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# Quality Seed Production of Onion (*Allium Cepa* L.) cv. Sukhsagar as Influenced by Bulb Size and Date of Planting

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**Abstract**

The experiment was conducted at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, for consecutive two years during *rabi* seasons of 2012 and 2013 to study the influence of bulb size and date of planting on quality seed yield and economics of onion. In this experiment, two different factors were considered, factor: (P) three levels of planting time *viz*., 15th October, 30th October and 15th November; (B) three levels of bulb size *viz*, small (≤50g), medium (51- 65g) and large (66 -75g). The experiment consisting of nine treatments combination was laid out in "Factorial Randomized Block Design" with three replications. The results of over two years of experimentations revealed that 15th November planting of mother bulb exhibited significantly increased the vegetative characteristics *viz*, plant height (64.58 cm), number of leaves (41.85); flower and umbel characteristics viz., number of flower stalks per plant (3.86) and number of seeds per umbel (727.13); yield characteristics viz., seed yield per plant (9.58g) and seed yield per hectare (8.66q); quality characteristics of freshly harvested seeds *viz*, germination (92.92%) as compared to other date of planting. Regarding size of bulb, planting of large size bulb produced significantly better results in all the characteristics under the study than other medium and small size bulb. From economic point of view, the combination of large mother bulb planted in 15th November was most suitable for quality seed production of onion cv. Sukhsagar under New Alluvial Zone of West Bengal.

**Keywords:** Bulb size; Date of planting; Onion; Production; Quality seed

## Introduction

Onion (*Allium cepa* L.) is by far the most important vegetable crop grown in India. It is valued for its distinct pungent flavour and antioxidental components like, *allicin, alliinthiosulfates* and sulphites *etc*. present in onion helps fighting against free radicals which causes cancer, high blood cholesterol, sugar, liver problems and intestinal problems. India is one of the largest producers of onion in the world second only to China, accounting for 24.47% of world area and 20.20% of production [1]. The area and production of onion in India are about 10.51 lakh hectares and 168.13 Lakh tonnes of bulb, respectively, with an average productivity of 16.0 t/ha (Anonymous, 2013). The productivity is very low as compared to the world average productivity of 19.4 t/ha (Anonymous, 2013). Thus, reflecting the huge scope to increase yield in India. Lower productivity of onion in India could be attributed to the limited availability of quality seeds and associated production technologies used, among the others.

India needs 6500 tonnes of onion seeds annually for covering 8 lakh hectares area. Organized sector contribute around 54% of the total seed requirement, produced by maintaining proper isolation distance and rest is met by farmers own seeds, often produced without meeting isolation requirement [2]. Therefore, it becomes important to increase the supply of quality seed through the efficient use of the technology. True to type selection of bulb and time of planting are the basic ethics in the production and supply of quality onion seed. The time of planting has great impact over the seed yield [3-5] and incidence of the disease. Whenever the seed crop is planted in first fortnight of October is subjected to the heavy incidence of diseases and resulting poor seed yield. The bulb weight has markedly influenced the seed production in onion [6-8] Many researchers studied the impact of planting dates and mother bulb size on onion seeds production and its quality and a lot of work has been conducted, but in India a little information's are available on onion seeds production. Improved seed contributes substantially to enhance crop yield as high as 30% [9]. Keeping the above in view, the present experiment was envisaged to work out the most profitable bulb size and planting time for economically successful onion seed production.

## Materials and Methods

The field experiment was undertaken at the Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, (23.5°N latitude, 89°E longitude having an average altitude of 9.75m from the sea level), on Onion cultivar Sukhsagar during the *rabi* seasons of 2013 and 2014. The mother bulb was planted at a spacing of 30 cm x 30 cm. The experiment was conducted in a factorial randomized block design with two factors, i.e. three different planting time (P) viz., 15th October, 30th October and 15th November; three different bulb size (B) viz., small (≤50g), medium (51- 65g) and large (66 -75g) with nine treatments combination and three replications in the Gangetic New Alluvial plains of West Bengal, where soil type is sandy loamy in texture and slightly acidic in nature and contained 0.35% organic carbon, 0.04% total N, 22.61 kg $ha^{-1}$ available phosphorus and 183.21 kg $ha^{-1}$ available potassium, 20.70 kg $ha^{-1}$ available sulphur. The treatment details are following (Table 1).

