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Effect of fruit retention and seed position on the seed yield and quality in pumpkin (*Cucurbita moschata*) cv Pusa Hybrid 1

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ABSTRACT

A field experiment was conducted to study the effect of fruit retention and seed position in fruit on the seed yield and seed quality in pumpkin (*Cucurbita moschata* Duch. ex Poir.) cv. Pusa Hybrid 1 during summer 2008 and 2009, Seed Production Unit, IARI, New Delhi. Among two methods of fruit retentions, one fruit per vine (T_1) showed superiority over two fruits per vine (T_2) in fruit development and seed yield attributes, viz. fruit weight (4.46 kg), fruit length (22.35 cm), fruit width (20.53 cm), cavity size, filled seeds (473.50), total number of seeds per fruit (479.42), 100 seed weight (14.67 g) and seed yield per fruit (70.44 g). Similarly, T_1 over T_2 were highly significant for germination (94.27 %), total seedling length (32.76 cm), seedling dry weight (51.01 mg), vigour index- I (3032.24), vigour index- II (4721.10) and low moisture content. Within the fruit, middle segment showed highest number of filled seed (166.40), total number of seed (175.70), germination (90.64 %), seedling length (20.94 cm),seedling dry weight (47.53 mg), vigour indices I and II (2666.44 and 3491.82),and low moisture content (8.63%). Based on this, it is proposed to retain one fruit per vine and extract seed from middle and stylar segments of fruit for high quality seed production in pumpkin cv. Pusa Hybrid 1.

Key words: Fruit retention, Pumpkin, Seed position, Seed yield, Seed quality

Pumpkin (*Cucurbita moschata* Duch. ex Poir.) is an important cucurbitaceous fruit vegetable rich in carotene (3332 IU), carbohydrates (22%), proteins (30%), oils (40-50%), minerals and vitamins (Singh 1998). In flowering plants, only a small fraction of the initial number of flowers pollinated in a given season develops into mature fruits. It is well known that most flowering plants produce more ovules than the number of seeds they produce (Stephenson 1981). Sometimes, ovules fail to become mature seeds because most of the flowers could not receive enough pollen to fertilize all of their ovules and are eventually aborted (Johnson and Nilsson 1999). Seed development and seed position are two intrinsic factors which influence the seed performance. Number of fruits on the mother plant and position of the ovules within the fruit determine the quality of seed**.** Seeds continue to develop and mature in the fleshy fruits until they got extracted from fruits (Ahmed *et al.* 1987). The quality of seeds in fleshy fruited species is further enhanced after acquisition of desiccation tolerance and maximum dry weight (Demir and Ellis 1996). Fruit development and seed maturation may occur independently, thus seed harvested at a time can be of different developmental stages (Liu *et al.* 1997).Fruit retention on mother plant has a significant effect on seed setting and seed quality. Retention of more number of fruits on mother plant resulted in high seed setting with poor seed quality and vice versa. Studies have shown that germination differs largely among seeds collected from different zones of sunflowercapitulum (Shekhargouda *et al.* 1996), umbels of carrot (Corbineau *et al.* 1995) and parsley (Thomas 1996). Seeds from the peduncular fruit segments were delayed in reaching maximum quality compared with seeds from other positions in cucumber (Jing *et al.* 2000). The effects of the fruit retention on the mother plants and seed position in fruit on seed characteristics and performance have not been studied extensively in pumpkin crop. Therefore, the present study was undertaken in pumpkin.

MATERIALS AND METHODS

The field experiment was conducted at Seed Production Unit, Indian Agricultural Research Institute (IARI), New Delhi during summer 2008 and 2009. The cultivar selected for the experiment was pumpkin cv. Pusa Hybrid 1. The seed of the parental lines were sown in soilless medium consisting of coco peat, vermiculite and perlite (3:1:1 ratio) in high tech nursery at Center for Protected Cultivation Technology (CPCT), IARI and 25 days old seedling (two true leaf stage) were transplanted at the rate of one seedling per hill in field adopting a spacing of 3.5m × 1m. The crop was well managed and protected from pests and diseases.

