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EVALUATION OF NUTRIENT MANAGEMENT PRACTICES FOR ENHANCING PRODUCTIVITY OF WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

A field experiment was conducted during *Rabi* season of 2023-24 at Crop Research Farm, Department of Agronomy, Tantia University, Sri Ganganagar, Rajasthan (India). The experiment was laid out in Randomized Block Design (RBD) with eight treatments and replicated thrice *viz.*, T_1: Control; T_2: 100% RDF; T_3: 100% RDF + Panchagavya; T_4: 100% RDF + PGPR; T_5: 100% RDF + PGPR+ Panchagavya; T_6: 75% RDF + Panchagavya; T_7: 75% RDF + PGPR; T_8: 75% RDF + PGPR + Panchagavya to study the effect of nutrient management practices on growth, yield attributes and yield of wheat (Variety DBW-303). The results revealed that, the significantly higher plant height at harvest; leaf length, number of leaves/plants, number of tillers/plants and leaf area index were recorded with 100% RDF + PGPR + Panchagavya. Similarly, the significantly higher spike length, grains per spike, test weight, grain, straw and biological yield and harvest index were recorded with 100% RDF + PGPR + Panchagavya. Based on the finding it may conclude that application of 100% RDF + PGPR + Panchagavya gave significantly higher growth, yield attributes and yield of wheat cultivation over rest of the treatments. Based on the above findings it can be recommended that wheat grown with application of 100% RDF + PGPR + Panchagavya can successfully sustain the crop productivity.

***Key words*:** Wheat, RDF, PGPR, Panchagavya, Productivity.

Introduction

Wheat (*Triticum aestivum* L.) is the second most important cereal food crop of India after rice. The population of India is more than 1.32 billion and it will reach 1.7 billion by 2050 (Anonymous, 2022). Currently, the wheat production of the country is 112.74 MT (Anonymous, 2022-23) and about 140 MT of wheat will be required to fulfil the demand by 2050 (Anonymous, 2015). So, we need to produce more food grains to fulfil the demand of increasing population of India. The wheat provides 55 per cent of carbohydrates, 21 per cent of the food calories and 20 per cent of the protein for more than 4.5 billion people in 94 countries and plays a key role in food and nutritional security (Khalid *et al.*, 2023). It is cultivated in 34.3 M ha area with a production of 112.74 million tonnes and 3424 kg/ha productivity (Anonymous, 2022-23). Wheat grain contains 61.3% of carbohydrates, 13.2% of crude protein, 2.5% of fat (EE), 10.7% of fibre, 2.5% of minerals (Iqbal *et al.*, 2022). However, wheat straw is an important dry fodder for livestock's that contains crude protein, ether extract, total ash, neutral detergent fiber and acid detergent fiber of 4.35, 1.34, 7.13, 78.04 and 52.51%, respectively (Ganai *et al.*, 2017).

Application of inorganic fertilizers even in balanced amount cannot sustain the soil fertility and crop productivity under continuous cropping or mono cropping system; as a result, agriculture is now facing a lot of stresses (Kundu *et al.*, 2010). Thus, the importance of organic sources of nutrients is recognized in current scenario in order to get higher yield without disturbing soil health. But the availability of organic source of nutrients is questions to provide sufficient nutrients for major field crops. (Bodruzzaman *et al.*, 2002) opined that the combined use of organic source of plant nutrient with inorganic fertilizers performed better than sole inorganic fertilizer to sustain the soil fertility. Therefore, combining use of bio-fertilizers with chemical fertilizers, would improve productivity and quality of fodder crops, and at the same time, decrease the amounts of chemical fertilizers, which will be reduce the costs of production and save the environment for future generation (Hend, 2017).

Unlike other countries which rely on medium to large scale dairy farms, about 80 per cent of the Indian cattle belong to small and marginal farmers with average herd size of 1-2 animals (Anonymous, 2018). The dung produced by these cattle is insufficient for supplying plant nutrients and its urine also is not handled properly. If by-products of cow are converted to any valuable product, *i.e.*, panchagavya, which is rich in plant nutrients, could help in supplying adequate plant nutrients in crops. Panchagavya is a special preparation made up from five by-products of cow *viz*., dung, urine, milk, curd and ghee (Vijayakumari *et al*., 2012) along with certain other ingredients. It contains macro and micro nutrients (Ram, 2017), growth regulatory substances *viz*., indole acetic acid (IAA), gibberellic acid (GA3), cytokinin (Perumal *et al*., 2006) and beneficial microbes *viz*., lactic acid bacteria, yeast, photosynthetic bacteria, *etc*. (Swaminathan *et al*., 2007). The low pH of panchagavya helps in killing of plant pathogens (Mathivanan *et al*., 2006). It has capacity to promote the plant growth and provide immunity in the plant systems. Inclusion of inorganic and organic source of nutrient has resulted in significant increase in crop productivity and profitability (Diacono and Montemurro, 2010). However, there is a scientific study have been carried out so far on the combined use of inorganic sources *viz*., urea, DAP, MOP and organic sources *viz*., PGPR and panchagavya in wheat. Keeping the above facts in mind the present investigation was to study the effect of nutrient management practices on growth, yield attributes and yield of wheat.

