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Effect of Nutrient Management on Growth and Quality of Garlic (*Allium sativum* L.) cv. Yamuna Safed-3

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ABSTRACT: Alliums are among the oldest cultivated plant species. The most widely cultivated are onion and garlic belongs to genus Allium. Garlic is a common spice and condiment crop. The present experiment was conducted at Horticultural Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.) during *Rabi season* of 2021-22 for evaluating the effect of nutrient management on growth and quality of garlic (*Allium sativum* L.) cv. Yamuna Safed-3". The experiment was carried out in Randomized Block Design (RBD) with three replications in nine treatment combinations. The maximum plant height (27.88 cm, 48.79 cm, 64.23 cm and 81.50 cm at 30, 60, 90 and at harvest, respectively), number of leaves per plant (5.23, 6.83, 7.34 and 8.59 at 30, 60, 90 and at harvest, respectively), length of leaves (23.87 cm, 36.26 cm, 47.74 cm and 48.82 cm at 30, 60, 90 and at harvest, respectively), leaf width (2.20 cm), collar height (6.52 cm), collar width (1.50 cm), fresh weight of plant (49.88 g), earliness in maturity (125.50 days), TSS (40.47°B), ascorbic acid (14.57 mg/l00g), A grade bulb (35.09%), B grade bulb (66.25%) except C grade bulb (18.52%) was recorded under the treatment (T_7)- 75% RDF (75:40:40:25 NPKS kg/ha) + FYM (2.5 t/ha) + PM (0.5 t/ha). However, the minimum value for above parameters were absorbed under treatment (T_1)- Control.

Keywords: Garlic, Growth, Quality, RDF, Treatments and Yamuna Safed-3.

INTRODUCTION

Garlic (*Allium sativum* L.) is an important bulb crop widely grown for as a spice or condiment. It's one of the major members of Alliaceae family and known by variety of local names in different parts of India. In India, it is commonly known as Lahsun. The primary center of origin of garlic is Central Asia and Southern Europe and secondary center is Mediterranean region (Thompson and Kelly 1957*).* Wild ancestor of garlic, *Allium longicuspis* Regel was known in Egypt as early as 3000 B.C. and also to the ancient Greeks and Romans (Som and Hazara 2006).

A colorless, odorless, water-soluble amino compound known as alliin is present in uninjured cloves of garlic. On injury of the cells, an enzyme, alliinase comes in contact with alliin and causes is breakdown into sulphur containing product allicin (diallyl thiosulfate) which gives typical odour of fresh garlic. Diallyl disulfide possess the true garlic odour (Som and Hazara 2006).

Garlic is considered, to possess antibacterial, antibiotic, antitumor, antiviral, antifungal, anticandidal, antimycotic, antithrombotic, fibrinolytic, hypoglycemic, cytotoxic and lipid lowering properties. (Thamburaj and Singh 2005).

China accounts 75% of the total world output and ranks first in production. In India, garlic is grown in an area of 274 thousand hectares with a production of 1.27 million tonnes. Among different states of India, Madhya Pradesh is the leading state accounting for 190.036 thousand hectares area and 1956.749 thousand tons of production contributing 48.64 % of area and 61.44 % in production of country's total (Anonymous, 2021).

High yield and good quality of garlic can be improved through nitrogen and sulphur application strategies as influenced by the source of N and S, as well as rates and times (Luo *et al.,* 2000). Use of both organic as well as inorganic nutrient sources not only help in increasing the yield of the garlic but also act as a store house of nutrients for successive crop growth period, besides this it is improving the physical condition of soil. Integrated nutrient application is the only liable

way for obtaining fairly high productivity with substantial fertilizer leading to sustainable agriculture. Also, it becomes indispensable to find out the optimum dose of organic manures and inorganic fertilizers combination for proper growth and development of crop.

