free from soil, chaff and/or leaf mould.

4) Each consignment shall be accompanied by an original copy of this import permit and Phytosanitary Certificate (International Model or its equivalent) from country of origin;

Additional Declarations:

i. Bactrocera zonata (Dacus zonatus (Sound.), Bactrocera cucumis- French (Dacus tryoni (French.), Anastrepha ludens (Linnaeus) Anastrepha fraterculus (Wied.), Anastrepha mombinpraeoptans Seinand, Rhagoletis cerasi (Linnaeus, Avocado sunblotch viroid, Phytophthora cryptogea, Parthenolecanium persicae, Protopulvinaria pyriformis are known not to occur in the country of origin or place of production. OR All insects have been killed by an appropriate treatment before dispatch and the seedlings have been tested and found free of Avocado sunblotch viroid and Phytophthora cryptogea
ii) The seedlings to be grown on sterile soiless media NB: details to be stated on the Phytosanitary Certificate (International model or its equivalent)
iii) Affix a Q Label.

Failure to furnish the required certificates may result in prohibition of entry of the plant materials.

5) Packaging The following materials must **not** be used: banana leaves, maize, rice, sorghum, palm, wheat straw soil or leaf mould. If any other plant residue is used as packaging material, the consignment must be accompanied by a certificate stating: all seeds, pathogens and insects have been killed before use of the material either by heating to 180°F / 83°C for ten minutes or by chemical treatment (N.B:- Details to be stated on Phytosanitary Certificate).

This permit is valid for six months from date of issue, but may be cancelled at any time by the Director of Agriculture or by the officer issuing the permit on his behalf

Official Stamp

(Signed) (NAME OF KEPHIS INSPECTOR)

for Director of Agriculture

"Import of genetically modified material will require clearance from the National Biosafety Authority in compliance with the Biosafety Act"

**The permission hereby granted is additional to any permission or licence required under any other law.*
Full name and address of supplier to be stated

ANNEX 3: LABORATORY SERVICE CAPABILITY FOR AVOCADO VALUE CHAIN

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
Name: KEPHIS Analytical Chemistry Laboratory and Food Safety, Oloolua Ridge, Karen Name of contact person: Prof. Theophilus M. Mutui (PhD) Email Address: director@kephis.org	Soil Nutrient testing	NPK and trace elements	10 working days
	Soil pH and EC	pH and EC	10 working days
	Soil suitability testing	Soil recommendations done based on soil fertility profile and crop to be planted	
	Soil pathology analysis	*Verticillium* spp, *Ralstonia*, *Pythium*, *Alternaria* spp., *Fusarium* spp, *Rhizoctonia* spp, *Phytophthora* spp	
	Leaf tissue testing	Trace elements e.g. copper, iron, zinc	10 working days
	Irrigation water quality	PH, EC anions and cations Compute SAR	10 working days
	Irrigation water pathology analysis		
	Packhouse water	Microbial pathogens	10 working days
	Drinking water: WHO Guidelines for Drinking-Water Quality, 2008	XX	XX
	Heavy metals	20 elements	10 working days
	MRLs GC-MS	140 pesticides	10 working days
	MRLs LC-MS	160 pesticides	10 working days
	Plant health diagnostics	*Verticillium* spp, *Ralstonia*, *Pythium*, *Alternaria* spp., *Fusarium* spp, *Rhizoctonia* spp, *Phytophthora* spp, entomology, virology	

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
Name: POLUCON SERVICES KENYA LIMITED Name of contact person: CHARLES MAINA MUTIGA Location: POLUCON HOUSE, NYATI ROAD OFF LINKS ROAD, MOMBASA, SAMEER INDUSTRIAL PARK, UNIT 2A, ROAD C INDUSTRIAL AREA NAIROBI Email Address: polucon@polucon.com laboratory@polucon.com	Soil Nutrient testing	Phosphorous, Potassium, Calcium, Magnesium, Sodium, Iron, Manganese, Aluminium, Copper, Boron, Zinc, Ca:Mg, %Organic Matter,	4-5 working days
	Soil PH and EC	pH value and ELECTRICAL CONDUCTIVITY (EC)	1-3 working days
	Soil suitability testing	ARSENIC AS As, BORON AS B, CADMIUM AS Cd, COBOLT AS Co, CHROMIUM, COPPER AS Cu, MERCURY AS Hg, LEAD AS Pb, NICKEL AS Ni, SELENIUM AS Se, ZINC AS Zn	4-5 working days
	Soil pathology analysis	Verticillium spp, Ralstonia, Pythium, Alternaria spp., Fusarium spp, Rhizoctonia spp, Phytophthora spp- No capability	
	Leaf tissue testing	SODIUM AS Na, PHOSPHOROUS AS P, POTASSIUM AS K, CALCIUM AS Ca, MAGNESIUM AS Mg, IRON AS Fe, ZINC AS Zn, MANGANESE AS Mn, COPPER AS Cu, BORON AS B, MOLYBDENUM AS Mo, SODIUM AS Na	4-5 working days
	Irrigation water quality	pH value, Total Dissolved Solids Lead, Cadmium, Total Chromium, Aluminium, Copper, Selenium, Cobalt, Boron, Zinc, Iron, Arsenic, Chloride, Fluoride, Escherichia coli, & Sodium Absorption Ratio (SAR)	3-5 working days
	Packhouse water	Physical, Chemical & Microbiological tests	5-6 working days
	Drinking water WHO Guidelines for Drinking-Water Quality, 2008	Physical, Chemical & Microbiological tests	5-6 working days
	Heavy metals	Arsenic, Cadmium, Lead, Copper, Manganese, Chromium, Selenium, Molybdenum, Nickel & Mercury	3-5 working days
	MRLs GC-MS	Organochlorines, Organophosphates and carbamates screening	24 hours (Express) 2-4 working days
	Dry matter content	Gravimetric – ISO 1026	2-3 Working days
	Oil content	Gravimetric – ISO 659	2-3 Working days

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
Bureau Veritas Kenya Limited Name of contact person: ... Edwin Githire Senengo Location: Mombasa. Email: edwin.senengo@bureauveritas.com	Soil Nutrient testing	pH, EC (Salts), Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Sodium, Iron, Manganese, Boron, Copper, Zinc, C.E.C, Total Nitrogen, Organic Matter, C/N ratio	7 working days
	Soil PH and EC	pH and EC	1 working day
	Soil pathology analysis	Verticillium spp, Ralstonia, Pythium, Alternaria spp., Fusarium spp, Rhizoctonia spp, Phytophthora spp	Subcontracted BV Dubai Lab (14 working days)
	Leaf tissue testing	Ralstonia, Pythium, Rhizoctonia spp, Fusarium spp, Botrytis cineria, Colletotrichum spp, Phytophthora spp, Verticillium spp, Alternaria spp.	Subcontracted BV Dubai Lab (14 working days)
	Irrigation water quality	pH, Electrical Conductivity, Ammonium, Calcium, Magnesium, Potassium, Phosphorus, Nitrate N, Nitrates, Sulphur, Sulphate, Iron, Manganese, Zinc, Boron, Copper, Molybdenum, Sodium, Chlorides, Bicarbonate, Silicon, Silica, SAR, Hardness, Turbidity,	5 working days
	Irrigation water pathology analysis	Alternaria spp., Ralstonia, Pythium, Rhizoctonia spp, Fusarium spp, Verticillium spp, Phytophthora spp	Subcontracted BV Dubai Lab (14 Days)
	Pack house water	pH, Electrical Conductivity, Ammonium, Calcium, Magnesium, Potassium, Phosphorus, Nitrate N, Nitrates, Sulphur, Sulphate, Iron, Manganese, Zinc, Boron, Copper, Molybdenum, Sodium, Chlorides, Bicarbonate, Silicon, Silica, SAR, Hardness, Turbidity, Total Coliforms, Faecal E. Coli, Total Viable Count @37, Pseudomonas aeruginosa, Staphylococcus aureus, Streptococcus faecalis, Sulphite reducing anaerobes, Shigella, Salmonella spp	5 working days
	Drinking water WHO Guidelines for Drinking-Water Quality, 2008	pH, Electrical Conductivity, Ammonium, Calcium, Magnesium, Potassium, Phosphorus, Nitrate N, Nitrates, Sulphur, Sulphate, Iron, Manganese, Zinc, Boron, Copper, Molybdenum, Sodium, Chlorides, Bicarbonate, Silicon, Silica, SAR, Hardness, Turbidity, Total Coliforms, Faecal E. Coli, Total Viable Count @37, Pseudomonas aeruginosa, Staphylococcus aureus, Streptococcus faecalis, Sulphite reducing anaerobes, Shigella, Salmonella spp	5 working days
	Heavy metals	Lead, Mercury, Arsenic, Cadmium Nickel, Chromium, Cobalt,	14 working days
	MRLs GC-MSMS	Pesticide Residue Screening (>400 Analytes)	14 working days (BV Dubai)
	MRLs LC-MSMS	Pesticide Residue Screening (>400 Analytes)	14 working days (BV Dubai)

