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Effect of different spacing and different levels of fertigation on quality parameters and cost economics of onion (*Allium cepa* L.) hybrid Arka Lalima

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Abstract

An investigation was carried out to study the effect of different spacing's and different levels of fertigation on quality parameters and cost economics of onion (*Allium cepa* L.) hybrid Arka Lalima at the Precision Farming Development Centre (PFDC), Department of Horticulture, UAS, GKVK, Bengaluru during 2015-16. The experiment was laid out in Randomized Complete Block Design with thirteen treatments and three replications. The performance of six spacings and fertigation at 80 per cent recommended dose of fertilizers (100:60:100 kg NPK ha⁻¹) and 100 per cent recommended dose of fertilizers (125:75:125 kg NPK ha⁻¹) with water soluble fertilizers (19: 19: 19, Urea and SOP) through drip fertigation was compared with soil application of normal fertilizers (Urea, DAP, MOP) and normal spacing 15 cm × 10 cm. The results revealed that treatment 5 i.e., Fertigation with 80 per cent recommended dose of fertilizers and plants spaced at 20 cm × 15 cm recorded maximum bulb volume, (122.63 cc) Total soluble solids (12.17) brix and highest pungency (7.1 μ mol g⁻¹) gross return (Rs.11,50,000), net returns (Rs.848301) and benefit cost ratio of (1:2.81) lowest bulb volume (41.53 cc), total soluble solids (10.01) brix, (gross returns Rs 7,08,000, net returns Rs. 2,57,682.06 and benefit cost ratio of 1: 0.72) was noticed in control (T₁₃) in case of soil application of recommended dose of fertilizers and recommended spacing. But pungency was significantly lowest in T₇ (4.04 μ mol g⁻¹) this might be due to smaller bulb size. From this investigation it can be concluded that fertigation with 80 percent recommended dose of fertilizers i.e., (100:60:100 kg NPK /ha) and the plant spaced at 20 cm × 15 cm is ideal for getting good quality parameters and economic returns of onion hybrid Arka Lalima by saving fertilizers cost nearly 20 per cent.

Keywords: spacing, fertigation, quality parameters, cost economics, Arka Lalima

1. Introduction

Onion (*Allium cepa* L.) is an important bulbous vegetable crop belonging to family Alliaceae is mainly grown for local consumption as well as for export purpose. It is also called as viz., *Pyaz*, *Ullagaddi*, *Eerulli*, *Neerulli* in vernacular language. Since it is an indispensable component of culinary in the Indian kitchen. Therefore onion is popularly referred as "Queen of the Kitchen". In addition to these onion is used as salad and pickle.

Central Asia is the primary centre of origin and the area near East and Mediterranean region is the secondary centre of origin for onion. (Jones and Mann, 1963).

Onion is also known to possess several medicinal and therapeutic properties its effectiveness range against common cold to diabetes, heart diseases, osteoporosis and other diseases. Onion is known for anti-platelet aggregation, anti-rheumatic, diuretic and fibriyotonic effects as well as it lowers the blood sugar. Onion contains a chemical compound quercetin believed to have anti-inflammatory, anti-cholesterol, anti-cancer and anti oxidant properties. Bulb juice is used as smelling agent against hysterical convulsion and faintness. Onion bulb is due to volatile sulphur based compound Allyl- propyl- disulphide responsible for alliaceous odour. The nutritive value includes it contains moisture (86.80 g.), carbohydrates (11.00 g.), proteins (1.20 g.), fibre (0.60 g.), and minerals like calcium (180 mg.), phosphorous (50 mg.), iron (0.70 mg.), nicotinic acid (0.40 mg.) and traces of thiamine per 100 g of bulb.

China ranks first followed by India with an area of 1270000ha production of 21564 000MT. The major Onion producing states includes Maharashtra 27.09MT /ha, Gujarat 25.48MT/ ha Karnataka stood 16th position in productivity i.e., 14.16 MT/ha (Horticulture statistics at a glance 2017) Spacing is an important parameter which determines the optimum plant population for getting good yield which also avoids the disease spreading. Drip fertigation

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remarkably increases the efficiency of the applied fertilizers by economizing the quantity of fertilizers, water, cost of labour.

