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Effect of micronutrient: Vegetable special on enhancing productivity and to improve the socio economic status of tomato growers of Bidar district of Kalyan Karnataka

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Abstract
Demonstrations on of Micronutrient through foliar spray conducted by ICAR KVK, Bidar emphasized on sustainable production of vegetables with higher yield which ultimately improves the economy and better livelihood of the vegetable grower. The present demonstrations were carried out in tomato during 2018-19, 2019-20 and 2020-21 respectively. The average number of fruits per plant was 10.81, 9.90 and 10.81 during 2018-19, 2019- 20 and 2020-21 respectively. The other yield parameters were also recorded in increasing trend. The net returns were recorded 3,52,000 Rs/ha, 2,48,440 Rs/ha and 2,36,640 Rs/ha during 2018-19, 2019- 20 and 2020-21 respectively. There was increased productivity over farmers practice and reduced extension gap and technology gap was could be due to variation in the soil fertility, varied climatic conditions, GMP followed by the farmers and also higher rated technology adoption. The present technology was very much feasible based on the lower technology index recorded in the study.

Keywords: Micronutrient, vegetable special, net returns tomato, productivity, pest incidence and economic status

Introduction
Managing agricultural nutrients to provide a safe food supply and secure the environment remains one of the immense challenges of the 21st century. Crop nutrient uptake and crop yields are the principal factors that determine optimal fertilization practices. Therefore, it is very important to apply fertilizers in an efficient way to minimize loss and to improve the nutrient use efficiency (Li *et al*., 2009) [6]. The intensive cropping, imbalanced fertilizer usage and minimum use of micronutrients and limited application of organic manures resulted in depletion of soil fertility. Balanced fertilizer is very much essential for better production and productivity of crops. For any particular crop micronutrient supply is as important as application of required amount of major and secondary nutrient.

Micronutrients are essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth (Brady, 1990) [3]. The knowledge about the mobility of micronutrient is very much important to decide the type of application which on the other hand helps in overcome the deficiency of particular micronutrient. Mobility of micronutrient in the soil has considerable influence on availability of micronutrients to plants. Foliar application of micronutrients during important phase of crop growth was successfully used for correcting the deficiency and improving the mineral status of plants as well as increasing the crop yield and quality (Kolota and Osinska, 2001) [5]. Spray application of micronutrient helps in 90% availability to the crops. The foliar application of micronutrient resulted in good plant growth yield and quality of the produce (El Tohamy *et al*., 2009 and Alam *et al*., 2010) [4]. To the best of our knowledge, previous studies on micronutrient responses were rarely conducted on important vegetable crops individually, and no one has reported micronutrient responses important to tomato as vegetable crops grown particularly in Bidar Taluk of Karnataka state. Among the vegetables, tomato is one of the most important vegetables by acreage, production, yield, commercial use, and consumption. Tomato is cultivated all over the country due to its adaptability to wide range of soil and climate. Its demand for both domestic and foreign markets has increased manifold due to its excellent nutritional and processing qualities. The congenial atmosphere remains for tomato production during low temperature winter season, that is, early November is the best time for tomato planting.

A significant impact of globalization on horticulture has been an increasing demand for quality improvement and the wider adoption of quality standards for fruit, vegetable and salad commodities. Tomato (*Lycopersicon esculentum* Mill.) is a major horticultural crop with an estimated global production of over 120 million metric tons (FAO, 2007). Salad tomatoes must have a flavour, colour and texture that satisfy the consumer's preference. At the same time they must be suitable for post-harvest handling and marketing, even over large distances. In addition, processing tomatoes must have the rheological characteristics required by the relevant food processing industry. Vegetables are paramount's in supply of vitamins, minerals and fibres. Sustainable production of vegetable is very much important to improve the economy and better livelihood of the farmer. Bidar district has around 14942 ha area under horticulture crops. Out of 14942 ha 6845 ha area cultivated by vegetable crops area. With this perspective demonstrations of foliar application of Arka Vegetable special conducted in important vegetables of tomato grown in Bidar region of Karnataka. These estimates will be helpful for improving fertilizer recommendations and for achieving sustainable production in important of Tomato vegetable crops of Bidar district in Karnataka.

