

## Comparative performance of growth, flowering behaviour and fruit development traits in parental lines of bitter gourd (*Momordica charantia* L.) cv. Pusa Hybrid-1

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**ABSTRACT** The present investigation on parental lines of bitter gourd (*Momordica charantia* L.) cv. Pusa hybrid-1 was carried out at CPCT farm ICAR-IARI, New Delhi during the summer season of 2010 under insect proof net (IPN) and open field condition (OFC). The female line (seed parent) and male parent (pollen parent) were transplanted in block method following the planting ratio of 3:1, under drip fertigation in IPN and OFC. Significantly higher vine length, number of leaf node on 30 & 45 days from transplanting (DFT) and inter nodal length were recorded in seed and pollen parent under IPN as compared to OFC. The time taken for opening of first female and male flower in seed parent and pollen parent (55.40 days and 51.10 days respectively) were significantly lower under IPN. The production of female flower (31.10/plant) and male flower (40.10/plant) were significantly higher under IPN as compared to OFC. The number of fruit set (3.00) and matured fruit (2.90/plant) was significantly higher under IPN than OFC (1.80 and 1.30 respectively). The overall percentage of fruit set and duration of fruit set under IPN was significantly higher than the OFC. The fruit development attributes i.e. fruit weight & fruit length was significantly higher in IPN, where as non-significant difference for fruit width and flesh thickness was recorded in cross fruits under both the conditions. The incidence of virus and insect pests was negligible or very low under IPN, whereas 54% plants were affected at maturity by virus, under OFC.

**Key Words:** Insect proof net, open field, growth behaviour, fruit setting, seed parent, pollen parent

Bitter gourd (*Momordica charantia* L.) is grown for its tender fruits and is rich in iron. An insulin-like compound, cherratin has been reported to be present in bitter gourd which reduces blood sugar in diabetic patients. The chemical compound, momordicine, which causes bitterness in fruits, has been found to lower the blood glucose in diabetes. It is also used for pickles, canning and dehydration (stored as a dry vegetable). It can be grown in both seasons for commercial production, but seed production, especially hybrid seed production requires vigorous growth, higher number of female flower and higher fruit set in seed parent for better fruit maturation and development attributes. Hybrid seed production in North Indian conditions cannot be organised successfully due to high incidence of insect pest and diseases. Therefore, attaining economic yield is a difficult task in *kharif* season. Contrary to this, summer season is considered better for hybrid seed production. However, the plant growth and development are greatly affected by changing environmental conditions like early onset of high temperature, which hamper the production of female flower, fruit set and fruit development. Therefore the present investigation was

planned to study the growth behaviour, flowering and fruit setting, duration of pollination and fruit development parameters under IPN and OFC in bitter gourd.

### MATERIALS AND METHODS

The experiment was conducted during summer 2010, at Centre for Protected Cultivation Technology (CPCT) farm, ICAR-Indian Agricultural Research Institute (IARI), New Delhi. The hybrid selected for the experiment was Pusa Hybrid-1. The seeds of parental lines of the hybrid Pusa Hybrid-1 were obtained from the Division of Vegetable Science, ICAR-IARI, New Delhi. The seedlings were raised in 1½" size conical pro-trays under controlled conditions, in artificial media. The plug trays were then kept in the germination room at a temperature of 20°C. Water was applied through fine sprinkler boom uniformly in the trays. Humidity was maintained at around 100% and irrigation was given whenever it reduced. Special treatment of growth regulators @ 140ppm was applied just after germination of seeds. Nutrients were applied in the form of N: P: K (1:1:1) @ 140ppm once in a week. The 20 days old seedlings were transplanted under two

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conditions, viz insect proof net and open field. The total numbers of female plants were 180 and male plants 60 under IPN and same number of female and male plants were also planted in OFC. The insect proof net is made up of UV stabilized white colour, 40 wire mesh insect proof nylon net, with double door facility and having dimensions of 60m x 6m x 2m. Drip fertigation facilities were laid in both growing conditions.

