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Effect of plant geometry on *rabi* and *kharif* onion production

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Abstract

The experiment was conducted to evaluate the effect of plant geometry on production of onion bulbs during *rabi* 2008–09 and *kharif*–2009. Eight week old seedlings of variety *Agrifound Light Red* in *Rabi* and seven week old seedlings of variety *Agrifound Dark Red* in *kharif* were transplanted in raised beds during the last week of December in *rabi* and August in *kharif* in different geometry *i.e.* S1- Normal planting 15 cm × 10 cm whole bed, straight row, S2-Zig zag planting 2 rows 30 cm × 10 cm whole bed, S3- Straight strip planting 10 cm × 10 cm (one strip 4 rows between strip 30 cm), S4-Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm) and S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm. *Rabi* data revealed that significantly higher equatorial bulb diameter (5.61 cm), polar diameter (3.93 cm), bulb size index (22.07 cm^2), and 20 bulb weight (1.38 kg) were noted in S5 and was at par with S4 (5.59 cm), (3.90 cm), (21.87 cm^2) and (1.33 kg), respectively. Treatment S5 showed highest total soluble solids (12%) and dry matter content (14%). Significantly highest gross yield (305 q ha^{-1}) and marketable yield (291 q ha^{-1}) were noted in S5 and was at par with S4 (302 q ha^{-1}) and (205 q ha^{-1}), respectively. In *kharif*, highest plant height (61.00 cm) was observed for S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm) which was, however, at par with S1-Normal planting 15 cm × 10 cm whole bed, straight row, and S4-Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm). The highest equatorial bulb diameter (5.42 cm), polar diameter (4.12 cm), 20 bulbs weight (1.18 kg) and bulb size index (22.28 cm^2) were noted in S5- Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm). The minimum thrips incidence (58 %) and number of thrips per plant (3) were noted in S5- Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm). Highest and significant gross yield (226 q ha^{-1}) and marketable yield (207 q ha^{-1}) were noted in S5. It is concluded from the experiment that S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm) gave better results over other geometry in *rabi* as well as in *kharif*.

Keywords: *Allium cepa*, geometry, spacing, yield

Introduction

Onion (*Allium cepa* L.) is one of the most important vegetable crops grown in India and is widely cultivated for domestic consumption as well as for export. About 73.23 mt of onions are produced in the world from 3.65 m ha. India is second largest producer of onion in the world after China. India produces 168.17 lakh MT onions from 10.14 L ha with productivity of 16.58 t ha^{-1} during 2012–13. It is predominantly

a *Rabi* season crop and most onion cultivars are sensitive to photo period and thus their range of adoption is limited (Gupta & Singh 2010). Apart from the varietal selection, the chief consideration for increasing the yield is plant population and plant geometry. Response of onion to different spacing is well documented but the work on plant geometry on onion is very scanty. Hence, the present investigation was under taken with a view to study the effect of different plant geometry on onion yield and quality during *rabi* as well as *kharif*.

Materials and methods

The experiment was conducted in a randomized block design with four replications at National Horticultural and Research Development Foundation, Nashik during *rabi* 2008–09 and *kharif*–2009 in a plot size of 3.0 m × 2.0 m. The treatment consisted of five plant geometries *i.e.* S1- Normal planting 15 cm × 10 cm whole bed, straight row, S2-Zig zag planting 2 rows 30 cm × 10 cm whole bed, S3- Straight strip planting 10 cm × 10 cm (one strip 4 rows between strip 30 cm), S4-Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm) and S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm. Nashik (20° N latitude and 73° E longitude) is located at altitude of 492 m above MSL. The minimum and maximum temperature and humidity ranges between 16-40°C and 48-80%, respectively with an annual average rain fall of 881 mm. Soil of the trial was clay loam, medium in OC (0.58%), available N (385.2 kg ha^{-1}), high in P (45.13 kg ha^{-1}) and available K (291.2 kg ha^{-1}). Eight week old seedlings of variety *Agrifound Light Red* in *rabi* and seven week old seedlings of variety *Agrifound Dark Red* in *kharif* were transplanted in raised beds during the last week of December in *rabi* and August in *kharif*. Recommended package of practices was uniformly followed. Ten randomly selected plants from each plot were taken to record the observations on plant height (cm), leaves $plant^{-1}$, neck thickness (cm), bulb diameter (cm), bulb size index (cm^2), weight of 20 bulbs (kg), total soluble solid (%), dry matter content (%), gross yield (q ha^{-1}), marketable yield (q ha^{-1}) and disease and insect incidence. The data of 2008–09 of *rabi* and 2009 for *kharif* were analyzed (Panse & Sukhatme 1984) and results presented.

Results and discussion

The maximum plant height (56 cm) was recorded during *rabi* in S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm) but significantly highest number of leaves $plant^{-1}$ (11) was noted in S4-Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm) which was at par with S5. Lowest neck thickness (1.27 cm) was noted in S2-Zig zag planting 2 rows 30 cm × 10 cm whole bed and was at par with S1- Normal planting 15 cm × 10 cm whole bed, straight row and S4 (1.32 cm) (Table 1). Significantly higher equatorial bulb diameter (5.61 cm), polar diameter (3.93 cm), bulb size index (22.07 cm^2) and 20 bulb weight (1.38 kg) was noted in S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm) and was at par with S4-Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm) (5.59 cm), (3.90 cm), (21.87 cm^2) and (1.33 kg), respectively. Treatment S5 showed highest total soluble solids (12%) and dry matter content (14%) but it was non-significant. Lowest thrips incidence (88%) and nymphs $plant^{-1}$ (14) was noted for treatment S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm) and S2-Zig zag planting 2 rows 30 cm × 10 cm whole bed, respectively. Regarding stemphylium blight, lowest incidence (68%) and intensity (10%) were noted for treatment S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm). Significantly highest gross yield (305 q ha^{-1}) and marketable yield (291 q ha^{-1}) was noted for S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm and was at par with S4-Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm) (302 q ha^{-1}) and (205 q ha^{-1}), respectively. Dubey *et al.* (2011) reported that during late *kharif*, the transplanting done on 30th October and spacing of 15 cm × 15 cm gave better bulb size and bulb development of yellow hybrid onion variety *Colina* at Karnal in Haryana.

