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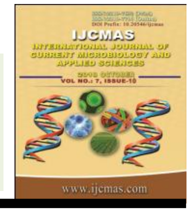

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Studies on the Effect of Macro and Micro Nutrients on Yield and Nutrient Uptake in Garlic (*Allium sativum* L.)

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A B S T R A C T

The present investigation entitled "Studies on the effect of macro and micro nutrients on yield and nutrient uptake in garlic (*Allium sativum* L.)" was conducted during *Rabi* season of 2015-16 at Horticultural Research and Training Station and KVK, Kandaghat of Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan. Ten combinations of different macro and micro nutrients were replicated thrice in the form of ten treatments in a plot having dimensions of 2.0x2.0m. The experiment was laid out in a randomized block design with three replications involving a spacing of 20x10cm. The cloves of garlic variety 'Kandaghat Selection' were sown on 1st October, 2015. The data were recorded onbulb yield per hectare (q) and NPK uptake by the plant. The results revealed that application of 125 per cent of recommended dose of NPK + Zn @ 7.5kg/ha produced best results in terms of bulb yield per hectare (q) and NPK uptake by the plant, whereas, minimum values for all these characters were recorded in the absolute control.

Introduction

Garlic (*Allium sativum* L.) is the most widely used cultivated *Allium* species after onion belongs to the family Amaryllidaceae. Garlic is one of the main *Allium* vegetable crops known worldwide with respect to its production and economic value. Garlic is cultivated all over India mainly in Gujarat, Orissa, Madhya Pradesh, Rajasthan, Uttar Pradesh and Maharashtra. In the Indian sub-continent, people use fresh leaves of garlic as salad and a tasty pickle is also prepared from its cloves. Garlic has higher nutritive value as compared to other bulbous crops. It is a rich source of carbohydrates (29.0%), proteins (6.3%), minerals (0.3%), essential oils (0.1 – 0.4 %) and also contains appreciable quantities of fats, vitamin C and sulphur (Memane *et al.*, 2008).

Keeping in view the increasing Indian population and decreased cultivated crop area, there is a need to enhance the production as well as productivity to meet out the vegetable requirement of the country. Modern agriculture largely depends on the use of chemical fertilizers. Reasons for low yield of garlic are mainly depletion of macro and micro nutrients from the soil, use of low yielding varieties with low or no inputs and poor management practices. The use of chemical fertilizer helps in achieving maximum yield of the crop (Singh and Tewari, 1968). Both macro and micro nutrients have various roles to play in different soils and their removal by different crops vary with different seasons and areas. In order to improve garlic production, different means of fertilizer application (type, time and rate) are considered to be the limiting factors which should be given due consideration (Brewster and Butler, 1989) and the production of vigorous sprouts is one of the most important factors of successful garlic production through balanced nutrient application (Potgieter, 2006). Bulbous crops are heavy feeder, requiring optimum supplies of nitrogen, phosphorus, potassium, zinc, sulphur and other nutrients which can adversely affect growth, yield and quality of bulbs under sub optimal levels in the soil (Gubb and Tavis, 2002). Mallangouda *et al.,* (1995) were of the opinion that nitrogen, phosphorus and potassium plays an important role in improving vegetative growth and yield of garlic.

Improved management of nitrogen, phosphorus, potassium and other inputs in the soil could improve yield and quality of vegetables and other crops (Nai-hua *et al.*, 1998). Garlic is a long day crop and has special root architecture i.e., shallow root system, low root densities and lack of root hairs, so it needs a high concentration of N, P and K in the soil solution to satisfy the potential demand. Hence garlic needs high levels of N, P and K in the soil (Brewster, 1994). High yield and good quality of garlic can therefore be obtained through efficient and balanced use of macro and micro nutrients.

Materials and Methods

'Kandaghat Selection' variety was choosen for the studies. It is a local clonal selection from Himachal Pradesh. The plants are of long day type. Bulbs are creamish white having diameter ranging from 3.5-5.5cm. Bulbs have 13-16 yellowish white cloves having diameter of 1.1-1.7cm. The cultivar is suitable for cultivation in Northern hilly regions of India. It is a medium storer and tolerant to common diseases. Average yield per hectare ranges from 140-200 q/ha. The experiment was laid out in randomized block design with three replications and ten treatments. The plot size was taken 2.0 x 2.0 m with spacing of 20 x 10 cm and total number of plots was thirty. The soil had 7.11 and 0.40 of pH and electrical conductivity, respectively. The soil had fertility status of 279.25 kg nitrogen/ha, 30.25 kg phosphorus/ka and 355.28 kg potassium/ha. Annual precipitation of the area is 1120mm, which is received during monsoon (June- September).

