



## FARMERS HANDBOOK

**THEME:**  
**GROWING THE FRUIT TOGETHER**  
**“TUKURIE MATUNDA HAMWE”**

**KAKUZI PLC**



QUALITY  
**KAKUZI**  
PRODUCTS

**KAKUZI** **PLC**



**For more info visit our office at Kakuzi Horticulture Packhouse along Thika Sagana road or call 020-2184122 or 0728 160 931**

**Kakuzi production booklet**

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**GROWING THE FRUIT TOGETHER**  
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# INTRODUCTION

*Dear beloved farmer, welcome to our Farmers Open Day 2019.*

## Climate

The climate for the 2018/2019 growing season was generally dry with very little rainfall. From September to December 2018, we received very little rainfall, which allowed the flowering and fruit set. The fruit set for 2019 was not as good as that of 2018, as 2019 was an off year, and the trees had overproduced in 2018 hence the trees were stressed and had minimum flowering. Between January 2019 and March 2019, very little rainfall was received, hence it affected the size of the fruits as the fruits didn't have enough moisture.

Between April and June 2019, we had some showers but it was still below the normal levels. The rivers and dams dried off as a result of the dry spell which prevailed in the course of the year. On a positive side, the dry spell meant we had less fungal infections.

## Maturity

Deliveries at the packhouse commenced on 11th March 2019. HCD banned the export of fruit before 1st March 2019 as some exporters were selling fruits outside the country whose maturity was questionable. In spite of the ban, immature fruits were still finding their way to France and the EU market. This should be well managed for Kenya to gain ground on international market. The lower coffee zones achieved maturity earlier compared to other areas. At the beginning of the season, as Kakuzi, we were only exporting fruits with a maturity of 77% moisture content or a dry matter of 23%. This continued to improve and at the close of the season, we were exporting fruits with 66% moisture content or a dry matter of 34%. In spite of the ban by HCD, we could see heaps of discarded immature



and small sized fruits on the roadside from other exporters, which did not meet the minimum standards. This resulted to loss of finance to the farmers as well as the government.

## **Harvesting & yields**

Due to the prices experienced in 2018, some of our farmers did not deliver fruits to Kakuzi. However, we kept receiving fruits from some of the existing farmers as well as new farmers, because of the confidence the farmers have in Kakuzi due to our transparency. A total of 442 farmers delivered their fruits to Kakuzi. A total of thirty-four 40ft containers from the smallholders and outgrowers were sent to the EU market. We had very little issues regarding quality. A total of 301,666kgs were sold to oil companies and these were fruits below count size 26. Our appeal to farmers is to follow our Kakuzi growing calendar and apply fertilizers as per recommendation and in time for the fruits to achieve the required size and quality. In spite of the dryspell we experienced this year for those farmers who followed our fertilizer program, there was a general improvement on the bigger size fruits compared to other years. As we have always emphasized, bigger size fruits - count 12-20 - will never miss a market and will always get a good price. Due to the challenges we have faced in the market on small fruits, the company will not be purchasing fruits of a smaller count, size 28, 30 and 32, as we cannot find a suitable market for them, especially when Peru and South Africa are on season. To avoid these smaller counts, the farmers should apply fertilizer on time and as per Kakuzi program.

## **Transport**

We have had several meetings with the County Government of Murang'a regarding ferrying of fruit from farmers to the Packhouse. This still remains a challenge as the fruits are being carried on open pickups. The suggestion is to look into the possibility of the fruit being

*Growing the Fruit Together*



transported using bread crates. The current transport system where overloaded pickups deliver fruits to the Packhouse has always resulted to temperature rise and compression of fruits resulting to loss of quality. There is always lenticel damages a result of fruits rubbing against one another, leading to loss of quality, hence the farmers getting a lower packout percentage.

## **Quality**

This year we had minimum quality issues as the farmers are getting better informed. We had less lenticel damage as most of the fruits were harvested when it was dry. There were less incidences of fungal infections on the fruits.



Our appeal to the farmers is to continue spraying Copper to protect the fruits against fungal infections and prune the trees to allow the penetration of light. Well pruned orchards will reduce the cost of purchasing Copper based fungicides. Maturity of fruits still remain a challenge. As a country, there is need to ensure whatever is being exported has good maturity and can ripen within 14 days. Kenyan fruits have always been discounted as a result of long ripening periods.

As one of the cardinal rules during harvesting, the fruits should never be harvested when it is raining, as this will result to lenticel damage. False Codling Moth remains a big challenge as there are no registered pesticides with PCPB for use in avocado. We are calling upon the County Government and the Avocado Society of Kenya to lobby the government to help in registering pesticides which can be used in the control of pests in avocado. Kakuzi encourages farmers to adopt the use of biological traps for control of FruitFly and FCM.

## **Marketing**

Being an off year, there was a general decline in the production of avocados in the world. The 2019 season opened with low prices but prices continued to increase as the season progressed. The season closed at the highest ever price achieved, due to international supply

and demand dynamics. The focus this year for most exporters was to diversify the market from EU to China. Unfortunately, the country was unable to export the fruit to China due to the stringent rules which China put in place. One of the requirements by the Chinese was to have the fruits sliced and cold-frozen. Only one company met the requirement. Exporters are still engaging with the Kenyan government for the Chinese to allow export of fresh avocado. Cold-freezing requires a major investment on coldrooms which most companies cannot afford.

