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Influence of vertical trailing on seed yield and quality during seed production of bottlegourd (*Legenaria siceraria*) cv. Pusa hybrid-3

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ABSTRACT The present experiment was carried out at Seed Production Unit, IARI, New Delhi, during *kharif* 2009-10 and 2010-11 with two growing systems *viz.* trailing and traditional method, whereas laboratory tests were conducted at Division of Seed Science and Technology, IARI New Delhi. The seed and pollen parent were grown following block method in 3:1 ratio. Significantly higher vine length and number of nodes per vine at flowering period was recorded in trailing as compared to traditional method. The number of fruit set (6.65) and matured fruit per vine (5.30) were significantly higher in trailing than those of traditional method. The fruit development attributes *i.e.* fruit weight, fruit length and fruit width was also significantly higher in trailing as compared to traditional method. The comparative results of seed yield attributes showed that the number of filled seeds/fruit (584.7), seed yield/vine (517.5 g) and seed yield/acre (689.6 kg) were significantly higher in trailing. The seed quality attributes *viz.* germination percentage, seedling length, seedling dry weight, vigour index I & II and seed moisture content, immediately after harvest were also significantly superior in trailing method. The cost-benefit analysis of hybrid seed production showed higher BC ratio in trailing (3.87) than those in traditional method (2.10).

Key words: Trailing, traditional, seed yield, seed quality, 100-seed weight, seed moisture, germination%, seedling dry weight and seedling vigour index

Bottlegourd *(Lagenaria siceraria* (Molina) Standl.) is one of the most important species amongst the gourds which are cultivated in India. The vegetable occupies about 7.98 million ha with a total production of 133.73 million tonnes. The average yield is only 16.7 MT per hectare NHB [7], which is very low as compared to those in other tropical countries. This low productivity is primarily due to lack of high yielding varieties/hybrid or poor seed production management practices.

The traditional method of planting of bottlegourd involves creating small hills that give the vines plenty of room to grow which is critical for a crop that possesses heavy foliage which tends to restrict light penetration to lower leaves and thus reduces the photosynthetic efficiency of the crop. The dense vining canopy also hampers proper air circulation and enhances high humidity that can promote the occurrence and spread disease. Traditional method of hybrid seed production involves more physical work, in bagging of flowers and pollination thus it enhances the cost of production and reduces the efficiency of labours. Moreover, it occupies a lot of space due to which farmers hesitate to take up seed production.

As vining plants, bottlegourd grows best with support, which keeps them off the ground and encourages straight fruit growth. To grow on a stake, train a primary runner or main shoot to the stake and tie at 12-14 inch intervals with wire mesh/plastic rope arch. Since trailing allows vertical growth instead of sprawling all over the

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seed production plot not only keeps the produce off the ground, it also allows to grow more plants in a smaller area.

There is a scope for the improvement of seed yield and quality of the bottlegourd cv. Pusa hybrid-3 by adopting some seed production technologies. Therefore, the present study was undertaken to compare the growing methods for bottlegourd hybrid seed production.

MATERIALS AND METHODS

The present investigation was conducted during *kharif* 2009-10 and 2010-11 at Seed Production Unit, Indian Agricultural Research Institute (IARI), New Delhi. The seeds of parental lines of the hybrid Pusa hybrid-3 were obtained from the Division of Vegetable Science, IARI, New Delhi.

The plants of seed parents were trailed vertically and the main vine of the plant was tied with support of bamboo. Plastic rope was used to connect one support to another for trailing of lateral stems. The plants were spaced at 60 cm apart in a row length of 60 m, whereas in the traditional method, the plants were allowed to creep on the ground with same plant spacing.

Thirty plants were randomly selected in trailing and traditional method for recording the observations *viz.* vine length (m), number of nodes, number of primary and secondary branches, days to first female flowering, fruit set, fruit development until maturity, fruit length (cm), fruit weight (kg), fruit width (cm), 100-seed weight (g), number of seeds/fruit, seed yield/fruit (g) and seed yield/acre (kg). Similarly, the laboratory tests were carried out at Division of Seed Science and Technology, IARI, New Delhi which included germination (%), moisture content (%), seedling length (cm), seedling dry weight (mg), vigour index-I, vigour index-II and seed health test. The seed health test was carried out using standard blotter method as per the ISTA rules [4].

