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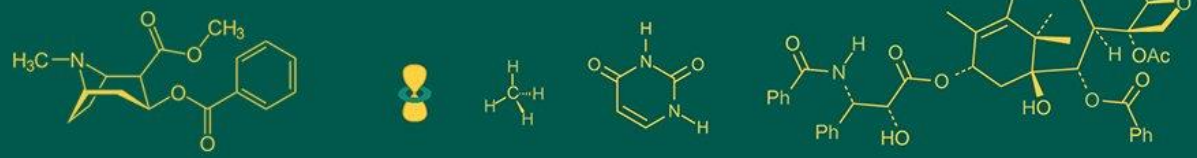

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Effect of nano fertilizer and nano mixed micronutrients for yield and quality of Onion (*Allium cepa* L.)

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Abstract
The research work entitled "Effect of nano fertilizer and nano mixed micronutrients for yield and quality of Rabi Onion (*Allium cepa* L.) variety "Agri found light red" was conducted at SHUATS, Prayagraj during the Rabi seasons of 2021 and 2022. The experimental design employed a Factorial Randomized Block Design (FRBD) with one factor focusing on the application of nano mixed micronutrients and the other on the application of nano fertilizers. The nano mixed micronutrients given were M_0-control; M_1-0.2 ml/ L of nano mix micronutrient/L of water as foliar application; M_2-0.4 ml/L of nano mix micronutrient/ L of water as foliar application; M_3-0.6 ml/ L of nano mix micronutrient/L of water as foliar application. The nano-fertilizers treatment given were F_0- Control (without fertilizer); F_1- 100% RDF as traditional fertilizer; F_2-5 ml/ L each of Nano NPK/ L of water as foliar application; F_3- 4 ml/L each of Nano NPK/ L of water as foliar application; F_4- 3 ml/L each of Nano NPK/ L of water as foliar application. 50% traditional fertilizers were applied in all treatments excluding control. From the experimental findings it was concluded that interaction effect of F_2M_3 (5 ml/L each of Nano NPK/L of water as foliar application+6 ml/L of Nano mix micronutrients) performed best for Bulb polar diameter (cm) a showed maximum (6.36 cm.). Among showed that the maximum Bulb equatorial diameter (7.41 cm) in term of quality parameters like TSS among the treatment at (14.85^0Brix) and titrable acidity (%) among the treatment at (0.26%).

Keywords: Acidity, fertilizer nano mixed, nutrient, onion

Introduction
Onion (*Allium cepa* L.) is a vegetable bulb crop widely cultivated and known to most cultures. [6, 7]. It is a biennial belongs to the family alliaceae and chromosome no. is 2n =16. Onion also possesses nutritional and medicinal importance. The outstanding characteristic of onion is the pungency, which is due to volatile oil known as *Allyl- propyl- disulphide*, which is Sulphur rich volatile compound. It acts as gastric stimulant and promotes digestion [19]. Onion is an indispensable item in every kitchen as condiment and vegetable, therefore commands an extensive internal market. It is also used by processing industry for dehydration in the form of flakes and powder which are in great demand in the world market [1]. For economic importance among vegetables, the onion ranks second after the tomato [3, 13]. Onion is also known to contain photochemical linked to positive nutritional and health impacts [8]. It is used as a remedy for various diseases like dysentery, convulsions, headaches, hysterial fits, rheumatic pain, malaria, fever and as a fine demulcent to give relief in piles [18]. The bulb has variable shapes and colors. [16]. Onion bulb is a rich source of minerals like phosphorus and calcium. It also contains protein and vitamin C, quercetin and flavonoids [17]. It contains 86.6 per cent Moisture, 40 kcal Calories, 1.10 g Protein, 9.34 mg Carbohydrates, 23 mg Calcium, 2 I.U Vitamins A, 7.4 mg Vitamins C, 0.027 mg Riboflavin, 0.0116 mg Niacin per 100 g of fresh edible portion [18]. Production of vegetables is estimated to be 204.84 million tonnes as against 200.45 million tonnes in 2020-21. Production of Onion is estimated to be 31.27 Million Tonnes as against 26.64 Million Tonnes in the year 2020-21[9]. Micronutrient fertilizers play a pivotal role in crop production by supplying essential trace elements such as iron, zinc, copper, manganese, and boron to plants. The application of nano mixed micronutrient fertilizers, either to the soil or as foliar sprays, helps rectify these deficiencies, resulting in heightened crop vigour, improved photosynthesis, and increased

resistance to diseases, and ultimately higher yields [12].

Materials and Methods

The trial took place at Sam Higginbottom University of Agriculture Science & Technology, Prayagraj (U.P.), stretching across the rabi season of 2021 and spanning two years, concluding in 2022. The experimental setup employed a Factorial Randomized Block Design (FRBD) consisting of 19 treatments and three replications (see Table No.1). With one factor focusing on the application of nano mixed micronutrients, and the other factor addressing the application of nano fertilizers. This design aimed to systematically assess the combined effects of these factors on the specified parameters, providing valuable insights into the potential benefits of using nano mixed micronutrients in the cultivation of onion, particularly the "Agrifound light red" variety.