The male flowers in seed parent were pinched off regularly before the anthesis and the female flowers likely to be opened on next day were tied during evening (5-7 pm). Also the male buds in the pollen parent were covered with non-absorbing cotton. On the next day the male buds were collected and pollination was carried out through hand pollination by rubbing the anthers gently over the stigmatic lobes [1]. Thirty plants were randomly selected in seed and pollen parent under both the conditions for detailed investigations. Vine length on 30 and 45 days from transplanting (DFT), number of leaf nodes on 30 and 45 DFT, inter nodal length of main vine on 30 DFT, days taken for the induction of first lateral, days taken for the opening of first female flower in seed parent, days taken for the opening of first male flower in pollen parent, number of female flower/plant in seed parent, number of male flower/plant in pollen parent, number of flowers pollinated/plant, number of fruit set/plant, number of mature fruit/plant and incidence of disease and insect pests (virus, whitefly and leaf miner) were recorded.

The meteorological observations on temperature, relative humidity and light intensity were recorded during the entire period of experiment (Table 1) and during flowering period of the crop (Table 2).

The data observations recorded were analysed statistically for testing the heterogeneity of means by adopting the 't-test' procedures. The probability was worked out at 5% ( $p=0.05$ ) and wherever t-value is non-significant, it was denoted by NS.

## RESULTS AND DISCUSSION

The results obtained on growth behaviour, flowering, fruit development and mature fruit attributes among parental lines have been discussed below.

### Growth behaviour of seed parent

Growth behaviour of female parent of 'Pusa Hybrid-1' showed significant difference between two growing conditions (Table 3). The vine length on 30 and 45 days from transplanting was 24.97 cm and 218.96 cm in IPN and 18.82 cm and 92.14 cm under open field. The number of leaf node on 30 and 45 days from transplanting was 5.00 and 12.30 under IPN and 3.70 and 8.20 in open field crop. The higher vine length and number of leaf node in female line and male line under insect proof net could be attributed to the stimulation of cellular expansion and cell division under shade conditions [2]. The results were in agreement with El-Aidy *et al.* in sweet pepper [3]. Similarly, the inter-nodal length in IPN was 12.17cm and it was only 5.22cm under OFCs. The significantly early induction of first lateral in female line was recorded on 22.40 days in insect proof net as compared to open field on 26.20 days [10].

This could be due to better assimilation of food reserves in the crop grown under insect proof net as compared to open field [3, 4]. The slightly higher temperature in IPN might be compensated by the shading effect of net which was evident from the recorded data (Table 3). The capacity of plants to perceive and adapt to changing light conditions is critical to the growth and development of photosynthetic organisms. Light quality and quantity can vary due to changes in cloud cover, shading of insect proof net used and the canopy of the plant [5, 6].

### Growth behaviour of pollen parent

The growth behaviour attributes of pollen parent, presented in the Table 3, showed highly significant

**Table 1. Mean monthly meteorological data during crop duration (February-May 2010)**

Month	Temperature (°C)			Relative Humidity (%)			Total Rain(mm)	Wind speed (Kmph)	Sun Shine (hrs)	Evaporation (mm)
	Max	Min	Mean	Max	Min	Mean				
Feb	23.6	11.3	17.4	87.9	37.9	62.9	6.1	2.2	7.6	2.1
Mar	30.9	14.5	22.7	79.0	30.1	54.5	4.0	1.6	7.9	4.9
April	36.1	21.3	28.7	45.5	24.3	34.9	1.8	4.9	8.9	8.0
May	38.3	24.2	31.2	54.3	36.2	45.2	30.4	4.7	11.7	9.7

**Table 2. Weather conditions during flowering period of the crop (averaged on weekly basis) from 01/04/2010 to 30/04/2010)**

Growing conditions	Temperature(°C)			Relative Humidity (%)			Light intensity ( lux )
	Max	Min	Mean	Max	Min	Mean	
<b>Insect proof net house</b>							
First week	27.0	16.2	21.6	74.0	21.6	47.8	436 x 100
Second week	33.1	17.9	25.5	47.5	29.3	38.4	400 x100
Third week	34.4	22.0	28.2	48.4	22.1	35.2	406 x100
Fourth week	36.1	26.1	31.1	36.9	20.8	28.8	430 x 100
<b>Open field</b>							
First week	28.7	16.9	22.8	68.9	23.5	46.2	494 x100
Second week	35.1	18.4	26.7	44.8	26.1	35.7	798 x100
Third week	35.4	22.8	29.1	45.9	22.8	34.3	770 x100
Fourth week	37.7	27.9	32.8	36.7	22.6	29.8	803 x100

