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EAST AFRICAN STANDARD

Fresh gherkins — Specification and grading

EAST AFRICAN COMMUNITY

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Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

In the preparation of this East African Standard, the following sources were consulted extensively:

Fruits and Vegetables Grading and Marking (Amendment) Rules, 2007, Ministry of Agriculture, Government of India, Schedule XXXII, *Grade Designation and Quality of Gherkins*

ISO 7560:1995, *Cucumbers — Storage and refrigerated transport*

CODEX STAN 193:1995 (Rev.5:2009), *General Standard for Contaminants and Toxins in Foods*

CODEX STAN 228:2001 (Rev.1:2004), *General methods of analysis for contaminants*

CODEX STAN 230:2001 (Rev.1:2003), *Maximum levels for lead*

Codex Alimentarius website: http://www.codexalimentarius.net/mrls/pestdes/jsp/pest_q-e.jsp

USDA Foreign Agricultural Service website: http://www.mrldatabase.com

USDA Agricultural Marketing Service website: http://www.ams.usda.gov/AMSv1.0/Standards

USDA Plant Inspectorate Service website: http://www.aphis.usda.gov/import_export/plants

European Union: http://ec.europa.eu/sanco_pesticides/public

Assistance derived from these sources and others inadvertently not mentioned is hereby acknowledged.

This standard has been developed to take into account:

— the needs of the market for the product;

— the need to facilitate fair domestic, regional and international trade and prevent technical barriers to trade by establishing a common trading language for buyers and sellers.

— the structure of the CODEX, UNECE, USA, ISO and other internationally significant standards;

— the needs of the producers in gaining knowledge of market standards, conformity assessment, commercial cultivars and crop production process;

— the need to transport the product in a manner that ensures keeping of quality until it reaches the consumer;

— the need for the plant protection authority to certify, through a simplified form, that the product is fit for crossborder and international trade without carrying plant disease vectors;

— the need to promote good agricultural practices that will enhance wider market access, involvement of small-scale traders and hence making fruit and vegetable production a viable means of wealth creation; and

— the need to keep unsatisfactory produce from the market by allowing the removal of unsatisfactory produce from the markets and to discourage unfair trade practices e.g. trying to sell immature produce at the beginning of the season when high profits can be made. Immature produce leads to dissatisfaction of customers and influences their choices negatively, which disadvantages those traders who have waited until the produce is mature.

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Fresh gherkins — Specification and grading

1 Scope

This standard applies to gherkins of varieties (cultivars) grown from *Cucumis sativus* L. of the *Cucurbitaceae* family to be supplied fresh to the consumer, gherkins for industrial processing being excluded.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CAC/GL 21, *Principles for the Establishment and Application of Microbiological Criteria for Foods*

CAC/RCP 1, *Recommended International Code of Practice — General Principles of Food Hygiene*

CAC/RCP 44, *Recommended International Code of Practice for the Packaging and Transport of Tropical Fresh Fruit and Vegetables*

CAC/RCP 53, *Code of Hygienic Practice for Fresh Fruits and Vegetables*

EAS 38, *Labelling of prepackaged foods — Specification*

CD/K/378:2010, *Horticultural industry — Code of practice*

3 Definitions

For the purpose of this standard the following definition shall apply:

3.1
well colored
not less than three-fourths of the surface of the cucumber is of a medium green or darker color, and that at least a light green color extends to the blossom end on one side of the cucumber

3.2
well formed
the cucumber is practically straight and not more than very slightly constricted or more than moderately tapered or pointed

3.3
overgrown
the cucumber has developed beyond the best stage for slicing. It usually yields to slight pressure of the thumb. The seeds may be tough and fibrous, and the pulp in the seed cavity is usually watery or jelly-like. In more advanced cases, pithy streaks may be found in the flesh of the cucumber.

3.4
injury caused by scars
scars which aggregate more than the area of a circle 1 cm in diameter on a cucumber 15 cm in length, or correspondingly greater areas of scars on larger cucumbers.

3.5
damage
any defect which materially affects the appearance, or the edible or shipping quality of the cucumber. Any one of the following defects, or any combination of defects the seriousness of which exceeds the maximum allowed for any one defect, shall be considered as damage:

(a) Scars when aggregating more than the area of a circle 1.6 cm in diameter on a cucumber 15 cm in length, or correspondingly smaller or greater areas of scars on smaller or larger cucumbers, respectively;

(b) Cuts which are fresh and more than slight; and,

(c) Bruises when materially affecting the appearance of the cucumber, or when sack imprints affect an aggregate area greater than that of a circle 5.7 cm in diameter.

3.6
diameter
the greatest dimension of the cucumber measured at right angles to the longitudinal axis, exclusive of “warts"

3.7
fairly well colored
not less than two-thirds of the surface of the cucumber is of a medium green or darker color, and that at least a light green color extends to within 12.7 mm of the blossom end on one side of the cucumber

3.8
fairly well formed
the cucumber may be moderately curved but not deeply constricted, not extremely tapered or pointed and not otherwise misshapen

3.9
moderately colored
at least one-half of the surface of the cucumber is of a light green or darker colour

3.10
badly deformed
the cucumber is so badly curved, constricted, tapered or otherwise so badly misshapen that the appearance is seriously affected

3.11
serious damage
any defect which seriously affects the appearance, or the edible or shipping quality of the cucumber. The following defects, or any combination of defects the seriousness of which exceeds the maximum allowed for any one defect, shall be considered as serious damage:

(a) Scars when aggregating more than the area of a circle 2.5 cm in diameter on a cucumber 15 cm in length, or correspondingly smaller or greater areas of scars on smaller or larger cucumbers, respectively; and,

(b) Bruises when seriously affecting the appearance of the cucumber, or when sack imprints affect more than one-third of the surface of the cucumber.

4 Provisions concerning quality

4.1 General

The purpose of the standard is to define the quality requirements for gherkins at the export-control stage after preparation and packaging.

However, if applied at stages following export, products may show in relation to the requirements of the standard:

— a slight lack of freshness and turgidity,

— for products graded in classes other than the “Extra” Class, a slight deterioration due to their development and their tendency to perish.

The holder/seller of products may not display such products or offer them for sale, or deliver or market them in any manner other than in conformity with this standard. The holder shall be responsible for observing such conformity.

4.2 Minimum requirements

4.2.1 In all classes, subject to the special provisions for each class and the tolerances allowed, the gherkins must be:

(a) intact, firm, sound and clean;

(b) fresh in appearance;

(c) free from any visible foreign matter;

(d) practically free from bruising;

(e) free from damage caused by pest and diseases;

(f) free from damage caused by low and/or high temperature;

(g) free of abnormal external moisture;

(h) free of any foreign smell and/or taste;

(i) free from stem or flowers.

(j) not shriveled.

4.2.2 The Gherkins must have been carefully picked and have reached an appropriate degree of development in accordance with criteria proper to the variety and to the area in which they are grown.

4.2.3 The development and condition of the gherkins must be such as to enable them:

(a) to withstand transportation and handling

(b) to arrive in satisfactory condition at the place of destination.

4.3 Classification

Gherkins are classified in three classes, as defined below:

4.3.1 “Extra” Class

Gherkins must be of superior quality. They must be well developed and have all the characteristic and colouring typical of the variety. They must be free of defects. Gherkins shall be

— well developed;

— well shaped and practically straight.

4.3.2 Class I

Gherkins must be of good quality. They must be characteristics of the variety. Following slight defects may be there, provided they do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package;

— slight deformation;

— slight defects in colour;

— slight skin defects (i.e. scratches, scars, scrapes and blemishes) not exceeding 2 % of the total surface area.

The defects should not affect the pulp of the fruit.

4.3.3 Class II

This grade includes Gherkins which do not qualify for inclusion in the higher grades, but satisfy the minimum requirements. Gherkins may have the following defects, provided they retain their essential characteristics as regards the quality, the keeping quality and presentation in the package.

— defects in shape and colour;

— crooked and nubbed;

— slight skin defects (i.e. scratches, scars, scrapes bruises and blemishes) not exceeding 5% of the total surface area.

The defects should not affect the pulp of the fruit.

5 Provisions concerning sizing

Size is determined by the weight of the fruit.

Size code	Weight in g
A	less than 5
B	6 – 10
C	11 – 20
D	21 – 35
E	36 – 50
F	51 – 70
G	71 – 100
H	101 – 150
I	150 and above

Maximum weight for Extra class would not be more than 20 g.

6 Provisions concerning tolerances

6.1 Quality tolerances

6.1.1 Extra class

5 % by number or weight of Gherkins not satisfying the requirements of the grade, but meeting those of Class I grade or, exceptionally, coming within the tolerances of that grade with the exception of overripe fruit.

6.1.2 Class I

10 % by number or weight of Gherkins not satisfying the requirements of the grade, but meeting those of Class II or, exceptionally, coming within the tolerances of that grade.

6.1.3 Class II

10 % by number or weight of Gherkins not meeting the requirements of the grade, but meeting the minimum requirements. Within this tolerance, not more than 2% in total may consist of deformed and discoloured fruits.

6.2 Size tolerances

For all classes, 10 % by number or weight of Gherkins not conforming to the minimum size specified for the grade, but meeting the size requirement for that grade immediately below.

7 Provisions concerning presentation

7.1 Uniformity

The contents of each package must be uniform and contain only Gherkins of the same origin, variety or type, quality and size (if sized).

The visible part of the contents of the package must be representative of the entire contents.

7.2 Packaging

The Gherkins must be packed in such a way as to protect the produce properly.

The Gherkins must be packed sufficiently tightly so as to avoid damage during transportation.

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 produce. 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 produce shall be such that, when removed, they neither leave visible traces of glue, nor lead to skin defects.

