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Effect of bulb size on quality seed production of onion in Bangladesh

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Abstract

A study was conducted in the experimental farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur, which is situated at 24.040 N latitude and 90.40 E longitudes with an elevation of 8.4 meter from the sea level and in the 28th Agro ecological Zone (AEZ) during the year 2011 to 2012. The purpose of the study was to evaluate the effect of bulb size on quality seed production of onion. Onion variety "Taherpuri" with three bulb sizes (4g, 8g and 12g) had a remarkable impact on seed yield, yield attributes and seed quality. Plant height, number of leaves per plant, length of scape, number of umbles per plant, umble diameter, seed yield per plant, germination percentage and electrical conductivity were positively influenced by bulb size of onion. It was revealed that the big bulbs (12 gm) gave larger numbers of umbels per plant than the umbels grown from the medium (8 gm) and small (4 gm) ones. Small bulbs gave lowest umbel diameter with smaller inflorescences than the medium and large ones. The bulb size also did not affect seed yield per one seed stalk, but it did affect the seed yield obtained from the entire plant, which was bigger for plants grown from large bulbs in comparison with the small ones. Bulb size, however, showed significant effect. Thus, as bulb size increased, the number of flower stalks per bulb increased, as did in seed production per plant and per hectare.

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Introduction

Onion (*Allium cepa* L.) belonging to the family Alliaceae is one of the most important spices crop in Bangladesh. The main edible portion of the onion plant is the bulb, which is a modified organ constituted by the thickened fleshy leaf sheaths and stem plate. The most important character is its flavor, which increases the taste of food. Besides, it has also preservative and medicinal value. It is used to relieve insect bites and sore throat (Bose and Som, 1990). But Domestic production is insufficient to meet local demand, so imports are necessary. The unavailability of good quality onion seeds is partly responsible for such low yield in Bangladesh. The demand for bulb onion as well as quality seeds are increasing day by day and the price of seeds remain fairly high in each season. The total production of onion seed in Bangladesh is about 150 metric tons per year, but the requirement is more than 300 metric tons. The seed yield of onion is very low (370 to 500 kg ha^{-1}) as compared to the yield (1000 to 1200 kg ha^{-1}) of some other countries of the world (Brewster,1994).

Demand of onion seed is increasing due to increase in onion consumption. To sustain onion production, it is very difficult to increase yield horizontally but there exists a great scope to do the same vertically that could be achieved by using good quality seed. Therefore, it is essential to generate new knowledge and technologies regarding seed quality attributes for increased production of onion. Increased onion production always depends on good variety, use of modern production technology and good quality seeds. Inferior seeds may decrease even up to 15-25% of the crop production. Every year the area under onion cultivation in Bangladesh is increasing but the farmers are facing with the shortage of high quality seeds. Generally, onion seed is produced from planting mother bulbs. According to Mondal *et al.* (1980) onion seed price is directly proportional to onion bulb price used for growing seed crop. Although, onion seed can be produced either by planting mother bulb or by sowing seed directly. But all of the plants raised from seeds do not bear inflorescence in our country. Again, the plants grown from seed generally have fewer inflorescences per plant than those raised from mother bulb. For this reason, planting of bulb for seed production is preferred. The quality onion seed production is still dealt by small farmers, who have inadequate knowledge for selecting proper grade of the bulbs. The farmers of our country always use small bulbs for onion seed production. Further, mother bulb size exerts significant influence on quality onion seed production. Lack of awareness of onion seed growers in our country regarding bulb size is responsible for poor seed yield and low quality onion seed. The present investigation was undertaken to find out the suitable bulb size for the maximum yield and better quality of onion seed.

Materials and methods

Experimental site, design and treatments

The experiment was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Salna, Gazipur during the year 2011-2012 in order to achieve the desired objectives. Field experiments were conducted at the horticultural research field and laboratory experiments were done in the Laboratory of the Department of Seed Science and Technology, BSMRAU, Gazipur. The field experiment was laid out in Randomized complete Block Design (RCBD) with three replications. An area of 71.25 m^2 was divided into three equal blocks. Each block consisted of 3 plots where treatments were allotted randomly. There were 9 plots altogether in the experiment. The size of each plot was 2. 5 m x 2 m. The distance between two blocks and two plots were 1m and 0.75m respectively. Bulbs were planted on the plots with 15cm x 20 cm spacing. In this study, the treatments were included as three size of onion bulbs i.e. S_1 = 4g, S_2 = 8g and S_3 = 12g.