### **Future of Avocado**

The future of Kenyan avocado is bright if only we can ensure good quality fruits are exported. The HCD and other government regulatory bodies, who have been bestowed with the responsibility of regulating the avocado industry, should ensure no immature fruits is exported. County Governments should come up with rules and regulations of controlling the harvesting of fruits before the season. This will minimize losses of fruits, which results to loss of revenue to the farmers as well as the government. Kakuzi will continue adhering to the standards required by the international market. We appeal to our farmers to ensure fruits delivered to the Packhouse are mature and do not have fungal infections, resulting from lack of spraying. This year, the company has produced farming calendars showing the activities the farmer is supposed to undertake every month, including fertilizer application, pest control and control of fungal infections.

### **Bonus 2019**

The bonus this year is the best Kakuzi has ever declared. There should be more understanding by the farmers that the bonus is based on the market prices. Kakuzi is very transparent on its operations and will continue supporting the farmers by paying them based on the market prices as realized in the market. I hereby declare and release the bonus payment into your bank accounts at the end of the meeting today. I kindly thank the farmers who continued to support us by delivering the fruits to Kakuzi in spite of the challenges we faced in 2018. Merry Christmas and a Happy New Year.

## **OUR SMALLHOLDER AVOCADO PROGRAM (Since 2012).**

- Started in October 2012 with an aim of economically empowering the avocado smallholders around Eastern and Central Kenya, by developing a sustainable supply of quality avocados through improved agronomic practices, technical assistance and improved market access.
- Economic empowerment, targeting a result of additional steady income twice a year to the individual farmers, their households, groups and eventually strengthening the country's economy.
- Kakuzi PLC Partnership with the smallholder farmer is for the long term and securing an economic future for the generations to come.
- The program is designed to work closely with schools and other learning institutions. To introduce commercial agriculture to the younger generation at an early age seemed a noble idea at the inception of this program and we believe it still remains as such if not more resounding.
- We began with 8 groups and about 100 individuals. This number has since increased to 125 groups and 2,800 individuals and still growing. The program has also extended its reach from Central and Eastern Kenya, to numerous counties countrywide.
- The program is set to work directly with farmers and connecting them to the market thus enabling the same farmers to get money directly. In the past middle men have continued to service the avocado sector and benefited from it at the expense of the farmer.
- Due to the unfavorable conditions and unreliability of the middle men, farmers were reluctant to venture or further invest in avocado farming. Kakuzi is set to turn the tables.
- The Program continues to work with various partners. We wish to acknowledge the support from the Office of the President through local administration, the Ministry of Agriculture, Environment and the County government.

## **EXTENSION SERVICES**

- To demonstrate our commitment to this initiative, we have established a smallholder department headed by Senior Manager and extension officers who run the day to day affairs of the smallholders.
- The extension officers are allocated and divided to zones, regularly visiting the farmers groups and individual farmers, handling their day to day enquiries. For example an officer takes care of farmers interests in Kandara, Gatanga, Kiambu and Nyeri and another one is responsible for Maragua, Kigumo, Kangema, Mathioya, Kirinyaga and Embu.
- Further, field extension officers are available to cover country wide when required.



## **TRAINING.**

- Farmers' capacity building is carried out through organized trainings on Good Agricultural Practices in conjunction with other training partners.
- Farmers are also trained on general awareness on safe use of pesticides and the food safety requirements for fruits.
- Training is carried out at both the farmer's location and practically on our established farms.
- Training material is offered to the Farmers free of Charge in the form of training brochures on every aspect of production and a new SMS – text broadcast, alerting farmers directly on their mobile devices. Information periodically sent guides the farmers on the activities they should be carrying out on their trees at the particular time.



## **ORCHARD ESTABLISHMENT.**

- As part of this program, we assist farmers to top-work their local and or Fuerte trees with Hass.
- The top-working program is ongoing. We also provide healthy and well maintained avocado seedlings at a fee to our registered farmers when available.
- Farmers are also trained in correctly setting up their Orchards including spacing, orientation and planting.

We are committed to closely work with the younger generation, farmers, groups and institutions to continue to see the success of this program.

The epitome of this program will be when there is enough competition between the different players in the avocado field with translated improved income to the smallholders, prompt payments and a booming country economy.

Kakuzi Plc is here for the long term business partnership and empowerment of the farmer, "Growing the fruit together". ('Tukurie Matuda hamwe')

## **PAYMENTS / RETURNS.**

- Payments to farmers are done in two instalments; the first payment is done within seven days from delivery of fruit while the second payment (bonus) is paid at the end of the year. This is an advantage to the farmer as you are assured a steady income twice a year.
- The second payment is a profit-share and is market related.

## **PARTNERING WITH KAKUZI PLC.**

Farmers are urged to partner with Kakuzi Plc due to numerous factors that make us the market leader in East and Central Africa.

- Incorporated in 1927.
- Largest fresh Avocado exporter in the region commanding a large share of exported volume from Kenya.
- Established export market and clientele in place, with a network to tap into the growing avocado demand worldwide.
- Known for Quality products. (Brand recognition)
- Has its own Packhouse and Marketing channels.
- Has its own Orchards and many years of practical experience.

- Working directly with farmers. (Direct economic benefit).
- Provision of extension services Free of Charge.
- Training and knowledge transfer based on long experience.
- Long term development for improvement of avocado production and constant improvement of fruit quality and productivity.
- Strive to find a market for all the produce at best prices including negotiating reject fruit to oil at decent prices. (No waste to the farmers).
- Assurance of improved income. (Openness and trust).

