

Studies on Methods of Pollination for Hybrid Seed Production of Pumpkin (*Cucurbita moschata* Poir.)

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Pumpkin (*Cucurbita moschata* Poir.), is an important member of cucurbitace family and is grown extensively during *kharif* and summer season across India, for tender immature and mature fruits. Its fruits are consumed in cooked form and also used for preparation of sweets. The flowers and fruit juice has many medicinal values. India is the second largest producer of pumpkin in the world after China [1]. Pumpkin, squash and gourd are grown in India over an area of 0.36 million ha, which is highest in the world with the production of 3.50 million tones [1]. The average productivity of pumpkin, squashes and gourds is about 9.72t/ha in India, which is lower than the average world productivity of 12.7t/ha. The average productivity of pumpkin, squashes and gourd in Israel and Netherland is over 45.0t/ha, with the highest average productivity of 55.0t/ha in Netherland [1]. The higher productivity in these countries is due to the coverage of maximum area under hybrids where as OP varieties occupied major area in India. Pumpkin are being cultivated by resource poor farmers through self-saved seed. In order to enhance the productivity and make it comparable with the developed countries, the development of hybrid and supply of quality hybrid seed plays a vital role.

The field experiment was carried out during summer 2006 at Seed Production Unit farm of the Division of Seed Science and Technology. The two sets of experiments *viz.* natural pollination and hand pollination was carried out. The seed

of parental lines of Pusa hybrid-1 was obtained from the Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi. The seedlings were raised in controlled conditions (modern nursery at CPCT) and 25 days old seedlings (two leaves stage) were transplanted one seedling per hill at the spacing of 3.5m x 1m. Planting ratio of 3:1 was applied i.e. 3 female and 1 male. The twenty-eight replications were designed for natural and hand pollination method, comprises of four blocks of seven sets in each block in both the methods of pollination. In natural pollination method, the male flowers were pinched from the seed parent before the anthesis regularly with utmost care to avoid the chance selfing. The pollination is carried out by the natural pollinating agents and that are arranged in order of decreasing frequency *Apis mellifera*, *Apis dorsata*, *Apis florae*, *Trigonella irridipennis*. In hand pollination method, the male flowers in seed parent were pinched regularly before the anthesis. The female flowers likely to be opened next day, were tied with coarse thread during evening (5-7 p.m.). On the same day, the male bud in the pollen parent was also tied with coarse thread. On the next day the male buds were collected and the anthers were rubbed gently over all the three stigmatic lobes. The female flower was again tied with the thread and label was placed over the peduncle of pollinated female flower. The pollination was performed in the morning between 6-7 a.m. continuously for one month duration.

Received April 2008

Revised July 2008

Accepted December 2008

Recommended cultural practices and plant protection measures were carried out during the crop production. The observations on number of fruit set per plant, number of mature fruits per plant, seed yield per fruit, seed yield per plant, number of seed per fruit, number of filled seed per fruit, number of unfilled seed per fruit, 1000 seed weight, seed length, seed width, seed thickness, germination per cent, seedling length, seedling dry weight, vigour index I & II and EC were recorded. The laboratory observations *viz.* germination percentage [2], seed vigour indexes [3], and electric conductivity [4] were carried out at Division of Seed Science & Technology, IARI, New Delhi. The data obtained was subjected to T-test analysis at Indian Agricultural Statistical Research Institute, New Delhi.

Effect of methods of pollination on seed yield attributes

Number of mature fruit per plant was significantly higher in case of hand pollination (1.63) than the natural pollination (1.05). Higher number of fruits per plant in hand pollination is due to the abundance of pollen grains on the stigma that resulted in higher number of fruits where as the stigma could have received fewer pollen grains in natural pollination consequent upon the abort and drop of fruit number of unfilled seed per fruit (35.58) in hand pollination was lower than the natural pollination (46.91) where as the number of filled seeds per fruit (356.83) was higher in hand pollination than the natural pollination (298.41). The results are in agreement with Sundriyal *et al.*, and Tuan [5, 6]. However, the results are not in agreement with Satish Kumar [1, 8]. This could be explained in view of the limited availability of pollinators (*Apis mellifera*, *Apis dorsata* *Trigonella irridipennis* *A. florum* and others) in natural method of pollination while adequate and timely pollination resulted less number of unfilled seeds and more number of filled seeds in hand pollination. Seed yield per fruit was significantly higher (52.33 g) in hand pollination in comparison to natural pollination (44.08 g), which could have resulted by higher number of filled seed in hand pollination. Seed yield per plant is a complex attribute and influenced by number of fruits per plant, filled seed per fruit and seed yield per fruit

and seed weight. Seed yield per plant (83.66 g) was significantly higher in hand pollination than natural pollination (46.00 g). The increase in seed yield per plant in hand pollination is due to higher number of fruit per plant, filled seeds, seed yield per plant, 1000 seed weight and seed yield per fruit (Table 1). Thousand seed weight was significantly higher (148.08g) in hand pollination in comparison to natural pollination (134.90g).