Table No.1: Treatment Combination

The experimental field was well prepared and standard cultural and plant protection measures were followed to raise a healthy crop. Analysis of variance was carried out as per the procedure.

1. Equatorial diameter (cm)

The diameter at the maximum width of the bulb across the polar length was measured with the help of Vernier Calipers and was expressed in centimeters.

2. Polar diameter (cm)

The lengths between two polar ends of the bulb were recorded with the help of Vernier Calipers and mean length was worked out from all the five bulbs in each plot and expressed in centimeters.

The total soluble solids (TSS): Contents of the bulb were measured with the help of hand refractometer. A drop of juice was placed over the prism of digital refractometer and was noted in per cent.

Titrable acidity (%): Acid content of the extracted juice was determined by titrating 5 ml of juice against N/10 NaOH using Phenolphthalein as an indicator. Acidity was expressed in term of anhydrous citric acid (A.O.A.C.1960) per 100 ml of bulb juice.

Results and Discussion

A. Yield Parameter

1. Polar diameter (cm)

Bulb polar diameter (cm) Pooled mean analysis also showed a similar pattern. Since the interaction effect is small compared to the average effect and has been found to be significant, the treatment ranking should not change from year to year. Therefore, it can be excluded. For pooled mean analysis, there were significant differences in the data regarding the bulb polar diameter (cm). Among the different treatment combination, T_{12} (5 ml/L each of Nano NPK/L of water as foliar appliction+0.6 ml/L of Nano mix micronutrients /L of water as foliar application) showed maximum Bulb polar diameter (6.36 cm). Minimum bulb polar diameter (cm) was observed in T_1 (Control Without fertilizer) with (4.10 cm) [11, 10].

2. Equatorial diameter (cm)

Bulb equatorial diameter (cm) Pooled mean analysis also showed a similar pattern. Since the interaction effect is small compared to the average effect and has been found to be significant, the treatment ranking should not change from year to year. Therefore, it can be excluded. For pooled mean analysis, there were significant differences in the data regarding the Bulb equatorial diameter (cm). Among the different treatment combination, T_{12} (5 ml/L each of Nano NPK/L of water as foliar appliction+0.6 ml/L of Nano mix micronutrients /L of water as foliar application) showed maximum Bulb equatorial diameter (7.41 cm). Minimum Bulb equatorial diameter (cm) was observed in T_1 (Control Without fertilizer) with (5.01 cm) Smilar result were also reported by [11, 10].

B. Quality Parameter

1. TSS (°Brix)

TSS (°Brix) Pooled mean analysis also showed comparable trends. The treatment ranking should not change from year to year because the interaction effect is significant even though it is smaller than the average effect. It is therefore excludable. There were significant differences in the data for the pooled mean analysis when comparing for TSS within a treatment. T_{12} (5 ml/L each of Nano NPK/L of water as foliar appliction+0.6 ml/L of Nano mix micronutrients /L of water as foliar application) had the highest TSS among the treatments at (14.85°Brix) and minimum was found to (12.01^0Brix) T_1 (Control Without fertilizer) was found significantly superior to T_{12}(F_2 M_3). Thus Nano mix Micronutrient and Nano fertilizer had low TSS (°Brix) than control ones. Similar result also reported that was [14, 15].

2. Titrable Acidity (%)

Titrable Acidity (%) Pooled mean analysis also showed comparable trends. The treatment ranking should not change from year to year because the interaction effect is significant even though it is smaller than the average effect. It is therefore excludable. There were significant differences in the data for the pooled mean analysis when comparing for Titrable Acidity (%) within a treatment. T_{12} (5 ml/L each of Nano NPK/L of water as foliar appliction+0.6 ml/L of Nano mix micronutrients /L of water as foliar application) had the lowest Titrable Acidity (%) among the treatments at (0.26%) and highest was found to (0.81) T_1 (Control Without fertilizer). was found significantly superior to T_{12} (F_2 M_3). Thus Nano fertilizers & nano mixed Micronutrient and Nano had low Titrable Acidity (%) than control ones. Similar result also reported that was [2, 5].