The quantitative data generated were analyzed statistically by using SAS 9.2 for testing the heterogeneity of means by adopting the independent 't'-test. The probability was worked out at 5% and 1% ($p = 0.05$ and $p = 0.01$).

RESULTS AND DISCUSSION

Growth characters

The results of pooled data presented in table 1 showed the significant difference for vine length among the two growing methods, *viz.* trailing and traditional methods. The maximum vine length was observed in trailing (4.96 m) and minimum vine length in traditional method (4.17 m). The number of nodes/vine and number of fruits set/vine was significantly higher in trailing method 47.03 and 6.65, respectively. There was a non-significant difference for primary branch was recorded for both the year and on pooled basis. A highly significant difference was noticed between the systems for the fruit development until maturity, with 5.30 in trailing than those to traditional method. An increase in growth parameters could be attributed to the better distribution of leaf canopy which might have resulted in increased photosynthetic activity and assimilation of carbohydrates for increased plant growth [11]. These results were in conformity with the findings in spongegourd and ridgegourd [3, 9, 10].

Seed yield contributing characters

The pooled data presented in table 2 showed significant differences in 100-seed weight in both the growing methods. Higher 100-seed weight (16.81 g) was recorded in trailing method and lower value (14.14 g) was recorded in traditional method. The fruit development attributes *viz.* fruit weight, length and width, showed significant difference with 2.27 kg, 48.35 cm and 9.72 cm, respectively in trailing, whereas 1.49 kg, 40.87 cm and 8.85 cm were recorded in traditional method. The increased fruit attributes in trailing may be due to the diversion of more dry matter from source (leaf) to these components as reported by Yadav *et al.* [11]. The significant difference also found in different growing conditions for number of seeds/fruit and seed yield/fruit was lower in traditional method (424.3 and 59.78 g) as compared to trailing method (584.7 and 98.14 g). The seed yield per vine and seed yield per acre was significantly higher in trailing method (517.5 g and 6.89 q/acre) than traditional method (137.0 g and 2.28 q/acre). The significantly higher seed yield/

Table 1. Effect of trailing and traditional methods on the growth parameters in bottlegourd cv. Pusa hybrid-3

Character	*Kharif* 2009-10					*Kharif* 2010-11					Pooled				
	Trailing method		Traditional method		Sig.	Trailing method		Traditional method		Sig.	Trailing method		Traditional method		Sig.
	Mean	S.E. (±)	Mean	S.E. (±)		Mean	S.E. (±)	Mean	S.E. (±)		Mean	S.E. (±)	Mean	S.E. (±)	
Vine length (m)	4.94	0.026	3.90	0.027	**	4.98	0.079	4.45	0.086	**	4.96	0.042	4.17	0.046	**
Number of nodes	47.00	0.812	41.37	0.767	**	47.07	0.986	42.13	0.871	**	47.03	0.738	41.75	0.675	**
No. of primary branch	4.70	0.167	4.17	0.144	NS	4.60	0.26	4.23	0.201	NS	4.65	0.196	4.20	0.161	NS
No. of secondary branch	4.83	0.225	3.70	0.152	*	4.20	0.308	3.70	0.209	NS	4.51	0.230	3.70	0.143	**
Days to first female flowering	49.83	0.386	50.63	0.216	NS	51.37	0.242	54.67	0.551	NS	50.60	0.213	52.65	0.305	NS
No. of fruits set	6.17	0.159	3.37	0.169	**	7.13	0.302	6.03	0.176	**	6.65	0.159	4.70	0.132	**
No. of fruits develop to maturity	5.03	0.122	1.90	0.12	**	5.57	0.228	2.83	0.127	**	5.30	0.125	2.36	0.089	**

Table 2. Effect of trailing and traditional methods on the fruit and seed yield parameters in bottlegourd cv. Pusa hybrid-3

