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EAST AFRICAN STANDARD

Fresh tomatoes on the vine — 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:

United States Standards for Grades of Tomatoes on the Vine, Effective January 17, 2008

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 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.

Contents

Fresh tomatoes on the vine — Specification and grading

1 Scope

This Standard applies to commercial varieties of tomatoes grown from *Lycopersicon esculentum* Mill. *Solanaceae* family, to be supplied fresh to the consumer while still attached to the vine, after preparation and packaging. Tomatoes for industrial processing are 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
similar varietal characteristics
the tomatoes are of the same characteristic shape and colour (bright red varieties shall not be mixed with varieties having a purplish tinge)

3.2
mature
the contents of two or more seed cavities have developed a jellylike consistency and the seeds are well developed. External colour shows at least a definite break from green to tannish-yellow, pink or red colour on not less than 10 percent of the surface.

3.3
soft
the tomato yields readily to slight pressure

3.4
clean
the individual tomato is practically free from dirt and other foreign matter

3.5
fairly well formed
the tomato is not more than slightly kidney-shaped, lopsided, elongated, angular, or otherwise slightly deformed from the characteristic shape of the variety

3.6
reasonably well formed
the tomato is not more than moderately kidney-shaped, lopsided, elongated, angular, or otherwise moderately deformed from the characteristic shape of the variety

3.7
tomatoes on the vine
two or more tomatoes attached to the same vine

3.8
damage
any specific defect described in this section; or an equally objectionable variation of any one of these defects, any other defect, or any combination of defects, which materially detracts from the appearance, or the edible or marketing quality of the tomato. References to area, aggregate area, length, or aggregate length are based on a tomato having a diameter of 63.5 mm in diameter. The following specific defects shall be considered as damage:

(a) Puffiness when the open space in one or more seed cavities materially detracts from the appearance of the tomato when cut through the centre at right angles to a line running from the stem to the blossom end;

(b) Catfaces when scars are rough or deep, when channels are very deep or wide, when channels extend into a seed cavity, or a fairly smooth catface aggregating more than an area of a circle one-half inch in diameter.

(c) Growth cracks (radiating from or concentric to the stem scar) when not well healed, when more than 3.2 mm in depth, or any individual radial crack 12.7 mm in length, or having more than a 25.4 mm aggregate length of all radial cracks measured from the edge of the stem scar;

(d) Scars (other than catfaces) no depth and aggregating more than an area of a circle 9.5 mm in diameter; and,

(e) Cuts, not well healed, not shallow, or a cut more than 12.7 mm in length.

3.9
serious damage
any specific defect described in this section; or an equally objectionable variation of any one of these defects, any other defect, or any combination of defects, which seriously detracts from the appearance or the edible or marketing quality of the tomato. References to area, aggregate area, length, or aggregate length are based on a tomato having a diameter of 63.5 mm in diameter. The following specific defects shall be considered as serious damage:

(a) Puffiness when the open space in one or more seed cavities seriously detracts from the appearance of the tomato when cut through the centre at right angles to a line running from the stem to the blossom end;

(b) Catfaces when scars are rough or deep, when channels are very deep or wide, when channels extend into a seed cavity, or a fairly smooth catface aggregating more than an area of a circle 25.4 mm in diameter.

(c) Growth cracks (radiating from or concentric to the stem scar) when not well healed, when more than 3.2 mm in depth, or any individual radial crack 19 mm in length, or having more than a 38.1 mm aggregate length of all radial cracks measured from the edge of the stem scar;

(d) Scars (other than catfaces) no depth and aggregating more than an area of a circle 25.4 mm in diameter; and,

(e) Cuts, not well healed, not shallow, or a cut more than 12.7 mm in length.

4 Provisions concerning quality

4.1 General

The purpose of the standard is to define the quality requirements of vine tomatoes 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

— 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,

(a) the tomatoes must be:

(i) intact: Tomatoes must not have any mutilation or injury spoiling the integrity of the produce. Figure 4

(ii) sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded. Tomatoes must be free from disease or deterioration which appreciably affects their appearance, edibility or market value. In particular, this excludes tomatoes affected by rotting, even if the signs are very slight but liable to make the tomatoes unfit for consumption upon arrival at their destination.

Tomatoes showing the following defects are therefore excluded:

(1) Marked bruises (soft patches) damaging the flesh occur due to rough handling and/or too tight packaging. Figure 5

(2) Fresh cracks due to rough handling. Figure 6

(3) Unhealed cracks (concentric or radial) caused by growth phenomena. Figure 7

(4) Unhealed damage caused by hail, showing deep pitting or corky roughness. Figure 8

(5) Damage caused by diseases. Figures 9 to 15

(6) Damage caused by low temperatures. Figure 16

(iii) clean, practically free of any visible foreign matter. Tomatoes must be practically free of visible soil, dust, chemical residue or other visible foreign matter. Figures 17, 18

(iv) fresh in appearance. Tomatoes must not show any sign of withering or loss of firmness. Figure 19

(v) practically free from pests. The presence of pests can detract from the commercial presentation and acceptance of the tomatoes. Figure 20

(vi) free from damage caused by pests affecting the flesh. Pest damage can detract from the general appearance, keeping quality and edibility of the tomatoes. Figures 21 to 23

(vii) free of abnormal external moisture. This provision applies to excessive moisture, for example, free water lying inside the package but does not include condensation on produce following release from cool storage or refrigerated vehicle.

(viii) free of any foreign smell and/or taste. This refers particularly to tomatoes which have been stored on badly kept premises or have travelled in a badly maintained vehicle, especially tomatoes which have acquired a strong smell from other produce stored on the same premises or travelling in the same vehicle. Therefore, care should be taken to use only non-smelling materials as protection in packaging.

(ix) of similar varietal characteristics (except when marked as mixed type or mixed variety)

(x) mature but not over-ripe or soft

(xi) free from green backs, hard core, cloud and growth cracks

(xii) free from decay, sunscald, and freezing injury

(xiii) attached to stems/vines

(b) the vines must be:

(i) be fresh, healthy, clean and free of all leaves and any visible foreign matter

(ii) not brittle and shall be free from decay

(iii) free from damage by mould or other means

4.2.2 The development and condition of the tomatoes must be such as to enable them:

— to withstand transportation and handling; and

— to arrive in satisfactory condition at the place of destination.

4.2.3 Maturity requirements

The tomatoes must be sufficiently developed and display satisfactory ripeness.

The development and state of maturity of the tomatoes must be such as to enable them to continue their ripening process and to reach the appropriate degree of ripeness.

4.3 Classification

Vine tomatoes are classified in the classes defined below:

4.3.1 Class I

Tomatoes in this class must be of good quality. They must be reasonably firm and characteristic of the variety.

They must be free of cracks and visible greenback. The following slight defects, however, may be allowed provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

— a slight defect in shape and development. Figures 27 to 29. A slight hollowness due to insufficient pollination is allowed. Figure 30

— slight defects in colouring

— slight skin defects. Slight skin defects such as scorching due to sun or chemical treatment, hail damage or slight damage caused by pests or disease are allowed. Figures 31, 32

— very slight bruises. Very slight bruises caused by rough handling are allowed provided they cause no more than slight damage to the flesh and are unlikely to develop further.

Furthermore, “ribbed” tomatoes may show:

— shallow healed cracks not more than 1 cm long. Figure 33

— no excessive protuberances. Slight deformations are allowed.

— small umbilicus, but not suberization. Figure 34

— suberization of the stigma up to 1 cm^2. Figure 35

— fine blossom scar in elongated form (like a seam), but not longer than two-thirds of the greatest diameter of the fruit. Figure 36

Tomatoes in this class shall meet the following requirements:

(a) Basic requirements:

(1) Similar varietal characteristics;

(2) Mature;

(3) Not overripe or soft;

(4) Clean;

(5) Well developed;

(6) Reasonably well formed; and,

(7) Not more than slightly rough.

(b) Free from:

(1) Decay;

(2) Freezing injury; and,

(3) Sunscald.

(c) Not seriously damaged by any other cause.

(d) For tolerances Clause 6.

4.3.2 Class II

This class includes tomatoes which do not qualify for inclusion in the higher classes, but satisfy the minimum requirements specified in 4.2.

Tomatoes in this class must be of marketable quality, suitably presented and suitable for human consumption.

They must be reasonably firm (but may be slightly less firm than in Class I) and must not show unhealed cracks. The flesh of the fruit must be reasonably firm, i.e. the fruit may be distinguishably marked after normal pressure by the fingers but is not actually damaged.

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

— defects in shape, development and colouring

a) shape Figures 37 to 39

b) development: hollowness due to insufficient pollination is allowed. Figure 40

— skin defects or bruises, provided the fruit is not seriously affected

Skin defects such as scorching due to sun or chemical treatment, hail damage or slight damage caused by pests or disease are allowed, provided the fruit is not seriously affected. Figures 41, 42

Bruises caused by rough handling are allowed provided they cause a not too serious damage to the flesh and are unlikely to develop further. Figure 43

— shallow healed cracks not more than 3 cm in length for round, ribbed or oblong tomatoes. Figures 44, 45

Some crops and varieties grown under special weather conditions may be particularly susceptible to the formation of “greenbacks”. Lots, which are graded at an early stage of ripeness and suspected of containing a large number of fruits with “greenbacks” not yet visible should only be graded Class II.

“Greenbacks” and “yellowbacks” which should not extend over the shoulder of the fruit are allowed. The “greenback” consists of a greenish, the yellowback of a yellowish ring around the stalk cavity being the visible sign of a hard, inedible part of the flesh. Figures 46 to 50

Furthermore, “ribbed” tomatoes may show:

— more pronounced protuberances than allowed under Class I, but without being misshapen. Figure 51

— an umbilicus. Figure 52

— suberization of the stigma up to 2 cm^2. Figure 53

— fine blossom scar in elongated form (like a seam). Figure 54

Tomatoes in this class shall meet the following requirements:

(a) Basic requirements:

(1) Similar varietal characteristics;

(2) Mature;

(3) Not overripe or soft;

(4) Clean;

(5) Well developed; and,

(6) May be misshapen.

(b) Free from:

(1) Decay; and,

(2) Freezing injury.

(c) Not seriously damaged by:

(1) Sunscald.

(d) Not very seriously damaged by any other cause.

(e) For tolerances Clause 6.

5 Provisions concerning sizing

The size of tomatoes may be specified by count or weight per container or specified to a minimum and/or maximum diameter.

— **Minimum diameter:** Will not pass through a round opening of the designated diameter when tomato is placed with the greatest transverse diameter across the opening.

— **Maximum diameter:** Will pass through a round opening of the designated diameter in any position.

6 Provisions concerning tolerances

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

6.1 Quality tolerances

6.1.1 Class I

6.1.1.1 Tomatoes

Not more than 10 percent of the tomatoes in any lot may fail to meet the requirements of the grade, but not more than one-half of this amount, or 5 percent, shall be allowed for serious damage, including in this latter amount not more than 2 percent for tomatoes which are soft or affected by decay. In addition, not more than 10 percent of the tomatoes in any lot may be detached from the stem/vine.

6.1.1.2 Vines

Not more than 10 percent of the vines may fail to meet the requirements of the grade, but not more than one-half of this amount, or 5 percent, shall be allowed for decayed stems/vines.

6.1.2 Class II

6.1.2.1 Tomatoes

Not more than 10 percent of the tomatoes in any lot may fail to meet the requirements of the grade, including not more than 2 percent for tomatoes which are soft or affected by decay. In addition, not more than 10 percent of the tomatoes in any lot may be detached from the stem/vine.

6.1.2.2 Vines

Not more than 10 percent of the vines may fail to meet the requirements of the grade, but not more than one-half of this amount, or 5 percent, shall be allowed for decayed stems/vines.

6.2 Size tolerances

15 percent of the tomatoes in any lot may vary from the specified diameter, including therein not more than 5 percent for tomatoes which fail to meet any specified minimum diameter.

6.3 Application of tolerances

The contents of individual packages in the lot are subject to the following limitations:

(a) For a tolerance of 10 percent or more, individual packages shall have not more than one and one-half times the tolerance specified: **Provided,** That when the package contains 15 specimens or less, any individual package shall have not more than double the tolerance specified, except that at least one defective and one off-size specimen may be permitted in any package: **And provided further,** That the averages for the entire lot are within the tolerances specified for the grade.

(b) For a tolerance of less than 10 percent, individual packages in any lot shall have not more than double the tolerance specified, except that at least one defective and one off-size specimen may be permitted in any package: **Provided,** That the averages for the entire lot are within the tolerances specified for the grade.

7 Provisions concerning presentation

7.1 Uniformity

7.1.1 General

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

The ripeness and colouring of tomatoes in Class I must be practically uniform. In addition, the length of “oblong” tomatoes must be sufficiently uniform.

However, a mixture of tomatoes of distinctly different colours, varieties and/or commercial types may be packed together in a sales unit[1], provided they are uniform in quality and, for each colour, variety and/or commercial type concerned, in origin.

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

7.2 Packaging

Tomatoes must be packed in such a way as to protect the produce properly. The materials used inside the package must be new[2], 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.

The containers shall meet the quality, hygiene, ventilation and resistance characteristics to ensure suitable handling, shipping and preserving of the tomatoes. Packages must be free of all foreign matter and smell.