## **STEPS TO INCOME IMPROVEMENT.**

For the smallholder to maximize on their returns, collectively, commitment is required to wholly deliver fruit to Kakuzi. The more fruit delivered and the bigger the fruit delivered the higher the returns to the individual farmers.

- We receive fruits in Kgs and the fruits are sold in Cartons and paid per carton.
- Price is dependent on Fruit Quality and Size.
- The better the quality, the better the price.
- The Bigger the fruit, the better the price.
- The better the price, the more money the grower gets.
- Quality Fruits.
- Mature Fruits.
- Hass cultivar.
- Non exportable can be sold for processing.
- Strength in numbers and farmers commitment to supply.

## **There are two payments.**

- First payment based on Packing report and Packout percentage.
- Second Payment (commonly referred to as 'Bonus') based on the Profit Margin and the number of containers of Export quality fruits delivered to Kakuzi Packhouse. (Smallholders cumulatively)

## **The second payment is highly dependent on: -**

- Count Size distribution.
- Share percentage will depend on number of Cartons of fruit exported from smallholders.
- The more the larger fruits, the better the second payment.

## Site Selection

**A**s the avocado is highly affected by water logging and Phytophthora root rot disease, selection of well drained sites need to be given top priority.

- Ensure there are no clay layers within a depth of 2ft. Avoid hollows where water accumulates even for shorter periods.



## Soil Analysis

- It should be done at least six months before planting. This allows time for required fertilizers to be applied and the soil to be conditioned ready for planting. This should be done with the help of the Area Agricultural/ Extension Officers.



Tractor Ploughing



Animal Ploughing

## **Soil tillage**

- Since most of the avocado roots occur within the first 600mm soil depth, it is important that hard pans are not created during ploughing.
- After ploughing, wheel traffic should be restricted between the trees especially under wet soil conditions to avoid soil compaction

## Seed selection and harvest.

**S**eeds are selected from healthy trees with the desired qualities e.g disease resistance, high yields etc. Fuerte seeds are preferred in this catchment. The fruit MUST be mature and free from disease.

## Soil preparation

- Nursery should be located in a site that has good drainage. Top soil is mixed with river sand at the ratio of 3:2. This means 3 wheelbarrow loads of top soil and 2 wheelbarrow loads of sand. Half kilo of agricultural lime is added to this mixture to neutralize acidity. Planting pot are then filled with this soil and stacked in beds.



## SEED SOWING AND ESTABLISHMENT

- The ripe fruit is cut and the seed removed. The skin on the seed is removed and the seeds kept in a cool, dry environment ready for sowing.



## GRAFTING

At 5 months from the sowing date, the seedling will have hardened properly and attained pencil thickness. This is the best time to graft. The following basic items are needed to carry out grafting:

- Secateurs.
- Grafting knife.
- Grafting tape.
- Grafting tube.
- Jik- For sterilizing the tools.



## Wedge Grafting procedure:

- Cut the rootstock off at a right angle to the upright shoot at the grafting level.
- Make a vertical cut to a depth of about 30mm at the center of the rootstock.
- Cut the scion to a wedge shape on the opposite sides, so that the sharp edge is about 30mm long.
- Use the grafting knife to force open the vertical cut in the rootstock and insert the wedge scion carefully, as far as it will go in.
- Use a PVC tape to tie the graft union.
- Use a grafting tube to cover the scion as shown on the photo



## MAINTENANCE

Fertilizers both granular and foliar are applied to boost the growth. Fungicides and insecticides are applied based on the observations made.



## SUMMARY

The following guide applies to timelines for various activities.

Sowing- germination	1 month
Germination -grafting	4 months
Grafting - hardening	5 months
Hardening - issue	2 months
<b>TOTAL</b>	<b>12 Months</b>

# PLANTING

## Planting and bringing the tree to bearing

- When planning a new orchard, the following aspects need to be involved: soil type, climate, and availability of irrigation water, management skills and cultivar to be planted.

## Orchard layout and spacing

- Set in a rectangular system that allows for movement of orchard equipment between the trees for spraying, and harvesting .
- Pruning may be required.
- Spacing of Hass avocado can vary from **5 M x 5M** to 9M x 5 M but the final decision of this rests with the grower.



5M X 5M Spacing

## Direction of rows

The tree rows should be planted as close as possible in an east-west direction for maximum sunlight on both sides of the trees. The tree drip area should be kept clean of any growing crop but should be mulched.

## Planting procedure

Make sure that at the time of planting the soil is clean of weeds in the planting rows, the irrigation has been installed and is in a working condition and enough stakes are available for supporting the trees directly after planting.

## Hole size and positioning

Trees should be kept upright and out of direct sunlight until they are physically planted. Planting holes can be dug with a hoe and spade and needs to be 2ft x 2ft x 2ft

## Removing paper

- When ready for planting the bag is carefully cut open along one side without disturbing the root system. Loose soil is piled into the planting hole so that the soil level of the avocado tree will be 1/3 above the ground.
- The tree is then kept upright and the hole is filled with soil and firmly pressed down. Fill to the soil level of the planting bag

## Watering

- Water the avocado tree directly after planting. Afterwards regular light irrigation every 2 to 3 days is necessary to keep the root system from drying out.

## Mulching

Mulching around the trees will also prevent drying out of the soil and will keep the root system cool and active .