**Table 1:** The details of the treatments.

| Factor I | Factor II |
|---|---|
| Date of planting (Factor =P) | Size of bulb (Factor =B) |
| 1. 15th October | 1. ≤50g (Small size) |
| 2. 30th October | 2. 51- 65g (Medium size) |
| 3. 15th November | 3. 66 -75g (Large size) |
| Treatment combinations: | |
| $T_1$ | $P_1B_1$ ( planted in 15th October with ≤50g bulb size ) |
| $T_2$ | $P_1B_2$ ( planted in 15th October with 51- 65g bulb size ) |
| $T_3$ | $P_1B_3$ ( planted in 15th October with 66 -75g bulb size ) |
| $T_4$ | $P_2B_1$ ( planted in 30th October with ≤50g bulb size ) |
| $T_5$ | $P_2B_2$ ( planted in 30th October with 51- 65g bulb size ) |
| $T_6$ | $P_2B_3$ ( planted in 30th October with 66 -75g bulb size ) |
| $T_7$ | $P_3B_1$ ( planted in 15th November with ≤50g bulb size ) |
| $T_8$ | $P_3B_2$ ( planted in 15th November with 51- 65g bulb size ) |
| $T_9$ | $P_3B_3$ ( planted in 15th November with 66 -75g bulb size ) |

Other cultural practices were followed in time as scheduled for its successful cultivation along with recommended dose of fertilizer (N: P: K: S: 125:80:100:40 kg $ha^{-1}$). Observations were taken on different vegetative, flower and umbel, yield and seed quality characteristics. The collected data were analysed statistically following the procedure described by [10]. Benefit cost ratio was worked out taking into consideration the cost of cultivation and net return.

## Results and Discussion

The inference drawn from the results obtained from two years of experiment are furnished below (on basis of pooled data over years).

### Effect of date of planting

**Table 2:** Plant height, Number of leaves per plant and Number of flower stalks per plant of onion seed crop as influenced by date of planting and bulb size (Pooled data of two seasons).

| Date of planting (P) | Plant height (cm) | | | | Number of leaves per plant | | | | Number of flower stalks per plant | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size of bulb (B) | | | | Size of bulb (B) | | | | Size of bulb (B) | | | |
| | $B_1$ | $B_2$ | $B_3$ | Mean | $B_1$ | $B_2$ | $B_3$ | Mean | $B_1$ | $B_2$ | $B_3$ | Mean |
| P1 | 53.85 | 58.59 | 67.01 | 59.82 | 28.64 | 36.71 | 41.85 | 35.74 | 2.11 | 2.96 | 2.62 | 2.56 |
| P2 | 58.28 | 63.76 | 67.46 | 63.17 | 30.24 | 33.93 | 48.32 | 37.50 | 2.79 | 3.21 | 3.87 | 3.29 |
| P3 | 57.90 | 67.11 | 68.73 | 64.58 | 31.86 | 41.56 | 52.14 | 41.85 | 2.86 | 3.99 | 4.74 | 3.86 |
| Mean | 56.68 | 63.15 | 67.73 | 62.52 | 30.25 | 37.40 | 47.44 | 38.36 | 2.58 | 3.39 | 3.74 | 3.24 |
| Factors | SE (m) ± | | CD (5%) | | SE (m) + | | CD (5%) | | SE (m) + | | CD (5%) | |
| Bulb size (B) | 0.72 | | 2.16 | | 1.37 | | 4.11 | | 0.06 | | 0.17 | |
| Date of planting (P) | 0.72 | | 2.16 | | 1.37 | | 4.11 | | 0.06 | | 0.17 | |
| Interaction (B X P) | 0.42 | | NS | | 0.79 | | NS | | 0.03 | | 0.10 | |


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| Treatment combinations: | | |
|---|---|---|
| $P_1$=15th October<br>October with ≤50g bulb size) | $B_1$=≤50g (small size) | $T_1=P_1B_1$ (planted in 15th |
| $P_2$=30th October<br>October with 51- 65g bulb size) | $B_2$=51- 65g (medium size) | $T_2=P_1B_2$ (planted in 15th |
| $P_3$=15th November<br>October with 66 -75g bulb size) | $B_3$=66 -75g (big size) | $T_3=P_1B_3$ (planted in 15th |
| October with ≤50g bulb size)<br>NS= Not significant | | $T_4=P_2B_1$ (planted in 30th |
| October with 51- 65g bulb size) | | $T_5=P_2B_2$ (planted in 30th |
| October with 66 -75g bulb size) | | $T_6=P_2B_3$ (planted in 30th |
| November with ≤50g bulb size) | | $T_7=P_3B_1$ (planted in 15th |
| November with 51-65g bulb size) | | $T_8=P_3B_2$ (planted in 15th |
| November with 66 -75g bulb size) | | $T_9=P_3B_3$ (planted in 15th |

