

AVRDC – The World Vegetable Center

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International Cooperators' Guide



Procedures for Tomato Variety Field Trials

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Introduction

The procedures described here allow comparison of the data collected in different test environments (locations, years, and seasons) by researchers participating in AVRDC multi-environment tomato variety trials. They could also be useful for other researchers interested in testing tomato varieties under local conditions.

Choice of land

Select a well-drained area with fairly uniform fertility and slope.

Number of entries

The suggested number of entries is from 5 to 20, which should include one or two locally popular varieties at each location (Table 1).

Experimental design

A randomized complete block design (RCBD) with three replications is recommended (Fig. 1). Each field trial has border rows on four sides.

Size of plot

Row length and plant spacing normally used in local production practices are recommended.

The minimum number of plants per plot is 12 (1-row planting for large entries, data is collected from the 10 inner plants). At AVRDC, each entry is grown on a 2-row, 4.8 m long and 1 m wide plot with furrows (ditches) 50 cm wide on each side. The distance between rows is 60 cm. Plant spacing within rows is 40 cm. Thus, each row accommodates 12 plants and a total of 24 plants per plot. Data is collected from the 20 inner plants. Any changes in plot dimensions should be reflected in the data sheet.

Cultural practices

For recommended cultural and pest management practices, please refer to:

Suggested Cultural Practices for Tomato

http://libnts.avrdc.org.tw/fulltext_pdf/E/1991-2000/e03437.pdf

Pruning and Staking Tomatoes

http://libnts.avrdc.org.tw/fulltext_pdf/E/1991-2000/e03439.pdf

Safer Tomato Production Techniques

http://libnts.avrdc.org.tw/fulltext_pdf/EB/2001-2010/eb0143.pdf

Table 1. Sample planting plan.

Entry code	Replication		
	I	II	III
	Plots 1-8	Plots 9-16	Plots 17-24
A	8	12	17
B	7	16	22
C	5	10	20
D	4	15	21
E	2	11	19
F	3	13	18
G	1	14	24
H*	6	9	23

