AGRICULTURE AND FOOD AUTHORITY

HORTICULTURAL CROPS DIRECTORATE

Nairobi Horticultural Centre next to JKIA; P.O. Box 42601 – 00100; Telephone: 020-2088469, 020-2131560
Email: directorhcd@afa.go.ke, directorhcd@agricultureauthority.go.ke Website: www.afa.go.ke

CUCUMBER (*Cucumis sativus*) GROWERS MANUAL

PREFACE

Kenya has been endowed with an enabling environment for production of horticultural crops that attracts high demand both in the domestic and international markets. Production is mainly by smallholder farmers, many of whom require skills and knowledge on good agricultural practices (GAP) to produce and handle the fresh produce. According to the Economic Survey 2022 published by the Kenya National Bureau of Statistics (KNBS), horticulture is among the leading sub sectors in agriculture. Therefore, enhancing the capacity of these producers could be of immense beneficial to the Kenyan economy.

Agriculture and Food Authority – Horticulture Crops Directorate (HCD) is a government agency mandated to Regulate, Promote and Develop the horticulture industry in Kenya. In carrying out its mandate, the Directorate through the Technical and Advisory Services department (TAS) has developed this grower's manual for its stakeholders. The manual has been designed with a simple language and where necessary photos have been used to highlights all processes from plough to plate. HCD envisages that by using this grower's manual, its stakeholders especially the smallholder farmers, extension staff and trainers would upgrade their knowledge and skills to enable them increase production of the crops thereby improving on food security, household health, as well as create employment and generate income.

The content has largely been developed from the TAS field staff experiences in the 26 stations spread across the country (*Collins & Dinah – Nairobi [NHC], Antonina – Nakuru, Miriam - Nandi, Grace – Homabay, Barnabas- Eldoret & Iten, Carol - Bungoma, Peter- Busia, Charles -Kisumu, Irene - Narok, Lal – Kisii, Victor – Mombasa, Crispin – Kibwezi, Esther Ngutho– Kitui, Esther Kabatha – Nyandarua, Susan – Taveta, Syphrosa – Machakos, Catherine – Yatta, James – Kitale, Julius – Kajiado, Amedeo & Brenda – Meru, Mary – Kericho, David & Delphina – Mwea, Fridah – Nyeri, Emma – Sagana, Sarah – Limuru*), some content were reviewed from literature and images used properly acknowledged. Technical editing and reviewing of the manuals were done by Mary Chacha, Syphrosa Wanyama, Barnabas Kiptum, Antonina Lutta, Carol Soita, Amedeo Muriungi, Peter Mwanja, Victor Omari, Emma Ndirangu, Esther Kabatha, David Makori, Dinah Karimi, Collins Otieno, Dr Jacqueline Oseko the acting Deputy Director, Technical and Advisory Services department and Director Benjamin Tito all of Horticulture Crops Directorate.

CUCUMBER (*Cucumis sativus*) GROWERS MANUAL

Family Name: Cucurbitaceae

Introduction

Cucumber is a cultivated creeping vine plant in the Cucurbitaceae family that bears cylindrical fruits used as culinary vegetables. It is grown for its immature fruits great in salads, soups and dips. Cucumber is a good source of vitamin C, can be eaten raw, cooked or pickled. They are high in water content and very low in calories. Grows in a wide range of agro-ecological zones.

Varieties

Varieties include Carmen f1, Palomar, Colorado, Hybrid Victory, Donora F1, early fortune and yellow fellow.

Ecological requirements

Altitude: 0 - 1700 m above sea level

Rainfall: 800mm per annum and access to direct light of 6-8 hours.

Temperature: The optimum temperature ranges is 18-30^{o}C

Soils: Loamy, warm, and silt loam, rich in nutrients with an pH range of 6.5-7.

Good Agricultural Practices (GAP)

Horticulture industry in Kenya is guided by a code of practice (KS1758-2016 part II) which is a food standard for vegetable, fruits, herbs and spices for both local and export market. The standard aims at ensuring food safety, environmental sustainability and social accountability by following good agricultural practices from production, processing, transportation and marketing of fresh produce. It is essential to keep accurate records for all operations for traceability purposes.

Land preparation

Soils should be cultivated well to a fine tilth early in the season.

Soil testing

Soil testing is recommended before planting to guide on fertilizer and manure application.

