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Effect of bulb size and planting geometry on seed yield and economics of onion (*Allium cepa*)*

ANKUR AGARWAL[1], SUNIL GUPTA[2] and Z AHMED[3]

Field Research Laboratory Research Station Partapur, Nubra Valley DRDO, Ministry of Defence, Leh, J&K C/o 56 APO

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'Brown Spanish' onion has been found suitable for Ladakh region being long day variety (Singh 1995). Systematic efforts to increase the availability of quality seed of this variety can lead to increase in local availability of fresh onion and thereby reducing the expenditure on transport to maintain the supply chain for troops in this sector *vis-a- vis* better socio-economic condition of local farmers. Since no information is available on the subject for this location, an experiment was envisaged to work out the most profitable bulb grade and planting geometry for economically successful onion seed production.

A field experiment was carried out at Field Research Laboratory Research Station Partapur, Siachen Sector (Ladakh, J&K) at the altitude of 2 850 m above meam sea level to study the influence of bulb grade and spacing on seed productivity of 'Brown Spanish' onion during 2006 and 2007. The bulbs harvested from the previous season crop were graded as A (200 g or more, 7.0–8.0 cm bulb dia), B (175 g, 6.0–7.0 cm), C (150 g, 5.0–6.0 cm) and D (100 g, 4.0–5.0 cm). These bulbs were planted in underground trenches (low cost structures of 0.75 m deep and 3.0 m wide with convenient length having a provision of covering the trench with 150 micron UV-stabilized polyethylene sheet for winter season cultivation in Ladakh due to sub-zero temperature) during September at 3 planting geometries S1 (40 cm × 40 cm), S2 (30 cm × 30 cm) and S3 (40 cm × 30 cm) in randomized block design with 3 replications.

The monthly average temperature during crop season varied between –4.32 and 18.17°C (minimum); 10.1–30.6°C (maximum) for 2006, whereas for 2007 monthly average temperature were –3.4 to 16.6°C (minimum) and 12.0 to 29.9°C (maximum). All recommended cultural practices were done uniformly in all the treatments. The fertilizer dose of 80:60:40 kg N:P_2O_5:K_2O/ha in the form of urea, di-ammonium phosphate and muriate of potash was applied. Full dose of phosphorus and potash along with half of the nitrogen was applied as basal while rest of the N was applied as top-dressing in 2 splits after 30 and 45 days of planting. Seeds were harvested manually as the umbels matured to brown colour. Observations were recorded on plant height, number of umbel/plant, umbel diameter, seed recovery/plant and weight of 100-dried seed. Marginal cost and benefit ratio was also calculated to work out the most economic combination suiting to the farmers. For estimating the benefit: cost ratio, seed sale value was calculated at a price of Rs 400/kg seed and bulb cost at an average price of Rs 10/kg bulb. Data were analyzed statistically as per the standard procedure.

Significant differences were observed in seed yield and attributing traits due to interaction of bulb size and planting geometry (Table 1) except umbels/plant and 100-seed weight. Plant height varied significantly due to treatment combinations and was the maximum under wider spacing, irrespective of the bulb grade which may be attributed to the better availability of nutrients and moisture due to less competition plants are facing as well as better availability of light for photosynthesis. Mirshekari *et al*. (2006) also reported significant effect of bulb size and intra-row spacing on onion seed yield and attributing traits. Although overall effect on umbels/bulb and umbel diameter were non-significant but smallest bulbs (100 g, 4.0 – 5.0 cm) under closest spacing (30 cm × 30 cm) produced smallest sized umbels (4.56 cm). Tiwari *et al.* (2002) also reported more number of umbels/bulb under wider spacing compared to closer spacing. Seed quality in terms of 100-seed weight not affected significantly by the treatment combinations but effect of bulb grade on seed weight was noticeable where bigger bulbs exhibited comparatively heavier seeds (0.47–0.43 g/100 seeds) than under sized bulbs (0.34 –0.32 g/100 seeds). Moslehuddeen (2008) also revealed the beneficial effect of large mother bulbs on seed yield and 100-seed weight.

