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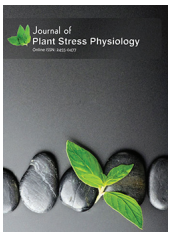

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# Effect of bulb size on seed yield of onion (*Allium cepa* L.)

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## ABSTRACT

The purpose of this study was to determine the bulb size on seed yield of onion (*Allium cepa* L.). The experiment was carried out over four months at Noakhali Science and Technology University. Normal environmental condition bulbs of different sizes were accordingly chosen and sown. Some minor factors, for instance, seed yield, thousands seed weight and germination rate were set and noted. Many times, the facts that were established were the line with our expectation of the link between bulb size and seed yield. Field grown bulbs producing larger flowers (40 g) always recorded higher seed yields as compared to the small bulbs (20 g). Additionally, bigger bulbs (40 g) specified even better germination incidences, hence showing a relationship between bulb size and seed quality. Based on these results, it might be postulated that in onion seed production appropriate classification of bulbs to produce seeds should be taken into consideration to obtain high quality seeds. Further studies can advance the understanding of a better way of cultivating to increase the efficiency of onion seed production.

**KEYWORD:** Onion Bulb Size, Seed Yield, Germination

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## INTRODUCTION

Onion (*Allium cepa* L.) of the Alliaceae family is one of the major spices in Bangladesh. The bulb that is mainly consisting of modified organ known as the meaty leaf sheathes and stem plate is the major edible part of the onion plant (Goldman, 2022). Among all crops that are used to produce spices, onions are very essential due the many uses in our daily lives. It usually goes by the title of the 'Queen of the Kitchen,' due to its valued taste, smell, and unique flavour that it adds together with the medicinal value of its essential oils (Ahmed *et al.*, 2020). The root system of a plant is called adventitious, and they are fibrous roots which grow mainly at the surface of the ground. The onion bulb can be found in onions can range in shape from flat to globular to oblong, and they typically come in three colours: these included red; yellow; and sometimes white. Onions contain two chemical groups known for their perceived health benefits: Flavonoids and alkenyl cysteine sulphoxides (ACSOs) (Griffiths *et al.*, 2002).

It has been revealed that the period of planting influences the seed yield and disease rate sharply. Sowing the seed crop during the first half of October also exposes it to diseases hence poor seed yield. Also, the burden of the bulb affects the production of onion seed significantly. Many researchers have studied the impact of planting date and bulb size of the mother stock on onion seed yield and quality, and tremendous research has been carried out in this context (Asaduzzaman *et al.*, 2012a).

Changes in consumer preferences toward increased consumption of onions are fueling demand in onion seeds. Onion seeds are raised for several uses and the plants are raised under various situations (Peters, 2018). There is great deal of scope to find out a way to increase the yield horizontally to sustain the onion production; however, vertically there is great potential to increase the same by using quality seed piece. It is, therefore, necessary for new knowledge and technologies concerning the quality attributes of the seed to be produced on how to enhance the production of onions in the identified areas. Increased yields of onions are always proportional to the quality of seeds used, better cultivation methods and available varieties (Yeptho *et al.*, 2012). Losses such as a deficiency in crop production by as much as 15-25 percent may be attributed to poor seeds. Every year the area under onion cultivation is increasing in Bangladesh, but there is a problem for the farmers to find good quality seeds. Onion seed is usually produced by planting the so called 'mother bulbs'. The cost of onion seed depends on the cost of onion bulbs used to produce seed crops

as estimated by (Ali *et al.*, 2015). Onion seed can be generated through two methods: such as direct seeding or planting of the mother bulb of the plants to be established. Nevertheless, in our country, not all plants that are started from seed develop an inflorescence. Again, the results obtained for the number of inflorescences from seedlings are lower than those from plants grown from mother bulbs, on average per plant. It is therefore preferred to plant bulbs to produce seeds as it takes only one cycle through the growth cycle to produce precious seeds. Small farmers still undertake the production of high-quality onion seeds, but this knowledge is not enough in selecting the right bulb grade. It is normally used by the farmers in our country to grow onion from small bulbs to produce seeds. In addition, the size of the mother bulb plays a very important role in the quantity of quality onion seeds that is produced. In our country, poor quality and low seed yield of onion seeds are attributed to onion seed growers' lack of awareness on the size of the onion bulb. To this end, the present study was carried out with a view to concluding on the right size of bulb that enhances on onion seed quality and yield, as stated by Wimalasekera (2015).

