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EFFECT OF BULB SIZE AND PLANT SPACING ON SEED PRODUCTION OF ONION (*Allium cepa* L.)

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Abstract

A field experiment was conducted at the `Research Farm` of Regional Seed Production Office of Lal Teer Seed Limited, Dinajpur, Bangladesh during November 2008 to April 2009. The study was conducted to investigate the effect of bulb size and planting spacing on seed production of cultivar *Taherpuri* onion. Three bulb sizes [small (5±2g), medium (10±2g), and large (15±2g)] and four planting spacing [closest 25×15, closer 25×20, wider 30×15, and widest 30×20cm] was considered in this experiment. Number of flowering stalks, length of flowering stalks, number of umbels per plant, number seeded fruits, seed weight per umbel, 1000-seed weight and seed yield per hectare were measured to assess the onion seeds. The results revealed that the highest seed yield (776.67 kg) per hectare was obtained from the large bulb (15±2g) with the closest spacing of 25×15cm followed by small bulb size of same spacing. The maximum number of flowers per umbel (371.39), seed weight per umbel (0.80g) and 1000-seed weight (3.92g) were obtained from the largest bulb size (15±2g) with widest (30×20cm) planting spacing. Hence, large bulb size with closest plant spacing is suggested for onion seed production in northern part of Bangladesh.

Keywords: Bulb size, spacing, onion seed production.

Introduction

Onion (*Allium cepa* L.) belongs to the family Amaryllidaceae (amaryllis) or liliaceae and is one of the most important monocotyledonous, cross-pollinated and cool season vegetable crops. It originated in Afganistan,Tajikistan and Uzbekistan, western Tien Shan India, western Asia and the area around the Mediterranean sea (Baloch, 1994). Among the spices, onion ranks first in Bangladesh in terms of production and area (BBS, 2008). During 2006-2007, onion occupied an area of 1, 28,745 hectares with a total production of 8, 94,000 m. tons (BBS, 2008). On an average, the total annual requirement of onion in Bangladesh is about 14, 50,000 m. tons but production is only 7, 25,100 m. tons (Anon., 2006). So, there is an acute annual deficit (50%) of onion. The

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unavailability of quality onion seeds is greatly responsible for low yield in this region (Bokshi *et al*., 1989). The onion's seed size and weight affect the final yield (Gamiely *et al.,* 1990).Furthermore, high quality seed is the critical input on which all other inputs depend for their potential yield. Thus, the yield of this spice is influenced by many factors but cultivars, soil and climate, seedling age, bulb weight, spacing, date of planting and seed quality are very important. Karim *et al.* (1999) observed the best yield of onion with large size mother bulb (20g). Moreover, onion is known to be a thermo-photo sensitive plant (Jones and Mann, 1963). So, due to environmental limitations, such as short winter season, the plants raised from seeds in most cases do not bear good seeds in the same season in Bangladesh. In this situation, many breeders (seed companies) transfer onion seed production to areas with optimal climate conditions in order to lower risk of losing crops (Hołubowicz, 2007). However, Bulb-to-seed method is appropriate for onion seed production in Bangladesh (Rahim *et al*., 1982). Due to lack of adequate information on different aspects of seed production, such as proper size of mother bulbs, the growers are reluctant to seed production. Bulb size and plant spacing are the key factors in producing quality onion seeds (Mirshekari and Mobasher, 2006). However, the information on bulb size and plant spacing of the cultivar *Taherpuri* is very low in respect of seed production. Therefore, the present study was conducted to investigate the effects of bulb size and plant spacing on seed production of *Taherpuri* onion cultivar in Bangladesh.

Materials and Method

Location: A field experiment was carried out in the Regional Seed Production Office of Lal Teer Seed Ltd., Dinajpur, Bangladesh during November 2008 to April 2009. Dinajpur is located in northwest of Bangladesh (25º52' to 26º62' N and 88º45 to 89º65' E), and lies under AEZ 1 (Old Himalyan Piedmont Plain). Land type is characterized by complex relief patterns comprising broad and narrow floodplain ridges and linear depression.

Experimental details: Two factors (bulb size and planting spacing) with three replications were used in the experiment where the field was laid out in Completely Randomized Block Design. Bulb size consisted of B_1 (5±2g), B_2 (10±2g), and B_3 (15±2g) where planting spacing comprised of S_1=25×15cm, S_2=25×20cm, S_3= 30×15cm, and S_4= 30×20cm. *Taherpuri* cultivar was used as a test crop. The size of a unit plot was 4×1.5 m^2. The distance between plots and blocks were 0.5 and 1.0 meter, respectively. Bulbs were planted on 10 November 2008 setting upright at a depth of 2.5cm (Abedin *et al*., 1999). Replacements of rotten bulbs were done within 7 days of planting by healthy extra bulbs planted at the border of the experimental field. The following doses of manures and fertilizers were applied in the experimental plots as per BARI recommendation (2005).