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The meteorological observations on temperature, relative humidity and light intensity were recorded during the entire period of crop growth. The experiment comprised two sub-experiments, viz. fruit retention and seed position. In fruit retention sub experiment, two treatments one fruit/vine (T_1) and two fruits/vine (T_2) were maintained, with only one vine per plant by pruning other vines. Thirty flowers were tagged and hand pollinated in each treatment on seed parent. The fruits were harvested at 60 days after anthesis (DAA) and observations on fruit and seed yield attributes, viz. fruit weight, fruit length, fruit width, cavity length, cavity size, filled seeds, unfilled seeds, total number of seeds per fruit, 100 seed weight, seed yield/fruit were recorded. To study the effect of seed position, ten randomly selected flowers were tagged, hand pollinated and fruits were harvested at 60 days after anthesis (DAA). The fruits were transversely cut into three segments of equal length, viz. the stylar, middle and peduncular from the tip of fruit towards the stem. The seeds with mucilage tissues were scoop out and the numbers of seeds per segment were counted. The extracted seeds were washed throughly in tap water for 10 minutes and excess water was removed by rolling seeds on a dry towel for 10 minutes. After removing excess water the seeds were dried under sun light during day time for five days. The seeds from different segments of fruits were used for testing seed quality in terms of germination, vigour indices (Vigour Index-I and II), moisture content and electrical conductivity of seed leachate in the Division of Seed Science and Technology, IARI, New Delhi as per ISTA (ISTA, 2008).The quantitative data generated in fruit retention sub experiment was analyzed statistically by adopting the independent 't-test' procedures and data obtained in seed position was analyzed following Randomized Complete Block (RCB) design using SAS 9.2.

Table 1 Effect of fruit retention on fruit development, seed yield and quality attributes in pumpkin cv. Pusa Hybrid 1

Characters	T_1 (One fruit/vine)		T_2 (Two fruits/vine)		Sig
	Mean	SE(d)	Mean	SE(d)	
Fruit weight (kg)	4.46	0.22	3.67	0.16	*
Fruit length (cm)	22.35	0.61	20.22	0.48	*
Fruit diameter(cm)	20.53	0.38	18.68	0.47	*
Cavity length (cm)	17.07	0.41	14.85	0.26	*
Cavity diameter (cm)	14.70	0.41	14.13	0.40	*
Flesh thickness (cm)	3.44	0.08	3.28	0.10	NS
Filled seeds/fruit	473.50	17.53	387.58	13.50	**
Unfilled seeds/fruit	5.92	0.99	15.92	1.88	**
Total no. of seeds/frt.	479.42	17.23	403.50	13.11	*
100 seed weight (g)	14.67	0.25	11.38	0.44	*
Seed weight/fruit (g)	70.44	2.68	45.62	2.53	**
Germination (%)	94.27 (77.18)	2.40	86.91 (70.08)	1.51	*
TSL (cm)	32.76	0.58	28.24	0.51	**
SDW (mg)	51.01	1.46	44.66	1.01	**
Vigour Index - I	3032.24	97.46	2458.64	75.94	**
Vigour Index - II	4721.10	189.70	3869.27	94.01	**
MC (%)	8.33	0.10	8.82	0.07	**
EC (μmhos/cm/g)	51.30	2.64	66.27	4.51	NS

** Significance at 1% level, * significance at 5% level; NS – Non significant, TSL–Total seedling length, SDW–Seedling dry weight, MC–Moisture content; EC-Electrical conductivity. Arc sine value in parenthesis

RESULTS AND DISCUSSION

Effect of fruit retention on seed yield attributes

The mean values for fruit weight, fruit length, fruit width, cavity length, cavity size, filled seeds, unfilled seeds and total number of seeds/fruit, 100 seed weight, seed yield/fruit have been presented in Table 1. The fruits harvested from one fruit/vine showed significantly higher mean values for fruit development characters, viz. fruit weight (4.46 kg), fruit length (22.35 cm), fruit width (20.53 cm), cavity length (17.07 cm), cavity size (14.70 cm), over the two fruits per vine. A non-significant difference for flesh thickness was recorded in one fruit per vine (3.44 cm) than in two fruits per vine (3.28 cm). The superiority in fruit traits was mainly attributed to diversion of more photosynthates towards the development of one fruit compared to two fruits per vine. This result was in conformity with the findings in cucumber (Ravikumar *et al.* 2005), and in bottle gourd (Tomar *et al.* 2005). In case of one fruit per vine (T_1) the smaller active sink facilitated accumulation of all photosynthates without having any competition for the carbohydrates, whereas in two fruits/vine (T_2), sink induced competition for food material, dividing it between the two fruits. Significant differences were also recorded for filled seeds, unfilled seeds, total number of seeds/fruit, 100 seed weight and seed yield/fruit with highest mean values in one fruit/vine (473.50, 5.92,479.42, 14.67 g and 70.44 g) over two fruits/vine (387.58, 15.92,403.50,11.38 g and 45.62 g respectively). The high values of these yield traits could be attributed to fruit developmental characters (fruit weight, length, width) and seed characters, viz. total number of filled seeds and 100 seed weight are high in big fruits. The positive influence of fruit size on seed yield and size has also been reported in pumpkin (Devdas *et al.* 1999), in ash gourd (Mini *et al.* 2000), in bitter gourd (Vanagamudi and Palaniswamy 1989) and in tomato (Palanisamy and Karivaratharaju 1990).