MATERIALS AND METHODS

The present study was carried out at Horticultural Research Centre of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (Uttar Pradesh) during *Rabi season* of 2021-22. The variety of garlic Yamuna Safed-3 was used to carried out in Randomized Block Design with three replications in nine treatments *viz*., T_1- Unfertilized plot (control), T_2- 100% RDF, T_3- 125% RDF, T_4- 150% RDF, T_5- 75% RDF + 25% through FYM through (5 t/ha), T_6- 75% RDF + 25% through PM (1 t/ha), T_7- 75% RDF + FYM (2.5 t/ha) + PM (0.5 t/ha), T_8- 100% RDF + FYM (5 t/ha) and T_9- 100% RDF + Poultry manure (2 t/ha).The flat beds of 3 × 2.5 m^2 size were prepared for planting in spacing of 15 × 10 cm. Five randomly selected plants from each plot were tagged for recording of the various observations on growth and quality characters in garlic. The Plant growth parameters *viz.,* plant height, number of leaves, length of longest leaf, width of leaf height and width of collar region, fresh weight of plant, earliness in maturity were recorded at 30 days, 60 days, 90 days and at harvest. The quality parameters like TSS, ascorbic acid grading of bulb. The data obtained were processed statistically to determine the effect of various treatments.

Standard error of mean

Standard error of mean was calculated as follows:

$$SEm \pm = \sqrt{\frac{EMSS}{r}}$$

Where, $SEm \pm$ = Standard error of mean
EMSS = Error mean sum of square
r = Number of replications on which the observation is based

Critical Difference

$$CD \text{ at } 5\% = \sqrt{\frac{2EMS}{r}} \times t_{0.05}$$

Where,
CD = Critical difference
EMS = Error mean square
SEm ± = Standard error of mean
t = value from Fisher's table (1963) for error degree of freedom at 5% level of significant.

RESULTS AND DISCUSSIONS

The application of different doses of organic manures and fertilizers significantly enhanced the vegetative growth parameters of garlic. The maximum plant height (Table 1) was recorded with the treatment 75% RDF + FYM (2.5 t/ha) + PM (0.5t/ha) with a value of 27.88 cm, 48.79 cm, 64.23 cm and 81.50 cm at 30, 60, 90 and at harvest respectively. In contrast, significantly lowest plant height was observed at all the stages of growth under control *i.e.,* 24.65 cm, 39.49 cm, 53.80 cm and 64.18 cm at 30, 60, 90 and at harvest respectively. The improvement in the nutrient uptake by plants is responsible for good vegetative growth. The similar results were also reported earlier by Talware *et al.* (2010); Ranjan *et al.* (2010); Singh *et al.* (2017).

The highest number of leaves per plant (Table 2) was obtained when the plants were supplied with 75% RDF + FYM (2.5 t/ha) + PM (0.5t/ha) *i.e.,* 5.23, 6.83, 7.34 and 8.59 at 30, 60, 90 and at harvest respectively. While, the control shows the minimum number of leaves per plant at all the successive stage of growth 4.22, 5.00, 5.56 and 6.28 at 30, 60, 90 and at harvest respectively. Similar findings were also reported earlier by Jayathilake *et al.* (2002); Yadav, (2015).

The highest length of leaves (Table 3) was recorded at all the successive stage of growth *i.e.,* 30, 60, 90 and harvesting is (23.87 cm, 36.26 cm, 47.74 cm and 48.82 cm) cm recorded in the plot which was treated with 75% RDF + FYM (2.5 t/ha) + PM (0.5t/ha). However, lowest length was recorded in control (T_1) *i.e*., 18.86 cm, 28.66 cm, 35.62 cm and 36.47 cm at 30, 60, 90 and at harvest. Results of experiment can be explained by correlating the observations with the work done by Patil *et al.* (2007); Islah (2010); Sachin *et al.* (2017) in garlic.

The uppermost value of leaf width (Table 4) 2.20 cm recorded in the plot which was treated with 75% RDF + FYM (2.5 t/ha) + PM (0.5t/ha). However, lowest leaf width was recorded in control (T_1) *i.e*., 1.66 cm. The increased length and width of leaves may be due to the production of promoting substances that might have result in cell elongation and multiplication and rate of photosynthesis. The maximum collar height and collar width (Table 4) was observed with the treatment T_7 75% RDF + FYM (2.5 t/ha) + PM (0.5t/ha) *i.e.,* 6.52 cm and 1.50 cm, respectively. However, the minimum value was observed with the treatment T_1 (control) 4.49 cm and 1.07 cm respectively. Maximum collar height and thickness in this treatment may be the result of high nitrogen supply resulting in increased growth and succulency. These results are in close agreement with those of Singh *et al.* (2002); Patil *et al.* (2007); Islah (2010); Priyanshu *et al.* (2020).

