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EFFECT OF NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF WHEAT (TRITICUM AESTIVUM L.)

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Abstract

The present experiment was conducted at Rama University's agricultural farm in 2023-24 Kanpur, 209217, Uttar Pradesh, India during rabi season of 2023-24 with a view to study the "Effect of nutrient management on growth and yield of wheat (Triticum aestivum L.)" The experiment was conducted in randomized block design and the treatments were consisted of seven levels of nutrient combination and three replications. Results revealed that treatment T4 (100% RDN + 2 foliar spray of nano-DAP @ 3 ml liter^{-1}of water at tillering and panicle initiation stages) recorded the highest plant height, number of total tillers, dry matter accumulation (g plant-^{1}), which was significantly superior over other treatments but was at par with T2, T3and T7 treatments.

Keywords: Nitrogen, phosphorus and nano-DAP, wheat, yield, yield attributes

Introduction

Wheat (Triticum aestivum L.) is a significant food grain crop that feeds around 36 percent of the world's population and is responsible for the green revolution in the Indian subcontinent. Compared to other cereal crops, wheat is primarily utilized as a staple food and higher in protein. It can be consumed in various kinds of foods including bread, cakes, biscuits, bakery goods and sweets. Due to its high nutritional composition (65-75% carbohydrate, 8-13% protein, 0.8-1.5% oil and fat, 0.3-0.5% mineral elements and 0.2% cellulose), wheat has become a more significant crop for human consumption (Sultana and Sheikh, 2022).

Across the world, wheat has occupied 224.05 M ha of land, producing 793.37 Mt of grain and 3.52 t ha^{-1} of productivity (Anonymous, 2023 a.) A approximately 13.54 percent of global wheat production, India is the world's second-largest producer behind China and the crophasgivenIndianagriculturethequickestrateofdevelopment.InIndia, wheatcultivated31.82 M ha during 2021-2022 and produced 112.74 Mt with an average productivity of 3.4 t ha^{-1}(Anonymous,2023 b.) .In Chhattisgarh, wheat is a significant crop and cultivated on an area of 0.22 M ha with an average productivity of 1.6 t ha^{-1}during 2020-21 (Anonymous, 2022).

Nitrogen is one of the major essential nutrients applied to the crop for higher vegetative growth, productivity and quality (Iqbalet al., 2012). One of the most vital elements for plant growth and development is phosphorus. It contributes in several of essential plant functions, such as the transmission of energy, photosynthesis, the transformation of carbohydrates and starches, the movement of nutrients throughout the plant. It uses a potassium ion to control the

stomata's opening and shutting. The most significant increase in leaf and stem length must be obtained by protecting turgor pressure with potassium.

Materials with a single unit size inat least one dimensionbetween1 and 100 nm are referred to as nanomaterials (Liu and Lal, 2015) [8]. Scientists created nano-fertilizers by utilising nanotechnology. The term "nano-fertilizer" describes a structure that is between 1 and 100 nm in size and is intended to provide nutrients to crops. Furthermore, this term should be expanded to include bulk materials that are combined with nanoscale structure to produce new products (for example-fertilizer molecules coated in metal nanoparticles). In respect to better nutrient use efficiency, less fertilizer waste and lower cultivation costs, nano fertilizer is a valuable tool in agriculture for enhancing crop growth, yield and quality parameters (Mahil and Kumar, 2019) .

Nano-fertilizers have been shown to increase productivity through target delivery or slow release of nutrients, thereby limiting the rate of fertilizer application (Kahatal.,2019).

The Indian Farmers Fertilizer Co-operative (IFFCO) recently introduced nano DAP fertilizer in India for demonstration and experimentation in agriculture field. The same amount of N (9kg) and P_2O_5 (23kg) obtained from 50 kg of DAP fertilizer is contained in 500 ml of liquid nano- DAP fertilizer. Its formulation contains nitrogen (8.0% N w/v) and phosphorus (16% P_2O_5w/v).