**Table 3. Effect of growing conditions on growth behaviour of parental lines of bitter gourd cv. Pusa Hybrid -1 during summer season**

Characters	Insect proof net house	Open field	Level of Significance
<b>Seed Parent</b>			
Vine length at 30 DFT ( cm)	24.97	18.82	**
Number of leaf node on 30 DFT	5.00	3.70	**
Vine length at 45 DFT (cm)	218.96	92.14	**
Total number of leaf Nodes on 45 DFT	12.30	8.20	**
Inter nodal length (cm)	12.17	5.22	**
Days taken for the induction of first lateral	22.40	26.20	*
<b>Pollen Parent</b>			
Vine length at 30 DFT ( cm)	23.40	14.77	**
Number of leaf node on 30 DFT	4.20	2.90	**
Vine length at 45 DFT (cm) 190.45 80.58 **			
Total number of leaf Nodes on 45 DFT	11.20	8.20	**
Inter nodal length (cm)	11.28	7.57	**
Days taken for the induction of first lateral	20.00	25.00	**

DFT: Days from transplanting; NS non-significant, \*Significant at P= 0.05, \*\* Significant at P=0 .01

difference between two growing conditions. The vine length on 30 and 45 days from transplanting was 23.40 cm and 190.45 cm in IPN whereas it was 14.77 cm and 80.58 cm under open field. In IPN, the number of leaf nodes on 30 and 45 days after transplanting was 4.20 and 11.20, but under open fields it was only 2.90 and 8.20. The inter nodal length was 11.28 cm in IPN and 7.57 under open field. In IPN 20 days were taken for the induction of first lateral, while in open field it took 25

days [10].

#### *Flowering behaviour of parental lines*

Flowering behaviour traits of parental lines showed highly significant difference between both the growing conditions (Table 4). In IPN, 55.40 days were taken for the opening of first female flower in the seed parent while under OFC, it took 61.70 days. The total number of female flowers/plant, up to 30 days after the appearance of first female flower, was significantly

higher in IPN (31.10) when compared to open field (6.10). In IPN, 51.10 days were taken for the opening of first male flower in pollen parent but under OFC, it took 57.40 days. The total number of male flowers/plant up to 30 days after the first male flower appearance was also significantly higher in IPN (40.10) in comparison with OFC (24.20). Significantly higher number of female flowers in female line may be due to favourable temperature conditions available for the crop under IPN (Table 4). The male flower opening was 4-5 days earlier than the female flower opening in both conditions. This is in agreement with the results

OFC (1.30). Similarly the percentage of fruit set was higher in IPN as compared to OFC (Table 6).

Significantly higher number of fruit set and mature fruit under IPN could be due to the congenial environmental conditions (Tables 1 & 2) which helped in maintaining the pollen viability and avoided desiccation of pollen on stigmatic surface as reported by Lapichino [8]. The reduction in number of matured fruit in OFC could be due to high irradiation which might have affected the fruit development and maturation [6, 9].

**Table 4. Effect of growing conditions on flowering behavior, pollination and fruit setting in parental lines of bitter gourd cv Pusa Hybrid -1 during summer season**

Characters	Insect proof net house	Open field	Level of Significance
Days to opening of first female flower in seed parent (days)	55.40	61.70	**
Number of female flowers up to 30 days of first flowering (per plant)	31.10	6.10	**
Days to opening of first male flower in pollen parent (days)	51.10	57.40	*
Number of male flowers up to 30 days of first flowering (per plant)	40.10	25.00	**
Number of flower pollinated/plant)	3.40	2.30	NS
Number of fruit set/plant (7 days after the pollination)	3.00	1.80	**
Number of matured fruit/plant	2.90	1.30	**

NS non-significant, \* Significant at P= 0.05, \*\* Significant at P=0 .01

**Table 5. Comparative incidence of insects and diseases in parental lines of Bitter gourd cv. Pusa Hybrid-1 during summer season**

Pests/ Diseases	Insect proof net house	Open field	Level of Significance
Virus	0.00	54.10	**
Whiteflies	1.90	46.00	**
Leaf miner	1.10	14.20	**

NS non-significant, \* Significant at P= 0.05, \*\* Significant at P=0 .01

obtained by Hossain *et al.* [7] and Xavier *et al.* [10] in pumpkin.