*Local check variety

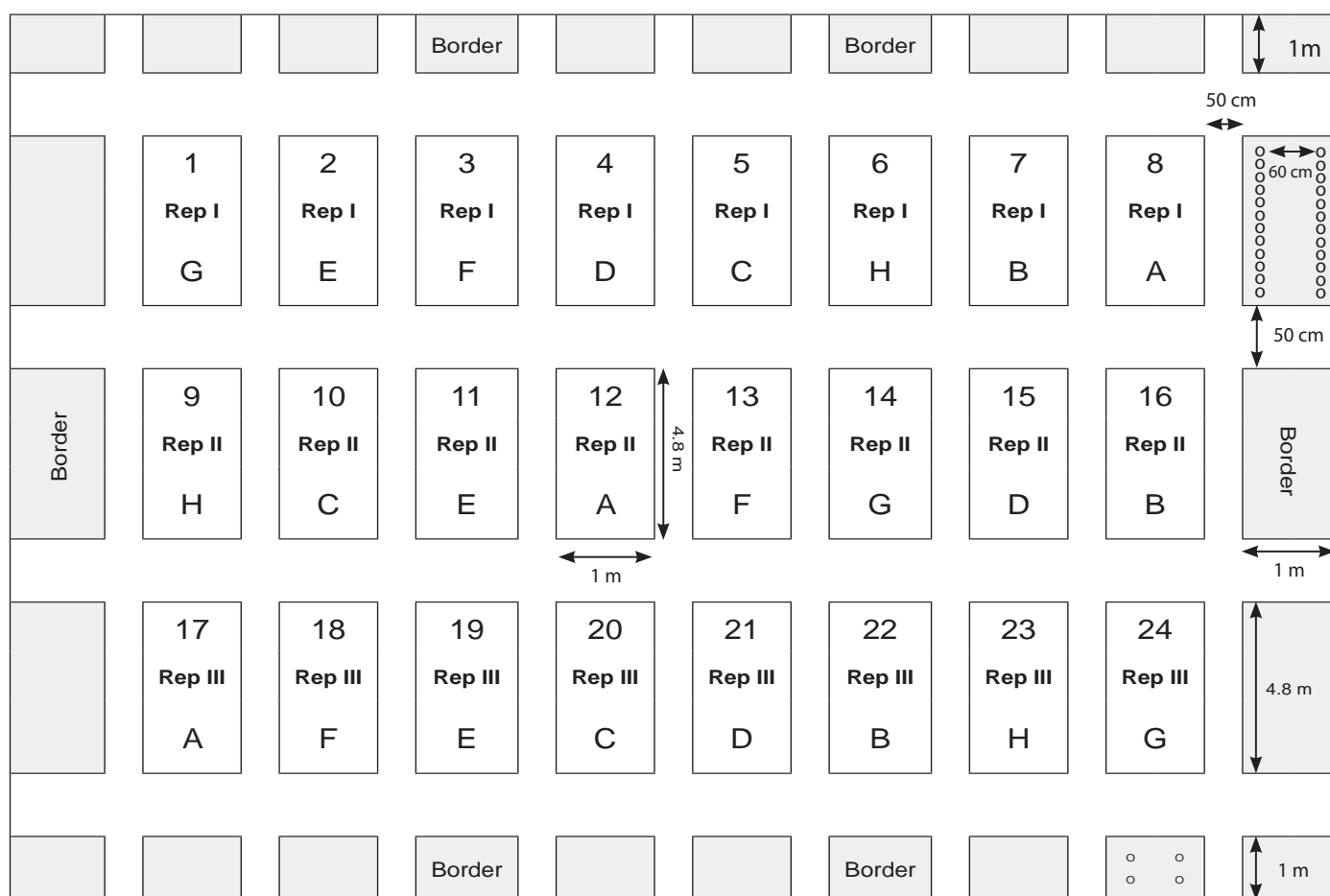


Figure 1. Sample field layout (the border area can have one or two rows of tomatoes).

Harvesting

For fresh market tomato, start harvesting at breaker stage (less than 10% surface pink or red). For cherry tomato, harvest the whole fruit cluster when 80-90% turns red. For processing tomato, harvest red ripe fruit. At AVRDC, determinate tomato plants are generally harvested three times and indeterminate types four or more times. Record harvest dates and times (Table 2).

Data to collect

Researchers should keep a record of the basic characteristics of the trial site and the management practices employed when conducting a variety trial (Tables 2 & 3). This information can be useful for explaining varietal performance in different environments. Plant characteristics and reactions to biotic stresses, yield and its components to be collected for each plot are as follows:

1. Days to 50% flowering:

Number of days after transplanting when 50% of the plants in a plot have open flowers. Check plots three times a week (Table 4).

2. Growth habit:

(1) *determinate*: short and bushy, produces two leaves between flower clusters and about five clusters per branch; (2) *indeterminate*: tall, produces three leaves between flower clusters and more than six clusters per branch; (3) *semi-determinate*: taller than determinate types, but not as tall as indeterminate types (Table 4).

3. Biotic stress rating:

Entries are evaluated every 1-2 weeks when pest pressure (damage) is most serious. Check Figures 2 to 4 for the rating scales of early blight, late blight and tomato yellow leaf curl disease (TYLCD); and Figures 5 to 7 for wilt symptoms of fusarium wilt, bacterial wilt and southern blight to help you score and record the severity of diseases (Table 4). For insect damage, count and weigh the

number of fruits damaged by tomato fruit borer (Tables 4 & 5).

4. Number of plants harvested:

Count the plants harvested from the 2-row plot. This will indicate population density and help explain low yields in plots with poor stands (Table 5).

5. Number of fruits and fruit yield:

Separate the marketable (worth selling) from nonmarketable fruits (with defects such as cracking, blossom end rot, graywall, blotchy ripening, puffiness, sunscald, catface, insect damaged fruits, etc.) after harvesting (Figure 8). Record the number and weight (kg/plot) of marketable and nonmarketable fruits. Repeat the process every time until harvesting is done. The total marketable yield is obtained by adding the yields of individual harvests (Table 5).

The yield per plot (kg/plot) can be converted into tonnes per hectare with the following formula:

$$\text{Yield (t/ha)} = \frac{\text{plot yield (kg)} / 1,000 \text{ (kg/t)}}{\text{harvested area (m}^2) / 10,000 \text{ (m}^2\text{/ha)}}$$

Example:

plot yield: 30 kg
harvested area: 20 m²

$$\text{Yield} = \frac{30 \text{ (kg)} / 1,000 \text{ (kg/t)}}{20 \text{ (m}^2) / 10,000 \text{ (m}^2\text{/ha)}} = 15 \text{ t/ha}$$

6. Fruit weight:

Average fruit weight (grams) can be calculated from 20 randomly selected marketable fruit per plot (Table 5).