Materials ad Methods

The experiment was conducted at Crop Research Farm, Department of Agronomy, Tantia University, Sri Ganganagar, Rajasthan (India) located at 28.4° N latitude, 72.2° E longitude and an altitude of 178 m above mean sea level. The experiment was laid out in Randomized Complete Block Design (RCBD) with eight treatments and replicated thrice on wheat (Variety DBW-303). During experiment, PGPR was applied @ 200ml inoculum/ha seeds, as seed-treatment at the time of sowing. It was containing 10^9 CFU/ml counts of consortium of microorganism. The panchagavya was applied @ 5% as foliar spray at 30 and 60 DAS as per the treatments. Several growths and yield attributing traits studied where, Growth parameters *viz.*, Plant height, Number of leaves per plant, Leaf length and Leaf area index (LAI). Yield attributes and yield *viz.*, Number of tillers per meter row length, Spike length, Grains spike^{-1}, Test weight, Grain and straw yield, biological yield and Harvest index. Treatments details are given in Table 1.

Table 1: Treatments details.

Treat-ments	Treatments Description
T_1	Absolute control
T_2	100% RDF
T_3	100% RDF + Panchagavya (Foliar spray)
T_4	100% RDF + PGPR
T_5	100% RDF + PGPR + Panchagavya (Foliar spray)
T_6	75% RDF + Panchagavya (Foliar spray)
T_7	75% RDF + PGPR
T_8	75% RDF + PGPR + Panchagavya (Foliar spray)

Statistical analysis

Experimental data were processed in Microsoft Excel-2019 and analyzed with the help of analysis of variance (ANOVA) technique for Randomized Block Design (RBD) (Gomez and Gomez, 1984). The significance of the treatments was tested using F test at 5% level of significance ($P \leq 0.05$) and means were compared using the critical difference (CD) test at $\alpha \leq 0.05$.

Results and Discussion

Growth parameters

The significantly higher plant growth parameters *viz.*, plant height leaf length, number of leaves/plants, number of tillers per m^2 and leaf area index was recorded with 100% RDF + PGPR + Panchagavya, might be due to higher availability of soil nitrogen, phosphorus, and potassium in available form to plant. Maximum plant height recorded with 100% RDF + PGPR + Panchagavya, which was found statistically at par with 100% RDF+PGPR, and both were found significantly higher over control.

Soil available nitrogen, phosphorus and potassium increase due to application of 100% recommended dose of fertilizer. PGPR is another source of nutrient to plant, that have mechanism to fix atmospheric nitrogen, solubilize insoluble inorganic phosphorus (Lavakush *et al.*, 2014), release ammonia into soil subsequence increase soil nitrate (Abbasi *et al.*, 2011), increase K^+/Na^+ ration in plant by suppressing Na^+ uptake (Ahmad *et al.*, 2014) and increase metal nutrients availability to plant by organic acid production (Cakmakci *et al.*, 2007) these all

Table 2: Effect of nutrient management practices on plant height of wheat.

Treatments		Plant height (cm)	Leaf length (cm)	Number of leaves per plant	Number of tillers (m^2)	Leaf area index
T_1	Control	71.03	28.53	4.40	255.70	2.95
T_2	100% RDF	97.39	35.76	5.51	350.61	4.05
T_3	100% RDF + Panchagavya	106.70	35.85	5.53	384.13	4.44
T_4	100% RDF + PGPR	106.92	36.21	5.58	384.91	4.45
T_5	100% RDF + PGPR + Panchagavya	111.14	38.36	5.91	400.12	4.62
T_6	75% RDF + Panchagavya	82.43	34.78	5.36	296.74	3.43
T_7	75% RDF + PGPR	83.50	35.25	5.43	300.59	3.47
T_8	75% RDF + PGPR + Panchagavya	96.17	35.49	5.47	346.20	4.00
SEm(±)		**3.57**	**1.58**	**0.24**	**12.84**	**0.15**
CD (P=0.05)		**10.81**	**4.80**	**0.74**	**38.93**	**0.45**

Table 3: Effect of nutrient management practices on plant height of wheat.