*mulching*

## supporting

- Use 1.8 to 2.0m treated poles/bamboo sticks for this purpose and plant them +/- 50mm away from the main stem of the tree.
- Do not fasten the trees too tightly against the pole, but rather loosely. Ensure the stake is not placed within the root zone.



*supporting*

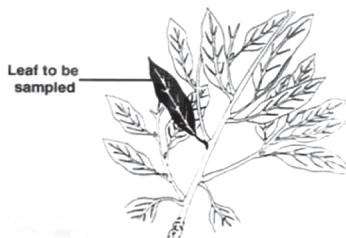
## FERTILIZER INPUTS

In general avocado orchard Fertilization is based on 3 broad facets;

- Leaf and soil sampling
- Crop removal
- Observation

**Leaf sampling:**

- Should be done annually, preferably between Feb-April (6-8 month old leaves)
- Can represent an area of up to 3Ha (Up to 7 acres).
- Leaves sought from non-fruiting branches that don't have new flush from stress-free trees.
- Take leaf approximately in the middle of branch, within the canopy.
- Selection of trees that represent the orchard.
- Place samples in clean plastic/perforated bag and take to lab within 2 days.



**Soil sampling:**

- Done every 2 years and is used to show the chemical composition of the soil.
- Topsoil (0-30cm) and subsoil (30-60cm) samples should be collected separately.
- Subsoil sample only required prior to planting.
- A sample consists of a combination of at least 10 samples collected in W or M pattern.
- A soil sample should be preferably taken from the same marked trees from which the leaf samples have been taken.
- A soil sample MUST NOT be taken soon after fertilization since it will contaminate the soil and lead to erroneous results.

### **Timing:**

- It's most important to do the initial lime applications before planting, basing on pre-plant soil analysis.
- Subsequent lime applications should be done soon after harvest.  
(Late Aug, Sept/Oct)

### **Liming products:**

- Dolomitic lime-contains both Ca and Mg. Most recommended
- Calcitic lime-contains Ca. Recommended for soils with low Ca:Mg ratio of less than 2
- Gypsum-Contains Ca+S
- Agricultural lime-Contains Ca

### **Rates of application:**

- Amount of pre-plant lime application depends on soil pH, exchangeable Al and clay content. Not to exceed 3 tons in a single application.
- After planting, regular lime application at 1–3Ton/ Ha every 2 years following soil analyses.

### **Application:**

- Apply by hand in the root zone (under canopy).
- Ensure to spread the lime as even as possible-Do not apply in lumps.

### **Phosphorus (P)**

- P is important for development and stimulation of root growth.
- Roots enable the avocado tree to access and uptake water and soil nutrients as well as providing anchorage to the tree.



# KAKUZI AVOCADO M

## THEME: GROWING T

### TUKURIE M

Phenology	Details	Justification/ Reason	Aug
	Note that timing of phenological events eg. Flowering/flush differs between areas, cultivars and seasons. Management should be according to phenonological events and not calendar months		
Foliar Sprays	Boron	Solubor / Borax	Only if B leaf levels <30mg/kg
	Boron + Zinc + Calcium	Solubor/Borax, Zincitrac ZnNO3 & Calcimax	Only if B leaf levels <45mg/kg, and/or Zn levels < 30mg/kg, Ca levels <1.0 mg/kg
	Zinc + Calcium	ZnNO3 & Calcimax/ CaNO3	Only if Zn leaf levels <45mg/kg, and/or Ca leaf levels <1.5 mg/kg
Soil Applied Fertilizers	Lime	Calcareous / Dolomitic	Dolomitic lime can also be used if Mg deficiencies exist
	Phosphate	TSP@ 10g/ Tree drip area,	Pleaf <0.15mg/kg, and/or soil <40mg/kg
	Boron	Solubor 21% @ 1g/Tree drip area x 3 rounds	Only if B leaf levels <40mg/kg
		Borax 11% @ 3g/Tree drip area.	B leaf < 55mg/kg & B level maintenance
	Zinc	Zn sulphate 13% @4g/Tree drip area	Zn leaf levels < 30mg/kg
	Gypsum	30g/Tree drip area.	Only if fruit & leaf levels are low (Fruit < 0.5mg/kg and/or leaves <1.5mg/kg)
	Nitrogen	CAN @ 12.5g/m <sup>2</sup> Tree drip area	Only if N leaf levels < 1.5mg/kg N supplied by nitrate/ MAP / Organic matter
	Potassium	K2SO4 @ 20g/m <sup>2</sup> Tree drip area or MOP @ 20g/m <sup>2</sup>	Only if leaf & soil levels are low ( Leaf < 0.8mg/kg, and or soil < 150mg/kg)
	Leaf & soil samples	Soil sample every 2 - 3 years Leaf sample annually	To determine nutrient levels
Disease Control	Copper sprays	Hass	Under wet humid conditions with >20°C
	Tree Injections	POTPHOS - After vegetative flushes hardened off/beginning of root flushes @ 60mg/tree	To limit P. cinnamomi infectionW
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 with 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 hives/ha + remove before insect sprays start	Target: 4 bees/m <sup>2</sup> of flowering canopy
	Irrigation	If available contact extension officers	
	Tree Management	Pruning	Light penetration/ tree height control of canopy management of vegetative flushes
		Mulch	Improve water infiltration and tree health, limit root rot
	General		
			Establish cover crops



# MANAGEMENT CHART THE FRUIT TOGETHER STUDA HAMWE



PIN HEAD SIZE STAGE



#### PEA HEAD SIZE STAGE



#### **GOLEBALL SIZE STAGE**



## MATURITY STAGE

## Phosphorous Products:

- TSP
- SSP
- Rock phosphate

## Timing:

- Pre-plant application is essential especially in low P soils.
- Subsequent Phosphorous is best supplied in split applications made to coincide with major root-flushes March-May, Sept-Dec).