Manures and fertilizers	Dose/ha	Dose/plot
Cowdung	10 tons	6 kg
Urea	260 kg	156 g
Triple Super Phosphate	260 kg	156 g
Muriate of Potash	150 kg	90 g

Four irrigations were applied: first was done in 25 November 2008, following 6 December 2008, 20 January 2009, and 10 February 2009 using a watering can. First weeding was done by hand picking at 20 days after planting the bulbs. Subsequent three weedings were followed by irrigation with *khurpi*. At the same time, earthling up was also done along with the rows. Ridomil MZ 68 WP was sprayed @ 2g per liter of water at 30 days after planting to keep the crops free from diseases. Second spraying was done with Dithen M 45 @ 2g per liter of water and Malathion 57 EC @ 2ml per liter of water to control *Thrips* spp. at 45 days after planting. The mature umbels were harvested in the morning with a small portion of flowering stalk between 9 and 20 April 2009, when 15-20% of the fruits exposed black seeds.

Data collection: Length of flowering stalk (cm) was measured from ground level to the tip of the flowering stalk before harvest and the average value was recorded. Number of flowering stalk and umbels per plant; number of seeded fruits, weight of seeds (g) per umbel was recorded from 10 randomly selected plants after completion of flowering. One thousand seeds were counted from each plot and were weighed with electric balance in gram (g) up to two decimal units. Seed yield per hectare was measured by converting the respective seed yield per plot and was expressed in kilogram (kg) per hectare. Both the cases, 9% moisture were adjusted during measurement.

Statistical analysis: Statistical analyses of collected data were done by using the statistical package program MSTAT-C developed by Russel (1986). Analysis of variance (ANOVA) was done and significance of differences between two means was performed by the least significant difference test (Gomez and Gomez, 1984).

Results and Discussion

Effect of bulb size on umbel and seed characteristics of onion: Significant differences of number of flowering stalks and its length, number of umbels per plant, number of seeded fruit, seed weight per umbel, 1000-seed weight, and seed yield per hectare were observed in respect of different bulb sizes (Table 1). The study revealed that the number of flowering stalks per plant was significantly high (3.63) in the large sized bulb (15±2g) whereas the minimum (2.45) in small sized bulb 5±2g (Table 1). The superiority of large bulbs may contain higher food reserves and be responsible for the higher number of flowering stalks per

plant. Similar kinds of finding were also reported by Abedin *et al.* (1999) and Singh and Sachan (1999) and their statement has supported the present study. Plant raised with larger bulb (15±2g) produced the maximum height of flowering stalk (83.39cm), while the lowest height of flowering stalk (72.43cm) was noted in the small sized bulbs (5±2g). The result revealed that height of flowering stalk gradually increased with the rise in bulb size. The highest number of umbels (3.51) was produced by the largest sized bulb (15±2g), while the lowest number of umbel per plant (2.41) was noted in the smallest sized bulb (5±2g). This results may be due to the fact that larger bulb contains higher food reserves. On the other hand, bulbs weighing 15±2g produced the highest number of seeded fruits per umbel (225.53), whereas the least value for the same parameter (203.64) was recorded from the bulb size (5±2g). The highest seed weight per umbel (0.75g) was recorded from the largest bulb size (15±2g), while the lowest seed weight (0.70g) was obtained from the smallest size (5±2g) of bulbs. Larger bulb containing higher food reserves produced higher number of flowers and seeded fruits per umbel which might be the cause of higher seed weight per umbel. Again, the highest 1000-seed weight (3.68g) was obtained in large sized bulb (15±2g) and the lowest (3.17g) from the smallest bulb (5±2g). High food reserves present in the large bulb might supply nutrient properly to the seeds, resulting in the highest weight of 1000-seed weight. Finally, it was observed that the largest bulb (15±2g) produced the highest amount of seed per hectare (877.90kg) and the least amount of seed per hectare (571.69kg) was noted from the smallest size of mother bulbs (Fig.1).