Example:

Weight of 20 marketable fruits = 1,250 g

$$\text{Average fruit weight} = \frac{1,250}{20} = 62.5 \text{ g}$$

7. Remarks:

Any other interesting observations not recorded elsewhere that could help explain the outcome of the trial.

Table 2. Data collection sheet for test location and crop management (1)

TOMATO VARIETY FIELD TRIALS: TEST LOCATION AND CROP MANAGEMENT DATA SHEET (1)												
Country _____ State / province / department _____ District / town / city _____ Farm or experiment station _____ Institution _____ Cooperator (s)/ data taker (s) _____ E-mail: _____					FIELD PLOT DATA Plot width (m) _____ Row length (m) _____ No. of rows / plot _____ No. of plants / row _____ Spacing between rows (cm) _____ Plant spacing within rows (cm) _____							
LATITUDE degrees minutes N or S □□ □□ □□			LONGITUDE degrees minutes E or W □□□ □□ □□			ALTITUDE above sea level □□□□m						
SOIL Classification _____ Previous crop _____												
surface texture			surface pH			drainage condition						
sandy <input type="checkbox"/>			unknown <input type="checkbox"/>			excellent <input type="checkbox"/>						
sandy loam <input type="checkbox"/>			> 8 <input type="checkbox"/>			very good <input type="checkbox"/>						
loam <input type="checkbox"/>			7.1 - 8 <input type="checkbox"/>			good <input type="checkbox"/>						
clay loam <input type="checkbox"/>			5.6 - 7 <input type="checkbox"/>			average <input type="checkbox"/>						
silty clay <input type="checkbox"/>			4 - 5.5 <input type="checkbox"/>			poor <input type="checkbox"/>						
clay <input type="checkbox"/>			< 4 <input type="checkbox"/>			very poor <input type="checkbox"/>						
other <input type="checkbox"/>			or <input type="checkbox"/>									
If other, specify _____			actual value _____									
PLANTING SCHEDULE												
date sown			date transplanted									
□□ □□ □□□□			□□ □□ □□□□									
HARVEST												
start date			end date			Number of times harvested _____						
□□ □□ □□□□			□□ □□ □□□□									
FERTILIZER APPLIED? <input type="checkbox"/> Yes <input type="checkbox"/> No Specify unit of fertilizer applied if different from kg/ha _____												
applied		day		month		year		quantity	%N	%P ₂ O ₅	%K ₂ O	Other element(s)
1st date		□□		□□		□□□□		□□□□	□□□□	□□□□	□□□□	□□□□
2nd date		□□		□□		□□□□		□□□□	□□□□	□□□□	□□□□	□□□□
3rd date		□□		□□		□□□□		□□□□	□□□□	□□□□	□□□□	□□□□
IRRIGATION ? <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, please specify methods and frequency												
methods					frequency							
Drip <input type="checkbox"/>					weekly <input type="checkbox"/>							
Furrow <input type="checkbox"/>					twice a month <input type="checkbox"/>							
Sprinkler <input type="checkbox"/>					monthly <input type="checkbox"/>							
Other <input type="checkbox"/>					other <input type="checkbox"/>							
If other, specify _____					If other, specify _____							
OTHER PRACTICES												
<input type="checkbox"/> Mulching <input type="checkbox"/> Staking <input type="checkbox"/> Others, please specify _____												

Table 3. Data collection sheet for test location and crop management (2)