Packages must be free of all foreign matter.

8 Marking or labelling

8.1 Consumer packages

In addition to the requirements of EAS 38, the following specific provisions apply:

8.1.1 Nature of produce

If the produce is not visible from the outside, each package shall be labelled as to the name of the produce and may be labelled as to the name of the variety and/or commercial type.

8.2 Non-retail containers

Each package[1] must bear the following particulars in letters grouped on the same side, legibly and indelibly marked, and visible from the outside:

8.2.1 Identification

The exporter, packer and/or dispatcher shall be identified by name and physical address (e.g. street/city/region/postal code and, if different from the country of origin, the country) or a code mark officially recognized by the national authority.[2]

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[1] Package units of produce prepacked for direct sale to the consumer shall not be subject to these marking provisions but shall conform to the national requirements. However, the markings referred to shall in any event be shown on the transport packaging containing such package units.

[2] The national legislation of a number of countries requires the explicit declaration of the name and address. However, in the case where a code mark is used, the reference "packer and/or dispatcher (or equivalent abbreviations)" has to be indicated in close connection with the code mark, and the code mark should be preceded by the ISO 3166 (alpha) country/area code of the recognizing country, if not the country of origin.

8.2.2 Nature of produce

— "Gherkins" if the contents are not visible from the outside

8.2.3 Origin of produce

Country of origin and, optionally, district where grown, or national, regional or local place name.

8.2.4 Commercial specifications

— Class

— Size (if sized) expressed in minimum and maximum weight

— Number of units (optional).

8.2.5 Official control mark (optional)

9 Contaminants

9.1 Heavy metals

Gherkins shall comply with those maximum levels for heavy metals established by the Codex Alimentarius Commission for this commodity. The current limits are as indicated below:

Metal	Unit of measurement	Maximum limit	Test method
Lead (Pb)	mg/kg wet weight	0.10	ISO 6633 (AAS)
Cadmium (Cd)	mg/kg wet weight	0.10	ISO 6561-1 or 6561-2

9.2 Pesticide residues

Gherkins shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity. The limits listed below were current as of the dates indicated. The limits listed below were current as of the dates indicated. Annex E provides current MRLs for the USA, EU and Codex markets.

Maximum pesticide residue limits and extraneous maximum residue limits in fruiting vegetables, cucurbits including gherkins (current as at 2009-06-07)

Type	Unit symbol	Limit	Method of test	Notes
Gherkins				
CARBENDAZIM	MRL (mg/kg) (*)	0.05		
FENHEXAMID	MRL (undef)	1		
FENPROPATHRIN	MRL (mg/kg)	0.2		
IMAZALIL	MRL (mg/kg)	0.5		
METALAXYL	MRL (mg/kg)	0.5		
PARAQUAT	MRL (undef)	0.02		
PERMETHRIN	MRL (mg/kg)	0.5		
PROCYMIDONE	MRL (mg/kg)	2		
VINCLOZOLIN	MRL (mg/kg)	1		

10 Hygiene

10.1 It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of CAC/RCP 1, CAC/RCP 53, and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

10.2 The produce should comply with any microbiological criteria established in accordance with CAC/GL 21.

Fresh gherkin

Sweet gherkins **Washed gherkins**

Fresh gherkins

Fresh gherkins

Mexican sour gherkins

Annex A
(informative)

Storage and refrigerated transport

A.1 Scope

This annex gives guidance on conditions for the successful storage and long-distance transport of cucumbers intended either for direct consumption or for industrial processing.

A.2 Application

This annex provides the necessary conditions of ensuring that the requirements outlined in Clause are met when the cucumbers are transported to markets not in the immediate vicinity of the farm.

A.3 Conditions for harvesting and storage

A.3.1 Harvesting

Cucumbers should be cut from the plant and handled carefully. Mechanical damage should be avoided, especially around the stalk of the fruits.

A.3.2 Characteristics for storage

Cucumbers intended either for consumption in the fresh state or for industrial processing should be harvested at a development stage corresponding to the quality requirements specified Clause 4 of this standard.

They should be characteristic of the variety and suitable for the intended use. Cucumbers should:

— be intact and sound;

— be free from any visible foreign matter;

— be of fresh appearance;

— be firm and free of abnormal external moisture;

— be free of any foreign odour or taste;

— have seeds which are soft and undeveloped.

Cucumbers should not be withered, senescent, yellowish or yellow ripened.

A.3.3 Classification

Cucumbers are classified into three classes as provided in Clause 4.

A.3.4 Sizing

Sizing of cucumbers shall be in accordance with Clause 5.

A.3.5 Packing

The methods of packing should be such as to maintain the quality of the cucumbers during storage, transportation and handling.

Medium-long salad cucumbers intended for consumption in the fresh state, and pickling cucumbers for industrial processing, may be packed in wooden crates or perforated fibreboard boxes.

Very small pickling cucumbers (from 3 cm to 6 cm long) and salad cucumbers grown under conditions of forced growth should be packed in wooden crates or perforated fibreboard boxes; the salad cucumbers should be packed in layers in the wooden crate or perforated fibreboard box, which should not contain more than 10 kg to 15 kg. Wrapping individually in film or cellophane or waxing the cucumbers is recommended.

A.4 Optimum storage and transport conditions

For measurement of the physical quantities affecting storage, see ISO 2169.

A.4.1 Temperature

The optimum temperature for the storage and transport of cucumbers is between +7 ℃ and +10 ℃. Because of the susceptibility of cucumbers to chilling, the temperature should only temporarily be allowed to fall below +7 ℃. Above +10 ℃, cucumber s turn yellow within 10 days, and at +15 ℃ even sooner, depending on the Stage of development of the cucumbers. Once yellowing has begun, the product is no longer suitable for storage and transport.

Cucumbers should be packed as soon as possible after harvesting, and put into the cold store so that they are cooled to +7 ℃ to +10 ℃ until loading.

A.4.2 Relative humidity

The optimum relative humidity is between 90 % and 95 %. Air with a lower relative humidity would favour wilting and loss in mass of the cucumbers. In the case of cucumbers for direct consumption, wrapping individually in film or cellophane, or waxing, serves to maintain this relative humidity.

A.4.3 Other conditions

During storage and transport, circulation of air should be assured so that constant temperature and relative humidity are maintained.

Yellowing of the cucumbers will be hastened by ethylene; products producing ethylene (such as apples, pears, peaches, bananas, tomatoes, melons and citrus fruits) should not be present in the same store or transport vehicle.

A.4.4 Duration of storage and transport

Cucumbers are highly perishable and they should therefore be stored and transported for the shortest time possible. The quality can be maintained for about 10 days at the optimum temperature of + 7 ℃ to + 10 ℃ and at 90 % to 95 % relative humidity.

If each fruit is packed separately in polyethylene film, cucumbers produced under conditions of forced growth can be stored at +12 ℃ to +13 ℃ for 2 week s. Cucumbers stored or transported at temperatures below +7 ℃ should be used within 2 to 4 days, or immediately after storage, or on arrival as, at higher temperatures, fruits previously kept at low temperatures soon show signs of damage caused by chilling (shallow surface pits followed by decay, caused by microorganisms).

A.4.5 Putting into storage

Cucumbers packed in wooden crates or fibreboard boxes may be placed in a pre-cooled cold store in stacks, according to the load-bearing capacity of the containers.

A.5 Transportation

A.5.1 Means of transport

Refrigeration of the cucumbers should be maintained during transport. For this purpose, ice-refrigerated or mechanically refrigerated railway trucks or refrigerated lorries may be used.

A.5.2 Requirements for the transport vehicle and loading

For the transportation of cucumbers, the vehicle used shall not have previously carried materials harmful to health (for example, fertilizers, plant protection materials or other chemical substances). It should be in good technical condition, for example, fans should be in working condition, drains should be free in ice-refrigerated railway trucks, and floor racks assuring the circulation of air in railway trucks or lorries should be in position.

Before loading, the temperature of the loading space in the vehicles should be cooled to that required, either by icing the bunkers or by mechanical refrigeration.

Wooden or fibreboard boxes containing cucumbers should be stacked lengthwise (facing forward), and only boxes necessary for filling spaces between the stacks to prevent them from moving during transport should be put crosswise. Similarly, any remaining gaps should be filled with empty boxes or crates for the same purpose.

The ice bunker if ice-refrigerated railway trucks should be re-iced to capacity after loading.

If, as a consequence of warm weather or a long transit period, the ice melts in ice-refrigerated railway trucks during transport, re-icing should be carried out at an interim station to ensure that, at the destination, the trucks arrive with their bunkers not less than one-third full.

A.6 Operations on arrival

After unloading, cucumbers should be continuously cooled or used immediately, depending on the storage and transport conditions. Cucumbers stored or transported at temperatures between +12 ℃ and +14 ℃ may be stored up to the recommended dura tion of storage.

Annex B
(informative)

Commercial production guide — Cucumber and squash

B.1 Origins, classification and uses

Cucumbers and squash are both members of the cucurbit family, *Cucurbitaceae*. Many other vegetables belong to this family of vining crops: watermelon, muskmelon, pumpkin and gourd. They are all warm-season tender annuals. Generally, they have a spreading growth habit and have tendrils at the leaf axes. Botanically, the fruit is called a pepo — a type of fruit in which the ovary wall and receptacle tissue are fused to form a hard (or semi-hard) rind. Both cucumbers and squash have a long history of cultivation for human consumption, although they originated on separate sides of the globe.

Although this annex focuses primarily on summer squash and slicing cucumber production, many of the practices described herein are also applicable to winter squash and pickling cucumber production.