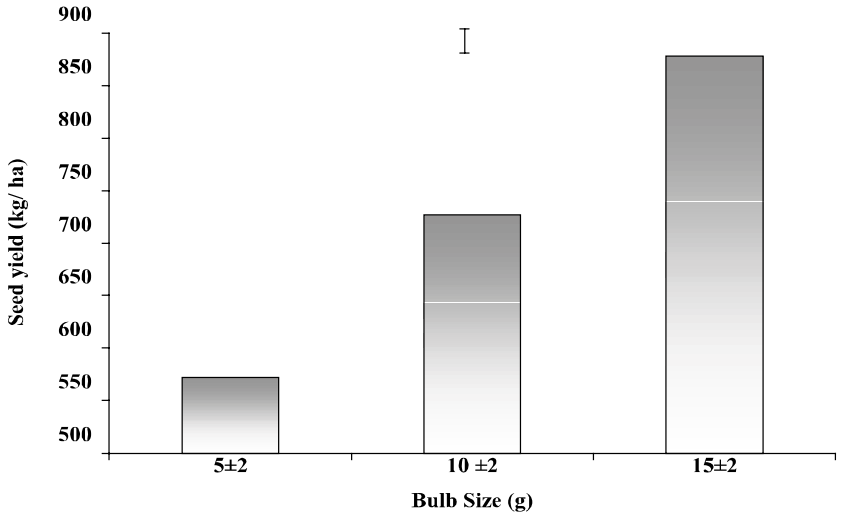

Fig. 1. Seed yield per hectare as influenced by bulb size (vertical bars indicates LSD 0.01)

Table 1. Effect of bulb size on umbel and seed characteristics of onion.

Bulb size (g)	Umbel characteristics				Seed characteristics	
	No. of flowering stalks/plant	Length of flowering stalk (cm)	No. of umbels/ plant	No. of seeded fruits/ umbel	Seed wt/ umbel (g)	1000-seed wt (g)
5±2g	2.45	72.43	2.41	203.64	0.70	3.18
10±2g	2.95	78.96	2.93	212.52	0.71	3.41
15±2g	3.63	83.39	3.51	225.52	0.75	3.68
LSD (0.01)	0.08	0.93	0.15	5.32	0.03	0.12
CV(%)	2.56	5.32	4.31	2.79	1.01	2.05

Effect of planting spacing on umbel and seed characteristics of onion: Significant differences of number of flowering stalks and its length, number of umbels per plant; number of seeded fruits, seed weight per umbel, 1000-seed weight, and seed yield per hectare was observed in respect of different spacings (Table 2). The significant variation in number of flowering stalks per plant (3.43) was obtained from the widest spacing of 30×20cm and the lowest number of flowering stalks (2.93) was observed from the bulbs spaced with closest spacing of 25×15cm. The increasing trend of the number of flowering stalks per plant was resulted with the increase in plant spacing. Plants of the widest spacing produced more green leaf probably due to less competition for nutrients, light, space, and moisture. Later on, these leaves accumulated photosynthate and ultimately encouraged producing more number of flowering stalk. Singh and Sachan (1999) also found the highest number of flowering stalk per plant from the widest spacing. The onion bulbs having the widest spacing of 30×20 cm produced the tallest flowering stalk (89.22cm), which was much higher than the shortest flowering stalk (76.53cm) produced from the closest spacing of 25×15cm. Length of flowering stalk increased with the increase in plant spacing. This might be due to the widest plant spacing produced more green leaf and extra food which promoted the length of flowering stalk. On the other hand, the maximum number of umbels (3.42) per plant was produced by bulbs spaced at the widest spacing of 30×20cm. More nutrient supply at the wider spacing may increase the number of umbels. The lowest number of umbels per plant (2.87) was recorded from the bulb having the closest spacing (25×15cm). So, umbel number reduced with the decrease in plant spacing. The maximum number of seeded fruits per umbel (227.17) was recorded from wider spacing (30×20cm) and the number of seeded fruit decreased gradually with closer spacing. The number of seeded fruits per umbel was minimum (213.11) in the closest spacing (25×15cm). Begum *et al*. (1995) also recorded the highest number of seeded fruits per umbel from the wider spacing. However, out of four planting spacing, the widest spacing of 30×20cm

gave the highest weight of seeds per umbel (0.76g), which was markedly superior to the seed weight per umbel under other spacing (Table 2). The lowest seed weight per umbel (0.71g) was obtained in closer spacing of 25×15cm. This increasing trend of weight of seeds per umbel might be due to more available nutrient at wider spacing compared to closer spacing. The highest 1000-seed weight was obtained (3.56g) at wider spacing (30×20cm) whereas the lowest 1000-seed weight (3.40g) was recorded at the closest spacing of 25×15cm. The trend of 1000-seed weight decreased as the plant spacing decreased. This might be due to the fact that wider spacing supplied more food materials to the growing seeds compared to the closest spacing. Ali *et al*. (1988) also found that 1000-seed weight was significantly higher at wider spacing. Finally, the bulbs having the closest spacing of 20×15cm showed the highest seed yield per hectare(781.12kg), while the lowest seed yield (644.06 kg) per hectare was recorded from the bulbs with the widest spacing 30×20cm (Fig. 2).