Results and Discussion

Response of a crop to fertilizer, which is a function of nutrient uptake, is highly variable and depends on crop, type of soil, past use of land, local weather conditions as well as choice of the season. In the present studies (Table 1), application of different combinations of nutrients significantly increased the N uptake in garlic plant. Maximum nitrogen uptake (44.49 kg/ha) was obtained in T_{10} (125% of recommended dose of NPK + Zn @ 7.5kg/ha). The data pertaining to phosphorus uptake (Table 1) have been presented which revealed significant effect of different treatments. Maximum phosphorus uptake (16.47 kg/ha) was obtained in treatment T_{10} (125% of recommended dose of NPK + Zn @ 7.5 kg/ha). Increasing N uptake with increasing N fertilizer application to the soil is due to the result of improved availability and uptake through increased root growth and effective absorption same results were also reported by Kumar and Rao (1992), Panda *et al.*, (1995), Nasreen and Hossain (2004) and Tamirat (2006).

The data (Table 1) showed that there was significant gain in potassium uptake by the use of different combinations of nutrients. Maximum uptake of potassium (32.93 kg/ha) was obtained in the treatment T_{10} (125% of recommended dose of NPK + Zn @ 7.5kg/ha). Potassium is a mobile element within the soil having higher moisture content and moves with water to different plant tissues. Potassium has a major role in plant metabolism as it activates some enzymes especially involved in the metabolism of carbohydrates. Under high levels, starch moves efficiently from sites of production to storage. In addition, it plays a potential role in the transport of water and essential nutrients throughout the plant in the xylem (Mansour, 2006). It seems that application of a combination of nutrients (as NPK and Zn in the present case) might have improved the nutrients uptake of the crop as a result of their cumulative effect on the nutrients uptake by increasing the dry matter production. According to Singh and Dhankar (1989), availability of higher potassium fertilizer could have caused higher uptake of K and other nutrients by garlic crop which could have increased production of carbohydrates during photosynthesis and this in turn, have increased TSS content of bulbs. Minimum potassium uptake was, however observed in the absolute control (15.08 kg/ha) where no nutrients were applied.

Table.1 Effect of different macro and micro nutrients on nitrogen, phosphorus and potassium uptake by garlic plants (kg/ha)

Treatment Code	Treatments	Bulb yield (q/ha)	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)
T1	Absolute control (No application of macro or micro nutrients)	138.75	19.87	6.47	15.08
T2	75% of recommended dose of NPK.	158.25	23.90	8.39	18.77
T3	75% of recommended dose of NPK + Zn @ 5 Kg/ha.	162.38	25.61	9.23	20.10
T4	75% of recommended dose of NPK+ Zn @ 7.5 Kg/ha.	170.25	26.30	9.82	21.01
T5	Recommended dose of NPK (100 % NPK).*	176.63	31.41	11.19	23.35
T6	Recommended dose of NPK+ Zn @ 5 Kg/ha.	182.40	33.37	12.09	25.02
T7	Recommended dose of NPK+ Zn @ 7.5 Kg/ha.	187.88	34.58	12.80	26.45
T8	125% of recommended dose of NPK.	190.58	40.05	14.85	29.89
T9	125% of recommended dose of NPK+ Zn @ 5 Kg/ha.	192.75	42.63	15.82	31.44
T10	125% of recommended dose of NPK+ Zn @ 7.5 Kg/ha.	197.25	44.49	16.47	32.93
CD $_{(0.05)}$		19.91	1.67	0.83	0.93

The yield per plot was calculated by weighing all the marketable bulbs in a plot and was multiplied with a suitable factor to work out yield per hectare. In the present studies (Table 1), per hectare yield ranged from 138.75q/ha (control plot) to 197.25q/ha in treatment T_{10} (125% recommended dose of NPK + Zn @ 7.5 kg/ha) which was 29.65 per cent more. The treatment which produced maximum yield i.e. $T_{10.}$ Assefa *et al.*, (2015) who also reported increased yield due to the application of N, P, S and Zn, possibly due to the combined effect of contribution of N to chlorophyll, enzymes and protein synthesis, as P is essential for root growth, phospho-proteins and phospho-lipids.

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