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EFFECT OF SOWING TIME AND PLANT SPACING ON GROWTH AND YIELD OF DWARF HYACINTH BEAN

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Abstract

Time of sowing and plant spacing has paramount significance in improving, growth and pod yield of hyacinth bean. The aim of the study was to determine appropriate sowing time and optimum plant spacing and their combination for better productivity of green beans. The treatments were three level of spacing (1.00 m × 0.50 m, 0.75 m × 0.50 m, 0.50 m× 0.50 m); four level of time of sowing (September 1st, September 15th, October 1st and October 15th. The experiment was conducted in Randomized Complete Block Design with three replications. Analysis of variance has shown that number of pods/plant, dry matter/plant at 60 DAS, yield/plot and yield/ha were significantly affected by the interaction effects of time of sowing and spacing. Weight of pod/plant was however affected only by the main effects of time of sowing and spacing. The highest yield (12.63 t/ha) was harvested from plants sown on September 15th and a spacing of 0.50 m × 0.50 m. Our data suggested that mid September seems the most appropriate time of sowing and a spacing of 0.50 m× 0.50 m is adequate for green dwarf hyacinth bean production.

Key words : Dwarf hyacinth bean, sowing time, plant spacing, growth, yield.

Introduction

The hyacinth bean (*Lablab perpurious* Syn. *Dolichos lablab*) is one of the most cultivated leguminous vegetables in the world, and it is the most important food legume (Getachew *et al.,* 2014). It is one of the most important, nutritious and popular winter vegetables in Bangladesh. It serves as a green vegetables and it provides protein, calories, vitamins and minerals such as calcium, phosphorus, iron (Lemma 2003).

Sowing time of bean has a very vital role on growth of the plants and yield. Sowing time determines the amount of rainfall and temperature to which the crop is exposed at different growth stages (Zeleke *et al.,* 2019). Site-specific factors, such as cultural practices and sowing date influence yield and yield characteristics of green bean. Selection of the most suitable variety, determining suitable sowing date and applying appropriate cultural practices are very important for increasing quality and yield of green bean. Among the various factors, optimum sowing date and best variety are of primary importance to obtain potential yield (Amanullah *et al.,* 2002).

Plant spacing is also an important agronomic practice for efficient capture of the environmental resources, as it has a key role in the regulation of plant competition within plant canopy (Singh *et al.,* 2006). The potential capacity of the canopy to capture environmental resources such as solar radiation, water and nutrients can be enhanced in an optimum plant population (Rossini *et al.,* 2011). High plant density increases interplant competition for resources leading to the depletion of some limiting resources (Jiang *et al.,* 2013). Moreover, improvement of the canopy structure can result in an optimum leaf area index and may increase photosynthesis capacity via effective interception of solar radiation (Wang *et al.,* 2015). Therefore, canopy structure may influence the physiological and phytochemical characteristics of the plants which are connected and related to access environmental resources.

Sowing date has the greatest effects on the yield of green bean. Sowing of soybean in July 5 gave the highest marketable yield in the Northeastern USA; whereas the