Tomatoes shall be packed in each container in compliance with CAC/RCP 44.

7.3 Presentation

The tomatoes may be presented as follows:

[1] The sales unit should be designed to be purchased in its entirety.

[2] For the purposes of this Standard, this includes recycled material of food-grade quality.

(i) as individual tomatoes, with or without calyx and short stalk;

(ii) as trusses of tomatoes, in other words, in entire inflorescence or part of inflorescence, where each inflorescence or part of each inflorescence should comprise at least 3 (2 if prepackaged)

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

— "Vines of tomatoes" and the commercial type if the contents are not visible from the outside. These details must always be provided for "cherry" (or "cocktail") tomatoes, whether in trusses or not.

— "Mixture of tomatoes", or equivalent denomination, in the case of sales units containing a mixture of distinctly different colours, varieties and/or commercial types of tomatoes. If the produce is not visible from the outside, the colours, varieties or commercial types of the sales unit must be indicated.

— Name of the variety (optional).

8.2 Non-retail containers

Each package[3] must bear the particulars outlined hereafter, 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.[4]

8.2.2 Origin of produce

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

In the case of sales units containing a mixture of distinctly different colours, varieties and/or commercial types of tomatoes of different origins, the indication of each country of origin shall appear next to the name of the colour, variety and/or commercial type concerned.

8.2.3 Nature of produce

— Name of the produce "vines of tomatoes" and the commercial type if the contents are not visible from the outside. These details must always be provided for "cherry" and "cocktail" tomatoes, whether in trusses or not;

— Name of the variety (optional).

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[3] According to the Geneva Protocol, footnote 2, "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".

[4] 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.

8.2.4 Commercial specifications

— Class

— Size (if sized) expressed as minimum and maximum diameters.

8.2.5 Official control mark (optional)

9 Contaminants

9.1 Pesticide residues

Tomatoes on the vine shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity.

Maximum pesticide residue limits and extraneous maximum residue limits in tomatoes on the vine (current as at 2009-06-07)

Pesticide	Unit symbol	Limit	Method of test	Notes
ABAMECTIN	MRL (mg/kg)	0.02		Used also as veterinary drug
AMITRAZ	MRL (mg/kg)	0.5		
AZINPHOS-METHYL	MRL (mg/kg)	1		
BENALAXYL	MRL (mg/kg)	0.5		
BIFENAZATE	MRL (undef)	0.5		
BITERTANOL	MRL (mg/kg)	3		
BROMIDE ION	MRL (mg/kg)	75		
BUPROFEZIN	MRL (mg/kg)	1		
CAPTAN	MRL (undef)	5		
CARBARYL	MRL (mg/kg)	5		
CARBENDAZIM	MRL (mg/kg)	0.5		Source of data: benomyl, carbendazim. Based on carbendazim use.
CHLOROTHALONIL	MRL (mg/kg)	5		
CHLORPYRIFOS	MRL (undef)	0.5		
CHLORPYRIFOS-METHYL	MRL (mg/kg)	0.5		
CLETHODIM	MRL (mg/kg)	1		
CLOFENTEZINE	MRL (mg/kg)	0.5		
CYFLUTHRIN	MRL (mg/kg)	0.2		Used also as veterinary drug
CYPERMETHRIN	MRL (mg/kg)	0.5		
CYPRODINIL	MRL (undef)	0.5		
DELTAMETHRIN	MRL (mg/kg)	0.3		Used also as veterinary drug
DIAZINON	MRL (mg/kg)	0.5		
DICHLOFLUANID	MRL (mg/kg)	2		
DICOFOL	MRL (mg/kg)	1		
DIFENOCONAZOLE	MRL (mg/kg)	0.5		
DINOCAP	MRL (mg/kg)	0.3		
DITHIOCARBAMATES	MRL (undef)	2		Source of data: propineb
ETHEPHON	MRL (mg/kg)	2		
ETHOPROPHOS	MRL (undef) (*)	0.01		
FAMOXADONE	MRL (undef)	2		
FENBUTATIN OXIDE	MRL (mg/kg)	1		
FENHEXAMID	MRL (undef)	2		
FENPROPATHRIN	MRL (mg/kg)	1		
FENVALERATE	MRL (mg/kg)	1		
FLUDIOXONIL	MRL (undef)	0.5		
FOLPET	MRL (undef)	3		
HEXYTHIAZOX	MRL (mg/kg)	0.1		
IMIDACLOPRID	MRL (mg/kg)	0.5		
INDOXACARB	MRL (undef)	0.5		
IPRODIONE	MRL (mg/kg)	5		
MALATHION	MRL (undef)	0.5		
METALAXYL	MRL (mg/kg)	0.5		
METHIDATHION	MRL (mg/kg)	0.1		
METHOXYFENOZIDE	MRL (undef)	2		
MYCLOBUTANIL	MRL (mg/kg)	0.3		
OXAMYL	MRL (mg/kg)	2		

PENCONAZOLE	MRL (mg/kg)	0.2		
PERMETHRIN	MRL (mg/kg)	1		
PIPERONYL BUTOXIDE	MRL (mg/kg)	2		
PROCYMIDONE	MRL (mg/kg)	5		
PROFENOFOS	MRL (mg/kg)	2		
PROPAMOCARB	MRL (mg/kg)	2		
PROPARGITE	MRL (mg/kg)	2		
PYRACLOSTROBIN	MRL (undef)	0.3		
PYRETHRINS	MRL (mg/kg) (*)	0.05		
PYRIMETHANIL	MRL (mg/kg)	0.7		
QUINTOZENE	MRL (mg/kg)	0.02		
SPINOSAD	MRL (undef)	0.3		
TEBUCONAZOLE	MRL (mg/kg)	0.2		
TEBUFENOZIDE	MRL (mg/kg)	1		
THIACLOPRID	MRL (mg/kg)	0.5		
TOLYLFLUANID	MRL (mg/kg)	3		
TRIFLOXYSTROBIN	MRL (undef)	0.7		
TRIFORINE	MRL (mg/kg)	0.5		
VINCLOZOLIN	MRL (mg/kg)	3		
ZOXAMIDE	MRL (mg/kg)	2		

9.2 Other contaminants

Tomatoes on the vine shall comply with those maximum levels for contaminants established by the Codex Alimentarius Commission for this commodity.

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.

Figure 1 — Round and cherry tomatoes

Figure 2 — Ribbed tomatoes

Figure 3 — Oblong tomatoes

Figure 4 — Damaged tomato — Not allowed

Figure 5 — Marked bruising — Not allowed

Figure 6 — Fresh cracks — Not allowed

Figure 7 — Unhealed cracks — Not allowed

Figure 8 — Unhealed damage caused by hail — Not allowed

Figure 9 — Pseudomonas — Not allowed

Figure 10 — Alternaria — Not allowed

Figure 11 — Signs of rotting — Not allowed

Figure 12 — Blossom-end rot — Not allowed

Figure 13 — Internal browning — External appearance — Not allowed

Figure 14 — Internal brownig — Internal appearance — Not allowed

Figure 15 — Watercore — Not allowed

Figure 16 — Chilling injury — Not allowed

Figure 17 — Treatment residues — Not allowed

Figure 18 — Soiled tomato — Not allowed

Figure 19 — Not fresh in appearance — Not allowed

Figure 20 — Caterpillar — Not allowed

Figure 21 — Damage by insects — External appearance — Not allowed

Figure 22 — Damage by insects — Internal appearance — Not allowed

Figure 23 — Damage by snails — Not allowed

Figure 24 — OECD colour gauge

Figure 25 — Perfect produce

Figure 26 — Very slight superficial defect — Limit allowed

Figure 27 — Slight defect in shape for Class I round tomato — Limit allowed

Figure 28 — Slight defect in shape for Class I ribbed tomato — Limit allowed

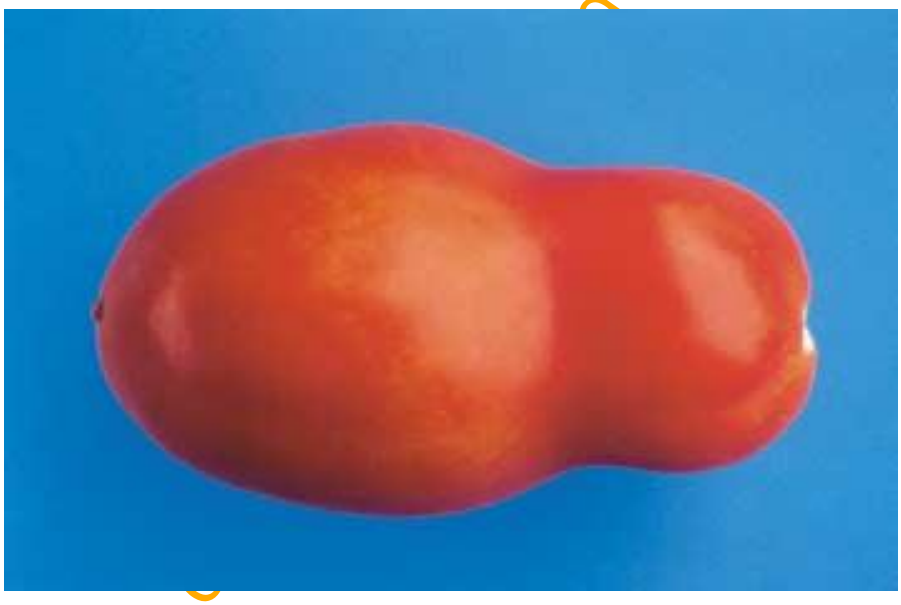

Figure 29 — Slight defect in shape for Class I oblong tomato — Limit allowed

Figure 30 — Slight hollowness — Class I — Limit allowed

Figure 31 — Slight superficial blemishes — Class I — Limit allowed

Figure 32 — Botrytis ghost spots — Class I — Limit allowed

Figure 33 — Healed cracks for ribbed tomatoes — Limit allowed

Figure 34 — Small umbilicus — Class I - Limit allowed

Figure 35 — Suberization of the stigma — Class I — Limit allowed

Figure 36 — Fine blossom scar — Class I — Limit allowed

Figure 37 — Defect in shape for Class II round tomatoes — Limit allowed

Figure 38 — Defect in shape for Class II ribbed tomatoes — Limit allowed

Figure 39 — Defect in shape for Class II oblong tomatoes — Limit allowed

Figure 40 — Hollowness — Class II — Limit allowed

Figure 41 — Superficial blemishes — Class II — Limit allowed

Figure 42 — Botrytis ghost spots — Class II — Limit allowed

Figure 43 — Bruises — Limit allowed

Figure 44 — Radial cracks — Limit allowed

Figure 45 — Concentric cracks — Limit allowed

Figure 46 — Green colouring and shape typical of the variety — Striped Roman

Figure 47 — Greenback — External appearance — Limit allowed

Figure 48 — Greenback — Internal appearance — Limit allowed

Figure 49 — Yellowback — External appearance — Limit allowed

Figure 50 — Yellowback — Internal appearance — Limit allowed

Figure 51 — Pronounced protuberances — Limit allowed

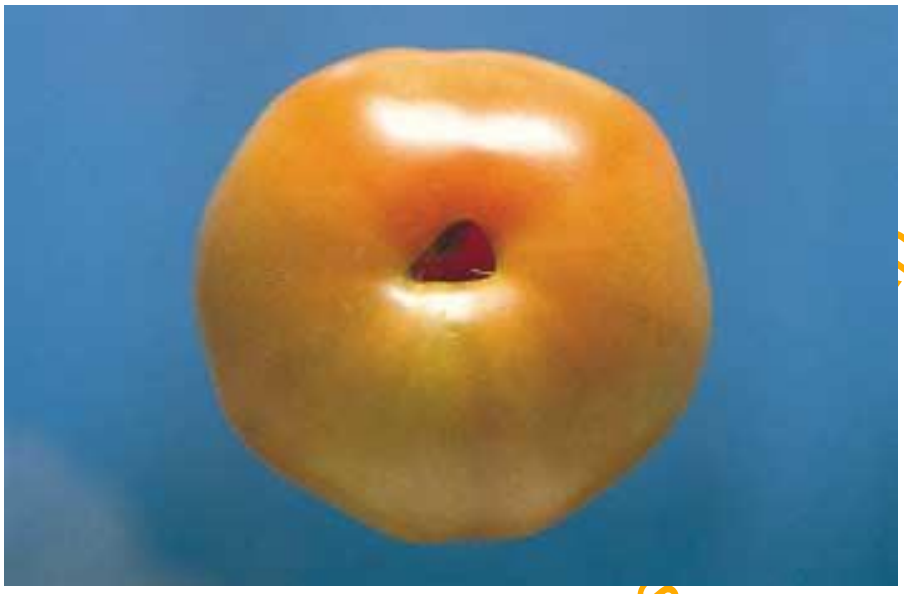

Figure 52 — Umbilicus — Class II — Limit allowed

Figure 53 — Suberization of the stigma — Class II — Limit allowed

Figure 54 — Fine blossom scar — Class II — Limit allowed

Figure 55 — Very careful presentation — “Extra” Class

Figure 56 — Careful presentation — Class I

Figure 57 — Suitable presentation — Class II

Figure 58 — Uniformity in packages

Figure 59 — Truss of round tomatoes

Figure 60 — Example of sales unit

Tomatoes on vine

Vine tomatoes

Annex A
(normative)

