

#14-775

# International Cooperators' Guide



## ***Procedures for Sweet Pepper Variety Field Trials***

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### **Introduction**

This guideline provides suggestions to for evaluating sweet pepper lines. Following this, the data recorded at different locations can be compared by researchers participating in AVRDC's International Sweet Pepper Nursery (ISPN) trials and other varietal evaluation trials.

### ***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 15 (or entries included in the ISPN), which should include two or three locally popular cultivars (open pollinated [OP] or hybrids) at each location as checks (Table 1).

### ***Experimental design***

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

### ***Size of plot***

Row length and plant spacing normally used in local production practices are recommended. At AVRDC, each entry is grown on a 30-cm high raised bed with 2-row planting. The plot size is 5.4 m long and 1.5 m wide between furrows (Fig. 1). The distance between rows is 50 cm. Plant spacing within rows is 45 cm. Thus, there would be a total of 24 plants planted in each plot and 12 plants per row. The plant density is 29,630 plants/ha. For a large number of entries, 1-row planting can be applied and the total number of plants per plot should be 12. 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 Sweet Pepper***

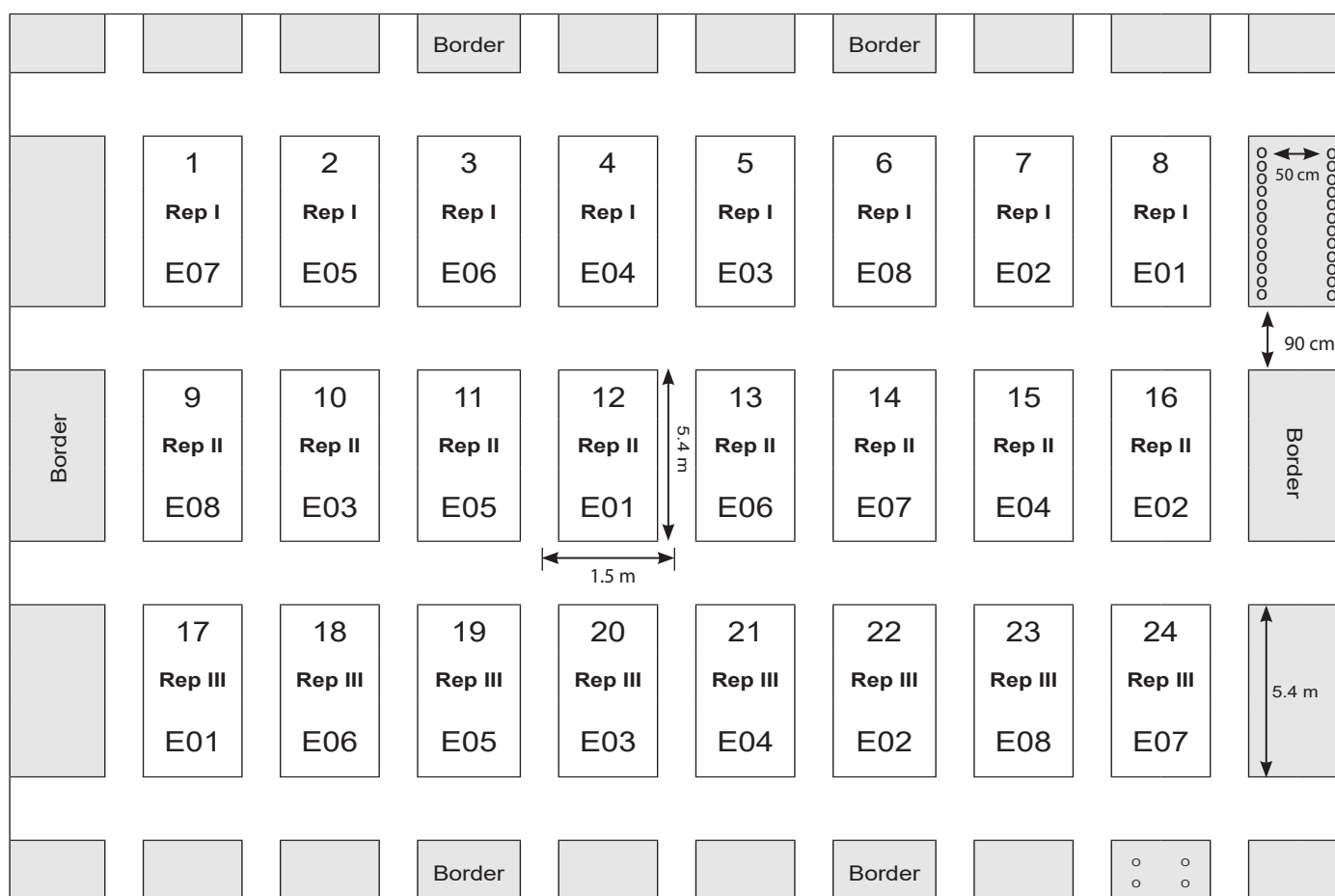
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**Table 1.** Sample planting plan

