



Seed yield and quality attributes in bottle gourd (*Lagenaria siceraria*) as influenced by position of seed in fruit

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ABSTRACT

An experiment was conducted at the research field of Seed Production Unit, IARI during *kharif* 2014-15 to find out the effect of seed position in fruit on the seed yield and quality in bottle gourd (*Lagenaria siceraria* Mol. Standl.) cv. Pusa Naveen and laboratory observations were carried out at Division of Seed Science and Technology, IARI, New Delhi for seed quality attributes. The results revealed that among the three segments of fruit, viz. stylar, middle and peduncular, the seed extracted from the middle segment of fruit significantly contributed to total number of seed (333.76), filled seed (294.65), seed weight (47.22 g), embryo weight (8.56 mg), germination (95.10%), seedling length (43.24 cm), seedling dry weight (6.98 mg), vigour index I and II (4118.90 and 66.48) followed by stylar segment (251.01, 215.78, 34.13 g, 7.51 mg, 89.6%, 37.81 cm, 5.65 mg, 3397.9 and 50.79 respectively) and lowest values (169.93, 133.28, 20.58 g, 7.15 mg, 83.1%, 30.45 cm, 5.16 mg, 2536.1 and 42.97 respectively) were recorded for peduncular portion. A non-significant difference was noted among the three segments with regard to unfilled seed and 100 seed weight but highest value observed in middle portion. Thus, the seed obtained from middle and stylar segments of fruit were superior in quality than peduncular portion for obtaining high quantity of quality seeds.

Key words: Middle segment, Peduncular segment, Seed quality, Seed yield, Stylar segment, Vigour index

India is the second largest producer of vegetables in the world after China with 168.3 mt production (NHB 2015-16). However, its vegetable production is much less than the requirement if balanced diet is provided to every individual. The average productivity of vegetable crops in India is 17.64 tonnes/ha which is comparatively lower than the average productivity of China with 23.34 tonnes/ha (NHB 2015-16, FAO 2014-15). The low productivity of vegetable crops is attributed to open cultivation, limited efforts for development and availability of high yielding varieties/hybrids, quality seeds *etc.* Among the major Cucurbit vegetable crops, bottle gourd [*Lagenaria siceraria* (Mol. Standl.)] has wide adaption and suitable for growing in both *kharif* and summer season. Considering its commercial and medicinal value, there is a need to enhance the productivity of this crop through enhanced use of quality seed for cultivation.

Successful seed performance is a crucial component in the ecology and advancement of plant life as well as in modern agriculture. Among various external and internal

factors, seed development and seed position are the two intrinsic factors that determine seed performance. In many cereals and legumes, seed quality peaks at physiological maturity and declines later (Ellis and Pieta Filho 1992). In disparity, the quality of seeds in fleshy fruited species is further enhanced behind acquisition of desiccation tolerance and maximum dry weight (Demir and Ellis 1992). Fruit development and seed maturation may take place independently. Thus, seeds harvested at the same time can be at different developmental stages. The position of a seed is determined by the position of the ovules within the fruit and fruit positions on the mother plant. In flowering plants, only a small fraction of the initial number of flowers pollinated in a given season develops into mature fruits. Most flowering plants produce more ovules than the number of seeds they produce (Stephenson 1981). Occasionally, ovules fail to become mature seeds because the majority of the flowers could not obtain sufficient pollen to fertilize all of their ovules and are eventually aborted (Johnson and Nilsson 1999). Studies have revealed that germination differs largely among seeds collected from different zones of sunflower capitulum (Shekhargouda *et al.* 1996), umbels of carrot (Muhammad *et al.* 2001) and parsley (Thomas 1996). Based on studies in species with a linear arrangement of ovules inside the ovary such as legumes and cucurbits, seed position effects may involve male gametophytic selection