As (Table 2) depicts, date of planting had significant effect on creating variation in plant height, number of leaves per plant and number of flower stalks per plant. These were increased with the progress in planting dates. Average values of these parameters were recorded as maximum as 64.58 cm, 41.85 and 3.86, respectively, from 15th November planting, while lowest values of 59.82 cm, 35.74 and 2.56, respectively were recorded from 15th October planting. Increased growth in onion, particularly plant height and number of leaves per plant, observed from 15th November of planting over the 15th and 30th October planting might be due to favourable cool temperature and fully sunny days during mid-November which promoted the maximum vegetative growth while the temperature at mid-October and late October was comparatively higher than 15th November. Moreover raining at mid-October and late October also caused excessive soil moisture and thus affected early damaged vegetative growth. Whenever the seed crop is planted in first fortnight of October, it is subjected to the heavy incidence of diseases, resulting in poor vegetative growth. The present results, in respect to the effect of date of planting on plant height, were in agreement with the findings of [3] who also observed significant positive effect of date of planting on final plant height. Observations of [5] regarding effect of date of planting on number of leaves production confirm the observations of the present investigation. They observed that 21st November and 26th November planting had better agronomic traits, respectively. [4] Who reported that highest significant increase in scape number per plant was resulted from planting on mid of November.

Significantly highest number of seeds per umbel, seed yield per plant and per hectare (727.13, 9.58g and 8.66q, respectively) was obtained from 15th November planted onion bulb followed by that in 30th October planted bulb, while minimum value of these parameters were recorded from 15th October planting (Table 3,4). Whereas, 1000 seed weight shows statistically *at per* with the different date of planting, however highest 1000 seed weight (3.50g) was recorded from 30thOctober planting. Planting time had significant effect on production of number of seeds per umbel. Onion planted on 21st November had better result as reported by Khodadadi, El-Helaly, Anisuzzaman et al., Verlag [3-6] also recorded that planting date had significant effect on number of seeds per umbel. The present findings are in conformity with the report of El-Helaly & Karam [4], who recorded that planting on mid of November significantly increased seed yield per plant. Similarly, these findings were also in conformity with the observations of [11]. These results on seed yield per hectare are influenced by date of planting, in consonance with the results of [4] who pointed out that the highest significant increase of seed yield per hectare was resulted from planting on mid-November. Anisuzzaman et al. and Singh et al. [5,12] also presented similar views. El-Helaly & Karam [4] recorded significant increase in 1000 seed weight were resulted from planting on mid of November.

It was also noticed that highest magnitude in 1000 seed weight, seed yield per plant and per hectare during 15th November irrespective of the other treatments might be due to the cumulative contribution of the entire yield contributing characters viz. number of seeds per umbel, weight of seeds per umbel, weight of seeds per plant and plot, higher occurrence of test weight of seed, boldness of seed and dry matter accumulation in reproductive parts of the plants, influenced by favourable weather condition during seed formation and maturation (comparatively high temperature and long day length) period. Seed yield of onion also depends on indirect components, a strong vegetative growth that comprises of plant height and number of leaves. Favourable cool temperature and fully sunny days in the mid-November promoted the better vegetative growth by encouraging photosynthesis and partitioning of photosynthesis to the reproductive part of the plant could be the reason for these improvements.

Date of planting did not show any marked increase in germination percentage of harvested seeds (Table 4). Though insignificant, highest magnitude of average germination potential was recorded as 92.92 % of seeds produced from 15th November planting and it was minimum as 89.50 % of seeds produced from 15th October planting during pooled condition of years of experimentation. Krishnaveni et al. [13] reported that planting of onion in 2ndand 3rd week in November gave best seed quality in terms of germination percentage. Similar results were also reported by [4]. The highest benefit and cost ratio i.e. 4.08 was observed from 15th November planting and lowest i.e. 2.05 were obtained from 15th October planting, which might be due to maximum yield and comparatively lower cost of cultivation than all other treatments.