B.2 Cucumber

Cucumbers, *Cucumis sativus*, are indigenous to an area of India between the Himalayas and the Bay of Bengal. One of the oldest cultivated vegetables, they were grown in western Asia as early as 1000 B.C. Cucumber is one of the plants specifically mentioned in the Bible. Cultivation migrated to Greece, Italy and China before arriving in Europe as early as the 9th century. Cultivation in England began around 1550.

Both the slicing and pickling varieties are members of the same species. Cucumbers are consumed as immature fruits. Slicing varieties are usually eaten raw in salads or as snacks. Pickled cucumbers are processed and used in numerous ways, including salad ingredients, relishes, sandwich slices and spears.

Slicing and pickling types of cucumbers can be differentiated primarily on the basis of the fruit appearance. Slicing types have long fruit, are generally dark green from stem to tip and have white spines that often are not visible. Pickling types are shorter and blockier and may have white or black spines. Fruit of pickling types are often dark green at the stem end and may be almost white at the blossom end.

B.3 Squash

Summer squash, *Cucurbita pepo*, has its origin in the areas of Mexico and Central America. Before Columbus' arrival in the New World, summer squash were cultivated in much of what is now the southwestern, midwestern and eastern United States by Native Americans. Seafarers returned with the crop to Europe, where it quickly gained popularity.

Summer squash are consumed as immature fruit and can be cooked in numerous ways or eaten raw. Winter squash are generally consumed as mature fruit and are usually used for baking or in pies. A number of common types of summer squash exist:

— **Crookneck**: Crookneck squash have slender, curved necks. Their surface is yellow and may become warty as they mature.

— **Straightneck**: Straightneck squash are similar in appearance to crooknecks except that, as the name implies, they have no curve in the neck, which is more slender than the base. These also may become warty as they approach maturity. Straightnecks are commercially popular because they pack more easily.

— **Acorn:** Acorn squash are deeply ridged and tapered at one end. They have a dark green rind and a firm yellow flesh. They weigh between 1 and 3 pounds. Both bush and vining types are available.

— **Butternut and Waltham Butternut:** These have cylindrical fruit that often bulge around the seed cavity. They have light tan rinds with orange flesh and are vining in growth habit.

— **Buttercup and Turk's Turban:** These turban-shaped squash have rinds that can be multicolored with green, orange, or gray stripes. The flesh is medium orange.

— **Spaghetti Squash:** This squash is also called vegetable spaghetti. These cylindrical (8 to 9 inches long) fruit have yellow flesh that is stringy.

— **Hubbard:** These are round in general shape but taper to a point at the bloom end. The rind is rough bluish-gray to green with occasional gray stripes. The flesh is orange-yellow in color.

— **Marrow**: This includes the zucchini squash. Zucchini are straight, elongated fruit with thin, smooth skins. They produce a whitish flesh with a green or gold skin. The Italian marrow, or cocozelle, is grown commercially. Fruit of this type squash are cylindrical, short and usually striped.

— **Scallop**: Scallop squash are flat or saucer-shaped with thickened waved edges. They may have a green or yellow skin but more commonly have a white skin.

B.4 Soils and fertilizer management

Soil requirements and fertilizer management are similar for squash and cucumbers whether they are grown for fresh market or for processing. Neither crop can be grown in poorly drained areas. Both crops will produce good yields with proper management when grown on any fertile, well-drained soil. Medium-textured soils with enough organic matter to hold moisture and keep the soil loose for proper root growth are ideal for both squash and cucumbers. Coarse, sandy soils are preferred for early production because they tend to dry out and warm up more quickly. However, these soils also require more intense fertilizer and irrigation management.

B.4.1 Crop rotation

Proper crop rotation is essential in squash and cucumbers to reduce potential problems from diseases, nematodes and herbicide carryover. Never grow squash or cucumbers on land that has been planted with any other cucurbit crop such as watermelons, cantaloupes, pumpkins, etc, within the last three years. Land planted with squash or cucumbers in the same time frame should also be avoided. Proper rotation with non-cucurbit crops will help prevent potential problems from carryover of disease organisms on plant material. Rotation with crops that discourage nematode increases is also beneficial. A good crop rotation program could include corn, rye or other small grains. Other well-fertilized vegetable crops not in the cucurbit family, such as fresh-market tomatoes or peppers, can be good crops to use in a squash or cucumber rotation. Residual fertilizer and organic matter help develop early growth.

Always be aware of any herbicide material that has been used in the last 12 to 18 months that might create a potential carryover problem on land intended for squash or cucumbers. Check labels of herbicides previously used for carryover restrictions.

B.4.2 Land preparation

Squash and cucumbers both produce moderately deep root systems. However, most of the roots are in the top 20 cm of soil. Therefore, plan soil preparation in order to produce good soil tilth to a depth of at least 20 cm. Work the soil when moisture is adequate, but avoid wet soils. Chop litter from previous crops and work it into the soil by disking prior to ploughing to speed up breakdown of organic matter.

Both squash and cucumber can benefit from subsoiling, particularly if a hard pan is present in the field. This allows crop roots to obtain water and nutrients from a greater volume of soil. This can be particularly beneficial in drought situations. When planting on bare ground, it is advisable to plant on a bed raised at least 10 cm high and tapered to the edges to provide good surface drainage, enhance warming of the soil and reduce damage to vines during spraying. The seedbed should be firm and have a uniform texture before planting.

B.4.3 Liming and fertilization

As with any vegetable production system, a recent soil test forms a basis for fertilizer and lime requirements. Take the soil test several months before crop establishment to determine lime requirements and to make necessary applications in a timely manner.

A pH of between 6.0 and 6.5 is best for squash and cucumber production. If soil tests reveal a need for lime, apply dolomitic lime at least three months before planting. Many nutrient deficiencies detected during the growing season, such as calcium or phosphorous deficiencies, can be traced to excessive soil acidity. Foliar applications often can overcome calcium deficiencies. Generally, phosphorous is in the soil but unavailable at low pH; this can be difficult to correct during the season.

Cucumbers and squash are fast-growing crops but are medium to light feeders of major nutrients.

Correcting deficiencies of major nutrients is not feasible through foliar nutrient applications. Therefore, an adequately managed soil fertility program is required to maintain proper growth and development. Some deficiencies of minor elements can be remedially corrected through foliar applications. However, it is always best to supply adequate amounts of these nutrients via your basic soil fertility program.

B.4.4 Plant tissue and petiole sap analysis

Plant tissue and petiole sap analyses are excellent tools in evaluating crop nutrient status. Periodic tissue analysis or sap tests can be used to determine if fertility levels are adequate or if supplemental fertilizer applications are needed. Both tests are useful in detecting nutrient deficiencies that may have developed during the growing season.

The most recently mature leaves of the crop are the subjects for plant tissue analysis. A sample of 20 to 30 leaves should be taken from the area(s) in question. Petiole sap analysis is a more recently developed method. Fresh sap pressed from leaf petioles is analyzed for nitrogen and potassium concentrations.

B.5 Varieties and culture

B.5.1 Climatic requirements

Both cucumbers and squash are warm-season crops that are sensitive to frost and cold injury. Two crops per year are common.

B.5.2 Planting and spacing

A variety of plant populations can be used for both crops. Cucumbers are generally planted in rows 90 cm apart with an in-row spacing of 23 cm to 30 cm. Bush type squash are usually planted in rows 90 cm apart with 30 cm to 45 cm between plants.

Always use quality treated seed from a reputable source. A windbreak of small grain strips placed periodically throughout the field will reduce sandblasting injury and mechanical damage (twisting, etc.) to young seedlings from spring winds.

Maturity dates for squash and cucumber will depend primarily on the variety and the environment. Temperature, soil type and moisture regime can have a significant impact on the number of days from planting to maturity.

B.5.3 Variety selection

Base variety selection of squash and cucumbers on criteria similar to that used for other vegetables. Obviously, yield is of primary concern to the grower; however, other factors such as horticultural characteristics, disease resistance and adaptability should also be considered. Varieties should produce a competitive yield compared with standard varieties currently produced. Quite often buyers

will prefer certain varieties. Therefore, it is a good idea to check with the buyer for preferences before making your selection.

When selecting varieties, find out as much as you can about adaptability of particular varieties to see if they perform well in your area. If possible, consult local growers familiar with the variety regarding their experience. Well-adapted varieties will perform well over a wide range of environmental conditions.

Horticultural characteristics such as colour, shape and skin texture are also important in variety selection. Summer squash should have a skin colour and texture that is acceptable to the market. They should develop seed slowly and maintain a glossy appearance as they mature. Slicing cucumbers should be uniformly smooth and dark green. They should have small seeds that do not harden early, have a desirable flavour and have an appropriate length to diameter ratio.

Recent advances in squash varieties have resulted in varieties that are resistant to some viruses that affect squash. Although these varieties may be resistant to certain viruses, they may not be resistant to all viruses present in your field. Therefore, a consistent oil spray program will still be necessary in seasons of high virus pressure. Also, because virus pressure is greater during summer and fall production, you may benefit from using resistant varieties for these plantings and the less expensive non-resistant varieties for early spring production.

Other disease resistance characteristics may also be present in some varieties. Any time disease resistance combines with good yield and good horticultural quality, the variety is that much more appropriate if it is adaptable and acceptable to the market.

Fresh market cucumbers should be more attractive in appearance and have a darker green skin than pickling varieties. They are also longer than most pickling cucumbers. Average length/diameter ratio (LDR) is an important characteristic of cucumber varieties. The LDR varies according to growing conditions, environment and position on the vine. Fruit at the crown of the plant will have lower LDR than those at the more distal ends of the vines. Conditions favourable to growth will increase LDR. Average LDR for slicing cucumbers varies between 3.0 and 4.5.

