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Optimisation of Planting Ratio for Hybrid Seed Production in Sponge Gourd

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ABSTRACT: The success of hybrids depends on the availability of quality seeds, which calls for standardization of hybrid seed production technology. ICAR-Indian Agricultural Research Institute, New Delhi released a promising sponge gourd hybrid Pusa Shreshta for commercial cultivation. The present study was carried out the planting ratio to optimize the seed production of this hybrid. The parental lines; DSG-43 (female parent) and DSG-31 (male parent) were sown in planting ratios of 3:1(F:M), 4:1(F:M), and 5:1(F:M) in isolation at IARI-Regional station, Karnal in *Kharif* 2020 and Spring-Summer 2021. The results showed that the planting ratios had no significant effect on vegetative growth and the flowering behaviour of the parental lines (node number and days to induction of first male and female flower appearance in the vine). However, significant differences were observed for fruit yield, seed yield and quality traits among the planting ratios. In *Kharif* season, the crop had better vegetative growth, flowering, fruit and seed yield than in the spring-summer season but the seed quality was better in the produce of the latter. Among the planting ratios, 3:1 recorded highest number of fruits/vine, fruit and seed yield/ plot and seed quality. The study concluded that a planting ratio of 3:1(female: male) was optimum for hybrid seed production of sponge gourd hybrid Pusa Shreshta in *Kharif* season under North Indian conditions.

Keywords: Sponge gourd, hybrid, seed production, planting ratio, seasons

INTRODUCTION

Sponge gourd (*Luffa cylindrical* L.) is an important cucurbitaceous vegetable crop of India. Hybrids have gained importance because of better fruit yield, their uniform fruit shape and size, resistance to pest and diseases, and quality. Sponge gourd crop is monoecious in nature and hybrid seed production is undertaken either by manual hand pollination or by pinching the staminate flowers manually in seed parent and facilitating insect pollination under open field conditions. The occurrence of gynoecism in sponge gourd is low but researchers have developed predominantly gynoecious (high female flowers/vine) and exclusively gynoecious lines (only female flowers in the vine) and utilized them for hybrid development [1]. But the gynoecious lines are sensitive to environment and require stage specific application of growth regulators for their maintenance. Thus, monoecious hybrids, in which the parental lines are monoecious, are preferred for hybrid seed production. ICAR-Indian Agricultural Research Institute, New Delhi has developed and released its first sponge gourd hybrid; *Pusa Shreshta* in 2019 for commercial cultivation. The success of hybrid depends on availability of quality seeds, which calls for standardization of hybrid seed production technology. The present study was undertaken for optimization of the planting ratio for hybrid seed production of *Pusa Shreshta* under open field conditions.

MATERIALS AND METHODS

The parental line seeds of DSG-43 (female parent) and DSG-31 (male parent) were sown in planting ratios of 3:1(F:M), 4:1(F:M), and 5:1(F:M) at different isolations (1000 m apart) at IARI-Regional station, Karnal in *Kharif* 2020 and Spring-Summer 2021. The plot size for each planting ratio was 12 x 4 m^2. The staminate flowers were pinched off from the female parent daily before anthesis to prevent self-pollination and allowed for cross pollination by insect pollinators. The data was recorded on vine length and number of branches/ vine after cessation of flowering in five tagged vines in each plot. The number of days to appearance of first male and female flowers were recorded on tagged plants and average was calculated. The total number of fruits/vine was counted in each planting ratio. The seed yield per plot was

calculated after extraction of seeds from all the hybrid fruits produced in each plot. The total number of seeds per fruit was recorded by counting the number of seeds extracted from each fruit. The germination test was conducted as per ISTA [2], following the between paper method on 200 seeds (50 seeds x 4 replications). The seeds were placed between two layers of moist germination paper, rolled and wrapped in a sheet of wax paper to reduce surface evaporation, and placed upright in a germinator at 25°C and 100 percent RH for 14 days. Normal seedlings were counted on the 14th day (final count) and expressed in percentage. At the end of the 14th day, ten normal seedlings were randomly picked from each replication and their seedling length (shoot tip to end of root) was measured and expressed in centimeters. The seedlings were dried in a hot air oven (100°C for 24 hours) and weighed for seedling dry weight and expressed in grams. The seedling vigour was estimated as per Abdul Baki and Anderson [3].