Fresh weight result shows (Table 4) that 75% RDF in treatment T_7 and using of 25 % FYM and PM gave significant results as compare to control and higher dose of RDF 100-150% with or without combination of organic manure. Treatment T_7- 75% RDF + FYM (2.5 t/ha) +PM(0.5t/ha) shows profound increase in the fresh weight of plant, highest value recorded is 49.88 g. While, the lowest value is observed in control 37.50g. The results supported by the finding reported by Singh (2002); Shashidhar *et al*. (2005); Islam *et al*. (2007).

The treatment 75% RDF + FYM (2.5 t/ha) + PM (0.5t/ha) recorded the earliness in maturity (Table-4)

125.50 days under study. However, the treatment control (T_1) took maximum days for maturity (136.86 days). The early maturity of bulb might be due to the hormones and organic acid secreted by organic manures during decomposition might have led to early maturity. The maximum number of days to be taken for maturity under control may be due to inadequate availability of nutrients resulting into more time to complete the vegetative growth (Sachin *et al.,* 2017).

The quality parameters (Table 5) like TSS (°Brix), ascorbic acid (mg/100g) and grading of bulbs were significantly affected by various doses of nutrients during the trialing. The quality parameters improve with using RDF to 75% of RDF doses with combinations of NPK, FYM and Poultry Manure then declined the quality parameters when sole application of NPK. The lowest moisture content, TSS and ascorbic acid were found under the control.

The Maximum value of TSS (40.47°B) was observed in the treatment receiving 75% RDF + FYM(2.5 t/ha) + PM(0.5t/ha). However, minimum T.S.S. (37.67°B) was recorded in control (T_1). The results supported by the finding reported by Waghachavare (2004); Sevak *et al.* (2012); Patidar *et al.* (2017). The maximum ascorbic acid content in garlic bulbs (14.57 mg/l00g) was recorded in the treatment 75% RDF + FYM (2.5 t/ha) + PM(0.5t/ha) and minimum ascorbic acid content observed in control (T_1). This might be due to physiological influence of FYM and vermicompost in combination with inorganic sources of nutrient and biofertilizers on activity of number of enzymes and due to more energy and food material available to the bulb due to strong vegetative growth Choudhary *et al.* (2013); Priyanshu (2020).

The effect of nutrient management was found significant in the different grades of garlic bulbs. The treatment 75% RDF + FYM (2.5 t/ha) + PM (0.5t/ha) recorded A grade bulb (35.09%), B grade bulb (66.25%) and C grade bulb (18.52%). However, treatment T_4 shows maximum C grade bulb percentage (32.24%) as compared to C grade (18.52%) of 75 % RDF + FYM(2.5 t/ha) + PM(0.5t/ha). The least bulb percentage value of A, B and C grade bulb were recorded with the control (T_1) *i.e*., 3.42%, 50.32% and 12.25% respectively. It is observed from the results that the treatment applied with combination of one or more organic manure with inorganic fertilizers shows more B and A grade large bulbs. This may be due to the reduction of inorganic nitrogen doses and better nutrient uptake, improved photosynthesis, besides excellent physiological and biochemical activities. Similar, results were reported earlier by Gowda *et al*. (2007); Banjare *et al.* (2015).

Table 1: Effect of Nutrient Management on plant height of garlic cv. Yamuna Safed-3.