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lowest marketable yield was obtained when sown on May 22 (Yan-sheng *et al.,* 2010). Sowing of French bean in 05 November gave the highest (41.20 cm) plant height in Bangladesh whereas the lowest (29.83 cm) plant height was observed from 5 December sowing (Jamil *et al.,* 2017). Yadav *et al.,* (2015) reported that french bean sown during first fortnight of November recorded higher plant height (44.48 cm) at harvest. The plant height decreased with delay in sowing. The lower plant height was recorded with first fortnight of December (36.06 cm). Singh and Singh (2000) found that number of branches significantly higher in rajmash sown on 30th October (15.99) compared to 15th October sown crop (15.34). From Bangladesh, Mozumder *et al.,* (2003) found that earlier (15 October) planting of rajmah required maximum time for flowering (48.53 DAP) while late planting (15 December) gave earlier flowering (44.90 DAP). Early sowing of snap bean produced higher yield and plant height but lower pod diameter, dry matter and pod length than the late sowing (Yoldas and Esiyok 2007). According Marlene *et al.,* (2008) mean pod width (diameter) were greater in the late planting season (17 mm) than in the early planting seasons (15–16 mm). Ismail and Khalifa (1987) reported reduced number of seeds per pod in late sown soybean, which might due to the decrease in day length and moisture following delayed sowing. Higher number of pods was obtained in the earlier sowing than the late sowing (Escalante *et al.,* 1989). Number of plant population that is plant spacing also plays an important role on increasing the yield. Optimum plant population has a promising impact in improving the growth and productivity of green bean. Dhanjal *et al.,* (2001) reported that plant height increases with the increase of plant density because of competition of light. Maximum plant height (44.5 cm) and minimum (3.86) branch per plant were obtained from the highest plant density (Moniruzzaman *et al.,* 2009). Marketable pod yield of snap bean increased linearly, as the spacing reduced in different sowing dates (Tyson and Kostewicz 1986). Higher pod dry weight was obtained when bush bean was planted at lower planting densities as compared to higher planting density and superior yield was observed in the case of high plant populations over that of low plant population of beans (Samih 2008). According to Pawar *et al.,* (2007), dry weight of green bean was increased with increased row spacing (30 cm) as compared to narrow row spacing (22.5 cm). Wider row spacing (60 cm and 45 cm) gave significantly higher number of pods compared to 30 cm row spacing (Mohammed *et al.,* 1984).

Bangladesh Agricultural Research Institute (BARI) has released a dwarf hyacinth bean variety named as BARI Sheem-5 but the standard production technologies *i.e.* sowing time, spacing etc for this released variety has not yet developed. With this view, the study was carried out to find out the suitable time of sowing and optimum plant spacing in order to get higher growth and yield of this variety.

Materials and Methods

The study was conducted by using BARI Sheem-5 at Horticulture Research Centre field, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Jamalpur. Four dates of sowing *i.e.* September 1st, September 15th, October 1st, October 15th and three different plant spacing *i.e.* 1.0 m × 0.50 m, 0.75 m × 0.50 m, 0.50 m × 0.50 m were included in this experiment. The experiment was designed as RCBD with three replications. The unit plot size was 5.0 m × 2.0 m. Twenty days old seedlings were transplanted in the main field. Manures and fertilizers were applied @ 10 ton cowdung, 50 kg urea, 200 kg TSP, 150 kg MP and 120 kg gypsum per hectare. Half of the cowdung was applied during land preparation. The remaining half of the cowdung, entire quantity of TSP and half of each of urea and MP were applied during final land preparation. The rest of urea and MP were applied as top dressing after 30 days of planting. One bamboo stick for each plant was provided as support. Irrigations, other intercultural operation (mulching, weeding) and plant protection measures were taken as and when needed. Data on plant height at last harvest, number of branch/plant, number of leaves/plant, days to 1st flowering, days to 1st harvest, number of pods/plant, weight of pod/plant, pod length, pod breadth, dry matter/plant at 60 DAS, yield/plot and per hectare were recorded and analyzed by with SAS version 9.4 (SAS, 2005) at the 5% significance level and least significant difference was employed for mean separation (Gomez and Gomez, 1984).

Results and Discussion

Main effect of sowing time on growth and yield of dwarf hyacinth bean

Significant variations were observed among different sowing times with respect to all parameter under study (Table 1). The tallest (93.64 cm) plant at last harvest was found from September 1 sowing and the shortest (82.97 cm) from October 15 sowing. The increase in plant height in early sown crop was due to more growing period and favourable temperatures and the decrease in plant height in late sown crop was due to lower temperatures prevailed during early growth phase of the

Table 1: Main effect of sowing time on growth and yield of dwarf hyacinth bean.

Sowing time	Plant height at last harvest (cm)	No. of branch/ plant	No. of leaves/ plant	Days to 1st flowering	Days to 1st harvest
S_1	93.64 a	14 a	25 a	35 b	54 d
S_2	92.44 a	15 a	25 a	38 a	61 c
S_3	91.82 a	15 a	26 a	38 a	65 b
S_4	82.97 b	10 b	19 b	39 a	70 a
Level of sig.	**	**	**	**	**
CV (%)	2.45	17.00	6.75	5.62	3.16

Table 1: Contd.