Classification of defects

Factor	Damage	Serious Damage	Very serious damage
Cuts and broken skins	Not shallow or not well healed, or shallow, well healed cut more than 13 mm in length, or other shallow, well healed skin breaks aggregating more than a circle 10 mm in diameter.	Not shallow or not well healed, or shallow, well healed cut more than 13 mm in length, or other shallow, well healed skin breaks aggregating more than a circle 13 mm in diameter.	Fresh or healed and extending through the tomato wall.
Puffiness	Open space in 1 or more locules materially detracts from appearance of tomato cut through centre at right angles to a line from stem to blossom end.	Open space in 1 or more locules seriously detracts from appearance of tomato cut through centre at right angles to a line from stem to blossom end.	Open space in 2 or more locules very seriously detracts from appearance of tomato cut through center at right angles to a line from stem to blossom end.
Catfaces	Scars are rough or deep, channels are very deep or wide, channels extend into a locule, or a fairly smooth catface aggregating more than a circle 13 mm in diameter.	Scars are rough or deep, channels are very deep or wide, channels extend into a locule, or a fairly smooth catface aggregating more than a circle 19 mm in diameter.	Channels extend into the locule, wall has been weakened to the extent that slight pressure will cause a tomato to leak, or a fairly smooth catface aggregating more than a circle 25 mm in diameter.
Scars (other than catfaces)	No depth and aggregating more than a circle 10 mm in diameter.	No depth and aggregating more than a circle 16 mm in diameter.	No depth and aggregating more than a circle 25 mm in diameter.
Growth cracks (radiating from or concentric to stem scar).	Not well healed, more than 3 mm in depth, individual radial cracks more than 13 mm in length, aggregate length of all radial cracks more than 25 mm measured from edge of stem scar. Any lot of tomatoes which are at least turning may have cracks which are not well healed provided they are not leaking.	Not well healed, more than 3 mm in depth, individual radial cracks more than 19 mm in length, aggregate length of all radial cracks more than 44 mm measured from edge of stem scar. Any lot of tomatoes which are at least turning may have cracks which are not well healed provided they are not leaking.	Not well healed, more than 6 mm in depth, individual radial cracks more than 25 mm in length, aggregate length of all radial cracks more than 73 mm measured from edge of stem scar. Any lot of tomatoes which are at least turning may have cracks which are not well healed provided they are not leaking, not more than 3 mm in depth, individual radial cracks are not more than 19 mm in length.
Hail	Deep, rough, not well healed and corked over, or fairly smooth, shallow hail marks aggregating more than a circle 10 mm in diameter.	Deep, rough, not well healed and corked over, or fairly smooth, shallow hail marks aggregating more than a circle 16 mm in diameter.	Fresh, very deep or fairly smooth, shallow hail marks aggregating more than a circle 25 mm in diameter.
Insect injury	Materially detracts from the appearance or any insect is present in the fruit.	Seriously detracts from the appearance or any insect is present in the fruit.	Very seriously detracts from the appearance or any insect is present in the fruit.

Annex B
(informative)

Guide to cold storage and refrigerated transport

B.1 Scope

This annex gives guidance on the operations to be carried out before and the conditions to be met during the cold storage and refrigerated transport of tomatoes for maintaining quality and avoiding deterioration. These recommendations are not applicable to tomatoes intended for industrial processing

B.2 Preparation of tomatoes intended for refrigerated transport and cold storage

B.2.1 Harvesting

Tomatoes should be harvested in dry weather. Their ripeness at harvest, which is identified by the colour of the tomatoes (see Table B.1), should be appropriate for the intended duration and conditions of transport, the intended use of the tomatoes and the required duration of storage.

The colour of tomatoes is thus the most important criterion for establishing the harvesting time. The destination and the time at which the fruits will be presented on the market should also be taken into consideration.

Tomatoes should be conditioned, packed and dispatched or stored as soon as possible after harvesting, with a delay not exceeding 12 h.

B.2.2 Quality

Tomatoes intended for transport or a short period of storage should comply with technical quality standards and specifications established for inland markets or food exportation in the country concerned.

Tomatoes should be conditioned carefully and size graded. They should be sound and clean, have a firmness characteristic of their degree of maturity and be free from excessive surface moisture.

The presence of the peduncle is optional; it depends on the destination of the fruits and does not constitute a condition necessary for successful transport or cold storage. It is important to ensure that the degree of ripeness of a lot of tomatoes is as uniform as possible and therefore the range in colour should not exceed two adjacent degrees on the colour chart (see Table B.1).

B.2.3 Packing

Tomatoes intended for cold storage and refrigerated transport may be packed in various types of packages (for example, wooden, fibreboard or plastic materials), provided that the pressure exerted on the fruits does not lead to a reduction in quality during transport or storage. It is considered that for both transport and storage, the total depth of tomatoes packed in layers should not exceed 20 cm. Good air circulation around and through the packages should also be provided.

B.2.4 Pre-cooling

If the tomatoes are to be kept under refrigeration until they are marketed, they should be pre-cooled. After the tomatoes have been harvested, conditioned and packed, they should be pre-cooled to a temperature that differs by no more than 2 °C from the optimum transport or storage temperature. To avoid water vapour condensation on the product. pre-cooling of the transport vehicle is also recommended.

B.3 Loading Into refrigerated vehicles or cold stores

Tomatoes should be loaded into the transport vehicle or into the cold store as soon as possible, but not later than 24 h, after harvesting.

The quality of the tomatoes is markedly impaired if the temperature of the fruit rises to above 25 °C for even a few hours.

If the optimum temperature range shown in Table B.1 and in Table B.2 cannot be maintained, the temperature should be between 6 °C and 25 °C, but the tomatoes should not be held at a temperature outside the optimum range for more than 12 h. It is recommended that any one transport vehicle or cell is filled with tomatoes of the same degree of ripeness and the same grade and size.

Packs containing tomatoes shall be handled carefully. If mechanized loading/unloading operations are used in the store, it is recommended that the packs are palletized and secured. When the packs are put into store, it is important to allow for good air circulation.

B.4 Optimum conditions during refrigerated transport and cold storage

B.4.1 Temperature

The optimum temperature to be used during the refrigerated transport and cold storage of tomatoes depends on the degree of ripeness of the tomatoes, the intended duration of transport and storage, and the conditions of distribution. In general, the riper the tomato, the lower the storage temperature it can withstand.

Table B.1 specifies recommended storage temperatures as a function of the degree of ripeness of the tomatoes. If it is necessary to complete the ripening of the tomatoes before distribution, it is recommended that they be kept at a temperature of at least 18 °C but not more than 25 °C for at least 12 h.

Table B.2 specifies recommended temperatures in transport vehicles as a function of the degree of ripeness of the tomatoes and the duration of transport.

Table B.1 — Optimum storage temperature in terms of ripeness

Degree of ripeness [1)]	Temperature °C
1	12 to 13
2	10 to 12
3	9 to 10
4	8 to 10
5	6 to 8

[1)] 1, turning; 2, light pink; 3, pink to light orange; 4, orange to light red; 5, red.

Table B.2 — Optimum temperature in transport vehicles in terms of ripeness and duration of transport

Degree of ripeness [1)] at loading	Duration of transport			
	2 days to 3 days		4 days to 6 days	
	Temperature during transportation °C	Degree of ripeness [1)] after transportation	Temperature during transportation °C	Degree of ripeness [1)] after transportation
1	12 to 14	4	12 to 14	5
2	12 to 14	4	12 to 14	5
3	10 to 12	5	10 to 12	5
4	8 to 10	5	6 to 8	5
			8 to 10	5
5	8 to 10	5	6 to 8	5
			8 to 10	5

[1)] See Table B.1.

B.4.2 Relative humidity of air

The relative humidity of the air should be maintained constant at (90 ± 3) %.

B.4.3 Circulation of air

The air circulation in transport vehicles and in cold stores should be such that the appropriate temperature and relative humidity are maintained constant and uniform.

B.4.4 Duration of storage in cold stores

The maintenance of the quality of tomatoes stored under the conditions of temperature and relative humidity specified varies as a function of the ripeness of the fruits, the storage temperature, the vehicle used for transportation and the cultivar.
Tomatoes are able to maintain their quality under the conditions specified for a period of 7 days to 21 days

B.5 Operations to be carried out during storage, at the end of storage and in transport vehicles

During storage, regular quality control of the stored tomatoes is recommended. At the end of a period of storage or transport. the tomatoes should be pre-warmed to avoid condensation of water vapour on the surface of the fruits.

B.6 Application limitations

This Annex gives general recommendations for the cold storage and refrigerated transport of tomatoes. These recommendations may need to be modified to suit particular cultivars of tomato, local climatic conditions, cultivation practices, market requirements and distances of transportation, etc. Experts will be able to establish those recommendations most appropriate for particular market requirements and ecological and agrotechnical factors. In addition, the quality of the harvest and the storage conditions attainable in particular transport vehicles and cold stores may necessitate modifications to these recommendations.

Subject to local conditions and the fact that tomatoes are living matter, the application of the recommendations made in this annex should enable much wastage during refrigerated transport and cold storage to be avoided.

Annex C
(informative)

Commercial production guide

C.1 History, significance, classification and growth

The tomato (*Lycopersicon esculentum* Mill.) is the most widely grown vegetable worldwide. From processing to fresh market, and from beefsteak to grape tomatoes, the variety and usefulness of the fruit is virtually boundless.

Tomatoes are members of the *Solanaceae* family, which includes peppers, eggplant, Irish potatoes and tobacco. The tomato originated in the area extending from Equador to Chile in the western coastal plain of South America. The tomato was first domesticated in Mexico where a variety of sizes and colours were selected. The fruit was introduced to Europe in the mid-1500s.

Tomatoes are members of the nightshade family and, because of this, were considered for many years to be poisonous. Indeed, many crops in this family contain highly toxic alkaloids. Tomatine occurs in toxic quantities in the tomato foliage but is converted enzymatically to a non-toxic form in the fruit. Because of these beliefs, the crop was not used for food until the 18th century in England and France. Tomato was introduced to the United States in 1910, but only became popular as a food item later in that century.

Tomatoes are an important source of lycopene, which is a powerful antioxidant that acts as an anticarcinogen. They also provide vitamins and minerals. One medium ripe tomato (~145 grams) can provide up to 40 percent of the Recommended Daily Allowance of Vitamin C and 20 percent of Vitamin A. They also contribute B vitamins, potassium, iron and calcium to the diet.

There are two types of tomatoes commonly grown. Most commercial varieties are *determinate.* These “bushy” types have a defined period of flowering and fruit development. Most heirloom garden varieties and greenhouse tomatoes are indeterminate, which means they produce flowers and fruit throughout the life of the plant.

Tomato is considered a tender warm season crop but is actually a perennial plant, although it is cultivated as an annual. It is sensitive to frost. Most cultivated tomatoes require around 75 days from transplanting to first harvest and can be harvested for several weeks before production declines. Ideal temperatures for tomato growth are 21-30 °C during the day and 18-21 °C at night. Significantly higher or lower temperatures can have negative effects on fruit set and quality. The tomato is a self-pollinating plant and, outdoors, can be effectively pollinated by wind currents.

C.2 Culture and varieties

C.2.1 Soil requirements and site preparation

Tomatoes can be produced on a variety of soil types. They grow optimally in deep, medium textured sandy loam or loamy, fertile, well-drained soils. Avoid sites that tend to stay wet. Also, rotate away from fields that have had solanaceous crops within the past 3-4 years. Select sites that have good air movement (to reduce disease) and that are free from problem weeds.

In field production, plants depend on the soil for (1) physical support and anchorage, (2) nutrients and (3) water. The degree to which the soil adequately provides these three factors depends upon topography, soil type, soil structure and soil management.

For tomato production, proper tillage is crucial for adequate soil management and optimal yields. Land preparation should involve enough tillage operations to make the soil suitable for seedling or transplant establishment and to provide the best soil structure for root growth and development.

The extent to which the root systems of tomato plants develop is influenced by the soil profile. Root growth will be restricted if there is a hard pan, compacted layer or heavy clay zone. Tomatoes are considered to be deep rooted and, under favourable conditions, some roots will grow to a depth of as much as 3 m. The majority of roots, however, will be in the upper 30 cm to 60 cm of soil. Since root development is severely limited by compacted soil, proper land preparation should eliminate or significantly reduce soil compaction and hard pans.

If a compaction pan exists just below or near moldboard plow depth, this hard pan can be disrupted by subsoiling to a depth of 40.64 cm to 45 cm to allow the development of a more extensive root system. Subsoiling also helps increase water infiltration.

If there is an abundance of plants or plant residues on the soil surface, discing or mowing followed by discing is usually advised prior to moldboard plowing. This should be done 6 to 8 weeks ahead of planting to bury residue and allow it to decay. Immediately prior to plastic mulch installation or transplanting, perform final soil preparation and/or bedding with a rotary tiller, bedding disc or a double disc hiller in combination with a bedding press or levelling board. This provides a crustless, weed-free soil for the installation of plastic mulch or the establishment of transplants.

