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Combined Impact of Major and Micronutrients on Vegetative Growth and *Incidence of Pests and Diseases of Garlic (Allium sativum* L.*)*

Shailendra Singh Yadav*, K.P. Asati, Swati Barche and Anjali Sharma
Department of Horticulture
R.V.S.K.V.V., College of Agriculture, Indore (Madhya Pradesh), India.

(Corresponding author: Shailendra Singh Yadav)*
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ABSTRACT: Incidence of pest and diseases is a common problem in garlic production. Micronutrients application may redress this problem to some extent. Therefore a field experiment was carried out at Research Farm, College of Agriculture, Indore (M.P.) during season 2020-21 to study the combined impact of major and micronutrients on vegetative growth and incidence of pests and diseases of garlic. The experiment comprising ten major-cum-micronutrients was laid out in a randomized block design with three replications. The Results revealed that the application of 100:50:50 NPK + boron 1 kg ha^{-1} (soil application) + boron 0.5% (foliar) T_7 recorded maximum plant height (54.31 cm), leaf width (1.94 cm) and length of pseudostem (4.95 cm). The yield was 143.44 q ha^{-1}. This was equally followed by T_2 and T_1 having foliar and soil applied boron respectively along with 100:50:50 NPK kg ha^{-1}. On the other hand, application of only 100:50:50 NPK recorded significantly lowest vegetative growth parameters and thereby yield (109.60 q ha^{-1}). The thrips and purple blotch incidence was found minimum under T_8 having 100:50:50 NPK + sulphur 30 kg ha^{-1} applied through soil + sulphur 0.6% applied through foliar which recorded maximum garlic yield up to 158.44 q ha^{-1}. This was followed by T_4 (156.44 q ha^{-1}) and T_3 (150.89 q ha^{-1}) having foliar and soil applied sulphur along with 100:50:50 NPK.

Keywords: Major, micronutrients, yield, disease pest, garlic.

INTRODUCTION

Garlic (*Allium sativum* L.) is one of the most important spices and condiments used in daily cooking in India. It is an important crop among all the spice crops due to its medicinal as well as flavour and taste imparting characters. Garlic belongs to the family Alliaceae with genus *Allium* and species *Sativum* having 2n=16 chromosome numbers. In Madhya Pradesh, garlic has the highest area of 178 thousand hectares and production 1808 thousand tonnes with the productivity up to 10.15 t ha^{-1} (National Horticulture Board, 2020). The Mandsaur and Indore districts are the main producer of garlic in Madhya Pradesh. Continuous low yield in garlic attributed due to many factors like lack of proper planting material, inappropriate agronomic practices, inadequate pest and disease management, marketing facilities etc. (Nasreen *et al.,* 2009). The use of major and micronutrients application is also very limited in this crop, resulting poor growth, yield and quality of garlic. Micronutrients are deficient in Indian soils because their removal by vegetable crops are never replenished (Rattan and Sharma 2014).

The micronutrients like sulphur, zinc, boron play an important role in photosynthesis, N-fixation, respiration and the metabolic processes of plant. Foliar application of micronutrients during crop growth correct the deficits and improving the mineral status of plants as well as increasing the crop yield and quality of garlic (Kolota and Osinska 2001). Garlic requires different micronutrients which are essential for health, growth and development. These are usually required in smaller amount than nitrogen, phosphorus and potassium. These are very important for growth and general health. (Singh *et al.*, 1995).

Due to non-addition of zinc and boron, crops suffer in many ways. In deficient condition of boron, growing plant become dead and ultimately the lateral shoots, buds and flowers dies. Chlorosis, thickening and curling of leaves were also observed (Francois, 1991). Limited work has been done on sulphur, zinc and boron towards the control of pests and diseases in garlic. Looking to all these facts the present research was taken up.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season of 2020-21 at the Research Farm, College of Agriculture, Indore (M.P.). The soil of the experimental field was silty clay-loam having pH 7.2, organic carbon 7.6 g kg^{-1}, available N, P and K 226, 10 and 448 kg ha^{-1}, respectively. The experiment was laid out in randomized block design keeping three replications. The 10 treatments having different combinations of major and micronutrients fertilizers were T_0=100:50:50 NPK (control), T_1=100:50:50 NPK + boron 1 kg ha^{-1}(soil application), T_2=100:50:50 NPK + boron 0.5% (foliar), T_3= 100:50:50 NPK + sulphur 30 kg ha^{-1} (soil application), T_4= 100:50:50 NPK + sulphur 0.6% (foliar), T_5= 100:50:50 NPK + zinc 7.5 kg ha^{-1} (soil application), T_6= 100:50:50 NPK + zinc 3% (foliar), T_7

