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Standardization of planting distance and nitrogen fertilization for multiplier onion (*Allium cepa*) in rice (*Oryza sativa*)–onion cropping sequence

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ABSTRACT

An experiment was conducted during 1996-97 and 1997-98 to standardize spacing and nitrogen levels for multiplier onion (*Allium cepa* L. var *aggregatum*) during winter season following rice (*Oryza sativa* L.) in rainy season and to work out the net return of rice–onion cropping sequence. The maximum yield of 85.13 q/ha was realized from 10 cm × 10 cm spacing. Application of 150 kg N/ha resulted in significantly higher bulb yield (79.29 q/ha) than other levels. The interaction effect of 10 cm × 10 cm spacing with 150 kg N/ha registered the highest bulb yield (86.33 q/ha) which was at par with that obtained with 10 cm × 10 cm spacing and 90 as well as 120 kg N/ha. The benefit : cost ratio of the sequence was the highest for 15 cm × 10 cm spacing (0.63) and application of 90, 120 and 150 kg N/ha (0.60 each). Closer spacing of 15 cm × 10 cm with 90 kg N/ha was economical and suggested for multiplier onion after rice crop.

Key words : Spacing, Nitrogen, Multiplier onion, Rice-onion cropping sequence

Rice followed by onion is one of the most popular and remunerative cropping sequences practised in western undulating zone of Orissa. Multiplier onion (*Allium cepa* L. var. *aggregatum*) is preferred for its better keeping quality and higher market price. However, no effort has been made to improve the productivity of this onion and to work out the net return of the sequence. Plant density and nutrient management particularly of nitrogen are the important factors for yield realization of onion. Hence present experiment was undertaken to find out the optimum planting distance and level of nitrogen application for maximizing yield of multiplier onion and net return of rice–onion cropping sequence.

MATERIALS AND METHODS

The field experiment was conducted during 1996–97 and 1997–98 at the Regional Research Station, Bhawanipatna. The soil of the experimental site was loamy clay with pH 7.1, low in organic carbon

(0.45%) and available P_2O_5 (8.7 kg/ha) and medium in available K_2O (258 kg/ha). The onion crop was tried using factorial randomized block design with 6 replications during winter season. 'Lalat' rice was transplanted on 20 July in both the years. The treatments for onion comprised 5 planting distances, i.e. 10 cm × 10 cm, 15 cm × 10 cm, 20 cm × 10 cm, 25 cm × 10 cm and 30 cm × 10 cm, and 4 levels of nitrogen, viz. 60, 90, 120 and 150 kg/ha. Each treatment was allotted to a plot of 3.0 m × 1.0 m. The bulblets of multiplier 'Rambha Local' onion were planted on 15 November in both the years. Farmyard manure @ 20 tonnes /ha was mixed in the soil during field preparation for onion. Nitrogen was applied to onion crop in 3 equal splits, viz. basal, 30 days and 50 days after planting. P_2O_5 @ 60 kg/ha as basal and K_2O @ 60 kg/ha in 2 equal splits, i.e. 30 days and 50 days after planting, were applied uniformly in all the plots. Standard agronomic package of practices were followed for the rice crop.

Observations were taken on number of leaves and bulblets/plant and weight of bulb/plant from 10 random plants of onion in each plot every year. The yields of both the crops were recorded and statistically analysed. Benefit : cost ratio was calculated according to prevailing market rates.

RESULTS AND DISCUSSION

The yield of rice was 44.3 and 47.6 q/ha in 1996-97 and 1997-98 respectively. Different spacings significantly influenced all the characters of multiplier onion (Table 1). Narrow spacing of 10 cm × 10 cm produced the minimum number of leaves and bulblets/plant (3.14) as well as weight of bulbs / plant (16.77 g), while wider spacing of 30 cm × 10 cm exhibited the maximum number of leaves and bulblets/plant and weight of bulbs/plant. On the otherhand, the highest yield was noticed with the closest spacing of 10 cm × 10 cm which was significantly superior to others. The trend of the result indicated that the yield of onion decreased, whereas other characters increased with the increase in planting distance. The finding indicated that closer spacing produced high density population.

The increased biomass of individual plants in wider spacing failed to compensate for the high density population per unit area in closer spacing resulting in higher bulb yield. The observations support those of Kumar *et al.* (1998).

The number of leaves and bulblets/plant, weight of bulb/plant and yield increased with corresponding increases in levels of N reaching the maximum at an application of 150 kg N/ha and was significantly superior to 60, 90 and 120 kg N/ha. Onion has a high physiological nitrogen-use efficiency (Kotur and Murty, 1999). The improvement in yield in the present study might be attributed to better availability and uptake of N which in turn led to more nitrogenous compounds in plant tissues and resulted in efficient metabolism. Consequently the increased sink capacity resulted in higher bulb yield with increased levels of N. This result corroborates the findings of Sharma *et al.* (1994) and Neeraja *et al.* (1999).