SVI-I = Germination%× Seedling length (cm)

SVI-II = Germination%× Seedling dry weight (g)

Statistical analysis

The experimental data were analyzed statistically for heterogeneity of means, adopting two factor analysis with SPSS programme for randomized block design for field parameters and completely randomized design for laboratory parameters. The percentage values were Arc sine transformed before analysis. The field parameters were analyzed for three replications. The probability was recorded at 5 % level of significance ($p<0.05$).

RESULTS AND DISCUSSION

Vegetative growth

The results of the study showed that the planting ratios had no significant effect on vegetative growth i.e. the vine length and number of branches/vine of the parental line. Among the growing seasons, vegetative growth was better in *kharif* than spring summer season. The vine length ranged from 366.7-370.3 cm and 345.53-351.0 cm respectively in *kharif* and spring-summer season in different ratios. The number of primary branches of the vine was also significantly higher in the *kharif* season; which ranged from 7.27-7.32 in different ratios. In spring-summer season; the number of primary branches ranged from 5.13-5.18 in different planting ratios. The temperature and relative humidity (RH) played important role in early vegetative growth of sponge gourd. In *kharif* season congenial weather conditions i.e. milder temperature (20.2-32.8°C), higher RH (52.1-85%) and rain spells favoured better vegetative growth of the vine. However, in spring summer season, high temperature (19.7 -37.1°C) with lower RH (40.3-73.2%) restricted the vegetative growth and reduced the crop duration (shorter vine length and lesser branches per vine). Results of the study were in conformity with the findings of Kaddi *et al.,* in cucumber [4] and Nagamani *et al.,* in bitter gourd [5] that the vine length and the number of leaf nodes were significantly greater in the *kharif* season than in the summer season.

Flowering behaviour

The results showed that the flowering in vine initiated 8-10 days earlier in *kharif* season than spring-summer whereas the staminate flowers appeared 1-2 days earlier than pistillate ones in a vine in both the seasons. In the seed production plots, the male flowers appeared in 37.57 days and in 47 days after sowing in spring -summer season whereas the female flowers appeared in 37.17 days and 48.43 days after sowing in *kharif* and spring-summer season, respectively (Table 1). The results showed that the flowering behavior (days to first flower induction) in the parental lines was not influenced by planting ratios. These findings are in agreement with Nagamani in bitter gourd [5]. The number of staminate and pistillate flowers were significantly higher in the *kharif* season than the spring-summer season in all the planting ratios which could be attributed to better vegetative growth and longer durations of crop in *kharif* season.

Fruit and seed yield

The number of fruits per vine was significantly higher in the *Kharif* season as compared to the spring-summer season. The fruit yield was significantly higher in 3:1 planting ratio (3.4/vine) as compared to 4:1 (3.2/vine) and 5:1 ratio (3.1/vine), which were at par during *kharif* season and were 3.3, 2.9 and 2.6 fruits/vine respectively in 3:1, 4:1 and 5:1 in spring- summer season (Table 1). A higher fruit weight was obtained in 4:1 planting ratio (88.75 g) as compared to 3:1 (85.75 g) and 5:1 (83.7) during *kharif* season and 73.75 g, 80.00 g, and 83.00 g, respectively in 5:1, 4:1 and 3:1 in spring-summer season (Table 1)**.** The higher fruit yield in 3:1 ratio could be attributed to the sufficient pollen load, and higher pollinator activity than in 4:1 and 5:1 ratios. The seed yield per vine was higher (62.46 g) in 3:1 planting ratio as compared to 4:1