## MATERIALS AND METHODS

### Experimental Site

An experiment was carried out to find out the effect of size of the bulb on the seed yield of a particular variety of onion during rabi 2022-2023. The field trial was conducted on Rice Field at Noakhali Science and Technology University (NSTU) Noakhali, Bangladesh with the duration of January 05, 2023 to May 02, 2023. The soil of the experimental area is sandy loam soil of young Megna Estuarine flood plain (AEZ-18) according to UNDP of 1988.

### Experimental Soil

The site experimented on was the loam soil consisting of 40% sand, 40% silt and 20% clay with moderate organic material content of 0. 68%. Investigations made on soil composition revealed that there is adequate fertility that supports different crops with the reading of 0. 04 g/kg total nitrogen, 27. The available phosphorus in the topsoil was 79 µg/g and 0. Potassium: 18 meq$^2$/100 g available potassium. Also, the nature of the soil was revealed to have a pH of 7. The pH level was 5, which indicating that it is slightly alkaline (Osman *et al.*, 2020)

### Experimental Climate

Geographically, Noakhali region experience tropical climatic conditions and distinct seasonal variations though the changes in temperature variation are slightly different to that of the coastal regions of Bengal with high temperature in summer and low temperature in winter. The climate can therefore be said to be warm with an average mean annual temperature of 25 degrees Celsius. 6 °C (78.1 °F), average precipitation is 3,302 mm. The rainy season is from June to September while the dry season is from October to May; May being the hottest month with mean temperature of about 28.3 °C (82.9 °F) with the extreme in January of 19.5 °C (67.1 °F). The driest month is identified to be December with only 12 mm (0. 47 in) rainfall while the wettest month is July with 671 mm (26. 4 in) rainfall.

### Experimental Layout

This was performed in a one-factor field experiment through Randomized Complete Block Design (RCBD) at three replicates. In this respect, the experiment was conducted with above method employing bulb size for studying the impact of seed yield of onions. First, one needs to choose an appropriate land in NSTU campus. It was located right behind the VC house. Here, the total land area which was available for the construction of the building was 49 m$^2$. It was divided in 9 plots. Dimension of each plot 2 m x 2 m in addition, plot to plot gaps are equated to 0. 5 m for drainage. Assign each treatment (bulb size) of the test to any of the plots within the block randomly. Plotting 10 number of treatment (bulb size) in each plot.

### Treatment and Replication Details

The experiment involved three treatments, which corresponded to different bulb sizes: The goals were to increase the amount of fat by 20 g, 30 g and 40 g. Also, we identified three replication numbers labelled R1, R2, and R3. It was purchase from local market of Noakhali. The details of the product profile are mentioned below: Land Planting treatments at the same time.

### Planting Materials

In this work, the onion bulbs of different size grades belonging to the 'Taher Puri' cultivars were selected and used. These seed bulbs were collected from Local market of Noakhali. Seed yield production of onions involves growing of onion plants for seed purpose only where the plant material is selected and grown with an aim of producing seeds. This process involves the growing of the onion plants to maturity and allowing the plants set flower heads which on maturity contain the seeds.

### Main Land Preparation

The land had been tilled 3 times power tiller. Then the weeds where cleared. Use daily basal dose of fertiliser like Cowdung-10 kg, urea-0.6 kg, TSP-0.5 kg, MoP-0.4 kg. These are well mixed with soil. The following are well mixed with the soil The Countryside these are well mixed with the soil.

### Irrigation

In the cultivation of the onion, sufficient water had to be supplied to these plants at certain developing stages, and this can only be done through efficient irrigation management. A proper irrigation regime was set with an aim of providing the needy moisture to the crop depending on the type of soil, prevailing climate conditions and crop plants/development stage. Special concern was taken to ensure that the plants received adequate water without which the plants would

either suffer water stress or water logging which affects growth, flowering and fruiting of the onion plants.

### Statistical Analysis

The generated data was regulated using IBM SPSS 26 statistical software and figures were generated by Microsoft Excel 2016. The statistical analysis used in the study was the one-way ANOVA T-test to establish the level of significance of the given treatments that was set at 0. 05%.

