QUALITY SEED PRODUCTION OF ONION (ALLIUM CEPA L.): AN INTEGRATED APPROACH OF BULB SIZE AND PLANT SPACING


ABSTRACT

A field study was conducted at Regional Seed Production Office of Lal Teer Seed Limited, Dinajpur, Bangladesh during 2008-09. The objective was to see the effect of bulb size and plant spacing on seed quality of onion cultivar Taherpuri. The experiment included three bulb sizes viz. small (10±1g), medium (15±1g) and large (20±1g); and four plant spacings viz. 20×15, 25×20, 25×15, and 25×10 cm². Data on number of green leaves per plant, umbel diameter, number of flowers per umbel, seed yield per plant, seed yield per plot and germination percentage of seed were recorded. The results revealed that the highest seed yield per plant (3.78 g) was obtained from large bulb (20 ± 1g) at closer spacing of 25 × 20 cm² whereas maximum seed yield per plot (411.61 g) was obtained with large bulb size (20 ± 1g) with minimum spacing of 25 × 10 cm². The highest seed germination percentage (87.22) was obtained from same bulb size with spacing of 25 × 15 cm². Hence, for quality onion seed production, large bulb size combined with wider plant spacing is suggested.

KEYWORDS: Allium cepa; bulbs; spacing; agronomic characters; Bangladesh.

INTRODUCTION

Onion (Allium cepa L.) belonging to the family Alliaceae, is a major bulbous vegetable which ranks second only to tomato in terms of total annual world production (4). It is cultivated almost throughout Bangladesh and amongst all spices ranks first in production and second in acreage (3). During 2007-2008, onion occupied an area of 1,25,177 hectares with a total production of 8,89,260 m.tons (3). The seed yield of onion in Bangladesh is very low (370 -

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500 kg/ha) as compared to that of some other countries of the world (1000-1200 kg/ha) (5, 9). Onion production might be increased by increasing the area with good variety and changing the existing management practices. Through improved seed production technology, both yield and quality can be improved, to fetch higher prices in the market. Brewster (9) observed significant differences in seed yields since it depended on genotype, locality, season as well as methods of production. Khokhar et al. (13) noted that planting of bulbs of suitable size increased onion yield. Verma et al. (19) found that interaction between bulb size and spacing was higher only for total seed yield per plant with the heaviest bulb and minimum spacing. Larger bulb size (5.5-7.0 cm diameter) produced seed yield significantly higher than small sized bulb (1). Number of leaves per plant, effective fruits per umbel, percentage of fruit set, and seed yield were positively influenced by the large-sized mother bulb (6). Bulb size and plant spacing are the two key factors in producing quality onion seeds (14).

In Bangladesh, information on bulb size and plant spacing for Taherpuri variety is insufficient in respect of seed production as it is famous variety in Bangladesh. This study was, therefore, undertaken to find out the optimum size of mother bulb and plant spacing needed to achieve the best quality onion seed of this variety under existing agro-climatic conditions of northern Bangladesh.

**MATERIALS AND METHODS**

This study was conducted at Regional Seed Production Office of Lal Teer Seed Limited, Dinajpur, Bangladesh during 2008-09. The two-factor field experiment was laid out in completely randomized block design with three replications. Factor-A based on three bulb sizes viz. small (10±1g), medium (15±1g) and large (20±1g). Factor-B based on four plant spacings viz. 20 × 15, 25 × 20, 25×15 and 25 × 10 cm². The size of a unit plot was 4×1.5 m².

In this study, onion variety Taherpuri was used. It is world famous variety for its some special characteristics, such as highly pungent, shiny, narrow necked, hat shape, very high keeping quality and compact single bulb.

The average number of green leaves was noted from ten randomly selected plants at 45 days after planting (DAP). Umbel diameter was determined with a slide-caliper from the umbels of ten randomly selected plants and later average value was calculated in centimeters (cm). Number of flowers per umbel was counted from ten randomly selected plants at maximum flowering
stage and then the values were averaged. Similarly seed yield per plant was recorded from ten randomly selected plants and average value was expressed in grams. The moisture was adjusted at 9 percent. Total amount of seeds for each plot was bulked and weighed in grams. The moisture was adjusted at 9 percent.