TOMATO VARIETY FIELD TRIALS: TEST LOCATION AND CROP MANAGEMENT DATA SHEET (2)																																											
Country _____ State / province / department _____ District / town / city _____ Farm or experiment station _____ Institution _____ Cooperator (s)/ data taker (s) _____ E-mail: _____	FIELD PLOT DATA Plot width (m) _____ Row length (m) _____ No. of rows / plot _____ No. of plants / row _____ Spacing between rows (cm) _____ Plant spacing within rows (cm) _____																																										
PROBLEM CHECKLIST <table style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 15%;">foliar disease</th> <th style="width: 15%;">root disease</th> <th style="width: 15%;">insect or mite damage</th> <th style="width: 15%;">rat or bird damage</th> <th style="width: 15%;">herbicide damage</th> <th style="width: 15%;">weed problem</th> </tr> </thead> <tbody> <tr> <td>none</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>trace</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>slight</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>moderate</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>severe</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> </tbody> </table>			foliar disease	root disease	insect or mite damage	rat or bird damage	herbicide damage	weed problem	none	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	trace	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	slight	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	moderate	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	severe	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	foliar disease	root disease	insect or mite damage	rat or bird damage	herbicide damage	weed problem																																					
none	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>																																					
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severe	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>																																					
IF A DISEASE PROBLEM IS MODERATE OR SEVERE, PLEASE SPECIFY: MAJOR DISEASE OBSERVED (OR SYMPTOMS) _____ CONTROL MEASURES AND DATE(S) APPLIED _____																																											
IF A INSECT OR MITE PROBLEM IS MODERATE OR SEVERE, PLEASE SPECIFY: MAJOR INSECT OBSERVED _____ CONTROL MEASURES AND DATE(S) APPLIED _____																																											
IF A WEED PROBLEM IS MODERATE OR SEVERE, PLEASE SPECIFY: MAJOR SPECIES, CONTROL MEASURES AND DATE(S) APPLIED _____																																											
CHEMICALS APPLIED ? <input type="checkbox"/> Yes <input type="checkbox"/> No HERBICIDE <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, specify product (s) _____ FUNGICIDE <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, specify product (s) _____ INSECTICIDE <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, specify product (s) _____ OTHERS <input type="checkbox"/> Yes <input type="checkbox"/> No If Yes, specify product (s) _____																																											
DATES APPLIED (DD/MM/YY) <table style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 15%;"></th> <th style="width: 15%;">Herbicide</th> <th style="width: 15%;">Fungicide</th> <th style="width: 15%;">Insecticide</th> <th style="width: 15%;">Others</th> </tr> </thead> <tbody> <tr> <td>1st spray</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>2nd spray</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>3rd spray</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> </tbody> </table>			Herbicide	Fungicide	Insecticide	Others	1 st spray	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	2 nd spray	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	3 rd spray	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>																						
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3 rd spray	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>																																							
CLIMATE DATA DURING TRIAL <input type="checkbox"/> Rainy season <input type="checkbox"/> Dry season Average min. temp. <input type="text"/> °C Average max. temp. <input type="text"/> °C Total rainfall <input type="text"/> mm Remarks about deviations from normal _____ _____																																											

Table 4. Data collection sheet for plant characteristics and reactions to biotic stresses.

Plot no.	Rep	Entry code	Days to 50% flowering	Growth habit ¹	Disease rating						Insect damage
					EB ²	LB ²	TYLCD ³	BW ⁴	FW ⁴	SB ⁴	TFB ⁵
1	1	G									
2	1	E									
3	1	F									
4	1	D									
5	1	C									
6	1	H									
7	1	B									
8	1	A									
9	2	H									
10	2	C									
11	2	E									
12	2	A									
13	2	F									
14	2	G									
15	2	D									
16	2	B									
17	3	A									
18	3	F									
19	3	E									
20	3	C									
21	3	D									
22	3	B									
23	3	H									
24	3	G									

¹ D: determinate type; ID: indeterminate type; SD: semi-determinate type² EB (= early blight) and LB (= late blight): rate the plants at one of three levels, 0 = healthy, 1 = slight, 2 = severe³ TYLCD (= tomato yellow leaf curl disease): rate the plants at one of three levels, 0 = healthy, 1 = slight, 2 = moderate, 3 = severe⁴ BW (= bacterial wilt), FW (= fusarium wilt) and SB (= southern blight): record number of wilted plants⁵ TFB (= tomato fruit borer): record number of TFB damaged fruits

Table 5. Data sheet to track yield and yield components.

Plot no.	Rep	Entry code	No. of plants harvested	Average fruit weight (g)	Fruit yield (kg/plot)												Total marketable fruit weight (kg)
					1 st harvest ()			2 nd harvest ()			3 rd harvest ()			4 th harvest ()			
					M ¹	NM ²	TFB ³	M ¹	NM ²	TFB ³	M ¹	NM ²	TFB ³	M ¹	NM ²	TFB ³	
1	1	G															
2	1	E															
3	1	F															
4	1	D															
5	1	C															
6	1	H															
7	1	B															
8	1	A															
9	2	H															
10	2	C															
11	2	E															
12	2	A															
13	2	F															
14	2	G															
15	2	D															
16	2	B															
17	3	A															
18	3	F															
19	3	E															
20	3	C															
21	3	D															
22	3	B															
23	3	H															
24	3	G															

() indicate the date of harvest. Add more columns if there are more than 4 harvests.

¹ M: marketable fruits

² NM: nonmarketable fruits

³ TFB: tomato fruit borer damaged fruits



1 (slight)

2 (severe)

Figure 2. Early blight rating scale: 0 = no symptoms, 1 = dark circular spots start on the old leaves, 2 = leaves dry and falling off.