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
UoN, CAVs LARMAT Department	Soil Nutrient testing	Capability available	1-2 weeks
	Soil PH and EC	Capability available	1-2 weeks
	Soil suitability testing	Capability available	1-2 weeks
	Soil pathology analysis	Verticillium spp, Ralstonia, Pythium, Alternaria spp., Fusarium spp, Rhizoctonia spp, Phytophthora spp	1-2 weeks
	Irrigation water quality	Capability available	1-2 weeks
	Irrigation water pathology analysis	Identification of pests presence, their abundance, virulence and severity of damage	1-4 weeks
University of Nairobi, Chiromo Campus	Drinking water WHO Guidelines for Drinking-Water Quality, 2008	Coliform group, minerals and pH	1-4 weeks
	Heavy metals	Identification of the elements present and the quantities in collaboration with Chemistry laboratory in Chiromo (UoN)	1-4 weeks
UNIVERSITY OF Nairobi, College of Agriculture and Veterinary Services, Crop Protection department and Food Science, Nutrition and Dietetics, Public health, Phamarcology and Toxicology Email: deanagric@uonbi.ac.ke Contact: +254 204 916 003	MRLs GC-MSMS	Pesticide Residue Screening	1-4 weeks
	Fruit quality testing Skin colour	Using colour charts	1-4 weeks
	Light transmission properties of the fruit	Optical method based on the chlorophyll content of the fruit	1-4 weeks
	Firmness	Use of Magnes-Taylor pressure analyzer that gives firmness value	1-4 weeks
	Plant health Diagnostic services	Direct microscopic examination of the samples/isolates, PCR method Bacterial basic PCR for direct methods of detection	1-4 weeks
	Entomology	Examining the damages, morphological characteristics, using reference specimen and basic PCR	1-4 weeks
	Virology	Use of diagnostic plants, serology and basic PCR	1-4 weeks
	Soil Nutrient testing	Total N, Total Organic Carbon (TOC), P, K, Na, Ca, Mg, Mn, Cu, Fe, Zn	15 working days
	Soil PH and EC	pH & EC in 1:1 (w/v) soil – water suspension	2-3 working days

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
Pathology Lab, KALRO NARL	Soil pathology analysis	Verticillium spp, Ralstonia, Pythium, Alternaria spp., Fusarium spp, Rhizoctonia spp, Phytophthora spp, Soilborne bacterial pathogens; Plant parasitic nematodes	10 working days
KALRO Soil Chemistry Laboratory Location: KALRO KABETE PLANT PATHOLOGY SECTION; OFF WAIYAKI WAY NAIROBI	Leaf tissue testing	N, P, K, Ca, Mg, Mn, Cu, Fe, Zn	10 working days
Pathology Lab, KALRO NARL Location: KALRO KABETE PLANT PATHOLOGY SECTION; OFF WAIYAKI WAY NAIROBI Name of contact person: DR. RUTH AMATA Email: ruthlodenyi@gmail.com...; ruth.amata@kalro.org	Irrigation water quality	pH, EC, Na, K, Ca, Mg, Carbonates, Bicarbonates, Chlorides, Sulphates	5-8 working days
	Irrigation water pathology analysis	Bacteria and Fungal pathogens; Nematode pests	10 working days
	Pathology	Microscopic identification and characterization of plant pathogenic fungi Microscopic identification and quantification of plant parasitic nematodes Identification of plant pathogenic bacteria through use of selective media and ELISA	10 working days 10 working days 10 working days
Entomology Lab, KALRO NARL Paddy Likhayo Location: Waiyaki Way Opposite ABC Place, Nairobi, Kenya Email: paddy.likhayo@kalro.org/ paddy.likhayo@gmail.com	Entomology	Pest identification, pest damage, pesticide efficacy and persistence evaluation	One to six months

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
Kenya Bureau of Standards (KEBS) Name of contact person: Sample Submission Centre Location: South-C, Popo road off Mombasa road, Nairobi, Kenya Email Address: scc@kebs.org, info@kebs.org	Irrigation water quality	pH, Aluminium, Arsenic, Chlorides as Cl, Chromium, Cobalt, Cadmium as Cd, Lead as Pb, Copper as Cu 10. Iron Fe, Fluoride as F, mg/l, Selenuim, Total Dissolved Solids, Zinc, E. coli	14 working days
	Irrigation water pathology analysis	N/A	
	Pack house water	Legionella, Salmonella	14 working days
	Drinking water WHO Guidelines for Drinking-Water Quality, 2008	pH,Total Dissolved Solids (TDS), mg/l, Suspended Matter, mg/l, Calcium as Ca, mg/l, Aluminium as Al, mg/l, Iron as Fe, mg/l, Zinc as Zn, mg/l, Magnesium as Mg, mg/l, Chloride as Cl-, mg/l, Potassium as K, mg/l, Sodium as Na+, Sulphates as SO_4, Fluoride as F, mg/l, Arsenic, as As, Mercury, as Cu, Selenium as Se, Ammonia NH_3, Nickel, as Ni, Molybdenum, Boron as boric acid, Nitrate as NO_3, mg/l, Manganese as Mn, mg/l, Copper as Cu, mg/l Cadmium as Cd, mg/l, Lead as Pb, mg/l, Chromium as Cr, mg/l, Barium as Ba, mg/l, E. coli, Pseudomonas aureginosa, Coliforms, Salmonella, Staphylococcus aureus, Iron sulphide reducing anaerobes, Streptococcus faecalis, Shigella	14 working days
	Heavy metals	Lead, Cadmium, Arsenic, Chromium (Cr), Mercury (Hg), Nickel (Ni), Thallium (Tl)	14 working days
	MRLs GC-MSMS	Pesticide residues	14 working days
	MRLs LC-MSMS	Pesticide residues	14 working days
Crop Nutrition Laboratory Services (CropNuts) Limuru, off Limuru road, P.O. Box 66437-00800 Nairobi – Kenya	Soil Nutrient testing	pH, EC (Salts), Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Sodium, Iron, Manganese, Boron, Copper, Zinc, C.E.C, Total Nitrogen, Organic Matter, C/N ratio	6 working days
	Soil PH and EC	pH, EC	2 working days
	Soil suitability testing	Soil Texture Analysis- Sand, Silt, Clay Basic Soil Analysis with Recommendations- pH, Phosphorus, Potassium, Calcium, Magnesium, Sodium, Organic Matter, Total Nitrogen, C.E.C	6 working days
	Soil pathology analysis	Verticillium spp, Ralstonia, Pythium, Alternaria spp., Fusarium spp, Rhizoctonia spp, Phytophthora spp	10 working days
	Leaf tissue testing	Total Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Sodium, Iron, Manganese, Boron, Copper, Molybdenum, Zinc	6 working days

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
	Irrigation water quality	pH, Electrical Conductivity, Ammonium, Calcium, Magnesium, Potassium, Phosphorus, Nitrate N, Nitrates, Sulphur, Sulphate, Iron, Manganese, Zinc,Boron, Copper, Molybdenum, Sodium, Chloride, Bicarbonate, Silicon, Silica,SAR, Hardness, Turbidity	4 working days
	Irrigation water pathology analysis	Alternaria spp., Ralstonia, Pythium, Rhizoctonia spp, Fusarium spp,Verticillium spp, Phytophthora spp	10 working days
	Packhouse water	**Physiochem-**pH, Electrical Conductivity, Aluminium, Ammonium, Calcium, Magnesium, Potassium, Sodium, Nitrates, Sulphate, Chloride, Phosphate, Fluoride, Nitrite, Bicarbonate, Boron, Copper, Iron, Manganese, Zinc, Hardness, Turbidity, Total Suspended Solids, Total Dissolved Solids, Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Nickel, Molybdenum, Selenium. **Microbiology-**TVC @22, TVC @37, Total Coliforms, E. Coli, Staphylococcus aureus, Sulphite reducing anaerobes, Salmonella ssp, Pseudomonas aeruginosa, Shigella, Streptococcus faecalis	10 working days
	Drinking water WHO Guidelines for Drinking-Water Quality, 2008	Faecal E. Coli, pH, Total Coliforms, Electrical Conductivity, Silicon, Silica, Ammonium, Calcium, Magnesium, Potassium, Sodium, Nitrate N, Phosphorus, Sulphur, Iron, Manganese, Zinc, Copper, Boron, Chloride, Bicarbonate, Fluoride, Molybdenum, Nitrates, Sulphate, Phosphate, Hardness, Turbidity,	5 Working days
	Heavy metals	Molybdenum, Arsenic, Cadmium, Chromium, Cobalt, Lead, Mercury, Nickel, Selenium, Zinc, Copper, Boron	5 Working days
	GC-MS	Over 250 scan peaks	7 Working days
	LC-MS	Over 250 scan peaks	7 Working days
	Fruit Quality: Dry matter content		10 working days
	Fruit Quality: Calcium: Nitrogen Ratio		10 Working Days
	Pathology	Ralstonia, Pythium, Rhizoctonia spp, Fusarium spp, Botrytis cineria,Colletotrichum spp, Phytophthora spp, Verticillium spp, Alternaria spp.	10 working days
	Virology	On application	7 working days