Seed yield exhibited the significant effect of bulb size and planting geometry and was the maximum (9.01q/ha) under treatment combination where biggest sized bulbs were planted under widest spacing, which may be attributed to

*Short note

[1]Scientist, DIBER (email: darl_ankur@rediffmail.com), [2]Senior Research Fellow (email: sunildihar@gmail.com), [3]Director, DIBER, Haldwani (email: darl_drdo@rediffmail.com)

Table 1 Effect of bulb size and planting geometry on seed yield and economics of 'Brown Spanish' Onion (pooled data for 2 years)

Treatment	Plant height (cm)	Umbels/ bulb	Umbel diameter (cm)	100-seed weight (g)	Seed recovery (g/plant)	Seed yield (kg/ha)	Seed sale value (Rs/ha)	Bulb cost (Rs/ha)	Gross returns (Rs/ha)
200 g (7.0–8.0 cm dia)									
40 cm × 40 cm	94.33	6.92	6.50	0.47	5.28	901.51	3 60 602	1 25 000	2 35 602
40 cm × 30 cm	80.67	6.03	6.16	0.42	4.57	798.06	3 19 225	2 22 222	97 003
30 cm × 30 cm	85.17	6.38	6.23	0.43	5.05	862.71	3 45 082	1 66 666	1 78 416
175 g (6.0–7.0 cm dia)									
40 cm × 40 cm	87.17	5.67	6.06	0.39	4.36	826.99	3 30 797	1 09 375	2 21 422
40 cm × 30 cm	78.73	5.13	5.81	0.38	3.35	637.92	2 55 167	1 94 444	60 723
30 cm × 30 cm	80.80	5.50	5.85	0.40	3.66	697.55	2 79 019	1 45 832	1 33 187
150g (5.0–7.0 cm dia)									
40 cm × 40 cm	80.80	4.72	5.78	0.37	3.20	549.20	2 19 679	93 750	1 25 929
40 cm × 30 cm	75.33	4.37	5.39	0.36	2.50	466.05	1 86 420	1 66 666	19 754
30 cm × 30 cm	78.70	4.53	5.62	0.34	2.72	506.97	2 02 789	1 24 999	77 790
100g (4.0–5.0 cm dia)									
40 cm × 40 cm	74.13	4.13	4.83	0.32	2.62	438.73	1 75 492	62 500	1 12 992
40 cm × 30 cm	71.30	3.78	4.56	0.34	2.40	403.33	1 61 333	1 11 111	50 222
30 cm × 30 cm	72.40	3.88	4.76	0.33	2.49	416.92	1 66 767	83 333	83 434
CD (*P*=0.05)	3.57	NS	NS	NS	0.38	51.6			

more and bigger umbels with heavier seed under bigger sized bulbs. Among the planting geometry, 40 cm × 40 cm resulted into highest seed yield which again may be attributed to better plant growth and less competition under wider spacing. The findings are in accordance with the reports of Mirshekari *et al.* (2006) and Moslehuddeen (2008) who reported higher seed yield of onion under bigger bulbs and wider spacing but contradiction with Tiwari *et al.* (2002) where closest spacing (45 cm × 30 cm) exhibited the maximum seed yield compared to widest spacing (60 cm × 45 cm). In the present study, the seed recovery per plant decreased significantly as the population density increased under closer spacing as a function of planting geometry and eventually resulted into less seed yield under closer spacing despite more number of plants per unit area. The planting geometry of 40 cm × 40 cm markedly improved most of the yield attributes over other geometric arrangements which may attributed to better absorption of moisture and nutrients and efficient photosysthesis, thereby resulting in better manifestation of yield attributes.

Considering the gross returns, 2 treatment combinations, ie 200 g and 175 g bulb under widest planting geometry ie 40 cm × 40 cm resulted into the maximum and at par returns (Table 1) significantly superior over others. Generally, the biggest sized bulbs (200 g or more) used in the present study are sold at premium price in market hence utilizing comparatively smaller bulbs (175 g) may be more beneficial. Therefore, treatment combination comprising 175 g, 6.0–7.0 cm bulb under 40 cm × 40 cm spacing can be advocated for economically successful seed production of 'Brown onion Spanish' onion in Ladakh region.

SUMMARY

A field experiment was carried out at an altitude of 2 850 m above mean sea level to study the influence of bulb size and planting geometry on the seed yield and yield-attributing traits of 'Brown Spanish' onion (*Allium cepa* L.). Four bulb sizes as A (200 g or more, 7.0–8.0 cm bulb dia), B (175 g, 6.0–7.0 cm), C (150 g, 5.0–6.0 cm) and D (100 g, 4.0–5.0 cm) were planted at 3 planting geometry, viz S1 (40 cm × 40 cm), S2 (30 cm × 30 cm) and S3 (40 cm × 30 cm) in 3 replications in randomised block design. The results revealed significant effect of bulb size and planting geometry on seed yield. Among the various grades, seed yield/plant was the maximum under biggest sized bulbs (200 g) and the minimum under poor sized bulbs (100 g). Among various planting geometry, seed yield was the maximum under 40 cm × 40 cm spacing. Treatment combination of 175 g bulbs at 40 cm × 40 cm planting geometry appeared most economic with high returns.

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