Materials and Methods

Geographically Bidar District lies in semi transitional zone (Zone number 1) with 17.9104° N, latitude, and 77.5199° E longitude. The present study was carried out in 33 different farmers' fields of Bidar district during 2018-19, 2019- 20 and 2020-21 in important crops of Tomato vegetable family *viz.*, *Lycopersicon esculentum* Mill. Demonstration of tomato vegetables conducted in Kamathana, Guma, Mirzapur and tarnalli village. The main aim of the demonstration was to applica

tion of Arka vegetable special (developed from Indian Institute of horticultural research, Bengaluru) as foliar application in critical phases of plant growth along with the recommended dose of NPK application. The micronutrient doses applied are as follows, for tomato vegetables 5g/lit of water. The area taken under each demonstration is 0.4 ha. The first spray was carried out 25 days after transplanting in Tomato, The second and third spray was carried out at monthly interval after 1st spray. The crop was raised with application of recommended dose of major and secondary nutrients and general cropping practices were followed with the guidance of KVK scientists in respect of package of practices. Technology gap, extension gap and technology index and pest incidence were calculated using following formula as suggested by Samui *et al*., (2000) [9].

$$\text{Increase yield (\%)} = \frac{\text{Demonstration yield} - \text{Farmers yield}}{\text{Farmers yield}} \text{ X } 100$$

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – yield under existing practice

$$\text{Technology index (\%)} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \text{ X } 100$$

Results and Discussion

Yield and yield attributing parameter

Effect of micronutrient – vegetable special on yield and yield attributing parameter are presented in Table 1.

Number of fruits/plants (No.)

Yield attributing parameters are very important to determine the ultimate yield of the particular crop. In the present demonstration tomato as vegetables showed increased number of fruits per plants over farmer's practices. On an average there was increase (Table 1) of 41 fruits/plant, 42 fruits/ plant and 41 fruits/plant in tomato was observed. In general vegetable growers of Bidar district are not aware of application of mixture of micronutrient, critical stage of application and also type of application. In the present demonstration increased number of fruits per plant was directed to decrease in flower drop and retention of fruits at the early stage of the crop. According to Upendra *et al*., (2003) [11], mineral nutrition might have increased the number of fruits per plant due to more fruit setting and retention due to availability of both secondary and micronutrient as a foliar application.

Average fruit weight (g), Average curd/head weight (kg)

Spray of micronutrient Arka vegetable special resulted in increased average fruit weight of tomato and showed 99.10, 95.90 and 100.48 g of increased average fruit weight. This result could be due to better absorption of all the micronutrient and secondary nutrients by the leaves of individual plants at the time of critical growth stage. This absorption helped in accumulation of carbohydrates in the final produce of the crop. The results of present demonstration are in accordance with the findings of Bhatt *et al*., (2006) and Amit *et al.,* (2018) [1]. This average fruit increase would ultimately resulted in increase in the total yield.

Yield (t/ha)

There was a significant increase in the yield/ha of tomato as vegetables considered in the demonstration. In tomato the yield difference of 9.04 tons/ha was observed in farmers practice during the year 2018-19 and the demonstration which was followed by 9.86 t/ha in 2020-21 and 9.02 t/ha in 2019-20. In this Solanaceous vegetables tomato was responded well to the micronutrient mixture. In these tomato vegetable difference in the yield/ha might be possible due to increased number of fruits per plant and also increased average fruit weight. Similar results obtained from Patnaik *et al*., (2001) [8] and Singh *et al*., (2003). In Cruciferous vegetables cabbage has given the yield difference of 2t/ha and 1.92 t/ha in cauliflower. This increased yield could be due to increased accumulation of carbohydrates and also other minerals.

Response of the micronutrient to the net returns

Data related to gross income and net income are presented in Table 2.

Net returns/ha (Rs)

Net returns of any crop are very much important to improve the socio economic status of the farmers. The main aim of the any demonstration conducted through Krishi Vigyan Kendra is to improve the overall production, enhance the productivity and improve the quality of the produce. In these demonstrations the Micronutrient spray technology demonstrated resulted in getting the higher returns to the vegetable tomato grower. With the increased productivity per hectare area was observed which resulted in increased net returns in every crop taken into consideration under demonstration. In tomato there was 36,400, 33,160 and 76,800 Rs per hectare difference in the net returns was

observed over farmers practice during 2018-19, 2019-20 and 2020-21 respectively. The more price to the produce was obtained basically from increased yield of the individual crop under demonstration which was supported by the improved quality of the produce. According to the farmer's opinion spray of micronutrient helped in improvement of quality of the vegetable through attractive appearance. This quality improvement helped in higher market price nearly 3-7 Rs per kg of the produce than the produce from the farmers practice.