LABORATORY CONTACTS	TEST REQUIRED	PARAMETER TESTED	TURNAROUND TIME
HCD	Dry matter content		
Institute for Tropical and Subtropical Crops (ITSC), South Africa.	Avocado sunblotch viroid		

ANNEX 4: LIST OF CERTIFIED AVOCADO NURSERIES (AS AT MAY 2022)

Disclaimer: The nursery materials can only be confirmed to be clean at the time of inspection and KEPHIS does not bear any responsibility for any propagation materials found infested after inspection

S/N	NAME OF NURSERY	LOCATION	CONTACT
1.	Slopes Nursery	Naivasha	Paul Ndungu: Tel: 0722342336
2.	Mukulima Nursery	Nakuru Town	Joseph Opande: Tel: 0725658913
3.	Nakuru Prisons Nursery	Nakuru Town	Faith Ikara
4.	Friends Tree Nursery	Bahati, Nakuru	Peter Githuka Njoroge
5.	Umoja Nursery	Subukia, Nakuru	Joseph Mwangi: Tel:0724412461/0717051683
6.	Ngaishi Environment Project.	Kimana, Oloitok tok	Parsanke Sayianka Email: psayianka@yahoo.com
7.	Tabby tree Nursery	Rombo, Oloitok tok	Dorcas Wanjiku: Tel: 0725345626
8.	Benjamin Lukano	Kapsara, Eldoret	Benjamin: Tel: 0733990574, 0725170692
9.	KVDA Suam Catchment at Kotoruk and Chepsurur	Kishaunet-Kapenguria	Chelimo: Tel: 0727984016 Elijah: 0538003859
10.	Menofa CBO	Chepchonia	Cleophas Wayongo: Tel: 0717186981
11.	Kitale Annex prison Nursery	Waitaluk-kitale	Mr.Maina: Tel: 0722448027
12.	Alime commercial Nursery	Laikipia central	0723818160
13.	Sweet-waters F. N	Nanyuki	0723818160
14.	Mac-nut products	Kiriaini/ Kangema	Mr. Mugi Tel:0722332496
15.	Gee Mac Agricultural Nurseries	Nginda - Maragua Muranga south	Macharia Kabui: Tel: 0722706037
16.	Mbari ya Mboche Nursery	Kariua – Muranga South	Peter Gicheru: Tel: 0721867625
17.	JKUAT enterprise Nursery	Juja- Thika	Francis Kimuyu:Tel: 0722333685
18.	KALRO -THIKA	Samuru – Thika	Wilson Cheluget: Tel:0722644315
19.	Maranjau G.K Prisons	Kabiti –Makuyu	Peter Mbuthia: Tel: 0727592879

20.	Mwea (G.K) Prison	Gathigiriri, Kirinyaga	Farm manager:Tel: 0721367578
21.	Kerugoya G.K Prison	Kerugoya	Farm manager: Tel: 02034597845
22.	Julia Nurseries	Kibirigwi/ Kirinyaga	M. Njogu. Box 619 Karatina
23.	Kibirigwi Co-op soc.	Kibirigwi-kirinyaga	Nursery in-charge: Tel: 0710728451
24.	Mahiga-ini Springs flowers & Fruit tree Nurseries	Nyeri	Tel: 0701258645
25.	Solidarity	Nyeri	0204756985
26.	G.K Prisons	Kingongo, Nyeri	Chirchir: Tel: 0721974958 Gerald Muchiri: Tel: 0723917922
27.	Avocado master Nursery	Nyeri/ Tetu	David Murigi: Tel: 0723367724
28.	Erastus Ng'iru Ramuchi	Nyeri / town	Tel: 0736943308
29.	Wamulu CBO	Kanduyi-East Bukusu, Bungoma	Robert: Tel:0720931793,0738507570
30.	Good Neighbors	Naitiri, Bungoma	Zippy Simiyu: Tel: 0722220889
31.	Nyambok women group	Homabay	Augustine Osunga
32.	Kibos prisons	Kisumu	Mr. Okoth: Tel: 0720002080
33.	Umoja tree Nursery	Marimanti – Meru	0734771336/0728028134
34.	Mitunguu Irrigation Scheme	Meru	Patrick: 0712438698/0722425587
35.	Vision Growers Agency	Meru	Julia: Tel: 0722895429
36.	ICRAF/KAGURU FTC	Nkubu	Gitonga/ P.O Box 112 Nkubu
37.	Siakago Agro-forestry & F.T.N.	Siakago, Embu	0713021442
38.	Kamiru F. T. N	Embu	0723780954
39.	Karanja Njuguna nurseries	Embu	Karanja Njuguna: 0722334026
40.	Bidii Tree Nursery	Mwingi	James: 0722893148
41.	Makindu Hand Craft Cooperative Society Nursery	Kibwezi District Nguumo location	Solomon: 0724744432 James: 0719533907/ Member: 0723553433

42.	Francis Muli Ndunda Nursery	Kibwezi District Kikumbulyo location	Francis Muli 072400380
43.	AIC Malooi Youth Nursery	Makueni District Nzaui location	0734647113
44.	ABC/ARTC Nursery	Machakos District Central location	0722859579 /044 21288
45.	Mwanzo Mpya Nursery	Machakos District, Central Location at DCs offices	0714326227
46.	Wildlife Works Organic Project	Voi, Maungu	Laurian Lenjo: 0722281851 Erick: 0729590531 Willy Kanyigi: 0717574765
47.	Kakuzi PLC	Muranga	0722 220083
48.	Isinya Avocado nurseries	Isinya	Mr. Shah - 0732 525 308
49.	Soloplants	Muranga	0733632969; +254 733 770399
50.	Olivado nurseries	Muranga	Bridget Mwangi: 0723749924 bridget@olivado.com
51.	Avocado Society of Kenya (ASOK)	Nairobi	+254 722292360 /0733917964 /0722457388

MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES
KENYA PLANT HEALTH INSPECTORATE SERVICE
(KEPHIS) PHYTOSANITARY CERTIFICATE
Agricultural Produce (Export) Act Cap 319

1. Name and address of exporter	*2. PHYTOSANITARY CERTIFICATE No.*
3. Declared name and address of consignee	*4. To Plant Protection Organization(s) of* **Spain**
5. Place of Origin **Kenya**	*6. Declared means of conveyance:* **By Air**
7. Declared point of entry **paris**	*8. Distinguishing marks* **labelled**
9. Number and Description of packages: **2 Boxes of 10.00 Kgs.**	*10. Name of Produce* **Avocado**
11.Botanical name of plants **Persea americana**	*12. Quantity declared* **10.00 Kgs**
13.This is to certify that the plants, plant products or other regulated articles described herein **Have been inspected and/or tested according to appropriate official procedurs and are considered to be free from the quarantine pests specified by the importing country and to conform with the current phytosanitary requirements of the importing country**	
14. Additional declaration ******	
15. Disinfestation and/or disinfection treat nent **** *16. Chemical (active ingredient)* **** *17. Duration and temperature* **** *18. concentration* *19. Date* **** *****	*place of issue* **Kephis JKIA** **Date** ..... ***Name of Inspector*** ***Name of Authorized Officer*** *Signature* ..... ***Authorized officer*** *Official Stamp*
20. Any additional Information **Inv.No: 001B, Adni.Info: *****	

Note: The certificate shall be completed in typescript or in block capitals
No financial liability with respect to this certificate shall attach to Kenya Plant Health Inspectorate Service or to any of its officers or representatives.