B.5.4 Sex expression

Advances in plant breeding of cucumbers have resulted in varieties of cucumbers that exhibit various combinations of flower types. These fall into several groups that are explained below. Growers will need to be familiar with this terminology in selecting varieties and versed in the ramifications that environmental conditions have on the various types.

B.5.4.1 *Gynoecious*

All plant flowers are female. Only female flowers produce fruit, so these types increase the incidence of female flowers in the field. They must however, be interplanted with a male pollinator to produce fruit.

B.5.4.2 *Predominantly female (PF)*

Plants are usually produced from crossing gynoecious and monoecious lines. These plants, as the name implies, generally produce mostly female flowers under normal conditions. Terminals and laterals of PF varieties usually produce continuous female flowers. Unstable varieties, cool temperatures and crowding of plants can increase the incidence of male flowers in these types.

B.5.4.3 *Monoecious*

Plants produce numerous male flowers and infrequent female flowers. These plants usually begin by producing only male flowers then go through a period of mixed flowering (producing both male and female flowers) and end with a period of only female flowers.

B.5.4.4 *Hermaphroditic*

Plants produce perfect flowers or flowers that have both male and female parts in the same flower. These are mostly experimental at this time.

The environment can have a marked influence on sex expression in cucumber *and squash* plants. Climatic conditions often radically change the ratio of male to female flowers. High temperatures and long days induce male flower development; low temperatures and short days cause predominantly female flower development.

B.5.5 Pollination

Because most squash and cucumber plants produce separate male and female flowers, pollen transfer from the male to the female flower is essential to the production of good yields of high quality fruit. Bees are the most common agent of pollination for cucurbit crops. Therefore, an ample supply of honeybees should be introduced into production fields to enhance and ensure pollination. Poorly pollinated fruit will be misshapen and have poor development, which usually results in unmarketable fruit. As a general rule, you should place one hive of honeybees for every acre of squash and one to two hives for each acre of cucumbers. Squash and cucumber flowers are generally open in the morning hours until early afternoon, which coincides with the hours that honeybees are most likely to be working. Schedule spraying and irrigation around these times to avoid disrupting pollination. Other important factors to consider in hive management include:

1. supplying a good clean source of water for bees;

2. grouping hives within 500 feet of one another, which increases competition so bees are more apt to forage further into the field;

3. removing competing sources of pollen near production fields;

4. placing hives in fields just before or just after the onset of blooming; and

5. avoiding pesticides with high toxicity to bees.

Bees often make several visits (7-10) to a flower to complete pollination. The use of chemical attractants is one option that many growers consider. Although these attractants may be of use in marginal situations, there is no substitute for a good supply of bees.

Periods of cloudy, cool, windy or wet weather also can hinder bee activity. Some evidence shows that the application of 90 G of boron two or three times beginning at first bloom can enhance pollination in some cucurbits. These applications can be made in conjunction with regular spray programs and are most effective in boron deficient soils.

Cross-pollination of squash with other cucurbit crops is often a concern of growers. In most cases this is not a problem. However, plants of the same species will cross-pollinate and some cross-pollination occurs between some other species. By knowing the genus and species of the crops in question you can determine the potential for cross-pollination. Unless you are going to save seed from the crop, which is not recommended, cross-pollination will rarely be a problem for the commercial grower. However, these are the combinations that can cross-pollinate between species:

— *Cucurbita maxima* will cross with *Cucurbita moschata.*

— *Cucurbita moschata* will cross with *Cucurbita pepo.*

— *Cucurbita pepo* will cross with *Cucurbita mixta.*

B.6 Squash and cucumber diseases

Squash and cucumber are subject to many diseases that cause serious losses throughout the state each year. Both crops share several common diseases; however, each has unique diseases affecting it. A clear understanding of the diseases and the disease management strategies are necessary for successful squash and cucumber production.

B.6.1 Cucumber diseases

Alternaria Leaf Spot

Alternaria leaf spot, caused by *Alternaria* spp., can cause serious damage under extended periods of wet weather. The occurrence of this disease in Georgia is sometimes sporadic but can be devastating if left unchecked.

Figure B.1

Symptoms

The disease causes tiny brown leaf spots, which enlarge and cause a target spot with concentric rings (Figure B.1). Older lesions will develop a dark colour in the concentric pattern. Spore production, which causes the dark colour, can infect new sites if no protective measures are followed.

Disease Management

Most fungicides used in disease management will suppress Alternaria leaf spot. No resistant cultivars are available.

Angular Leaf Spot

Angular leaf spot, a bacterial disease caused by *Pseudomonas lachrymans*, attacks cucumber leaves, stems and fruit. The bacterium that causes angular leafspot overwinters on old plant debris and on cucumber seed. During rains it splashes from the soil to the stems, leaves and later to the fruit. Once infection takes place, the organism spreads over the field on the hands of workers or by cucumber beetles. Angular leafspot is most severe during extended rainy periods when temperatures are between 70º and 80ºF.

Figure B.2

Symptoms

Spots on the foliage are straw coloured to light brown and angularly shaped (Figure B.2). Affected areas first seem water soaked, then gradually dry and split. After the diseased tissue splits open, portions of it tear out, leaving irregularly shaped holes in the leaves. Small, circular spots develop on the fruit. These diseased areas later crack open and turn white.

Disease Management

The primary disease prevention tool is disease-free seed. Angular leaf spot resistant cucumber varieties are available. A two-year rotation behind crops other than cucurbits and cultivating the soil when it is dry will decrease the ability of the bacterium to survive and infect upcoming cucumber crops. During warm, moist periods, when disease development is favourable, copper sprays may reduce the spread of the disease.

Figure D.3

Figure B.4

Anthracnose

Anthracnose, caused by the fungus *Colletotrichum lagenarium*, attacks all above-ground parts of the cucumber plant. The fungus causing anthracnose overwinters locally on old cucurbit vines and may appear any time during the growing season. It may reach epidemic proportions when rainfall is above average and temperatures are between 21 °C and 28 °C.

Symptoms	Disease Management
The first symptom of anthracnose is observed on the oldest leaves as round, reddish-brown spots. The centres of some spots fall out, giving the leaf a shot-hole appearance (Figure B.3). Often the leaves at the centre of the plant die first, leaving the crown of the plant bare. Light brown to black elongated streaks develop on stems and petioles. Round, sunken lesions may appear on the fruit. These lesions first appear water-soaked and then turn a dark green to brown. The pinkish ooze often noticed in the centre of the lesion is a mass of spores of the fungus.	A one-year rotation and deep turning infected debris immediately after harvest are effective cultural practices for reducing inoculum levels in subsequent crops. Using disease-free seed produced from areas not known to have anthracnose is an essential disease-prevention measure. Cucumber varieties resistant to anthracnose races 1, 2 and 3 are available. Several protectant fungicide options, are available.

Gummy Stem Blight

Gummy stem blight, caused by *Didymella bryoniae*, attacks only the leaves and stems of cucumbers and is one of the most destructive diseases of cucumbers in the state. This disease is driven by cool, moist periods, especially extended periods of leaf wetness. The gummy stem blight fungus can easily be brought into a new area on or in the seed. Once the disease becomes established, it produces millions of sticky spores. These spores spread over the field as humans, other animals and machines move through wet vines.

Symptoms	Disease Management
It is noticeable when an individual runner or an apparently healthy plant suddenly dies. Vine cankers are most common near the crown of the plant (Figure D.4). This disease is usually identified by finding elongated, water-soaked areas on the stem. These areas become light brown cracks in the vine and usually produce a gummy ooze. On the older leaves, this disease may produce brown to black spots. It spreads from the centre of the hill outward, as does anthracnose and downy mildew.	Choosing high quality, disease-free seed and transplants should be the first line of defense in preventing losses to gummy stem blight. A two-year rotation with crops other than cucurbits is another appropriate disease-management tool. Protective fungicide sprays can offer the most effective disease suppression if applied in a timely manner.

Target Spot

Target spot, caused by the fungus *Coryneospora cassiicola*, can defoliate and destroy an entire crop if left unchecked. It occurs very sporadically and can be confused with downy mildew and other leaf spotting diseases.

Symptoms	Disease Management
Target spot begins on leaves as yellow leaf flecks becoming angular with a definite outline (Figure D.5). Later spots become circular with light brown centres surrounded by dark brown margins. Lesions join together and produce large dead areas with dead and shedding leaves.	Most protective fungicides used to control other foliar pathogens will suppress target spot. Destroying infected debris or sanitizing greenhouse areas will greatly aid in reducing the spread of the disease. Several cucumber varieties have resistance to target spot and are the best assurance against severe disease losses when combined with sanitation and fungicide applications.

Figure D.5

Belly Rot

Belly rot has been a common problem in cucumber plantings in Georgia. The two fungi primarily responsible for belly rot are *Pythium* (also called cottony leak) and *Rhizoctonia*. Belly rot can occur on fruits at any stage of growth; however, it is most noticeable when cucumbers are mature.

Symptoms

Symptoms may vary from small, yellow sunken areas to large rotted spots on the undersides of fruit. *Pythium* causes a water-soaked lesion that develops into a watery soft rot. White, cottony mycelium is also generally associated with *Pythium* lesions (Figure B.6). *Rhizoctonia* belly rot typically appears as dry, sunken cracks on the underside of cucumber fruit (Figure B.7).

Disease Management

Rotation and deep turning are cultural practices that can reduce the amount of disease inoculum near the soil surface. Practices that ensure good drainage can also reduce losses to these fungi. Systemic fungicides may aid in suppression of *Pythium*; fungicides have proven inconsistent in dealing with *Rhizoctonia* belly rot.