Tomatoes are usually transplanted into plastic mulch on raised beds. A raised bed will warm up more quickly in the spring and therefore will enhance earlier growth. Since tomatoes do poorly in excessively wet soils, a raised bed facilitates drainage and helps prevent waterlogging in low areas or in poorly drained soils. Raised beds are generally 3 to 8 inches high. Keep in mind, however, that tomatoes planted on raised beds may also require more irrigation during drought conditions.

C.2.2 Cover crops and minimum tillage

Cover crops help protect the soil from water and wind erosion. When incorporated into the soil as “green manure,” cover crops contribute organic matter to the soil. Soil organic matter consists of plant and animal residues in various stages of decay. Organic matter improves soil structure (helps to reduce compaction and crusting), increases water infiltration, decreases water and wind erosion, increases the soil’s ability to resist leaching of many plant nutrients, and releases plant nutrients during decomposition.

Planting tomatoes in reduced tillage situations has been tried with variable results in different parts of the country. Often cover crops can be killed with a burn down herbicide. Then tomatoes are either transplanted directly into the cover, or a narrow strip is tilled and prepared for transplanting while leaving the residue between rows. While these residues can protect the fruit from direct contact with the soil, currently the impediments outweigh the benefits for large-scale commercial production. Leguminous covers can provide nitrogen to the crop and there are certainly soil conservation advantages.

The primary encumbrance to success in reduced tillage systems is adequate weed and disease control. The application of phosphates, potash and lime are also more difficult in these systems, so reduced tillage is used only on a limited basis in commercial tomato production. With advances in weed and disease control technology, this type of production may become more feasible in the future.

C.2.3 Windbreaks

Crop windbreaks can aid in crop protection and enhance early growth and yield. Frequency or intervals between windbreaks is dictated by distance between tomato rows, spray or harvest alleyway intervals, land availability and equipment characteristics. For instance, bed arrangements may be such that a windbreak is present between every set of four, six or eight beds. Plant windbreaks perpendicular to the prevailing wind direction. When using a taller growing windbreak such as rye, you can expect the windbreak to be effective to a width of about 10 times its height. For instance, with a rye crop that is 3 feet high, the windbreaks can be effective up to 30 feet apart.

In general, close windbreaks give the best wind protection and help moderate the tomato plants’ microenvironment and enhance earliness. Especially on sandy soils, windbreaks reduce damage from sandblasting of plants and small fruit during early spring. Sandblasting can be more of a problem with plastic mulch, as the soil particles are carried easily by the wind across the field. Many growers

spread small grain seed after the plastic mulch is applied to reduce sand blasting. Windbreaks also conserve soil moisture by reducing direct evaporation from the soil and transpiration from the plant. This can enhance plant growth throughout the season.

Regardless of the species selected to be used as a windbreak, plant it early enough to be effective as a windbreak by the time tomatoes are transplanted. Wheat, oats or rye all make good windbreak crops. Windbreaks can be living or non-living. Tomato beds can be established between the windbreaks by tilling only in the bed area.

To minimize insect migration to the tomato crop, destroy windbreak crops by herbicides, mowing and/or tillage before they lose their green colour and begin to die back.

C.2.4 Transplanting

Seeding tomatoes directly into the field is not recommended due to the high cost of hybrid seed and the specific conditions required for adequate germination. Most tomatoes are transplanted to the field from greenhouse-grown plants. Direct seeding has other disadvantages: (1) Weed control is usually much more difficult with direct seeded than with transplanted tomatoes; (2) direct seeding requires especially well made seedbeds and specialized planting equipment to adequately control depth of planting and in-row spacing; (3) because of the shallow planting depth required for tomato seed, the field must be nearly level to prevent seeds from being washed away or covered too deeply with water-transported soil; and (4) harvest dates will be at least 2 to 3 weeks later for direct seeded tomatoes.

At 15, 20 and 25 degrees C soil temperature, tomato seed require 14, 8 and 6 days, respectively, for emergence when planted 6.4 mm deep.

Typically, 5- to 6-week old tomato seedlings are transplanted into the field. As with most similar vegetable crops, container-grown transplants are preferred over bare root plants. Container grown transplants retain transplant growing medium (soil-substitute) attached to their roots after removal from the container (flat, tray). Many growers prefer this type transplant because (1) they are less subject to transplant shock, (2) usually require little, if any, replanting, (3) resume growth more quickly after transplanting, and (4) grow and produce more uniformly. Tomato plants produced in a 2.5 cm cell size tray are commonly used for transplanting.

Tomato transplants should be hardened off before transplanting to the field. Hardening off is a technique used to slow plant growth prior to field setting so the plant can more successfully transition to the less favourable conditions in the field. This process involves decreasing water for a short period prior to taking the plants to the field.

For maximum production, transplants should never have fruits, flowers or flower buds before transplanting. An ideal transplant is young (15 cm to 20 cm tall with a stem approximately 6.4 mm to 19 mm in diameter), does not exhibit rapid vegetative growth, and is slightly hardened at transplanting time. Rapid growth following transplanting helps assure a well established plant before fruit development. In most cases, it is more economically feasible to have transplants produced by a commercial transplant grower than to grow them on the farm. When purchasing transplants, be sure the plants have the variety name, have been inspected and approved by a plant inspector, and they are of the size and quality specified in the order.

C.2.5 Plant spacing

The optimal plant population per acre may be influenced by plant growth habit (compact, spreading), plant size at maturity (small, medium, large), vigour of specific cultivars, climate, soil moisture, nutrient availability, management system and soil productivity.

C.2.6 Varieties

Select varieties on the basis of marketable yield potential, quality, market acceptability, adaptability and disease resistance or tolerance. Other characteristics to consider include maturity, size, shape, colour, firmness, shipping quality and plant habit.

Plants need to produce adequate foliage to protect fruit. Basically, a variety must be adaptable to the area, produce a competitive yield and be acceptable to buyers. Disease resistance will be most important with diseases for which there are no other good management options. Varieties should be resistant to *Fusarium* wilt (Races 1 and 2) and *Verticillium* wilt (Race 1). In recent years, resistance to Tomato Spotted Wilt Virus has become equally as important, since varietal resistance is the most effective control method at this time. Other resistance of significance should include Gray Leaf Spot and Tobacco Mosaic Virus.

C.2.7 Staking and pruning

Most commercial determinate tomatoes are produced using short stake culture for trellising. This type of culture produces fruits that are higher in quality and easier to harvest and enhances spray coverage. In this system, stakes approximately 1.2 m long and 1.9 to 2.5 cm wide are placed between every one or two plants depending on the tying system that is employed. Stakes are usually driven about 30 cm into the ground. An additional stake can be supplied at the ends of each section to strengthen the trellis.

Stake plants immediately after planting to minimize damage to the root system and to have the trellis ready when needed.

Determinate tomatoes often still require some level of pruning. Pruning is the removal of suckers (axillary shoots). The degree to which pruning is needed will vary with the variety used but can impact yield and quality significantly. Plants that produce vigorous foliage that are not pruned will produce more, but smaller fruit. Pruning helps increase the size of the fruit. It can also enhance earliness of the crown set, reduce pest pressure and enhance spray coverage. In general, pruning will involve removal of one to all suckers up to the first fork (the sucker just below the first flower cluster).

Prune plants when the foliage is dry to reduce the spread of disease.

C.2.8 Transplant production

Tomato transplant production is a relatively easy but highly specialized function of production. Many growers have neither the greenhouse facilities nor the expertise to undertake transplant production; instead, they will rely on greenhouse growers to produce their transplants. For these growers to ensure a quality supply of transplants, they should contract early with their greenhouse grower to secure plants of the variet(ies) they wish to grow.

C.3 Irrigation

Irrigation is essential to produce consistent yields of high quality tomatoes. Rainfall amounts are often erratic during the growing season, and tomatoes are often grown in sandy soils with low water holding capacity. This combination of factors makes supplemental irrigation necessary for commercial tomato production.

Irrigation studies show that irrigation increases annual tomato yields by an average of at least 60 percent over dryland production. Quality of irrigated tomatoes is also much better. Irrigation eliminates disastrous crop losses resulting from severe drought.

Moisture stress in tomatoes causes shedding of flowers and young fruit, sunscalding and dry rot of fruit. The most critical stages for watering are at transplanting, flowering and fruit development.

C.4 Physiological problems

C.4.1 Blossom-end rot

Blossom-end rot is a calcium deficiency that occurs at the blossom end of the fruit. It is characterized by black, necrotic, sunken tissue at the blossom end. Fruit with necrotic tissue is unsalable and the damage cannot be corrected. Although the tissue is calcium deficient, preplant applications of calcium or postplant applications to correct the disorder often have no effect.

To a certain extent, this problem can be alleviated with even moisture during plant growth. Wide swings from wet to dry conditions as well as overwatering tend to aggravate this problem. Exogenous applications of calcium as foliar sprays have been suggested to alleviate this problem. Any such application would have to occur prior to visible symptoms when fruit are just forming, but there is little evidence this is an effective practice.

C.4.2 Blossom drop

Although tomatoes are warm season vegetables, they require relatively moderate temperatures to set fruit. Nighttime temperatures above 70 degrees F. will cause blossom drop, which in turn will reduce yields. This problem is solved by planting at that time of year when night temperatures will be below this threshold during flowering and fruiting.

C.4.3 Fruit cracking

There are two different types of cracking — radial and concentric — both of which occur at the stem end. Radial cracking is more common and usually occurs during periods of high temperatures (at or above 90 degrees F.) and prolonged rain or wet soil when fruit will rapidly expand and often crack. This is particularly prevalent after a long period of dry weather. This type of cracking is also more prone to occur if fruit are exposed to intense sunlight. Finally, fruit load may also be a factor, with a light load more prone to cracking.
Maintaining even moisture conditions, avoiding excessive pruning, and having a heavy fruit load will help prevent this problem. Variety selection can also help alleviate this problem. Generally, cracking susceptible varieties will crack when fruit are still in the green stage, whereas resistant varieties often don't show cracking until later, when the fruit is turning color.

Concentric cracking is also caused by rapid growth, but generally occurs when there are alternating periods of rapid growth followed by slower growth. This can occur with wet/dry cycles or cycles of high and low temperatures. Generally this type of cracking occurs as fruit near maturation. Even moisture throughout the growing period will help alleviate this problem. Also avoid fertilization spikes that encourage cyclic growth.

C.4.4 Catfacing

Catfacing is characterized by distorted growth at the blossom end of fruit, often with rough calloused ridges. Catfacing generally occurs when fruit are formed during cool or humid weather that favors the corolla adhering to the developing fruit. The adhesion of these flower parts causes the distortion that appears as the fruit matures. Usually catfacing is most evident during the first harvest with fruit that was set during cooler temperatures. Planting later and using varieties resistant to catfacing will help prevent this from occurring.

Zippering may be related to catfacing, only the damage occurs in straight lines from the blossom end to the stem end. The line may have a calloused or corky appearance.

C.4.5 Puffiness

Fruit may appear normal or nearly so but, when cut, the locules appear empty. There is little or no fruit gel or seeds present. This usually occurs when fruit develop under conditions that are too cool or too hot (below 55 degrees F or above 90 degrees F.), which interferes with normal seed set. Tomatoes are self-fertile but require some disturbance of the flower in order for the pollen to be shaken onto the stigma. This can occur from insects or wind, or during the normal handling of plants (staking and pruning). Wet, humid and cloudy weather may interfere with insect pollination and the pollen may not shed as readily. Cool weather will slow the growth of pollen tubes. In addition, excess nitrogen appears to be a factor with this condition. Little can be done to alleviate this problem other than planting at the proper time of year. Hot set varieties appear to be less susceptible to this problem.

C.4.6 Sunscald

Tomato fruit may develop a papery thin area on the fruit that will appear tan or white in colour. This is caused by sunscald, where the area affected is exposed to intense sunlight and heat resulting in a

breakdown of the tissue. Sunscald may also appear as hard yellow areas on the fruit that are exposed. Maintaining good foliage cover during fruit development and avoiding excessive pruning will minimize this problem.

C.4.7 Greywall or blotchy ripening and internal browning

Several different factors may contribute to these conditions. Internal browning may be caused by a virus (tobacco mosaic virus). Silverleaf whitefly has also been associated with uneven ripeness in tomatoes.

Greywall and blotchy ripening may occur together and may be caused by a bacteria. The outer wall will appear gray and be partially collapsed. Internally there are necrotic areas within the walls of the fruit. Factors associated with this condition include high nitrogen, low potassium, low temperatures, excessive soil moisture and soil compaction. Addressing these factors may reduce the incidence of this disorder.

C.4.8 Internal white tissue

Occasionally, a tomato will exhibit white tissue in the crosswalls when cut. This is rarely seen when fruit are harvested at the mature green stage, but it can be a problem with vine ripe fruit. It is unclear what causes this, but adequate potassium fertilizer appears to reduce the problem.

C.4.9 Rain check

Rain check is the formation of tiny transverse cracks on the fruit. These cracks may heal, forming a rough texture on the fruit; generally these fruit are unmarketable.

As with many of these disorders, it is unclear what causes this, but it is associated with rain events. Heavy rains following dry periods are times when this is most likely to occur. This phenomenon may be related to other types of cracking and may be alleviated with growing conditions that don't encourage wet/dry cycles.