ANNEX 7: CERTIFICATE OF CONFORMITY TEMPLATE

1. Exporter	2. Certificate No.		
3. Packer identified on packing (if other than exporter)	**MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES** **KENYA PLANT HEALTH INSPECTORATE SERVICE (KEPHIS)** **CERTIFICATE OF CONFORMITY** **Agricultural Produce (Export) Act Cap 319**		
4.Identification of means of transport **By Air**	5. Country of Origin **Kenya**	6. Country of Destination **Spain**	
7. Packages (number & type)	Nature of Produce (variety if specified)	Quality Class	8. Total Weight in Kgs Gross weight / Net weight
2 Boxes	Avocado, Fuerte	Class I	11.00 / 10.00
9. Duration of Validity	3 days		
10. Comments	Invoice Number	001B	
11. KEPHIS certifies that following inspection by sampling the above consignement conforms with the standards in force Name of Inspector — Place of issue *Name of Authorized Officer* *Official Stamp* Date — Signature Of Authorized Officer			

No financial liability with respect to this certificate shall attach to KEPHIS or any of its officers or representatives.

CERTIFICATE OF ORIGIN

Issue Date	15/04/2016	041516190900	ORIGINAL

1. Exporter's Name

Nairobi Exporters

P.O.Box

Tel: 123

Fax:

Email: nairobiexporters@gmail.com

Unique serial Number

QR CODE

KNCCI KENYA NATIONAL CHAMBER OF COMMERCE & INDUSTRY — *Growing your Business together*

Heritan Hse, Woodland Rd Off Argwings Kodhek Rd, Opp D.O.D Hq
Hurlingham
P.O. Box 47024-00100 Nairobi-Kenya
Tel:+254 725 453 376 / 739 522 563
Email:info@kenyachamber.or.ke
www.kenyachamber.or.ke

2. Consignee's Name

China Exporters Ltd

P.O.Box -

Tel: 1242424214

Fax:

Email: info@china.com

5. Country of Origin: Kenya

6. Country of Destination: United Arab Emirates

7. Customs Export's Code No.: 987

8. PIN Code: 456

3. Mode of Shipment(Sea,Air,Rail,Road): Land

Trading License No.: 041516190900

10. Bill of Lading / Airway Bill: 567

11. Marks/Number of Packages	12. Tariff No.	13. Description of Goods	14. Gross Weight	15. Invoice No.	16. Value
90.0	234	Tomatoes	20.0	123	20.0
10.0	234	Tomatoes	23.0	234	90.0

ANNEX 8: BILL OF LADING

SHIPPER

EXPORTER ADDRESS
DETAILS

DRAFT
BILL OF LADING

VOYAGE NUMBER: 0JN3YN1MA
BILL OF LADING NUMBER: MOB0128576

CONSIGNEE

IMPORTER ADDRESS DETAILS

EXPORT REFERENCES

NOTIFY PARTY, Carrier not to be responsible for failure to notify

COOL CONTROL BV
HONDERDLAND 90
2676LS
MAASDIJK
NETHERLANDS

CMA CGM

CARRIER: CMA CGM Société Anonyme au Capital de 234 968 330 Euros
Head Office: 4, quai d'Arenc - 13002 Marseille - France
Tel: (33) 4 88 91 90 00 - Fax: (33) 4 88 91 90 95
562 024 422 R.C.S. Marseille

PRE CARRIAGE BY*	PLACE OF RECEIPT*	FREIGHT TO BE PAID AT	NUMBER OF ORIGINAL BILLS OF LADING
		ROTTERDAM	THREE (3)
VESSEL	**PORT OF LOADING**	**PORT OF DISCHARGE**	**FINAL PLACE OF DELIVERY***
INDIAN EXPRESS	MOMBASA	ROTTERDAM	**********

MARKS AND NOS CONTAINER AND SEALS	NO AND KIND OF PACKAGES	DESCRIPTION OF PACKAGES AND GOODS AS STATED BY SHIPPER SHIPPER'S LOAD STOW AND COUNT SAID TO CONTAIN	GROSS WEIGHT CARGO	TARE	MEASUREMENT
			KGS	KGS	CBM
CAIU5557562 SEAL H2709451	1 x 40RC	4500 CARTONS 1*40FCL STC 4,500 CTNS OF AVOCADO 4KG: 3,960 CARTONS 10KG: 540 CARTONS NET WEIGHT: 21,240 KGS SHIPPERS REF: H21290 VARIETY: HASS DAT TEMPTALE NO:- JCARN0273V (P 5779) RAT TEMPATLE NO:- JB51C00HP0 (RF P 5771) STARCOOL CA INSTALLED. SET POINT TEMPARATURE: +4.5c STEP DOWN AT JEDDAH TO +4.0c	23490.000	4420	50.000
TTNU8620760 SEAL H2709491	1 x 40RC	4188 CARTONS 1*40FCL STC 4,188 CTNS OF AVOCADO 4KG: 3,432 CARTONS 10KG: 756 CARTONS NET WEIGHT: 21,288 KGS SHIPPERS REF: H21291 VARIETY: HASS DAT TEMPTALE NO:- JCARN00WEV PLTN5014 RAT TEMPATLE NO:-JB51C00J50 PLTN5809 STARCOOL CA INSTALLED.	23382.000	4330	50.000

Continued on Next Sheet Sheet 1 of 2

ABOVE PARTICULARS DECLARED BY SHIPPER, CARRIER NOT RESPONSIBLE.

ADDITIONAL CLAUSES

4. Cargo at port is at merchant risk, expenses and responsibility
5. FCL
77. THC at destination payable by Merchant as per line/port tariff
91. Ground rent/storages/power supply/monitoring costs at port of discharge for Merchant s account according to port rates.
92. Reefer container can only be operated by electrical power. During land transportation the Carrier will not be liable in any respect whatsoever for consequences, due to non refrigeration.
194. For the purpose of the present carriage, clause 14(2) shall exclude the application of the York/Antwerp rules, 2004.
202. Demurrage and detention shall be calculated and paid as per general tariff available on the web site www.cma-cgm.com , or in any of CMA CGM agency. However if special free time conditions are granted, then rates applicable as per general tariff grid shall start from the day following the last free day.
216. Mis-declaration of cargo weight endangers crew, port workers and vessels' safety. Your cargo may be weighed at any place and time of carriage and any mis-declaration will expose you to claims for all losses, expenses or damages whatsoever resulting thereof and be subject to freight surcharge.
225. The shipper acknowledges that the Carrier may carry the goods identified in this bill of lading on the deck of any vessel and in taking remittance of this bill of lading the Merchant (including the shipper, the consignee and the holder of the bill of lading, as the case may be) confirms his express acceptance of all the terms and conditions of this bill of lading and expressly confirms his unconditional and irrevocable consent to the possible carriage of the goods on the deck of any vessel.
274. The Merchant is responsible for returning any empty container, with interior clean, free of any dangerous goods placards, labels or markings, at the designated place, and within 60 days following to the date of release, failing which the container shall be construed as lost. The Merchant shall be liable to indemnify the Carrier for any loss or expense whatsoever arising out of the foregoing, including but not limited to liquidated damages equivalent to the sound market value - or the depreciated value due by the Carrier to a container lessor. The Carrier is entitled to collect a deposit from the Merchant at the time of release of the container which shall be remitted as security for payment of any sums due to the Carrier, in particular for payment of all detention and demurrage and/or container indemnity as referred above.

RECEIVED by the carrier from the shipper in apparent good order and condition (unless otherwise noted herein) the total number or quantity of Containers or other packages or units indicated above stated by the shipper to comprise the cargo specified above for transportation subject to all the terms hereof (including the terms on page one) from the place of receipt or the port of loading, whichever is applicable, to the port of discharge or the place of delivery, whichever is applicable. Delivery of the Goods will only be made on payment of all Freight and charges. On presentation of this document (duly endorsed) to the Carrier, by or on behalf of the holder, the rights and liabilities arising in accordance with the terms hereof shall (without prejudice to any rule of common law or statutes rendering them binding upon the shipper, holder and carrier) become binding in all respects between the Carrier and Holder as though the contract contained herein or evidenced hereby had been made between them.

All claims and actions arising between the Carrier and the Merchant in relation with the contract of Carriage evidenced by this Bill of Lading shall exclusively be brought before the Tribunal de Commerce de Marseille and no other Court shall have jurisdiction with regards to any such claim or action. Notwithstanding the above, the Carrier is also entitled to bring the claim or action before the Court of the place where the defendant has his registered office.

In witness whereof three (3) original Bills of Lading, unless otherwise stated above, have been issued, one of which being accomplished, the others to be void.