= 100:50:50 NPK + boron 1 kg ha^{-1} (soil application) + boron 0.5% (foliar), T_8= 100:50:50 NPK + sulphur 30 kg ha^{-1} (soil application) + sulphur 0.6% (foliar), T_9= 100:50:50 NPK + zinc 7.5 kg ha^{-1} (soil application) + zinc 3% (foliar). The garlic var. G-282 was sown on 6 October 2020 using 500 kg seed ha^{-1} and keeping 15 x 10 cm spacing. Application of fertilizers major and micro nutrients were apply as per treatment by Urea, Di-ammonium phosphate, murate of potash, Richbore (20% boron), turbo zinc (12% zinc) and sulpho max (90% sulphur). The crop was harvested during the first week of April, 2021. The plant growth parameters, yield and yield attributing parameters were recorded in each treatment. Before presenting the result data were statistically analyzed.

Pest incidence. Pest incidence was recorded at regular interval from randomly selected plants from each plot. Hand lens was used for counting nymph and adult of thrips.

Disease incidence. Disease incidence was recorded at regular interval in five diseased samples were collected from each plot for identification of purple blotch .Observations were recorded with respect to disease severity of purple blotch with the following formula.

$$\text{DI} = \frac{\text{Number of infected plant}}{\text{Total number of inspected plant}} \times 100$$

RESULTS AND DISCUSSION

Vegetative growth parameters. The data furnished in (Table 1) indicated that the plant height of garlic was significantly increased (54.31 cm) with 100:50:50 NPK + boron 1 kg ha^{-1} soil application + boron 0.5% foliar application (T_7). This was closely followed by boron 0.5% foliar application (T_2) (51.30 cm height) as well as soil application of boron 1 kg ha^{-1} (T_1) (50.55 cm height). The significant increased in plant height due to application of boron might be due to their role in the cell division and cell enlargement in the coincident enlargement of the protoplast through water uptake. Similar results have been reported by Chanchan *et al.* (2013); Pramanik and Tripathy (2017); Yadav *et al.* (2018). Significantly highest number of leaves per plant by foliar and soil application of boron (T_7) (9.22) and followed by foliar application of boron (T_2) (8.55). Thus, the use of boron increased the more leaves per plant than other micronutrients. This was due to their significant role in cell division, meristematic activity of plant tissue and expansion of cells. Significantly increased number of leaves per plant with application of boron was also reported by Dake *et al.* (2012); Manna *et al.* (2013); Acharya *et al.* (2015).

Table 1: Effect of major and micronutrients on growth, pests and disease parameters of garlic.

Tr. No.	Plant height (cm)	Leaves plant^{-1}	Leaf length (cm)	Leaf width (cm)	Length of pseudostem (cm)	Thrips incidence (in number)	Purple blotch disease incidence (%)	Bulb yield (q ha^{-1})
T_0	42.03	7.11	41.87	1.45	3.84	34.67	41.41	109.67
T_1	50.55	8.44	47.32	1.78	4.48	24.00	29.79	136.78
T_2	51.30	8.55	47.87	1.81	4.58	17.33	24.24	141.33
T_3	44.49	7.22	44.84	1.61	4.04	10.33	20.70	150.89
T_4	46.37	7.44	44.89	1.65	4.12	9.67	18.68	156.44
T_5	48.26	7.78	45.63	1.69	4.18	25.24	33.83	126.66
T_6	49.15	8.22	46.18	1.72	4.25	24.67	32.32	131.11
T_7	54.31	9.22	49.48	1.94	4.95	14.67	23.23	143.44
T_8	47.67	7.66	45.53	1.66	4.20	4.33	12.62	158.44
T_9	49.18	8.33	46.91	1.76	4.35	24.33	31.31	132.22
CD at 5%	**1.52**	**0.66**	**0.87**	**0.05**	**0.27**	**1.29**	**2.23**	**7.19**

