

Effect of growing conditions on growth, flowering behaviour and seed yield of parental lines of pumpkin (*Cucurbita moschata*) cv. Pusa hybrid-I

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ABSTRACT The present investigation on parental lines of pumpkin (*Cucurbita moschata* Dutch Exploir.) cv. Pusa hybrid-1 was carried out at CPCT farm IARI, New Delhi during summer season under insect proof net (IPN) and open field Condition (OFC). The female line (seed parent) and male line (pollen parent) were transplanted in block method following the planting ratio of 3:1 at drip fertigation in IPN and OFC. Significantly higher vine length, number of leaf node on 30 days, 45 days from transplanting (DFT) and inter nodal length were recorded in seed and pollen parent. Days to first female and male flower opening in seed and pollen parent (56 days and 63.40 days, respectively) were significantly lower under IPN. The production of female flower (30.6/ plant) and male flower (40.3/plant) were significantly higher under IPN as compared to OFC. The number of fruits set (3.6) and matured fruit (3.5/plant) were significantly higher under IPN than OFC (1.9 and 1.4, respectively). The incidence of pumpkin mosaic virus and insects were very low under IPN as compared to open field.

Key words: Insect proof net, open field, growth behaviour, fruit setting, pollen parent

Pumpkin (*Cucurbita moschata* Dutch Exploir.), indigenous to Central America and distributed across the globe, is easy to grow and a rich source of β -carotenoids and fibre. Therefore, through various preparations and cooked form, it is recommended by World Health Organization (WHO) for public sponsored mid-day meal etc. Commercial cultivation as well as hybrid seed production in North Indian conditions could not be organized successfully in kharif season due to high incidence of insect and diseases in open field. Contrary to this summer season is considered better for hybrid seed production. The plant growth and development are affected by changing environmental conditions, early onset of high temperature hampered the production of female flower, fruit set and fruit development, therefore, the present investigation.

MATERIALS AND METHODS

The experiment was conducted during summer season at Centre for Protected Cultivation Technology (CPCT) farm, Indian Agricultural Research Institute (IARI), New Delhi. The pumpkin cv. Pusa hybrid-1 was selected for the present investigation and seeds of parental lines of Pusa hybrid-1 were obtained from the Seed Production Unit, IARI New Delhi. The seedlings were raised in 1½" size conical pro-trays under controlled conditions in artificial media. The 25-days-old seedlings were transplanted under two conditions viz. insect proof net and open field. The insect proof net is made up of UV stabilized, white, 40 wire mesh insect proof nylon net, with double door facility and having dimensions 60 m x 6 m x 2 m. Drip fertigation facilities were laid in both growing conditions.

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The female and male flowers likely to open on next day were tied with coarse thread during evening (5-7 pm) day before the anthesis in female line as well as in male line. The pollination was done by hand following Vishwanath [1]. The pollinated flowers were again tied and labeled with date over the peduncle. The pollination was performed in the early morning (5-7 am) regularly up to 30 days.

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 for the induction of first lateral, days to first female flower opening in seed parent, days for the opening of first male flower in pollen parent, number of female flowers/plant in seed parent, number of male flowers/plant in pollen parent, number of flowers pollinated/plant, number of fruits set/plant, number of mature fruits/plant and incidence of diseases and insects (Virus, white fly, red pumpkin beetle, leaf miner) were recorded.

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

The data were analysed statistically for testing the heterogeneity of means adopting the 't-test' procedures. The probability was worked out at 5% ($p = 0.05$). Non-Significant t-values 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 parental lines

There were significant differences between growth of vine, number of leaf nodes, days to first female and male flower opening, production of female and male flowers, number and percentage of fruits set and fruit development attributes in parental lines among the growing conditions (Table 3).