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(Stephenson 1992) and competition for maternal resources (Rocha and Stephens 1991). Ovules at specific positions are fertilized first 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 deprived positions either exhibit low quality or fail to reach maturity. Recent studies in other species also favour these concepts (Rigney 1995, Delph *et al.* 1998, Susko *et al.* 1999). Demir and Ellis (1992) illustrated that tomato seeds at high positions on plants exhibit accelerated development and higher quality. In cucurbit crops, viz. ash gourd, cucumber (Jing *et al.* 2000) and pumpkin (Vinod *et al.* 2015) quite elaborate experiments were carried out on effect of position of seed on seed quality; such studies are scanty in bottle gourd especially for the latest varieties of public sector which are predominantly cultivated in Delhi, Haryana, Uttar Pradesh, Punjab, Maharashtra and Madhya Pradesh. This study results are expected to provide valuable additional information for quality seed production in bottle gourd.

MATERIALS AND METHODS

The field experiment was conducted at Seed Production Unit, Indian Agricultural Research Institute (IARI), New Delhi during *kharif* 2014-15. Characteristics of cultivar Pusa Naveen, chosen for the experiment, are provided in Table 1. The furrows were opened by middle buster at the spacing of 2.5 m in well prepared field. The channels were finally prepared by removing the excess soil and pressed both the sides manually. The seeds were soaked overnight in bavistin (methyl benzimidazol-2-ylcarbamate) solution @ 2 g per kg of seeds and shade dried for two hours. The treated seeds were dibbled @ two seeds per hill by hand at the spacing of 0.50 m. The plants were thinned out 20 days after sowing by keeping single healthy seedling per

hill. In the each furrow, eight feet length bamboo poles (1.5 inch diameter) were fixed in the soil at 12 feet distance and two poles were connected with 12 feet long bamboo with pole and supported with other bamboos in one side to form right triangle. On the poles, at a height of one meter onwards, five to seven rows of flat white plastic rope were tied. The vines were loosely tied with jute thread and trailed over a criss-cross network of plastic ropes. The crop was managed soundly and protected from pests and diseases. The meteorological observations on temperature, relative humidity and light intensity were recorded during the whole period of crop growth.

To study the consequence of seed position, ten arbitrarily selected vines were tagged in each furrow 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 carefully in tap water for 10 min and surplus water was removed by rolling seeds on a dry towel for 10 min. 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 yield attributes, viz. filled seeds, unfilled seeds, total number of seeds per fruit, 100 seed weight, seed yield/fruit, seed coat weight, embryo weight and seed quality attributes in terms of germination percentage, seedling length, seedling dry weight, vigour indices (Vigour Index-I and II), 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 experiment was analyzed statistically by adopting the independent 't-test' procedures.

RESULTS AND DISCUSSION

Consequence of seed position on seed yield attributes

Seed position in fruit of bottle gourd showed a significant influence on seed yield attributes (Table 2). Among different segments within the fruit, the middle segment outperformed over stylar and peduncular portions with respect to filled seeds/fruit (294.65), total number of seeds (333.76) and total seed weight (47.22 g). The higher number of filled seeds in middle and stylar segments could be attributed to lower chance of seed abortion which is claimed to be an effect of the gametophytic competition for the access to ovules as well as resource inadequacy. It is alleged that ovules positioned 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 and Vinod *et al.* 2015). A non-significant difference was also noted among the three segments with regard to unfilled seeds, 100 seed weight and seed coat weight. Test weight gradually decreased from stylar to peduncular portion with highest value observed in stylar segment (15.9 g) and the

Table 1 Varietal characteristics of bottle gourd cv. Pusa Naveen

Characters	Descriptions
Plant growth habit	Medium viny (3.5-5.5 m)
Stem shape	Angular
Leaf shape	Cordate
Fruit skin colour	Dark green
Fruit shape in longitudinal section	Cylindrical
Fruit Length	Long (> 45 cm)
Fruit Diameter	Medium (8-12 cm)
Fruit neck	Uncrooked
Fruit pubescence	Present
Fruit shape of base at blossom end	Semi blunt
Fruit shape of apical peduncle end	Flat
Fruit gelatinous flesh	Absent
Seed texture at marketable stage	Medium
Seed length	Medium (1-1.5 cm)
Seed shape	Rectangular