Table 1: Treatment Combination of onion on different Nano Fertilizer and Nano mixed Micronutrients

S. No.	Combination	Treatment	Combination
1.	F_0M_0	T_1	Control (Wihtout fertilizer)
2.	F_0M_1	T_2	Control (Wihtout fertilizer)+ 0.2 ml/L of Nano mix micronutrients /L of water as foliar application
3.	F_0M_2	T_3	Control (Wihtout fertilizer)+ 0.4 ml/L of Nano mix micronutrients /L of water as foliar application
4.	F_0M_3	T_4	Control (Wihtout fertilizer)+ 0.6 ml/L of Nano mix micronutrients /L of water as foliar application
5.	F_1M_0	T_5	100% RDF as traditional fertilizer+ Control (Wihtout fertilizer)
6.	F_1M_1	T_6	100% RDF as traditional fertilizer+0.2 ml/L of Nano mix micronutrients /L of water as foliar application
7.	F_1M_2	T_7	100% RDF as traditional fertilizer+0.4 ml/L of Nano mix micronutrients /L of water as foliar application
8.	F_1M_3	T_8	100% RDF as traditional fertilizer+0.6 ml/L of Nano mix micronutrients /L of water as foliar application
9.	F_2M_0	T_9	5 ml/L each of Nano NPK/L of water as foliar application+ Control (Wihtout fertilizer)
10	F_2M_1	T_{10}	5 ml/L each of Nano NPK/L of water as foliar appliction+0.2 ml/L of Nano mix micronutrients /L of water as foliar application
11	F_2M_2	T_{11}	5 ml/L each of Nano NPK/L of water as foliar appliction+0.4 ml/L of Nano mix micronutrients /L of water as foliar application
12	F_2M_3	T_{12}	5 ml/L each of Nano NPK/L of water as foliar appliction+0.6 ml/L of Nano mix micronutrients /L of water as foliar application
13	F_3M_0	T_{13}	4 ml/L each of Nano NPK/L of water as foliar application+ Control (Wihtout fertilizer)
14	F_3M_1	T_{14}	4 ml/L each of Nano NPK/L of water as foliar appliction+0.2 ml/L of Nano mix micronutrients /L of water as foliar application
15	F_3M_2	T_{15}	4 mlL each of Nano NPK/L of water as foliar appliction+0.4 ml/L of Nano mix micronutrients /L of water as foliar application
16	F_3M_3	T_{16}	4 ml/L each of Nano NPK/L of water as foliar appliction+0.6 ml/L of Nano mix micronutrients /L of water as foliar application
17	F_4M_0	T_{17}	3 ml/L each of Nano NPK/L of water as foliar application+ Control (Wihtout fertilizer)
18	F_4M_1	T_{18}	3 ml/L each of Nano NPK/L of water as foliar appliction+0.2 ml/L of Nano mix micronutrients /L of water as foliar application
19	F_4M_2	T_{19}	3 ml/L each of Nano NPK/L of water as foliar appliction+0.4 ml/L of Nano mix micronutrients /L of water as foliar application
20	F_4M_3	T_{20}	3 ml/L each of Nano NPK/L of water as foliar appliction+0.6 ml/L of Nano mix micronutrients /L of water as foliar application

Table 2: Performance of Nano Fertilizers and Nano mixed Micronutrients yield and quality parameter in the year 2021 & 2022

Treatment Notation	Treatments combination	Polar diameter (cm)	Equatorial diameter (cm)	TSS (°Brix)	Titrable Acidity (%)
		Pooled	Pooled	Pooled	Pooled
T_1	F_0M_0	4.10	5.01	12.01	0.81
T_2	F_0M_1	4.68	5.78	12.70	0.76
T_3	F_0M_2	4.61	5.67	12.56	0.77
T_4	F_0M_3	5.91	6.93	14.19	0.39
T_5	F_1M_0	4.43	5.48	12.40	0.80
T_6	F_1M_1	5.14	6.19	13.20	0.65
T_7	F_1M_2	4.98	6.04	13.22	0.70
T_8	F_1M_3	5.85	6.93	14.21	0.46
T_9	F_2M_0	5.65	6.74	13.90	0.52
T_{10}	F_2M_1	6.04	7.02	14.44	0.31
T_{11}	F_2M_2	6.26	7.35	14.73	0.28
T_{12}	F_2M_3	6.36	7.41	14.85	0.26
T_{13}	F_3M_0	6.00	7.06	14.29	0.37
T_{14}	F_3M_1	6.20	7.23	14.65	0.33
T_{15}	F_3M_2	5.22	6.27	13.47	0.57
T_{16}	F_3M_3	4.77	5.86	12.90	0.70
T_{17}	F_4M_0	4.70	5.81	12.80	0.75
T_{18}	F_4M_1	5.17	6.26	13.35	0.60
T_{19}	F_4M_2	5.38	6.43	13.70	0.57
T_{20}	F_4M_3	5.78	6.83	14.06	0.47
	'F' Test	**S**	**S**	**S**	**S**
	SE.m (±)	0.090	0.084	0.131	0.041
	$CD_{0.05}$	0.031	0.029	0.045	0.014

Conclusion

Based on present investigation, the interaction effect of F_2M_3 (5 ml/L each of Nano NPK/L of water as foliar appliction+0.4 ml/L of Nano mix micronutrients /L of water as foliar application), was found superior in terms of yield parameters like polar diameter and equatorial diameter of bulb & quality parameters like TSS and titrable acidity in rabi season onion. Therefore, nano fertilizers & nano mixed micronutrients & has important function in growth and development of onion.

Competing Interests

Author have declared that no competing interests Exist.

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