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Effect of the organic and inorganic sources of nutrients on growth performance of wheat in central plain zone of Uttar Pradesh

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Abstract

A field experiment was conducted during Rabi seasons of 2024-25 and 2025-26 at the Student Instructional Farm, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, (U.P.) The investigation was undertaken to studies on the effect of organic and inorganic sources of nutrients on soil health, growth and yield attributes of wheat (*Triticum aestivum* L.). The treatments consisted three levels of organic sources (control, FYM @ 5 t ha⁻¹, vermicompost @ 2.5 t ha⁻¹), two levels of inorganic sources (control, ZnSO₄ @ 5 kg ha⁻¹ + boron @ 2 kg ha⁻¹) and three levels of bio-inoculants (control, *Azotobacter*, PSB). The experiment was replicated thrice in a factorial randomized block design (FRBD). The results revealed that application of different treatments affect the growth parameters like dry matter accumulation and leaf area of wheat were improved significantly due to the integration of organic and inorganic sources of nutrients. The significant higher values of dry matter accumulation and leaf area under vermicompost @ 2.5 t ha⁻¹ compared to control clearly indicate the effect of organic sources of nutrients in an improvement of growth.

Keywords: Bio-inoculants, growth parameters, micronutrients, organic manures, wheat

1. Introduction

Wheat (*Triticum aestivum* L.) is the second most important food grain crop being consumed next to rice. It is grown all over the world for its wider adaptability and high nutritive value. Wheat is staple food throughout the world and is also consumed in several ways in a number of industrial and commercial products. Wheat grains are comparatively better source of protein. The increasing population, rising food demand, and progressive reduction in cultivable land and other natural resources have imposed significant stress on the existing agricultural systems. To address these challenges and enhance crop yields, farmers are increasingly adopting an integrated nutrient management approach that combines both synthetic and organic fertilizers in a balanced manner. Among many biotic and abiotic factors, the high cost of inputs (mainly fertilizers) along with no or sub-optimum application of micronutrients is the important factor responsible for low wheat yield in the country. Such a supplementation of organic fertilizers expands bio-activities beneath the soil surface with increased water and nutrient holding capacity which resulted in less soil crust and moisture/nutrient losses (Defra, 2002; Weil and Magdoff, 2004) [4, 10]. Haque *et al.* (2002) [12] also stated that integrated plant nutrients management has great potential for yield stabilization whereas combined application of organic and chemical sources is useful practice in increasing fertility, quality and yield of crop (Duan *et al.* 2004) [5]. Rehm and Sims (2006) [11] reported that the application of NPK along with micronutrients plays key role in yield enhancement especially when the soils are deficient in organic matter, nitrogen, phosphorus and micronutrients. Such deficiency of trace elements affects the quantity as well as quality of different plant products (Ahmadikhah *et al.* 2010) [1].

In addition to improving soil health, balanced fertilizers made from both organic and inorganic sources increase wheat productivity. Efficacy of organic sources to meet the nutrient requirement of crop is not as assured as mineral fertilizers, but the joint use of chemical fertilizers along with various organic sources is capable of improving soil quality and higher crop productivity on long-

term basis. Majorly poor management of fertilizer has key role to play in obtaining low yield productivity, so in order to achieve optimum crop productivity management of nutrients through judicious application of organic sources, bio-fertilizers and micro-nutrients are required. Integrated use of organic and inorganic nutrient sources support to sustain yield and build up soil quality for enhanced production (Kumara *et al.*, 2013; Brar *et al.*, 2015) ^[6, 3]. Besides it has manorial proteins and it has valuable supports soil biological activities besides improving soil structure, water holding capacity and other physicochemical properties of soil. Highest productivity of crops in sustainable manner without deteriorating the soil and other natural resources could be achieved only by applying appropriate combination of different organic manures and inorganic fertilizers (Chandra shekara *et al.* 2020). Therefore, to sustain the land and to achieve production potential of crops, judicious use of fertilizers in integration of organic manures and their scientific management is important. Keeping in view the above points, present investigation was carried out.

2. Materials and Methods

2.1 Experimental Location and Season

The experiment was conducted at “Students’ Instructional Farm”, Department of Agronomy, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, (U.P.) which is situated between 25° 26' to 26° 58' North latitude, 79° 31' to 31° 34' East longitude and at the 125.9 meters above sea level in the alluvial tract of Indo - Gangatic Plain zone of central part of Uttar Pradesh, India during the Rabi Season 2024-25 to 2025-26.

2.2 Experimental Design and Treatments Details

The experiment was arranged in a Factorial Randomized Block Design with 54 treatment combinations involving three levels of organic sources (control, FYM @ 5 t ha⁻¹, vermicompost @ 2.5 t ha⁻¹), two levels of inorganic sources (control, ZnSO₄ @ 5 kg ha⁻¹ + boron @ 2 kg ha⁻¹) and three levels of bio-inoculants (control, *Azotobacter*, PSB, replicated thrice. Wheat var. K- 1317 was taken as a test crop to observe direct effect of the treatments. The 100% NPK recommended dose of fertilizer for wheat was 120 kg N, 60 kg P₂O₅ and 60 kg K₂O ha⁻¹, respectively. Half dose of N and full dose of P and K were applied as basal in the form of urea, di ammonium phosphate and muriate of potash manually by placement method into open furrows, respectively. The remaining N was applied in two equal splits at tillering and flower initiation stages, respectively during both the years.