The number of seeds germinated was recorded for each petridish daily according to Timson (18). Seeds were considered to have germinated when radical emerged about 1 mm from the seed (12). Germination percentage was determined by the following formula.

\[
\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds set for germination}} \times 100
\]

**RESULTS AND DISCUSSION**

**Effect of bulb size on plant characteristics**

**Number of green leaves per plant:** A significant difference in number of green leaves per plant in respect of bulb size was recorded (Table 1). Maximum number of green leaves (12.28/plant) was produced by large bulb size (20±1g) which decreased with decreasing bulb size. The poorest number of green leaves per plant (9.12) was recorded from small bulb size (10±1g). As bigger bulbs contain more sprouting initials leaf and reserve food material, those might be responsible for producing more leaves than smaller ones. Islam (10) also observed significantly higher leaf number from larger bulbs.

**Umbel diameter:** The mother bulb size considerably influenced the umbel diameter. The dissimilarities in umbel diameter for different bulb sizes were found to be statistically noteworthy (Table 1). Plants from large bulbs (20±1g) produced the highest umbel diameter (5.37cm) while the smallest bulb size (10 ±1g) produced the lowest diameter (4.75 cm). These results agree to the findings of Ambulker *et al.* (2) who found higher umbel diameter from larger bulb size of onion.

**Number of flowers per umbel:** Number of flowers per umbel varied considerably due to different bulb sizes (Table 1). Reduction in number of flowers per umbel was found with decrease in bulb size. Maximum number of flowers (228.30) observed with the largest bulb size (20±1g) and the lowest (176.40) from the smallest bulb size (10±1g). High food reserves in the large
bulb might have encouraged the initiation of more number of flowers per umbel.

**Seed yield per plant:** Seed yield per plant also significantly varied due to different bulb sizes (Table 1). The results revealed that the highest seed yield per plant (3.23g) was obtained from the largest bulb size (20±1g) and the lowest seed yield (2.53g) from small bulb size (10±1g). More number of flowers per umbel and flowers per plant caused by the larger sized bulbs increased the seeded fruits and finally seed weight per umbel as well as seed weight per plant. Muktadir et al. (15) reported that different bulb sizes had significant disparities in seed yield per plant which increased with increase in bulb size.

Table 1. Effect of bulb size on growth, yield contributing characteristics, yield and quality of onion seeds.

<table>
<thead>
<tr>
<th>Bulb size (g)</th>
<th>No. of leaves/plant</th>
<th>Umbel diameter (cm)</th>
<th>No. of flowers/umbel</th>
<th>Seed yield/plant (g)</th>
<th>Seed yield/plot (g)</th>
<th>Seed germination (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10±1</td>
<td>9.124</td>
<td>4.747</td>
<td>176.4</td>
<td>2.530</td>
<td>279.1</td>
<td>83.59</td>
</tr>
<tr>
<td>15±1</td>
<td>10.17</td>
<td>5.130</td>
<td>194.7</td>
<td>2.840</td>
<td>300.4</td>
<td>89.82</td>
</tr>
<tr>
<td>20±1</td>
<td>12.28</td>
<td>5.365</td>
<td>228.3</td>
<td>3.228</td>
<td>335.6</td>
<td>94.36</td>
</tr>
<tr>
<td>LSD</td>
<td>(0.05)</td>
<td>0.3824</td>
<td>0.2637</td>
<td>4.747</td>
<td>0.09275</td>
<td>5.435</td>
</tr>
</tbody>
</table>

CV% 4.29 6.12 2.81 3.82 2.10 2.93 3.64

*Significant at 5% level of probability, **Significant at 1% level of probability

**Seed yield per plot:** A significant decreasing trend of seed yield per plot was also observed with the reduction in bulb size (Table 1). The largest bulb (20±1g) produced maximum seed yield per plot (335.60g) against minimum seed yield per plot (279.10g) from the smallest bulbs (10±1g). This might be due to the production of maximum seed yield per plant by the largest bulbs. These results confirm the findings of some earlier workers (8, 9).

