KENYA AGRICULTURAL AND LIVESTOCK RESEARCH ORGANIZATION

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FACTSHEET FOR TECHNOLOGY INNOVATORS WORKING WITH SMALL HOLDER FARMERS IN KENYA

KALE

INTRODUCTION

- Kale is a member of the Brassicaceae family which includes crops such as Cabbage, Cauliflower, Broccoli, and Radish. A popular leafy vegetable in Kenya grown mainly for the domestic market.
- Kales has a valuable source of vitamins (A, B, Folate) and minerals (Ca, K, Mg) Other vitamins present include Riboflavin and Niacin.
- A source of income for most smallholder farmers.Kales has a lower cost of production compared to other horticultural crops.
- Varieties include collards, marrow stem and Thousand Headed are the most common varieties, other varieties include Mfalme F1 and Moss Curled Kale.

SITE SELECTION

Altitude range

- Kale does well at altitudes of 800-2200M above sea level.

Soil type and conditions

- Kale requires fertile, well-drained loam soils with high organic matter content and high water holding capacity. The optimal soil pH range is 5.5 – 7.0.

Temperature range

- The temperatures should be 15 – 30 °C.

Rainfall

- Kale requires sufficient amounts of moisture throughout the season.

A well distributed rainfall of 300-500mm is ideal for optimum yield. Irrigation is recommended if rainfall is inadequate.

LAND PREPARATION

- Early land preparation is recommended in order to expose pests to sunlight and birds.
- Ploughing should be done 2 to 3 weeks in advance at about 7-9 inches deep, followed by harrowing, 2 to 3 weeks after ploughing then preparation of the soil to a fine tilth.

Crop residue can significantly increase the organic content if incorporated into the soil.

PLANTING

Varieties and their attributes

Variety	Attributes
 Collards	• Tolerant to Soft Rot and Black Rot. • Widely adapted even to warmer areas. • Flowers after a short period of harvesting. • Yield: 15,000kg per acre.
 Mfalme F1	• A prolific variety of long harvesting period of more than a year. • Harvesting starts 45 days after transplanting. • Has uniform dark bluish green leaves. • Has soft tender leaves that are easy to cook. • Very sweet taste, non-acidic and highly palatable.

	• Yield: 15,000-20,000kg per acre depending on level of management.
 Thousand Headed	• A popular variety with succulent leaves. • Extended production period of up to 3 months. • Yield: 10,000kg per acre.
 Moss Curled Kale	• Dark curly leaves that are very tasty. • Not a commonly grown variety. • Yield: 15,000kg per acre.
 Marrow Stem	• Dark green leaves with sweet taste and little • fibre • Good digestibility • Low dry-matter content • Yield: 12,000kg per acre

Raising Seedlings

- Use certified seed with special attributes, such as tolerance/resistance to pest and diseases and high yielding.
- The seed rate is about 50 g per acre.

Nursery Site Selection:

- The nursery should be located in a plot that has not been planted with crops in the *Brassicaceae* family for at least three (3) year.
- Land close to the homestead (for security) and near source of water.
- Well exposed to the sun, but protected against severe heat.
- Well protected against animal damage and strong wind.

Nursery Establishment:

- Prepare a seed bed of 1 m width and of convenient length.
- Make 2 cm deep drills on the seedbed at a spacing of 10 – 15 cm apart.
- Thinly sow the seeds in the drills and cover lightly with soil.
- Mulch and water the nursery beds.

Management of Nursery:

- Water the seedlings regularly.
- Avoid over-watering which can lead to "Damping-off" disease.
- Start hardening the seedlings 1 – 2 weeks before transplanting by reducing the frequency of watering and the shade over the nursery.

Note: It may be effective to raise seedlings in pots (potting) in order to improve percentage take and avoid overgrowing in the nursery.

- Seedlings are raised in the nursery and are ready for transplanting after 4-6 weeks, after attaining 3-4 leaves and they should be about 10 cm tall.
- Harden the seedlings before transplanting by reducing the rate of irrigation a week before transplanting.
- Kale is a cool-weather crop that can tolerate temperatures as low as -6 - 7°C, it does not tolerate heat.
- Timing of Planting (direct seeding or transplanting) kale is necessary so that it comes to harvesting before daytime temperatures exceed 26°C.

SOIL AND WATER CONSERVATION MEASURES

- Practice conservation farming approaches, minimum soil disturbance, permanent soil cover, crop rotation and soil water conservation measures.
- Kale requires an optimal amount of 750 mm of rainfall during the growing period in areas with lower rainfall, water deficit problems should be addressed through irrigation
- Mulching, planting of cover crops and use of higher organic matter content increases soil moisture holding capacity.

SOIL FERTILITY REQUIREMENTS AND MANAGEMENT

- Maintain soil health for good production and income.
- Test soils first to guide application of manure and fertilizer.
- Generally, during planting / transplanting apply fertilizer (TSP) at the rate of 80 kg/acre.