C.5 Lime and fertilizer management

Lime and fertilizer management should be tailored to apply optimal amounts of lime and nutrients at the most appropriate time(s) and by the most effective application method(s). Fertilizer management is impacted by cultural methods, tillage practices and cropping sequences. A proper nutrient management program takes into account native soil fertility and residual fertilizer. Therefore, the first step in an appropriate fertilizer management program is to properly take a soil test 3 to 5 months before the crop is to be planted.

Plant tissue analysis or petiole sap analysis is an excellent tool for measuring the nutrient status of the crop during the season. Particularly with fertigation, it is simple to adjust fertilizer injection rates according to the analysis results.

C.6 Diseases

C.6.1 Bacterial diseases

Bacterial spot a most serious disease affecting tomatoes. This disease is caused by the bacterium *Xanthomonas axonopodis* pv. *vesicatoria*. Bacterial spot lesions can be observed on leaves, stems and fruit and occurs during all stages of plant growth. Leaf lesions usually begin as small water-soaked lesions that gradually become necrotic and brown in the center (Figure C.5). During wet periods the lesions appear more water-soaked. Lesions generally appear sunken on the upper surface and raised on the lower surface of infected leaves. During periods of favorable weather, spots can coalesce and cause large areas of chlorosis (Figure C.6). Premature leaf drop is the ultimate result of leaf infection. Fruit lesions appear as small, round, dark brown to black spots (Figure C.7).

Figure C.5 — Leaf lesions caused by bacterial spot

Figure C.6 — Chlorotic leaves caused by bacterial spot

Figure C.7 — Fruit lesions from bacterial spot

The bacterium is primarily seed-borne and most epidemics can be traced back, directly or indirectly, to an infected seed source. Infected seedlings carry the disease to the field, where it spreads rapidly during warm, wet weather. Workers working in wet fields can also be a major source of disease spread.

Prevention is the best method for suppressing losses to bacterial spot. Purchase seed from companies that produce the seed in areas where the disease is not known to occur. Hot water seed treatment can also be used, and tomato seed can be soaked in water that is 122 degrees F for 25 minutes to kill the bacterium. Transplant production should take place in areas away from commercial production to avoid contamination from production fields or vice versa.

Tomatoes have little to no commercially available cultivars resistant to bacterial spot. Rotate away from fields where tomatoes have been grown within the past year and use practices that destroy volunteer plants that could allow the disease to be carried over to a subsequent crop. Cull piles should be located away from production fields or transplant houses. Copper fungicides used in conjunction with maneb will suppress disease losses if applied on a preventive schedule with a sprayer that gives adequate coverage. Other bacterial-spot suppressive treatments are also available.

Bacterial wilt, caused by *Ralstonia solanacearum*, is a devastating bacterial disease of tomatoes worldwide. This bacterium can last in the soil for several years and has been responsible for taking whole fields out of production. Bacterial wilt is recognized by a rapid wilting of the tomato plant, often while the plant is still green (Figure C.8). Wilted plants will eventually die. A quick diagnostic tool is to cut a lower stem of a suspected infected plant and place it in a clear vial or glass of water and watch for the opaque, milky bacterial streaming that comes from the cut area (Figure C.9).

Figure C.8 — Bacterial wilt causes rapid wilting

Figure C.9 — Bacterial streaming from infected plant cut and placed in water

Bacterial wilt is not easily controlled by fumigation or chemical means. There are few commercially available cultivars with resistance to bacterial wilt. The best control tool is to rotate away from infested fields for several years.

Bacterial speck, caused by *Pseudomonas syringae* pv. *tomato* is more of a problem of the cooler growing regions. Leaflet lesions are very small, round and dark brown to black. During favourable weather the lesions can coalesce and kill larger areas of leaf tissue. Bacterial speck causes oval to elongated lesions on stems and petioles. Tomato fruit may have minute specks with a greener area surrounding the speck. Control measures are similar to bacterial spot.

C.6.2 Virus diseases

Virus diseases have been a severe limiting factor in tomato production. Most virus diseases cause stunting, leaf distortion, mosaic leaf discoloration, and spots or discoloration on fruit. The distribution of virus-infected plants is usually random with symptomatic plants often bordered on either side by healthy, non-symptomatic plants. Virus diseases are almost always transmitted by insect vectors, and the severity of a virus disease is usually tied to the rise and fall in the populations of these vectors from season to season and within a given season.

Tomato spotted wilt virus (TSWV) is transmitted by thrips and can affect tomato at any stage of development. The extensive host range of TSWV in weeds allows for a continual source of inoculum for infection. Early infections tend to cause more yield losses than those occurring later in plant development. TSWV causes plant stunting (Figure C.10), ringspots (Figure C.11) and bronzing on infected plants. Tomato fruit produced on infected plants may be misshapen, have dark streaks (Figure C.12) or have chlorotic spots (Figure C.13). TSWV is suppressed through the use of metalized plastic and other coloured mulches as well as resistant varieties.

Figure C.10 — Plants on left stunted by TSWV

Figure C.11 — TSWV ring-spots on foliage

Figure C.12 — Dark streaks caused by TSWV

Figure C.13 — Chlorotic spots caused by TSWV

Cucumber mosaic virus (CMV) is a very common disease of tomato and can be very devastating where it occurs. This virus is transmitted by aphids and can be maintained in several weed species that surround production fields. The characteristic symptoms for CMV are severely stunted, distorted and strapped (faciated) leaves, stems and petioles. Symptoms of CMV often resemble phenoxy herbicide injury. Few options are available for suppressing losses to CMV, but destruction of weed hosts that harbor the virus will aid help suppress disease spread.

Tomato yellow leaf curl virus (TYLCV) is a virus that is whitefly-transmitted and is only a problem in years when whitefly populations are high. Infected plants appear to be severely stunted and little to no yield can be obtained from these plants (Figure C.14). Plant symptoms appear as severely stunted individual plants with greatly reduced leaves that take on a mouse-eared appearance (Figure C.15). Tomato leaflets of infected plants may also have a distinct marginal chlorosis (Figure C.16).

Figure C.14 — Small plant is severely stunted by TYLCV

Figure C.15 — "Mouse-eared" appearance of leaves on plants infected with TYLCV

Figure C.16 — Marginal leaf chlorosis associated with TYLCV

This disease is often brought in on infected transplants and then spread by whiteflies, so transplant inspection is a must. Identifying infected plants soon after transplanting and removing them will help prevent secondary spread. Preventive, systemic insecticide applications may prevent disease spread as well.

C.6.3 Fungal diseases

Early blight caused by ***Alternaria solani*** is the most common fungal disease of tomato foliage. Leaf symptoms appear as round to oblong, dark brown lesions with distinct concentric rings within the lesion (Figure C.17). Lesions are generally surrounded or associated with a bright yellow chlorosis. Stem lesions are slightly sunken, brown and elongated with very pronounced concentric rings. Fruit may become infected around the calyx, and a velvety spore mass can often be observed on fruit lesions. The disease is introduced by wind or rain-splash and is carried over to subsequent crops on infested debris.

Figure C.17 — Leaf lesions from early blight

Wet, humid weather favours disease development. In the field, the fungus spores are spread mainly by wind. Unless controlled, it causes severe defoliation. Resistant varieties are available to avoid losses to early blight. Rotation and deep turning are important for reducing initial inoculum. The disease is easily controlled with chemical sprays. Spray programs used for bacterial leaf spot will suppress early blight, but the addition of chemicals specifically targeted at early blight should be incorporated into the spray program.

Late blight is caused by *Phytopthora infestans.* This is probably one of the best known tomato diseases worldwide. This disease causes dark, water-soaked, greasy lesions on stems and foliage. A whitish-gray, fuzzy sporulation can be seen on the undersides of leaf lesions and directly on stem lesions during periods of high moisture. A soft rot of fruit can also be observed.

Phytopthora is a fungal-like organism is a water-mould, oomycete organism that has a mobile swimming-spore stage as part of its life cycle. The pathogen is carried by wind to non-infested areas, where it remains in the soil and on infested plant debris until favourable weather and a new host crop coincide to create a new epidemic. Warm days and cool nights coupled with adequate moisture favour the spread and infection of the late blight pathogen.

Destroying plant debris and rotating away from fields with a history of the disease is a must. Preventive fungicide sprays are generally relied on heavily where this disease occurs as a yearly problem.

Septoria leaf spot (*Septoria lycopersici*) and **Target spot** (*Corynospora cassiicola*) are foliar fungal diseases but are not generally a problem with the current spray regime that is targeted at early blight and bacterial spot.

Fusarium wilt caused by *Fusarium oxysporum* f.sp. *lycopersici*. Fusarium wilt is a soilborne disease of tomatoes that is generally a problem in specific fields where the pathogen has been introduced. The disease is initially brought into a field on infested seed, plant stakes, transplants or infested soil on equipment.

Symptoms usually appear during hot weather and after fruit set has begun. Symptoms appear as a yellowing and wilting on one side of the plant at first, usually during the hottest part of the day, followed by the eventual complete yellowing and wilting of the plant (Figure C.18). Entire death of the plant is the final result. Vascular discoloration is often observed on stems above the soil line (Figure C.19).

Figure C.18 — Complete yellowing and wilting from Fusarium wilt

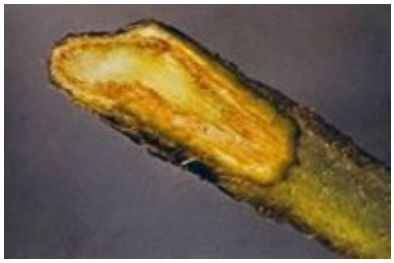

Figure C.19 — Vascular discoloration from Fusarium wilt

This fungus can stay in the soil in a resting state for several years, and rotation away from these fields for 5-7 years will lessen the severity but will not completely eliminate the disease. Fumigation really only delays disease onset and may lessen the total disease incidence. Preventing the disease from getting into the field is the best control measure, followed by the use of resistant varieties. Several races of this disease occur, however, and resistance must be specific to the race of Fusarium that is in the field in question.

Stem blight iscaused by *Sclerotium rolfsii*. If most tomatoes are rotated with peanuts, soybeans and other susceptible crops, the disease becomes a major problem. The fungus attacks the stem of the

plant near or at the soil line and forms a white mould on the stem base. Later in the season, small, round brown bodies appear in the mould (Figure D.20). Infected plants wilt and slowly die. Vascular discoloration can be observed on stem tissues above the lesion.

Figure C.20 — Southern stem blight mold and reproductive structures on stem

The severity of the disease can be lessened by following good cultural practices: rotation, litter destruction and deep turning with a moldboard plow are the best cultural defenses against this disease. Fumigation as well as at-plant and drip-applied fungicides are also effective in reducing losses to southern stem blight.

C.6.4 Nematodes

Root-knot nematodes (*Meloidogyne* spp) can cause serious economic damage to tomatoes. These tiny worms live in the soil and feed on the roots of tomatoes. Not only do they cause physical damage that interferes with the uptake of water and nutrients, but they allow the establishment of other diseases.

Nematode infected plants are generally stunted with pale green to light yellow foliage. Symptoms may be temporarily masked by supplying additional fertilizer and water. Soils infested with root-knot nematodes should be avoided or treated with fumigant or chemical nematicides before tomatoes are planted.

C.7 Insect management

Insect pests can damage tomato throughout the growing season, but severity varies with location and time of year. The severity of damage to tomato by insect pests is largely due to abundance of the pests, which is related to environmental conditions. With most insects, outbreaks are difficult to predict, and it is even more difficult to predict if control measures will be required. A knowledge of insect habits, careful pest monitoring and timely use of effective control measures will enable growers to avoid or at least reduce the damage they suffer. Tomato is well suited for insect pest management.

C.7.1 Seedling pests

Cutworms. Young tomato transplants may be cut down just above the soil surface by cutworms. While this damage is readily apparent, the insects are difficult to detect during the day as the larvae typically hide in the ground. Detection of the insects and verification of the pest problem is most easily accomplished when larvae are feeding at night.

Cutworms are generally considered a seedling pest, but they may also feed on foliage and fruit of mature plants. Use preventive insecticide treatments on fields with a history of cutworms or on tomato fields following grass sod. Where preventive treatments are not used, use directed sprays for cutworm control when 5 percent of the seedlings have been damaged or destroyed and cutworms are still present. All directed or foliar sprays used for cutworm control should be applied late in the day when cutworms are active.

Other insects attacking the main stem of seedlings. Several occasional pests may cause damage similar to cutworms. White grubs may cut off plants, but they will typically cut plants slightly below the soil line as compared to cutworms, which will usually cut at or slightly above the soil line.

Vegetable weevils, crickets and grasshoppers may also attack the main stems of seedlings. Generally these pests do not cut off plants except for the smallest transplants. They tend to feed up and down the main stem, removing the softer outer tissue, and can completely girdle the plant. This damage generally causes plant death and, at the least, makes the plant susceptible to lodging and seedling diseases.

Three-cornered alfalfa hopper may also attack seedlings. This pest has piercing-sucking mouth parts and does not remove plant tissue. It will circle small stems while feeding, producing a "girdle" on the stem, which interferes with water and nutrient translocation. This weakened area makes the plant susceptible to lodging.

Thrips. Thrips may be present in tomato fields throughout the growing season, but they are more prevalent in the spring. Prior to plants blooming, tobacco thrips generally dominates the population since this species readily feeds and reproduces on foliage. Flower thrips species populations can increase dramatically once blooming and pollen availability increases. Flower thrips populations may increase prior to the crop blooming if outside sources of pollen are plentiful.

