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Efect of levels of nitrogen and phosphorus in conjuction with varying plant densities on some important bulb characters and yield of garlic (*Allium sativum* Linn.)

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ABSTRACT
Garlic (*Allium sativum* Linn.) having the 88100 ha cultivation area in India, is an important spice and condiment crop (Anon, 2002). Besides its cultinary uses it is well known all over the world for therapeutic effectiveness. Recently, in the era of the World Trade Organization and new policy of economic liberalization in the country, it has now become an immensely attractive crop for international trade. Notwithstanding all this, its productively, which has already been very low, has further gone down from 4.37 t/ha to 3.67 t/ha over the period of 1984-91. Although efforts have been made to boost up its productivity through various agronomic manipulations (Rao and Purewal, 1957; Anon, 1978, 1987 and 1992), the effects of plant density and N and P_2O_5 fertilization and that too, in respect of alluvial plain of eastern U.P. has been scantily tested. It is with this view, the present experiment were conducted and the results of which have been presented herewith.

Key words : Spice, Condiment, Culinary, Clove, Plant density therapeutic, Garlic.

INTRODUCTION

Garlic (*Allium sativum Linn.)* a member of the family Amaryllidaceae, has long been cultivated in India as an important spices and/condiment. Although a hardy perennial bulbus plant, it is grown as an annual crop. The edible part, which is composed of several bulblets or segments called “Clove”. The number of cloves normally very from 6 to 50 but some times single clove bulb also found. The therapeutic value of garlic has attracted the attention of one and all since vedic era and every Indian home can prescribed garlic based effective treatment for many common ailments. Because of its medicinal properties. The various uses and properties of garlic has created its big demand for it within and outside of the country. In 1992-93 India exported 7700 tones garlic worth Rs. 71.69 millions, putting it among high foreign exchange earner. Since large quantities of dry matter and carbohydrates are synthesized by bulb crops, application of nitrogen, phosphorus is very important for getting high economic yields. Garlic responds well to nitrogen, phosphorus and specing be achieved without adversely affecting the productivity in long run. Apart from essential elements, appropriate plant density is also an important factor effecting the yield. (Maurya and Bhuyan, 1982) . By manipulating optimum nitrogen and phosphorus levels in conjunction with suitable plant density, maximum economic yield per unit area and time can.

MATERIALS AND METHODS

The experiment was conducted at KAPG, P.G. College, Allahabad (U.P.) during 1986-87 and 1987-88. The design of the experiment was split plot with three levels of each of N and P2O5 i.e. 0,120, 160 Kg N and 0, 80, 120 Kg P2O5/ha as Urea and S.S.P. respectively in the main plots and three plant spacing (15x10 cm. 10 x 10 cm. And 5 x 10 cm.) in the sub-plots. A local white skin cultivar of garlic was used during both the years of experimentation. The experiment was replicated thrice. The important yield contributing characters, viz., bulb diameter, No. of cloves,/bulbs, fresh and dry weight of bulbs and the yield, which was computed to q/ha, were recorded at 150 DAP at harvest. Response curve was fitted to ascertain the most economic levels of treatment. The data obtained were subjected to statistical analysis by usual method of analysis of variance.

RESULTS AND DISCUSSION

While none of the treatments had any effect on number of cloves/bulb, all treatments significantly affected other characters and the yield (Table-1).

Effect of N levels

The minimum diameters of 2.26 and 2.24 cm and under without nitrogen treatments significantly increased to 3.48 and 3.31 cm in respective two years under the highest level of nitrogen. The mid respective two years under the highest level of nitrogen. The mid level of 120 kg/ha was also significantly superior to without nitrogen but inferior to highest levels in both the years,. Identical trends were witnessed in the case of fresh and dry weight also. The lightest bulbs 12.44 and 11.84 g fresh weight and 5.96 and 5.83 g dry weight produced under without nitrogen treatment which went on increasing up to highest level.

Effects of P_2O_5 levels

Similar to the effects of N, the bulb diameter was significantly affected with each increasing level of P_2O_5. It increased from 2.75 and 2.58 cm in respective two years to 2.83 and 2.80 under 80 Kg P_2O_5/ha which further spot up to 2.93 and 2.91 under the highest dose of 120 Kg/ha. The similar trend was in respect of fresh and dry weights as well which significantly increased with each increasing level.

Spacing effects

The effect of spacing on diameter was not as pronounced as in the case of fertilizers. The spacing effect in the second year turned out to be non-significant. In the first year too, the effects between lowest density and mid density (15x10cm and 10x10 cm) and mid density and highest density (10x10 cm and 5 x 10 cm) turned out to be non-significant, but L.S.D. between minimum and maximum spacing (15 x 10 cm and 5x10cm) was enough to make the effect significant. So far as the fresh and dry weights are concerned, these significantly reduced with the increase in the plant density. The fresh weight in the two respective years (21.62 and 20.66 g/bulb) at 15x10 cm. Spacing reduced to almost 50 per cent i.e. to 10.79 and 10.19 g under 5x10 cm spacing. The reduction in the case of dry weight was still more pronounced which reduced from 10.52and 10.35 g to 4.41 to 4.24 under the influence of highest plant density in both the respective years.

Effects on yield :
Nitrogen levels

Like three character parameters, bulb yield also went to increasing with each incremental level of nitrogen in both the years and the increase was found to be significant. The minimum yield of 118.60 and 111.74 g/ha under control increased to 168.12 and 159.50 g/ha respectively under 120 Kg N/ha. This further increased to 207.62 and 179.33 g/ha with highest level of 160 Kg/N/ha.