ROUTINE CROP MANAGEMENT PRACTICES

Weeds control

- Kale does not compete well with weeds and therefore the field should be kept weed-free.
- Weeds cause significant losses as they compete for growth factors like nutrients and water and prevent pathogens which could attack the crop.

Topdressing

- Two (2) split applications of CAN are recommended to replenish soil nutrient status
- First split is applied at a rate of 40 kg per acre (20 g CAN per plant) when plant are 20 cm tall or two weeks after transplanting.
- Second split application is applied at a rate of 80kg per acre 3 weeks later.
- Placement method is recommended as it is more effective and economical.

Top-dressing by placement method

DISEASE AND PEST MANAGEMENT

Pest management

Aphids

Identification:

- Aphids are pale green or light green to yellowish green and are usually covered with a light dust of mealy powder, but some types of aphids do not form mealy powder.
- They suck plant sap from the central part of the plant and near the base of leaves.

Damages:

- Aphid attack results in curled, discolored and distorted leaves.
- Large colonies of aphids are found on the underside of kales leaves during drought causing stunted growth.

Control:

- Field hygiene through removal and destruction of crop residue and alternative wild hosts.
- Use of insecticides, such as Lambdacyhalothrin (KARATE 2.5WG®) PHI: 3 days.Thiamethoxam (ACTARA 25 WG®) PHI: 7day,Deltamethrin (DECIS 2.5EC®) PHI: 1day.

Sawfly

Identification:

- Adult insect resembles a fly except for the presence of 2 pairs of membranous wings with dark head and thorax and bright abdomen.
- Eggs are laid singly inside the leaf.
- The grayish green larvae with a black head and more than six pairs of legs.

Damage:

- Windows on leaves from feeding by larvae.
- They feed on the blade of the leaves often leaving only the main veins and midrib.

Control:

- Destruction of wild plants in the Cruciferae family.
- Use of appropriate pesticides such as Methoxyfenozide 240 g/L (RUNNER 240 SC PHI: 10days),Pyrethrins 40g/L (PYAGRO 4 EC).

Cutworms

Identification:

- The grayish black larvae that curl up tightly when disturbed.
- They are often found hiding in soil near the cut seedlings.

Damage:

They girdle and cut-off young seedlings at ground level during the night dragging them into the tunnel in the soil and feed on them during the day.

Symptoms:

Cut stems,attacked plant wilt and die.

Control:

- Hand removal since the pest is easily found near the damaged plant, especially at the beginning of infestation.
- Early weeding destroys sites for egg laying.
- Flooding of the field for a few days before sowing or transplanting can help kill cutworm caterpillars in the soil.
- Chemical control: (drench at the base in the evenings),Lambda-cyhalothrin 25g/L (TATA UMEME 2.5EC®(PHI: 3days), Halothrin .5EC®(PHI: 3days),Alpha-cypermethrin (ALPHA CYMBA 10EC®(PHI: 3days)

White flies

Identification:

- Adult whitefly resembles small white moth – like insect which cluster on the underside of upper leaves from which they suck sap.
- Eggs are laid in arc or circle on the underside of young leaves.
- When eggs hatch, they produce greenish white nymphs which resemble scales.

Damages:

- Suck plant sap and remove nutrients which cause yellowing of infested leaves.
- The larvae secrete honey dew which supports growth of black sooty mould.
- Transmit viral diseases, especially Tomato Yellow Leaf Curl Virus (TYLCV).

Control:

- Keep kale fields weed-free.
- Use of yellow sticky traps to monitor their population levels.
- Cover kale seedling nurseries with nylon nets or insect proof nets to protect seedlings from Whitefly infestations.

Use of insecticides,Amitraz (Mitac 20EC®) – Buprofezin (Applaud 40%SC®) – Azadirachtin (Nimbecidine®) – Imidacloprid (Confidor 70 WG®) – Lambda Cyhalothrin (Karate 2.5WG®) – Lambda- cyhalothrin + Thiamethoxam (LEXUS 247 SC®).

Disease management

Powdery mildew *Golovinomyces orontii*

General Descriptions:

This is a fungal disease that affects a wide range of plants.Powdery Mildews are severe in warm, dry climates.

Symptoms:

Appears as white, powdery spots that may form on both surfaces of leaves.Leaves infected with Powdery Mildew may gradually turn completely yellow,die, and fall off.

Control:

- Crop rotation
- **Cultural Control:** Remove infected leaves to reduce the spread.
- **Chemical Control:** Use of **fungicides**, such as Sulphur (COSAVET DF) PHI: 3days,Sulphur 800g/L (FLOSUL PLUS) PHI: 3days).

Leaf spot *Alternaria alternata*

General Descriptions:

This is a seed borne fungal disease. Infected compost is the source of the inoculum and it is spread by wind.

Symptoms:

Circular brown grey spots on the leaves which are often bordered by a green margin and with black – specked concentric zones.

Control:

- Use of certified seeds.
- Field sanitation-remove and destroy infected plants.
- Crop rotation for at least 2 years.
- Use of fungicides, such as Copper Oxychloride (COBOX 50 WP®) PHI: 3days.