## RESULTS AND DISCUSSION

### Effect of Bulb Size on Plant Height

This difference was noticeable in all the treatments, explaining the variation that was observed (Figure 1). Bulbs as large as 40 g produced the tallest plants, with an average height of Approximately 49.21 cm, compared to the more compact bulbs up to 60 days after planting (DAP). At the same time, the medium bulb (30 g) produced plants about 45 cm tall (average), while the smallest bulb yielded approximately 39.36 cm (average). The three treatments showed considerable differences. On the other hand, the observations taken at 45 DAP and 30 DAP also gave similar results. There was also a significant difference. As found in the results, bulb size has a strong influence on plant height. Plant height varies depending on the size of the planted bulb. The largest bulb produced the tallest plant compared to the smallest bulb. This finding is consistent with the study conducted by Ashrafuzzaman *et al.* (2009), who reported that the larger bulb size resulted in the tallest plant, followed by the medium-sized bulb, while the smallest bulb yielded the shortest plant.

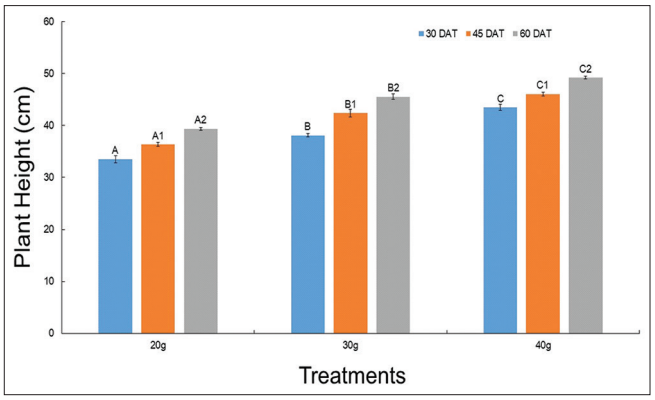


**Figure 1:** Effect of bulb size on plant height. 20 g the smallest size bulb, 30 g the medium size bulb, 40 g the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

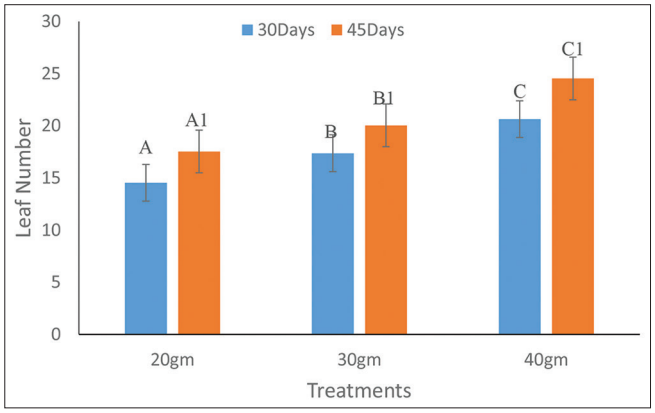


**Figure 2:** Effect of bulb size on leaf number. 20 g the smallest size bulb, 30 g the medium size bulb, 40 g the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

### Effect of Bulb Size on Leaf Number

Essentially, the researchers observed notable variations in the number of onion leaves, which they attributed to differences in bulb size (Figure 2). The results showed that the largest bulb (40 g) produced the highest number of leaves, with an average of 24.53 leaves at 45 DAP. In comparison, the medium-sized bulb (30 g) produced approximately 20 leaves (average), while the smallest bulb (20 g) yielded an average of around 17.53 leaves. These findings suggest a positive correlation between bulb size and leaf production.

Similarly, the observation at 30 DAP reflected a comparable trend, indicating that leaf number continued to vary with bulb size. A significant difference was observed among the treatments. Among all the bulbs, the largest one consistently produced the highest number of leaves. In terms of qualitative parameters, both medium and small bulbs produced fewer leaves than the large bulbs, suggesting that the number of leaves is influenced by bulb size. This result aligns with the findings of Ali *et al.* (2015), who reported a significant difference in leaf production based on bulb size. According to their study, at 30 DAP, the highest number of leaves per plant in an average (around 18.38) was observed in plants grown from the largest bulbs (40 g), whereas the lowest number in an average (about 8.63) was recorded in plants grown from the smallest bulbs (20 g). Furthermore, at 45 and 60 DAP, plants from large bulbs (40 g) produced in an average around 23.46 and 24.39 leaves per plant, respectively, while those from small bulbs (20 g) produced only in an average around 10.86 and 12.09 leaves per plant. This trend clearly illustrates a direct relationship between bulb size and the number of leaves per plant, likely due to the greater nutrient reserves in larger bulbs, which promote increased plant vigor and leaf development.