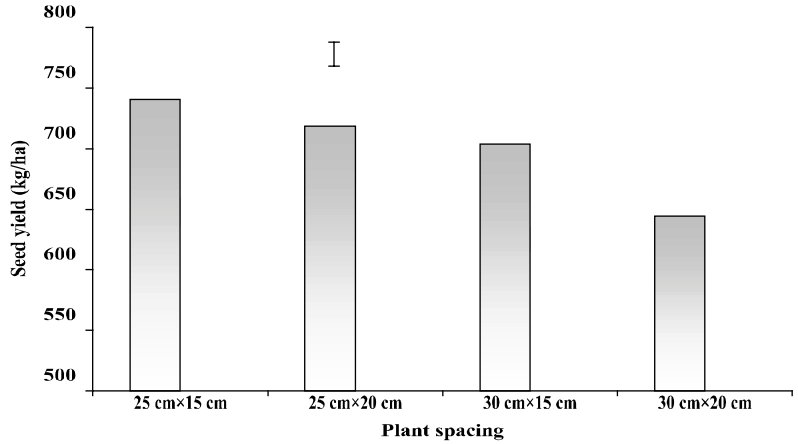

Fig. 2. Seed yield per hectare as influenced by spacing (vertical bars indicates LSD 0.01).

Table 2. Effect of plant spacing on umbel and seed characteristics of onion.

Spacing (cm)	Umbel characteristics				Seed characteristics	
	No. of flowering stalks plant	Length of flowering stalk (cm)	No. of umbels/ plant	No. of seeded fruits umbel	Seed wt/ umbel (g)	1000-seed wt (g)
25×15cm	2.93	76.53	2.87	213.11	0.71	3.40
25×20cm	3.01	78.63	2.92	219.63	0.73	3.45
30×15cm	3.15	81.25	3.11	216.50	0.74	3.50
30×20cm	3.43	83.25	3.42	227.17	0.76	3.56
LSD (0.01)	0.07	0.81	0.06	5.6	0.03	0.14
CV(%)	2.91	0.71	1.25	3.15	4.47	2.38

Interaction effect of bulb size and spacing on umbel and seed characteristics of onion: Significant variations on the interaction effect of bulb size and planting spacing was observed on the number of flowering stalks and its length, number of umbels per plant, number of seeded fruits, seed weight per umbel, 1000-seed weight, and seed yield per hectare is presented in Table 3. Highest number of flowering stalk (4.00) was obtained in the combination of the largest bulb (15±2g) and the widest spacing of 30×20cm, while the lowest value (2.23) was made up by the smallest sized bulb (5±2g) with a closer spacing of 25×20cm. The result revealed that larger bulb size with wider spacing produced higher number of flowering stalks per plant. In turns, the highest length of flowering stalk (89.22cm) was obtained when the largest bulb (15±2g) was planted at widest spacing of 30×20cm and the shortest of flowing stalk (70.53cm) was recorded from the smallest bulb (5±2g) with closest spacing of 25×15cm. The results revealed that larger bulb size with wider spacing produced higher length of flowering stalk. The highest number of umbels per plant (3.97) was found from the largest bulb (15±2g) planted at widest spacing of 30×20cm and the lowest number of umbels (2.35) per plant from the smallest bulbs (5±2g) with closer spacing of 25×20cm. Besides this, the largest sized bulb (15±2g) produced the maximum number of seeded fruits per umbel (245.16) when planted at 30×20cm spacing, but the lowest number (202.45) was noted from the small sized bulb (5±2g) with closer spacing of 30×15cm. However, numerically the highest seed weight per umbel (0.80 g) was obtained from the large bulb (15±2g) with widest spacing (30×20cm), but the lowest amount of seed per umbel (0.69g) was obtained from the bulbs of small size (5±2g) at closer spacing of 25×15cm. Begum *et al*. (1995) also found the highest number of seeds per umbel from the large bulb planted at the wider spacing. Again, the highest 1000-seed weight (3.92g) was noted in large bulb size (15±2g) with wider spacing of 30×20 cm while the small bulb (5±2g) at a closer spacing of 25×15cm produced the lowest weight of 1000-seed (3.15g). Finally, the estimated highest yield (776.67kg) per hectare was obtained from the large bulb size (15±2g) with closer spacing of 25×15cm, while the lowest yield (530kg) was obtained from the small bulb (5±2g) with wider spacing of 30×20cm (Fig. 3).