Figure B.6

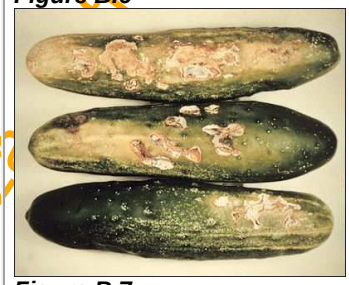

Figure B.7

Bacterial Wilt

The bacterium *Erwinia tracheiphila* causes bacterial wilt. The bacterium affects only cucurbits, except for watermelon, which is almost completely immune. The pathogen overwinters in the godies of the spotted and striped cucumber beetles. It then hibernates in the beetle's digestive tract and in the spring finds its way through the faeces of the carriers to the young plant. The bacterium enters the plant tissue only through deep wounds produced by beetles when feeding.

Symptoms

The most typical symptom associated with bacterial wilt is individual runners or whole plants wilting and dying very quickly (Figure B.8). Affected runners usually will turn dark green before becoming necrotic as the wilt becomes irreversible. Long strands of bacterial slime can be observed if wilted runners are cut and the cut ends are pressed together and then pulled apart.

Disease Management

The most effective tool for managing bacterial wilt in cucumber is controlling the cucumber beetle. This can be achieved by using contact or soil applied insecticides. The use of resistant varieties is also recommended.

Figure B.8

Figure B.9

B.6.2 Diseases affecting both cucumber and squash

Nematodes

Nematodes are slender microscopic roundworms that live in the soil. The root-knot nematode is the most common type attacking cucurbits. If not controlled, this pest can completely destroy a squash crop, especially in sandy soil.

Symptoms

Root-knot nematodes enter young squash feeder roots during their common feeding process, causing the roots to swell. The most common below-ground symptom is the formation of galls or knots on the roots (Figure B.9). Nematode injury interferes with the uptake of water and nutrients, thus giving the top portion of the plants an appearance resembling a lack of moisture or a fertilizer deficiency. Stunting, yellowing, irregular growth and rapid decline are also above-ground symptoms of nematode injury.

Control

Rotating squash with a grass crop, such as rye or corn, is somewhat beneficial in managing root-knot nematodes, but this practice is no substitute for soil fumigation. In light soils where root-knot nematodes are widespread, the use of soil fumigants is essential in most fields to maximize yields. Fumigant nematicides are most effective against nematodes and must be applied three weeks before planting.

Figure B.10

B.6.3 Squash diseases

Squash production is hindered by severe disease losses. Diseases such as mosaic and scab destroy at least 50 percent of the squash crop in many areas each year. To produce squash successfully, a working knowledge of the diseases and their management is needed.

Scab

Squash scab, caused by the fungus *Cladosporium cucumerinum*, inflicts severe losses on the crop in all areas where moisture is high and temperature is relatively low (70º to 75ºF). The fungus causing scab lives in old squash and cucumber vines and on infected seed. Early infection may come from either of these sources. Spots are produced soon after the fungus begins to sporulate and are spread by insects, humans or tools, or are blown long distances in moist air.

Symptoms

Although scab can attack any above-ground portion of the plant, injury to the fruit is most noticeable. Fruit can be infected at all stages of growth. Spots first appear as gray, sunken areas about 3 mm in diameter (Figure B.10) from which a sticky substance may ooze. The spots grow darker with age and gradually sink into the squash until a cavity forms. Several areas may run together, forming lesions 5 cm in diameter.

The presence of pale green water-soaked areas is the first sign of disease on the foliage. These spots gradually turn gray to white and become angularly shaped. The dead leaf tissue usually splits open and falls out, leaving a ragged hole in the leaf. Under favourable weather conditions, scab can deform young leaves by shortening the internodes.

Disease Management

Losses to this disease can be effectively and economically reduced through a complete disease control program. The critical steps are as follows:

1. **Disease Free Seed:** Always use high quality, western grown seed obtained from a reputable seed source. Seeds obtained from this source are grown in disease-free arid conditions and must meet high standards of the trade and the government.
2. **Crop Rotation:** Never grow squash on land where cantaloupes, cucumbers, pumpkins or squash has been grown within the past three years.
3. **Use Clean Wash Water:** Many growers wash their squash in a tub of water soon after harvest. If one diseased squash passes through the wash water, every squash being washed thereafter will be inoculated with the scab-causing fungus and will most likely rot soon after reaching the market. Squash should always be washed under running water or in water containing HTH (65 % chlorine) at 56 g per 378 litres of water or sodium hypochlorite at a rate to make a similar concentration. Exact amounts of HTH or sodium hypochlorite will depend on temperature and pH of water.
4. **Fungicide Sprays:** Several fungicides can reduce the severity of scab if applied on a schedule after first bloom.

Crown Rot
Crown rot, caused by the fungus *Phytophthora capsici*, may inflict serious damage once established. The fungus infects all above-ground parts of cucurbits. Because of a relatively wide host range, the disease is now causing problems in watermelons, cantaloupes, cucumbers and eggplant.

Symptoms	Disease Management
Symptoms on squash appear as constricted, water-soaked lesions near the base of stems close to the soil (Figure B.11). Infected fruit may have circular, sunken, water-soaked lesions that may contain a pasty or powdery sporulation of the fungus.	Rotation with a non-susceptible crop has been highly effective in disease prevention. Planting a susceptible crop in an infested field is inadvisable for two years. Measures that ensure good field drainage, such as utilizing crowned beds, subsoiling and avoiding overirrigation, will decrease the severity of the disease. Preventive applications of some fungicides have shown some promise in suppressing this disease in the field.

Figure B.11

B.6.4 Mildews

Mildews on squash are a common occurrence in commercial squash plantings, causing growers to spray on a regular basis. This practice will result in increased yields (10 percent to 15 percent). This is especially true in large fields and where several harvests are desired. Two distinct mildew diseases exist; each favoured by a different weather pattern, and each requiring different materials for control. Unfortunately, the symptoms and occurrence of these diseases overlap considerably.

Powdery Mildew
Powdery mildew, caused by the fungi *Sphaerotheca fuliginea* and *Erysiphe cichoracearum*, is much more widespread on squash than downy mildew, especially during dry hot periods.

Symptoms	Disease Management
This disease is characterized by a white or brownish, mealy growth found on the upper and lower sides of the leaves and young stems (Figure D.12). If plants are severely attacked, the leaves and young stems may wither and die. In less severe cases, the plant may be weakened or stunted. Early defoliation resulting from the disease may cause premature ripening or sun scald.	The use of preventive fungicide applications is the most effective means of suppressing powdery mildew. However, several squash varieties have been released that demonstrate significant levels of resistance to this disease. Fungicides used in conjunction with resistant varieties offer the most complete disease management program for powdery mildew on squash.

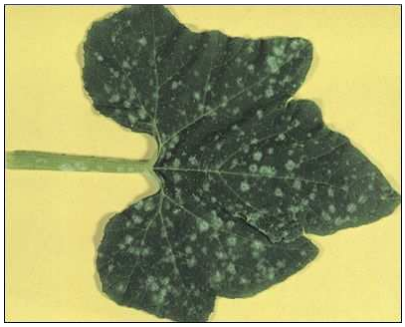

Figure B.12

Downy Mildew
Downy mildew, caused by the fungus *Pseudopernospora cubenis*, has not been a serious problem on squash in recent years. During wet, cool weather, however, it can cause considerable damage.

Symptoms	Disease Management
This disease produces irregular to angular, yellow to brownish areas on the upper sides of diseased leaves (Figure B.13). The undersides of the leaves may show a pale greyish-purple mould after damp weather. The mould may vary from white to nearly black in colour. The diseased	Follow the same spray program recommended for scab control. Fungicides containing mefenoxam are the most effective for control of downy mildew. However, fungal insensitivity to these fungicides has been observed. When this

Figure B.13

spots may enlarge rapidly during warm, moist weather, causing the leaves to wither and die. This damage may resemble frost injury because the entire vine dies. The fruit from diseased plants is usually small and has poor flavour.	occurs, alternative fungicides should be used.	 ***Figure B.14***

D.6.5 Viral diseases

Mosaic

This disease is caused by one or more of five major viruses. The most prevalent are cucumber mosaic virus (CMV), papaya ringspot virus (PRV), watermelon mosaic virus II (WMVII), zucchini yellow mosaic virus (ZYMV) and squash mosaic virus (SMV). The most common virus in cucumbers is CMV. One or a combination of these viruses may affect squash. Aphids transmit all of these viruses with the exception of squash mosaic, which is seed transmitted. Surveys have indicated that only about 2 percent of all squash virus infections are caused by squash mosaic. Aphids must acquire the virus from a host reservoir and are capable of transmitting it for 10 to 15 minutes in most cases.

Figure B.15

<u>Symptoms</u> Symptoms of virus disease are mottling, strapping and vein distortion (Figures B.14-B.15). One virus may cause mild symptoms, while additional viruses in the same plant cause much more dramatic symptoms. In some cases the symptoms may appear to be phytotoxic chemical damage. Fruit from infected plants may be discolored or have raised bumps or mottles (Figure B.16).	<u>Disease Management</u> Resistant varieties are available for avoiding losses to some virus diseases but cultivars with true resistance to all of the squash viruses are not available as of yet. Stylet oil sprayed on a two- to three-day schedule has been shown to delay the spread of virus. Viral diseases are much worse in late summer and fall plantings because aphid populations are much higher and virus-carrying host plants are more available. Early spring plantings usually have less virus; however, control measures are recommended to delay virus infection. Yield losses are directly related to time of infection. The later the infection occurs, the less damage observed.

Figure B.16

B.7 Insect management

Squash and cucumber are subject to attack by a variety of insect pests. These attacks do not always result in economic injury, so certain insect management practices can be used to ensure cost-effective control decisions. Indiscriminate use of insecticides often creates more favourable conditions for the development of harder-to-control insect pests, thus increasing the cost of production.