The growth behaviour of female line showed significant differences between two growing conditions (Table 3). The vine lengths on 30 and 45 days from transplanting were significantly higher *i.e.* 28.60 cm & 245.40 cm in insect proof net and 21.00 cm & 95.30 cm under open field. The number of leaf nodes on 30 DFT was 6.00 under insect proof net and 4.90 in open field. The higher vine length and number of leaf nodes 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]. The number of leaf nodes and internodal length on 45 DFT were significantly higher in insect proof net (16.80, 13.30 cm), as compared to open field (9.80, 5.95 cm). The significantly early induction of first lateral in female line was recorded on 23 days under insect proof net as compared to open

Table 1. Mean monthly meteorological data during crop growth (February-June)

Month	Temperature (°C)			Relative humidity (%)			Total rain fall (mm)	Wind speed (Kmph)	BSS hr	Evaporation (mm)
	Max	Min	Mean	Max	Min	Mean				
February	23.8	11.6	17.7	88.3	39.3	63.8	6.5	2.2	7.6	2.4
March	31.2	14.8	23.0	78.2	29.1	53.6	3.9	1.7	7.9	5.2
April	36.6	20.1	28.4	46.4	23.4	34.9	2.0	5.2	8.9	7.8
May	38.0	24.9	25.2	55.0	37.4	46.2	43.3	4.9	11.7	9.3

field on 27.50 days. This could be due to better assimilative power of food reserve in the crop grown under insect proof net as compared to open field [3, 4]. The slightly higher temperature in insect proof net house might be compensated by the shading effect of net which was evident from data presented (Table 2). 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].

Table 2. Meteorological data during flowering period of the crop (Average on weekly basis during April month)

	Temperature (°C)			Relative humidity (%)			Light intensity (lux)
	Max	Min	Mean	Max	Min	Mean	
<i>Open field</i>							
First week	27.3	16.7	22.0	84.0	21.2	52.0	488x100
Second week	34.0	18.4	26.2	48.3	29.0	38.0	802x100
Third week	34.0	22.4	28.2	48.0	22.5	35.3	798x100
Fourth week	36.7	26.8	31.7	37.5	21.7	29.6	797x100
<i>Insect proof net house</i>							
First week	29.0	17.2	23.1	77.0	24.0	50.5	432x100
Second week	36.0	19.1	27.5	45.0	26.4	35.7	404x100
Third week	35.0	23.6	29.3	44.6	23.1	33.8	436x100
Fourth week	37.5	28.0	32.7	37.5	22.0	29.8	377x100

Table 3. Effect of growing conditions on growth behaviour of parental lines of pumpkin cv. Pusa hybrid-1 during summer season

Character	Insect proof net	Open field condition	Level of significance
<i>Female parent</i>			
Vine length on 30 DFT (cm)	28.60	21.00	**
Number of leaf nodes on 30 DFT	6.00	4.90	**
Vine length on 45 DFT (cm)	245.40	95.30	**
Number of leaf nodes on 45 DFT	16.80	9.80	**
Inter nodal length (cm)	13.30	5.95	**
Days taken for the induction of first lateral	23.00	27.50	*
<i>Male parent</i>			
Vine length on 30 DFT (cm)	27.10	15.00	**
Number of leaves on 30 DFT	5.30	3.80	**
Vine length on 45 DFT (cm)	210.40	81.50	**
Number of leaf nodes on 45 DFT	13.30	9.70	**
Inter nodal length (cm)	12.05	8.05	**
Days taken for the induction of first lateral	20.30	25.30	**

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

The growth behaviour attributes of pollen parent showed highly significant differences between two growing conditions (Table 3). The vine lengths on 30 & 45 DFT were significantly higher *i.e.* 27.10 cm & 210.40 cm in insect proof net, whereas it was 15.00 cm & 81.50 cm under open field. In insect proof net house, the number of leaf nodes on 30 & 45 DFT were also significantly higher *i.e.* 5.30 & 13.0 but under open fields it were 3.90 & 10.0, respectively. The internodal length was 12.05 cm in insect proof net house and 8.05 cm under open field conditions. In insect proof net 20 days were taken for the induction of first lateral, whereas it was 25 days in open field conditions.

Flowering behaviour of parental lines

The flowering behaviour of parental lines presented in table 4 showed highly significant differences between the two growing conditions. In insect proof net, 56 days were taken for the opening of first female flower, whereas under open field conditions, it took 63.40 days. The total number of female flowers/plant within 30 days from the appearance of first female flower was significantly higher in insect proof net (30.60) as compared to open field (5.90). The opening of first male flower took 52 days and 59 days in IPN and OFC, respectively. The total number of male flowers/plant up to 30 days from the initiation of flowering was also significantly

higher in insect proof net house (40.30) in comparison with open field conditions (25.00). Significantly higher number of female flowers may be due to favourable environment to the crop under insect proof net (Table 4). The male flower opening was 4-5 days earlier than the female flower opening in both conditions. These results were in agreement with Hossain *et al.* [7] in pumpkin.

