



World Vegetable Center

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International Cooperators' Guide



Procedures for Bitter Gourd Variety Field Trials

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Introduction

This guide provides suggestions for evaluating bitter melon lines. Data recorded at different locations can be compared by researchers participating in World Vegetable Center's multi-environment bitter melon variety 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 20, which should include one or two 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 the World Vegetable Center (WorldVeg), each entry is grown on a 20-cm high raised bed with 1-row planting. The plot size is 12 m long and 1.6 m wide between furrows (Figure 1). Plant spacing within rows is 1 m. Thus, there would be a total of 12 plants planted in each plot. The plant density is 6250 plants/ha. 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 Bitter Gourd

https://avrdc.org/download/publications/crop-guides/cucurbits/icg_bitter-gourd-cultural-practices_final.pdf

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

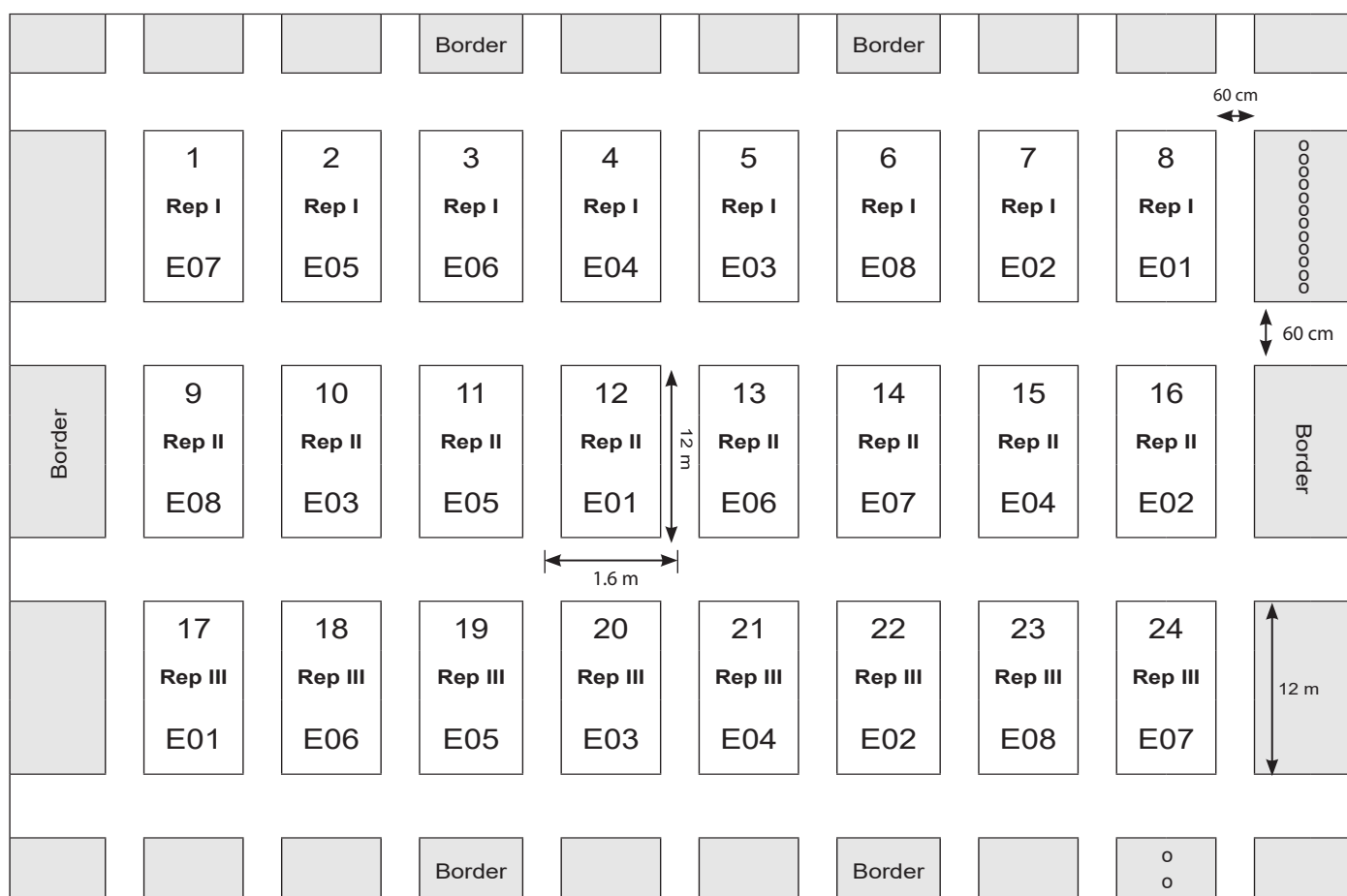


Figure 1. Sample field layout for single row planting

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Harvesting

Bitter melon requires close attention at harvest time. Harvest the fruits when they are shiny green/white, thick and juicy, and the seeds are still soft and white. Yields should be recorded on a fresh weight basis. It usually takes 15-20 days after fruit set or 60-75 days from planting for fruit to reach marketable age, depending upon the genotypes. Bitter melon production can continue for several months under optimum conditions depending on genotypes and the environment, but the yield data for variety field trials can be recorded for only 4 weeks.

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 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 female flowers). Check plots three times a week and record data in Table 3.

2. Days to 50% maturity:

Number of days after transplanting (DAT) to 50% maturity (50% of plants in a plot have shiny green/white fruits). Check plots three times a week and record data in Table 3.

3. Biotic stress rating:

Evaluate incidence of diseases and insects when the first harvest is done. Record disease 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 2-7 for the symptoms of downy mildew, powdery mildew, Fusarium wilt, Cercospora leaf spot, virus and root-knot nematode; and Figure 8 for insect damage symptoms of aphid and melon

fly to help you identify, score and record the level of severity (Table 3). For rate the severity of melon fly, count and weigh the number of fruits damaged by melon fly (Table 3 & 4). Other diseases or insect pests with high incidence should be recorded after proper diagnosis.

4. Number of plants harvested:

Count the plants harvested from the 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 4 weeks. 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 1-row planting (data collected from 10 inner plants):

plot yield: 25 kg

harvested area: 16 m² (=1 m x 10 plants x 1.6 m)

$$\text{Yield} = \frac{25 \text{ (kg)} / 1,000 \text{ (kg/t)}}{16 \text{ (m}^2\text{)} / 10,000 \text{ (m}^2\text{/ha)}} = 15.6 \text{ t/ha}$$

6. Fruit length, width and weight:

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

Example:

Total weight of 10 marketable fruits = 2,300 g

$$\text{Average fruit weight} = \frac{2,300}{10} = 230 \text{ g}$$

7. Remarks:

Include 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.

BITTER GOURD VARIETY FIELD TRIALS: TEST LOCATION AND CROP MANAGEMENT DATA SHEET									
Country _____									
Cooperator(s) / data taker(s) _____									
E-mail / address: _____									
LOCATION DATA									
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 _____									
EXPERIMENT DATA									
PLOT DATA Plot width (m) _____					Plot length (m) _____				
No. of plants/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 st □□/□□ 2 nd □□/□□ 3 rd □□/□□ 4 th □□/□□ (day/month)									
OTHER PRACTICES <input type="checkbox"/> Mulching <input type="checkbox"/> Staking <input type="checkbox"/> Others, please specify _____									
BIOTIC STRESSES OBSERVED AND CONTROL									
Diseases: <input type="checkbox"/> downy mildew <input type="checkbox"/> powdery mildew <input type="checkbox"/> Fusarium wilt <input type="checkbox"/> Cercospora leaf spot									
<input type="checkbox"/> virus <input type="checkbox"/> root-knot nematode <input type="checkbox"/> others _____									
Control methods: <input type="checkbox"/> chemicals applied <input type="checkbox"/> others _____									
Pests: <input type="checkbox"/> melon fly <input type="checkbox"/> aphid <input type="checkbox"/> others _____									
Control methods: <input type="checkbox"/> chemicals applied <input type="checkbox"/> others _____									
In your opinion, considering yield, plant type, fruit acceptability to local consumers, and other factors, which are the four best bitter gourd lines?									
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% female flowering	Days to 50% maturity	Incidence of diseases and insects*								Remarks
					DM ¹	PM ¹	FW ¹	CLS ¹	Virus ¹	RKN ¹	Aphid	Melon fly ²	
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											

¹ DM (= downy mildew), PM (= powdery mildew), FW (= Fusarium wilt), CLS (=Cercospora leaf spot), RKN (= root-knot nematode)

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)

² Melon fly: record number of melon fly damaged fruits

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 ¹ wt. (kg)	
				Length (cm)	Width (cm)	Weight (g)	1 st harvest ()			2 nd harvest ()			3 rd harvest ()			4 th harvest ()				
							M ¹	NM ²	MF ³	M ¹	NM ²	MF ³	M ¹	NM ²	MF ³	M ¹	NM ²	MF ³		
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. Add more columns if there are more than 4 harvests.