Effect of methods of pollination on seed quality attributes

The germination is considered as one of the important attributes of seed quality and germination percentage was higher (96) in hand pollination than natural pollination (91). The higher germination in hand pollination could be due to the sound development of fruit and seed that might result in high germination percentage.

Seedling length, seedling dry weight and vigour attribute, was found to be higher in hand pollination. Seedling length was significantly higher in hand pollination (33.49cm) as compared to natural pollination (28.09cm) and also seedling dry weight was significantly higher in hand pollination (0.4223mg/seedling) as compared to natural pollination (0.3632mg/seedling) which could be higher due to the higher 1000/seed weight (148.08g) in hand pollination. Resultant vigour index-I (3209) and vigour index-II (40.47) was also higher in hand pollination than natural pollination.

However, no significant differences were noted for electrical conductivity, seed length (mm), seed width (mm), and seed thickness (mm) among the methods of pollination.

Effect of methods of pollination on seed quality attributes after ambient storage

The seeds were stored for one season under ambient conditions and seeds were evaluated for seed quality attributes and the results are presented in Table 3. The seeds produced from hand pollination had maintained its superiority for most of seed quality attributes. Germination percentage remained higher (94) in hand pollination than natural pollination (90). Seedling length was significantly higher in hand

Table 1. Effect of methods of pollination (hybrid seed production) on seed yield attributes in pumpkin cv. Pusa hybrid-1

Characters	Methods of hybrid seed production		(P = 0.05)
	Natural	Hand pollination	
Number of fruit set (45 days) per plant	1.78	3.27	**
Mature fruits per plant	1.05	1.63	**
Seed yield per plant (g)	46.00	83.66	**
Seed yield per fruit (g)	44.08	52.33	**
Number of filled seed per fruit	298.41	356.83	**
Number of unfilled seed per fruit	46.91	35.58	**
1000 seed weight (g)	134.90	148.08	**

Table 2. Effect of methods of pollination (hybrid seed production) on seed quality attributes in pumpkin cv. Pusa hybrid-1

Characters	Methods of hybrid seed production		(P = 0.05)
	Natural	Hand pollination	
Seed length (mm)	16.89	17.0	NS
Seed width (mm)	9.17	9.16	NS
Seed thickness (mm)	2.63	2.81	NS
Germination (%)	91	96	**
Seedling length (cm)	28.09	33.49	**
Seedling dry wt (mg)	0.3632	0.4223	**
Vigour index-I	2564	3209	**
Vigour index-II	33.08	40.47	**
EC (μ mg/seed)	57.67	58.88	NS

*Significant at 0.01 level

**Significant at 0.05

NS = Non significant

pollination (27.04cm) as compared to natural pollination (25.11cm) and also seedling dry weight was significantly higher in hand pollination (0.3605mg/seedling) as compared to natural pollination (0.3335mg/seedling). Resultant vigour index-I (2520) and vigour index-II (33.95)

was also higher in hand pollination than natural pollination. Electrical conductivity was on par between the methods of pollination. The superiority of quality attributes had indicated the sound development of seed. Thus it is concluded from this investigation that hand pollination

Table 3. Effect of methods of pollination (hybrid seed production) on seed quality attributes in pumpkin cv. Pusa hybrid-1 after 6 months of ambient storage

Characters	Methods of hybrid seed production		(P = 0.05)
	Natural pollination	Hand pollination	
Germination (%)	90	94	*
Seedling length (cm)	25.11	27.04	*
Seedling dry wt (mg)	0.3335	0.3605	*
Vigour index-I	2294	2520	**
Vigour index-II	30.14	33.95	**
EC (mmg/seed)	120.66	135.66	NS

should be employed for hybrid seed production of Pumpkin cv. PH-1 than natural pollination.

ACKNOWLEDGEMENTS

The author acknowledge Dr Rajender Prasad National Fellow of IASRI for providing necessary guidance and assisting in analysis of data.

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