Insects cause injury to the leaves, stems, roots and fruit. The developmental stage of the plant at the time of attack often governs which plant part different insect pests may injure. However, some insects feed specifically on one plant structure; others may feed on several structures. The first step in control is to identify the insect.

Certain cultural practices may have a dramatic affect on the potential for economic injury by certain insects. Planting during optimal growing conditions ensures rapid seedling emergence and subsequent growth. This reduces the amount of time that plants are susceptible to injury from seedling insect pests.

Most insect problems can be treated as needed if detected early, but no one insecticide will adequately control all the insects that may attack squash and cucumber. Scouting for insects is the most efficient way to determine what problems may exist and what action should be taken. Preventive treatments may be necessary for certain insect pests. Preventive treatments are used against insects that are certain to cause economic injury if they are present. Preventive treatment decisions are influenced by field history, harvest dates and insect pressure in nearby production areas.

B.7.1 Root maggot

The seedcorn maggot adult *Hylemya platura*, is a fly similar to the housefly, only smaller. It has many bristles on the body. The larvae or maggot is creamy white, 6.4 mm long at maturity and legless. The body tapers sharply from rear to head.

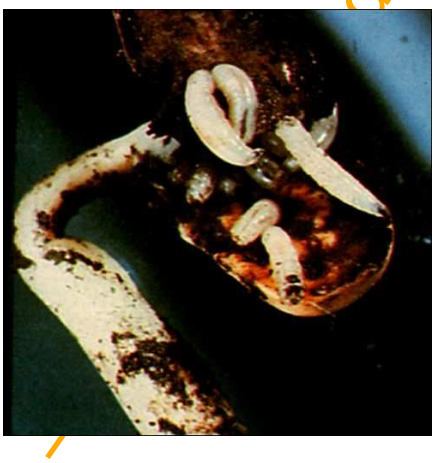

Figure B.17 — Root maggots

The maggot is the damaging stage. Root maggots tunnel into the seeds or the roots and stems of seedlings. Seeds usually succumb to secondary rot organisms and fail to germinate following attacks. Seedlings often wilt and die from lack of water uptake. Seedlings that survive are weakened and more susceptible to other problems.

Cool, wet conditions favour the development of root maggot infestations. Early plantings are therefore most subject to attack. Egglaying adults are attracted to soils with high organic matter. Dead or dying organic matter such as weeds or previous crop residue attracts the flies.

Greenhouse grown transplants are grown in high organic soil mixtures that attract the flies in the greenhouse environment. Eggs may be laid on the soil while the plants are in the greenhouse. The eggs may hatch after the transplants are placed in the field and the maggots attack and kill the seedlings. Several practices may be used to help control maggots. Previous crop litter and weeds should be turned deeply several weeks prior to planting so there is adequate time for decomposing. Plant during optimum conditions for rapid germination and seedling growth. Early plantings should be preceded by incorporation of a recommended soil insecticide. Plants should be maintained stress free until they are beyond the seedling stage. (Figure B.17)

B.7.2 Wireworms and Whitefringed Beetle Larvae

Figure B.18 — Wireworm (top), whitefringed beetle larvae

Wireworms, mostly *Conoderus* spp., and whitefringed (WFB) beetle larvae, *Graphognathus* spp., can reduce stands dramatically if present in even moderate numbers (one per square yard). Wireworms are less likely to affect early planting because they are relatively inactive during the early spring.

The WFB adults, weevils, are not important in squash or cucumber. Larvae are creamy white and legless. They grow to about 5 cm long and are C-shaped grubs. The mouthparts are dark brown, pincherlike structures that are highly visible. The head capsule is slightly recessed and blends so well with the rest of the body that it appears headless.

Whitefringed beetle larvae pass the winter in the larval stage and may be active even during the milder winter months. Presently, no effective insecticides are labelled for control of this insect. If one WFB larva per square yard is found during land preparation, do not plant field in squash or cucumber. (Figure D.18)

D.7.3 Cucumber beetles

Several species of cucumber beetles may attack squash and cucumber. The most common species found in Georgia are the spotted cucumber beetle, *Diabrotica undecimpunctata*, and the striped cucumber beetle, *Acalymma vittata*. The banded cucumber beetle, *Diabrotica balteata*, is occasionally found.

Figure D.19 — Spotted cucumber beetle (top), striped cucumber beetle and stem damage (middle), cucumber beetles and foliage damage

Cucumber beetles are sometimes mistaken for lady beetles, which are beneficial predators. Cucumber beetles are more oblong than lady beetles, which are nearly circular. The spotted

cucumber beetle adult is about 6.4 mm long with 11 black spots on its yellowish-green to yellow wing covers. The striped cucumber beetle is slightly smaller than the spotted cucumber beetle. The striped cucumber beetle is yellow with three black stripes on the back. The banded cucumber beetle is the least significant of the three species.

The larvae of the different cucumber beetles are very similar and live underground. Larvae are creamy, yellowish-white, soft-bodied worms with three pairs of inconspicuous legs. Mature larvae of the spotted cucumber beetle may be from 12.7 mm to 19 mm long. The striped cucumber beetle larvae are slightly smaller. Both larvae have a dark brown head and a dark brown plate on the last body segment.

Beetles and larvae may damage squash and cucumber. The beetles have been responsible for most economic damage. Beetles feed on the stems and foliage of the plant. Beetles feed on the stems until the plants become less attractive because of hardening, after which more foliage damage will be apparent. Feeding begins on the undersides of the cotyledons, or true leaves. If beetle populations are high during the seedling stage, stand reductions can occur. The beetle may also transmit bacterial wilt disease in cucumbers. This disease does not affect squash. Larvae may feed on all underground plant parts and usually cause insignificant amounts of damage.

Cucumber beetles can be controlled with foliar applications of insecticides when 10 percent or more of the seedlings are infested. In squash, insecticide applications may be terminated once plants are bearing fruit. In cucumbers, the beetles should be controlled throughout the growing season. Beetles should be controlled if they are found infesting more than 20 percent of the cucumber plants. The natural feeding behavioUr of cucumber beetles leads to their avoidance of insecticidal sprays during the seedling stage, so thorough spray coverage is imperative. The most cost-effective application method is to band over-the-top and direct sprays to the base of the plant. There are no recommendations for control of the larvae (Figure D.19).

D.7.4 Aphids

The melon aphid, *Aphis gossypii*, and the green peach aphid, *Myzus persicae*, are common in Georgia squash and cucumber. Aphids are soft-bodied, oblong insects that rarely exceed 2.4 mm long. Adults may be winged or wingless, most often wingless. Aphids have two exhaustpipe-like structures called cornicles located on the rear of their abdomens. Immature aphids are wingless and look like the adults, only smaller.

Aphids are slow-moving insects that live in colonies on the undersides of leaves. Aphids feed on the leaves with their piercing-sucking mouthparts. As they remove plant sap, the leaves curl downward, giving them a puckered appearance. Heavy populations cause plants to yellow and wilt. Aphids secrete a substance known as honeydew, which collects on the surface of the lower leaves. Under favourable conditions the honeydew provides the sustenance for the growth of sooty mould, a fungus that blackens the leaf surface. This reduces photosynthesis; thereby reducing quality, yield or both.

The greatest damage caused by aphids is indirect. Aphids vector several viruses that can reduce fruit marketability. For this reason, aphid populations should be kept to a minimum. Winged aphids are the primary vectors of such diseases and should be monitored two to three times per week throughout the season, especially in squash. The green peach aphid is one of the most common vectors.

The aphid acquires the viruses while feeding on infected weed or crop host plants. Virus particles from infected cells contaminate the aphid's needlelike sucking mouthpart called the stylet. Transmission occurs when the contaminated aphid flies to and feeds on squash plants. This feeding must occur almost immediately because the mosaic viruses are very unstable and become inactivated within a few minutes to an hour after removal from cells of infected host plants.

After primary infection sites have been established, secondary infection occurs from movement of aphids within the field. The highest populations of aphids carrying the viruses occur in the fall. When primary infection occurs early (as the cotyledons break through the soil), 100 percent infection may be expected by the time squash is ready for first harvest. Fall squash production without an oil spray program is questionable.

Control of aphids on squash is not difficult, but controlling aphids has very little impact on the final incidence of mosaic. The use of foliar or at-planting systemic insecticides to kill aphids before they are able to successfully vector the viruses has failed more often than not. Aphids usually feed long enough to transmit the viruses before receiving a lethal dose of insecticide.

D.7.5 Silverleaf Whitefly

The silverleaf whitefly, *Bemesia argentifolii*, may infest both squash and cucumber; however, silverleaf is only induced in squash. Because of this, whitefly control is more important in squash that in cucumber. Infestations of small numbers of immature whiteflies can induce silverleaf in squash. The foliage turns silver and the fruit becomes very pale and unmarketable.

Figure B.20 — Silverleaf whitefly

Fortunately, the oil sprays used to delay mosaic virus transmission by aphids also gives excellent prevention of silverleaf. The whitefly also should be controlled with insecticides tank-mixed with the oil sprays. Insecticides are not needed in every oil application but rather used as needed to suppress whitefly development (Figure B.20). However, in late summer plantings of squash, special efforts are required to reduce transmission of mosaic virus diseases.

D.7.6 Thrips

Several species of thrips may inhabit squash and cucumber fields, but they are not very well understood as pests. Thrips are very small, spindle-shaped insects 2.5 mm or less long. Immature thrips are wingless; the adults have wings with hairlike fringe.