Entry code	Replication		
	I	II	III
	Plots 1-8	Plots 9-16	Plots 17-24
E01	8	12	17
E02	7	16	22
E03	5	10	20
E04	4	15	21
E05	2	11	19
E06	3	13	18
E07	1	14	24
E08*	6	9	23

\*Local check cultivar



**Figure 1.** Sample field layout for 2-row planting (the border area can have one or two rows of sweet pepper). The suggested distance between furrows is 1.5 m for 2-row planting or 1 m for 1-row planting.

## Harvesting

During the initial plant growth stage, pinch off the flower buds and/or small developing fruits at first and second nodes. Harvest the fruit when fruits reach full size and become firm at the green mature stage, just before mature color begins to develop. It usually takes 50–60 days from flowering to optimum harvest stage.

## 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 (Table 2). This information can be useful for explaining varietal performance in different environments. For 2-row planting, data are collected from 20 inner plants. For 1-row planting, data are collected from 10 inner plants. 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 (DAT) to 50% anthesis (50% of plants in a plot have open flowers at the second node). Check plots three times a week and record on Table 3.

### 2. Days to 50% maturity:

Number of days after transplanting (DAT) to 50% maturity (50% of plants in a plot have green mature fruits ready to harvest or have turned to yellow or red color). Check plots three times a week and record on Table 3.

### 3. Biotic stress rating:

Evaluate incidence of diseases and insects when the first harvest is done. Record incidence as R (=resistant, 70-100% of plants per plot are healthy), MR (=moderate resistant, 50-70% of plants per plot are healthy), MS (=moderate susceptible, 20-50% of plants per plot are healthy) or S (=susceptible, 0-20% of plants per plot are healthy). Check figures 2-6 for the symptoms of bacterial spot, bacterial wilt, Phytophthora blight, anthracnose and virus; and figures 7-9 for insect damage symptoms to help you identify, score and record the severity of pests (Table 3).

### 4. Number of plants harvested:

Count the plants harvested from the 2-row or 1-row plot. This will indicate population density and help explain low yields in plots with poor stands (Table 4).

### 5. Fresh fruit yield:

Separate the marketable (worth selling) from nonmarketable fruits (damaged due to biotic and abiotic stress or remarkably tiny fruits) after harvesting. Record weight of marketable and nonmarketable fruits from each plot and the harvest dates. Repeat the process for four harvests. The total marketable yield is obtained by adding the yields of individual harvests (Table 4).

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 of 2-row planting (data collected from 20 inner plants):*

plot yield: 40 kg

harvested area: 6.75 m<sup>2</sup> (=0.45 m x 10 plants x 1.5 m)

$$\text{Yield} = \frac{40 \text{ (kg)} / 1,000 \text{ (kg/t)}}{6.75 \text{ (m}^2\text{)} / 10,000 \text{ (m}^2\text{/ha)}} = 59.3 \text{ t/ha}$$

### 6. Fruit length, width and weight:

Average fruit length (cm), width (cm) and weight (grams) can be calculated from 10 randomly selected marketable fruits in the first or second harvest (Table 4).

*Example:*

Total weight of 10 marketable fruits = 1,300 g

$$\text{Average fruit weight} = \frac{1,300}{10} = 130 \text{ g}$$

### 7. Remarks:

Any other interesting observations not recorded elsewhere that could help explain the outcome of the trial (Table 3).