Effect of micronutrient spray on percent increase of productivity and Extension gap, technology gap and technology index are present in Table 3.

Productivity increase (%), extension gap (t/ha) and technology gap (t/ha)

Micronutrient spray resulted in more increase of productivity in tomato i.e. more than 50%. In relation to increased productivity reduced extension gap and technology gap was observed. In tomato extension gap and technology gap was 4.42, 4.46, 4.69 t/ha and 21.73, 21.11, 22.76 t/ha during2018-19, 2019-20 and 2020-21 respectively. Similar kind of result was obtained by Savita *et al.* (2016) in Okra. On the other hand it was less than 10t/ha in rest of the other vegetable which considered under the demonstration. The technological gap observed may be attributed to variability of soil fertility, climatic condition, management practices, also adoption by the particular farmer and extent of area covered by the particular crop. The extension gap emphasized the need to educate the farmers through various means for the adaptation of this particular micronutrient management in major vegetable crops of Bidar district.

Technology index (%)

During the present demonstration more decreased technology index was observed in Tomato 28.97%, 28.15% and 30.35% under demonstration. The technology index always shows the feasibility of the particular technology at the farmer field. Lower the value of the technology index indicates the more feasibility of the technology.

Table 1: Effect of micronutrient – vegetable special on yield and yield attributing parameter in tomato

Year	Farmers practice			Demonstration			Increase		
	No. of fruits/plant	Average fruit weight (g)	Yield (t/ha)	No. of fruits/plant	Average fruit weight (g)	Yield (t/ha)	No. of fruits/plant	Average fruit weight (g)	Yield (t/ha)
2018-19	37	86.8	48.85	41	95.4	53.27	10.81	99.10	9.04
2019-20	38	87.6	49.43	42	96.0	53.89	9.90	95.90	9.02
2020-21	37	85.3	47.55	41	95.1	52.24	10.81	100.48	9.86
Mean	37.3	86.56	48.61	41.3	95.5	53.13	10.72	98.50	9.31

Table 2: Economic benefit from micronutrient – vegetable special spray in tomato in Bidar district

Year	Farmers practice				Demonstration			
	Gross cost (Rs.) Net	Gross Returns(Rs.)	Returns (Rs.)	B:C	Gross cost (Rs.) Net	Gross Returns(Rs.)	returns (Rs.)	B:C
2018-19 (8000)	75,200	3,90,800	3,15,600	5.19	73,400	4,26,160	3,52,000	5.80
2019-20 (6000)	81,300	2,96,580	2,15,280	3.64	74,900	3,23,340	2,48,440	4.31
2020-21 (6000)	80,800	2,85,300	2,04,500	3.53	76,800	3,13,440	2,36,640	4.08
Mean	79,100	3,24,227	2,45,127	4.09	75,033	354313	2,79,280	4.73

Table 3: Effect of micronutrient- vegetable spray on percent increase of productivity and extension gap, technology gap and technology index

Year	Yield in Farmers practice (t/ha)	Average yield in FLD (t/ha)	Increase over Farmers Practice (%)	Extension gap (t/ha)	Technology gap (t/ha)	Technology index (%)
2018-19	48.85	53.27	9.04	4.42	21.73	28.97
2019-20	49.43	53.89	9.02	4.46	21.11	28.15
2020-21	47.55	52.24	9.86	4.69	22.76	30.35
Mean	48.61	53.13	9.31	4.52	21.87	29.16

Conclusion

Application of micronutrient through foliar spray on tomato has given better result than the soil application. The average number of fruits per plant was higher than the control during all the three years of demonstration. The higher net returns were realised by the farmers from the demonstrated plots than the farmer's practice plot. The application of micronutrient through foliar spray was proved to be very much feasible based on the lower technology index recorded in the study.

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