Table 1. Effect of planting ratios on flowering behaviour, fruit and seed yield in the *Pusa Shreshta*

Planting ratio/ season	Days to induction of first male flower			Days to induction of first female flower			Number of fruits/vine			Fruit weight (g)/vine			Seed yield per vine (g)			Seed yield per plot (kg)		
	K	SS	Mean	K	SS	Mean	K	SS	Mean	K	SS	Mean	K	SS	Mean	K	SS	Mean
5F:1M	37.30	46.50	41.90	37.40	47.90	42.65	3.10	2.60	2.85	83.70	73.75	78.73	56.42	48.56	52.49	1.77	1.67	1.72
4F:1M	38.10	47.20	42.65	37.00	48.40	42.70	3.20	2.90	3.05	88.75	80.00	84.38	61.84	53.59	57.72	1.90	1.78	1.84
3F:1M	37.30	47.30	42.30	37.10	49.00	43.05	3.40	3.30	3.35	85.75	83.00	84.37	62.46	55.98	59.22	1.93	1.80	1.86
Mean	37.57	47.00	42.28	37.17	48.43	42.80	3.23	2.93	3.08	86.07	78.91	82.49	60.24	52.71	56.48	1.86	1.75	1.80
C.D. (P≤0.05)																		
Planting ratio (A)		NS			NS			0.23			1.31			1.12			0.12	
Season (B)		0.90			0.66			0.19			1.07			0.91			0.10	
A x B		NS			NS			NS			NS			NS			NS	

K:*Kharif*, SS: spring-summer

and 5:1 planting ratios which recorded 61.84 g and 56.42 g seed yield per vine, respectively during *kharif* season (Table 1). Among the planting ratios, 3:1 ratio recorded higher seed yield per vine (59.22g) in comparison to 4:1(57.72g) and 5: 1(52.49g) planting ratio. Among the seasons, the *kharif* recorded higher seed yield per vine than spring-summer season. Among the planting ratio, the mean plot yield (1.86 kg) was higher in 3:1 ratio than 4:1 and 5:1 row ratio. Among the seasons, the *kharif* season yielded higher as compared to spring-summer season (Table 1). These higher floral rewards and favourable temperature and RH conditions favoured better activity of honey bees leading to effective pollination and higher fruit set in *kharif* season) (Table 1). Similar findings were obtained by Kushwaha and Pandey [6].where a planting ratio of 4:1 was recommended for hybrid seed production of bottle gourd for higher seed yield and better quality. Sharma *et al.,* [7] also reported a row of 3:1 ratio for hybrid seed production in cucumber. Lal *et al.,* [8] observed that a row ratio of 2: 1 (F:M) yielded higher hybrid seed yield in muskmelon.

Seed quality

Among the planting ratio, the 3:1 and 4:1 were at par, whereas the inferior quality seeds were obtained in the 5:1 ratio. Seeds produced in 3:1 and 4:1 had the higher germination percentage (93%) than 5:1 (90%) during *kharif* season whereas the germination was more in spring-summer season which had 96% germination in 3:1 ratio seed and 95% and 93% germination in 4:1 and 5:1 ratio respectively (Table 2). The vigour index I was marginally higher in 4:1 ratio (4076.05), followed by 3:1 (4058.07) and 5:1 (3858.23) in *kharif* season (Table 2). Similarly, in spring-summer season vigour index I was 4245.36, 4238.40 and 4035.15 in 3:1, 4:1 and 5:1 ratio, respectively. Results concluded that the spring- summer season had better seedling vigour index I than *kharif* and 3:1 ratio was better than 4:1 and 5:1 ratio for this trait. The seedling vigour index II valued 5.00 in 4:1 ratio which was higher than in :1 (4.98) and 5:1(4.19) row ratio in *kharif* season. Similarly, the seedling vigour index II was 5.22, 5.16, and 4.47 in 3:1, 4:1 and 5:1 ratio respectively in spring-summer season (Table 2).