Plant injury is caused by both nymphs and adults (Figure C.21) puncturing leaf and floral tissues and then sucking the exuding sap. This causes reddish, gray or silvery speckled areas on the leaves. With severe infestations, these areas can interfere with photosynthesis and result in retarded growth. Heavy infestations during the bloom stage may cause damage to developing fruit through egg laying. This damage appears as dimples with necrotic spots in the center and may be surrounded by a halo of discolored tissue. Occasionally thrips aggregate on fruit well hidden from sprays. This may result in russeting damage from continual feeding during fruit development. While thrips can cause direct damage to foliage and fruit, their role as vectors of tomato spotted wilt (TSWV) is of primary.

Figure 21 — Adult thrips

To prevent direct damage, make applications of insecticides when 20 percent of plants show signs of thrips damage, or when 5 or more thrips per bloom are found. An effective in-field survey method for thrips in blooms is to place several blooms in a vial of alcohol and count the thrips as they die and settle to the bottom.

Where TSWV is of concern, grow virus resistant varieties. For management of TSWV in susceptible varieties, UV-reflective plastic mulch, or metalized mulch, has proven useful in suppression of thrips populations and virus incidence. Insecticides also are frequently used in a preventive manner where TSWV is of concern.

C.7.2 Foliage feeders

Aphids — Aphids or plant lice are small, soft-bodied insects that may feed on tomato plants from time of planting until last harvest. Aphids cluster in shaded places on leaves, stems and blossoms. While winged migrants (Figure D.22) move from field to field spreading virus diseases, host plant resistance

in tomatoes has helped minimize this problem. Large populations of aphids on young plants can cause wilting and stunting but rarely occur. At harvest, infestations can represent a contamination both through their presence and through production of honeydew, which gives rise to sooty mould.

Figure D.22 — Adult winged aphid

Establishment of aphid colonies on tomato is often reduced by wet weather, but during cool, dry weather, large numbers of aphids may develop quickly. Feeding by these pests causes newly formed leaves to be crinkled and malformed. Aphid populations can be assessed by examining terminals and the undersides of leaves.

Potato Beetle — Potato beetles occasionally occur in damaging numbers in tomato fields. They lay orange-yellow eggs in groups of a dozen or more on the undersides of leaves; these eggs are often mistaken for lady beetle eggs. Injury to tomatoes is due to actual consumption of foliage and stems by the chewing adults and larvae. Young plants may be completely defoliated.

Because of their short life cycle and high reproductive capacity, treatments are needed as soon as beetle eggs or larvae are found. Because this is a rare pest, determine its presence by scouting.

Flea Beetles — These are small beetles with enlarged hind legs, which jump vigorously when disturbed. Their injury consists of small, rounded or irregular holes eaten through or into the leaf. The most common flea beetles are about 1.6 mm long and nearly a uniform black in colour (Figure C.23).

Figure D.23 — Adult flea beetle

Flea beetles may attack tomatoes at any time during the growing season but are often most numerous and of greatest concern early in the season. Apply insecticides for control of flea beetles when flea beetles become numerous and defoliation is greater than 10 percent. Flea beetles generally do not require control once plants are beyond the 5 leaf stage.

Hornworms — Hornworms are large, green cater-pillars with white diagonal markings. They reach a length of 76 mm. The most distinguishing characteristic of hornworms is the slender horn projecting

back-ward from the rear of the body (Figure C.24). Hornworms may feed on green fruit, but they primarily feed on the foliage of tomato plants and may cause enough defoliation to allow sun scald of fruit. The adult moths deposit spherical translucent eggs, singly, on the undersides of leaves. Apply treatments for hornworm control when one larva is found on 4 percent of the plants examined.

Figure C.24 — Hornworm larva

Cabbage looper — The cabbage looper (Figure C.25) is a foliage feeder and damage to fruit is rare. Larvae chew irregular holes in leaves. Leaf damage is of concern only when large numbers of larvae attack small plants or if feeding is extensive enough to open the canopy to expose fruit to sunburn. Mature plants can tolerate multiple larvae per plant without significant loss.

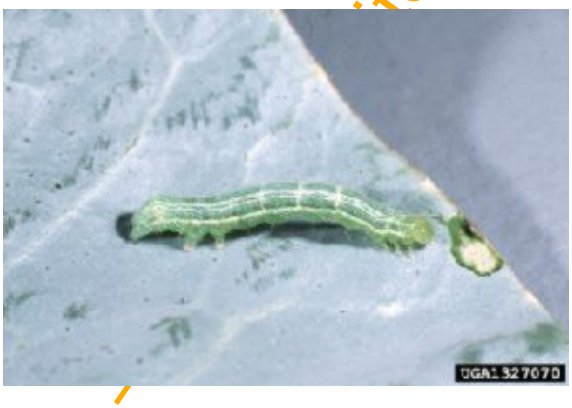

Figure C.25 — Cabbage looper larva

Looper larvae are easily identified by their habit of arching their backs into a loop as they crawl. Loopers are frequently controlled by insecticide applications applied for other caterpillar pests.

Leafminers — Adult leafminers are tiny, shiny, black flies with yellow markings. Adult female flies lay eggs within the leaves, and white to pale yellow larvae with black mouthparts mine between the upper and lower leaf surface for about 5 to 7 days before dropping to the ground to pupate. As the larvae grows and consumes more leaf tissue, the winding mine increases in diameter. Leafminer infestations usually are first detected as these slender, white, winding trails caused by the larvae (Figure C.26). The leaves are greatly weakened and the mines may serve as points where decay and disease may begin. With severe infestations, heavy leaf loss may lead to sun scald of fruit.

Figure C.26 — Winding mines in leaf created by leafminers

Several parasites attack this pest and can keep leaf-miner populations under control. Begin treatments for leafminer control when populations reach an average of five mines/leaf with at least 25 percent of the mines containing live larvae.

Spider Mites — Spider mites generally feed on the underside of leaves, but can cover the entire leaf surface when populations are high. The minute eight-legged mites appear as tiny, reddish, greenish or yellow moving dots on the undersides of leaves (Figure C.27. Because of their size, the first detection of spider mite infestations is usually damage to the leaves. Leaves of tomato plants infested with spider mites are initially lightly stippled with pale blotches (Figure C.28). In heavy infestations, the entire leaf appears light in colour and dries up, often turning reddish-brown in blotches or around the edge and may be covered with webbing.

Figure C.27 — Adult spider mites and eggs (highly magnified)

Figure C.28 — Speckled leaf caused by spider mites

Greatest damage to tomatoes occurs during dry, hot weather, which is favourable for development of extremely large mite populations. Spider mites are also generally considered a secondary pest, with damaging populations frequently occurring after application of broad spectrum insecticides. To check for spider mites, observe plant foliage for characteristic damage. Look on the undersides of leaves for mites. Pay close attention to field borders and weedy areas. Mites frequently get started and reach their highest density along field margins adjacent to roads where the plants are covered with dust.

In general, apply treatments for mite control when mites become numerous and their damage appears excessive. Some of the newer acaricides, however, are slow acting or effective only on selective stages of mites. If these acaricides are used, a more preventive approach to management is required. Where a history of mite problems exists, this preventive approach may be justified in tomatoes, which are favored hosts of spider mites.

Whiteflies — Adult whiteflies are tiny (about 3 mm) insects with white wings, a yellow body and piercing-sucking mouthparts. Adults are found on the underside of leaves, where they feed and lay eggs. While adults can cause direct damage by feeding, typically the nymphs are the more damaging stage. The scale-like nymphs (Figure C.29) also occur on the underside of leaves and all but the first instar are sessile.

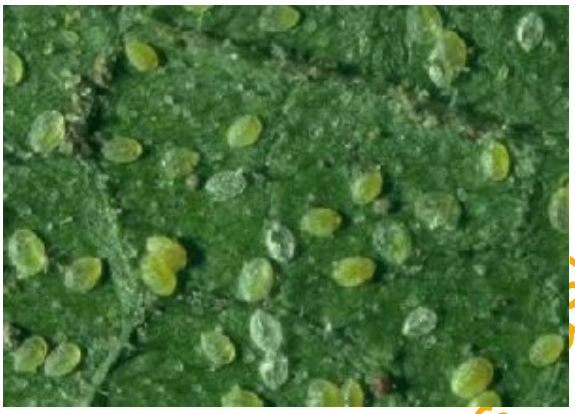

Figure C.29 — Sweet potato whitefly nymphs on the underside of a leaf

Whiteflies, particularly the sweet potato or silverleaf whitefly, can be a severe pest in tomatoes grown in the fall. The sweet potato whitefly can cause direct damage when populations are large enough to cause defoliation, and can produce enough honeydew and sooty mould to be a contamination problem at harvest. At much lower densities, however, this pest causes irregular ripening of fruit and can transmit severe viral diseases, including tomato yellow leaf curl.

C.7.3 Fruit feeders

Tomato Fruitworm (corn earworm) — Among the most serious pests of tomatoes is the tomato fruitworm or corn earworm. The larvae vary greatly in colour from a light green to brown or nearly black and are lighter on the underside (Figure C.30). They are marked with alternating light and dark stripes running lengthwise on the body. Early instar larvae have stout hairs, which gives them a somewhat spiny appearance as compared to the smooth skin of most other caterpillars found on tomatoes (Figure C.31).

Figure C.30 — Late instar fruitworm larva

Figure C.31 — Early instar fruitworm larva

Eggs are laid singly on the terminals or close to flowers or small fruit. The eggs hatch in 3 to 5 days, and the larvae can attack buds and fruit shortly after hatching. If fruiting structures are not available, the larvae can feed on foliage. The larva are rather restless and shift from one fruit to another so a single caterpillar may spoil several fruit without eating the equivalent of a single fruit. This movement does benefit control efforts, as the caterpillars are exposed to insecticide applications as they move among fruit. Several generations of tomato fruitworm may develop each year. Apply treatments for tomato fruitworm control when 1 percent of fruit are infested with larvae or if eggs are easily found.

Beet Armyworms — Beet armyworm (Figure C.32) appears to be becoming a more consistent pest. Historically, it is considered a secondary pest, with large populations usually occurring only after multiple applications of broad spectrum insecticides. This pest is now a fairly consistent pest in the summer and fall, however.

Figure C.32 — Late instar beet armyworm

Beet armyworms feed on both the foliage and fruit of tomato plants. Eggs are laid in masses on the undersides of foliage. Young larvae remain near the site of hatching (Figure C.33), feeding in groups that cause characteristic foliar damage referred to has "hits." After feeding on foliage for a few days, medium sized larvae (3rd instar) may migrate to the fruit. They may tunnel into the fruit under the calyx or eat directly through the fruit wall.

Figure C.33 — Beet armyworm egg mass hatching

Because beet armyworms start as foliage feeders, treatments can be delayed until hits are detected but should be applied prior to third instar. In practice, treatments are generally begun with first detection of egg masses or hits.

Other Armyworms — Both Southern armyworm and Yellowstriped armyworm are commonly encountered defoliators of tomatoes. Their behaviour is similar to the beet armyworm, with eggs laid in masses, early instars feeding gregariously on foliage, and later instars feeding on foliage or fruit. Larvae of both species have two lines of dark triangular marks on their backs and a longitudinal white to yellow line along each side (Figure C.34). Yellowstriped armyworm seldom reach population densities that require treatment, but can be difficult to control. Large outbreaks of southern armyworm can occur, but this pest is easily controlled with insecticides. Insecticides targeted at other caterpillar pests likely prevent more frequent damage by southern armyworm.

Figure C.34 — Yellowstriped armyworm larva

Tarnished Plant Bugs — Tarnished plant bugs are sucking bugs that primarily attack the young flower buds causing them to abort. Young flower buds turn yellow to black after tarnished plant bug feeding. Infestations may be heavy in spring plantings and fruit set can be poor if the bugs are not controlled. Both nymphs and adults feed on tomato. The nymphs are difficult to find unless high numbers are present. Scouting for the adults is relatively simple. Visually examine plants and treat if one adult per six plants is found.

Stink Bugs and Leaffooted Bugs — Several species of stink bugs can damage tomatoes. Stink bug adults are generally medium sized shield-shaped bugs with broad "shoulders" and a bluntly rounded abdomen (Figure C.35). They also have a triangular shaped shield on their backs. The most common species in tomatoes are either a uniform green color (green stink bug) or tan to brown with light colored undersides (various species of brown stink bugs). Stink bug nymphs are more oval shaped (Figure C.36) and vary greatly in color. Eggs are somewhat barrel-shaped and are deposited on end in tightly packed clusters. Leaffooted bugs are brown, medium sized bugs which get their common name from the flattened leg segment of the hind leg, which gives this segment a leaf-like appearance (Figure C.37).