Sowing time	No. of pod/plant	Pod weight (g/plant)	Pod length (cm)	Pod breadth (cm)	Dry matter (g/plant) at 60 DAS	Yield (kg/plot)	Yield (t/ha)
S_1	98 a	486.55 a	9.24 b	2.58 b	31.44 b	15.87 b	10.69 b
S_2	104 a	517.77 a	9.74 a	2.67 ab	38.01 a	16.97 a	11.43 a
S_3	70 b	331.32 b	9.31 b	2.60 b	32.81 b	12.50 c	8.42 c
S_4	41 c	194.55 c	9.05 b	2.79 a	16.25 c	7.50 d	5.05 d
Level of sig.	**	**	*	*	**	**	**
CV (%)	8.70	15.08	3.42	5.87	7.07	4.28	4.29

S_1: September 1st, S_2: September 15th, S_3: October 1st and S_4: October 15th

Table 2: Main effect of spacing on growth and yield of dwarf hyacinth bean.

Plant spacing	Plant height at last harvest (cm)	No. of branch/ plant	No. of leaves/ plant	Days to 1st flowering	Days to 1st harvest
D_1	89.72	13	24	37	63
D_2	90.83	14	24	37	62
D_3	91.10	13	24	37	62
Level of sig.	NS	NS	NS	NS	NS
CV (%)	2.45	17.00	6.75	5.62	3.16

Table 2: Contd.

Spacing	No. of pod/plant	Pod weight (g/plant)	Pod length (cm)	Pod breadth (cm)	Dry matter (g/plant) at 60 DAS	Yield (kg/plot)	Yield (t/ha)
D_1	108 a	519.99 a	9.42	2.62	29.33 ab	12.08 c	8.13 c
D_2	83 b	347.07 b	9.35	2.68	28.79 b	13.53 b	9.11 b
D_3	47 c	280.58 c	9.57	2.68	30.76 a	14.02 a	9.44 a
Level of sig.	**	**	NS	NS	*	**	**
CV (%)	8.70	15.08	3.42	5.87	7.07	4.28	4.29

D_1 : 1.0 m × 0.50 m, D_2 : 0.75 m × 0.50 m and D_3 : 0.50 m × 0.50 m

Figures in a column having same letter (s) do not differ significantly at 5% level NS: Not Significant

* indicate significant at 5% level of probability, ** indicate significant at 1% level of probability

crop. These results are in conformity with the findings of Moniruzzaman *et al.,* (2007) in French bean. Maximum (15.00) number of branch was produced from September 15 and October 1 sowing whereas the minimum (10.00) from October 15. Maximum (26.00) number of leaves was produced from the October 1 sowing whereas minimum (19.00) was produced from October 15 sowing. Kurmawanshi *et al.,* (1994) noticed superior plant height and branches per plant on faba bean when the crop was raised on 30th October compared with other dates of sowing with every 10 days interval up to 10th December. Begum *et al.,* (2003) reported that the best morphological and reproductive characters of french beans were observed in early sowing which lend support to the present findings. The treatment September 1 sowing took minimum days to flowering (35) and harvesting (54) as compared to maximum days to flowering (39) and harvesting (70) in October 15 sowing. Number and weight of pods per plant (104.00 and 517.77 g) were noted maximum when seeds were sown on 15 September. Minimum number (41.00) and weight (194.55 g) of pod per plant were obtained from the plants which were sown on 15 October. The longest pod (9.74 cm) was produced by September 15 sowing and the shortest (9.05 cm) pod was produced by October 15 sowing. October 15 sowing produced the widest (2.79 cm) pod as against the narrowest (2.58 cm) pod was recorded in September 1 which was closely followed by October 15 (2.60 cm) and September 15 sowing (2.67 cm) pod and also statistically at par to each other. Maximum (38.01 g/plant) dry matter at 60 DAS was recorded from September 15 sowing and minimum (16.25 g) from October 15 sowing. The highest yield (16.97 kg/ plot and 11.43 t/ha) were produced by September 15 sowing whereas the lowest yield (7.50 kg/plot and 5.05 t/ha) were produced by October 15 sowing.