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### Effect of bulb size

Mother bulb size significantly influenced the plant height, number of leaves per plant and number of flower stalks per plant (Table 2). In general these parameters increased with increase in bulb size. When average was made over planting dates, significantly maximum plant height, number of leaves and number of flower stalks per plant(67.73 cm, 47.44 and 3.74, respectively) were recorded after big size bulb which followed by medium size bulb and small size bulb. Larger sized bulbs produced the highest plant height, number of leaves and no. Of flower stalks per plant, while it was reverse for the small sized bulbs, which may be due to the influence of relatively greater amount of internal food reserves stored in large size bulbs than smaller ones leading to vigorous vegetative growth with enhanced plant height, number of leaves per plant and number of flower stalks per plant. The present results were in close line with the findings of [6] who also reported significant influence of bulb size on enhancement in plant height, which can also be supported by the findings of Neeraj et al., Kumar and Singh and Singh et al. [14,15]. production of higher number of leaves due to planting of large size bulbs have also been reported by Asaduzzaman et al., Neeraj et al., Kumar and Singh and Singh et al. [14-16]. Verlag [6] who observed that plants grown from large bulbs produced highest number of flower stalks.

**Table 3:** Number of seeds per umbel, 1000 seed weight and seed yield /ha as influenced by date of planting and bulb size (Pooled data of two seasons).

| Date of planting (P) | Number of seeds per umbel | | | | 1000 seed weight (g) | | | | Seed yield per plant(G) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size of bulb (B) | | | | Size of bulb (B) | | | | Size of bulb (B) | | | |
| | B1 | B2 | B3 | Mean | B1 | B2 | B3 | Mean | B1 | B2 | B3 | Mean |
| P1 | 527.75 | 745.07 | 774.05 | 682.29 | 3.26 | 3.36 | 3.40 | 3.34 | 3.47 | 7.43 | 6.33 | 5.75 |
| P2 | 650.77 | 703.35 | 776.75 | 710.29 | 3.53 | 3.43 | 3.52 | 3.50 | 5.98 | 8.42 | 8.80 | 7.73 |
| P3 | 626.10 | 779.26 | 776.04 | 727.13 | 3.35 | 3.58 | 3.53 | 3.49 | 5.66 | 10.47 | 12.61 | 9.58 |
| Mean | 601.54 | 742.56 | 775.61 | 706.57 | 3.38 | 3.46 | 3.49 | 3.44 | 5.04 | 8.78 | 9.25 | 7.69 |
| Factors | SE (m) ± | | CD (5%) | | SE (m) ± | | CD (5%) | | SE (m) + | | CD (5%) | |
| Bulb size (B) | 6.20 | | 18.61 | | 0.07 | | NS | | 0.17 | | 0.52 | |
| Date of planting (P) | 6.20 | | 18.61 | | 0.07 | | NS | | 0.17 | | 0.52 | |
| Interaction (B X P) | 3.58 | | 10.75 | | 0.04 | | NS | | 0.10 | | 0.30 | |

**Treatment combinations:**

| | | |
|---|---|---|
| $P_1$=15th October<br>October with ≤50g bulb size) | $B_1$=≤50g (small size) | $T_1=P_1B_1$ (planted in 15th |
| $P_2$=30th October<br>October with 51- 65g bulb size) | $B_2$=51- 65g (medium size) | $T_2=P_1B_2$ (planted in 15th |
| $P_3$=15th November<br>October with 66 -75g bulb size) | $B_3$=66 -75g (big size) | $T_3=P_1B_3$ (planted in 15th |
| October with ≤50g bulb size)<br>NS= Not significant | | $T_4=P_2B_1$ (planted in 30th |
| October with 51- 65g bulb size) | | $T_5=P_2B_2$ (planted in 30th |
| October with 66 -75g bulb size) | | $T_6=P_2B_3$ (planted in 30th |
| November with ≤50g bulb size) | | $T_7=P_3B_1$ (planted in 15th |
| November with 51- 65g bulb size) | | $T_8=P_3B_2$ (planted in 15th |
| November with 66 -75g bulb size) | | $T_9=P_3B_3$ (planted in 15th |


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**Table 4:** seed yield, quality and economics of seed production as influenced by date of planting and bulb size (Pooled data of two seasons).