Planting and Spacing

Cucumbers are directly sown into the field. It is also possible to first raise them in a seedbed and transplant into the main field, but this can cause disturbances to their root systems. 2 -3 seeds are sown in each hole about 2cm deep. Spacing is 90cm by 100 cm.

Weeding and mulching.

Weeds compete for nutrients, space, water, sunlight as well harboring pathogens. Shallow cultivation using a jembe is recommended as the plant has a delicate root system.

Mulching has the following benefits: conservation of moisture, suppression of weed growth, improvement of soil structure and water infiltration, control of soil erosion and reduction of pests' incidence. Mulching using dry straws, grass or plastic is essential.

Pruning and training.

Cucumbers are trellised on a string or wire system to suspend the fruits. The main aim is to capture sunlight uniformly. Proper balance is needed between the vegetative growth and fruit load so as to get maximum yields.

Irrigation and fertigation

Irrigation should be done frequently to maintain a steady soil moisture level during the growth period. Drip Irrigation is preferred as it ensures that the foliage is dry and prevents spread of diseases.

During planting mix soil with organic manure and about 80kg of DAP per Ha. Top-dress with 100kg of top dress fertilizer 30 days after sowing.

Pests Management

Integrated crop management **(ICM)** is the best option for food safety. These methods include scouting for pests, field hygiene, proper spacing, physical methods like use of traps, pheromones, biological methods and others that will only give use of pesticides as a last option.

Pest (Insects)	Symptoms	Control options
Aphids (*Myzus persicae*)  *https://plantvillage.psu.edu/topics/cucumber/infos*	Feed by piercing and sucking sap on tender shoots, especially on the lower leaf surface. Attacked shoots become stunted and the leaves are curled and twisted. They also transmit viral diseases like cucumber mosaic virus	-Use available biological methods eg parasitic wasps -Crop rotation with non- host plants. -Proper weed control to avoid other hosts plants Apply neem based insecticides.
Fruit Flies (*Bactrocera cucurbitae)*  *https://plantvillage.psu.edu/topics/cucumber/infos*	They pierce cucumber fruits then lay eggs in the in the fruits. Their maggots feed from inside the fruit causing sunken, discoloured patches with open cracks that serve as entry points for fungi and bacteria, causing cucumber fruit rot.	-Pheromone traps -Methyl Eugenol used together with Malathion -Remove fruits with dimples and oozing clear sap -Kill maggots by burning, burying or tying collected fruits in black plastic bags – Use of pesticides, such as Deltamethrin, Trichlofon
Whiteflies (*Bemisia tabaci)*  *https://plantvillage.psu.edu/topics/cucumber/infos*	They suck plant sap and excrete honeydew that encourages moulds affecting plant growth and vigor, yellowing, downward curling and drying of leaves. The tobacco whitefly is a major pest which cause serious crop damage	-Weed free field to avoid other host plants. -Yellow sticky traps for monitoring - Natural predator such as ladybugs. -Use of aluminum reflective mulch. - Chemical control - neem oil, Lamba-cyhalothrin ,Thiamethoxam
Epilachna beetles (Striped – *Acalymma vittata*, Spotted – *Diabrotica undecimpunctata*, 	Adults feed on leaves leaving a fine net of veins, damaged leaves shrivel and dry up. Young plants can be entirely destroyed while the older ones can tolerate considerable leaf damage. This beetle is a vector of squash mosaic virus which	- Hand picking ad killing -Early ploughing, which reduces the number of eggs deposition. -Spray with neem based insecticide e.g.) Nimbecidine

https://plantvillage.psu.edu/topics/cucumber/infos	affects performance of cucumber.	
Red spider mites *(Tetranychusurticae*)  *https://plantvillage.psu.edu/topics/cucumber/infos*	Spider mites can be a problem in dry and hot conditions Plants under water stress are more likely to suffer damage. They feed by piercing and sucking while damaging the leaves, which turn yellowish to whitish and dry up. They form webs on the undersides of the leaves in severe cases.	**-**Adequate irrigation -Mulching to improve water holding capacity -Chemical control using miticides
Leaf miners (*Liriomyza sativae**)***  *https://plantvillage.psu.edu/topics/cucumber/infos*	The larvae mine under the leaf surface, resulting into white mines, which are irregular in shape and increase in width as the larvae mature. This reduces photosynthetic area and leads to leaf wilting.	-Yellow stickers to monitor population -Biological control using parasitoids of *Liriomyza sativae* and *Liriomyza trifolii* and *Liriomyza huidobrensis*) often display little specificity. -Chemical control is prolematic
Cutworms (Argotic spy)  *https://plantvillage.psu.edu/topics/cucumber/infos*	They bite and chew young plants. Mostly found in the soil near the plant root zone. They cut down young plants causing significant crop losses.	-Hand picking ad killing -Early ploughing, which reduces the number of eggs deposition. -Use of beneficial parasites and natural enemies, e.g. parasitic wasps. - Use of chemicals such as deltametrin, Abamectin.