### Effect of Bulb Size on Umbel Number Of Onion

In the present study, there was a significant difference between the 20 g and 40 g treatments (Figure 3). However, there was no significant difference between the 20 g and 30 g treatments. Among the three bulb sizes, the largest bulb (40 g) exhibited the highest number of umbels. The largest bulb (40 g) had about 4.43 umbels (average). On the other hand, the medium bulb (30 g) had about 2.73 umbels (average), and the smallest bulb (20 g) had about 1.47 umbels (average). The result also showed that the largest bulb (40 g) produced more umbels than the smallest bulb (20 g). This indicates that the number of umbels depends on bulb size. This finding was consistent with

the study by Asaduzzaman *et al.* (2012b). Asaduzzaman *et al.* (2012b) found that the size of the maternal bulb significantly influenced the number of umbels per plant, with an increase in bulb size resulting in a higher number of umbels per plant.

## Effect of Bulb Size on No. of Flower per Umbel

There was a significant difference among the three types of bulbs (Figure 4). More flowering umbels were seen in the large size bulbs (40 g), with a number of about 215 (average). Then, the medium-sized bulb (30 g) had comparatively fewer flowering umbels, producing about 195 flowers (average). The smallest number of flowering umbels was observed in the small-sized bulb (20 g), with about 183 flowers (average). The difference in the number of flowers per umbel between the largest bulb size (40 g) and smallest bulb size (20 g) was about 32. The large-sized bulb (40 g) produced the highest number of flowers. This finding was supported by Mohanty (2000). According to Mohanty (2000), the number of flowers per umbel demonstrated a statistically significant relationship with bulb size. The large-sized bulb exhibited the highest number of flowers per umbel, with a mean of 301.33, whereas the small-sized bulb showed the lowest number of flowers per umbel, with a mean of 212.17.

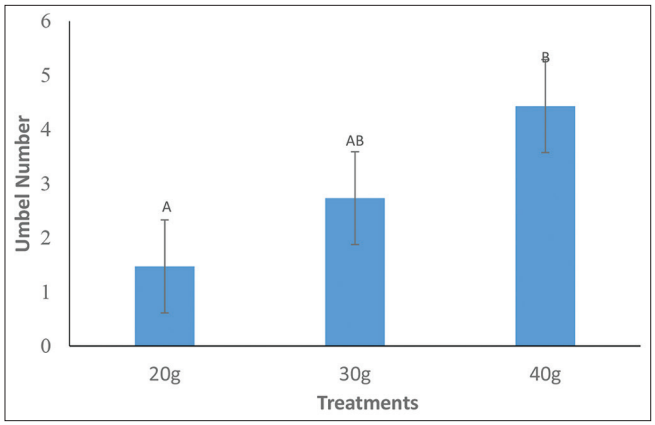


**Figure 3:** Effect of bulb size on umbel number of onion. 20 g the smallest size bulb, 30 g the medium size bulb, 40 g the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

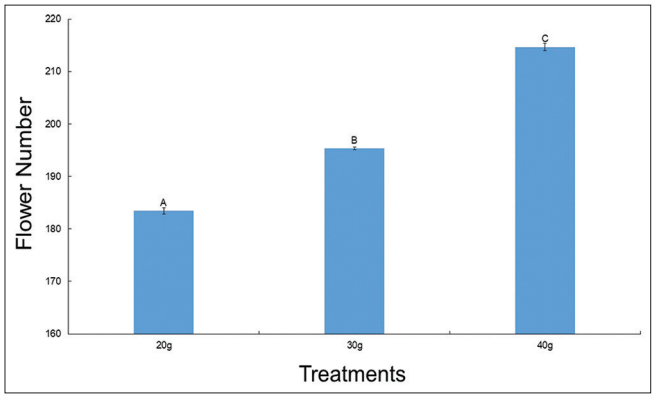


**Figure 4:** Effect of bulb size on No. of flower per umbel. 20 g the smallest size bulb, 30 g the medium size bulb, 40 g the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