Phosphorus levels

Each incremental dose of P_2O_5 also positively and significantly affected bulb yield in both the years. In this case also, lowest yields of

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145.15 and 141.21 g/ha under control increased to 183.17 and 169.96 g/ha with highest level of P_2O_5 the yields under mid level of P_2O_5 (80 kg/ha) were also significantly superior and inferior respectively to that under control at highest level.

Table 1 : Effect of levels of N and P_2O_5 in conjunction with varying plant densities on the bulb character of garlic.

Treatment	Diameter of bulb (cm)		Fresh weight of bulb (g)		Dry. Wt. Of bulb (g)		No. of clove/bulb		Yield g/ha	
	1986-87	1987-88	1986-87	1987-88	1986-87	1987-88	1986-87	1987-88	1986-87	1987-88
N levels										
N_0	2.26	2.24	12.44	11.84	5.96	5.83	19.14	18.96	118.60	111.74
N_{120}	2.76	2.73	16.68	15.78	7.72	7.55	20.16	20.00	168.12	159.50
N_{160}	3.48	3.31	20.48	19.65	9.57	9.37	20.27	20.18	207.62	179.33
CD (P=0.05)	0.04	0.22	0.38	1.01	0.08	0.38	NS	NS	11.77	12.26
P_2O_5 levels										
P0	2.75	2.58	14.88	14.04	47.03	6.86	19.56	19.67	145.15	141.21
P80	2.83	2.80	16.41	15.68	7.78	7.63	20.22	20.13	166.01	157.40
P120	2.93	2.91	18.32	17.52	8.44	8.26	20.30	20.23	183.17	169.96
CD (P=0.05)	0.04	0.22	0.38	1.01	0.18	0.38	NS	NS	11.77	12.26
Spacing										
S_1 (15 x 10 cm)	2.91	2.85	21.62	20.66	10.52	10.35	16.86	16.69	144.44	137.03
S_2 (10 x 10 cm)	2.83	2.78	17.21	16.41	8.33	8.17	21.54	21.36	168.80	159.43
S_3 (5 x 10 cm)	2.77	2.67	10.79	10.19	4.41	4.24	22.26	22.09	181.11	172.12
CD (P=0.05)	0.10	0.48	0.67	1.28	0.32	0.44	NS	NS	19.15	21.52

Plant spacing

The highest plant density with 2 lakh plants/ha (5x10 cm spacing) resulted in 181.11 and 172.12 g/ha yield in the two consecutive years. This went on decreasing with each increased spacing. However, the difference in the yield as affected by mid density (10 x 10 cm spacing) and lowest density (15 x 10 cm) was non-significant.

Discussion

Based on the above findings, it is concluded that none of the treatments affected clove number/bulb. As since it is totally genetic trait hence it may not be affected by environmental factors. It is therefore, obviously clear and need no further explanation.

The positive effects of nitrogen on all other bulb characters studied can be explained in the light of the fact that nitrogen is an important cell constituent and effect plant physiology in more than one way. It affects in increased nucleic acid, amino acids and compounds containing high nitrogen specially proteins, help in formation of more carbohydrate in the source which goes down to sink resulting in increased diameter, fresh and dry weights. Nitrogen also helps in increased turgidity. Similar results have also been borne out with the studies of Pandey and Mundra (1971).

Phosphorus, which is considered “key to life” element, directly involved in most life processes. It helps in development and growth of almost all yield parameters and also favorably affects the response of higher nitrogen fertilization. The vegetative development is directly associated with formation of cell well in which P2O5 is a major constituent. The phosphorus availability made this function convenient and response was found significant in respect of bulb diameter and fresh and dry weight of bulbs. These results are in close conformity with the finding reported by Singh and Tiwari (1969) and Lachica (1982).

Plant spacing which determines the plant number per unit area, affects various plants activities mainly by the amount of sunlight, air, nutrients and moisture, the individual plant receives, which in turn affectsd photosynthesis and other plant process. In the present study the bigger size bulbs, high fresh and dry weights under wider spacing, which gradually went on decreasing with the decreased spacing, must be due to low competition among the individual plants at wider spacing. This identical results have been also reported by Lachica (1982). Maurya and Bhuyan (1982) and Olrowski and Reskowska (1989) in this regard.

Yield of the co-ordinated interplay of growth and development characters, vigorously growing plants under increased N and P2O5levels were able to absorb larger quantities of nutrients and moisture through their well developed root and top systems. As a result, yield parameters were improved as explained. This in turn affected the final yield favorably. The high nutrient levels did not prove too high to have adverse effects on yield. The same was again supported by Singh and Tiwari (1968) and Singh and Batra (1972).

The significant effect of decreased spacing on increased yield upto mid level (10x10 cm.) only and not beyond that must be due to higher competition among the individual plants. This negatively affected the yield contributing characters as explained earlier.

SUMMARY

The experiment was conducted to assess the effects of higher levels of N and P_2O_5 (120, 160 Kg N and 80, 120 Kg P_2O_5/ha) than that normally evaluated and three plant spacing (15 x 10, 10 x 10 and spacing (15 x 10, 10 x 10 and 5 x 10 cm) on some important bulb characters and yield of garlic.

Although number of cloves per bulb remained unaffected by any treatment, bulb diameter, fresh and dry weight and yield were significantly affected. It was revealed that N and P2O5 levels as high as 160 kg and 120 kg/ha respectively with 10 x 10 cm. Spacing will give the most economic yield and return of garlic.

Cost of cultivation, gross and net income increased due to increasing levels of nitrogen, phosphorus and closer spacing except in spacing where net income at medium spacing (10 x 10 cm) was higher than closest spacing (5 x10 cm.). The net profit per rupee invested increased with increasing nitrogen and phosphorus.

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