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Assessment of the Liquid Organic Nutrient and Micronutrients for Yield and Quality of Chilli at Farmers Field

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ABSTRACT: An On-Farm Trial (OFT) was conducted over three consecutive years (2021–22 to 2023–24) across multiple farmers' fields under the jurisdiction of KVK Banaskantha-II to assess the impact of liquid organic nutrients and micronutrient applications on the growth, yield, and quality of chilli (*Capsicum annuum* L.). Three treatments were evaluated: T_1 (control, no foliar application), T_2 (foliar spray of Novel Liquid Fertilizer at 1.0% during flowering and fruiting stages), and T_3 (foliar application of $ZnSO_4$ thrice at 30, 40 and 50 DAT and one Spray 19:19:19 + Mn @ 1% at 60 DAT). The results indicated that the maximum average plant height (79.24 cm) was observed in T2, followed by T3, while the lowest height (63.20 cm) was recorded in T1. The number of fruits per plant was highest in T2 (89.15), followed by T3 (84.95), and lowest in T1. Regarding fruit quality parameters, T3 recorded the greatest average fruit length (8.51 cm) and fruit weight (3.85 g), followed by T2 (7.93 cm and 3.64 g, respectively), with T1 showing the lowest values. In terms of yield, the highest total fruit yield was recorded in T3 (163.60 q/ha), followed by T2 (158.48 q/ha). Economic analysis revealed that T3 had the highest gross cost (₹88,923/ha), but also produced the highest gross return (₹2,12,681/ha), resulting in the maximum net return (₹1,28,874/ha) and benefit-cost (B:C) ratio of 2.39. These findings suggest that the integrated application of $ZnSO_4$ with balanced nutrients (19:19:19 + Mn) can significantly enhance chilli productivity and profitability under field conditions.

Keywords: Chilli, On farm trail, Growth parameter.

INTRODUCTION

Chilli (*Capsicum annuum* L.) is one of the important vegetable and spice crop belongs to the family Solanaceae. Chilli, known for its fiery flavor and vibrant color, Yanty *et al.* (2024) holds a significant place in Indian agriculture and cuisine. in addition to its traditional use as a vegetable, spice, condiment, sauce, and in pickle Vani *et al*. (2023) chilli is also increasingly being utilized in the pharmaceutical, cosmetic, and beverage industries. Tiwari *et al.* (2005). India is the largest producer, consumer, and exporter of chillies globally, with diverse varieties grown across different states. India is the world leader in chilli production followed by China, Thailand, Ethiopia and Indonesia with an area of 8.71 lakh ha and production of 25.97 lakh MT, (Anonymous, 2024) with an average productivity of 10.48 t/ha. Nair *et al.* (2023). In India, the major chilli-producing states include Andhra Pradesh, Telangana, Madhya Pradesh, Karnataka, Odisha, and West Bengal. Gujarat, however, ranks seventh in both area and production. In Gujarat, chilli is cultivated on 0.40 lakh hectares, yielding an annual production of 6.49 lakh metric tonnes. The major chilli-growing districts in Gujarat are Anand, Panchmahal, Mehsana, Vadodara, Rajkot, and Sabarkantha (Anonymous, 2024). Banskantha district, in particular, is emerging as a significant chilli-growing area, with regions like Palanpur, Badgam, Danta, Lakhani, and Tharad contributing to a cultivation area of 0.016 lakh hectares and an annual production of 1.86 lakh metric tonnes. However, the district's productivity stands at only 11.2 MT per hectare, which is relatively low compared to the state's average productivity of 16.23 MT per hectare (Anonymous, 2024). The district having predominately sandy loam and the availability of Sulphur and micronutrients in soils is lacking Desai *et al.* (2018). The importance of enhancing chilli yield and production efficiency is paramount for farmers in the district. One effective strategy involves the utilization of micronutrients and liquid organic nutrients. Micronutrients such as zinc, boron, and manganese play essential roles in the plant's metabolic processes Angami *et al*. (2017). Farmers often face challenges related to soil nutrient deficiencies, which can adversely affect crop productivity Singhal (2024). Incorporating balanced doses of micronutrients through soil application or foliar spray has shown promising results in bolstering chilli yields Devi *et al*. (2013). Additionally, the application of liquid organic nutrients

has gained traction among farmers due to its dual benefits of improving soil health and enhancing crop vigor. Organic inputs derived from compost, Plant biomass, vermicompost, and biofertilizers not only provide essential nutrients but also foster beneficial microbial activity in the soil Shaji *et al.* (2021). This biological approach supports sustainable agriculture practices while minimizing environmental impact. OFTs conducted by KVKs involve direct participation of farmers, enabling them to observe, learn, and adapt new techniques under local conditions. These trials not only validate the scientific principles but also provide practical insights into the feasibility and economic viability of adopting these practices on a larger scale.