## Effect of Bulb Size on No. of Capsule per Umbel

Treatments had a large effect on capsule number. The largest bulb yielded the highest average number of capsules per umbel compared to the other bulbs (Figure 5). The number of capsules in an umbel of the largest bulb (40 g) was about 59 (average). Medium-sized bulbs (30 g) had about 52 (average), and the smallest-sized bulbs (20 g) had about 46 (average). The difference in capsules per umbel between the largest and smallest bulbs was 13. The ability to produce capsules depends on the size of the bulb. Larger bulbs can produce more capsules. This finding aligns well with the study by Ahmed *et al.* (2020). Ahmed *et al.* (2020) also reported that the number of umbels per plot showed significant differences in terms of bulb size. Thus, there was a significant difference in the performance of the different bulb sizes, with the largest size providing the highest number of umbels per plot, averaging 46.83. The highest bulb size produced the most umbels per plot (average: 36.33), while the smallest bulb size yielded the lowest number of umbels per plot.

## Effect of Bulb Size on Scapes Height of Onion

There was a significant difference between the largest bulb (40 g) and the smallest bulb (20 g). However, no significant difference was observed between the medium and the largest bulbs (Figure 6). The bulb with the highest scape height was the largest one, measuring approximately 70 cm (average). In comparison, the medium-sized bulb produced a shorter scape height of about 60 cm (average). The smallest bulb (20 g) showed the lowest scape height, around 56.10 cm (average). Therefore, scape height appears to depend on bulb size-larger bulbs tend to produce taller scapes.

Ali *et al.* (2015) also reported that significant variation in scape length was attributed to bulb size. The medium-sized bulb (S2) exhibited the highest scape lengths, measuring 40.02 cm and 67.73 cm at 65 and 85 days after planting (DAP), respectively. Conversely, the smallest bulb (S1) yielded the lowest scape

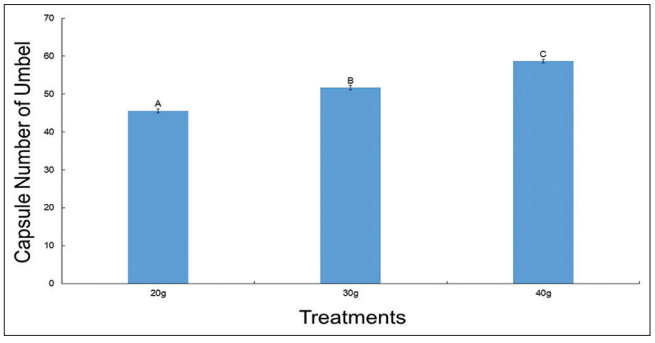


**Figure 5:** Effect of bulb size on No. of capsule per umbel. 20 g the smallest size bulb, 30 g the medium size bulb, 40 g the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

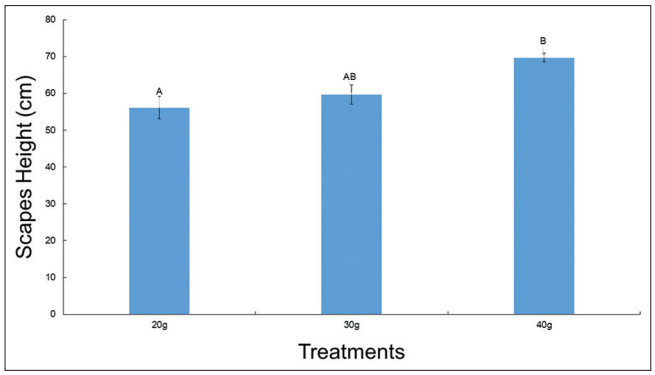


**Figure 6:** Effect of bulb size on Scopes height of onion. 20 g is the smallest size bulb, 30 g is the medium size bulb, 40 g is the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