2. Materials and Methods

The present investigation was carried out at the department of horticulture precision farming development centre UAS GKVK Bengaluru during 2015-16. The details of the observations were discussed below:

Quality parameters

The quality parameters of ten randomly selected plants were recorded after harvesting and curing of bulbs for about one month and the average values were computed.

Total soluble solids (°Brix)

The juice from the ten randomly selected bulbs were extracted and observed for total soluble solids with the help of digital hand refractometer and expressed in °Brix.

Pungency ($\mu\text{mol g}^{-1}$)

The juice sample was extracted from the ten randomly selected bulbs from various portions of the bulb.

Procedure

The randomly selected bulbs were cut into convenient sizes and placed in a mixer using common blender then filter to extract the juice using muslin cloth after filtration add 0.1ml of onion juice and treated with 4ml of 2.4.DNPH (Di nitro phenyl hydrazine) and kept in water bath at 37°C for 10 minutes finally 4ml of NaOH was added and absorbance recorded using spectrophotometer at 515 nm.

Bulb volume (cc)

The volume of ten randomly selected bulbs were measured by water displacement method. Each bulb was immersed in glass measuring cylinder and raise in the level was noted. The difference in the water level after immersing the bulb was calculated as bulb volume and expressed in cubic centimeter (cc).

Cost economics

The cost of cultivation of onion hybrid Arka Lalima under open condition with different spacings and levels of fertigation was worked out by considering the existing price of inputs and the labour cost that were prevailing at the time. Gross returns, Net returns and benefit cost ratios were worked out for each treatment by adopting the following formulae. Net returns (Rs. ha⁻¹) = Gross returns (Rs. ha⁻¹) – Cost of cultivation (Rs. ha⁻¹)

$$\text{Benefit: Cost ratio} = \frac{\text{Net returns (Rs. ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs. ha}^{-1}\text{)}}$$

3. Result

Bulb volume (cc)

The highest (122.63 cc) bulb volume was noticed in the treatment (T₅) with plant spacing of 20 cm × 15 cm and receiving fertigation level of 80 per cent (100: 60: 100 kg NPK ha⁻¹) while, it was significantly lowest (41.53 cc) in control (T₁₃) in case of soil application of recommended dose of fertilizers and recommended spacing.

Total soluble solids (°B)

Total soluble solids was recorded after harvesting and curing and it was noticed highest (12.17 °B) in the treatment level of (T₅) with plant spacing of 20 cm × 15 cm and receiving fertigation level of 80 per cent (100: 60: 100 kg NPK ha⁻¹), while it was significantly low (10.01 °B) in control (T₁₃) in case of soil application of recommended dose of fertilizers and recommended spacing.

Pungency ($\mu\text{mol g}^{-1}$)

The highest (7.1 $\mu\text{mol g}^{-1}$) pungency was noticed in the treatment (T₁) with plant spacing of 10 cm × 5 cm and receiving fertigation level of 80 per cent (100: 60: 100 kg NPK ha⁻¹) followed by (6.90 $\mu\text{mol g}^{-1}$) in the spacing level and fertigation level of 100 per cent (125: 75: 125 kg NPK ha⁻¹) (T₇) while it was significantly low (4.04 $\mu\text{mol g}^{-1}$) in control (T₁₃) in case of soil application of recommended dose of fertilizers and recommended spacing.

Table 1: Effect of spacing and different levels of fertigation on bulb volume and Shelf life onion hybrid Arka Lalima