The thrips that cause early foliage damage are often different from those present during the period of heavy fruit set in spring plantings. The most noticeable damage is to the foliage. Narrow bronze lesions appear on the leaf surface. The entire field may have silvery appearance from heavy feeding. This damage is caused by the thrips rasping the leaf surface before its expansion. The most severe damage occurs during the periods of slow growth. Damage is quickly outgrown during periods of rapid growth, and usually no treatment is required.

The western flower thrips (WFT), *Frankliniella occidentalis*, is the species most common during rapid fruit set. WFT is a large species two to three times larger than the common onion and tobacco thrips often found infesting early plantings. Whether WFT or any other species causes any significant damage to squash or cucumber is not very well known. Thrips mechanically damage plants during the feeding process. If thrips fed on prepollinated fruit, the damage would not be noticeable until the fruit were larger. Physical damage of this type would appear as catfacing, light russeting or other deformities on the surface of the fruit.

Thrips can be controlled with foliar insecticide applications. There are no treatment thresholds developed for thrips. As a rule of thumb, treatments generally are not necessary if thrips are damaging only the foliage. Treatments for thrips during early fruit development should be initiated when a majority of the blooms are found infested with large numbers of thrips, 75 or more per bloom. (Figure B.21)

Figure b.21 — Thrips damage, seedling (top); thrips damage, mature leaf

D.7.7 Cutworms

The granulate cutworm, *Feltia subterranea*, is the larvae of a nondescript moth. Larvae are greasy-looking caterpillars that may be 38 mm to 45 mm long at maturity. Young larvae may be pinkish-grey; older larvae are usually dingy grey. A series of chevron-shaped markings, slightly lighter grey than the body, run along the back.

Cutworms feed at night and remain inactive during the day, either on the soil surface or below ground. Cutworms may attack all plant parts, but the most severe damage occurs when they feed on young seedlings. Cutworms damage young plants by chewing on the stem slightly above or below ground. Stand reductions may occur.

Figure B.22 — Cutworms

Cutworms can be difficult to control, but understanding their behaviour can help. Cutworms pass the winter months in the larval stage. This means that the larvae may be present at the time of planting. In these cases, stand reductions will likely occur. Inspect fields during land preparation and just before and during the planting operation. If cutworms are found, treatments should be made either by incorporation of a soil insecticide prior to planting or by a directed spray if plants are already present. Foliar sprays should be made as late in the day as possible to coincide with the greatest larval activity. (Figure B.22)

D.7.8 Pickleworm and Melonworm

The pickleworm, *Diaphania nitidalis*, is a migratory insect that has squash and cucumbers as preferred hosts in the cucurbit group. Close monitoring will help in making spray-scheduling decisions. (Figure B.23)

Figure B.23 — Pickleworm, young larva (above left); pickleworm, mature larva (above); melonworm (left)

B.7.9 Fruitworms

Any worm that feeds directly on the fruit may be called a fruitworm. The most common worms that may fit this description are cutworms, corn earworms, loopers, and beet and fall armyworms. When the fruit is attacked, the insect must be identified correctly because no one insecticide will control all of the aforementioned species.

B.7.10 Miscellaneous insect pests

Some insects become pests of squash or cucumber only if a preferred host is not available, populations are very high or environmental conditions are just right for rapid development. Flea beetles, spider mites, leaf miners, stink bugs, leafhoppers, squash bugs and grasshoppers are just a few. These problems can be addressed on a case-by-case basis.

B.7.11 Honeybees

Honeybees are necessary to ensure adequate pollination; because most insecticides are toxic to honeybees, certain practices should be followed to prevent bee kills. Honeybees may be active from dawn to dusk. Insecticide applications should be made late in the day, after sunset if possible, after bee activity has ceased. If it is necessary to spray large acreages during the day, hives should be removed from the field on the preceding day. If these precautions are followed, bee kills will be kept to a minimum. Once dried on the leaf surface, the toxic effects of most insecticides are dramatically reduced.

B.8 Irrigation

Water is a critical component in the production of cucumbers and squash. These are all fleshy fruits that consist of 90 percent to 95 percent water. Thus an adequate water supply is critical to produce profitable yields and to maintain marketable quality. Soil moisture should be maintained at adequate levels until harvest.

B.9 Good agricultural practices in the harvest, handling and packaging of fresh squash market squash and cucumbers

B.9.1 Introduction

Cucumber and squash growers/shippers should comply with safe production and handling practices designed to minimize potential hazards in their crops.

B.9.2 Quality and safety

Produce quality and safety are often perceived by consumers to mean the same thing. Good quality produce may be visually appealing and delicious, yet may contain pathogens or toxins that can cause illness to the consumer. Safe produce, in contrast, may be discoloured, over mature and unappealing,

yet present no hazard to the consumer. Unfortunately, the safety of fresh produce cannot be determined by its outward appearance or condition.

B.9.3 Field sanitation program

B.9.3.1 *Raw product safety*

Ensuring fresh cucumber and squash safety begins with preventing hazards in the field. The best guarantee of a safe raw product is a proactive food safety program that has been designed and implemented to identify and prevent hazards during production and postharvest handling of these vegetables. Growers/shippers should familiarize themselves with safe production practices so they might be viewed as qualified suppliers among potential buyers. Some issues of concern during fresh production are summarized in Table B.1.

B.9.3.2 *Land-use history*

Grazing animals on or near cropland can introduce to the soil bacteria that are pathogenic to humans. Growers should ensure that land has not been used for animal husbandry and that it is not in proximity to animal feedlots or water runoff from grazing lands. Past improper use of pesticides can result in hazardous residues on raw products. Buyers might insist on letters of guarantee from grower/shippers that the land is suitable and safe for the crops being produced. Before planting, soil residue levels of pesticides and heavy metals should be determined.

B.9.3.3 *Fertilizer use*

Incompletely composted organic fertilizers may contain bacteria pathogenic to humans derived from animal or human faeces. If organic fertilizers are used, they must be certified that they have been completely composted so no pathogens are present. Composted sewage sludge should not be used because it may contain pathogens as well as heavy metals.

B.9.3.4 *Irrigation*

Surface water may be used but should be tested for the presence of the bacterium *Escherichia coli* (*E. coli*), which is an indicator of faecal contamination. Groundwater is less likely to harbour human pathogens but should be analyzed for heavy metal and pesticide contamination.

Overhead irrigation is more likely to spread contamination to above-ground plant parts than is root zone irrigation.

B.9.3.5 *Pesticide usage*

Inspection, monitoring and documentation of proper use of pesticides will prevent unsafe or illegal pesticide residues from contaminating the raw product. Growers must be able to answer the following questions:

— Do you oversee your pesticide-spraying program?

— Do you have record-keeping procedures to track all spraying of this crop?

— Do you or the government regularly test your crops for residue levels?

B.9.3.6 *Harvesting*

Mechanical harvesting can wound produce, encouraging contamination from the soil. Hand harvesting may lead to pathogen contamination if field workers practice poor hygiene. Field crews must be trained and monitored for personal hygiene, and portable bathroom and hand-washing facilities must be provided in the field.

B.9.3.7 *Field containers (boxes, buckets, bins, etc.)*

Containers for harvesting fresh cucumbers and squash should be nontoxic, easy to clean and free of extraneous materials (e.g., nails, wood splinters) that can carry over into processing. After detergent

cleaning, field bins, buckets, etc., can be sanitized using a strong sodium hypochlorite solution dispensed from a high-pressure sprayer.

Table B.1 — Potential hazards during cucumber and squash production

Production Factor	Potential Hazard	Prevention	Documentation
Land use	Faecal contamination (source of pathogens) from animals	No grazing animals or feedlots on/near production land	Grower certification of no recent animal husbandry on land used
	Toxic pesticide residues in soil	Review pesticide history for plant back restrictions	Pesticide selection/application records
Fertilizers	Pathogenic bacteria from organic fertilizers	Use inorganic fertilizer	Credible test results
	Heavy metal toxicity from sewage sludge	Use certified organic fertilizers or tested and approved sludge	Credible test results
Irrigation water	Pathogenic bacteria from surface water	Test/monitor water supply	Water test results
	Heavy metal/pesticide residues in ground and surface water	Test/monitor water supply	Water test results
Pesticide use	Illegal/hazardous residues on product	Employ only professional, licensed applicators and monitor pesticide use	Examine applicator records; test for residues if contamination suspected
Hand harvesting	Faecal contamination of product	Field worker personal hygiene; field washing/sanitizing facilities available	Training programs on worker hygiene
Field containers	Soil and human pathogens	Use plastic bins; clean/sanitize all containers	Field sanitation records

B.9.4 Harvest quality

Summer squash (both yellow and green types) and cucumbers are harvested at the same physiological maturity, as immature fruits. Optimum maturity for squash harvest is best judged by size and succulence of skin. Desired squash is 38 mm to 50 mm in diameter. At this stage, young fruit has a tender skin, glossy appearance, slightly sweet taste; seeds have not begun to enlarge and harden. Toughening of the rind and seeds can be expected in zucchini and yellow straightneck types when sizes increase beyond about 15 cm in length.

Generally, cucumber fruit are harvested at a slightly immature stage, near full size but before seeds fully enlarge and harden. A glossy dark to medium green colour with no yellowing and firm texture are indicators of optimum harvest quality. At proper harvest maturity, a jelly-like material has begun to form in the cucumber seed cavity.

B.9.5 Harvesting

Cucumbers and squash should be picked at frequent intervals to optimize quality and avoid losses from overmaturity. Harvest of both crops is done by hand at intervals of one to three days, depending on environmental conditions. Wet fruit should not be picked because surface moisture increases field heat accumulation in the load and enhances disease development. Crews must exercise extreme care to minimize fruit damage during harvest.