Thrips (*Frankliniella occidentalis*)  *https://plantvillage.psu.edu/topics/cucumber/infos*	Both the adults and nymphs feed on the leaves and flowers by sucking the sap thus causing damages, which may lead to cucumber flower damage/abortion.	-Scouting plants regularly -Ploughing and harrowing before planting to kill pupae in the soil.' - Blue stickers for monitoring pest population Chemical control - acetamiprid, azadirachtin (neem oil)
Root-knot nematodes  https://plantvillage.psu.edu/topics/cucumber/infos	These are microscopic parasites found in the soil, and infestation by these nematodes leads to wilting of plant. Roots of infected plant can be seen to be distorted, swollen and bearing knots or galls. These roots eventually rot causing death of the plant,	-Solarize seedbeds by covering soil with clear polythene sheet for 2 – 3 months -Deep plough the field Use repellant crops, such as Marigold -Chemical control using neem extracts

Disease	Symptoms	Control options
Damping off (*Rhizoctania solani)*  https://www.gardeningetc.com/advice/cucumber-diseases-and-pests	A soil borne disease that causes failure of emergence and rotting of seedlings. The roots of these infected seedlings exhibit a white cottony growth. Disease is favoured by humid condition.	-Plough soil deeply prior to planting. -Use plastic mulch to create a barrier between fruits and soil. - Proper drainage to avoid waterlogging -Chemical control

Downy mildew (*Pseudoperonospora cubensis*)  https://www.gardeningetc.com/advice/cucumber-diseases-and-pests	Small, pale-yellow spots appear on the upper leaf surface while purplish, grey whitish growth appears on the underside of the yellowish spots in humid conditions. Affected leaves curl, shrivel and eventually die. Infected plants are stunted and die while fruits are of low quality.	-Avoid overcrowding plants during planting. -Avoid overhead irrigation -Chemical control using - Mancozeb -Propineb + Cymoxanil -Dimethomorph + Mancozeb
Anthracnose (*Colletotrichum orbiculare)*  https://www.gardeningetc.com/advice/cucumber-diseases-and-pests	Circular black or brown sunken lesions occur on fruits. When wet, the centres of these lesions become purplish due to a mass of fungal spores. Water soaked lesions are also seen on leaves and stems. On the stem they can girdle the stem causing wilting of the vines.	-Plant resistant varieties such as, Brickyard, Bristol F1 Cobra F1, Thunder. - Use certified seeds - Crop rotation every year - Chemical control - Copper Oxychloride Mancozeb and Azoxystrobin
Angular leaf spot *Pseudomonas syringae*  https://www.gardeningetc.com/advice/cucumber-diseases-and-pests	Angular shaped spots appear on leaves. Initially these spots are water soaked. Severe cases of infections can cause defolation.	- Crop rotation - Plant resistant varieties such as Brickyard, Bristol, Cobra F1, Cutter, Darlington F1, Ashley F1. -Chemical control - Copper Oxychloride Mancozeb and Azoxystrobin

Powdery mildew *Podosphaera xanthii or Erysiphe cichoracearum*)  https://www.gardeningetc.com/advice/cucumber-diseases-and-pests	Symptoms first develop as whitish talcum like powdery growth on upper leaf surface. As infection progresses, the stems also get infected. Severely infected parts turn yellowish and eventually wilt.	-Plant resistant varieties such as Brickyard, Bristol, Cobra F1, Cutter. -Chemical control - Famoxadime+Cymoxanil– Azoxystrobin, Difenoconazole
Fusarium wilt *Fusarium oxysporum* and *Fusariun solani*  https://www.gardeningetc.com/advice/cucumber-diseases-and-pests	Initially, symptoms appear as chlorosis of the leaves, and as infection progresses, leaves begin wilting from bottom to top. The brown vascular discoloration inside infected stem or root leads to the eventual death of plants.	-Plant resistant varieties such as Brickyard, Bristol, Cobra F1, Cutter - Crop rotation - Liming application to bring the soil PH to 6.5 to 7.0 can reduce symptoms -Uprooting and destruction of diseased plants. -Proper soils drainage -Use of certified seeds. -Use of well decomposed manure and compost
Cucumber mosaic virus (*Cucumovirus)*  https://www.gardeningetc.com/advice/cucumber-diseases-and-pests	This is a viral disease, and the virus is mechanically transmitted and also spread by several species of aphids. Attacked leaves have patches of dark-green tissue alternating with yellow-green. Generally, the plant becomes stunted and fruits develop water soaked lesions with central solid spots.	- Control aphids which are vectors of transmission. - Use mulch material that reflect aphids (alluminium mulch - Plant resistant varieties such as Bush champion, Alcazar F1