Thus, in the study, the seed quality traits seed germination and vigour were significantly higher in the spring summer season as compared to the *kharif* season and seed quality was higher in planting ratios, 3:1 and 4:1 as compared to 5:1 ratio. It could be attributed to lesser number of fruits and better seed filling and fruit maturity under dry weather

Table 2. Effect of planting ratios on hybrid seed quality of *Pusa Shreshta*

Planting ratio/ season	Germination (%)			Seedling vigour index I				Seedling vigour index II			
	K	SS	Mean	K	SS	K	SS	Mean	K	SS	Mean
5F:1M	90.00 (71.60)	93.00 (74.70)	91.50 (73.09)	42.88	43.38	3858.23	4035.15	3946.69	4.19	4.47	4.33
4F:1M	93.00 (74.70)	95.00 (77.12)	94.00 (75.86)	43.84	44.61	4076.50	4238.40	4157.45	5.00	5.16	5.08
3F:1M	93.00 (74.70)	96.00 (78.50)	94.50 (76.48)	43.64	44.22	4058.07	4245.36	4151.72	4.98	5.22	5.10
Mean	92.00 (73.61)	94.60 (76.60)	93.33 (75.07)	43.45	44.07	3997.60	4172.97	4085.29	4.72	4.95	4.84
C.D. (P≤0.05)											
Planting ratio (A)		2.39 (2.58)				98.30				0.140	
Season (B)		1.95 (2.11)				80.27				0.110	
A x B		NS				NS				NS	

K: *Kharif*, S: spring-summer
Values in parenthesis are arc sine converted values

conditions in spring-summer season which favoured bolder seeds with better seed quality. These findings were in agreement with the reports of Kushwaha and Pandey [6], Sharma *et al.,* [7] in cucumber and Kumar [9] in bottle gourd.

The results of the study clearly showed that the planting ratios had no significant effect on vegetative growth (vine length and number of branches/vine) and flowering behaviour of the parental lines, but had significant effect on fruit and seed yield of the parental lines. A planting ratio of 3:1(female: male) was found optimum for efficient hybrid seed production of Sponge gourd hybrid; Pusa Shreshta under North Indian conditions.

REFERENCES

1. JIANNING S L, HGO G, LUO S B AND GARY H (2000). Breeding of new F_1 hybrid 'Yalu No.1' of *Luffa acutangula* Rooxb. *China Vegetables,* **3**: 26-28.
2. ISTA (2019). *International Rules for Seed Testing*. International Seed Testing Association, Bassorsdorf, Switzerland.
3. ABDUL-BAKI AA AND J D ANDERSON (1973). Vigour determination in soybean by multiple criteria. *Crop Science,* **10**: 31-34.
4. KADDI G, TOMAR B S, SINGH B AND KUMAR S A (2014). Effect of growing conditions on seed yield and quality of cucumber (*Cucumis sativus*) hybrid. *Indian Journal of Agricultural Sciences*, **84(5)**: 624-627.
5. NAGAMANI S, BASU S AND BEHERA T K (2018). Comparative evaluation of hybrid seed production of bitter gourd in rainy and spring summer season. *Indian Journal of Horticulture*, **75(2)**: 245-251.
6. KUSHWAHA ML AND PANDEY ID (1998). Hybrid seed production in bottle gourd. *Punjab Vegetable Grower,* **33**: 27-29.
7. SHARMA R K, PATHANIA N AND JOSHI A K (2004). Studies on hybrid seed production in cucumber. *Seed Research,* **32(1)**: 103-104.
8. LAL T AND SINGH S (1990). Effect of plant density on hybrid seed production in Muskmelon. *Seed Research*, **18(1)**: 11-14.
9. KUMAR SATISH (2005). Studies on pollination requirements for hybrid seed production in Bottle Gourd (*Lagenaria sineraria* M. standl.). Ph.D. thesis, P. G. School, Indian Agriculture Research Institute, New Delhi.