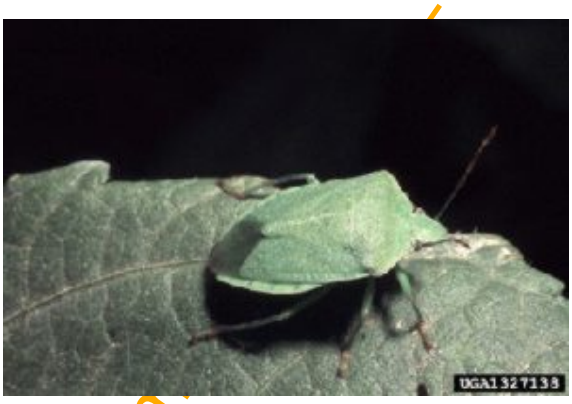

Figure C.35 — Green stink bug adult

Figure C.36 — Green stink bug nymph (late instar)

Figure C.37 — Leaffooted bug adult

Stink bugs and leaf-footed bugs have needle-like mouthparts with which they puncture plant tissue and remove sap. The greatest damage results from feeding on fruiting structures. Severity of the damage to fruit varies greatly with the developmental stage of the fruit. Damage early in fruit development can lead to severe deformities and abscission, while damage near harvest may result in small dark spots at the feeding site. These insects may also introduce bacteria and yeast as they feed, or may simply provide a site of entry for disease organisms, resulting in fruit decay.

Tomato Pinworm — Tomato pinworms are small moths with a somewhat speckled appearance. Damage is caused by the caterpillar, which appears smooth-skinned with a purplish appearance in older larvae (Figure C.38). Larvae usually begin feeding in leaf mines before moving to fruit but may enter fruit soon after hatching. In leaves, larvae mine for the first two instars, then form leaf folds in which the last two instars are completed. The most important damage occurs when larvae enter fruit. Larvae may enter fruit of any maturity. Larvae generally bore into fruit under the calyx, and the entry holes are difficult to detect. Once larvae have been feeding for a while, brown granular frass can often be seen at the edge of the calyx. Larvae may feed shallowly beneath the skin of the fruit near the stem or may bore into the core of the fruit. The feeding creates narrow blackened tunnels and exposes fruit to decay. It is difficult to sort out infested fruit, and larvae present at harvest may create a contamination problem. Adults can be monitored with pheromone traps, and pheromones have been used for mating disruption.

Figure C.38 — Tomato pillworm larva and damage (calyx of fruit removed)

Problems with pinworm frequently arise from use of infested transplants; use of locally produced “clean” transplants is recommended to avoid transplanting pest problems with the crop. Close scouting of the crop for leafmines and frass around the calyx should detect populations before they reach damaging levels. This pest is likely controlled by insecticide applications targeting other lepidopterous species.

C.8 Harvest, Handling and Sanitation

C.8.1 Field maturity

Tomatoes should only be harvested when they reach the *mature-green* stage. If tomatoes are harvested any earlier, the fruit will fail to ripen normally. Since the mature-green state is difficult to judge externally, growers will often take a representative sample of fruit from their fields and cut it open for internal examination. A typical mature-green tomato will have a jelly-like matrix in all locules, and seeds will be sufficiently developed so as not to be cut when the fruit is sliced with a sharp knife.

C.8.2 Harvesting

Fresh market tomatoes are harvested by hand. Good harvesting management is needed to pick high quality tomatoes. Care must be taken when harvesting “breaker” stage fruit because the riper the tomato, the more susceptible it is to bruising. Harvest crews should carefully place fruits into picking containers instead of dropping them. Research has demonstrated that a drop of more than 15 cm onto a hard surface can cause internal bruising that is not evident until after the tomato is cut open.

Pickers should do preliminary grading to remove decayed fruit from the plants as they harvest the field. This will prevent crossover disease contamination to otherwise healthy, sound fruit. Wet tomatoes should never be harvested, because surface moisture increases field heat accumulations in the load and enhances disease development.

All picking buckets should be cleaned and sanitized at the end of each harvest day to prevent the potential accumulation of disease organisms from infecting sound fruit picked the next production day.

For processing tomatoes the ethylene-producing compound, ethephon or Ethrel, is applied prior to harvest when only 10% of the fruit is ripe; this accelerates and concentrates fruit-ripening and facilitates once-over machine harvest.

C.8.3 Postharvest handling

The importance of care in handling tomatoes between the time of harvest and shipping to market cannot be overemphasized, since about half of the cost of tomato production is in the grading, cooling and packing of the product.

Annex D
(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/093:2010, *Fresh vine tomatoes — 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.

Annex E
(informative)

Tomato — Fact sheet

Lycopersicon esculentum

Authority	Mill.
Family	Magnoliopsida:Asteridae:Solanales:Solanaceae
Synonyms	*Lycopersicon lycopersicum* (L.) Karst. ex Farw., *Solanum lycopersicum* L.
Common names	Tomato, love apple, tomate, tomaat, tamatar, vilayti, baingan, rangam, tomat, faan ke'e, tomati, tomatl, jitomate pomodoro, tomata, temata, temeta, tamatie
Editor	
Ecocrop code	1379

Description

Variable erect, or spreading, coarsely hairy, herbaceous plant 0.7-2 m tall. There are many varieties of tomatoes with red or yellow fruits of different size and shape.

Uses

Tomatoes are grown for there edible fruits. The tomatoes are eaten cooked or raw, in a variety of ways. The fruit are used to produce soup, juice, sauce, ketchup, puree, paste, and powder. The are often canned and green, unripe tomatoes are pickled and preserved. Seeds contain 24% oil used as a salad oil and for making margarine and soaps. The residual press cake is fed to livestock or used as fertilizer.

Growing period

Variable annual herb, fruits of upright cultivars can normally be harvested 70-130 days from transplanting. Other cultivars may require 120-140 days.

Further information

Tomato is probably native of Mexico. It can be grown at altitudes between sea level and 2000 m in the tropics, but yields are generally higher at elevations over 1000 m. A diurnal variation of at least 5-6°C is considered necessary for optimum development. High relative humidity can be harmful to the tomato crop and fruits rarely ripen fully in wet and dull weather. On the other hand tomato is also sensitive to sunburn and hot dry winds can lead to flower drop and reduced yields. For many varieties trellising and tying to trellises increases yields and fruit quality. Yields are mainly between 20-40 t/ha bur yields up to 150 t/ha have been recorded.

Annex F
(informative)

Codex, EU and USA pesticide residue limits

Users are advised that international regulations and permissible Maximum Residue Levels (MRL) frequently change. Although this International MRL Database is updated frequently, the information in it may not be completely up-to-date or error free. Additionally, commodity nomenclature and residue definitions vary between countries, and country policies regarding deferral to international standards are not always transparent. This database is intended to be an initial reference source only, and users must verify any information obtained from it with knowledgeable parties in the market of interest prior to the sale or shipment of any products. The developers of this database are not liable for any damages, in whole or in part, caused by or arising in any way from user's use of the database.

Results Key

MRL values in *{Italics}* are more restrictive than US
--- indicates no MRL value is established.
Cod, EU, etc. indicates the source of the MRL and EXP means the market defers to the exporting market.
All numeric values listed are in parts per million (ppm), unless otherwise noted

	US *1*	**Cod**	**EU**
Abamectin	0.02	0.02	0.02
	1. United States does not maintain a specific MRL for the Abamectin/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *2*	**Cod**	**EU**
Acetamiprid	0.2	---	*{0.1}*
	2. United States does not maintain a specific MRL for the Acetamiprid/Tomato combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *3*	**Cod**	**EU**
Acibenzolar-S-methyl	1	---	1
	3. United States does not maintain a specific MRL for the Acibenzolar-S-methyl /Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU *4***
Azinphos-methyl	2	*{1}*	*{0.05}*
	4. European Union does not maintain a specific MRL for the Azinphos-methyl/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Solanacea" group.		
	US	**Cod**	**EU *5***
Azoxystrobin	0.2	---	2
	5. European Union does not maintain a specific MRL for the Azoxystrobin/Tomato combination, but does maintain an MRL of 2 PPM for its "Solanacea" group.		
	US *6*	**Cod**	**EU**
Bensulide	0.1	---	---
	6. United States does not maintain a specific MRL for the Bensulide/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Benthiavalicarb-isopropyl	0.45	---	*{0.3}*
	US	**Cod**	**EU**
Beta-cyfluthrin	0.2	0.2	---
	US	**Cod**	**EU**
Bifenazate	2	*{0.5}*	*{0.5}*
	US	**Cod**	**EU *7***
Bifenthrin	0.15	---	0.2
	7. European Union does not maintain a specific MRL for the Bifenthrin/Tomato combination, but does maintain an MRL of 0.2 PPM for its "Solanacea" group.		
	US *8*	**Cod**	**EU**
Boscalid	1.2	---	*{1}*
	8. United States does not maintain a specific MRL for the Boscalid/Tomato combination, but does maintain an MRL of 1.2 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *9*	**Cod**	**EU**
Buprofezin	1.3	*{1}*	*{1}*
	9. United States does not maintain a specific MRL for the Buprofezin/Tomato combination, but does maintain an MRL of 1.3 PPM for its "Vegetable, Fruiting, Group 8" group.		

	US *10*	**Cod**	**EU**
Captan	0.05	5	2
	10. United States does not maintain a specific MRL for the Captan/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *11*	**Cod**	**EU**
Carbaryl	5	5	*{0.5}*
	11. United States does not maintain a specific MRL for the Carbaryl/Tomato combination, but does maintain an MRL of 5 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *12*	**Cod**	**EU *13***
Carfentrazone-ethyl	0.1	---	*{0.01}*
	12. United States does not maintain a specific MRL for the Carfentrazone-ethyl/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	13. European Union does not maintain a specific MRL for the Carfentrazone-ethyl/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		
	US *14*	**Cod**	**EU**
Chlorantraniliprole	0.7	---	*{0.3}*
	14. United States does not maintain a specific MRL for the Chlorantraniliprole/Tomato combination, but does maintain an MRL of 0.7 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU *15***
Chlorfenapyr	1	---	*{0.05}*
	15. European Union does not maintain a specific MRL for the Chlorfenapyr/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU *16***
Chlorothalonil	5	5	*{2}*
	16. European Union does not maintain a specific MRL for the Chlorothalonil/Tomato combination, but does maintain an MRL of 2 PPM for its "Solanacea" group.		
	US	**Cod**	**EU**
Clethodim	1	1	1
	US	**Cod**	**EU**
Cryolite	7	---	---
	US	**Cod**	**EU**
Cyazofamid	0.2	---	0.2
	US	**Cod**	**EU**
Cyfluthrin	0.2	0.2	*{0.05}*
	US *17*	**Cod**	**EU**
Cymoxanil	0.2	---	0.2
	17. United States does not maintain a specific MRL for the Cymoxanil/Tomato combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Cyprodinil	0.45	0.5	1
	US	**Cod *18***	**EU *19***
Cyromazine	0.5	1	1
	18. Codex does not maintain a specific MRL for the Cyromazine/Tomato combination, but does maintain an MRL of 1 PPM for its "Fruiting vegetables, other than Cucurbits" group.		
	19. European Union does not maintain a specific MRL for the Cyromazine/Tomato combination, but does maintain an MRL of 1 PPM for its "Solanacea" group.		
	US	**Cod**	**EU**
DCPA	1	---	1
	US	**Cod**	**EU**
Deltamethrin	0.2	0.3	0.3
	US	**Cod**	**EU**
Diazinon	0.75	*{0.5}*	*{0.01}*
	US	**Cod**	**EU *20***
Dichlorvos	0.05	---	*{0.01}*
	20. European Union does not maintain a specific MRL for the Dichlorvos/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		

	US	**Cod**	**EU *21***
Dicloran	5	---	*{0.3}*
	21. European Union does not maintain a specific MRL for the Dicloran/Tomato combination, but does maintain an MRL of 0.3 PPM for its "Solanacea" group.		
	US *22*	**Cod**	**EU**
Dicofol	2	*{1}*	*{1}*
	22. United States does not maintain a specific MRL for the Dicofol/Tomato combination, but does maintain an MRL of 2 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Difenoconazole	0.6	*{0.5}*	2
	US	**Cod**	**EU *23***
Dimethoate	2	---	*{0.02}*
	23. European Union does not maintain a specific MRL for the Dimethoate/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Fruiting vegetables" group.		
	US *24*	**Cod *25***	**EU**
Dimethomorph	1.5	*{1}*	*{1}*
	24. United States does not maintain a specific MRL for the Dimethomorph/Tomato combination, but does maintain an MRL of 1.5 PPM for its "Vegetable, Fruiting, Group 8" group.		
	25. Codex does not maintain a specific MRL for the Dimethomorph/Tomato combination, but does maintain an MRL of 1 PPM for its "Fruiting vegetables, other than Cucurbits" group.		
	US *26*	**Cod**	**EU**
Dinotefuran	0.7	---	---
	26. United States does not maintain a specific MRL for the Dinotefuran/Tomato combination, but does maintain an MRL of 0.7 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod *27***	**EU *28***
Disulfoton	0.75	*{0.5}*	*{0.02}*
	27. Codex does not maintain a specific MRL for the Disulfoton/Tomato combination, but does maintain an MRL of 0.5 PPM for its "Vegetables (Except as otherwise listed)" group. 28. European Union does not maintain a specific MRL for the Disulfoton/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU**
Emamectin	0.02	---	---
	US	**Cod**	**EU**
Endosulfan	1	1	*{0.5}*
	US *29*	**Cod**	**EU *30***
EPTC	0.1	---	*{0.05}*
	29. United States does not maintain a specific MRL for the EPTC/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Fruiting Vegetables" group.		
	30. European Union does not maintain a specific MRL for the EPTC/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Fruiting vegetables" group.		
	US	**Cod**	**EU**
Ethephon	2	2	*{1}*
	US	**Cod**	**EU**
Etoxazole	0.2	---	*{0.1}*
	US	**Cod**	**EU**
Etridiazole	0.15	---	*{0.05}*
	US	**Cod**	**EU**
Famoxadone	1	2	1
	US *31*	**Cod**	**EU**
Fenamidone	1	---	*{0.5}*
	31. United States does not maintain a specific MRL for the Fenamidone/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Fenhexamid	2	2	*{1}*
	US *32*	**Cod**	**EU *33***
Fenpropathrin	1	1	*{0.01}*
	32. United States does not maintain a specific MRL for the Fenpropathrin/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group. 33. European Union does not maintain a specific MRL for the Fenpropathrin/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Solanacea" group.		
	US	**Cod**	**EU *34***
Fenvalerate	1	1	*{0.02}*