Character	*Kharif* 2009-10					*Kharif* 2010-11					Pooled				
	Trailing method		Traditional method		Sig.	Trailing method		Traditional method		Sig.	Trailing method		Traditional method		Sig.
	Mean	S.E. (±)	Mean	S.E. (±)		Mean	S.E. (±)	Mean	S.E. (±)		Mean	S.E. (±)	Mean	S.E. (±)	
Fruit weight (kg)	2.31	0.073	1.88	0.075	**	2.25	0.093	1.11	0.053	**	2.27	0.061	1.49	0.045	**
Fruit length (cm)	49.51	0.363	42.88	0.715	**	47.20	0.832	38.87	0.760	**	48.35	0.484	40.87	0.498	**
Fruit width (cm)	9.95	0.117	9.00	0.222	**	9.49	0.146	8.12	0.156	**	9.72	0.096	8.55	0.139	**
100-seed weight (g)	16.49	0.249	15.04	0.368	**	17.12	0.293	13.23	0.300	**	16.81	0.175	14.14	0.223	**
No. of seeds/fruit	616.8	28.013	481.5	23.53	**	552.5	37.357	367.2	31.362	**	584.7	20.126	424.3	19.651	**
Seed yield/fruit (g)	101.30	4.516	71.91	3.654	**	95.01	7.159	47.65	3.903	**	98.14	3.813	59.78	2.714	**
Seed yield/vine (g)	512.10	27.842	135.60	10.682	**	522.81	41.831	138.30	14.961	**	517.50	17.894	137.00	9.916	**
Seed yield/acre (kg)	2133.50	116.00	565.2	44.51	**	2178	174.3	576.20	62.34	**	689.60	31.28	228.2	19.32	**

fruit, seed yield/vine and seed yield/acre in trailing method as compared to traditional method, might be due to increased growth components of the plant, such as increased number of branches, fruit set, fruit weight/vine and number of filled seeds/fruit. The vertical training has been reported by Konsler and Strides [5] to improve the yield and quality of cucumber and to aid in the control of its foliar and fruit diseases. Improved photosynthetic efficiency has been cited as one of the possible reasons for increased yield [2]. An increase in the total dry matter accumulation in the plant might have been diverted towards the development of seed yield components, thereby resulting in higher seed yield/acre. These results were in agreement with the reports of Mangal *et al.* [6] in tomato and Patil *et al.* [8] in tomato, who have recorded higher fruit and seed yield with increase in the yield components.

Seed quality attributes

The pooled data on seed quality as influenced by growing methods are presented in table 3. The germination percentage was significantly higher in trailing method (96.85%) than those of traditional method (92.11%). Seedling length was also significantly higher in trailing method (34.17 cm) when compared to traditional method (28.33 cm). Similarly, a significant difference was recorded in seedling dry weight, between both the methods, which was higher in trailing method (0.417 g) than traditional method (0.348 g). Seed moisture content was also significantly lower in trailing method (8.87%) as compared to traditional method (9.30%). A highly significant difference was noted in seed vigour index I, it was superior in trailing method (3313.9) as compared to traditional method (2611.5). Similarly, seed vigour index II recorded significantly higher under trailing method (40.45) than in traditional method (32.12). The higher germination and other seed quality parameters in trailing method may be due to the better development of fruit which in turn resulted in better development of seed. These results were in agreement with the reports of Hilli *et al.* [3] in ridgegourd.

Table 3. Effect of trailing and traditional methods on the seed quality parameters in bottle gourd cv. Pusa hybrid-3

Character	*Kharif* 2009-10			*Kharif* 2010-11			Pooled		
	Trailing method		Traditional method	Trailing method		Traditional method	Trailing method		Traditional method	Sig.
	Mean	S.E. (±)	Mean	Mean	S.E. (±)	Mean	Mean	S.E. (±)	Mean	S.E. (±)	
Germination (%)	96.43	0.265	91.03	0.607	**	97.26	0.625	93.2	1.351	**	96.85	0.363	92.11	0.784	**
Seedling length (cm)	34.09	0.427	30.00	0.49	**	34.25	0.733	26.65	0.65	**	34.17	0.394	28.33	0.378	**
Seedling dry weight (g)	0.401	0.0074	0.365	0.01	**	0.433	0.006	0.33	16.959	**	0.417	0.004	0.348	0.006	**
Vigour index I	3288.1	41.67	2735.2	54.75	**	3339.5	84.268	2487.7	76.27	**	3313.9	46.521	2611.5	44.03	**
Vigour index II	38.71	0.718	33.38	1.073	**	42.19	0.777	30.85	1.098	**	40.45	0.539	32.12	0.694	**
Moisture content (%)	8.49	0.026	8.81	2.448	**	9.26	0.0618	9.79	0.12	**	8.87	0.034	9.3	0.066	**

Seed health attributes

Seed health is a major consideration in seed production programme next to vigour and viability of seeds. The bottlegourd is affected by several fungi, many of which are seed-borne or soil borne. The trailing method recorded lower fungal incidence than those in traditional method (Table 4).