Main effect of plant spacing on growth and yield of dwarf hyacinth bean

Most of the traits were statistically insignificant except plant height at 60 DAS, number of pod/plant, weight of pod/plant, dry matter/plant at 60 DAS, pod yield/plant, yield/plot and yield/ hectare (Table 2) due to the effect of different plant spacing. The tallest (91.10 cm) plant at last harvest was produced by the

closer spacing of 0.50 m × 0.50 m and the shortest (89.72 cm) by the spacing of 1.00 m × 0.50 m. The reason for these variations/differences might have been more competition between plants for nutrients, soil moisture as well as for sunlight at high plant density/spacing due to which plants attained maximum plant height. This argument was supported by the statement of Dhanjal *et al.,* (2001) and Welu (2015) who mentioned that plant height increased with the increase of plant density because of competition for light. Increment in plant height may be attributed to either an increase in node number or internodes length or both (Ahmed *et al.,* 2010). Mc Ewen (1973) opined that, field bean produced higher plant height with closer spacing as compared to wider spacing. Subramanian *et al.,* (1977) also indicated that, in cowpea in Coimbatore closer spacing increased plant height as compared to other spacing. The result of the present study is in agreement with the findings of Singh and Tripathi (1994) who observed higher plant height with closer spacing than wider. Similar results were also reported by Dwivedi *et al.,* (1994) and Yadav (2003) in cowpea, Ravinder and Singh (1998) in mungbean. All of the spacing treatments had the same days to 1st flowering (37 days). Days to 1st harvest ranged from 62 to 63. Plant spacing of 1.00 m × 0.50 m resulted in maximum number (108.00) of pod per plant compared to minimum (47.00) in a spacing of 0.50 × 0.50 m. This result was in line with Malek *et al.,* (2013) who reported that the number of pods per plant of lentil was significantly influenced by plant density. Maximum weight (519.99 g/plant) of pods was recorded from the spacing of 1.00 m × 0.50 m as compared to minimum values (280.58 g) in spacing of 0.50 m × 0.50 m which was similar to the result of *Chakravarty et al.,* 2009 who reported that wider spacing produce more number of pods/plant. Pod length and pod breadth ranged from 9.35 to 9.57 cm and 2.62 to 2.68 cm, respectively. Dry matter/plant at 60 DAS was ranged from 28.79 to 30.76 g. The highest yield (14.02 kg/plot and 9.44 t/ha) were noted in the plant spacing of 0.50 m × 0.50 m. Plant spacing of 1.00 m × 0.50 m demonstrated the lowest yield (12.08 kg/plot and 8.13 t/ha). This result is in agreement with the findings of Mozumder *et al.,* (2003); Singh *et al.,* (1996) and Moniruzzaman *et al.,* (2009). The increase in yield with closer row spacing was mainly due to significantly higher performance of all the growth and yield components compared to wider spacing. These results are in conformity with Angne *et al.,* (1993), Arora

Table 3: Interaction effect of sowing time and plant spacing on growth and yield of dwarf hyacinth bean.

Sowing time × spacing	Plant height at last harvest (cm)	No. of branch/ plant	No. of leaves/ plant	Days to 1st flowering	Days to 1st harvest
$S_1 \times D_1$	96.20	14	25	35	55
$S_1 \times D_2$	91.00	14	24	34	54
$S_1 \times D_3$	93.73	15	25	35	54
$S_2 \times D_1$	91.26	15	25	37	61
$S_2 \times D_2$	92.40	15	26	39	61
$S_2 \times D_3$	93.66	15	25	39	61
$S_3 \times D_1$	90.33	15	26	38	65
$S_3 \times D_2$	93.80	15	26	39	65
$S_3 \times D_3$	91.33	14	26	38	65
$S_4 \times D_1$	82.63	10	19	40	70
$S_4 \times D_2$	81.70	11	19	38	70
$S_4 \times D_3$	84.60	10	19	39	70
Level of sig.	NS	NS	NS	NS	NS
CV (%)	2.45	17.00	6.75	5.62	3.16

Table 3: Contd.