Treatments		Plant height (cm)			
		30 DAP	60 DAP	90 DAP	At harvest
T_1	Control	24.65	39.49	53.80	64.18
T_2	RDF(100:50:50:30kg NPKS kg/ha)	26.60	42.98	59.33	73.85
T_3	125%RDF(125:65:65:40 NPKS kg/ha)	26.65	43.57	59.93	74.46
T_4	150%RDF(150:75:75:45 NPKS kg/ha)	26.85	43.85	60.38	75.68
T_5	75%RDF(75:40:40:25NPKSkg/ha) + 25% through FYM through(5 t/ha)	27.40	44.63	61.46	76.97
T_6	75%RDF(75:40:40:25 NPKS kg/ha) + 25% through PM(1 t/ha)	27.81	47.90	63.04	80.38
T_7	75%RDF(75:40:40:25NPKS kg/ha) + FYM(2.5 t/ha) + PM(0.5t/ha)	27.88	48.79	64.23	81.50
T_8	RDF(100:50:50:30kg NPKS kg/ha) + FYM(5t/ha)	27.85	46.76	62.35	79.15
T_9	RDF(100:50:50:30 kg NPKS kg/ha) + Poultry manure(2t/ha)	27.78	46.14	60.97	77.11
	S.E.(m) ±	**0.53**	**0.49**	**0.72**	**0.39**
	CD (P=0.05)	**1.53**	**1.41**	**2.10**	**1.15**

Table 2: Effect of Integrated Nutrient Management on number of leaves in garlic cv. Yamuna Safed-3.

Treatment		Number of leaves			
		30 DAP	60 DAP	90 DAP	At harvest
T_1	Control	4.22	5.00	5.56	6.28
T_2	RDF(100:50:50:30kg NPKS kg/ha)	4.53	5.02	6.35	6.94
T_3	125%RDF(125:65:65:40 NPKS kg/ha)	4.71	5.15	6.24	7.19
T_4	150%RDF(150:75:75:45 NPKS kg/ha)	4.71	5.18	6.33	7.45
T_5	75% RDF(75:40:40:25NPKSkg/ha)+25% through FYM through (5 t/ha)	5.17	5.28	6.66	7.59
T_6	75% RDF(75:40:40:25 NPKS kg/ha) +25% through PM(1 t/ha)	5.18	6.31	7.24	8.45
T_7	75% RDF(75:40:40:25NPKS kg/ha)+FYM(2.5 t/ha) + PM(0.5t/ha)	5.23	6.83	7.34	8.59
T_8	RDF(100:50:50:30kg NPKS kg/ha) + FYM(5t/ha)	5.12	5.59	6.77	8.01
T_9	RDF(100:50:50:30 kg NPKS kg/ha) +Poultry manure(2t/ha)	5.08	5.46	6.70	7.80
	S.E.(m) ±	**0.22**	**0.39**	**0.30**	**0.38**
	CD (P=0.05)	**0.63**	**1.14**	**0.88**	**1.12**

Table 3: Effect of Integrated Nutrient Management on length of leaves in garlic cv. Yamuna Safed-3.

Treatment		Length of leaves (cm)			
		30 DAP	60 DAP	90 DAP	At harvest
T_1	Control	18.86	28.66	36.47	35.62
T_2	RDF(100:50:50:30kg NPKS kg/ha)	22.11	28.84	38.75	37.67
T_3	125%RDF(125:65:65:40 NPKS kg/ha)	22.18	29.66	39.26	38.65
T_4	150%RDF(150:75:75:45 NPKS kg/ha)	22.45	30.56	40.69	39.57
T_5	75%RDF(75:40:40:25NPKS kg/ha) + 25% through FYM through(5 t/ha)	23.28	31.26	43.19	42.24
T_6	75%RDF(75:40:40:25 NPKS kg/ha) +25% through PM(1 t/ha)	23.65	34.78	46.97	46.03
T_7	75%RDF(75:40:40:25NPKS kg/ha) + FYM(2.5 t/ha) + PM(0.5t/ha)	23.87	36.26	48.82	47.74
T_8	RDF(100:50:50:30kg NPKS kg/ha) + FYM(5t/ha)	23.51	34.12	46.32	44.89
T_9	RDF(100:50:50:30 kg NPKS kg/ha) + Poultry manure (2t/ha)	23.33	33.27	44.81	44.14
	S.E.(m) ±	**0.52**	**0.61**	**0.59**	**0.63**
	CD (P=0.05)	**1.52**	**1.76**	**1.73**	**1.83**

Table 4: Effect of Integrated Nutrient Management on leaf width, collar height, collar width, fresh weight (g) and days to maturity of garlic cv. Yamuna Safed-3.