Planting material and cultural practices

Onion bulbs of the Taherpuri variety were used as planting materials. Manure and fertilizers such as Cowdung, Urea, Triple Super Phosphate (TSP), Muriate of Potash (MOP), Zinc and Boron were applied in the experimental field as per recommendation of BARI (1996). Bulbs were planted on November 16, 2011. The depth of planting was 5 cm from the surface of the soil. Sprouting was occurred between November 20 and 23, 2011. Un-sprouted bulbs were replaced on November 28, 2011 by healthy bulbs of same size within a week of initial planting. The seeds were harvested by cutting off the umbels when about 15-30% of the heads had black seeds exposed. Harvesting was done early in the morning to prevent shattering of seeds. After harvesting, the umbels were dried in scorching sun light for 3-4 days and then threshed manually. After threshing, seeds were cleaned and dried properly and kept in polyethylene bags, which were stored properly at room temperature.

Data Collection

Data on following parameters were recorded from randomly selected ten plants from each plot and their averages were taken for treating as per plant.

Number of leaves per plant: Number of leaves per plant was counted at the 30,45and 60 day after planting.

Plant height (cm): Measured from the ground level to the tip of the tallest leaves at the 30, 45 and 60 day after planting.

Scape length (cm): Measured from the ground level to the tip of the tallest flower stalk when all the flowers bloomed and 65, 85 day after planting.

Number of umbels per plant: Number of umbels per plant was counted 65, 85 day after planting at least two weeks before harvesting.

Umbel diameter (cm): Determined by measuring the diameter of the umbel, average diameter was recorded from the sample plants.

Seed yield / plant (g): The weight of seeds harvested from the tagged plants was recorded and then seed yield per plant was determined.

Seed yield per hectare (kg): The weight of seeds harvested from each plot was recorded and then seed yield per hectare was calculated.

Laboratory experiment

Collection of data: The data on thousand seed weight, electrical conductivity and germination percentage were recorded by using the following procedures.

Thousand Seed Weight (g).

Mean weight of randomly selected 1000 seeds were measured by using an electrical balance in gram (g).

Germination (%).

One hundred seeds in four replications were taken from each treatment and the germination test was conducted using top of paper method as per ISTA Rules (Anon, 1976) . The trays were placed in the germinator at a constant temperature of 25±1^{o}c and 95±1 percent relative humidity. The number of normal seedlings were counted at 6th and 12th day of the test of germination and expressed in percentage.

Electrical Conductivity (mS cm^{-1}).

Three grams of seeds from each treatment in four replications were taken and thoroughly washed in distilled water for five times. Then the seeds were soaked in 50 ml deionized water and kept in an incubator maintained at 25±1^{o}c for 20 hours. The seed leachate was collected and volume was made up to 50 ml by adding distilled water. The electrical conductivity of the seed leachate was measured in the digital conductivity meter expressed in mili Simons per centimeter (mS cm^{-1}).

Statistical analysis

The collected data from the experiment were analyzed by using statistical package programme MSTAT-C (version 2.6) to illustrate the statistical significance of the experimental results developed by Gomez and Gomez (1984). The means differences were compared by using Least Significant Difference (LSD) test at 5% level of significance.

Results and discussion

Number of leaves per Plant

There was a significant variation in leaf number per plant due to bulb size. The maximum number of leaves per plant (18.38) was found in large size bulbs (S_3) whereas, small size bulbs (S_1) produced the minimum number (8.63) per plant at 30 DAP. At 45 and 60 DAP the highest number of leaves per plant (23.46 and 24.39) was found in large size bulbs (S_3) whereas; small size bulbs (S_1) produced the lowest number (10.86 and 12.09) per plant (Table 1). It was evident that the number of leaves per plant increased with the increase of bulb size. Increased number of leaves per plant produced by larger size bulb due to presence of higher stored food materials resulting vigorous plants. The result is in conformity with the results of Hussain *et al.* (2001) and Asaduzzaman *et al.* (2012) who reported maximum number of green leaves per plant produced from large bulbs.

Table 1. Effect of bulb size on leaves/plant, plant height and scape length.

