AVRDC – The World Vegetable Center

AVRDC Publication Number: 11-751

International Cooperators'

Guide

Procedures for Tomato Variety Field Trials

Peter Hanson, Li-ju Lin, Gregory C. Luther, Wen-shi Tsai, R. Srinivasan, Chien-hua Chen, Chih-hung Lin, Zong-ming Sheu and Shu-fen Lu

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

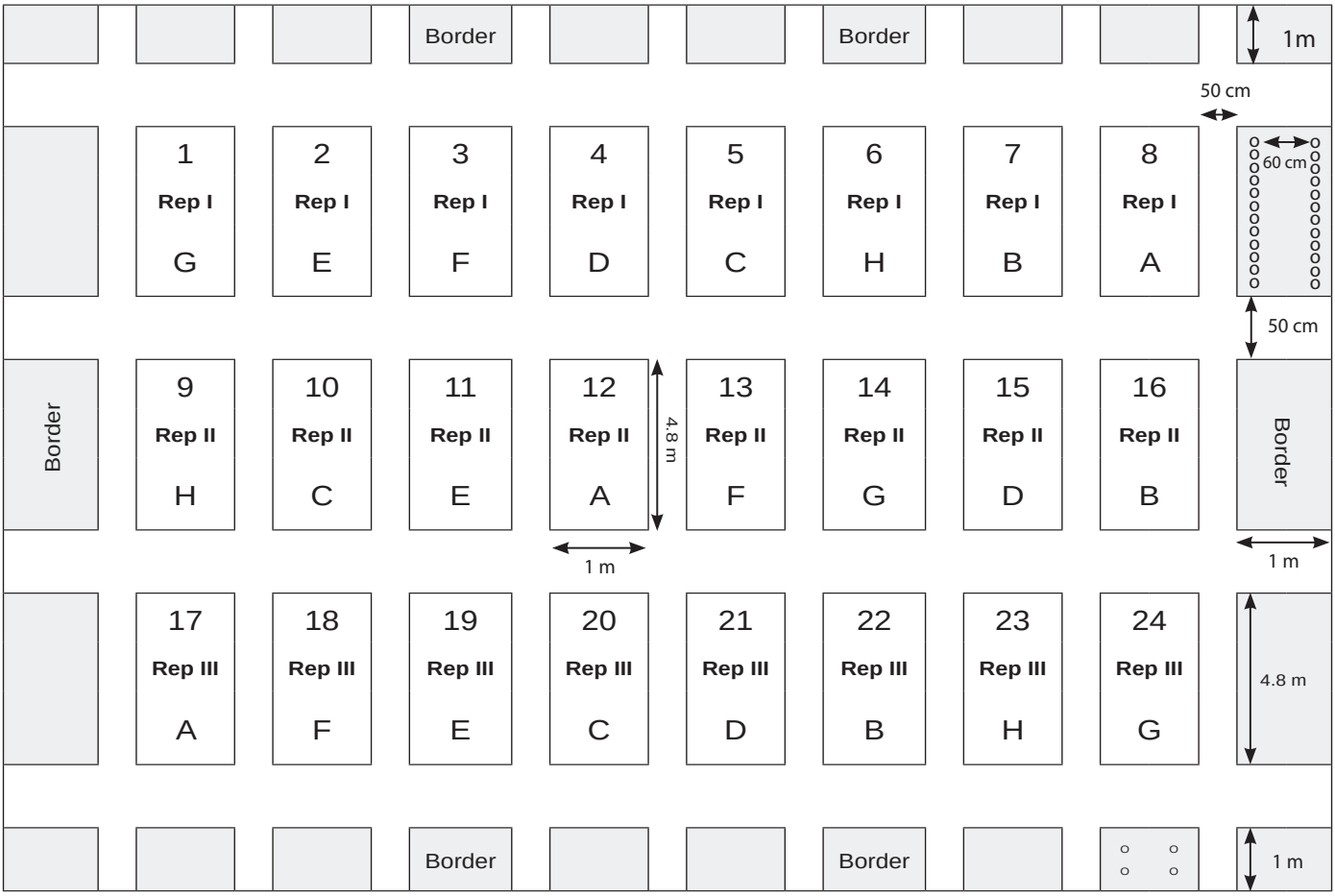

Figure. 1. *Sample field layout (the border area can have one or two rows of tomatoes).*

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:

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

Example:
plot yield: 30 kg
harvested area: 20 m^2

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

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

sandy	☐
sandy loam	☐
loam	☐
clay loam	☐
silty clay	☐
clay	☐
other	☐

If other, specify _____

surface pH

unknown	☐
> 8	☐
7.1 - 8	☐
5.6 - 7	☐
4 - 5.5	☐
< 4	☐

or

actual value _____

drainage condition

excellent	☐
very good	☐
good	☐
average	☐
poor	☐
very poor	☐

PLANTING SCHEDULE

date sown day ☐☐ month ☐☐ year ☐☐☐☐

date transplanted day ☐☐ month ☐☐ year ☐☐☐☐

HARVEST

start date day ☐☐ month ☐☐ year ☐☐☐☐

end date day ☐☐ month ☐☐ year ☐☐☐☐

Number of times harvested _____

FERTILIZER APPLIED? ☐ **Yes** ☐ **No** Specify unit of fertilizer applied if different from kg/ha _____

applied	day	month	year	quantity kg/ha	%N	$\%P_2O_5$	$\%K_2O$	Other element(s)
1st date	☐☐	☐☐	☐☐☐☐					
2nd date	☐☐	☐☐	☐☐☐☐					
3rd date	☐☐	☐☐	☐☐☐☐					