MATERIAL AND METHODS

An On Farm trail (OFT) on effect of liquid organic nutrient and micronutrients on yield and quality of chilli was tested at different farmers fields under KVK Banaskantha-II Jurisdiction area. A total of 15 trials were conducted in the villages Janadi and Pratappura of Tharad Taluka during the Rabi seasons of 2021-22 to 2023–24 in a total area of 4.0 ha. The trial was conducted in Golden hot a widely cultivated hybrid of chilli with three treatments T1- Farmer Practice– Recommended fertilizer dose only, T2- Foliar spray of Novel Liquid Fertilizer 1.0 % at flowering and fruiting stage and T3 - Foliar spray of $ZnSO_4$ @ 0.5 % thrice at 30, 40 and 50 DAT (Days after transplanting) and one Spray 19:19:19 + Mn @ 1 % at 60 DAT (Days after transplanting) in the chilli growing farmer's field. The transplanting was done at the spacing of 60 × 30 cm in the 1st week of July during all three years. The crop was supplemented with 20 MT of FYM and recommended dose of fertilizers total of 70:50:50 kg N: P_2O_5 : K_2O per ha. Nitrogen was split into two equal doses; half of the dose was given during planting and the other half was applied at flower initiation, whereas full doses of phosphorus and potassium were applied at the time of transplanting uniformly common to all the treatments. In each trial plot, hoeing, weeding, and other intercultural operations were frequently done. The observation was taken from of 5.0 m^2 area. The observation on plant height (cm), number of fruits per plant, average fruit weight (g), average fruit length (cm), yield per plant (g), estimated yield per ha (t/ha), net income (Rs.), B:C ratio were recorded. The treatments arranged as per Randomized Complete Block Design with five replications (Five farmers plot) and the data were statistically analysis as suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Growth and yield parameter. A comparative evaluation of the treatments revealed that both T_2 (foliar application of Novel Liquid Fertilizer) and T_3 (foliar application of $ZnSO_4$ thrice at 30, 40 and 50 DAT and one Spray 19:19:19 + Mn @ 1 % at 60 DAT) significantly outperformed the conventional practice (T1: farmer practice involving only the recommended dose of fertilizers, RDF) across most growth and yield parameters. In terms of plant height, T_2 recorded the maximum average height of 79.24 cm, followed by T_3, while T_1 showed the lowest at 63.20 cm. The enhanced vegetative growth under T_2 and T_3 can be attributed to the improved nutrient uptake efficiency facilitated by foliar feeding, as foliar applications allow for rapid absorption of essential nutrients Rajasekar *et al*. (2017) directly through the leaf cuticle Fernández *et al*. (2017). Moreover, zinc and manganese are known to play critical roles in enzyme activation and chlorophyll synthesis, which directly influence cell elongation and plant stature Alloway (2008). The number of fruits per plant was highest in T_2 (89.15), followed by T_3 (84.95), whereas T_1 recorded only 73.25. This significant increase in fruit set may be due to the timely availability of micronutrients that are essential during the reproductive phase, promoting better flower retention and pollination success Fageria *et al*. (2011). Similar findings were reported by Angami *et al*. (2017); Rajendiran *et al*. (2024); Ahmed *et al*. (2024) who observed that foliar application of Zn and Mn improved flowering and fruiting in horticultural crops. In terms of fruit length, T_3 achieved the highest average (8.51 cm), followed by T_2 (7.93 cm), while T_1 recorded the lowest (7.01 cm). Fruit weight followed a similar trend, with T3 (3.85 g) and T_2 (3.64 g) significantly exceeding T_1 (2.74 g). These improvements are likely a result of enhanced carbohydrate translocation and cell division facilitated by micronutrient availability during fruit development Ahmed *et al.* (2024). Studies have shown that foliar sprays of balanced nutrient solutions improve fruit quality parameters such as size, weight, and appearance Deore *et al.* (2010); Ziogas *et al*. (2020); Khandaker *et al.* (2017).