¹ M: marketable fruits

² NM: nonmarketable fruits

³ MF: melon fly damage fruits



Figure 2. Typical symptoms of **downy mildew**: small angular and yellowish to pale green lesions coalesce into large spots limited by leaf veins. White to gray mycelia observed on the underside of leaves. Please observe the incidence and rate the plants in Table 3.

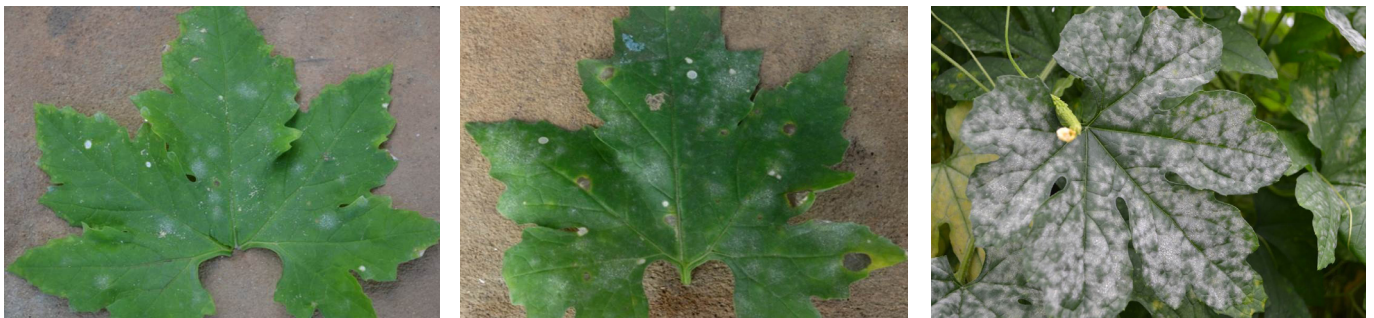


Figure 3. Typical symptoms of **powdery mildew**: white powdery mycelia with aerial spores cover the upper leaf surface, petiole and stem. The infected leaves turn yellow, shrivel and defoliation may occur. Severe infection results in leaf drying and death of the plant. Please observe the incidence and rate the plants in Table 3.



Figure 4. Typical symptoms of **Fusarium wilt**: vines show partial or complete wilt with or without yellowing. Vascular discoloration is visible inside stems. Severe infection causes death of plant. Please observe the incidence and rate the plants in Table 3. (Source of photos b & c: HY Huang, Kaohsiung District of Agricultural Research and Extension Station, Taiwan)



Figure 5. Above ground symptoms of **root-knot nematode** include stunting, yellowing and wilting; roots develop knots (galls). Please observe the incidence and rate the plants in Table 3.



Figure 6. Virus-like symptoms include leaf yellowing, leaf rolling or cupping, leaf deformation and/or size reduction. The leaves may also be blistered and/or narrowed with green vein-banding, and/or have chlorotic mosaic and mottle patterns or yellow spots. Buds can become necrotic. Fruits may be small and malformed with green mottle and/or water-soaked lesions. Please observe the incidence and rate the plants (if possible please record the predominant symptom types in remarks) in Table 3.



Figure 7. The symptoms of *Cercospora leaf spot* include brown or greyish circular rings or circular necrotic spots with white or light tan centers that appear on older leaves. Please observe the incidence and rate the plants in Table 3.



Figure 8. The symptoms of **aphid** damaged plants include stunted growth, infested leaves that curl downwards, yellowing and cupping of leaves, and presence of honey dew, which is often attended by ants and development of black sooty-mold (**left**); feeding by melon fly larvae causes yellowing and rotting of the fruit (**top right**); close-up image of melon fly (**bottom right**). Please observe the incidence and rate the plants in Table 3 for aphid and Tables 3 & 4 for melon fly.

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This guide and Excel format data sheets are available online at:
<https://avrdc.org/seed/improved-lines/bitter-gourd/#.U9rp6fmSxLD>

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