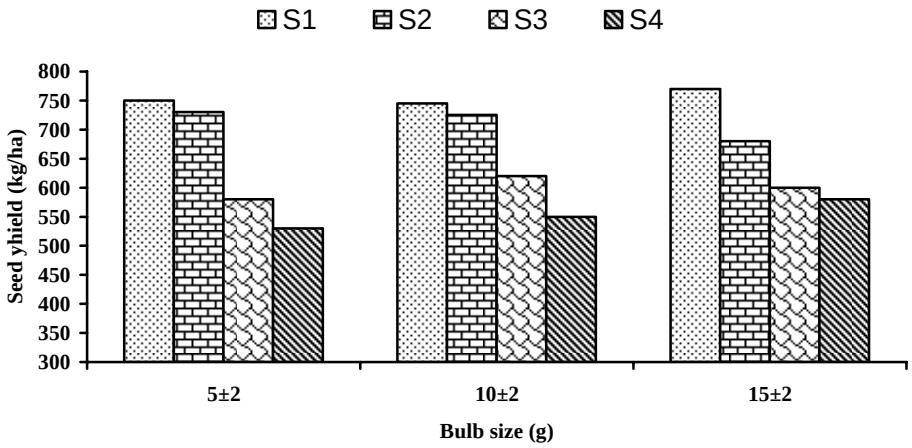

Fig. 3. Interaction effect of bulb size and spacing on the seed yield of onion (vertical bars indicates $LSD_{0.01}$).

Plant spacing: S_1 = (25x15cm), S_2 = (25x20cm), S_3 = (30x15cm), S_4 = (30x20cm).

Table 3. Interaction effect of bulb size and plant spacing on umbel and seed characteristics of onion.

Bulb size × spacing		Umbel characteristics				Seed characteristics	
		No. of flowering stalks/plant	Length of flowering stalk (cm)	No. of umbels/ plant	No. of seeded fruits/ umbel	Seed wt/ umbel (g)	1000-seed wt (g)
B_1	S_1	2.39	70.53	2.37	208.44	0.69	3.15
	S_2	2.38	72.98	2.35	205.70	0.71	3.21
	S_3	2.50	75.86	2.42	202.45	0.72	3.27
	S_4	3.01	77.58	3.05	213.46	0.73	3.28
B_2	S_1	2.87	78.06	2.89	209.11	0.70	3.41
	S_2	2.99	78.06	2.96	228.07	0.71	3.43
	S_3	3.13	79.55	3.14	211.11	0.71	3.45
	S_4	3.27	81.81	3.24	222.89	0.74	3.47
B_3	S_1	3.53	80.63	3.35	221.78	0.74	3.64
	S_2	3.65	81.00	3.45	225.11	0.76	3.70
	S_3	3.81	83.36	3.76	235.94	0.78	3.79
	S_4	4.00	89.22	3.97	245.16	0.80	3.92
LSD (0.01)		0.34	1.36	0.06	11.39	0.06	0.039
CV (%)		3.21	2.56	2.43	4.21	3.89	3.54

Bulb size: B_1 = Small (5±2g), B_2 = Medium (10±2g), B_3 = Large (15±2g), Plant spacing: S_1 = (25x15cm), S_2 = (25x20cm), S_3 = (30x15cm), S_4 = (30x20cm).

Conclusion

The study concluded that the yield of onion seeds (*Taherpuri* cultivar) was significantly affected by the interaction effects of bulb size and plant spacing. The yield attributes and quality of onion seed were found to be gradually increased with the increase in bulb size. Plant spacing also greatly influenced the yield and quality of onion seeds. However, the largest bulb (15±2g) planted at the closest spacing (25×15cm) resulted in the highest seed yield per unit area with the greatest seed yield attributing traits and seed quality. Further investigation is, therefore, suggested for different agro-ecological climates of Bangladesh in order to confirm the present findings. In addition, economic analysis also needed to know the cost and benefits of the onion seed productions for the growers.

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