The interaction effect of spacing and nitrogen levels elucidated that 30 cm × 10 cm spacing coupled with 150 kg N/ha displayed the maximum leaves/plant,

Table 1. Effect of planting distance and levels of nitrogen on the performance of multiplier onion (pooled of 2 years)

Planting distance	N (kg/ha)				
	60	90	120	150	Mean
10 cm × 10 cm					
L	25.93	27.80	28.80	29.47	28.00
B	2.87	2.87	3.20	3.60	3.14
W	16.20	16.20	16.93	17.73	16.77
Y	83.32	84.80	86.07	86.33	85.13
15 cm × 10 cm					
L	31.60	33.37	34.00	34.87	33.44
B	3.27	3.87	4.13	4.60	3.97
W	18.00	19.07	19.40	19.53	19.00
Y	81.40	82.80	83.80	84.53	83.13
20 cm × 10 cm					
L	37.53	38.40	39.07	40.07	38.77
B	4.13	4.47	4.60	4.80	4.50
W	19.27	19.53	20.20	20.93	19.98
Y	76.80	77.47	78.87	80.40	78.39
25 cm × 10 cm					
L	39.33	40.07	40.67	41.20	40.32
B	4.93	5.20	5.60	5.93	5.42
W	21.73	22.20	22.60	23.07	22.40
Y	71.47	72.47	73.93	75.27	73.29
30 cm × 10 cm					
L	42.00	42.80	43.13	43.87	42.95
B	5.80	6.27	7.00	7.40	6.62
W	22.83	24.33	25.53	27.20	24.97
Y	65.73	68.07	69.00	69.93	68.18
Mean					
L	35.28	36.47	37.13	37.90	
B	4.20	4.54	4.91	5.27	
W	19.60	20.27	20.93	21.69	
Y	75.75	77.12	78.33	79.29	
CD (P = 0.05)		*Levels of N*	*Planting distance*		*Interaction*
L		0.89	0.99		1.98
B		0.33	0.37		0.72
W		0.54	0.60		1.21
Y		0.74	0.82		1.66

L, Leaves/plant; B, bulblets/plant; W, weight of bulbs/clump (g); Y, bulb yield (q/ha)

followed by 30 cm × 10 cm spacing in combination with 120, 90 and 60 kg N/ha. Similarly, 30 cm × 10 cm spacing in conjunction with 150 kg N/ha manifested the maximum bulblets/plants, followed by 30 cm × 10 cm spacing with 120 kg N/ha. Application of 150 kg N/ha in association with 30 cm × 10 cm spacing exhibited the

Table 2. Economics of rice-onion cropping sequence (pooled)

Treatment	Gross return/ year (Rs/ha)	Net return/ year (Rs/ha)	Benefit : cost ratio
Rice + planting distance of onion			
10 cm × 10 cm	50,117	18,992	0.61
15 cm × 10 cm	49,317	18,992	0.63
20 cm × 10 cm	47,421	17,896	0.61
25 cm × 10 cm	45,381	16,656	0.58
30 cm × 10 cm	43,337	15,412	0.55
Rice + N (kg/ha) in onion			
60	46,365	17,245	0.59
90	46,913	17,523	0.60
120	47,397	17,737	0.60
150	47,781	17,851	0.60

Cost (Rs/q); Rice, 350; onion 400

maximum weight of bulb/plant and was significantly superior to other combinations. However, the highest bulb yield of 86.33 q/ha was obtained from 10 cm × 10 cm spacing accompanied by 150 kg N/ha which was statistically at par with 10 cm × 10 cm spacing along with 120 kg as well as 90 kg N/ha. This illustrated that high density planting (10 cm × 10 cm) with application of 90 kg N/ha was optimum for releasing higher yield of aggregatum onion.

The economics of the rice-onion cropping sequence (Table 2) explained that the highest net return was obtained from both 10 cm × 10 cm and 15 cm × 10 cm spacing, and from application of 150 kg N/ha when multiplier onion was taken after rice crop.

However, the benefit : cost ratio expressed that maximum profit/rupee invested was realized from 15 cm × 10 cm spacing and application of 90 kg, 120 kg as well as 150 kg N/ha in this cropping sequence. This showed that high density (15 cm × 10 cm) planting of multiplier onion with moderate application of N (90 kg/ha) was beneficial to the farmers. Although 10 cm × 10 cm spacing showed significantly higher yield than 15 cm × 10 cm spacing the former utilized 50% higher bulblets than the latter for planting an hectare, thereby enhanced the cost of production and reduced the benefit : cost ratio rendering it uneconomical. The high yield manifested by 10 cm × 10 cm spacing could not compensate the extra expenditure incurred on seed material which is an important costly input in multiplier onion cultivation.

Thus the present investigation led to infer that 15 cm × 10 cm spacing with application of 90 kg N/ha in multiplier onion was economical and advocated for rice-onion cropping sequence in western undulating zone of orissa.

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