**Seed germination percentage:** The germination percentage of harvested seeds varied significantly due to different bulb sizes (Table 1). Seeds obtained from the largest sized bulb (20±1g) gave the highest germination percentage (94.36) while those produced from the smallest bulbs (10±1g) showed the lowest germination percentage (83.59). Muktadir et al. (15) also recorded higher seed germination percentage from larger mother bulbs.
Effect of plant spacing on plant characteristics

**Number of green leaves per plant:** Highly significant variation in number of green leaves per plant was recorded among different plant spacings (Table 2). More number of leaves (12.89) was recorded from the plants sown with wider spacing of 25×20 cm² against minimum (9.38) from the closest spacing 20×10 cm² (Table 2). Number of green leaves per plant increased with the decrease in plant density which might be due to less competition among plants of wider spacing for space, moisture, nutrients and light. These results support the findings of Singh and Sachan (17).

**Umbel diameter:** There was a significant disparity in respect of umbel diameter due to different plant spacings. The closer spacing (25×10 cm²) gave the lowest umbel diameter (4.79 cm) and wider spacing (25×20 cm²) gave the highest umbel diameter (5.44 cm) (Table 2). The increasing trend of umbel diameter was found with the increase in plant spacing. This might be due to higher supply of food materials to the umbel by the plants grown at wider spacing. This type of result has also been observed by Pandey et al. (16) that plants at wider spacing uptake nutrients (especially nitrogen) and water, producing large size of umbel.

**Table 2.** Effect of bulb size on the growth, yield contributing characteristics, yield and quality of onion seeds.

<table>
<thead>
<tr>
<th>Plant spacings (cm)</th>
<th>No. of leaves/plant</th>
<th>Umbel diameter (cm)</th>
<th>No. of flowers/umbel</th>
<th>Seed yield/ plant (g)</th>
<th>Seed yield/plot (g)</th>
<th>Germination percentage of seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>20×15</td>
<td>9.718</td>
<td>4.927</td>
<td>191.330</td>
<td>2.717</td>
<td>307.190</td>
<td>86.54</td>
</tr>
<tr>
<td>25×20</td>
<td>12.089</td>
<td>5.437</td>
<td>229.497</td>
<td>3.263</td>
<td>257.613</td>
<td>92.64</td>
</tr>
<tr>
<td>25×15</td>
<td>10.916</td>
<td>5.169</td>
<td>205.507</td>
<td>2.988</td>
<td>296.527</td>
<td>89.63</td>
</tr>
<tr>
<td>25×10</td>
<td>9.383</td>
<td>4.790</td>
<td>172.906</td>
<td>2.497</td>
<td>358.761</td>
<td>83.85</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>0.4416</td>
<td>0.3045</td>
<td>5.481</td>
<td>0.1071</td>
<td>6.275</td>
<td>0.98151</td>
</tr>
<tr>
<td>LSD (0.01)</td>
<td>0.5198</td>
<td>0.3584</td>
<td>6.451</td>
<td>0.1261</td>
<td>7.387</td>
<td>0.09854</td>
</tr>
<tr>
<td>CV%</td>
<td>4.29</td>
<td>6.12</td>
<td>2.81</td>
<td>3.82</td>
<td>2.10</td>
<td>6.38</td>
</tr>
<tr>
<td>Level of significance</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Significant at 5% level of probability, **Significant at 1% level of probability, NS = Non-significant.

**Number of flowers per umbel:** Number of flowers per umbel differed significantly due to spacing (Table 2). Significant increase in number of flowers per umbel with wider spacing was recorded. Maximum number of...
flowers per umbel (229.50) was obtained from wider spacing (25×20 cm²) and minimum (172.91) at the closest spacing (25×10 cm²). This might be due to maximum length and diameter of umbel at wider spacing which ultimately encouraged production of more number of flowers per umbel. Begum et al. (8) also observed higher number of flowers per umbel from higher plant spacing in onion.