The seeds extracted from traditional method showed higher per cent of fungal incidence *i.e.* 87.29%, out of which 28.42% was *Aspergillus flavus*, followed by *Altenaria alternata* with 19.23%, *Macrophomina phaseolina* with 16.45%, *Fusarium moniliforme* with 16.28% and *Trichoderma* sp. 6.89%. However, in trailing method, fungal incidence per cent was 44.62%, out of which 12.96% was *Aspergillus flavus*, followed by *Altenaria alternata* (9.58%), *Macrophomina phaseolina* (8.65%), *Fusarium moniliforme* (8.45%) and *Trichoderma* sp. (4.98%). Similar results had been reported by Booth [1] on seed rot, seedling blight and wilt in a number of cucurbitaceous crops.

Economics of hybrid seed production

The economic analysis of hybrid seed production in bottlegourd showed that the hybrid seed production as vertical trailing was more profitable than traditional method (Figs. 1 & 2). The total cost of hybrid seed production under trailing and traditional method were Rs. 3, 20,525.00 and Rs. 1,95,375.00, respectively and the corresponding gross incomes were Rs. 9,45,932.00 and Rs. 2,39,529.0, respectively. The estimated net returns in trailing and traditional method were Rs. 9, 20,935.00 and Rs. 2, 15,529.00. In trailing method BC ratio was 3.87 and in traditional method BC ratio was 2.10. The results inferred that trailing received the highest gross return and net return compared to traditional method.

Table 4. Comparative occurrences of various fungi in seeds produced in trailing and traditional methods in bottlegourd cv. Pusa hybrid-3

Name of fungus	Trailing (%)	Traditional (%)
Altenaria alternata	9.58	19.23
Aspergillus flavus	12.96	28.42
Fusarium moniliforme	8.45	16.28
Trichoderma sp.	4.98	6.89
Macrophomina phaseolina	8.65	16.45

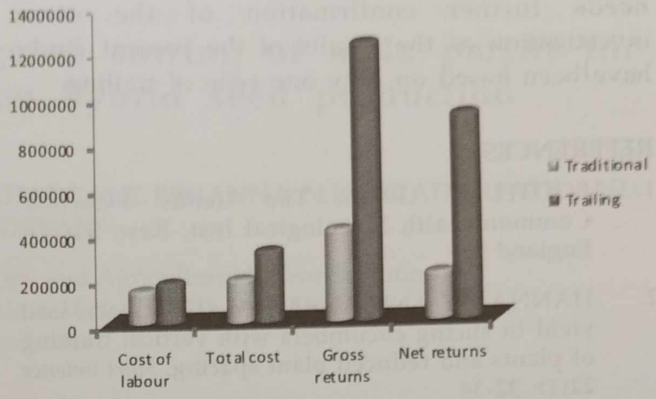

Fig. 1. Economic analysis of trailing and traditional methods in hybrid seed production of bottlegourd cv. Pusa hybrid-3

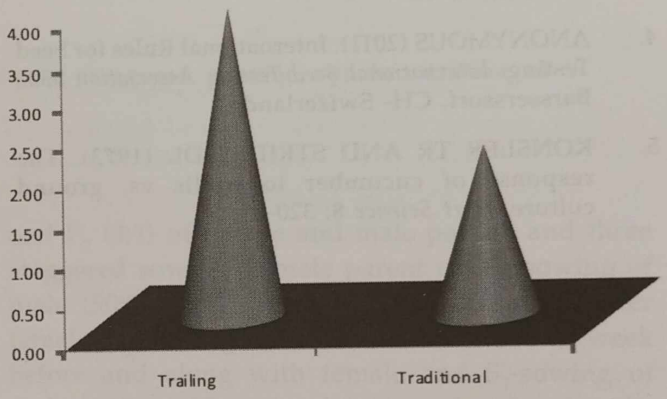

Fig. 2. Benefit ratio of trailing and traditional methods in hybrid seed production of bottlegourd cv. Pusa hybrid-3

CONCLUSION

Among the two methods, the trailing method proved as the best method due to its production of longest fruit, fruit weight, fruit width, number of fruits/plant and ultimately the highest yield. Therefore hybrid seed production of bottlegourd cv. Pusa hybrid-3 organized in trailing method can be advised for obtaining maximum seed yield, better seed quality, higher economic returns and minimum diseases during *kharif*, under Delhi conditions. It

needs further confirmation of the same investigation as the results of the present study have been based on only one type of trailing.

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