Treatments		Spike length	Grains per spike	Test weight	Harvest Index
T_1	Control	8.39	31.28	4.40	39.93
T_2	100% RDF	10.82	40.15	5.51	41.18
T_3	100% RDF + Panchagavya	11.86	43.99	5.53	41.26
T_4	100% RDF + PGPR	11.88	44.07	5.58	41.30
T_5	100% RDF + PGPR + Panchagavya	12.35	45.82	5.91	41.41
T_6	75% RDF + Panchagavya	9.16	33.98	5.36	40.90
T_7	75% RDF + PGPR	9.28	34.42	5.43	40.94
T_8	75% RDF + PGPR + Panchagavya	10.69	39.64	5.47	40.99
SEm(±)		**0.40**	**1.39**	**1.47**	**0.03**
CD (P=0.05)		**1.20**	**4.21**	**4.46**	**0.08**

Table 4: Effect of nutrient management practices on plant height of wheat.

Treatments		Grain Yield (q/ha)	Straw Yield (q/ha)	Biological Yield (q/ha)
T_1	Control	34.51	51.92	86.43
T_2	100% RDF	48.70	69.55	118.25
T_3	100% RDF + Panchagavya	53.35	75.94	129.29
T_4	100% RDF + PGPR	53.46	75.99	129.45
T_5	100% RDF + PGPR + Panchagavya	55.67	78.77	134.45
T_6	75% RDF + Panchagavya	41.16	59.47	100.63
T_7	75% RDF + PGPR	41.75	60.23	101.98
T_8	75% RDF + PGPR + Panchagavya	48.08	69.21	117.29
SEm(±)		**1.78**	**2.53**	**4.31**
CD (P=0.05)		**5.41**	**7.66**	**13.07**

mechanism recharge soil fertility status as well as increase essential plant nutrients in available form to plant that contribute to increase plant growth and development. In another way PGPR synthesis phytohormones (Auxin, gibberellin, cytokinin) (Kumar *et al.*, 2014), decrease ethylene levels in plant due to PGPR release ACC-deaminase (Ahmad *et al.*, 2014) and suppress pathogen spore germination due to production HCN secondary metabolites (Kumar *et al.*, 2014) these all mechanism increases physiological process of plant that contributes in healthy plant growth and development.

Above source increase soil available nutrients status, resulted enhance uptake, utilization and assimilation of

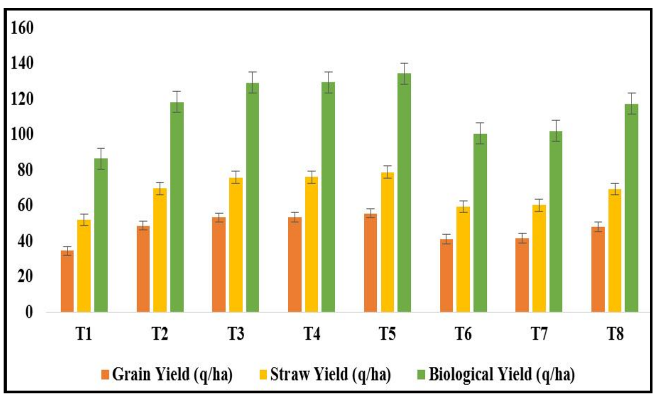

Fig. 1: Effect of nutrient management practices on yield of wheat.

nutrients by plants. Growth parameters increase due to higher production of organic matter and their accumulation in different parts of plant. Cell division increase number of cells and higher accumulation of photosynthate in cells increase cell size resulted, greater production number of basal nodes that responsible to increase number of tillers/ plants, a greater number of internodes as well as increase their length that responsible to increase number of leaves/ plants and plant height (Iqbal *et al*., 2017). These results are conformed with the similar findings of Kumar *et al.,* (2014) in wheat and Chattha *et al.,* (2017) in fodder sorghum.

Yield attributes and yield

The significantly higher number of effective tillers per m^2 (at harvest), spike length, grains per spike, test weight as well as harvest index (Table 3), grain, straw and biological (Table 4 and Fig. 1) of wheat recorded with 100% RDF + PGPR + Panchagavya due to balanced supply of essential plant nutrients attributed to increases plant physiological processes mostly photosynthetic process in which produce organic compound that translocated and assimilated in different parts of plant attributed to increase effective tillers, spike length, grains per spike and test weight. Increased yield attributes lead to increase grain yield of wheat. More number of tillers, increased plant height and number of leaves attributed to increase straw yield of wheat. More grain setting or grain yield as compared to straw yield attributed to increase harvest index of wheat.

Conclusion

Yield attributes *viz.*, number of effective tillers per m^2, spike length, grains per spike and test weight of wheat was significantly influenced by different nutrient management practices and recorded significantly highest with 100% RDF + PGPR + Panchagavya, which was found statistically on par 100% RDF + PGPR. The significantly higher grain, straw and biological as well as harvest index of wheat recorded with 100% RDF + PGPR + Panchagavya, which was found statistically on par 100% RDF + PGPR. Based on the findings of present investigation, it may conclude that application of 100% RDF + PGPR + Panchagavya gave higher growth, yield attributes and yield improvement of wheat cultivation. Based on the above findings it can be recommended that wheat grown with application of 100% RDF + PGPR + Panchagavya can successfully sustain the crop productivity.

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