Table 1: Performance of the technology on growth and yield attributes of chilli at farmers field.

Technology	Plant height (cm)	No. of fruits per plant	Fruit length (cm)	Average fruit weight (g)	Fruit yield q/ha
T_1- Farmer Practice– Used only RDF	63.20	72.92	7.01	2.74	133.52
T_2- Foliar spray of Novel Liquid Fertilizer 1.0 % at flowering and fruiting stage	79.24	89.15	7.93	3.64	158.48
T_3 - Foliar spray of $ZnSO_4$ @ 0.5 % thrice at 30, 40 and 50 DAT and one Spray 19:19:19 + Mn @ 1 % at 60 DAT	78.76	84.95	8.51	3.85	163.60
SE(M) ±	0.43	0.39	0.10	0.0644	0.39
CD (5 %)	1.26	1.15	0.31	0.188	1.15

Regarding total fruit yield T_3 produced the highest yield of 163.60 q/ha, followed by T_2 with 158.48 q/ha, whereas T_1 yielded only 133.52 q/ha. These findings are consistent with those of Devi *et al*. (2013); Krishnasree *et al*. (2020) who demonstrated that integrated foliar application of macro- and micronutrients significantly boosts fruit yield in various crops. The higher yield observed in T_2 and T_3 treatments underscores the importance of foliar nutrition in supplementing soil-based fertilization, particularly in stages of peak nutrient demand when root uptake may be limited. Foliar application of novel liquid fertilizer and micronutrients (Zn, Mn) not only improved vegetative and reproductive growth but also enhanced fruit development and overall productivity.

ECONOMICS

The economic evaluation of three fertilizer application technologies presented in Table 2 revealed notable differences in cost-effectiveness and profitability. The traditional farmer practice (T_1), which involved the use of only recommended doses of fertilizers (RDF), recorded a gross cost of ₹78,882 per hectare and generated a gross return of ₹1,73,579 per hectare, resulting in a net return of ₹94,696 and a benefit-cost (B:C) ratio of 2.20. In comparison, the foliar spray of Novel Liquid Fertilizer at 1.0% during the flowering and fruiting stages (T_2) increased both cost and returns, with a gross cost of ₹87,217 per hectare and a gross return of ₹2,06,028 per hectare. This led to a higher net return of ₹1,18,811 and an improved B:C ratio of 2.36. The most profitable treatment was T_3, which included three foliar sprays of $ZnSO_4$ at 0.5% on the 30th, 40th, and 50th day after transplanting (DAT), along with a combined spray of 19:19:19 and Mn at 1% on the 60th DAT. This treatment had the highest gross cost at ₹88,923 per hectare but also achieved the greatest gross return of ₹2,12,681 per hectare, resulting in the highest net return of ₹1,28,874 and a B:C ratio of 2.39. These findings suggest that T_3 is the most economically efficient technology, offering the greatest profitability despite slightly higher input costs, followed by T_2, while the traditional RDF-based practice (T_1) remains the least beneficial in terms of economic returns.

Table 2: Economics of technology tested at farmer field on Chilli.

Technology	Gross cost (Rs/ha)	Gross return (Rs/ha.)	Net return (Rs/ha)	B:C Ratio
T_1- Farmer Practice– Used only RDF	78882	173579	94696	2.20
T_2- Foliar spray of Novel Liquid Fertilizer 1.0 % at flowering and fruiting stage	87217	206028	118811	2.36
T_3 - Foliar spray of $ZnSO_4$ @ 0.5 % thrice at 30, 40 and 50 DAT and one Spray 19:19:19 + Mn @ 1 % at 60 DAT	88923	212681	128874	2.39

CONCLUSIONS

The study clearly demonstrates that foliar applications of novel fertilizers and micronutrients addition to the recommended dose of fertilizer result in superior growth and yield compared to traditional practices. The foliar sprays not only improved fruit size but also contributed to better fruit development, which was reflected in the higher average fruit weight. These findings suggest that adopting application of Micronutrients or Novel liquid organic nutrient in chilli in this region could help to achieve higher yields, better fruit quality, and overall improved productivity in chilli farming.

FUTURE SCOPE

The current investigation provided the information regarding the use of micronutrient application with addition to the recommended dose of fertilizer as the study region having poor and saline soil with poor nutrient availability. The results will helpful for chilli growing farmers of Banaskantha district to get higher yield as well as higher net income and benefit cost ratio in chilli.

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Conflict of Interest. None.

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