**Seed yield per plant (g):** The seed yield per plant was significantly influenced by plant spacings. A gradual increase in seed yield per plant was recorded with the increase in plant spacing (Table 2). The highest seed yield per plant (3.269) was produced by the bulbs spaced at wider spacing (25×20 cm²) and the lowest (2.50) from maximum spacing (25×10 cm²). This increasing seed yield per plant, might be due to availability of more moisture, nutrient, space and light at wider spacing.

**Seed yield per plot:** Statistical analysis showed a significant variation in seed yield per plot due to plant spacings (Table 2). The seed yield per plot was the highest in closer spacing in spite of minimum seed yield per plant. The highest seed yield per plot (358.76g) was obtained from the bulbs with the closest spacing (25×10 cm²) and the lowest (257.61g) from wider spacing (25×20 cm²). This reverse result from previous parameters might be due to fact that the highest seed yield per unit area was associated with the closest spacing due to accommodation of maximum number of plants.

**Seed germination percentage:** The data revealed non-significant effect of spacing on the germination percentage (Table 2). The highest germination percentage (92.64%) was counted in case of maximum spacing (25×20 cm²) and minimum germination (83.85%) from minimum spacing (25×10 cm²). A decrease in seed germination percentage was noted as the plant spacing decreased. This might be due to lower availability of nutrients and water for the plants in case of closer spacing.

**Interaction effect of bulb size and plant spacing**

**Number of green leaves per plant:** Significant disparity in respect of number of green leaves per plant was recorded in the interaction effect of bulb size and spacing (Table 3). The largest bulb (20±1g) planted at the widest spacing (25×20 cm²) gave maximum number of green leaves per plant (14.50) and the smallest bulb (10±1g) with the closest spacing (25×10 cm²) produced minimum number of green leaves per plant (8.14).
Quality seed production of onion

**Umbel diameter:** The interaction effects of bulb size and plant spacing were statistically insignificant in respect of umbel diameter (Table 3). Treatment combination of large bulb (20±1g) and wider spacing produced maximum umbel diameter (5.69cm) and small bulbs (10±1g) at closest spacing produced minimum umbel diameter (4.47cm) (Table 3). This might be due to higher supply of food materials to the umbel by larger bulb, more light and nutrient absorption at wider spacing.

**Table 3. Interaction effect of bulb size and plant spacing on growth, yield contributing parameters, yield and quality of onion seeds.**

<table>
<thead>
<tr>
<th>Bulb size (g)</th>
<th>Plant spacing (cm²)</th>
<th>No. of green leaves/plant</th>
<th>Umbel diameter (cm)</th>
<th>No. of flowers/umbel</th>
<th>Seed germination (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10±1</td>
<td>20x15</td>
<td>8.81</td>
<td>4.59</td>
<td>170.64</td>
<td>78.33</td>
</tr>
<tr>
<td></td>
<td>25x20</td>
<td>10.27</td>
<td>5.14</td>
<td>198.09</td>
<td>80.67</td>
</tr>
<tr>
<td></td>
<td>25x15</td>
<td>9.28</td>
<td>4.79</td>
<td>185.46</td>
<td>79.78</td>
</tr>
<tr>
<td></td>
<td>25x10</td>
<td>8.14</td>
<td>4.47</td>
<td>151.58</td>
<td>76.33</td>
</tr>
<tr>
<td>15±1</td>
<td>20x15</td>
<td>9.21</td>
<td>4.97</td>
<td>186.04</td>
<td>81.78</td>
</tr>
<tr>
<td></td>
<td>25x20</td>
<td>11.50</td>
<td>5.48</td>
<td>224.63</td>
<td>84.22</td>
</tr>
<tr>
<td></td>
<td>25x15</td>
<td>10.47</td>
<td>5.24</td>
<td>199.79</td>
<td>83.00</td>
</tr>
<tr>
<td></td>
<td>25x10</td>
<td>9.51</td>
<td>4.83</td>
<td>168.49</td>
<td>80.33</td>
</tr>
<tr>
<td>20±1</td>
<td>20x15</td>
<td>11.13</td>
<td>5.22</td>
<td>217.31</td>
<td>84.67</td>
</tr>
<tr>
<td></td>
<td>25x20</td>
<td>14.50</td>
<td>5.69</td>
<td>265.77</td>
<td>87.22</td>
</tr>
<tr>
<td></td>
<td>25x15</td>
<td>13.00</td>
<td>5.48</td>
<td>231.27</td>
<td>85.78</td>
</tr>
<tr>
<td></td>
<td>25x10</td>
<td>10.50</td>
<td>5.07</td>
<td>298.67</td>
<td>84.22</td>
</tr>
<tr>
<td>LSD</td>
<td></td>
<td></td>
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<tr>
<td>CV%</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Level of significance</td>
<td>*</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at 5% level of probability, **Significant at 1% level of probability.

