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Research Article

Effect of Nano Fertilizers on Growth, Yield and Economics of Tomato Variety Arka Rakshak

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ABSTRACT

The experiment was conducted by Krishi Vigyan Kendra, Jajpur in collaboration with IFFCO, Jajpur in the farmer's field of village Dihakuransa, Block Rasulpur of Jajpur District of Odisha to study the effect of Nano fertilizers on growth, yield and economics of Tomato variety Arka Rakshak in Rabi season 2019. The experiment was laid out in randomized block design (RBD) with five treatments and five replications. Treatments involved were T_1 - Farmers Practice (FP) (100% NPK + 100 % Zn application), T_2 - FP (50% N+100% PK+100% Zn) + two sprays of Nano N , T_3 – FP (100 % NPK + 50 % Zn) + two sprays of Nano Zinc, T_4 – FP (100% NPK + 100% Zn) + two sprays of Nano Cu) , T_5 - FP (50 % N + 100 % PK + 50 % Zn) + 1st spray Nano N + 2nd spray Nano Zn + 3rd spray Nano Cu @ 4ml / lit water each. First spraying was done 20 days after transplanting, 2nd spraying at 15 days after 1st spraying and 3rd spraying was done 10days after 2nd spraying. From the experiment it was observed that application of T_5 produced maximum plant height (122.45cm), No. of branches per plant (12.4), fruit length (7.15cm), fruit girth (5.32cm), maximum number of fruits per plant (64.03), individual fruit weight (66.48g) and highest Yield per ha. (425.24q) followed by T_2 (414.32 q/ha), T_3 (409.28 q/ha) and T_4 (407.42 q/ha). Lowest yield was found in T_1 (398.20 q/ha) where RDF was 175:150:175 kg NPK per ha. Application of T_5 ie. FP (50 % N + 100 % PK + 50 % Zn) + 1st spray Nano N + 2nd spray Nano Zn + 3rd spray Nano Cu recorded highest gross income of Rs 2,12,620 / ha with net return Rs 1,59,720 / ha and maximum benefit cost ratio 4.01. N- Nitrogen, P- Phosphorus, K- Potash, Zn- Zinc, Cu-Copper.

Keywords: *Nano fertilizers, Growth, Yield, Economics and Tomato.*

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) belonging to Family Solanaceae (2n =24) is one of the most important and third most consumed vegetables worldwide. As it is a relatively short duration crop and gives a high yield, it is economically attractive and the area under cultivation is increasing daily (Naika et al., 2005).

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Fruit is rich in minerals, vitamins, essential amino acids, sugars and dietary fibres with much vitamin B and C, iron and phosphorus. Tomato fruits are consumed fresh in salads or cooked in sauces, soup and meat or fish dishes. They can be processed into purées, juices and ketchup. Canned and dried tomatoes are economically important processed products. The growth and yield of vegetable crops are mainly depends on the quality and quantity of fertilizers used. Loss of mineral nutrients through leaching and runoff to surface and ground water along with abundant volatilization constitute growing concerns owing to economic losses and environmental pollution. The recent use of chemical fertilizers has resulted in many serious, environmental problems such as accumulation of heavy metals in soil and plant systems. (Abdel Wahab et al., 2017). Conventional application techniques are resulting in seriously overdosing of chemical fertilizers .Nanotechnology is a promising field of research which utilizes nano materials of less than 100 nm size, may offer an unprecedented opportunity to develop concentrated sources of plant nutrients having higher-absorption rate, utilization efficacy, and minimum losses. One of the most important uses of nano technology is nanofertilizer, which improves the ability of the plants to absorb nutrients (Mousavi & Rezai (2011), Srilatha (2011), Ditta (2012). Nano fertilizers are being prepared by encapsulating plant nutrients into nano materials, employing thin coating of nano materials on plant nutrients, and delivering in the form of nano-sized emulsions. Nano-pores and stomatal openings in plant leaves facilitate nanomaterial uptake and their penetration deep inside leaves leading to higher nutrient use efficiency (NUE). Nano fertilizers have higher transport and delivery of nutrients through plasmodesmata, which are nano sized (50–60 nm) channels between cells. The higher NUE and significantly lesser nutrient losses of nano fertilizers lead to higher productivity (6–17%) and nutritional quality of field crops.