1 (slight)

2 (severe)

Figure 3. Late blight rating scale: 0 = no symptoms, 1 = irregular dark, water-soaked spots develop on leaves and the undersides of lesions may be covered by a white fuzzy growth, 2 = brown to black lesions appear on stems and shiny, dark or olive-colored lesions develop on fruits.



Figure 4. Tomato yellow leaf curl disease rating scale: 0 = no symptoms, 1 = curling of upper leaves, 2 = curling, blistering and yellowing of leaves, 3 = stunting and distortion.



Figure 5. Symptoms of fusarium wilt: Yellowing begins on lower leaves and eventually leads to leaf drop and plant wilt.

Figure 6. Typical symptoms of bacterial wilt first appear as drooping of a few young leaves. A sudden complete wilt soon follows. Infected plants display wilting but not yellowing leaves. Most of the time, leaves are still green when the plants wilt.



Figure 7. Symptoms of southern blight: White fungal growth is produced on the stem at the soil line and mustard seed-sized, round, tan to dark brown structures appear on the white fungal growth, leading to a rapid wilting of the entire plant.

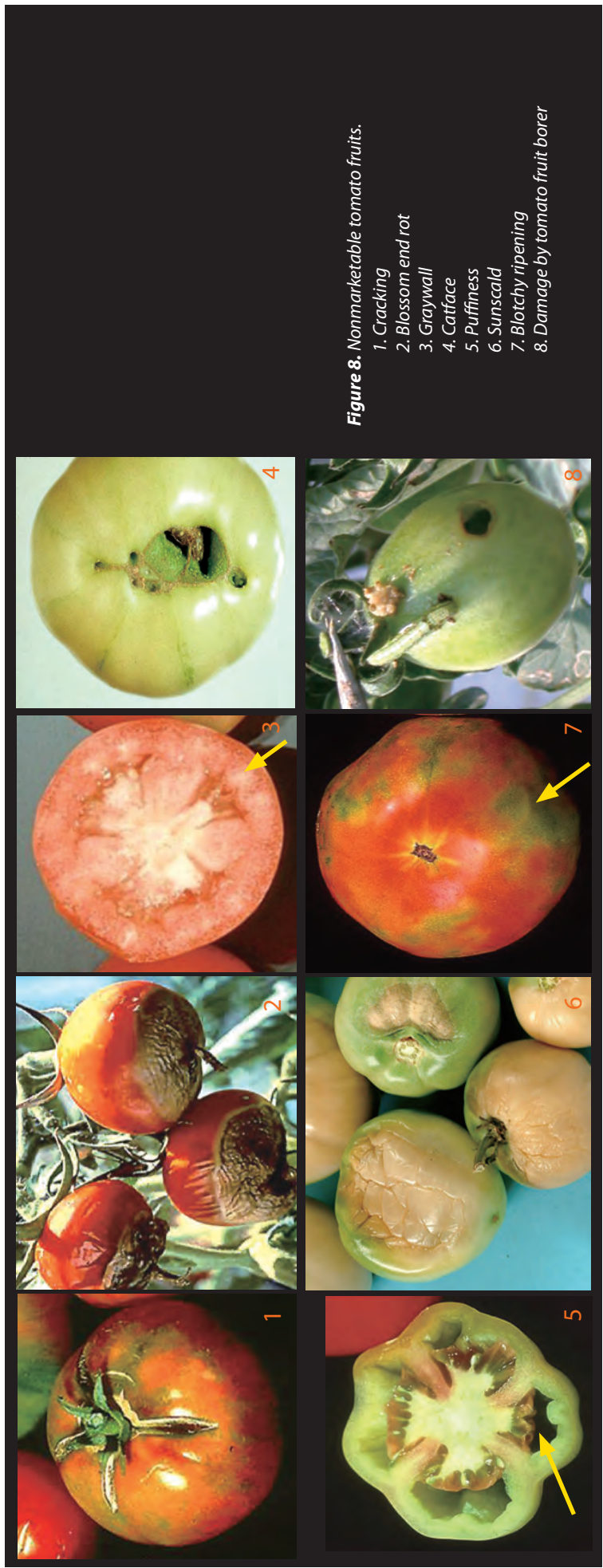


Figure 8. Nonmarketable tomato fruits.

1. Cracking
2. Blossom end rot
3. Graywall
4. Catface
5. Puffiness
6. Sunscald
7. Blotchy ripening
8. Damage by tomato fruit borer