Treatments	Bulb volume (cc)	Shelf life (days)
T ₁ -10 cm × 5 cm + 80 % RDF	43.97	45.33
T ₂ -10 cm × 10 cm + 80 % RDF	63.73	40.33
T ₃ - 15 cm × 10 cm + 80 % RDF	80.13	39.33
T ₄ -15 cm × 15 cm + 80 % RDF	105.66	37.00
T ₅ - 20 cm × 15 cm + 80 % RDF	122.63	32.00
T ₆ - 20 cm × 10 cm + 80 % RDF	113.03	34.00
T ₇ -10 cm × 5cm + 100 % RDF	41.73	41.67
T ₈ -10 cm × 10 cm + 100 % RDF	55.13	37.33
T ₉ - 15 cm × 10 cm +100 % RDF	55.73	38.66
T ₁₀ -15 cm ×15 cm +100 % RDF	83.20	36.66
T ₁₁ - 20 cm × 15 cm +100 % RDF	102.10	30.66
T ₁₂ - 20 cm ×10 cm +100 % RDF	102.93	31.67
T ₁₃ - 15 cm × 10 cm +100 % RDF (NF +SA)	41.53	29.33
S.Em ±	1.38	1.03
F test	*	*
CD at 5 %	4.02	3.01

*Significant at 5% level

(NF- Normal fertilizer, SA-Soil application, Recommended spacing-15 cm × 10 cm, Recommended dose of fertilizers -125:75:125 kg NPK ha⁻¹)

Table 2: Effect of spacing and different levels of fertigation on TSS ($^{\circ}$ B) and Pungency μ mol g^{-1} onion hybrid Arka Lalima

Treatments	TSS ($^{\circ}$ B)	Pungency (μ mol g^{-1})
T ₁ -10 cm \times 5 cm + 80 % RDF	10.25	7.10
T ₂ -10 cm \times 10 cm + 80 % RDF	10.27	6.25
T ₃ - 15 cm \times 10 cm + 80 % RDF	11.09	5.97
T ₄ -15 cm \times 15 cm + 80 % RDF	11.03	5.32
T ₅ - 20 cm \times 15 cm + 80 % RDF	12.17	6.13
T ₆ - 20 cm \times 10 cm + 80 % RDF	11.08	5.85
T ₇ -10 cm \times 5cm + 100 % RDF	10.33	6.90
T ₈ -10 cm \times 10 cm + 100 % RDF	10.88	6.17
T ₉ - 15 cm \times 10 cm +100 % RDF	10.20	5.57
T ₁₀ -15 cm \times 15 cm +100 % RDF	10.31	5.02
T ₁₁ - 20 cm \times 15 cm +100 % RDF	10.72	4.55
T ₁₂ - 20 cm \times 10 cm +100 % RDF	10.33	4.99
T ₁₃ - 15 cm \times 10 cm +100 % RDF (NF +SA)	10.01	4.04
S.Em \pm	0.31	0.15
F test	*	*
CD at 5 %	0.92	0.45

*Significant at 5 % level

(NF- Normal fertilizer, SA-Soil application, recommended spacing-15 cm \times 10 cm, recommended dose of fertilizers - 125:75:125 kg NPK ha^{-1})

Cost economics

The cost economics of cultivation of onion as influenced by different spacing and fertigation levels under open condition for an area of 195 m^2 per crop during *kharif* was worked out and presented in the Table 3.

Among the treatment combination of spacing and levels of fertigation, the treatment (T₅) 20 cm \times 15 cm spacing and

receiving fertigation level of 80 per cent (100: 60: 100 kg NPK ha^{-1}) recorded maximum gross return (Rs.11,50,000), net returns of (Rs.848301) and cost benefit ratio of (1:2.81) while, least in (T₁₃) in case of soil application of recommended dose of fertilizers and recommended spacing (Rs 7,08,000, Rs. 2,57,682.06 and 0.72 respectively

Table3: Effect of spacing and different levels of fertigation on cost economics of onion hybrid Arka Lalima