MATERIALS AND METHODS

One field experiment was conducted by Krishi Vigyan Kendra, Jajpur in collaboration with IFFCO, Jajpur in the farmer's field of village Dihakuransa, Block Rasulpur of Jajpur District to study the effect of Nano fertilizers on growth, yield and economics of Tomato variety Arka Rakshak in Rabi season 2019. The experiment was laid out in randomized block design (RBD) with five treatments and five replications. Treatments involved were T_1 - Farmers Practice (FP) (100% NPK + 100 % Zn application), T_2 - FP (50% N+100% PK +100% Zn) + two sprays of Nano N, T_3 – FP (100 % NPK + 50 % Zn) + two sprays of Nano Zinc, T_4 – FP (100% NPK + 100% Zn) + two sprays of Nano Cu) , T_5 - FP (50 % N + 100 % PK + 50 % Zn) + 1st spray Nano N + 2nd spray Nano Zn + 3rd spray Nano Cu @ 4ml / lit water each where , RDF was recommened dose of fertilizers (175:150:175 NPK kg/ha.). The land was brought to a fine tilth through ploughing and tillage. Irrigation channels and bunds were prepared according to layout. The twenty five days old seedlings were planted in the field with a spacing of 1m x 1m directly. Light irrigation was given just after transplanting. Organic manures were applied one week before transplanting. Full dose of phosphorus, potassium and half dose of nitrogen as per treatments were applied just before transplanting. The remaining half dose of nitrogen was applied twenty five days after sowing. First spraying was done 20 days after transplanting, 2nd spraying at 15 days after 1st spraying and 3rd spraying was done 10days after 2nd spraying All cultural practices were followed regularly during crop growth and observations were recorded on yield and yield attributing characters. The data on these parameters were subjected to statistical analysis to draw logical conclusions.

RESULTS AND DISCUSSION

It was observed that yield as well as yield attributing characters like plant height, fruit length, fruit girth, fruit number, fruit weight and yield were significantly influenced by different treatments. Application of nutrients through soil application and foliar application in form of nano fertilizers were proved

beneficial increasing growth and yield of tomato.

The plant height was found maximum in T_5 (122.45 cm) where 50 % N + 100 % PK + 50 % Zn) was applied inorganically to soil along with 1st foliar spray with Nano N, 2nd spray with Nano Zn and 3rd spray with Nano Cu and was significantly differed from all other treatments. The plant height was found lowest in T_1 (94.18cm) where (FP) (100% NPK + 100 % Zn) was applied. The present findings corroborate with the findings of Abdel wahab et al. (2019) in red radish, Ekinci et al. (2012) in tomato, Khaveh et al. (2015) in corn plant, Tantawy et al. (2014) in tomato.

Maximum number of branches was observed in T_5 (12.4) followed by T_2 (11.8) and T_3 (11.6) respectively. For this character T_5, T_3 and T_2 were found at par with each other. Minimum number of branches was found in T_1 (10.2). Highest fruit length (7.15cm) and fruit girth (5.32cm) were observed in T_5 whereas lowest fruit length (5.72 cm) and fruit girth (4.32cm) were recorded in T_1. There was no significant differences between the treatments except T_1 so far as fruit length is concerned. But for fruit girth T_5 and T_2 were found at par and significantly differed from other treatments. Fruit weight was found maximum in T_5 (66.48g) and minimum in T_1 (63.28g). Same type of result has been reported by Yessen et al. (2017) in cucumber. T_5 and T_1 were found at par for this character. Maximum number o fruits per plant were observed in T_5 (64.03) followed by T_3 (63.85), T_4 (63.75) respectively. So far as fruit number is concerned there was no significant difference among the treatments. High test yield was recorded in T_5 (425.24 q/ha) followed by T_2 (414.32q/ha), T_3 (409.28 q/ha), T_4 (407.42 q/ha) respectively. Lowest yield was found in T_1 (398.20 q/ha). T_5 was significantly differed from all other treatments. This is due to the fact that nano fertilizers hold potential to fulfill plant nutrition requirements along with imparting sustainability to crop production systems. Nano-pores and stomatal openings in plant leaves facilitate nano material uptake and their penetration deep inside leaves leading to higher nutrient use efficiency (NUE). Nano fertilizers have higher transport and delivery of nutrients through plasmodesmata, which are nano sized (50–60 nm) channels between cells. The higher NUE and significantly lesser nutrient losses of nano fertilizers lead to higher productivity (6–17%) and nutritional quality of vegetable crops. (Muhammad Aamir Iqbal, 2019). The present finding is in accordance with same type of results obtained by Ferbanat, 2013 who found that Ferbanat application increased yield of cabbage with 38-.42% and in potatoes with 35-40% compared to control. The high concentration of nano fertilizer led to increased yield of corn (Khaveh et al., 2015). Wang et al., 2001 reported that nano preparation coated nitrogen fertilizer increased the yield of rice. Zareabyanel et al. 2015 reported that the treatment of nano-nitrogen chelate, sulpher coated nano-nitrogen chelate, sulpher coated urea fertilizers led to increased potato yield by 56.10, 59.61, 49.76% respectively compared to urea application. Similar findings were also reported by, Khanm et al. (2017) in tomato, Jyothi et al. (2017) in cereals, Davarpanah et al. (2017) in pomegranate, Gajc-wolska et al. (2018) in sweet pepper, Rathnayaka et al. (2018) in rice and Meghany et al. (2019) in cucumber.