Treatment		Leaf width (cm)	Collar height (cm)	Collar width (cm)	Fresh weight (g)	Days to Maturity
T_1	Control	1.66	4.49	1.07	136.86	37.50
T_2	RDF(100:50:50:30kg NPKS kg/ha)	1.76	5.08	1.11	130.09	39.37
T_3	125%RDF(125:65:65:40 NPKS kg/ha)	1.90	5.44	1.16	132.25	42.51
T_4	150%RDF(150:75:75:45 NPKS kg/ha)	1.93	5.70	1.24	132.04	44.76
T_5	75%RDF(75:40:40:25NPKS kg/ha) + 25% through FYM through(5 t/ha)	2.13	5.87	1.26	134.37	45.90
T_6	75%RDF(75:40:40:25 NPKS kg/ha) + 25% through PM (1 t/ha)	2.01	6.42	1.46	127.80	47.30
T_7	75%RDF(75:40:40:25NPKSkg/ha) + FYM(2.5 t/ha) + PM(0.5t/ha)	2.20	6.52	1.50	125.50	49.88
T_8	RDF(100:50:50:30kg NPKS kg/ha) + FYM(5t/ha)	2.10	6.25	1.42	135.71	47.46
T_9	RDF(100:50:50:30 kg NPKS kg/ha) + Poultry manure(2t/ha)	1.99	6.02	1.33	135.14	45.11
	S.E.(m) ±	**0.09**	**0.36**	**0.10**	**0.55**	**0.58**
	CD (P=0.05)	**0.27**	**1.04**	**0.28**	**1.61**	**1.69**

Table 5: Effect of Nutrient Management on TSS, ascorbic acid and grading of bulbs (%) in garlic cv. Yamuna Safed-3.

Treatment		TSS (°B)	Ascorbic acid (mg $100g^{-1}$)	Grading of bulbs (%)		
				A	B	C
T_1	Control	37.67	12.04	3.42	50.32	12.25
T_2	RDF(100:50:50:30kg NPKS kg/ha)	38.89	13.02	3.67	53.20	14.30
T_3	125%RDF(125:65:65:40 NPKS kg/ha)	38.99	13.20	10.39	61.24	15.82
T_4	150%RDF(150:75:75:45 NPKS kg/ha)	39.13	13.13	14.38	62.35	32.24
T_5	75%RDF(75:40:40:25NPKSkg/ha) + 25% through FYM through (5 t/ha)	39.26	13.71	15.42	63.36	20.10
T_6	75%RDF(75:40:40:25 NPKS kg/ha) + 25% through PM(1 t/ha)	39.91	14.28	31.27	65.82	30.20
T_7	75%RDF(75:40:40:25NPKSkg/ha) + FYM(2.5 t/ha) + PM(0.5t/ha)	40.47	14.57	35.09	66.25	18.52
T_8	RDF(100:50:50:30kg NPKS kg/ha) + FYM(5t/ha)	39.53	14.14	22.67	64.54	23.40
T_9	RDF(100:50:50:30 kg NPKS kg/ha) + Poultry manure(2t/ha)	39.39	13.97	18.62	64.26	20.50
	S.E.(m) ±	**0.48**	**0.40**	**0.30**	**0.49**	**0.39**
	CD (P=0.05)	**1.39**	**1.17**	**0.86**	**1.42**	**1.13**

CONCLUSION

On the basis of results obtained in present investigation, it is concluded that treatment 75% RDF + FYM 2.5 t/ha + PM 0.5t/ha and 75% RDF + PM1 t/ha which were significantly at par with each other in mostly all the treatments was found to be the best for enhancement in plant height, number of leaves, length and width of leaves, height and width of collar, fresh weight of plants, TSS, Ascorbic acid, grading of bulbs and reduced days to maturity which eventually increased the growth and quality of garlic.

FUTURE SCOPE

Based on the results of the current study, it can be said that the treatments of 75% RDF + FYM 2.5 t/ha + PM 0.5 t/ha and 75% RDF + PM 1 t/ha were the most effective combinations for the growth and quality parameters of garlic. Additionally, it promotes early development and aids in supplying the growing demand for garlic among farmers.

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