

Influence of Bulb Size and Spacing on Crop Growth, Yield and Quality of Onion (*Allium cepa*) Seed under High Altitudes of Leh-Ladakh

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ABSTRACT Three bulb size (2.5 cm, 5.0 cm and 7.5 cm diameter) and three spacing combinations (45 cm x 10 cm, 45 cm x 20 cm and 45 cm x 30 cm), showed significant effects on crop growth, yield and quality attributes (except germination %) of the seeds during seed production of onion cv. Early Grano – 50 at Defence Institute of High Altitude Research, Leh-Ladakh (J&K). The maximum seed yield of 10.4 q/ha was obtained with bulb size of 7.5 cm dia. The closer spacing of 45 cm x 10 cm had marked influence on plant height and seed yield. However, wider spacing of 45 cm x 30 cm recorded better performance or almost all the other studied attributes.

Key words: High altitude, onion seed production, bulb size, spacing, seed yield, seed quality

Onion (*Allium cepa* L.) is one of the major vegetable crops required in large quantity by the civil population and armed forces in Leh-Ladakh Sector of J&K. It can be stored for a longer period under underground storage [technique standardized by Defence Institute of High Altitude Research (DIHAR) for high altitude cold-desert conditions]. But the production and productivity of onion are very low in Ladakh region. The local farmers are able to meet only about 20 per cent of the total requirement of the region and the remaining quantity is imported from other states [1]. During summer season, it is transported by surface, and in winter by air, which is a very expensive. The main reasons, identified behind the lower production and productivity were non-availability of quality seed of high-yielding long day cultivars and poor application of improved production technology. Ladakh being a high altitude cold-desert region has different types of physiographic conditions. The region is identified as an ideal seed production pocket, for certain vegetable crops, due to naturally occurring favourable climatic conditions, such as low rainfall and humidity, bright sunshine, long photoperiod and incidence of pests and diseases during the cropping season

[2]. The information on onion seed production technology for high altitude cold-desert regions, needed to be standardized by an appropriate efficient seed production technology for attaining higher yield.

The type of cultivar and bulb size are known to affect seed yield, seed quality and production cost [3, 4]. Planting space of the bulbs also play an important role in harvesting better seed quality coupled with optimum yield [5]. Therefore, this study was conducted to identify the effects of bulb size and spacing on onion seed production in high altitude cold-desert conditions of Leh-Ladakh.

MATERIALS AND METHODS

A field experiment was conducted at DIHAR, Leh-Ladakh (J&K) and laboratory study on seed quality parameters was carried out at DIHAR Base Office, Chandigarh during 2008 and 2009. It consisted of nine treatment combinations comprising three bulb size, viz. 2.5 cm, 5.0 cm and 7.5 cm diameter and three spacing, viz. 45 cm x 10 cm, 45 cm x 20 cm and 45 cm x 30 cm. The experiment was laid out in a Factorial Randomized Block Design in three replications.

The long-day cultivar, Early Grano-50 (EG-50) of Bejo Sheetal Seeds Pvt. Ltd, suitable for Leh-Ladakh condition for obtaining higher yield with quality bulbs was selected. The mature onion bulbs were harvested in last week of October in 2007 and 2008, for conducting the trials in the cropping season (May-October) of 2008 and 2009, respectively sorted, cured and graded. The bulbs were stored from November to second week of April in an underground (2.4 m deep) store, following standardized method [2]. Bulbs were taken out from the store in third week of April, and the reselected bulbs were planted in well-prepared field beds of 1.8 m x 1.8 m size in last week of April, during both the years.

The FYM @ 25 MT/ha was incorporated before the ploughing. A dose of 70 kg P₂O₅, 46 kg K₂O and 27 kg N/ha was applied just before planting of bulbs and 90 kg N/ha was applied by topdressing in two split doses (first 30 and second 55 days from sowing). Cultural operations including irrigation, weeding, earthing up, etc. were carried out as per described by Singh and Singh [2]. The crop was harvested in September. The data on plant height, sprouts/hill, umbel/hill, umbellates/umbel, seeds/umbel, seed yield, seed germination percentage, seedling length and seed vigour index were recorded.

RESULTS AND DISCUSSION

The data presented in Tables 1, 2 & 3 indicated that bulb size and spacing had influenced the crop growth, seed yield and seed quality. Significant effects of both the factors were observed on all characters except seed germination percentage.

Effects of bulb size

The bulb size showed significant effects on plant height, number of sprouts/hill, number of umbel/hill, number of umbellates/umbel and number of seeds/umbel (Table 1). All these parameters showed boosting effects with increased bulb size. Large-sized bulbs produced maximum plant height (96.2 cm). This might be due to the possibility of higher food and nutrients reserve present in large-sized bulbs. Dadhanja and Gajipara [6] reported maximum height of the

plants with large-sized bulbs. The same is true in production of maximum number of sprouts and umbel/hill. Similar trend was also reported by Singh and Sachan [7]. Significantly higher number of umbellates/umbel (178.8) was obtained by larger bulbs of 7.5 cm diameter. Similar results on superiority of larger bulb one for size of the umbel were reported by Singh *et al.* [8] and Thapa *et al.* [9].

The maximum seed yield (10.4 q/ha) was recorded with large bulb of 7.5 cm (Table 1). This might be due to higher food and nutrients reserve in large bulbs, thus have beneficial effects on the crop growth and seed yield.

Seed yield was directly related to better plant in terms of significantly higher number of umbel/plant, and seeds/umbel in large-sized bulbs. These findings were in agreement with those of Thapa *et al.* [9] and Srivastava *et al.* [10].