Materials and Methods

A field experiment was conducted during rabi season of 2023-24 at the Research Farm, Rama University's agricultural farm in 2023-24 Kanpur, 209217, Uttar Pradesh, India.. The wheat variety 'C.G.1044 was sown on24th December 2023 and harvested 31st march 2024. The soil of the experimental plot was sandy clay loam in texture, low organic carbon (0.50%), low in available nitrogen (213.38 kg ha^{-1}), medium in available phosphorus (10.77 kg ha^{-1}) and medium in available potassium (265.45 kg ha^{-1}). The experiment was laid out in randomized block design (RBD) with seven treatments and three replications. The treatment comprised of T_1: 100% RDN, T_2:100% RDN + 1 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering stage, T_3:100% RDN + 1 foliar spray of nano-DAP @ 3 ml liter^{-1}of water at panicle initiation stage, T_4:100% RDN+ 2 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering and panicle initiation stages, T_5: 75% NP + 100% K + 1 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering stage, T_6: 75% NP +100% K + 1 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at panicle initiation stage, T_7: 75% NP +100%K+2 foliar spray of nano-DAP @3 ml liter^{-1}of water at tillering and panicle initiation stages.

To evaluate the treatment effect, the various morphological observations, growth analysis and yields were recorded in the experiment at 30, 60, 90 days after sowing and at harvest. The recommended dose of nutrient for wheat are 100:60:40 kg of N, $P_2O_5$and K_2O kg ha^{-1} respectively. Full dose of P_2O_5, K_2O kg ha^{-1} were applied as basal in all the plots through single

superphosphate and muriate of potash, respectively. As per the treatment nitrogen was applied in three splits viz. half as basal and the remaining half was top dressed equally after 1st and 2nd irrigation. Foliar spray of nano-DAP at tillering and panicle initiation stages. Growth parameters were recorded before harvesting of crop. Harvesting was done when the ear head matured and plant was dried up. The threshing of the crop was done by manually by plot wise and grain, straw were collected separately.

Results and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads.

Plant height (cm)

Among the different treatments has significantly effect of plant height of wheat under the investigation. Treatment T4 (100% RDN + 2 foliar spray of nano-DAP @ 3 ml liter^{-1}of water at tillering and panicle initiation stages) at 30 (38.11 cm), 60 (82.22 cm), 90 DAS (98.19 cm) and at harvest (96.67 cm) recorded significantly maximum plant height. However, it was at par with T2 (100% RDN + 1 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering stage), T3 (100% RDN + 1 foliar spray of nano-DAP @ 3 ml liter^{-1}of water at panicle initiation stage and T7 (75%NP+100%K+ 2 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering and panicle initiation stages) treatments. Further, treatment T2 (100% RDN + 1foliar sprayofnano-DAP @ 3 ml liter^{-1}of water at tillering stage) sturd in 2nd position but at par with T3, T7 and T1treatments. Similarly, T6 (75%NP+100% K + 1 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at panicle initiation stage) at 30 (31.60 cm), 60 (71.72 cm), 90DAS (87.28cm) and at harvest (85.50cm) recorded significantly minimum plant height and at par with T5 and T1 treatments.

Table1: Effect of nutrient management on plant height at different growth stages of wheat

Treatments		Plant height (cm)			
		30 DAS	60 DAS	90 DAS	At harvest
T1	100% RDN	33.28	75.30	91.90	88.79
T2	100%RDN+1foliarsprayofnano-DAP@3 ml liter^{-1}ofwater at tillering stage	36.61	79.51	95.59	93.82
T3	100%RDN+1 foliar sprayofnano-DAP@3ml liter^{-1}ofwater at panicle initiation stage	36.40	78.22	95.14	93.22
T4	100%RDN+2 foliar sprayofnano-DAP@3 ml liter^{-}	38.11	82.22	98.19	96.67

	[1]ofwater at tillering and panicle initiation stages				
T5	75%NP+100%K+ 1 foliar sprayofnano-DAP@3 ml liter^{-1} of water at tillering stage	32.31	73.14	88.24	87.67
T6	75%NP+100%K +1foliarsprayofnano-DAP@3mlliter^{-1} of water at panicle initiation stage	31.60	71.72	87.28	85.50
T7	75%NP+100%K +2foliarsprayofnano-DAP@3mlliter^{-} [1]ofwaterat tillering and panicle Initiation stages	35.65	77.79	93.86	92.71
	S.E.M.(±)	0.76	1.39	1.54	1.44
	CD (5%)	2.37	4.29	4.75	4.44

Number of total tillers (m⁻²)

The maximum number of tillers (m-²) at 30 (218.20), 60 (325.05), 90 DAS (394.68) and at harvest (387.53) were recorded in treatment T4(100% RDN + 2 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering and panicle initiation stages) which was significantly higher as compare to other treatment (Table 2), which was at par with T2,T3, and T7 treatments. Similarly, T6 (75% NP +100% K + 1 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at panicle initiation stage) at 30 (194.75), 60 (296.15), 90 DAS (376.75) and at harvest (369.81) recorded significantly minimum number of total tillers and at par with T5 and T1treatments.