Nutrition and Nutrition Deficiencies.

During flowering and fruiting stages of the cucumber plant, spray foliar feeds that induce flowering and fruiting, prevent flower abortion as well as ensure production of good quality fruits.

Nutrient deficiency	Symptoms	Contol
Phosphorous 	Deficient plants become stunted, internodes shorten, and leaves turn purplish. There is production of poor-quality flowers, which bear low quality fruits.	**-**Apply phosphate fertilizers before planting. - A soluble phosphorus source such as monopotassium phosphate can be supplied through irrigation ('fertigation')
Nitrogen 	Leads to reduced growth rate of plants and leaves turn yellow, starting with the older ones	-Top dress using a nitrogen fertilizer - Foliar sprays
Potassium 	Young leaves become small, dull and cupped while the older ones develop marginal chlorosis. In severe cases, leaves dry.	- Incorporate Potassium fertilizers in the soil before planting. -Fertigation or drip feeding can also be used to treat a deficient crop.
Boron deficiency 	Growing points of affected plants die and leaves become chlorotic. Fruit quality is greatly reduced.	- Excess boron can be toxic. -Application of borax to deficient soil before planting -Foliar sprays of borax may also be used.
Calcium 	Leaves stop expanding and fold downwards. Blossom end rot.	-Regular foliar sprays of calcium nitrate - Apply lime to acidic soils and reduce the use of ammonium-based or potassium-based fertilizers.

Harvesting

Harvesting is done after 45 to 60 days after sowing depending on the variety. Harvesting is by picking the cucumber off the vine using a sharp knife or secateurs. Maturity indices include firmness and external glossiness. Generally, fruits are harvested at a slightly immature stage, near full size but before seeds fully enlarge and harden.

Expected Yields:

Expected yield is 3 - 4 tonnes per Acre.

Postharvest activities

Transportation: Harvested cucumber should be transported in closed trucks as per the Horticultural Crops Regulations 2020.

Pre cooling: Cucumbers can be held 10 -14 days at temperature of 10-12.5ºC and 95% relative humidity. The fruits are very susceptible to shrivelling so the relative humidity must be kept high. Temperatures lower than 10^0 C will result to chilling injury.

Sorting: Sorting is done by hand to remove fruits that are free from growth or defects, decay, mechanical injuries, immature, over-mature, misshapen etc.

Grading: Harvested cucumbers are graded based on colour, size and stage of maturity.

Packaging: Packaging of cucumbers should be done in a way to maintain quality. Cucumbers are normally packed and solid in cartons or crates.

Markets

The biggest buyers of cucumber are high end supermarkets, grocery shops, hotels and restaurants.

GROSS MARGIN ANALYSIS FOR CUCUMBER PER ACRE 2023

Item	Unit	Quantity	Unit price	Total
Marketable yield/ Revenue	**Kgs**	**3,600**	**50**	**180,000**
Variable costs				
Soil testing	Acre	1	2500	2500
Land preparation	Acre	1	8000	8,000
Seeds	Kgs	0.5	5000	2,500
Manure	Tons	1	2000	2,000
Fertilizers - DAP -CAN	Kgs Kgs	80 100	120 80	9,600 8,000
Insecticides	Lts	2	2000	4,000
Fungicides	Kgs	2	1500	3,000
Insect traps – Aphids, Thrips	No	10	200	2,000

Labour costs				
Planting	Man days	6	500	3,000
Topdressing	Man days	4	500	2,000
Weeding, pruning trellising and watering	Man days	20	500	10,000
Spraying	Man days	4	500	2,000
Harvesting	Man days	6	500	3,000
Marketing costs				5,000
Total variable costs				**64,100**
Gross margin				**180,000-66,600 =113,400**

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