Pollination and fruit setting in female line

It is evident from the perusal of the data presented in table 4 that number of flowers pollinated in female line showed non-significant difference between two growing conditions. Significantly higher number of fruits set (3.60) was recorded in female line in IPN than those in OFC (1.90). A highly significant difference was noted for number of matured fruits/plant in insect proof net (3.50) as compared to open field conditions (1.40).

Significantly higher number of fruits set and mature fruits under IPN could be due to the congenial environmental conditions (Tables 1 & 2) 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 higher irradiation which might have affected the fruit development and maturation [6, 9].

Table 4. Effect of growing conditions on flowering behaviour and fruit setting in parental lines of pumpkin cv. Pusa hybrid -1 during summer season

Character	Insect proof net	Open field condition	Level of significance
Days to opening of first female flower in female parent (days)	56.00	63.40	**
Number of female flowers within 30 days from first flowering (per plant)	30.60	5.90	**
Days to opening of first male flower in male parent (days)	51.80	58.70	**
Number of male flowers within 30 days from first flowering (per plant)	40.30	25.00	**
Number of flowers pollinated/plant	4.20	3.40	NS
Number of fruits set/plant	3.60	1.90	**
Number of mature fruits/plant	3.50	1.40	**

NS: Non-significant; *Significant at P= 0.05; **Significant at P=0.01

Seed yield attributes of parental lines

The data presented in table 5 showed highly significant differences for total seed, unfilled seed, filled seed, seed yield/fruit and 100-seed weight between the insect proof net and open field conditions.

Performance of female line

The significantly higher number of filled seeds (382.75) and less unfilled seeds (6.83) were recorded in IPN as compared to open field conditions. Similarly, the seed yield/fruit was significantly higher in IPN (78.98 g) than those in OFC (61.88 g). The 100-seed weight was higher in insect proof net (15.18 g) as compared to open field conditions (14.19 g).

Performance of male line

Significantly higher number of total seed (387.20) and filled seed (368.46) were recorded in insect proof net as compared to open field condition. Seed yield/fruit was significantly superior (65.03 g) in insect proof net than the open field conditions

Table 5. Effect of growing conditions on seed yield of parental lines of pumpkin cv. Pusa hybrid-1 during summer season

Character	Insect proof net	Open field condition	Level of significance
Female parent			
Total seeds/fruit	389.83	376.40	**
Unfilled seeds/fruit	6.83	16.80	**
Filled seeds/fruit	382.75	359.60	**
Seed yield/fruit (g)	78.98	61.88	**
100-seed weight (g)	15.18	14.19	*
Male parent			
Total seeds/fruit	387.20	304.35	**
Unfilled seeds/fruit	18.06	10.57	**
Filled seeds/fruit	368.46	293.98	**
Seed yield/fruit (g)	65.03	42.20	**
100-seed weight (g)	17.79	13.36	**

NS: Non-significant; *Significant at P= 0.05; **Significant at P=0 .01

(42.20 g). The 100-seed weight was also higher in insect proof net (17.79 g) as compared to open field conditions (13.36 g).

Incidence of pests

The data (Table 6) showed significant differences in incidence of viruses and insects *i.e.* white flies, red pumpkin beetle and leaf miner. The percentage of incidence of virus was significantly lower under insect proof net (1%) as compared to open field (68%). Similarly, the incidence of insect like white flies was significantly lower in insect proof net (2%) than under open field conditions (51%). The percentage of incidence of red pumpkin beetle and leaf miner were also significantly lower in insect proof net (0 & 2%, respectively) in comparison to open field (34 & 20%, respectively).

Table 6. Comparative incidence of insects and diseases in parental lines of pumpkin cv. Pusa hybrid-1 during summer season

Character	Insect proof net	Open field condition	Level of significance
Pumpkin mosaic virus (%)	1	68	**
White flies (No. of flies/leaf)	2	51	**
Red pumpkin beetle (No./plant)	0	34	**
Leaf miner (No./plant)	2	20	**

NS: Non-significant; *Significant at P=0.05; **Significant at P=0 .01

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