## Application

•SSP, , TSP, , rock phosphate are hand applied either pre-plant by incorporating in the topsoil that will hold the seedling or around the root-zone for already planted trees.

## Nitrogen (N)

- N is important for growth, flowering and fruit-set of avocado plants.
- Low nitrogen can be manifested by any of or a combination of the following; small and few fruit, premature leaf shedding and pale green leaves (yellowing of leaves).

- Excessive N lead to highly vegetative trees with dense foliage, large and deep green leaves.
- Organic Matter besides other purposes is a good supplier of N especially for small scale context.
- Every 1% O.M in a soil releases 30Kg/Ha/annum of N for use by the plant. This is a generous supply of N considering the small scale farmer has ready access to organic material.

## **N Products:**

- CAN
- KNO<sub>3</sub>
- CaNo3, MAP, DAP, KNo3 also supply N besides other nutrients

## **Timing and rates of application:**

- N and K fertilizers should be split into applications targeting the active growing period for young trees.
- For bearing trees, N should be split into 3 major applications;
- 20% before full flowering( Sept)

- 40% to coincide with spring vegetative growth (Mar-Apr)
- 40% to coincide with summer vegetative growth (Dec-Jan)

## Potassium(K)

- K is important for both yield and fruit quality especially in mature trees.

### K Products;

- $\text{K}_2\text{SO}_4$
- $\text{KNO}_3$
- $\text{KCl}$
- MOP

## MICRONUTRIENTS

Essential micronutrients include;

- Zinc (Zn)
- Boron (B)
- Manganese (Mn)
- Molybdenum (Mo).



Most common deficiencies shown by

avocados include Zn and B. Mn deficiencies, though not common can be induced by excessive liming and P applications. Excessive leaf Mn can be toxic to the avocado trees.

### Boron

- Boron is essential for good flower formation, pollen viability and fruit set.
- In cases of severe deficiency, apical and axillary growing points die off, leaves are distorted (crinkled and with holes), the midrib and main vein on the lower surface are frequently split and young twigs may swell.
- Boron treatment can be achieved through soil application of

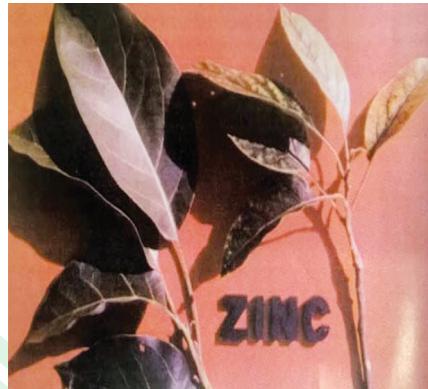
Borax or Solubor or foliar of solubor.



## Zinc

**Z**inc deficiencies are characterized by chlorosis (yellowing) of young leaves and rounding of the fruits.

- Zinc may be applied with ZnSO<sub>4</sub> soil application.



## **Crop factor**

- Denotes the amount of nutrient that is removed when fruit crop is harvested. Besides leaf and soil analyses guideline in fertilizer calculation, the expected nutrient removal in the harvested crop should be replenished through fertilizer application.
- The below table indicates the amount of element nutrients removed for every ton of fruit harvested.
- Crop removal

ELEMENT	N	P	K	Ca	Mg	Zn	B	Fe
Kg/ton	7.5	1.4	12.5	4.6	2.2	0.24	0.08	0.08

## MACRONUTRIENTS

### Lime

- Soil acidity: presence of high exchangeable Aluminum ions +low soil pH.
- These leads to leaching of essential plant nutrients such as Calcium, Magnesium, Potassium. Soil acidity is correlated to avocado fruit yield.
- pH of **5.8-6.5** and exchangeable Al content of 20mg/Kg is optimal for avocado trees.

## Proposed fertilizer program BORAX

Month	Nutrient	Fertilizer	Rate/Ha	Rate/Tree	Remarks
	Element	To apply			
JAN	K	MOP	80-120Kg	200-400g	
	ZnSO4	ZnSO4.	10-15 or 20-30	60-100g	Apply in lumps-Do not spread
	N	CAN	30—50 kgs	80—120 gms	
FEB	B	BORAX	20-30Kg	60-100g	
MAR	N	CAN	30-50Kg	80-120g	
	K,S	K2SO4	120-150Kg	300-600g	
APR	P	TSP	60-100Kg	150-300g	Meant to replenish P, Apply annually
	P	Rock Phosphate.	80-120Kg	200-400g	Apply only when soil analysis indicates very low hence build up
MAY					
JUNE	B	Solubor/Borax	20-30Kg	60-100g	
JULY					
AUG	Ca,N,Zn, S	CaNo3+ZnSo4	(15-25, 15-25,) Kg	(50-80, 50-80) g	Apply together just before flowering upto early flowering stage
	Raise pH	Lime (Immediately after harvest)	500Kg-2000Kg	2-5Kg	Apply every 2-3 years. Base rates on soil analysis
SEPT	B	BORAX	20-30Kg	60-100g	
OCT	Raise Ph, Ca	Apply Gypsum	500Kg-2000Kg	2-5Kg	Apply every 2-3 years. Base rates on soil analysis
	N	CAN	30—50 kgws	80—120 gms	
	K	MOP	80-120Kg	200-400g	
	ZnSO4	ZnSO4.	20-30Kg	60-100g	
NOV					
DEC	B	Solubor/Borax	20-30Kg	60-100g	

# IRRIGATION

## When to irrigate.

The most efficient way to water is to apply water when it begins to show signs of stress from lack of water.