Sowing time × spacing	No. of pod/plant	Pod weight (g/plant)	Pod length (cm)	Pod breadth (cm)	Dry matter (g/plant) at 60 DAS	Yield (kg/plot)	Yield (t/ha)
$S_1 \times D_1$	170 a	640.00	9.42	2.56	30.18 de	14.50 d	9.76 d
$S_1 \times D_2$	89 cd	461.33	9.20	2.62	27.42 e	16.00 c	10.78 c
$S_1 \times D_3$	52 f	358.33	9.10	2.58	36.72 ab	17.12 b	11.53 b
$S_2 \times D_1$	101 bc	640.66	9.70	2.51	37.49 ab	14.51 d	9.77 d
$S_2 \times D_2$	110 b	513.66	9.64	2.75	37.58 ab	17.65 b	11.89 b
$S_2 \times D_3$	99 b-d	399.00	9.89	2.76	39.98 a	18.75 a	12.63 a
$S_3 \times D_1$	95 cd	507.33	9.18	2.60	30.86 de	11.85 f	7.98 f
$S_3 \times D_2$	47 d	239.32	9.18	2.62	34.99 bc	12.98 e	8.74 e
$S_3 \times D_3$	54 g	247.33	9.57	2.59	32.59 cd	12.68 ef	8.54 ef
$S_4 \times D_1$	68 e	292.00	9.39	2.81	18.82 f	7.47 g	5.03 g
$S_4 \times D_2$	45 f	174.00	9.39	2.76	15.17 g	7.50 g	5.05 g
$S_4 \times D_3$	20 h	117.66	9.74	2.81	14.78 g	7.54 g	5.07 g
Level of sig.	**	NS	NS	NS	**	**	**
CV (%)	8.70	15.08	3.42	5.87	7.07	4.28	4.29

S_1: September 1st, S_2: September 15th, S_3: October 1st and S_4: October 15th

D_1: 1.00 m × 0.50 m, D_2: 0.75 m × 0.50 m and D_3: 0.50 m × 0.50 m

Figures in a column having same letter (s) do not differ significantly at 5% level NS: Not Significant

* indicate significant at 5% level of probability,

** indicate significant at 1% level of probability.

et al., (1971) in french bean in closer spacing compared to wider spacing. Closer spacing accommodates higher number of plants per unit area. The individual plants might contribute cumulatively towards more yield than more spaced plants.

Interaction effect of sowing time and plant spacing on growth and yield of dwarf hyacinth bean

There were statistically significant differences among the treatment combinations with respect to plant height at 60 DAS, number of pods/plant, dry matter/plant at 60 DAS, yield/plot and per hectare and insignificant variations were observed in other variables under study (Table 3). Sowing on September 1 combined with 1.00 m × 0.50 m spacing resulted in the highest number of pods/plant (170.00) as compared to the lowest number of pods/plant (20.00) in October 15 sowing at spacing of 0.50 m × 0.50 m. Maximum weight of pods/plant (640.66 g) was recorded from the treatment combination of September 15 sowing and plant spacing at 1.00 m × 0.50 m as against minimum weight of pod/plant (117.66 g) from October 15 sowing along with plant spacing of 0.50 m × 0.50 m. Dry matter/plant at 60 DAS was recorded maximum (39.98 g) from the combination of September 15 sowing with 0.50 m × 0.50 m plant spacing and minimum (14.78 g) was recorded from October 15 sowing with 0.50 m × 0.50 m plant spacing. September 15 sowing combined with a plant spacing of 0.50 m × 0.50 m showed the highest yield (18.75 kg/plot and 12.63 t/ha) compared to the least (7.47 kg/plot and 5.03 t/ha) yield in the combination of October 15 sowing and 1.00 m × 0.50 m spacing.

Conclusion

Therefore, it can be concluded that, for profitable cultivation of dwarf hyacinth bean var. BARI Sheem-5 sowing on September 15th by maintaining a planting distance of 0.50 m × 0.50 m between and within the rows is most favorable for higher pod yield.

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