IRRIGATION ? ☐ **Yes** ☐ **No** If Yes, please specify methods and frequency

methods

Drip	☐
Furrow	☐
Sprinkler	☐
Other	☐

If other, specify _____

frequency

weekly	☐
twice a month	☐
monthly	☐
other	☐

If other, specify _____

OTHER PRACTICES

☐ Mulching ☐ Staking ☐ 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

	foliar disease	root disease	insect or mite damage	rat or bird damage	herbicide damage	weed problem
none						
trace						
slight						
moderate						
severe						

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 ? ☐ Yes ☐ No

HERBICIDE ☐ Yes ☐ No **If Yes, specify product (s)** _____

FUNGICIDE ☐ Yes ☐ No **If Yes, specify product (s)** _____

INSECTICIDE ☐ Yes ☐ No **If Yes, specify product (s)** _____

OTHERS ☐ Yes ☐ No **If Yes, specify product (s)** _____

DATES APPLIED (DD/MM/YY)	Herbicide	Fungicide	Insecticide	Others
1st spray	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐
2nd spray	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐
3rd spray	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐	☐☐ ☐☐ ☐☐☐☐

CLIMATE DATA DURING TRIAL ☐ Rainy season ☐ Dry season

Average min. temp. ☐☐℃ **Average max. temp.** ☐☐℃ **Total rainfall** ☐☐☐☐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 type
[2] EB (= early blight) and LB (= late blight): rate the plants at one of three levels, 0 = healthy, 1 = slight, 2 = severe
[3] TYLCD (= tomato yellow leaf curl disease): rate the plants at one of four levels, 0 = healthy, 1 = slight, 2 = moderate, 3 = severe
[4] BW (= bacterial wilt), FW (= fusarium wilt) and SB (= southern blight): record number of wilted plants
[5] 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)
					1st harvest ( )			2nd harvest ( )			3rd harvest ( )			4th 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

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

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.*

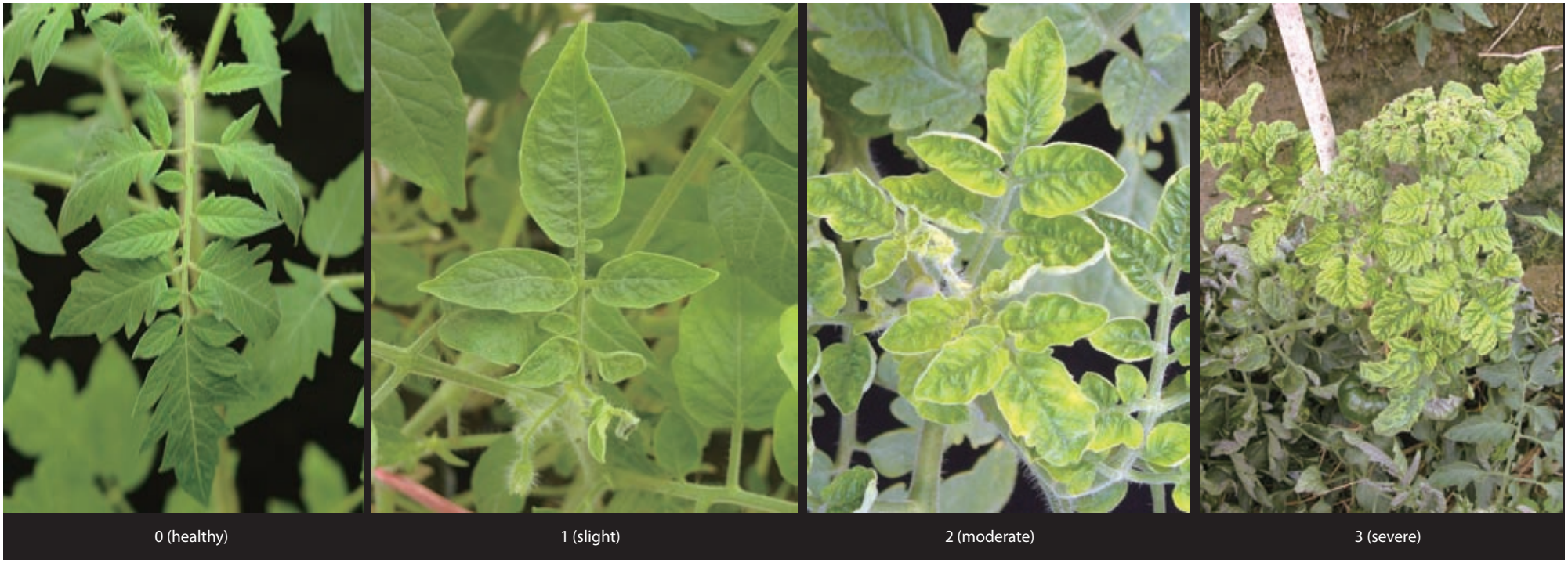

Figure 4. *Tomato yellow leaf curl disease rating scale: 0 = no symptoms, 1 = curling of upper leaves, 2 = curling, blistering and yellowing of leaves, 3 = stunting and distortion.*

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*

AVRDC – The World Vegetable Center
Headquarters
P.O. Box 42, Shanhua, Tainan 74199
Taiwan

T +886 6 5837801
F +886 6 5830009
E info@worldveg.org
I www.avrdc.org

This guide and Excel format data sheets are available online at www.avrdc.org/index.php?id=746

12/2011