(OTHER TERMS AND CONDITIONS OF THE CONTRACT ON PAGE ONE)

PLACE AND DATE OF ISSUE	MOMBASA	15 SEP 2021	SIGNED FOR THE CARRIER CMA CGM S.A. BY CMA CGM Kenya Ltd as agents for the carrier CMA CGM S. A.
SIGNED FOR THE SHIPPER			

*APPLICABLE ONLY WHEN THIS DOCUMENT IS USED AS A COMBINED TRANSPORT BILL OF LADING

CMA CGM

DRAFT
BILL OF LADING

VOYAGE NUMBER
0JN3YN1MA
BILL OF LADING NUMBER
MOB0128576

PRE CARRIAGE BY*	PLACE OF RECEIPT*	FREIGHT TO BE PAID AT	NUMBER OF ORIGINAL BILLS OF LADING
		ROTTERDAM	THREE (3)
VESSEL	**PORT OF LOADING**	**PORT OF DISCHARGE**	**FINAL PLACE OF DELIVERY***
INDIAN EXPRESS	MOMBASA	ROTTERDAM	**********

MARKS AND NOS CONTAINER AND SEALS	NO AND KIND OF PACKAGES	DESCRIPTION OF PACKAGES AND GOODS AS STATED BY SHIPPER SHIPPER'S LOAD STOW AND COUNT SAID TO CONTAIN	GROSS WEIGHT CARGO	TARE	MEASUREMENT
			KGS	KGS	CBM
		SET POINT TEMPARATURE: +4.5c STEP DOWN AT JEDDAH TO +4.0c			
CAIU5509420 SEAL M2467661	1 x 40RC	4968 CARTONS 1*40FCL STC 4,968 CTNS OF AVOCADO 4KG: 4,752 CARTONS 10KG: 216 CARTONS NET WEIGHT: 21,168 KGS SHIPPERS REF: M21292 VARIETY: HASS DAT TEMPTALE NO:- JCARN00VPV PLTN5827 RAT TEMPATLE NO:-JB51C00FV0 PLTN5831 STARCOOL CA INSTALLED. SET POINT TEMPARATURE: +4.5c STEP DOWN AT JEDDAH TO +4.0c	23652.000	4420	50.000
CAIU5533663 SEAL M2467662	1 x 40RC	4656 CARTONS 1*40FCL STC 4,656 CTNS OF AVOCADO 4KG: 4,332 CARTONS 10KG: 324 CARTONS NET WEIGHT: 20,568 KGS SHIPPERS REF: M21293 VARIETY: HASS DAT TEMPTALE NO:- JCARN0201V PLTN5860 RAT TEMPATLE NO:-JB51C00GH0 PLTN5879 STARCOOL CA INSTALLED. SET POINT TEMPARATURE: +4.5c STEP DOWN AT JEDDAH TO +4.0c	22896.000	4500	50.000
FCL/FCL		FREIGHT COLLECT			
		Cargo is stowed in a refrigerated container set at the shipper's requested carrying temperature of 4.5 degrees Celsius Shipped on Board INDIAN EXPRESS 15-SEP-2021 CMA CGM Kenya Ltd As agents for the Carrier			
Weight in Kgs Total: 4 CONTAINER(S)		Continued From Previous Sheet Sheet 2 of 2	93420.000	17670	200.000

ABOVE PARTICULARS DECLARED BY SHIPPER, CARRIER NOT RESPONSIBLE.

ADDITIONAL CLAUSES

343. In the event that this Bill of Lading is a Paperless Bill of Lading, it shall be governed by the Terms and Conditions available on the CMA CGM website (https://www.cma-cgm.com/products-services/shipping-guide/bl-clauses) which the Merchant has read and accepted. The delivery of the cargo carried under a Paperless Bill of Lading shall be made to the Consignee after the Paperless Bill of Lading has been surrendered to the Carrier on the eBusiness platform and after payment of any outstanding Freight and charges.

358. Following the exceptional measures adopted by various governments in relation with the outbreak of COVID-19 virus and the operational constraints resulting thereof, the Merchants are hereby notified that the carriage of cargo may be disrupted or delayed. Cargo may not be loaded on the intended vessel and may be on forwarded to the port of destination on any alternative vessel at Carrier's sole discretion. Furthermore in case of disruption of ports' operations, the cargo may be discharged in an alternative port without notice and - subject to availability - be on forwarded to the original intended port of destination. Carrier reserve its rights to accomplish the bill of lading in any alternative port. All additional costs, including but not limited to storage, demurrage, plugging, monitoring at the alternative discharge port or extra on forwarding costs, shall be on Merchant's account and payable before delivery and the carrier shall have no liability whatsoever for any loss or damage resulting thereof.

366. The Merchant warrants that the particulars relating to the Goods have been checked and that such particulars are adequate and correct. In case of failure of the Merchant to comply with such warranty, the Carrier shall be entitled to charge the Merchant at any time an amount of USD 2,000 per Container or Goods (for non-containerized cargo) as processing and administrative fees. This fee shall also be applicable in case of discrepancy between the Verified Gross Mass (VGM) sent to the Carrier, or the weight declared to the Carrier (for non-containerized cargo), and the weight declared by the Shipper in his shipping instruction or otherwise weighted during the Carriage.

PLACE AND DATE OF ISSUE MOMBASA 15 SEP 2021

SIGNED FOR THE SHIPPER

*APPLICABLE ONLY WHEN THIS DOCUMENT IS USED AS A COMBINED TRANSPORT BILL OF LADING

SIGNED FOR THE CARRIER CMA CGM S.A.
BY CMA CGM Kenya Ltd
as agents for the carrier CMA CGM S. A.

ANNEX 9: CERTIFICATION PROCEDURE BY KEPHIS AND DEPARTMENT OF AGRICULTURE, FORESTRY AND FISHERIES (DAFF)

1. **Registration of Production Sites, Pack houses and Storage Facilities.**

   Companies/firms interested in exporting to South Africa will apply to the Managing Director of KEPHIS to be registered to export Avocado to South Africa. The applicant will give the following details at least 4 months prior to harvesting;

   a. Name of company,
   b. GPS location(s) of production sites,
   c. Acreage
   d. List of approved pesticides as per IPM program
   e. Pest management protocol for fruit fly and false codling moth
   f. Quality certification system in place at farm level (such as global GAP or equivalent if any),

   Upon receipt of the application KEPHIS audits the farm(s) and if the pest management protocols in the farms and measures put in place in the pack house demonstrates ability to comply with the South African export requirements, an approval letter detailing the farms registered and the pack house as well as their respective codes is then granted by KEPHIS.

   The farms are then entered into the KEPHIS certification program for South Africa and the South African plant quarantine authorities (DAFF) notified over the same on annual basis upon successful re-audits.

   The approved farms and pack houses are then published in the DAFF website.

   KEPHIS ensures that avocado fruit for export to South Africa only originates from production sites and pack houses that have been approved

2. **Pre-harvest good agricultural practices, pest management programs and general surveillance.**

   Have in place a management program for fruit flies and false codling moth

   Initiate fruit fly and FCM monitoring at least 4 months before harvesting OR when the crop starts to flower.

   Maintain weekly pest monitoring data for fruit flies and FCM and submit a copy to KEPHIS on a monthly basis. This information shall be made available to DAFF upon request.

   Bury, destroy, or remove culled and fallen fruits from the production site at least twice a week

   Undertake random destructive sampling of symptomatic fruits at the orchard to check for fruit fly and FCM and keep records of the same.

Post-harvest measures

During harvest and packing of fruit, growers should avoid bruising the fruit. Rejected or over-ripe fruit should be removed from the packing area and disposed of at the end of each day.

The registered pack house(s) and storage facility (ies) should be maintained clean, free of pests, soil and plant debris; safeguarded and equipped to avoid fruit contamination.

The packaging material for avocado fruit should be new and clean cardboard boxes/cartons or plastic crates.

3. Inspection

Avocado for export to South Africa should be inspected and certified by KEPHIS and should be maintained in secure storage to prevent mixing with Avocado for export to other destinations or the domestic market and kept in secure storage until export.

Post-harvest inspections should be conducted according to ISPM 31. Should any quarantine pest of concern be detected; the consignment should be rejected if quarantine pests are detected.

Fruit should be appropriately inspected, packed, stored and transported, so as to safeguard against consignment contamination with quarantine pests of concern to South Africa and to ensure that the level of maturity is according to:-

VARIETY	MATURITY LEVEL (colour when ripe)
Pinkerton	Green-skinned
Fuerte	Green-skinned
Hass	Black-skinned

Fruit should be free from leaves and plant debris.

No packaging material of plant origin, including straw, should be used.

Should wood packaging material be used, it should comply with ISPM 15: Regulation of wood packaging material in international trade (FAO, 2009).

4. Traceability

KEPHIS should ensure that packhouses have a defined traceability system to the approved farms for exports to South Africa by maintaining the integrity of lots.

5. **Labelling**

Each carton (box) of Avocado fruit should be marked in English with correct and accurate information as follows:

Country of origin .....