Table2: Effect of nutrient management on number of total tillers at different growth stages of wheat

Treatments		Number of total tillers (m^{-2})			
		30 DAS	60 DAS	90 DAS	At harvest
T1	100% RDN	202.20	308.18	380.43	374.75
T2	100%RDN+1foliar sprayofnano-DAP @ 3 mlliter^{-1} of water at tillering stage	214.49	321.25	392.61	386.67
T3	100%RDN+1foliar sprayofnano-DAP@3ml liter^{-} [1]of water at panicle initiation stage	210.07	317.50	386.54	382.33
T4	100%RDN+2 foliar sprayofnano-DAP@3mlliter^{-} [1]ofwaterat tillering and panicle initiation stages	218.20	325.05	394.68	387.53
T5	75%NP+100%K +1 foliar sprayofnano-DAP@3 mlliter^{-} [1]ofwater at tillering stage	196.46	301.54	377.64	372.55
T6	75%NP+100%K +1foliarsprayofnano-DAP@3mlliter^{-1}	194.75	296.15	376.7	369.81

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	ofwater at panicle initiation stage			5	
T7	75%NP+100%K+2 foliarsprayofnano-DAP@3mlliter^{-1}ofwaterat tillering and panicle Initiation stages	208.21	315.78	384.31	380.35
	S.E.M.(±)	3.63	3.93	4.03	4.01
	CD (5%)	11.31	12.11	12.43	12.38

Dry matter accumulation (g plant^{-1})

As shown in the table 3 dry matter accumulation did not become statistically significant at 30 DAS. However, significant variances were observed in 60, 90 DAS and at harvest. The highest dry matter accumulation was (viz.,0.65,8.44,19.61and 25.30) in treatment T4 (100% RDN + 2 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering and panicle initiation stages). However, it was at par with T2 (100% RDN + 1 foliar spray of nano-DAP @ 3 ml liter^{-1}of water at tillering stage), T3 (100% RDN + 1 foliar spray of nano-DAP@3mlliter^{-1} of water at panicle initiation stage) and T7 (75% NP +100% K + 2 foliar spray of nano-DAP @ 3 ml liter^{-1}of water at tillering and panicle initiation stages). Further, treatment T2 (100% RDN + 1 foliar spray of nano- DAP @ 3 ml liter^{-1} of water at tillering stage) sturd in 2nd position but at par with T3, T7and T1 treatments. Similarly, T6 (75%NP +100%K+1foliars prayofnano-DAP @3 ml liter^{-1} of water at panicle initiation stage) recorded significantly minimum dry matter accumulation was (viz., s0.60, 6,90, 14.73 and 20. 34) and at par with T5 and T1 treatments. This result was confirmative with Rahman et al. (2014) [11].

Table4: Effect of nutrient management on dry matter accumulation at different growth stages of wheat

Treatments		**Dry matter accumulation (g plant^{-1})**			
		30DAS	**60DAS**	**90DAS**	**At harvest**
T1	100% RDN	0.62	7.67	16.25	22.01
T2	100%RDN+1foliar sprayofnano-DAP@3mlliter^{-1} ofwater at tillering stage	0.64	8.28	18.38	24.08
T3	100%RDN+1foliarsprayofnano-DAP@3ml liter^{-1} ofwater at panicle initiation stage	0.64	8.13	18.16	23.50
T4	100%RDN+2foliar sprayofnano-DAP@3ml liter^{-1}ofwater at tillering and panicle Initiation stages	0.65	8.44	19.61	25.30
T5	75%NP+100%K+ 1 foliar sprayofnano-DAP@3 ml liter^{-1}ofwaterat tillering stage	0.61	7.12	15.59	20.49

T6	75%NP+100%K+1 foliar sprayofnano-DAP@3mlliter^{-1}ofwater at panicle initiation stage	0.60	6.90	14.73	20.34
T7	75%NP +100%K+2 foliar spray of nano-DAP @ 3 mllite-^{1}of water at tillering and panicle initiation stages	0.63	7.80	17.48	23.37
	S.E.M(±)	0.01	0.25	0.71	0.68
	CD (5%)	NS	0.77	2.2	2.11

Conclusion

Application of T4 (100% RDN+2 foliar spray of nano-DAP @ 3 ml liter^{-1} of water at tillering and panicle initiation stages) indicated significantly highest plant height, tillers, dry matter of wheat.

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