Treatments	Total yield ha^{-1} (tons)	Totalcost of cultivation (Rs.) ha^{-1}	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	C:B ratio
T ₁ -10 cm \times 5 cm + 80 % RDF	64.17	327799	962550	634751	1.93
T ₂ -10 cm \times 10 cm + 80 % RDF	57.91	312174	868650	556476	1.78
T ₃ - 15 cm \times 10 cm + 80 % RDF	41.25	306849	825000	518151	1.68
T ₄ -15 cm \times 15 cm + 80 % RDF	40.42	303424	808400	504976	1.66
T ₅ - 20 cm \times 15 cm + 80 % RDF	46.00	301699	1150000	848301	2.81
T ₆ - 20 cm \times 10 cm + 80 % RDF	44.57	304349	1114250	809901	2.66
T ₇ -10 cm \times 5cm + 100 % RDF	53.00	381762	795000	413238	1.08
T ₈ -10 cm \times 10 cm + 100 % RDF	48.57	366137	728550	410983	1.12
T ₉ - 15 cm \times 10 cm +100 % RDF	43.57	360812	873400	512588	1.42
T ₁₀ -15 cm \times 15 cm +100 % RDF	37.32	357387	746400	389013	1.08
T ₁₁ - 20 cm \times 15 cm +100 % RDF	33.95	355662	848750	493088	1.38
T ₁₂ - 20 cm \times 10 cm +100 % RDF	37.92	358312	948000	589688	1.64
T ₁₃ - 15 cm \times 10 cm +100 % RDF (NF +SA)	28.32	355887	708000	257682.06	0.72

*Significant at 5% level

(NF- Normal fertilizer SA-Soil application, recommended spacing-15 cm \times 10 cm, recommended dose of fertilizers -125:75:125 kg NPK ha^{-1}).

Note: The bulbs were graded and sold based on the size (Small- Rs.15 Medium- Rs.20, Big-Rs. 25/ kg bag).

4. Discussion

Effect of different spacing and fertigation levels on Quality parameters of onion hybrid ArkaLalima

Different spacing and fertigation levels showed significant effect on quality parameters like bulb volume, TSS, pungency and shelf life of onion.

Bulb volume (cc)

The higher bulb volume was obtained in T5 (122.63). Increase in the bulb weight has positive effect on the bulb volume. Similar findings were also obtained by Balraj et al. (1998) [2] and Stoffella (1996).

TSS ($^{\circ}$ Brix)

Significantly higher TSS (12.17 $^{\circ}$ B) was obtained in T5 in both spacings and fertigation levels. Widely spaced plants and 80 per cent recommended dose of fertilizers resulted in higher TSS content of the bulbs. This might be due to the good light penetration in widely spaced treatments has led to enhanced production of photosynthates resulting in increased TSS content. Similar results were also obtained by Tripathy et al. (2013) [9] and Shafeek (2013) [7].

Pungency (μ mol g^{-1})

The pungency rate was significantly higher (pyruvic acid

content) in T₁ (7.1 μ molg⁻¹) followed by T₇ (6.90 μ molg⁻¹). This might be due to the fact that due to closer spacing the bulb size will be less and smaller the bulb size the pungency will be more. Similar results were also obtained by Singh and Verma (2001)^[8] and Anthon and Barret (2003)^[1].

Fertigation helps in fulfillment of optimum demand of crop for moisture and nutrients and their proper utilization. These results were online with the findings of Nagaich *et al.* (1999)^[4] who reported better quality of onion can be obtained with proper nutrient application. Whereas Kebede (2003)^[3] also said that Pyruvic acid, TSS and storability of onion were not much affected by P application.

Effect of different spacing and fertigation levels on cost economics of onion hybrid Arka Lalima

Among different spacing and fertigation regimes tried application of 80 per cent recommended dose of fertilizers with a spacing of 20 cm \times 15 cm T₅ has recorded the highest net returns (Rs. 848301 ha⁻¹) and cost benefit ratio (1: 2.81) compared to the other treatments. Though the yield was higher in T₁ the benefit cost ratio was less mainly due to the small bulb size and poor quality in T₁ leading to lesser consumer preference and also lower prices. Increased cost benefit ratio in T₅ might be due to increased bulb size that leads to good market prices. These results were in conformity with Savitha *et al.* (2010)^[6] and Sarkar *et al.* (2014).

5. Summary

From the foregoing discussion it could be concluded that application of 80 per cent recommended dose of fertilizers (100: 60:100 kg NPK ha⁻¹) through drip fertigation with spacing of 20 cm \times 15 cm (T₅) as superior over other treatments in respect of quality and cost economics of onion hybrid Arka Lalima. The cost benefit ratio was also highest in this treatment as it saves 20 per cent fertilizers.

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