Effect of fruit retention on seed quality attributes

Among the seed quality characters, one fruit per vine (T_1) showed significantly higher values for germination (94.27%), seedling length(32.76 cm), seedling dry weight (51.01 mg), vigour index-I (3032.24), vigour index- II (4721.10),and lower values of moisture content (8.33%), electrical conductivity (51.30) of seed leachates than seeds extracted from two fruits per vine (Table 1). The superiority in seed performance could be correlated with seed weight that is directly related to seed size, suggesting accumulation of more dry matter in bolder seeds. Large seed size implies

Table 2 Effect of seed position on seed yield and quality attributes in pumpkin cv. Pusa Hybrid 1

Treatment	Filled seed	Unfilled seed	Total seed	100 seed weight (g)	Germination (%)	TSL (cm)	SDW (mg)	Vigour Index-I	Vigour Index - II	MC (%)	EC (µmhos/ cm/g)
S	84.00 b	3.35	87.35 b	14.00	87.67a (69.77)	26.60ab	39.75ab	2342.27ab	3491.82 b	8.63ab	45.03ab
M	166.40 a	9.30	175.70 a	13.83	90.64a (72.49)	29.42 a	47.53 a	2666.44 a	4302.86 a	8.56 b	40.86b
P	72.85 b	7.65	80.50 b	13.19	79.36 b (63.56)	25.23 b	38.29 b	2021.40 b	3038.45 b	8.89 a	50.81a
Mean	107.75	6.77	114.52	13.67	85.86 (68.58)	27.11	42.19	2344.71	3638.79	8.69	45.62
SE(d)	15.67	2.33	15.33	0.42	2.94	1.27	2.86	145.36	226.93	0.10	2.60
Tukey's HSD at 5%	40.00	NS	39.13	NS	7.83	3.38	7.62	387.04	604.28	0.28	6.95

S – Stylar segment; M – Middle segment; P – Peduncular segment. MC – Moisture content; EC – Electrical conductivity. Means with the same letter are not significantly different

large initial seedling giving the plant an early start in light interception and assimilation. This is in agreement with the performance of ash gourd (Murugesan and Vanangamudi 2005), cucumber (Jing *et al.* 2000) and winter melon (Incalcaterra and Caruso 1994).

Effect of seed position on seed yield attributes

It was evident from the pooled data presented in Table 2, among different segments within the fruit, the middle segment outperformed over stylar and peduncular portions with respect to filled seeds/fruit (166.40) and total number of seeds (175.70). The higher number of filled seeds in middle and stylar segments could be attributed to lower probability of seed abortion which is claimed to be a consequence of the gametophytic competition for the access to ovules as well as resource limitation. It is presumed that ovules located closer to the point of entry of pollen tubes will present a lower probability of abortion, while those found farther from the entry point will present a higher probability of abortion (Mohan *et al.* 1996). A non-significant difference was also noted among the three segments with regard to 100 seed weight (g) steadily decreasing from stylar to peduncular portion with highest value observed in stylar segment (14.00) and the lowest value in peduncular segment (13.19) with overall mean value of 13.67g.

Effect of seed position on seed quality attributes

There was also a variation in seed quality among different segments of fruit. The seed from middle segment showed superiority in respect of germination (90.64%), seedling length (29.42 cm), seedling dry weight (47.53 mg), vigour indices–I (2666.44), and II (4302.86). Lower values of MC and EC were recorded in middle segment (8.56% and 40.86 µmhos/cm/g) whereas it was higher in peduncular portions (8.89% and 50.81µmhos/cm/g) (Table 2). The values of middle and stylar segments differed significantly with peduncular segment with respect to all seed quality parameters butthe difference between values of middle and stylar segments was non-significant. This superiority could be attributed to ovules at stylar and middle segments are first fertilized by high vigour pollen and have a temporal advantage in competing for maternal resources. Seeds from these ovule positions exhibit higher quality, whereas seeds from peduncular positions either exhibit low quality or fail to reach maturity. The results are in conformity with the findings in ash gourd (Murugesan and Vanangamudi 2005) cucumber (Jing *et al.* 2000) and sunflower (Shekhargouda *et al.* 1996).

It is concluded that retaining one fruit per vine was more effective in producing the big size fruits in terms of fruit weight, fruit length and diameter, cavity size, flesh thickness than two fruits per vine. The seed yield and quality attributes were superior in one fruit per vine. The seed obtained from middle and stylar segments of fruit were superior in quality than peduncular portion. Hence, it is proposed to retain single fruit on mother plant and extract seed from middle and stylar segments to obtain best quality seed.

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