| Date of planting (P) | Seed yield per hectare (q) | | | | Germination (%) | | | | Benefit and cost ratio | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Size of bulb (B) | | | | Size of bulb (B) | | | | Size of bulb (B) | | | |
| | $B_1$ | $B_2$ | $B_3$ | Mean | $B_1$ | $B_2$ | $B_3$ | Mean | $B_1$ | $B_2$ | $B_3$ | Mean |
| $P_1$ | 3.03 | 6.54 | 5.46 | 5.01 | 87.67(69.47) | 90.33(71.85) | 90.50(72.05) | 89.50(71.09) | 1.02 | 3.03 | 2.10 | 2.05 |
| $P_2$ | 5.38 | 7.58 | 8.07 | 7.01 | 89.50(71.09) | 92.67(74.32) | 93.67(75.46) | 91.94(73.46) | 2.49 | 3.58 | 3.32 | 3.13 |
| $P_3$ | 5.10 | 9.49 | 11.39 | 8.66 | 89.17(70.81) | 94.60(76.56) | 95.00(77.08) | 92.92(74.55) | 2.32 | 4.72 | 5.21 | 4.08 |
| Mean | 4.50 | 7.87 | 8.30 | 6.89 | 88.78(70.45) | 92.53(74.11) | 93.05(74.77) | 91.45(73.05) | 1.94 | 3.78 | 3.54 | 3.09 |
| Factors | SE (m) + | | CD (5%) | | SE (m) ± | | CD (5%) | | | | | |
| Bulb size (B) | 0.15 | | 0.45 | | 1.26 | | NS | | | | | |
| Date of planting (P) | 0.15 | | 0.45 | | 1.26 | | NS | | | | | |
| Interaction (B X P) | 0.09 | | 0.26 | | 0.73 | | NS | | | | | |

| Treatment combinations: | | |
|---|---|---|
| $P_1$=15th October | $B_1$=≤50g (small size) | $T_1=P_1B_1$ (planted in 15th |
| October with ≤50g bulb size) | | |
| $P_2$=30th October | $B_2$=51- 65g (medium size) | $T_2=P_1B_2$ (planted in 15th |
| October with 51- 65g bulb size) | | |
| $P_3$=15th November | $B_3$=66 -75g (big size) | $T_3=P_1B_3$ (planted in 15th |
| October with 66 -75g bulb size) | | |
| October with ≤50g bulb size) NS= Not significant | | $T_4=P_2B_1$ (planted in 30th |
| October with 51- 65g bulb size) | | $T_5=P_2B_2$ (planted in 30th |
| October with 66 -75g bulb size) | | $T_6=P_2B_3$ (planted in 30th |
| November with ≤50g bulb size) | | $T_7=P_3B_1$ (planted in 15th |
| November with 51- 65g bulb size) | | $T_8=P_3B_2$ (planted in 15th |
| November with 66 -75g bulb size) | | $T_9=P_3B_3$ (planted in 15th |

Figure in parenthesis indicates the angular transformed value.

The size of bulb showed profound effect on flower, umbel and yield parameters. Significantly marked effects were recorded for varying bulb size on number of seeds per umbel, seed yield per plant and seed yield per hectare (Table 3&4). Plant raised from large size bulb recorded significantly maximum number of seeds per umbel (775.61), seed yield per plant (9.25g) and seed yield per ha (8.30q) which was significantly superior to small size bulb and were *at par* with medium size bulb . Lowest values for these parameters were recorded in small size bulb. Whereas, 1000 seed weight shows statistically insignificant with the different bulb size, however highest 1000 seed weight (3.49g) was recorded from large size bulb planting. Bulb size also had significant effect on number of seeds per umbel. These results were in consonance with the report of Verlag [6] who noted that large size bulb produced highest number of seeded florets per umbel. Corroborative results regarding influence of bulb size were reported by Asaduzzaman et al. [16] who revealed that the highest seed yield per plant was obtained from large size bulb. Results in effect of bulb size on seed yield per hectare are generally analogous to the studies of [6,7] who also revealed that large size bulb produced higher seed yield per hectare. Similar results are also recorded by Agarwal et al., Neeraj et al., Khan et al. and Singh et al. [8,14,17,18]. Significant effect of bulb size on 1000 seed weight were observed by Singh et al. [18], wherein highest 1000 seed weight was recorded after large size bulbs (5.0-6.0 cm diameter). These results might be due to the greater availability of nutrients from large size bulbs and prevailing favourable weather condition for seed development and maturation resulting increased number of umbels per plant, weight of seeds per umbel and increased seed yield per plant, which contributed to these values.