Treatment	Leaves/plant (no.) at			Plant height (cm) at			Scape length (cm) at	
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	65 DAP	85 DAP
S1	8.63c	10.86c	12.09c	42.34a	47.30a	51.99a	34.15b	67.14a
S2	12.89b	17.12b	18.73b	41.12b	46.02a	50.57a	40.02a	67.73a
S3	18.38a	23.46a	24.39a	40.17c	45.33a	47.70b	39.02a	67.24a
LSD (5%)	2.358	2.413	2.462	0.808	1.978	2.473	4.073	4.349
CV (%)	7.82	6.21	5.90	0.87	1.89	2.18	12.75	6.01

S_1 = 4g, S_2 = 8g and S_3 = 12g.

Plant height (cm)

There was a significant variation in plant height at 30 and 60 DAP due to bulb size but plant heights were statistically similar at 45 DAP. The highest plant height (42.34 cm and 51.99 cm) was found in small size bulbs (S_1) whereas, large size bulbs (S_3) produced the lowest plant height (40.17 cm and 47.70 cm) at 30 and 60 DAP respectively (Table 1). Probably it happened due to internal hormonal effect.

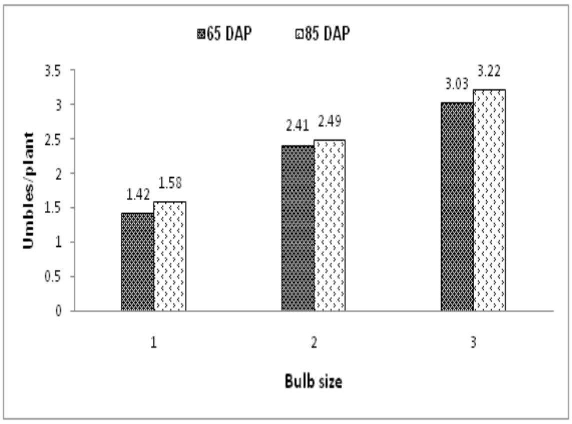
Table 2. Effect of bulb size on umbel diameter, seed yield/ha, Thousand seed weight, germination % and Electrical conductivity**.**

Treatment	Umbel diameter (cm)	Seed yield/ ha (kg)	Thousand seed weight(g)	Germination (%)	Electrical Conductivity (mS cm^{-1})
S_1	8.66b	1193.33c	3.31a	90.50c	0.52ab
S_2	9.27a	1383.33b	3.32a	94.75b	0.53a
S_3	8.93ab	1563.33a	3.29a	95.00a	0.49b
LSD (5%)	0.442	104.353	0.053	0.209	0.027
CV (%)	5.84	9.27	1.97	0.26	4.67

S_1 = 4g, S_2 = 8g and S_3 = 12g.

Scape length (cm)

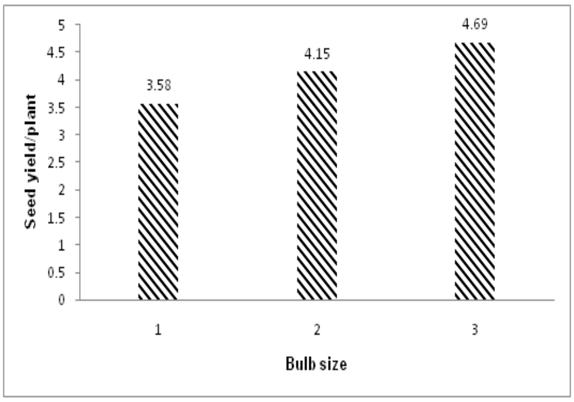
There was significant variation in scape length due to bulb size. The highest scape length (40.02 cm and 67.73 cm) was found in medium size bulb (S_2) whereas, small size bulb (S_1) produced the lowest (34.15 cm and 67.14 cm) scape length at 65 and 85 DAP, respectively (Table 1). Asaduzzaman *et al.* (2012); Farag and Koriem (1996) also reported that the tallest scape produced from large sized bulb while, the shortest scape from small-sized ones. In contrast to the results of the present study, Morozowska and Holubowicz (2009) reported no significant difference between scape heights. This might be due to environmental conditions of the experimental area.
Number of umbels per plant.



1=S_1 (4g), 2=S_2 (8g) and 3=S_3 (12g)

Fig. 1. Effect of bulb size on umbels per plant.