**Number of flowers per umbel:** There was insignificant effect of interaction of bulb size and plant spacing on number of flowers per umbel (Table 3). Large bulbs (20±1g) and wider spacing (25×10 cm²) gave maximum number of flowers per umbel (298.67) while small bulbs size (10±1g) and minimum spacing (25×10 cm) produced minimum flowers (151.58).

**Seed yield per plant:** This traits was significantly affected by interaction of bulb size and plant spacing. The highest yield per plant (3.78g) was harvested from combination of large bulb (20±1g) and wider spacing (25×20 cm²) (Fig. 1). Minimum seed yield (2.15g) was recorded from small bulb ((10±1g)) with the closest spacing. These results agree to the findings of
Mondal and Rahman (2000) where maximum seed yield per plant was obtained from the biggest sized bulbs planted at maximum spacing.

![Graph showing the interaction effect of bulb size and plant spacing on seed yield per plant of onion.](image)

**Fig. 1.** Interaction effect of bulb size and plant spacing on seed yield per plant of onion. Vertical bar indicates LSD at 0.01 level of probability.

**Seed yield per plot:** The combined effect of bulb size and plant spacing on seed yield per plot differed significantly at 5 percent level of probability (Fig. 2). The seed yield increased with reduction in spacing and increase in bulb size (Fig. 2). Maximum seed yield per plot (411.61g) was harvested in the combination of large bulb size (20±1g) with minimum spacing (25×10 cm²) against poor performance of the smallest size bulb (10±1g) at wider spacing.

![Graph showing the interaction effect of bulb size and plant spacing on seed yield per plot of onion.](image)

**Fig. 2.** Interaction effect of bulb size and plant spacing on seed yield per plot of onion. Vertical bar indicates LSD at 0.01 level of probability.

(25×20 cm²). These contradictory results from previous parameter i.e seed yield per plant might be due to fact that maximum seed yield per unit area
was associated with the closest spacing due to accommodation of maximum number of plants. Singh and Sachan (17) also obtained the highest seed yield per plot from minimum spacing with large bulbs.

**Germination percentage of seed:** The interaction effect of bulb size and spacing had highly significant influence on germination percentage. The highest seed germination (87.22%) was obtained from larger onion bulb (20±1g) planted at wider spacing (30×20 cm²) while maximum germination (76.33%) was noted in small bulb (10±1g) and closer spacing (20×10 cm²) (Table 3). Singh and Sachan (17) found that seed germination was non-significantly affected by the interaction of bulb size and plant spacing.

The yield attributes and germination percentage of onion seeds were found to be gradually increased with increase in bulb size. The largest bulbs (20±1g) excelled in quantity and quality of onion seeds. Plant spacing also greatly influenced the yield and germination percentage of onion seed. The closest spacing (25×10 cm²) surpassed in seed yield per plot whereas bulbs with the wider spacing (25×20 cm²) produced the highest seed yield per plant. The onion seed yield was significantly affected by the interaction of bulb size and plant spacing. The largest bulb planted at minimum spacing resulted in the highest seed yield per unit area, seed yield and germination percentage.

**REFERENCES**