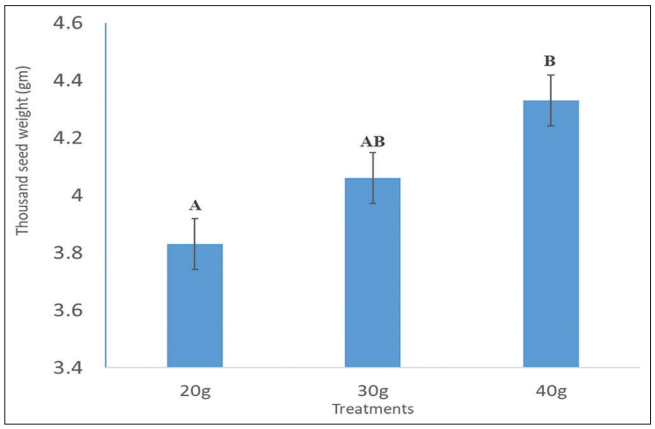


**Figure 7:** Effect of Bulb size on thousand seed weight. 20 g the smallest size bulb, 30 g the medium size bulb, 40 g the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

lengths, with mean values of 34.15 cm and 67.14 cm at 65 and 85 DAP, respectively.

### Effect of Bulb Size on Thousand Seed Weight

A notable distinction was perceived between the lightest bulb (20 g) and the heaviest bulb (40 g) (Figure 7). However, no statistically significant difference was found between the lightest bulb (20 g) and the moderate-sized bulb (30 g). Similarly, the difference between the heaviest bulb (40 g) and the moderate-sized bulb (30 g) was not statistically discernible. The bulb size influenced seed weight, with larger bulbs producing heavier seeds than smaller ones. In contrast, Mollah *et al.* (2015) reported that seed yield was consistently and significantly higher from large-sized bulbs.

### Effect of Bulb Size on Percentage of Seed Germination

The significance difference seen in three sizes of bulb. High germination percentage contain in large size of bulb (Figure 8). It's about 82.33%. Large size of bulb germination percentage was less than that obtained from medium size of bulb. It's about 47.33%. On the other hand, small size of bulb had the least germination percentage. It's about 24%. Difference germination percentage between the largest and the smallest bulb was 58.33%. High germination percentage contains seed of the largest bulb. It was like the study conducted by the author (Muktadir, 2000). As cited by (Muktadir, 2000), it was the revealed that the attributes of larger mother bulbs positively affect the germination in the seeds.

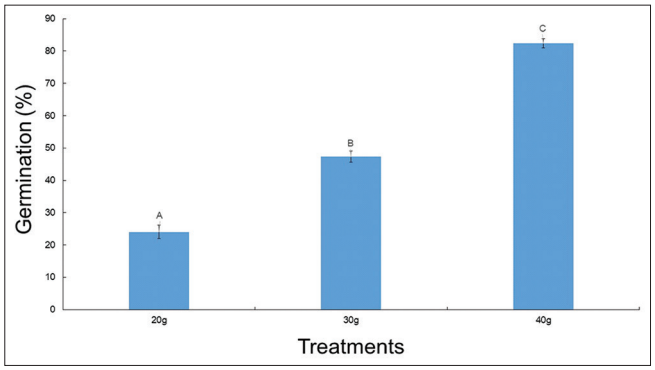


**Figure 8:** Effect of Bulb size on percentage of seed germination. 20 g the smallest size bulb, 30 g the medium size bulb, 40 g the largest bulb. Vertical bars indicate the standard error of the mean against each interaction

## SUMMARY AND CONCLUSION

The study revealed that bulb size interchangeably influenced the yield of onion seeds of the Taherpuri cultivar positively. The given characteristics associated with yield and quality of onion seeds pointed towards a gradual increase in value on average in proportion to the size of the bulbs. Nonetheless, the largest type of bulb (40 g) produced the highest seed yield per unit area, proving buffer traits of seed yield and quality.

From this study, it was found that there were significant differences among the treatments used. It was seen from the experiment that a plant with the largest bulb of 40 g had an average taller plant height of 49 cm. Significant differences in the number of onion leaves were also detected, which were attributed to the various sizes of onion bulbs. This was supported by another finding: the largest bulb (40 g) produced the highest average number of leaves (24.53). Furthermore, while analyzing the number of umbels, there was no statistical difference observed between the 20 g and 30 g treatments. Yet, a significant average difference was found between the 20 g and 40 g treatments. The largest bulb (40 g) had approximately an average of 43 umbels. A high germination percentage was also found in large-sized bulbs (40 g), which was on average about 82.33%. The results showed that the yield of onion seeds increased gradually on average with the increase in bulb size.

Therefore, it is suggested that similar research should be carried out in other agro-ecological regions of Bangladesh to validate these findings. However, an economic analysis is necessary to determine the cost-effectiveness and potential returns of cultivating onion seeds by farmers.

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