Because of its thin, tender skin, summer squash is more easily damaged than any other vegetable during harvest. The most prevalent types of damage are puncture by fingernails, sand abrasion, scratches inflicted by abrasion from the harvesting container and bruising because of impact or compression damage. Every puncture, abrasion or bruise is a potential site for latent decay development. Harvesters must keep their fingernails closely clipped or perhaps wear soft cotton gloves during harvest. Squash should be cut from the plant with a knife (also sanitized between harvest periods) leaving about 12.7 mm of the stem attached to the fruit. In harvesting, the worker should grasp the fruit lightly because they are easy to break and bruise with too much external pressure.

Research has shown that summer squash with intact stems are more resistant to bacterial soft rot. Decayed, off-grade and overmature squash should be removed from the plant to initiate new fruit set. Picking pails of squash should not be stacked or excessive bruising and damage will occur during transport from the field to the packing shed.

In the harvest of cucumbers, workers should never pull the fruit from the vine. This may tear the fruit and damage the vine, either of which increases decay and disease. When properly picked, the stem is pushed off the fruit with the thumb. Although squash are transported in picking pails, cucumbers are emptied into pallet bins for transport to the packinghouse. Physical damage may occur during bulk bin loading as cucumbers split or become bruised when striking hard wooden bottoms. Field demonstration research has shown that padding bin bottoms with insulated carpet reduced splitting and bruising by more than 20 percent.

B.9.6 Field packing

The trend toward field packing is increasing for summer squash. It offers some advantages over a packinghouse operation:

1. The grower needs less capital investment.
2. Culled and decayed fruits are left in the field.
3. Less handling is involved; thus, damage decreases and pack-out yields increase.
4. Harvesting and packing can be more closely coordinated.

Containers of squash are dumped into a vat of water on a flatbed trailer. This water should be kept clean by chlorinating and changing it frequently, because dirty squash will use up the chlorine strength rapidly. Squash should be hand agitated to remove sand, dirt, etc., and off-grade fruit should be removed. Care should be taken to remove blossoms at the flower end. These are a source of enzymes, which if left intact, can cause squash softening. The fruit should be stacked carefully in a box so they lie close together and do not move around during handling of the carton. Care should be used in washing and packing to avoid skin damage.

B.9.7 Packinghouse operations

At the packinghouse, summer squash is dumped into a tank of water for cleaning. This water should be kept clean by frequent changes and chlorination. Dump tank water should be chlorinated at a rate of 150 ppm free chlorine. After squash washing, excess water should be removed by sponge rollers or air blowers. Fruit is then graded, ensuring flower removal, sized and packed into a variety of containers. Packing line workers should wear plastic gloves when packing fruit to avoid gouging its tender surface.

Cucumbers may be dumped into a chlorinated tank of water or into a holding pit. This area should be padded with hard foam to help break the fall during unloading and to reduce bruising or splitting. Once dumped, cucumbers are elevated from the holding pit past spray washers to remove field debris. This water should be chlorinated at 75 to 100 ppm free chlorine and monitored regularly using test kits. Soft brushes remove excess water. Fruit may or may not move through a waxer depending on market preference. Food grade waxes are applied to inhibit water loss and to enhance appearance. Approved fungicides may be added to waxes to extend shelf life. Cucumbers proceed down the packing line, where they are graded, mechanically sized and packed into either wirebound or fibreboard boxes according to buyer specification. Graders should remove blossoms, which produce enzymes that can lead to fruit softening.

B.9.8 Quality defects and pack specifications

Cucumber quality and grading are based on the requirements of this standard.

B.9.9 Cooling and storage

Summer squash is a highly perishable commodity that will display shriveling (dehydration) quickly if not cooled promptly after harvest. Cucumbers, although not as perishable, should be promptly cooled to prevent water loss and extend shelf life. Forced air cooling is the most efficient type of precooling to remove field heat. To prevent dehydration of these vegetables during cooling, the refrigeration system used should be designed with a large evaporator coil surface to maintain high relative humidity (90 percent to 95 percent). Summer squash should be cooled to 45ºF and held at 95 percent relative

humidity. Under these ideal conditions, yellow varieties have a shelf life of 10 days; green varieties, 14 days. Cucumbers, which should be stored at a slightly higher temperature, 50ºF, and 95 percent relative humidity, have a shelf life of 14 days. Both commodities are subject to chilling injury if held for more than three or four days below their optimal storage temperatures. Chilling manifests itself in summer squash as water-soaked skin, pitting, browning and decay and in cucumber as pitting and accelerated decay. Because growers/shippers normally use the same cold storage facility for both crops, to compensate for these differences, hold squash in the rear of the facility (coldest at 45ºF) and cucumbers in the front of the facility (warmest at 50ºF) near the door.

B.9.10 Mixed load/storage compatibility

Chilling injury, which begins at 31ºF, and dehydration are the two most common physiological disorders affecting summer squash. Chilling injury is exhibited by water-soaked patches of the soft rind becoming brown and gelatinous over time. Dehydration causes loss of firmness and shrivelling. Summer squash have similar shipping and storage requirements as cucumbers, eggplant, okra, peppers, snap beans and watermelons. Therefore, these vegetables can be safely stored together without detrimental effects. Ice, however, should never make contact with these commodities. Summer squash is sensitive to low to moderate (0.1 to 10 ppm) ethylene depending on variety. Accelerated yellowing of green varieties can be caused by long term ethylene exposure. Recent research has demonstrated that temperature preconditioning can prevent chilling injury and double the shelf life of zucchini squash. Temperature preconditioning involves holding squash at 59ºF for two days before being stored at 41ºF.

Cucumbers are highly sensitive to ethylene exposure (0.1-1), causing skins to undergo premature yellowing. Chilling injury is initiated at 31ºF. Cucumbers should never be stored with ethylene-producing commodities such as bananas, cantaloupe or tomatoes. Cucumbers are compatible with eggplant, potatoes, pumpkins, watermelons, grapefruit and limes.

B.9.11 Postharvest decay

Diseases are an important source of postharvest loss for both cucumbers and summer squash, especially in combination with physical injury and chilling stress. Summer squash and cucumbers are subject to the same types of marketing diseases. For example, bacterial soft rot is a common disorder on both vegetables. Bacterial and fungal decay pathogens do not normally enter healthy exterior tissue. However, when mechanical damage (caused by physical injury) or weakening of tissue (caused by chilling stress) occurs, these organisms penetrate core tissue. Pathogens in contaminated water may also enter through natural openings in the skin. Proper handling, grading and temperature management will minimize occurrence of these diseases.

B.9.12 Sanitary guidelines for packinghouse operations

Receiving incoming product

Harvest crews should remove as much dirt and mud from the product as is possible before the produce leaves the field. An area should be set aside in the receiving yard so pallets can be cleaned before dumping in bins or cooling.

Water sanitation

Water used in cleaning and cooling should be chlorinated at a concentration of 75 to 150 ppm of free chlorine. Chlorination can be accomplished using a gas injection system, adding bleach or using calcium hypochlorite tablets. Chlorination levels in the water should be monitored frequently during operation through the use of chlorine litmus paper or, more accurately, with a chlorine test kit. Water pH should be maintained between 6.5 and 7.5 to avoid having to use excess chlorine in order to maintain recommended free chlorine levels. Excessive use of chlorine causes gassing off — objectionable chlorine odour, irritating to skin, corrosive to equipment and inflationary to sanitation cost.

Employee hygiene

Good employee hygiene is essential. Employee training, health screening and constant monitoring of packinghouse sanitation practices (hand washing, personal hygiene) are important in reducing contamination by employees.

Packinghouse equipment

Packinghouse equipment should always be maintained in clean condition. The remnants of product left on belts, tables, lines and conveyors could provide a source for microbial growth; therefore, cleaning by scrubbing to remove particles should be part of the cleaning procedure.

If it is deemed appropriate, sanitizing with a chlorine solution could be accomplished, especially on belt conveyors and equipment, by spot spraying with hand sprayers. Knives, blades, boots, gloves, smocks and aprons should be cleaned or replaced as needed.

Pest control

A pest control program should be in place to reduce, as much as possible, the risk of contamination by rodents or other animals. In an open or exposed packinghouse operation, the best control is constant vigilance and elimination of any discovered animals and their potential nesting locations. Product and/or product remnants will attract pests; therefore, the daily cleaning of the packinghouse to eliminate the attractive food source should help reduce pest activity.

Facility sanitation

Packinghouse facilities have the potential for developing microbial growth on walls, tunnels, ceilings, floors, doors and drains. Scheduled wash down and/or sanitizing of the facility will reduce the potential for microbial growth. The cooling system should be monitored and cleaned as necessary depending on the type of system.

Temperature control

Maintenance of proper holding room temperature could affect product quality and could be a factor in reducing microbial growth. Temperature should be monitored to ensure maintenance at established product temperature parameters.

Annex C
(informative)

Model certificate of conformity with standards for fresh fruits and vegetables

1. Trader:	Certificate of conformity with the Community marketing standards applicable to fresh fruits and vegetables No. …….. (This certificate is exclusively for the use of inspection bodies)	
2. Packer identified on packaging (if other than trader)	3. Inspection body	
	4. Place of inspection/country of origin ([1])	5. Region or country of destination
6. Identifier of means of transport	7. ☐ Internal ☐ Import ☐ Export	
8. Packages (number and type)	9. Type of product (variety if the standards specifies)	10. Quality Class / 11. Total net weight in kg

12. The consignment referred to above conforms, at the time of issue, with the Community standards in force, vide:

CD/K/069:2010, *Fresh gherkins — Specification and grading*

Customs office foreseen …… Place and date of issue ……

Valid until (date): ……

Signatory (name in block letters): ……..

Signature — Seal of competent authority

13. Observations:

([1]) Where the goods are being re-exported, indicate the origin in box 9.