Downy mildew *Peronospora sparsa*

General Information:

This is a fungal disease that affects various types of plants.Downy mildew is worst in cool, shady climates.Conditions that favour disease development include:

1. Cool, moist weather conditions.
2. Host weeds found in between the crops.
3. Crop residues in the field.
4. Poor plant aeration.

5. Overcrowding (planting in high densities).

Symptoms

- Symptoms of downy mildew infection include small, pale yellow spots with indefinite borders on the upper leaf surface.
- Purplish discolouration of the upper leaf surface is seen on some hosts.
- A downy growth (sporangiophores) may be seen directly under the spots on the underside of the leaf, on fruits or on stems early in the morning or when foliage is wet.
- Older leaves usually remain attached.
- Affected areas on the leaf enlarge and turn brown and papery.
- When the disease is severe, whole leaves die.

Symptoms of downy mildew on upper leaf.Photo by Yuan-Min Shen, Taichung District Agricultural Research and Extension Station (CC BY-NC).

Symptom of downy mildew on lower leaf.Photo by Gerald Holmes, California Polytechnic State University at San Luis Obispo (CC BY-NC).

Downy mildew sporulation (white masses) on the underside of a collard leaf. Photo from Dr. Tony Keinath.

Control

- Practice crop rotation with non-brassica crops.
- Use disease free planting materials, e.g. transplants.
- Provide adequate plant spacing to reduce the density of the canopy and increase aeration.
- Uproot infected plants and prune infected leaves.
- Avoid overhead watering; It lengthens the duration of leaf wetness and favours further development of the disease. Instead consider irrigating during the late morning to facilitate rapid leaf drying or use drip irrigation.
- Remove all crop residues/plant debris after harvest to reduce inoculum level
- Plant resistant or tolerant cultivars.
- Maintain a balanced program of nutrition. For instance, deficiency of potash increases the susceptibility of seedlings to downy mildew.
- Remove any source of spores, e.g. heavily infected trays of seedlings, old infected seedlings, and weedy crucifer weeds.
- Choose planting sites with good air movement and without shading.
- Inspect crops for symptoms regularly.
- Carbendazim (2-3g/ lit), difenocozole (e.g. Score, 5ml/10lit water) and mancozeb (2-3g/1lit water) can be used as field sprays.

Black Rot *Guignardia bidwellii*

General Descriptions:

This is a seed borne bacterial disease. Black rot infection and spread is favored by wet conditions and high temperatures (20 – 30 0C).Crowded plants provide conditions that are ideal for bacterial spread to nearby plants.

Symptoms:

- In early stage, yellowish brown V-shaped lesions are observed on the leaf margins of affected plants.
- On the margins of mature leaves, the veins become distinctly black.
- The lesions extend into the leaf, killing large areas of affected leaves.
- A cross sectional cut of infected stem reveals a characteristic black ring.
- Seedlings that are infected systemically become yellow, drop lower leaves, and may die.

Control:

- Use certified planting material.
- Use of tolerant varieties e.g.) Collards.
- Field sanitation (hygiene).
- Minimum two-year crop rotation.
- Spray copper fungicide (AMICOP 50WP, COBOX50WP®) when the first symptoms are seen.

Harvesting

- Harvesting Period begins 6 weeks after transplanting and can last for 4 – 6 months
- Kale is hand harvested either as a whole plant, shoots or just for its leaves.
- A picker should look for kale with firm, deeply colored leaves and moist hardy stems.
- Pluck the lower leaves each time leaving 3 –4 top leaves.
- When harvesting the leaves, always leave part of the stalk attached to the stem.

Harvesting Kales

Post-harvest handling

Grade the leaves by size, bunching those of the same size and tying in small bundles before packing in well ventilated container for transportation to markets.

Storage

- Do not store Kale together with ripening fruits or vegetables the ripening fruits and vegetables emit ethylene which causes yellowing of leaves.
- Kale can be wrapped in a damp paper towel, placed in a plastic bag and stored in the refrigerator for up to 14 –21 days.
- It should not be washed before storing since this may cause it to become limp.
- Store in a place with adequate air circulation.
- Alternatively, sell the produce immediately while fresh

Markets

- KAMIS is the source of market data (prices and volumes) in the Kenyan region AMIS Kilimo Call Centre 0800 724 891.
- Sauti Trade and Market Information Platform Dial *384*35#.
- TruTrade Venture Labs East Africa http://www.trutradeafrica.net/Tel: +254 (0)725 850 906

References

- The proposed agrochemicals are in accordance with "Products Registered for Use on Crops Version 1_2018". The registered agrochemicals are subject to change. Please refer to the latest registered agrochemicals by Pest Control Product Board.
- Infonet Biovision
- National Agricultural Commodities Market Information (NAFIS) http://www.nafis.go.ke/category/market-info/
- Taimba https://taimba.co.ke/ 254-709-790-00

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