**Table 2.** Sample data sheet for test location and crop management

SWEET PEPPER VARIETY FIELD TRIALS: TEST LOCATION AND CROP MANAGEMENT DATA SHEET									
Country _____									
Cooperator(s) / data taker(s) _____									
E-mail / address: _____									
<b>LOCATION DATA</b>									
Farm or experiment station _____									
State / province / department _____									
LATITUDE degrees minutes N or S			LONGITUDE degrees minutes E or W			ALTITUDE above sea level			
□□ □□ □□			□□□ □□ □□			□□□□m			
SOIL Previous crop _____									
Surface texture <input type="checkbox"/> sandy loam <input type="checkbox"/> clay loam <input type="checkbox"/> silty loam <input type="checkbox"/> other _____									
Surface pH <input type="checkbox"/> >7 <input type="checkbox"/> 6-7 <input type="checkbox"/> <6 or actual value _____									
CLIMATE DATA DURING TRIAL <input type="checkbox"/> Hot-wet <input type="checkbox"/> Hot-dry <input type="checkbox"/> Cool-dry <input type="checkbox"/> Cool-wet <input type="checkbox"/> Other									
Average min. temp. □□°C Average max. temp. □□°C Total rainfall □□□□mm									
Remarks about deviations from normal _____									
<b>EXPERIMENT DATA</b>									
PLOT DATA Plot width (m) _____ Plot length (m) _____ Spacing between rows (cm) _____									
No. of plants/plot _____ No. of rows/plot _____ Plant spacing within row (cm) _____									
SEEDLING MANAGEMENT <input type="checkbox"/> bare root <input type="checkbox"/> seedling tray <input type="checkbox"/> other _____									
PLANTING SCHEDULE day month year day month year									
date sown □□ □□ □□□□ date transplanted □□ □□ □□□□									
HARVEST 1 <sup>st</sup> □□/□□ 2 <sup>nd</sup> □□/□□ 3 <sup>rd</sup> □□/□□ 4 <sup>th</sup> □□/□□ (day/month)									
OTHER PRACTICES <input type="checkbox"/> Mulching <input type="checkbox"/> Staking <input type="checkbox"/> Others, please specify _____									
<b>BIOTIC STRESSES OBSERVED AND CONTROL</b>									
Diseases: <input type="checkbox"/> bacterial spot <input type="checkbox"/> bacterial wilt <input type="checkbox"/> Phytophthora blight									
<input type="checkbox"/> anthracnose <input type="checkbox"/> virus <input type="checkbox"/> others _____									
Control methods: <input type="checkbox"/> chemicals applied <input type="checkbox"/> others _____									
Insects: <input type="checkbox"/> broad mite <input type="checkbox"/> aphid <input type="checkbox"/> thrips <input type="checkbox"/> others _____									
Control methods: <input type="checkbox"/> chemicals applied <input type="checkbox"/> others _____									
<b>In your opinion, considering yield, plant type, fruit acceptability to local consumers, and other factors, which are the four best sweet pepper lines?</b>									
1 _____									
2 _____									
3 _____									
4 _____									

**Table 3.** Sample data sheet for plant characteristics and reactions to biotic stresses

Plot no.	Rep	Entry code	Days to 50% flowering	Days to 50% maturity	Incidence of diseases and insects*						Remarks	
					BS	BW	PB	Virus	BM	Aphid		Thrips
1	1	E07										
2	1	E05										
3	1	E06										
4	1	E04										
5	1	E03										
6	1	E08										
7	1	E02										
8	1	E01										
9	2	E08										
10	2	E03										
11	2	E05										
12	2	E01										
13	2	E06										
14	2	E07										
15	2	E04										
16	2	E02										
17	3	E01										
18	3	E06										
19	3	E05										
20	3	E03										
21	3	E04										
22	3	E02										
23	3	E08										
24	3	E07										

\* BS (= bacterial spot), BW (= bacterial wilt), PB (= Phytophthora blight), Virus (= virus like symptoms), BM (= broad mite)

Rate the plants when the first harvest is done at one of four levels: **R** (=resistant, 70-100% healthy plants/plot)