Table 2 Influence of seed position on seed yield attributes in bottle gourd cv. Pusa Naveen

Treatment	Total seed	Filled seed	Unfilled seed	100 seed weight (g)	Total seed weight (g)	Seed coat weight (mg)	Embryo weight (mg)
Stylar segment	251.01b	215.78b	35.26a	15.9a	34.13ab	8.26a	7.51ab
Middle segment	333.76a	294.65a	44.09a	15.7a	47.22a	8.12a	8.56a
Peduncular segment	169.93c	133.28c	36.64a	15.3a	20.58c	7.75a	7.15b
Mean	251.5	214.5	38.6	15.63	33.98	8.05	7.74
SE(d)	25.04	24.34	1.84	0.49	4.45	0.21	0.26
Tukey's HSD at 5%	71.28	61.53	NS	NS	19.45	NS	1.37

HSD (5%), TUKEY's Honest Significant Difference and NS, Non significant

Table 3 Influence of seed position on seed quality attributes in bottle gourd cv. Pusa Naveen

Treatment	Germination (%)	TSL (cm)	SDW (mg)	Vigour Index-I	Vigour Index-II	EC (mhos/cm/g)
Stylar segment	89.60a	37.81ab	5.65ab	3397.9ab	50.79ab	97.54ab
Middle segment	95.10a	43.24a	6.98a	4118.9a	66.48a	85.94b
Peduncular segment	83.10b	30.45c	5.16b	2536.1b	42.97b	115.37a
Mean	89.31	37.17	5.93	3350.97	53.41	99.61
SE(d)	1.87	2.20	0.32	263.21	3.92	5.32
Tukey's HSD at 5%	6.10	10.35	1.43	1129.90	16.09	27.56

HSD (5%) - TUKEY's Honest Significant Difference, NS - Non significant, TSL-Total seedling length, SDW-Seedling dry weight, EC-Electrical conductivity

lowest value in peduncular segment (15.3 g) with overall mean value of 15.63 g. Embryo weight also showed a significant difference among the segments of fruit with significantly higher embryo weight in middle segment (8.56 mg) followed by stylar (7.51 mg) and peduncular segment (7.15 mg). Sound development of fruit and seed resulted in more food reserve in embryo (8.56 mg) and less seed coat weight (8.12 mg) in middle segment of fruit.

Consequence of seed position on seed quality attributes

Seed position in fruit of bottle gourd also showed significant influence on seed quality parameters like germination, seedling length, seedling dry weight and vigour index (Table 3). The seed from middle segment showed superiority in respect of germination (95.10%), seedling length (43.24 cm), seedling dry weight (6.98 mg), vigour indices-I (4118.90), and II (66.48). Lower value of EC was recorded in middle segment (85.94 μ mhos/cm/g) whereas it was higher in peduncular portion (115.37 μ mhos/cm/g). The values of middle and stylar segments differed significantly with peduncular segment with respect to all seed quality parameters but the difference between values of middle and stylar segments was non-significant. This superiority could be attributed to the fact that ovules at stylar and middle segments are fertilized first 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 were in conformity with the findings in ash gourd (Murugesan and Vanangamudi 2005), cucumber (Jing *et al.* 2000), sunflower

(Shekhargouda *et al.* 1996) and pumpkin (Vinod *et al.* 2015).

It is concluded that seed obtained from middle and stylar segments of fruit were superior in both quantity and quality than peduncular portion for producing the good quality fruits in terms of fruit weight, fruit length and diameter, cavity size, flesh thickness. Hence, it is proposed to extract seed from middle and stylar segments to obtain best quality seed in high quantity.

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