Production site name or its registered unique code .....

Packing facility name or its registered unique code .....

For the Republic of South Africa .....

6. **Plant Import Permit**

An import permit is required in line with Agricultural Pests Act, 1983 (Act No. 36 of 1983) and associated Regulations R.111 of 27 January 1987 as amended.

Exporters need to liaise with their customers in South Africa to obtain import permits from the South African authorities.

The Plant import permit should be presented to the KEPHIS exit point inspection while applying for a Phytosanitary certificate.

7. **Phytosanitary certification**

A Phytosanitary Certificate should only be issued for Avocado fruit that meets the phytosanitary requirements by KEPHIS. Additional declarations are indicated on the Phytosanitary certificate.

8. **Phytosanitary inspection on arrival**

Once a shipment of avocados arrives at the designated port of entry, the DAFF examines the consignment, relevant documents and markings.

Any consignment with certification that does not conform to the specifications should be rejected.

Upon arrival of the consignment at the port of entry, a representative sample should be drawn and inspected for all quarantine pests listed in **Annex 1** and suspected fruits should be dissected to determine the status of infestation.

Should pests or symptoms of infection be found, the samples should be sent for laboratory identification, and the shipment should be detained pending the result of laboratory identification. The DAFF notifies KEPHIS of such interception immediately.

Should **annex 1** pests be detected on arrival, the consignment should be rejected in accordance with the relevant section of the Agricultural Pests Act, 1983 (Act No. 36 of 1983) and DAFF immediately notifies KEPHIS.

Should any of the quarantine pests in **Annex 2** be detected on arrival,

- The consignment should be rejected and DAFF immediately notifies KEPHIS in accordance with the notification procedures outlined in ISPM 13: Guidelines for the notification of non-compliance and emergency action (FAO, 2001).

- The production site should then be suspended while an investigation is carried out by KEPHIS.
- DAFF and KEPHIS should consult and implement corrective measures as deemed necessary.
- Fruits certified for South Africa prior to the date of suspension and which are already en route should remain eligible for export.
- Such consignments should be detained, inspected and a sample should be taken, and laboratory tests conducted for the quarantine pests in **Annex 2**.

If a live specimen of *Bactrocera dorsalis* and *B. cucurbitae* is detected during phytosanitary inspection upon arrival,

- The export of Avocados from Kenya should be suspended immediately. The DAFF immediately notifies KEPHIS.
- DAFF and KEPHIS shall consult and implement corrective measures as deemed necessary.

Should any quarantine pests of concern to South Africa be detected, the consignment/lot should be rejected.

The detection of any quarantine pest not listed in **Addendum A** should result in a review of these phytosanitary import requirements to ensure that phytosanitary measures provide the appropriate level of phytosanitary protection for South Africa.

The importer is responsible for all costs relating to disposal, removal or rerouting, including costs incurred by the DAFF to monitor the action taken.

NOTE 1: QUARANTINE PESTS OF AVOCADO FRESH FRUIT OCCURING IN KENYA

1. *Aleurodicus dispersus* (spiralling whitefly)
2. *Bactrocera dorsalis* (Fruit fly)
3. *Bactrocera cucurbitae* (melon fly)
4. *Ceroplastes floridensis*
5. *Icerya aegytiaca* breadfruit mealybug
6. *Pseudococcus cryptus*
7. *Vinsonia stellifera*
8. *Maconellicoccus hirsutus* (pink hibiscus mealybug)

NOTE 2: QUARANTINE PESTS OF AVOCADO FRESH FRUIT NOT OCCURING IN KENYA

Mites:

Eotetranychus sexmaculatus [Acari]
Oligonychus persea [Acari]
Oligonychus punicae [Acari]
Oligonychus yothersi [Acari]
Tegolophus myersi [Acari]
Tetranychus tumidus [Acari]

Insects:

Amorbia cuneana [Tortricidae]
Amorbia emigratella [Totricidae]
Anastrepha fraterculus [Tephritidae]
Anastrepha ludens [Tephritidae]
Anastrepha serpentina [Tephritidae]
Anastrepha striata [Tephritidae]
Argyotaenia citrana [Tortricidae]
Bactrocera aquilonis [Tephritidae]
Bactrocera carambolae Tephritidae]
Bactrocera facialis [Tephritidae]
Bactrocera passiflorae [Tephritidae]
Bactrocera tryoni [Tephritidae]
Ceroplastes ceriferus [Coccidae]
Conotrachelus -aguacatae [Curculionidae]
Conotrachelus perseae [Curculionidae]
Ephiphyas postvittana [Tortricidae]
Heilipus lauri [Curculionidae]
Heilipus pittier, [Curculionidae]
Heilipus perseae [Curculionidae]
Kilifia acuminata [Coccidae]
Parthenolecanium persicae persicae [Fabricius]
Planococcus minor [Pseudococcidae]
Planococcus njalensis [Pseudococcidae]
Pseudococcus jackbeardsleyi [Pseudococcidae]
Rastrococcus invadens [Pseudococcidae]
Stenoma catenifer [Oecophoridae]

Viroid .....

Potato spindle tuber viroid .....

ADDENDUM A: NATIONAL QUARANTINE PESTS OF AVOCADO FRESH FRUIT

Mites:

Eotetranychus sexmaculatus [Acari]
Oligonychus persea [Acari]
Oligonychus punicae [Acari]
Oligonychus yothersi [Acari]
Tegolophus myersi [Acari]
Tetranychus tumidus [Acari]

Insects:

Aleurodicus dispersus [Aleyrodidae]
Amorbia cuneana [Tortricidae]
Amorbia emigratella [Totricidae]
Anastrepha fraterculus [Tephritidae]
Anastrepha ludens [Tephritidae]
Anastrepha serpentina [Tephritidae]
Anastrepha striata [Tephritidae]
Argyotaenia citrana [Tortricidae]
Bactrocera aquilonis [Tephritidae]
Bactrocera carambolae Tephritidae]
Bactrocera cucurbitae [Tephritidae]
Bactrocera dorsalis (complex) including: *B. caryeae*, *B. kandiensis*, *B. occipitalis*, *B. pyrifoliae* [Tephritidae]
Bactrocera facialis [Tephritidae]
Bactrocera passiflorae [Tephritidae]
Bactrocera tryoni [Tephritidae]
Ceroplastes ceriferus [Coccidae]
Ceroplastes floridensis [Coccidae]
Conotrachelus aquactae [Curculionidae]
Conotrachelus perseae [Curculionidae]
Ephiphyas postvittana [Tortricidae]
Heilipus lauri [Curculionidae]
Heilipus pittier [Curculionidae]
Heilipus perseae [Curculionidae]
Icerya aegytiaca [Margarodidae]
Kilifia acuminata [Coccidae]
Maconellicoccus hirsutus [Pseudococcidae]
Parthenolecanium persicae persicae [Fabricius]
Planococcus minor [Pseudococcidae]
Planococcus njalensis [Pseudococcidae]
Pseudococcus cryptus [Pseudococcidae]
Pseudococcus jackbeardsleyi [Pseudococcidae]
Rastrococcus invadens [Pseudococcidae]
Stenoma catenifer [Oecophoridae]
Vinsonia stellifera [Coccidae]

Viroid .....

Potato spindle tuber viroid .....

TERMS AND DEFINITIONS

The definitions given below are applicable for the purposes of this document.

(PESTICIDE) LABEL

a written text bearing indication for use, safety information and graphic symbols (pictograms), attached or attached to the packaging of the pesticide, to its first container, to its outer container or to the package in which the pesticide is presented for retail sale.

A1 PESTS

These are pests that are absent from the EPPO region and are recommended for regulation as quarantine pests.

A2 PESTS

are pests that are locally present in the EPPO region but are recommended for regulation as quarantine pests.

ACTIVE SUBSTANCES

substances or micro-organisms, including viruses, having a general or specific action on harmful organisms or on plants, parts of plants or plant products.

ALTERNATIVE TO PESTICIDES

any method or judicious combination of methods of plant protection that allows a reduction in the use of pesticides and rational management of populations of bio-aggressors and beneficial organisms.

BIODIVERSITY

Biodiversity, in the etymological sense of the term, evokes the diversity of living things, i.e. all the processes, lifestyles or functions that lead to maintaining an organism in a state of life. The term refers to the diversity of the living world at all levels: diversity of environments (ecosystems), diversity of species, genetic diversity within a single species.

BIOLOGICAL CONTROL

prevention and control method based on the use of natural mechanisms (e.g., natural antagonisms between living beings; predation; parasitism; etc.). It is a technique whereby a biological control agent (mite, insect, fungus, bacterium, virus, nematode, etc.), which may be an exotic species, is introduced into an environment in order to control a specific harmful organism under given conditions.