**MR** (=moderate resistant, 50-70% healthy plants/plot)

**MS** (=moderate susceptible, 20-50% healthy plants/plot)

**S** (=susceptible, 0-20% healthy plants/plot)

**Table 4.** Sample data sheet to track yield and yield components

Plot no.	Rep	Entry code	No of plants harvested	Average fruit			Fruit yield (kg/plot)								Total M <sup>2</sup> wt. (kg)
				L <sup>1</sup> (cm)	Wd <sup>1</sup> (cm)	Wt. <sup>1</sup> (g)	1 <sup>st</sup> harvest ( )		2 <sup>nd</sup> harvest ( )		3 <sup>rd</sup> harvest ( )		4 <sup>th</sup> harvest ( )		
							M <sup>2</sup>	NM <sup>2</sup>	M <sup>2</sup>	NM <sup>2</sup>	M <sup>2</sup>	NM <sup>2</sup>	M <sup>2</sup>	NM <sup>2</sup>	
1	1	E07													
2	1	E05													
3	1	E06													
4	1	E04													
5	1	E03													
6	1	E08													
7	1	E02													
8	1	E01													
9	2	E08													
10	2	E03													
11	2	E05													
12	2	E01													
13	2	E06													
14	2	E07													
15	2	E04													
16	2	E02													
17	3	E01													
18	3	E06													
19	3	E05													
20	3	E03													
21	3	E04													
22	3	E02													
23	3	E08													
24	3	E07													

( ) indicate the date of harvest. Add more rows if there are more than 8 entries.

<sup>1</sup> L: length; Wd: width; Wt.: weight

<sup>2</sup> M: marketable fruits; NM: nonmarketable fruits



**Figure 2.** Typical symptoms of **bacterial spot (BS)** first appear as tiny water-soaked spots, and become necrotic lesions surrounded by a yellow halo. Lesions may be sunken on the upper surface and slightly raised on the underside of the leaf. Dark spots and elongated lesions can be found on stem, petioles, peduncles and fruits. Please observe the incidence and rate the plants in Table 3.



**Figure 3.** Typical symptoms of **bacterial wilt (BW)** first appear as drooping of a few young leaves. A sudden complete wilt soon follows. Infected plants display wilting with little or no yellowing leaves (left). The disease can be correctly diagnosed by observing bacterial streaming from vascular system in the lower stem using a stem-ooze test (right). Please observe the incidence and rate the plants in Table 3.



**Figure 4.** The first symptom of *Phytophthora blight* (PB) on pepper in the field is commonly crown rot (3). A lesion girdling the base of the stem (4) causes rapid collapse and death of the plant (1 & 5). Following rainstorms, some typical symptoms such as water-soaked lesions on leaves and fruits, and brown to dark purplish lesion on upper stem can be found (2). All plant parts including roots, crowns, stems, leaves, and fruit at any growth stage can be attacked. The wilting symptom is very similar to bacterial wilt if no foliar infection occurs. However, no bacterial streaming can be found using a stem-ooze test. Please observe the incidence and rate the plants in Table 3.





**Figure 5.** Typical symptoms of **anthracnose** are usually on fruits at both immature and mature stage. The symptoms initially begin as water-soaked lesions that become sunken and tan. The lesions expand soon and eventually produce gelatinous, salmon-colored conidia spores. Concentric rings of the acervuli are common within the lesion. In some cases, the lesions are dark due to the formation of numerous black setae or other fungal tissue. Please observe the incidence and record in Table 2.



**Figure 6.** **Virus-** like symptoms include vein yellowing, yellow, brown ring and necrotic spots, mosaic and mottle leaves (1-4) and deformation, green rings, necrotic spots and yellow strips on fruits (5 & 6). Please observe the incidence and rate the plants in Table 3.



**Figure 7.** The symptoms of **aphid** damaged plants include leaf distortion and mottling; chlorotic leaf spots and black sooty mold. Please observe the incidence and rate the plants in Table 3.



**Figure 8.** The symptoms of **broad mite** damaged plants include leaves curling downwards; growing point and young leaves are bronzed and stunted; necrosis on the growing point and dropping of old leaves; and cork-like fruits. Please observe the incidence and rate the plants in Table 3.



**Figure 9.** The symptoms of **thrips** damaged plants include young leaves curling upwards; fruits netted with cork-like streaks; plants stunted with small leaves on young shoots. Please observe the incidence and rate the plants in Table 3.

This guide and Excel format data spreadsheets are available online in **HARVEST**, the WorldVeg document and data archive:

<https://worldveg.tind.io>

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