#### *Pollination and fruit setting in seed parent*

From the data presented in Table 4, the number of flowers pollinated in seed parent showed non-significant difference between both the growing conditions. Significantly higher number of fruit set (3.40) was recorded in female line in IPN than those in OFC (2.30). A highly significant difference was noted for the number of fruit set per plant (seven days after pollination) between both the growing conditions. In IPN it was 3.00, while in OFC it was only 1.80. A highly significant difference was also obtained for number of matured fruits per plant in IPN (2.90), as compared to

#### *Fruit attributes*

The data presented in Table. 7 showed highly significant difference for fruit weight and fruit length between IPN and OFC. The fruit weight was highly significant in IPN (160.50 g) than OFC (65.00 g). The fruit length was also significantly higher in IPN (17.63 cm) when compared to OFC (10.30 cm). However fruit width and fruit thickness showed non-significant difference under both the conditions, whereas the fruit width was numerically higher in IPN (4.91 cm) as compared to OFC (3.68 cm). Similarly, the flesh thickness was also numerically higher in IPN (0.88 cm) as compared to OFC (0.73 cm). The higher fruit width and fruit length under IPN may be due

**Table 6. Percentage of fruit set (Datewise i.e. from 04/04 to 30/04 in seed parent of bitter gourd cv. Pusa Hybrid-1 in insect proof net house and open field conditions in summer season**

Date	Insect proof net house		Open field	
	Flowers pollinated	% of fruit set	Flowers pollinated	% of fruit set
04/04/10	12	11 (92)	8	5 (62)
07/04/10	11	10 (91)	5	3 (60)
10/04/10	14	14 (100)	5	3 (60)
13/04/10	23	22 (96)	4	3 (75)
16/04/10	25	24 (96)	7	5 (71)
19/04/10	13	12 (92)	4	2 (50)
22/04/10	10	9 (90)	0	0 (0)
25/04/10	9	8 (89)	0	0 (0)
28/04/10	8	7 (88)	0	0 (0)
30/04/10	8	7 (88)	0	0 (0)

**Table 7. Effect of growing conditions on fruit development attributes in cross fruits of bitter gourd cv. Pusa Hybrid-1**

Characters	Insect proof net house	Open field	Level of Significance
Fruit weight (g)	160.50	65.00	**
Fruit length (cm)	17.63	10.30	**
Fruit width (cm)	4.91	3.68	NS
Flesh thickness (cm)	0.88	0.73	NS

NS non-significant, \* Significant at P= 0.05, \*\* Significant at P=0 .01

to better photosynthetic efficiency of plant in comparison to OFCs and increased quantity of chlorophyll [3, 5].

#### Incidence of pests

The data depicted in Table 5 showed significant differences in the percentage of incidence of diseases like virus and insect pests i.e., whiteflies and leaf miner. The percentage of incidence of virus was significantly negligible under IPN (0%) as compared to OFC (54.10 %). Similarly, the incidence of insects like whiteflies was significantly lower in IPN (1.90 %) than OFC (46%). The percentage incidence of leaf miner was also significantly lower in IPN (1.1) in comparison to open field (14.20).

The superior performance of growth, flowering and fruit set/plant under IPN showed that the use of IPN in bitter gourd hybrid seed production could be quite effective in reducing the incidence of virus and other insects pests like whiteflies, leaf miners etc.

Therefore, it can be concluded that for attaining better growth, flowering, fruit setting, fruit development

attributes, the hybrid seed production of bitter gourd cv. Pusa Hybrid-1 should be undertaken in IPN. The growing of seed crop under IPN can fetch higher net returns as compared to open field cultivation.

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