BIOPESTICIDE

a plant protection product of biological origin that can be a living organism or a substance of natural origin. Within plant protection products, biopesticides are a sub-group of products derived from natural materials (e.g., products based on plant extracts; products containing a micro-organism; or pheromones, chemical substances emitted by plants and animals that modify the behaviour of other individuals within the same species).

CHEMICAL CONTROL

a prevention and control technique in which an active substance is applied systematically (according to a treatment schedule, for prevention) or in a reasoned manner (according to an alert system that shows the level of damage and advises treatment to limit economic losses) to destroy a pest.

COMMERCIAL QUALITY

a quality product is one whose characteristics enable it to satisfy the needs (expressed or implicit) of customers (AFNOR definition). Commercial quality is achieved when the product meets the expected specifications.

COMPETENT AUTHORITY

The Competent Authority is in any agency, authority, government body, department, inspection, minister, ministerial official, parliament or public or statutory person (autonomous or not) having jurisdiction over any of the activities envisaged by national legislation or international agreements (e.g., SPS Agreement). The Competent Authority is responsible for the enforcement of legislation in the SPS (sanitary and phytosanitary) field, including the organization of inspections and controls in the food chain.

CONFORMITY VERIFICATION PROCEDURE (FOR A CONSIGNMENT)

official method used to verify the compliance of a consignment with the phytosanitary import requirements or phytosanitary measures relating to transit.

CONSIGNMENT

A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots)

CONTAINER (CONTAINER, PACKAGING)

any object (e.g., cardboard box, bottle, ...) used to contain and preserve a certain volume or quantity of product (e.g., pesticide).

CONTAMINANTS

(Micro)organisms (biological contaminants) or harmful substances (chemical contaminants; allergens) that are present in trace amounts in food and drink, either as residues (e.g., pesticide) or unintentionally (e.g., environmental contamination; heavy metals in the soil; neoformed products; products migrating from packaging; etc.), and which can harm health if, due to their concentration, the toxicity threshold is exceeded.

CONTAMINATING HARMFUL ORGANISM

a harmful organism carried by a commodity, packaging, means of transport or container or present in a storage place, but which, in the case of plants and plant products, does not infest them.

CONTAMINATION (HEALTH ASPECT)
unintentional presence of a pathogenic microorganism (for humans or animals) or a contaminant of a chemical nature (e.g., heavy metals, residues, mycotoxins, etc.), inside or on the surface of a good.

CONTAMINATION (PHYTOSANITARY ASPECT)
presence of a contaminating harmful organism or unintentional presence of a regulated article inside or on the surface of a good, packaging, means of transport, container or storage place.

CONTROL PLAN
control programme that allows the targeted search for anomalies, non-conformities and even fraud.

ENVIRONMENT
the surrounding environment, including water, air, soil and their relationships, as well as all the relationships of these elements with living organisms.

EUROPHYT
notification and early warning system for phytosanitary interceptions. It is a system established for the Member States of the European Union and Switzerland dealing with interceptions for phytosanitary reasons of consignments of plants and plant products imported into the EU or traded within the EU. EUROPHYT is managed by the Directorate-General for Health and Food Safety of the European Commission.

EXTREMELY HAZARDOUS PESTICIDES
pesticides that are known to present particularly high levels of acute or chronic risks to health or the environment, according to internationally recognized classification systems such as the WHO classification or the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), or indicated as such under applicable binding international conventions or agreements.

GOOD AGRICULTURAL PRACTICE (GAP)
the use of pesticides (dose/ha, maximum number of applications/seasons, pre-harvest interval, application technique) officially recommended by national authorities and which must be respected, to control pests effectively and reliably while avoiding exceeding acceptable pesticide residue limits (MRLs).

HACCP (HAZARD ANALYSIS CRITICAL CONTROL POINT) OR HAZARD ANALYSIS AND CRITICAL CONTROL POINT
a method of food safety control developed in the United States.

HARMFUL ORGANISM

any species, strain or biotype of plant, animal or pathogenic agent harmful to plants or plant products, material objects or the environment, including vectors of pests or pathogens of human and animal diseases and animals injurious to public health.

HAZARD

a property inherent in a substance, biological agent, or situation that may have undesirable consequences (such as properties that may have adverse effects on health, the environment or property).

INFESTATION (OF A COMMODITY)

The presence in a commodity of a living organism harmful to the plant or plant product concerned. Infestation (by a pest) also includes infection (by a pathogen).

INSPECTION

Examination carried out as part of official control, monitoring or verification of compliance.

INSPECTOR

a person (officer belonging to a public service) authorized by a National Plant Protection Organization to carry out the functions of the latter.

INTEGRATED PEST MANAGEMENT OR INTEGRATED PROTECTION (IPM: INTEGRATED PEST MANAGEMENT)

the careful consideration of all available techniques to control pests and the subsequent integration of appropriate measures to prevent the emergence of pest populations and to keep the use of pesticides and other types of intervention to economically justified levels, while minimizing risks to human or animal health and the environment. Integrated Pest Management focuses on growing a healthy crop with minimal negative impact on agricultural ecosystems and gives priority to natural pest control mechanisms.

INTERCEPTION (OF A CONSIGNMENT)

Refusal or conditional entry of an imported consignment resulting from non-compliance with phytosanitary regulations.

LABELLING (OF THE PESTICIDE)

all the information affixed or printed directly on the packaging. This information is on the visible label (without having to handle it to access it) or is delocalized in leaflets (separate document accompanying the packaging) or booklets. Multi-sheets which are slipped into the box.

LIFE CYCLE OF A PESTICIDE

All the stages in the life of a pesticide, from its production to its degradation in the environment after use, to its destruction as an unused product. The life cycle of a pesticide includes the manufacture, preparation, packaging, distribution, storage, transport, use and final disposal of the product and/or its container.

MAXIMUM RESIDUE LIMIT OR MRL (USUALLY EXPRESSED AS MG OF ACTIVE SUBSTANCE PER KG OF FOOD)

the maximum concentration of a residue that is legally permitted or considered acceptable in or on a food, agricultural product or animal feed product.

MONITORING MECHANISM

a set of activities for collecting, centralizing and analyzing data, informing stakeholders, coordinating activities, etc., carried out on an ongoing basis according to formalized protocols with a certain level of coordination, for given monitoring methods.

NURSERY STOCK

refers to young plants grown in a nursery.

OBSOLETE PESTICIDES

Obsolete pesticides are pesticides that can no longer be used or repackaged either because they are no longer registered locally or because they have been banned internationally.

OPERATOR

In this guide, the term "operator" is used to refer to all those who intervene directly in the supply chain ... and can thus have an impact on the quality and sanitary and phytosanitary safety of the product. The main operators in the sector ... are in particular nurseries, producers, processors and distributors.

ORGANIC AGRICULTURE

Organic agriculture is a production system that maintains and improves the health of soils, ecosystems and people. It is based on ecological processes, biodiversity and cycles adapted to local conditions, rather than on the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science for the benefit of the common environment and promotes fair relationships and a good quality of life for all involved (IFOAM). It is a mode of agricultural production that is mainly characterized by the refusal to use synthetic chemical inputs and seeks to return to traditional practices.

PACKAGING

material used to support, protect or contain a commodity, pesticide or agricultural product.

PESTICIDE WASTE

waste consisting, in whole or in part, of pesticides as well as materials contaminated by pesticides. This definition includes rinse water (from rinsing empty containers, tanks and spraying equipment), concentrated products that have expired or have been withdrawn from the market, empty containers, soiled mixing utensils, leftover spray liquid and soiled protective clothing and equipment.

PESTICIDES (PLANT PROTECTION PRODUCTS)

any substance or combination of chemical or biological substances that is intended to repel, destroy or control harmful organisms or to be used as a plant growth regulator. Pesticides include the active substance, the commercial speciality or preparation composed of one or more active substances, plant growth regulators, defoliants (to make leaves fall off), desiccants and a number of adjuvants (e.g., wetting agents, humectants).

PESTS

organisms that are enemies of plants that harm their growth or subsequent reproduction or multiplication. See "pests". In food safety, "pests" usually refers to insects, rodents or birds that enter production sites and may be responsible for contamination of products.

PHYTOSANITARY CERTIFICATE

an official paper document or its official electronic equivalent, conforming to the IPPC model certificates, attesting that a consignment meets the phytosanitary import requirements.

PHYTOSANITARY CONTROL

all the operations of monitoring, checking and treatment of plants or plant products from agricultural, forestry and horticultural resources with a view to eliminating or minimizing the harm that harmful organisms associated with these resources may cause to the environment and/or the consumer.