The quality characteristics of harvested seed showed statistically *at par* with different bulb size (Table 4). However, among the different bulb size, big size bulb produced seeds showed maximum germination percentage (93.05%). Lowest values of this quality characteristic were recorded from small size bulb. Large size bulbs produced seeds with highest germination percentage were reported by Asaduzzaman et al., Khan et al., Singh et al., Singh & Ahmed [16-19] Insignificant enhancement in germination potential recorded in the present investigation may be due to greater environmental influence and/or different variety included in condition of the experiment.


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From economic point of view regarding cost of cultivation highest benefit cost ratio was observed in medium size bulb (3.78), due to low cost of cultivation than big size bulb. The lowest value was reported from small size bulb. These results are in close line with the findings of Khan et al. [17].

### Interaction effect

Interaction effects of date of planting and bulb size on plant height and number of leaves per plant did not differ significantly (Table 2). However, large size bulb planted in 15th November recorded the highest plant height (68.73 cm) and number of leaves per plant (52.14). The interaction effects of date of planting and bulb size on flower and umbel characters were found to be statistically noteworthy (Table 3). However, maximum values for number of flower stocks per plant (4.74) was observed from big size bulb planted in 15$^{th}$ November and maximum number of seeds per umbel (779.26) were observed from medium size bulb planted in 15$^{th}$ November. Significant influence on plant growth due to interaction of date of planting and bulb size as recorded by Uddeen [20] and [3] was in contradiction to the present findings, may be due to either inclusion of variety with different genetic background or varied environmental situation of experimental site or both. The better flower and umbel characters were observed in 15$^{th}$ November planting than those in 15$^{th}$ and 30$^{th}$ October planting. These results were expected since favourable weather conditions are pre requisite for flower stalks initiation and development, which are generally received by the plants planted on 15$^{th}$ November. High temperature and heavy rain during 15$^{th}$ October and 30$^{th}$ October planting may have caused excessive soil moisture and poor vegetative growth leading to reduced availability of photosynthates for initiation of strong flower stalks, larger umbel development and seed setting percentage per umbel. Onion requires cool weather during inflorescence initiation and seed stalk development [21]. A moderately high temperature and dry weather conditions are congenial for seed maturation.

The treatment combinations between date of planting and bulb size also resulted in a significant increment in yield characteristics except 1000 seed weight. However maximum values for seed yield per plant (12.61g) and seed yield per hectare (11.39q) were noted from $P_3B_3$ treatment combination. Whereas, maximum value of 1000 seed weight (3.58g) was observed from $P_3B_2$ treatment combination. . Combined influence of planting date and bulb size is in agreement of the findings of [3], who also reported that the highest number of seeds per umbel belongs to planting 6$^{th}$ November with mother bulb size 65 to 80 mm. The interaction effects between date of planting and bulb size on seed yield per plant are in accordance with the findings of [20] and Khokhar et al. [22]. Regarding seed yield per ha the interaction effects are consistent with the research done by Anisuzzaman et al., Singh et al., and Khokhar et al. [3,5,18,20,22,23].

Regarding seed quality character in respect to germination percentage of harvested seeds showed no marked effect due to interaction effect between date of planting and bulb size (Table 4). Large size bulb planted in 15$^{th}$ November showed maximum germination percentage (95%) and maximum economic in respect to benefit cost ratio (5.21). The treatment combinations of small size bulb planted in 15$^{th}$ October showed lowest results regarding all vegetative, flower and umbel characteristics, yield and quality characteristics. Results on interaction effects are in close line with that of [24], who found that seed germination was insignificantly affected by the interaction of bulb size and plant spacing. These results on economics are in close accordance to the studies of [7] who pointed out that medium sized bulbs are better and economical for seed production and last week of October to first fortnight of November is the best time for planting of bulbs in rabi onion varieties for getting economic benefit from onion seed production. Singh et al. [18] also expressed similar opinion.

## Conclusion

The results of this experiment showed that planting dates had varied influence on quality seed production of onion. Among the planting dates studied, 15$^{th}$ November was the more suitable than other planting dates. The vegetative growth and seed production ability of the plants increased gradually with the increase in bulb size. From economic point of view, the combination of large mother bulb planted in 15$^{th}$ November was most suitable for quality seed production of onion *cv*. Sukhsagar under New Alluvial Zone of West Bengal.

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