- It's paramount to avoid water stress unless it's by design to induce it; lest one may incur massive crop loss on both quantity and quality. The following signs are indications of water stress;
- Footprints or tire tracks that remain in the grass long after being made.
- Many leaf blades folded in half.
- If a soil sample sought from a profile 1-2ft deep is not pliable and shreds into soil droplets upon dropping to the ground.
- Premature fruit drop and/or flaccid fruits on trees.

## Efficiency of water application

- An efficient watering does not saturate the soil, and does not allow water to run-off.
- Avoid extremes in watering frequency and amount. If you apply too much water, it runs off and is wasted.
- On the other hand, light frequent watering is inefficient and encourages shallow/restricted root systems.
- Typically, 2-3 irrigation rounds per week in the peak irrigation periods is ideal. If rainfall occurs, irrigation should be suspended depending on rainfall amounts.

## Timing of irrigation

- The best time to irrigate is in the early morning hours and/or late evening. Watering during the day can be wasteful due to evaporation Avocado water requirement
- Avocados require 8000-9000 m<sup>3</sup> per Ha for the whole year, including water supply from rain.
- The avocado trees have varied moisture requirement in amount depending on the prevailing physiological stage.
- Aspects/stages directly influenced by optimal water regime on avocados include; Flowering, fruit set, fruit drop, fruit sizing and fruit quality.
- In this region, 50-60 m<sup>3</sup> suffices to supply adequate moisture to 1Ha of avocados in a 2 week cycle of irrigation in dry periods.
- This translates to 100-150 liters of water per tree in 2 weeks.
- In a week, 50-75 liters being applied per tree will supply adequate moisture to support the tree during peak demands.

- Below is a guideline on irrigation calendar for the small-holder farmer.

Period	Plant physiology	Irrigation status	Water volumes and rounds	Comment
Dec to Mar	Fruit set and rapid expansion	Irrigate fully until rains start	25-35 liters per tree twice every week	There must be no stress on trees
Apr to May	Fruit development	Do not irrigate		Rainy season
June to Aug	Harvest	Partially irrigate.	5-10 liters per tree once a week	Maintenance only
Sept to mid Oct	Dormant period	Do not irrigate		Stress prior to flowering
Mid Oct to Rains (Nov)	Flowering and fruit set	Irrigate fully	25-35 liters per tree twice every week	There must be no stress on trees

### Irrigation method options for a small-holder farmer

#### Drip irrigation.

- Install a drip-line in the orchard to be served by a tank through gravity. Ensure the tank is raised and/or installed on higher ground.
- 2 drip-lines to serve a row of trees.
- The tank can be filled with water by manually pouring using Jericans or through pumping.

#### Manual Irrigation.

- Entails manually transporting water in 5, 10, 20 or 30 liter containers sprinkling around the root zone.
- Care should be taken to avoid excessive water application that can lead to run-off.
- Water can also be applied using watering cans and these give a better distribution.

#### Mulching

- This is an important operation that helps retain moisture around the root zone.
- It's important to maintain mulch around the tree always.

## PESTS AND DISEASES OF AVOCADOS

It is good to note that avocado orchards enjoy natural enemies (predators and parasites) that are able to maintain a biological balance.

- Cultural control is also effective depending on the level of infestation.
- When both the biological and cultural control system are not working, selective use of chemical insecticides to control pests and diseases is necessary.
- This approach is referred to as IPM.

See pictures of common pests as a guide. Monitor for any other unique pests.



Adult mosquito bug and its nymph.

### MOSQUITO BUGS (*Helopeltis schountedeni*) - Stainers      Threshold: 0

#### *The Adult mosquito bug:*

- Feeds early in the morning hours, late afternoon and at night. They fly quite fast and thus have a potential to affect many fruits.
- *The nymph mosquito bug:*
- They don't fly and thus they only affect few fruits that are within their reach.
- NB: This is the best stage to control.
- To make decision on *control method* we monitor for the two stages of the pest and for the fruits damage.



### FRUIT FLIES Tolerance: 0

- The female lays its eggs under the rind of an avocado fruit .
- Careful monitoring using pheromone traps is critical to establish population levels when to control and the efficacy of control measures taken.

## Control.

- Both cultural and chemical methods are used.
- For chemical control, we bait. We use a protein bait as an attractant mixed with a chemical as the poison. Sprays are to continue until the trapped number reach 0 , and sprayed at low volumes.
- For cultural control method, the key thing is sanitation. Fruits fallen to the ground are also collected and disposed. Routine eradication of alternative hosts like guavas is also done.

## FALSE CODLING MOTH (FCM)

- It is a major phytosanitary threat.
- When eggs laid on the surface of the fruit hatch, the caterpillars bore into the fruit, rendering it undesirable for consumption and leaving the fruit vulnerable to plant diseases and rots. (see the photos).
- Fruit may also ripen and drop from trees prematurely. The resulting fruit loss and damage could potentially result in millions in economic losses. The fruit is prone to secondary infections.