The maximum test weight (1000-seed weight), seedling length and seed vigour index were recorded with large-sized bulb of 7.5 cm dia over 5.0 and 2.5 cm diameter (Table 2). However, seed germination percentage did not vary significantly with difference in size of bulbs under present study. Thapa *et al.* [9] reported higher 1000-seeds weight with large bulb of 50-65 g.

Effects of spacing

The data showed that spacing of bulbs had significant effects on plant height, number of sprouts/hill, number of umbel/hill, number of umbellates/umbel and number of seeds/umbel (Table 1). Higher plant height (98.7 cm) was recorded with closer spacing (45 cm x 10 cm) and it was significantly superior to all the other spacing treatments. This might be the results of less space for lateral growth and competition between the plants to get more sunlight [8]. The maximum number of sprouts/hill (5.5) were recorded when the bulbs were planted at wider spacing of 45 cm x 30 cm. This might be due to the availability of more moisture, minerals, nutrients and sunlight to plants in comparison to the closer-spaced plants. This tendency was reported by Thapa *et al.* [9]. The highest number of umbel/hill (3.9) was obtained when the

Table 1. Effects of bulb size and spacing on crop growth and seed yield of onion

Treatment	Plant height (cm)	No. of sprouts/hill	No. of umbel/hill	No. of umbellates/umbel	No. of seed/umbel	Seed yield (q/ha)
Diameter of bulb (cm)						
2.5	81.1	3.6	3.2	133.8	335.7	7.3
5.0	88.6	4.3	3.8	158.2	585.5	9.8
7.5	96.2	5.3	4.0	178.8	638.4	10.4
CD (p=0.05)	5.6	0.5	0.3	16.3	56.4	0.9
Spacing (cm)						
45 x 10	98.7	3.4	3.0	121.5	273.3	10.2
45 x 20	84.6	4.4	3.6	153.4	535.0	8.7
45 x 30	80.8	5.5	3.9	195.7	751.3	6.9
CD (p=0.05)	5.6	0.5	0.3	16.3	56.4	0.9

Table 2. Effects of bulb size and spacing on seed quality of onion seed

Treatment	Seed yield (q/ha)	1000-seeds wt (g)	Germination (%)	Seedling length (cm)	Seed vigour index
Diameter of bulb (cm)					
2.5	7.3	3.6	81.7	7.6	639.6
5.0	9.8	4.1	87.7	8.5	745.6
7.5	10.4	4.3	88.4	9.4	859.4
CD (p=0.05)	0.9	0.3	NS	0.7	98.7
Spacing (cm)					
45 x 10	10.2	3.7	79.7	7.3	622.4
45 x 20	8.7	3.8	83.2	8.2	684.7
45 x 30	6.9	4.1	84.8	9.3	805.6
CD (p=0.05)	0.9	0.3	NS	0.7	98.7

NS = Non-significant; values were pooled over two years

spacing was increased from 45 cm x 10 cm to 45 cm x 30 cm. The results showed similar trend as reported by Singh and Sachan [7]. Maximum number of umbellates and seeds/umbel was

recorded with wider spacing. Spacing had influenced seed yield and quality parameters of seed (Tables 1, 2). The significantly higher seed yield 10.2 q/ha was obtained when bulbs were

Table 3. Economics of seed production of onion cv. EG-50 under Leh-Ladakh region

Treatment	Seed yield (q/ha)	*Gross income (Rs/ha)	Cost of production (Rs/ha)	Net return (Rs/ha)	Cost : benefit ratio
D ₁ S ₁	7.82	273700	136670	137030	1.00
D ₁ S ₂	7.03	246050	113330	132720	1.17
D ₁ S ₃	6.32	221200	105550	115650	1.10
D ₂ S ₁	9.23	323050	183330	139720	0.76
D ₂ S ₂	8.83	309050	136670	172380	1.26
D ₂ S ₃	8.01	280350	121110	159240	1.31
D ₃ S ₁	11.33	396550	230000	166550	0.72
D ₃ S ₂	10.92	382200	160000	222200	1.39
D ₃ S ₃	9.07	317450	136670	180780	1.32

*Rs 350/kg of seed considered for calculation of gross income; where D₁ : 2.5 cm, D₂ : 5.0 cm, D₃ : 7.5 cm; S₁ : 45 x 10 cm, S₂ : 45 x 20 cm, S₃ : 45 x 30 cm

planted closed. This might be due to the fact that higher plant population with minimum spacing resulted in more seed yield. These results were in agreement with other workers [11, 12].

Maximum test weight (1000-seeds weight) was found with wider spacing, as plant in this spacing has yielded bold-sized seeds. Similar views were expressed by Nawab Ali *et al.* [13]. However, higher germination percentage was recorded with wider spacing treatment but non-significant difference was observed between the treatments. Significantly higher seedling length and seed vigour index were recorded with wider spacing. This might be due to the plants yielded bold-sized seeds, due to better development of seedlings and maturation of seeds. The results are similar with those of Singh *et al.* [8].

Economics of seed production

Data related to economics of onion seed production (Table 3) showed that maximum seed yield were recorded with large bulb with close spacing, but larger bulb size (7.5 cm diameter) planted at medium spacing (45 cm x 20 cm) gave maximum net return (Rs 2,18,700/ha) with a

cost : benefit ratio of 1.0:1.37, which was higher than all the other bulb size and spacing combinations. Therefore, it was recommended that onion bulbs of cv. EG-50 with 7.0 cm diameter should be planted at the spacing of 45 cm x 20 cm to achieve maximum cost-effective net return under the high altitude cold-desert of Leh-Ladakh region.

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