	34. European Union does not maintain a specific MRL for the Fenvalerate/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Vegetables Fresh or Frozen" group.		
	US *35*	**Cod**	**EU**
Flonicamid	0.4	---	*{0.3}*
	35. United States does not maintain a specific MRL for the Flonicamid/Tomato combination, but does maintain an MRL of 0.4 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *36*	**Cod**	**EU**
Flubendiamide	0.6	---	*{0.2}*
	36. United States does not maintain a specific MRL for the Flubendiamide/Tomato combination, but does maintain an MRL of 0.6 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Fludioxonil	0.5	0.5	1
	US *37*	**Cod**	**EU *38***
Flumioxazin	0.02	---	0.05
	37. United States does not maintain a specific MRL for the Flumioxazin/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Vegetable, Fruiting, Group 8" group.		
	38. European Union does not maintain a specific MRL for the Flumioxazin/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US *39*	**Cod**	**EU**
Fluopicolide	1.6	---	*{0.4}*
	39. United States does not maintain a specific MRL for the Fluopicolide/Tomato combination, but does maintain an MRL of 1.6 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU *40***
Fluoxastrobin	1	---	*{0.05}*
	40. European Union does not maintain a specific MRL for the Fluoxastrobin/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU**
Fosetyl-Al	3	---	100
	US	**Cod**	**EU *41***
Fosthiazate	0.02	---	0.02
	41. European Union does not maintain a specific MRL for the Fosthiazate/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU**
Gamma Cyhalothrin	0.1	---	---
	US *42*	**Cod**	**EU *43***
Glyphosate	0.1	---	0.1
	42. United States does not maintain a specific MRL for the Glyphosate/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	43. European Union does not maintain a specific MRL for the Glyphosate/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Fruiting vegetables" group.		
	US	**Cod**	**EU *44***
Halosulfuron-methyl	0.05	---	*{0.01}*
	44. European Union does not maintain a specific MRL for the Halosulfuron-methyl/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		
	US *45*	**Cod**	**EU**
Imidacloprid	1	*{0.5}*	*{0.5}*
	45. United States does not maintain a specific MRL for the Imidacloprid/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Indoxacarb	0.5	0.5	0.5
	US	**Cod**	**EU**
Inorganic bromide resulting from fumigation	20	75	50
	US	**Cod**	**EU *46***
Lactofen	0.02	---	*{0.01}*
	46. European Union does not maintain a specific MRL for the Lactofen/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		

Lambda Cyhalothrin	**US** 0.1	**Cod** ---	**EU** 0.1
Malathion	**US** 8	**Cod** *{0.5}*	**EU *47*** *{0.02}*
	47. European Union does not maintain a specific MRL for the Malathion/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Solanacea" group.		
Mancozeb	**US** 4	**Cod** *{2}*	**EU** *{3}*
Mandipropamid	**US *48*** 1	**Cod** ---	**EU** 1
	48. United States does not maintain a specific MRL for the Mandipropamid/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group.		
Maneb	**US** 4	**Cod** *{2}*	**EU** *{3}*
Metalaxyl	**US *49*** 1	**Cod** *{0.5}*	**EU** *{0.2}*
	49. United States does not maintain a specific MRL for the Metalaxyl/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group.		
Metaldehyde	**US** 0.24	**Cod** ---	**EU *50*** *{0.05}*
	50. European Union does not maintain a specific MRL for the Metaldehyde/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Fruiting vegetables" group.		
Methamidophos	**US** 1	**Cod** ---	**EU *51*** *{0.01}*
	51. European Union does not maintain a specific MRL for the Methamidophos/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Fruiting vegetables" group.		
Methomyl	**US** 1	**Cod** ---	**EU** *{0.2}*
Methoxyfenozide	**US *52*** 2	**Cod** 2	**EU** 2
	52. United States does not maintain a specific MRL for the Methoxyfenozide/Tomato combination, but does maintain an MRL of 2 PPM for its "Vegetable, Fruiting, Group 8" group.		
Metolachlor	**US** 0.1	**Cod** ---	**EU *53*** *{0.05}*
	53. European Union does not maintain a specific MRL for the Metolachlor/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
Metribuzin	**US** 0.1	**Cod** ---	**EU *54*** 0.1
	54. European Union does not maintain a specific MRL for the Metribuzin/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Fruiting vegetables" group.		
Mevinphos	**US** 0.2	**Cod** ---	**EU *55*** *{0.01}*
	55. European Union does not maintain a specific MRL for the Mevinphos/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Vegetables Fresh or Frozen" group.		
Myclobutanil	**US** 0.3	**Cod** 0.3	**EU** 0.3
Naled	**US** 0.5	**Cod** ---	**EU** ---
Napropamide	**US *56*** 0.1	**Cod** ---	**EU** 0.1
	56. United States does not maintain a specific MRL for the Napropamide/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Fruiting, Group 8" group.		
Novaluron	**US** 1	**Cod** ---	**EU** 1
O-phenylphenol	**US** 10	**Cod** ---	**EU** ---
Oxamyl	**US** 2	**Cod** 2	**EU** *{0.02}*
Paraquat dichloride	**US *57*** 0.05	**Cod *58*** 0.05	**EU *59*** *{0.02}*
	57. United States does not maintain a specific MRL for the Paraquat dichloride/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetable, Fruiting, Group 8" group.		

	58. Codex does not maintain a specific MRL for the Paraquat dichloride/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Fruiting vegetables, other than Cucurbits" group.		
	59. European Union does not maintain a specific MRL for the Paraquat dichloride/Tomato combination, but does maintain an MRL of 0.02 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU *60***
Pendimethalin	0.1	---	*{0.05}*
	60. European Union does not maintain a specific MRL for the Pendimethalin/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Fruiting vegetables" group.		
	US	**Cod**	**EU *61***
Permethrin	2	*{1}*	*{0.05}*
	61. European Union does not maintain a specific MRL for the Permethrin/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU *62***
Phosphine	0.01	---	0.05
	62. European Union does not maintain a specific MRL for the Phosphine/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Fruiting vegetables" group.		
	US	**Cod**	**EU**
Piperonyl Butoxide	8	*{2}*	---
	US	**Cod**	**EU *63***
Propamocarb hydrochloride	2	2	10
	63. European Union does not maintain a specific MRL for the Propamocarb hydrochloride/Tomato combination, but does maintain an MRL of 10 PPM for its "Solanacea" group.		
	US *64*	**Cod**	**EU**
Pymetrozine	0.2	---	0.5
	64. United States does not maintain a specific MRL for the Pymetrozine/Tomato combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *65*	**Cod**	**EU**
Pyraclostrobin	1.4	*{0.3}*	*{0.2}*
	65. United States does not maintain a specific MRL for the Pyraclostrobin/Tomato combination, but does maintain an MRL of 1.4 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU *66***
Pyrethrins	1	*{0.05}*	1
	66. European Union does not maintain a specific MRL for the Pyrethrins/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU**
Pyridaben	0.15	---	0.3
	US *67*	**Cod**	**EU**
Pyridalyl	1	---	---
	67. United States does not maintain a specific MRL for the Pyridalyl/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Pyrimethanil	0.5	0.7	1
	US *68*	**Cod**	**EU *69***
Pyriproxyfen	0.2	---	1
	68. United States does not maintain a specific MRL for the Pyriproxyfen/Tomato combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Fruiting, Group 8" group.		
	69. European Union does not maintain a specific MRL for the Pyriproxyfen/Tomato combination, but does maintain an MRL of 1 PPM for its "Solanacea" group.		
	US	**Cod**	**EU *70***
Rimsulfuron	0.05	---	0.05
	70. European Union does not maintain a specific MRL for the Rimsulfuron/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		
	US *71*	**Cod**	**EU *72***
S-metolachlor	0.1	---	*{0.05}*
	71. United States does not maintain a specific MRL for the S-metolachlor/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	72. European Union does not maintain a specific MRL for the S-metolachlor/Tomato combination, but does maintain an MRL of 0.05 PPM for its "Vegetables Fresh or Frozen" group.		

	US *73*	**Cod**	**EU**
Sethoxydim	4	---	*{1}*
	73. United States does not maintain a specific MRL for the Sethoxydim/Tomato combination, but does maintain an MRL of 4 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *74*	**Cod**	**EU *75***
Spinetoram	0.4	---	0.5
	74. United States does not maintain a specific MRL for the Spinetoram/Tomato combination, but does maintain an MRL of 0.4 PPM for its "Vegetable, Fruiting, Group 8" group.		
	75. European Union does not maintain a specific MRL for the Spinetoram/Tomato combination, but does maintain an MRL of 0.5 PPM for its "Solanacea" group.		
	US *76*	**Cod**	**EU**
Spinosad	0.4	*{0.3}*	1
	76. United States does not maintain a specific MRL for the Spinosad/Tomato combination, but does maintain an MRL of 0.4 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *77*	**Cod**	**EU**
Spiromesifen	0.45	---	1
	77. United States does not maintain a specific MRL for the Spiromesifen/Tomato combination, but does maintain an MRL of 0.45 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *78*	**Cod**	**EU**
Spirotetramat	2.5	---	*{2}*
	78. United States does not maintain a specific MRL for the Spirotetramat/Tomato combination, but does maintain an MRL of 2.5 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Streptomycin	0.25	---	---
	US *79*	**Cod**	**EU**
Tebufenozide	1	1	1
	79. United States does not maintain a specific MRL for the Tebufenozide/Tomato combination, but does maintain an MRL of 1 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *80*	**Cod**	**EU**
Thiamethoxam	0.25	---	*{0.2}*
	80. United States does not maintain a specific MRL for the Thiamethoxam/Tomato combination, but does maintain an MRL of 0.25 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *81*	**Cod**	**EU**
Trifloxystrobin	0.5	0.7	0.5
	81. United States does not maintain a specific MRL for the Trifloxystrobin/Tomato combination, but does maintain an MRL of 0.5 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US	**Cod**	**EU**
Trifloxysulfuron	0.01	---	---
	US	**Cod**	**EU *82***
Trifluralin	0.05	---	0.5
	82. European Union does not maintain a specific MRL for the Trifluralin/Tomato combination, but does maintain an MRL of 0.5 PPM for its "Fruiting vegetables" group.		
	US *83*	**Cod**	**EU**
Uniconazole-P	0.01	---	---
	83. United States does not maintain a specific MRL for the Uniconazole-P/Tomato combination, but does maintain an MRL of 0.01 PPM for its "Vegetable, Fruiting, Group 8" group.		
	US *84*	**Cod**	**EU *85***
Zeta-Cypermethrin	0.2	0.5	0.5
	84. United States does not maintain a specific MRL for the Zeta-Cypermethrin/Tomato combination, but does maintain an MRL of 0.2 PPM for its "Vegetable, Fruiting, Group 8" group.		
	85. European Union does not maintain a specific MRL for the Zeta-Cypermethrin/Tomato combination, but does maintain an MRL of 0.5 PPM for its "Solanacea" group.		
	US	**Cod**	**EU *86***
Ziram	7	*{2}*	*{0.1}*
	86. European Union does not maintain a specific MRL for the Ziram/Tomato combination, but does maintain an MRL of 0.1 PPM for its "Vegetables Fresh or Frozen" group.		
	US	**Cod**	**EU**
Zoxamide	2	2	*{0.5}*

Annex G
(informative)

Pepino (*Solanum muricatum*)

A medium sized (2-5") fruit with a mild taste, very similar to cantaloupe. The pepino has a thin, creamy colored, sometimes purple spotted skin much like a tomato. Popular in New Zealand, the pepino is becoming common in some United States markets.

Description: A small bush or shrub much like the tomato. Usually fruits in 9-12 months, so a frost free climate is preferred for optimal survival. Growth habit is similar to the tomato and plants benefit from some support. Shrubby growth to 4-6ft. Great in containers. The multi-colored flowers are borne in clusters and fruits follow a few months later.

Hardiness: Hardy to the upper 20's (F), but for adequate fruiting, a frost-free environment is preferred.

Growing Environment: Treat much like tomato plants. Grow in full sun, water regularly. Use well-drained soil. Protect from hard freezes.

Propagation: By seeds, which can take several weeks to germinate. By cuttings.

Uses: Commonly eaten fresh, the pepino's flesh is so soft and juicy it makes a quick and easy treat.

Native Range: Native to the Andes mountain region.