The highest plant height (61.00 cm) was noted during *kharif* for S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm), which was, however, at par with S1- Normal planting 15 cm × 10 cm whole bed, straight row and S4-Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm) (Table 2). The highest equatorial bulb diameter (5.42 cm) polar

Table 1. Effect on plant geometry on onion bulb production during *rabi* season

Treatment	Plant height (cm)	Leaves plant^{-1}	Neck thickness (cm)	Bulb equatorial diameter (cm)	Bulb polar diameter (cm)	Bulb size index (cm^2)	Weight of 20 bulbs (kg)	TSS (%)	Dry matter (%)	Gross yield (q ha^{-1})	Market-able yield (q ha^{-1})	Thrips		Stemphylium blight	
												Incidence (%)	Nymphs plant^{-1}	Incidence (%)	Intensity (%)
S_1	50.0	9.90	1.28	5.21	3.77	19.74	1.16	12.08	13.65	269.16	254.16	97.50	16.23	75.00	11.50
S_2	50.0	9.85	1.27	5.20	3.73	19.48	1.11	12.15	13.70	275.41	261.24	95.00	13.45	72.50	11.75
S_3	53.0	9.65	1.38	5.41	3.74	20.27	1.20	12.23	13.77	287.50	273.33	90.00	15.33	75.00	12.00
S_4	50.0	10.85	1.32	5.59	3.90	21.87	1.33	12.20	13.73	301.66	285.41	95.00	19.45	82.50	10.50
S_5	56.0	10.65	1.41	5.61	3.93	22.07	1.38	12.25	13.79	304.99	290.93	87.50	14.30	67.50	9.63
Sem+-	1.00	0.00	0.04	0.07	0.07	0.51	0.06	0.0	0.00	3.00	3.00	5.00	3.00	8.00	1.00
CD (P<0.05)	3.00	1.00	0.09	0.15	0.15	1.11	0.13	NS	NS	7.00	7.00	NS	NS	NS	2.00

Table 2. Effect on plant geometry on onion bulb production during *kharif* season

Treatment	Plant height (cm)	Leaves plant^{-1}	Neck thickness (cm)	Bulb equatorial diameter (cm)	Bulb polar diameter (cm)	Bulb size index (cm^2)	Weight of 20 bulbs (kg)	TSS (%)	Dry matter (%)	Gross yield (q ha^{-1})	Market-able yield (q ha^{-1})	Thrips		Stemphylium blight	
												Incidence (%)	Nymphs plant^{-1}	Incidence (%)	Intensity (%)
S_1	60.45	9.25	1.60	5.21	3.95	20.56	1.10	10.28	11.44	220.83	204.58	72.50	4.98	92.50	6.38
S_2	57.20	9.30	1.53	5.13	3.92	20.08	1.05	10.68	12.08	211.04	197.70	70.00	4.15	95.00	7.38
S_3	57.25	9.15	1.52	5.10	3.93	20.02	.980	11.70	12.82	200.62	188.33	62.50	2.60	90.00	6.25
S_4	58.80	9.15	1.63	5.15	3.9	20.08	1.03	10.48	11.84	216.40	199.58	72.50	4.68	87.50	5.25
S_5	60.60	9.20	1.56	5.42	4.12	22.28	1.18	10.93	12.20	226.25	207.08	57.50	2.65	87.50	4.38
Sem+-	1.16	0.31	0.03	0.03	0.05	0.30	0.045	0.54	0.47	1.81	2.33	6.19	0.66	4.43	0.73
CD (P<0.05)	2.53	NS	0.07	0.07	0.11	0.65	0.098	NS	NS	3.94	5.08	NS	1.44	NS	1.59

Treatments: S_1=Normal planting 15 cm × 10 cm whole bed, straight row; S_2=Zig zag planting 2 rows 30 cm × 10 cm whole bed; S_3=Straight strip planting 10 cm × 10 cm (one strip 4 rows between strip 30 cm); S_4=Zig zag strip planting 20 cm × 10 cm (one strip 4 rows between strip 30 cm); S_5=Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm)

diameter (4.12 cm), 20 bulb weight (1.18 kg) and bulb size index (22.28 cm^2) was noted in S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm). Minimum thrips incidence (58%) and thrips per plant (3) was noted in S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm). Highest and significant gross yield (226 q ha^{-1}) and marketable yield (207 q ha^{-1}) was noted in treatment S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm). It is concluded from the experiment that S5-Paired row planting 30 cm × 10 cm (2 rows between pair 20 cm) gave better result over the other geometry styles in *rabi* as well as in *kharif*. Naik *et al.* (2000) and Singh *et al.* (2011) reported that a closer spacing (15 cm × 10 cm) produced significantly higher yield in *kharif*.

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