T_0= 100:50:50 NPK (control), T_1= 100:50:50 NPK + boron 1 kg ha^{-1}(soil application), T_2= 100:50:50 NPK + boron 0.5% (foliar), T_3= 100:50:50 NPK + sulphur 30 kg ha^{-1} (soil application), T_4= 100:50:50 NPK + sulphur 0.6% (foliar), T_5= 100:50:50 NPK + zinc 7.5 kg ha^{-1} (soil application), T_6= 100:50:50 NPK + zinc 3% (foliar), T_7= 100:50:50 NPK + boron 1 kg ha^{-1}(soil application) + boron 0.5% (foliar), T_8= 100:50:50 NPK + sulphur 30 kg ha^{-1}(soil application) + sulphur 0.6% (foliar), T_9= 100:50:50 NPK + zinc 7.5 kg ha^{-1}(soil application) + zinc 3% (foliar).

The leaf length of garlic plant was also significantly influenced by foliar along with soil application of boron (49.48 cm) than other micronutrient application (44.84 cm to 47.87 cm) and control (41.87 cm). The significant effect of boron with foliar and soil application in combined with chemical fertilizers (NPK) was recorded. In case of leaf width and length of pseudostem significant enhancement was noticed. The increase in leaf length, leaf width and length of pseudostem might be due to role of boron in nitrogen, carbohydrate metabolism and cell enlargement. The better efficiency of boron has also been reported by Yadav *et al.* (2018); Shukla *et al.* (2018).

The present study clearly indicated the beneficial impact of boron on the growth of garlic crop, which might be due to the involvement of boron in different physiological processes and cellular function within the plant. In addition boron plays an essential role in improving the plant growth through cell enlargement and increased uptake of potassium and phosphorus which are responsible for promoting plant growth in garlic Rani *et al.*, (2015); Yadav *et al.*, (2018); Shukla *et al.*, (2018).

Disease and pest incidence. The significantly minimum percentage of (purple blotch) disease (12.62%) and thrips incidence (4.33%) was observed in T_8 treatment. The second best treatment was foliar application of sulphur, T_4 (18.68% purple blotch and 9.67%, thrips). The maximum disease and pest incidence (41.41% and 34.67%, respectively) was observed in T_0 (control). The minimum incidence of disease and pest may be due to sulphur containing some metabolities like glutathione and glucosinolates which are involved in the pathogen resistance and gaseous release of volatile sulphur. Sulphur acts as a strong fungicide in vegetable cultivation that is one of the impetuses of minimum disease incidence Fernando *et al*. (2021).

Bulb yield. The 100% recommended dose of 100:50:50 NPK in concurrence with sulphur, boron and zinc micronutrients was related with the corresponding increase in bulb yield. The bulb yield per hectare was significantly influenced by the different treatments. The maximum bulb yield up to 158.44 q ha^{-1} was observed under 100:50:50 NPK + sulphur 30 kg ha^{-1} applied through soil + sulphur 0.6% through foliar whereas the minimum bulb yield 109.67 q ha^{-1} was recorded under the 100:50:50 NPK (control).

The increased efficiency of applied sulphur might be due to combined effect of its foliar–cum-soil application on growth and development, consequently bulb yield as compared to its soil or foliar application. The availability of sulphur along with foliar application enhanced the photosynthesis rate in leaves, nitrogen metabolism and other compounds required for plant metabolism. consequently, increased the transfer of food materials towards the sink. Similar findings have also been supported by Farooqui *et al.* (2009); Babaleshwar *et al*. (2017); Yatsenko *et al.* (2020).

CONCLUSION

The finding conclude that the best treatment was 100:50:50 NPK along with sulphur applied from both the routes (soil and foliar) as in T_8 treatment which minimized the pest and diseases and produced maximum garlic (158.44 q ha^{-1}). There was inverse relationship between incidence of thrips and purple blotch with the vegetative growth parameters of garlic.

FUTURE SCOPE

Vegetable crops are heavy nutrient feeder. Generally micronutrients are neither recommended nor added in the manurial schedule programme. The general tendency is that the total crop removal of micronutrients is never replenished. The crop response to applied micronutrients would be but natural. Therefore research work and recommendation based on soil test basis would be the future demand and scope.

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