Growth and yield of Tomato as affected by Nano fertilizers

Treatment	Plant height (cm)	No. of branches	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	No. of Fruits/plant	Yield(q/ha)
T_1	94.18	10.2	5.72	4.32	63.28	62.92	398.20
T_2	116.62	11.8	7.01	5.12	65.14	63.60	414.32
T_3	112.42	11.6	6.94	4.82	64.12	63.85	409.28
T_4	106.32	10.7	6.84	4.67	63.94	63.75	407.42
T_5	122.45	12.4	7.15	5.32	66.48	64.03	425.24
SE(m)±	1.34	0.42	0.11	0.13	0.67	0.74	2.77
CD(0.05)	3.92	1.24	0.31	0.37	1.96	2.18	8.11

Economics:

Maximum cost of Rs.53,800/ ha^{-1} was incurred in T_4 where 100% NPK + 100% Zn were applied inorganically to soil with two foliar sprays of Nano Cu. Whereas, minimum cost of Rs. 52,000/ ha^{-1} incurred in T_2 where 50% N+100% PK+100% Zn were applied inorganically to soil with two foliar sprays of Nano N. Highest gross income of Rs.2,12,620/ ha^{-1}were obtained in treatment T_5 whereas lowest of Rs.1,79,190/ ha^{-1}were obtained in T_1. Similarly highest net return of Rs. 1,59,720/ ha^{-1} were obtained in T_5 and was followed by T_2 (Rs1,55,160/ ha^{-1}). Whereas, lowest of Rs.1,26,590/ ha^{-1}were obtained in T_1 where 100% NPK + 100% Zn were applied inorganically to soil. This might be due to that application of 50% N + 100 % PK + 50 % Zn inorganically to soil along with 1st foliar spray of Nano N, 2nd spray of Nano Zn and 3rd spray of Nano Cu recorded significantly higher yield, which resulted in higher economic return. Highest B: C ratio (4.01) was observed in T_5 followed by T_2 (3.98) and T_3 (3.83). The lowest B: C ratio of 3.40 was observed in T_1 (Farmer practice). The increase in B: C ratio and other crop economic parameters might be due to increase in yield which fetched more prices in market. This findings is in accordance with the findings of Panda et al. (2020).

Economics of Tomato as affected by Nano fertilizers

Treatment	Cost of cultivation (Rs / ha)	Gross return (Rs / ha)	Net return (Rs / ha)	B:C ratio
T_1	52,600	1,79,190	1,26,590	3.40
T_2	52,000	2,07,160	1,55,160	3.98
T_3	53,400	2,04,640	1,51,240	3.83
T_4	53,800	2,03,500	1,49,700	3.78
T_5	52,900	2,12,620	1,59,720	4.01

CONCLUSION

From the experimental result it was observed that application of 50% N + 100% PK + 50% Zn inorganically to soil along with 1st foliar spray with Nano N, 2nd spray with Nano Zn and 3rd spray with Nano Cu was found best in producing more plant height. more no, of branches, fruit length, fruit girth, number of fruits per plant, fruit weight and also higher yield.

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