Size of mother bulb showed significant influence on number of umbels per plant. The number of umbels per plant was found to increase with the increase in bulb size (Fig. 1). The highest number of umbels per plant (3.03 and 3.22 at 65 and 85 DAP respectively) was produced from the large size bulb (S_3) which was followed by the medium size bulb (S_2). The lowest number of umbels per plant (1.42 and 1.58 at 65 and 85 DAP, respectively) was produced in small size bulb (S_1). The results of this experiment pertaining umbel production ability of bulbs were in agreement with the findings of several workers (Jones and Emsweller, 1939; Mondal *et al*., 1980; Rathore *et al*., 1980).



1=S_1 (4g), 2=S_2 (8g) and 3=S_3 (12g)

Fig. 2. Effect of bulb size on seed yield per plant.

Umbel diameter (cm)

There was significant variation in umbel diameter due to bulb size. The highest umbel diameter (9.27 cm) was found in medium size bulb (S_2), which was followed by large (S_3) and small (S_1) size bulb (8.93 cm and 8.66 cm) (Table 2). This might be due to higher supply of food materials to the umbel by larger bulb size. Asaduzzaman *et al.* (2012) revealed that plants from large bulbs produced the highest umbel diameter while the smallest bulb size produced the lowest diameter.

Seed yield per plant

Significant variations due to different bulb size were observed in respect of seed yield per plant. The large size bulb (S_3) produced the highest amount of seeds per plant (4.69 g) which was followed by medium size bulbs (S_2) and the small size bulbs (S_1) produced the lowest amount of seeds (3.58 g) per plant (Fig.2). It was evident that the seed yield per plant increased with the increase in bulb size. The higher food reserves in larger mother bulbs lead to the increased vegetative growth of plants which consequently related in higher seed yield per plant. The increase in seed yield per plant with the increase of bulb size might be directly related with the number of umbels per plant as influenced by bulb size. Rathore *et al.* (1980) reported that different bulb size had a marked effect on seed yield and they found that the seed yield was positively related with size of the mother bulb. Increase of seed yield with the increase of bulb size has also been reported by (Jones and Emsweller, 1939; Rusev, 1978; Mondal*et al.*,1980).

Seed yield per hectare

Significant variations due to different bulb size were observed in respect of seed yield/ha. The large size bulb (S_3) produced the highest amount of seeds/ha (1563.33 kg) which was followed by medium size bulbs (S_2) and the small size bulbs (S_1) produced the lowest amount of seeds (1193.33 kg) per hectare (Table 2). It was evident that the seed yield/ha increased with the increase in bulb size. Rathore *et al.* (1980) reported that different bulb size had a marked effect on seed yield and they found that the seed yield was positively related with size of the mother bulb. Seed yield increase with the increase of bulb size has also been reported by (Jones and Emsweller, 1939; Rusev, 1978; Mondal *et al.*,1980). This result agrees with the findings of Ud-Deen (2008) who reported that onion seed yield per hectare could be affected by the mother bulb size and the highest seed yield were obtained from large mother bulb while, the lowest seed yield was obtained from small mother bulb .

Thousand seed weight (g)

Seed size is an important parameter of seed quality because bigger seed encourages better seedling establishment in the field. Bulb size had no significant effect on 1000 seed weight. However the highest weight of 1000 seed (3.32 g) was recorded from medium size bulbs (S_2) and the lowest weight of 1000 seed (3.29 g) was recorded from large size bulbs (S_3)(Table 2).

Germination percentage

Bulb size had a significant effect on the harvested seed germination percentage. The highest percent of germination (95%) was recorded from large size bulbs (S_3) and the lowest percent of germination (90.50%) was recorded from small size bulbs (S_1) (Table 2). It is evident that the germination percent decreases with the decrease of bulb size. Increase in germination percentage might be due to high food reserves present in the large bulb which, in turn, might supply nutrient to the seeds. These results agreed with the results of Muktadir *et al.* (2001). They stated that the highest percentage of germination was obtained from the larger mother bulbs.

Electrical conductivity

There was significant variation among different bulb size in respect of electrical conductivity. The highest electrical conductivity (0.53 mS cm^{-1}) recorded from medium size bulbs (S_2) and the lowest electrical conductivity (0.49 mS cm^{-1}) was recorded from large size bulbs (S_3) (Table 2).

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