PHYTOSANITARY INSPECTION

official visual examination of plants, plant products or other regulated articles to determine the presence or absence of harmful organisms and/or to ensure compliance with phytosanitary regulations.

PHYTOSANITARY LEGISLATION

basic laws, giving a National Plant Protection Organization the legal authority to implement phytosanitary regulations.

PHYTOSANITARY REGULATIONS

a set of official regulations to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including the establishment of procedures for phytosanitary certification.

PHYTOSANITARY RISK

the probability of introduction and spread of a pest and the magnitude of the potential economic consequences associated with it (for quarantine pests) and the probability that a pest present in plants for planting will affect the intended use of those plants with unacceptable economic impact (for regulated non-quarantine pests).

PLANT PROTECTION PRODUCTS

term established by international regulations to designate preparations containing one or more mineral or organic chemical substances, whether synthetic or natural, presented in the form in which they are supplied to the user. More commonly referred to in the Guide as "pesticides". They are also referred to as "plant protection products" or "PPPs" plant protection products. Depending on the category, a distinction is made between insecticides, fungicides, nematicides, molluscicides, herbicides

PLANT PROTECTION

activity which aims, among other things, to identify the agronomic, biological and cultural components involved in problems closely related to the health of plant species and whose role is to implement all legal, administrative, technical and logistical means available to safeguard the health of plants and plant products.

PROHIBITED

a pesticide whose all uses have been banned by final regulatory action to protect human health or the environment. Applies to a pesticide whose registration has been rejected for a first use or which has been withdrawn by industry from the sub-regional market or by a Member State, where it is clear that such action has been taken to protect human health or the environment.

QUARANTINE PEST

a pest that is of potential importance to the economy of the threatened area and is either not **yet present** in the area or is present but not widely distributed and is under **official control**.

REGISTRATION

the process by which the competent national or regional authorities approve the sale and use of a pesticide (or other input) after consideration of comprehensive scientific data showing that the product is effective for its intended uses and does not present an unreasonable risk to human and animal health and the environment.

REGULATED NON-QUARANTINE PEST

a pest which is **not a quarantine** pest, the presence of which in plants intended for planting affects the intended use of such plants, with **unacceptable economic impact,** and which is therefore regulated in the territory of the importing Contracting Party.

REGULATED PEST
quarantine pest or regulated non-quarantine pest.

RISK
The combination of probability and severity of an adverse effect on human health or the environment, which is a function of the nature of the hazard, the probability and magnitude of exposure to the pesticide.

SAMPLING
operation of taking a sample in a survey work (this may be an elementary operation or a set of operations consisting of successive stages of sampling separated by stages of fragmentation, homogenization, drying, etc.). The aim is to study a selected part in order to draw conclusions applicable to a whole. Sampling is directed and sampling is carried out on the basis of targeting criteria in order to increase the probability of detecting contamination in the target population. Sampling of plants, plant products and other regulated commodities may take place prior to export, at the time of import or at other stages as decided by NPPOs.

SANITARY AND PHYTOSANITARY MEASURES
any legislation, regulation or official method designed to prevent the introduction or spread of quarantine pests or to limit the economic impact of regulated non-quarantine pests.

SEVERELY RESTRICTED PESTICIDE
a pesticide for which almost all uses have been prohibited by final decision of the competent authority in order to protect human health or the environment, but for which one or more specific uses remain authorized. The term applies to a pesticide for which registration for substantially all uses has been refused or which has been withdrawn by industry either from the market or from the national registration process where it is clear that such action has been taken to protect human health or the environment.

SURVEILLANCE PLAN
a non-targeted control programme which makes it possible to obtain an estimate of the prevalence or level of contamination by one or more agents in a defined production (target population) and thus to estimate the risk of consumer exposure to this hazard.

SURVEILLANCE
an official device whose function is to collect by survey, monitoring or other methods and to archive data on the presence or absence of harmful organisms.

SUSTAINABLE AGRICULTURE (ALSO CALLED SUSTAINABLE AGRICULTURE)

Sustainable Agriculture is generally defined as a way of farming that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is a mode of production that applies principles of sustainable development to agriculture while respecting the ecological, economic and social limits that ensure the sustainability of this production over time. It does not damage the integrity of people, living beings and their environment. Sustainable agriculture limits the use of pesticides that can harm the health of farmers and consumers and aims to protect biodiversity.

a. to prevent or limit other damage in the territory of the Member arising from the entry, establishment or spread of pests. Sanitary or phytosanitary measures include all relevant laws, decrees, regulations, requirements and procedures, including, inter alia, end-product criteria; production processes and methods; testing, inspection, certification and approval procedures; quarantine regimes, including relevant requirements related to the transport of animals or plants or materials necessary for their survival during transport; provisions on relevant statistical methods, sampling procedures and risk assessment methods; and packaging and labelling requirements directly related to food safety.

b. to protect animal or plant life or health within the territory of the Member from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms.

c. to protect human and animal life and health within the territory of the Member from risks arising from additives, contaminants, toxins or disease-causing organisms in food, beverages or feedstuffs.

d. to protect human life and health within the territory of the Member from risks arising from diseases carried by animals, plants or their products, or from the entry, establishment or spread of pests; or,

TOXIC OR POISON

substance capable of disturbing the normal functioning of a living organism. It may be natural (e.g., dust, pollen) or artificial (e.g., urea formaldehyde), chemical (e.g., acetone) or biological (e.g., aflatoxins, anthrax) in nature.

TOXICITY

Physiological or biological properties that cause a chemical product to damage or alter a living organism by other than mechanical means.

ABBREVIATIONS AND ACRONYMS

ACP	Africa, Caribbean, Pacific
AEA	Avocado Exporters Association
AEAK	Avocado Exporters Association of Kenya
AFA	Agriculture, Fisheries and Food Authority
ASBV	Avocado Sunblotch Viroid
ASOK	Avocado Society of Kenya
CABI	Centre for Agriculture and Bioscience International
CCP	Critical Control Points or “Critical Control Points”.
CEO	Chief Executive Officer
CODEX	Codex Commission. The Codex Alimentarius (or Codex Alimentarius)
COLEAD	Committee Linking Entrepreneurship Agriculture Development
CP	Control Point
ECOWAS	Economic Community of West African States
EPA	Economic Partnership Agreement
EPPO	European and Mediterranean Plant Protection Organization
ESC	Electronic Certification System
EU	European Union
EUROPHYT	European Union Notification System for Plant Health Interceptions
FAO	Food and Agriculture Organization of the United Nations
FCM	False Codling Moth
FPC	Fresh Produce Consortium
FPEAK	Fresh Produce Exporters Association of Kenya
GAP	Good Agricultural Practices (defines the conditions of use of a PPP)

GHP	Good Hygiene Practices
GLOBAL G.A.P	Global Good Agricultural Practices
GPG	Good Practice Guide
GPP	Good Phytosanitary Practices
GWP	Good working practice
HACCP	Hazard Analysis and Critical Control Points
HCD	Horticultural Crop Directorate
ILO	International Labour Organization
IPPC	International Plant Protection Convention
ISO	International Organization for Standardization
ISPM	International Standards for Phytosanitary Measures
ITSC	Institute for Tropical and Subtropical Crops
KALRO	Kenya Agricultural Livestock Research Organization
KEBS	Kenya Bureau of Standards
KEPHIS	Kenya Plant Health Inspectorate Services
KEPROBA	Kenya Export Promotion and Branding Agency
KS	Kenya Standard
KU	Kenyatta University
LD	Determination Limit (synonymous with LOQ)
LM	Maximum Limit
LMR	Maximum Limit for Residues
LOQ	Limit of Quantification
MD	Managing Director

MDD	Minimum Durability Date, old DLUO (Deadline for Optimum Use) with the same characteristics.
MOALFC	Ministry of Agriculture Livestock Fisheries and Cooperatives
NEXT KENYA	New Export Trade Kenya Programme
NPPO	National Plant Protection Organization
OCR	EU Official Control Rules
OECD	Organization for Economic Cooperation and Development
OIE	World Organization for Animal Health
PA	Point of attention
PCPB	Pest Control Products Board
PGI	Protected Geographical Indication
PHT	Pre-harvest time
PIP	Plant Import Permit
PPP	Plant protection product = Phytopharmaceutical product
RASFF	Rapid Alert System for Food and Feed
SADC	Southern African Development Community
SAR	Sodium Adsorption Ratio
SMES	Small or Medium Enterprises
SPS	Sanitary and Phytosanitary
SPS QMS	Sanitary and Phytosanitary Quality Management System
UNECE	United Nations Economical Commission for Europe
WHO	World Health Organization
WTO	World Trade Organization

GROWING PEOPLE

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