*Adult moth.*



*Damage caused*

## SYSTATES WEEVILS

- Adult and Systate weevil damage.
- Notched (uneven) feeding on leaves is a classic sign of feeding by adult.
- This is significant on young trees and not on big trees.
- The pest hides in the leaves, mulch and soil.
- Control is difficult because of their behavior. Cultural method of control is practiced. If the pressure persists, chemical control is done.
- The timing of spray is critical.



## PEST AND DISEASES.

- When you see diseases on the tree, the damage is done.
- Early detection is a great plus.
- Anthracnose & Collecto-trichum
- 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”.
- These diseases are most likely to occur during wet conditions.
- When the fruit is small, i.e. smaller than pigeon egg size, it is not susceptible.
- Fruit bigger than this size is susceptible to infection at any time under favorable climatic conditions for the fungus.
- Control with copper



*Can be controlled with well timed applications of copper*

## ROOT ROT MANAGEMENT.

### i). Soil Selection

- Well drained and Well aerated
- NB Ridging/ mounding

### ii) Resistant/Tolerant Rootstocks

- 'Dusa', 'Duke 7', 'Bounty',
- Disease-free nursery trees

### iii). Irrigation Management

- Beware of over-irrigation in sick trees
- Use of Micro-jet or drip irrigation for better control

### iv). Chemical Control

- Young trees use Alliete paint
- Mature trees inject with Phosphorous acid.



# HARVESTING



**H**arvesting is prompted by maturity of fruits. The main criteria is by oil content and is done in our laboratory by collecting fruit samples from field. This is the most reliable method to test maturity.

- Maturity can also be determined by appearance of the fruit. Immature fruit is light green with a shiny appearance while a mature fruit is dark green and an over-mature fruit has patches of purple on the skin.
- Maturity can also be determined by seed coat. It's done by cutting unripe fruit into two halves using a sharp knife. If the seed coat is dark brown and tissue thin, the fruit is probably mature.
- Immature fruit may be rejected in the market since it does not ripen well. Determining maturity is most important early in the season.

## Picking

- By careful harvesting one can get a higher return for fruits. Remember avocados are easily bruised or scratched.
- Pick when it's not raining.



## Care in picking

- Wear cotton gloves
- Do not pull fruit from the stalk.
- Clip the stem as close as possible without injuring the fruit
- Lay fruit on the ground with some protection underneath it or use crates if available
- Use proper picking equipment such as ladders, pole clippers and canvas picking bags.
- Do not drop fruit as it will cause mechanical injuries.

## Care in handling

- Do not overfill field boxes or crates as top fruits will be bruised
- Store the picked fruit in shade or cover the top box with leaves.
- Transport fruits to pack house as soon as possible.

### Fruit sizes

- Fruits are packed according to their sizes
- Sizing is done by machine which determines fruits of the same mass to fall on the same place.
- Fruit sizes is given by the number of fruits with almost the same mass and added together to make a net weight of 4 Kgs in a carton.

Sizes	Grams
<b>12</b>	<b>300- 371</b>
<b>14</b>	<b>258- 313</b>
<b>16</b>	<b>227- 274</b>
<b>18</b>	<b>203- 243</b>
<b>20</b>	<b>184- 217</b>
<b>22</b>	<b>165- 196</b>
<b>24</b>	<b>151- 175</b>
<b>26</b>	<b>144- 157</b>
<b>28</b>	<b>134- 147</b>



*Mass specification*

### Rejects

#### *What causes rejects;*

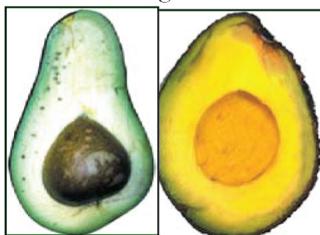
- Fruit malformation
- Pest and disease
- Immature and over mature fruits.
- Lenticel damage
- Mechanical damages
- Weather conditions-harvesting during rainy season.
- Poor storage facility
- Sunburn



*Insect damage*



*Lenticel damage*



*Pulp spotting*

*Stem end-rot*

*Vascular browning*

### Transportation

- Do not put in plastic bags
- Do not overload vehicles
- If possible transport in crates .
- Cover the floor and sides of the vehicle with thick banana leaves to secure fruits.

## **AVOCADO RECEIVING AND POST-HARVEST HANDLING**



### **RECEIVING**

The small holders (SH) vehicle is weighed at the weighbridge and gross weight is measured.

The SH registers entry of his vehicle at the askari with His full names, ID number, SH number and telephone number.

They proceed to the smallholder bay to offload the fruit.

The avocado is to be offloaded onto a crate on top of a pallet carefully to avoid mechanical damage.

Do not overfill the crates, and each pallet should have 30 crates per pallet. The fruit is weighed again by the receiving clerk and a Goods Receipt Note is raised for the avocado received from the farmer.

The farmer is given a tag to be able to identify his fruit.

This tag has: Farmer name, Number of crates, date delivered and GRN number.

This tag is to be placed on every pallet the individual farmer has brought.

Every pallet has a unique pallet number with the weight indicated. This helps in calculating the tare weight.

Principle of first in first out is used when processing the smallholder fruit.



### **POST-HARVEST TREATMENT**

The fruits are then tipped over the line onto a soft conveyer belt.



The avocados are first spray cleaned with plain clean water over soft brushes to remove dust and other dirt.

They are then rolled over to the second wash basin that has chlorinated water.

This chlorine is added as a disinfectant to the avocado.

Sorting out of visibly non export avocados is done after the second washing bay.

The fruits are then dried by passing them under hot air for a few minutes and proceeds to packing.



### **PACKING AND COLD STORAGE**

Packing of export fruit is in both 4kg cartons and 10kg cartons

Sizing is done by machine which determines fruits of the same mass to fall on the same place.

Fruit sizes is given by the number of fruits with almost the same mass and added together to make a net weight of 4 Kgs or 10kgs in a carton.

Cold chain management is essential to ensure good arrivals to our agents in Europe.



Maximum hours avocado should spend from being harvested to reach the cold room is 24 hours so as to slow down the ripening process.

### **EXPORT AND PAYMENTS**

Kakuzi PLC pays farmers twice. The first payment is done after seven days of delivery.

Second payment is based on how well the market performs.

The company agents place the fruit in markets to achieve the best returns.

This is a collective responsibility of the farmers and should ensure maximum deliveries to increase profit margin.

## PRUNNING

**P**runing is an essential operation to ensure that trees in an orchard remain economically viable. Reasons for pruning include;

- To promote light penetration into the tree, thus keep the shoots active.
- To maintain the framework hence training for size and shape for effective light utilization, air movement and manage tree height.
- To maintain size and shape for optimal tree and orchard management eg tractors can move within the orchard with ease.
- To encourage regular shoot and branch renewal, rejuvenating growth ensuring availability of new wood for fruiting.
- To obtain tree complexity for maximum bearing units thus maximizing production
- To open up the trees hence reduce instances of fungal disease spread hence reduce instances of fungal diseases.eg Cercospora
- To rehabilitate older trees.
- Reducing plant tree vigor in water shoot removal.



Farmers trained on proper pruning on their farms using a pruning saw

## TRAINING YOUNG TREES.

- Training starts in tree seedlings whilst in the nursery. This entails selection of the strongest upright growing branch as a leader. There is also the removal of any other strong branch developing on the tree to curb competition for energy and nutrients.
- Furthermore, horizontal side branches are spread evenly along the main stem to ensure that a strong frame, balanced framework will develop.
- Tree height can be maintained at 4.5 m
- During the rest of the growing season, removal of water shoots has to be done continuously while horizontal growing branches are tipped sparingly to stimulate side shoot development hence achieve branch complexity.
- As a guideline, any branch thicker than half the thickness of the leader is removed whereas any branch thicker than a third the thickness of the leader is pruned back severely to control its vigor.

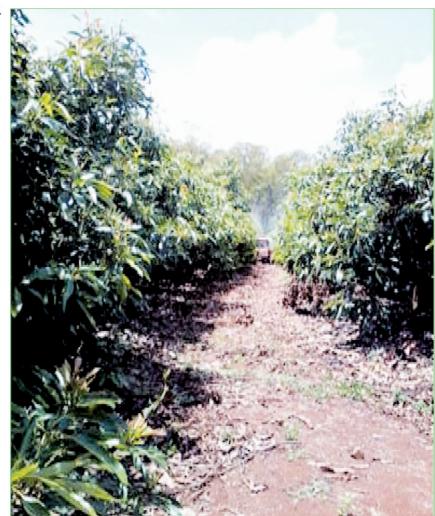
- In the 1<sup>st</sup> year, several actions are taken;
  - Selection and developing of the leader.
  - Removal of leader competition
  - Inducing shoot complexity.
  - Developing a well-balanced branching system (framework).
- In the 2<sup>nd</sup> year, the following actions are taken;
  - Water shoot and unwanted shoot removal
  - Shoot and branch thinning for light penetration.
  - Besides these operations, shoots developing too close together are thinned.
  - From the 3<sup>rd</sup> year onwards, this regular and timed pruning continues to enhance the shape of the plant.
- A **pyramid shape** is preferred as the best shape for avocado optimum crop production. To curb massive loss in production after pruning for shape achievement, one side of the tree rows running is pruned singly in a season after which the other part is pruned in the following season. Concurrently, **branch renewal** is done after harvest to maintain branch vigour for good production.
- This is done by pruning back the branch to a new developing branch inside the tree.
- **The height** of the tree is maintained at 70% of the work-row width to ensure adequate light interception into the rows onto the lower parts of the adjacent rows thus curbing the would-be shading effect if the trees were to be left to increase excessively in height.
- **Watershoot removal** remains a continuous operation in the tree management.
- Pruning is a tool that is used to rehabilitate older trees. Trees older than 12 years are usually very high, and equally wide.

- Pruning is a tool that is used to rehabilitate older trees. Trees older than 12 years are usually very high, and equally wide.
- This makes irrigation, spraying, picking, fertilizer application and general orchard management cumbersome. Production declines as well as fruit size and quality.



*Balancing shoots and branches for light penetration.*

- Heavily encroached orchards require a 3-year pruning programme to reduce the tree size and open up the orchard. Overhanging branches are removed completely to ensure that sunlight reaches into the tree up to the base. Any upward growing branch branches on the outer edge of the tree are removed. These diminish energy reserves by producing wood rather than fruit.
- Height control up to 70% of the work-row tree then starts in the 2<sup>nd</sup> year. Shaping of the tree to achieve pyramid shape also starts. Continuous water shoot removal also continues. Maintenance pruning then continues from here.



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100% Pure Natural Kakuzi Honey.

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& Timber requirements.

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For all your Choice Kakuzi  
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**Kakuzi Livestock.** Pure Boran cattle for all your livestock needs.

# Notes



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