3. Results and Discussion

Growth parameters

The data pertaining to growth parameters under different treatments are presented in Table 1 and figure 1. A perusal of data on dry matter accumulation as affected by various treatments under study indicated that application of organic and inorganic sources of nutrients have significant effect on dry matter accumulation during both the years and on pooled basis also. Pooled analysis of data showed that organic sources at vermicompost @ 2.5 t ha⁻¹ (O₂) were recorded significantly maximum dry matter accumulation (g plant⁻¹) 2.19, 7.84, 19.21

and 22.90 at 30, 60, 90 DAS and at harvest stage followed by PSB (B₂) 2.16, 7.80, 18.78 and 22.33 at 30, 60, 90 DAS and at harvest stage and minimum dry matter accumulation (g plant⁻¹) 2.15, 6.28, 16.78 and 20.17 at 30, 60, 90 DAS and at harvest stage were recorded under the treatment of control (O₀). In case of inorganic source of nutrients practices significantly maximum dry matter accumulation (g plant⁻¹) 2.18, 7.83, 19.06 and 22.70 were recorded under ZnSO₄ @ 5 kg ha⁻¹ + boron @ 2 kg ha⁻¹ (I₁) as compared to without inorganic source treatment (I₀) 2.16, 6.79, 17.45 and 20.90 at 30, 60, 90 DAS and at harvest stage. Bioinoculants practices also significantly influenced by application of *Azotobacter* (B₁) recorded significantly maximum dry matter accumulation (g plant⁻¹) 2.22, 7.62, 18.97 and 22.64 at 30, 60, 90 DAS and at harvest stage followed by PSB (B₂) 2.15, 7.43, 18.37 and 21.91 at 30, 60, 90 DAS and at harvest stage and minimum dry matter accumulation (g plant⁻¹) 2.13, 6.88, 17.44 and 20.85 at 30, 60, 90 DAS and at harvest stage recorded under the treatment of control (B₀). The might due to better photosynthetic activity due to greater exposure to light and increased availability of nutrients to plants. A notable increase in the amount of chlorophyll in the leaves may have led to improved solar energy absorption and utilization, which in turn may have increased the photosynthetic rate and, ultimately, the crop's buildup of dry matter. Similar observations have been reported by Singh *et al.* (2016) ^[8], Maurya *et al.* (2019) ^[7].

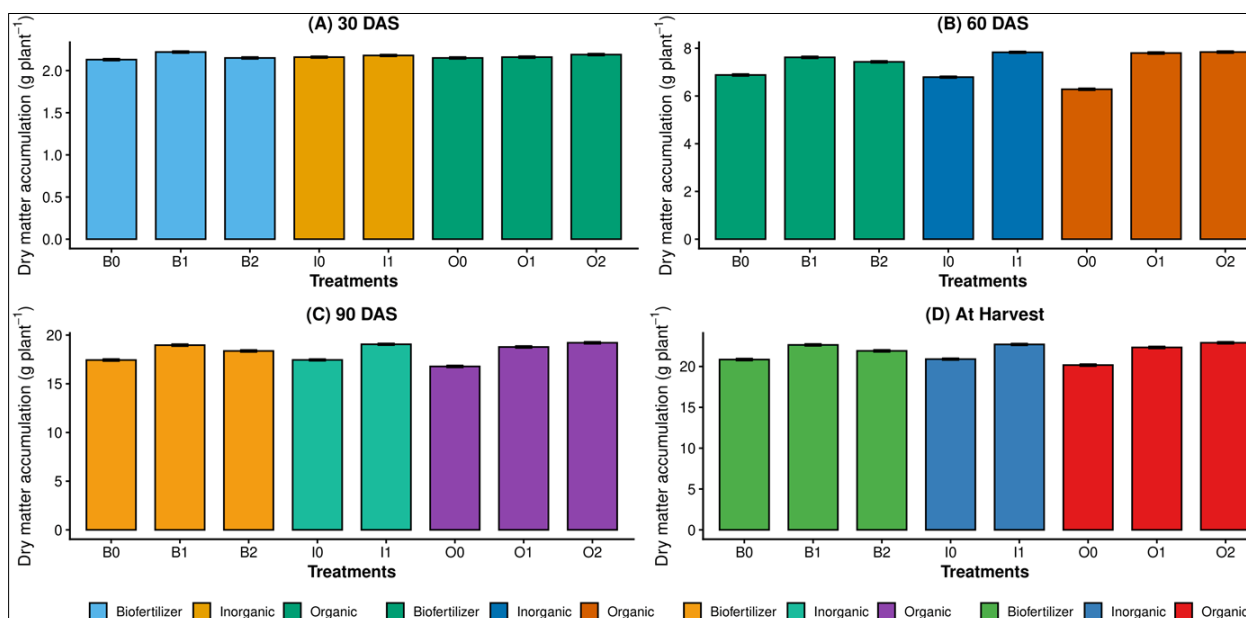
The data pertaining to growth parameters under different treatments are presented in Table 2 and figure 2. A perusal of data on leaf area (cm plant⁻¹) as affected by various treatments under study indicated that application of organic and inorganic sources of nutrients have significant effect on leaf area during both the years and on pooled basis also. Pooled analysis of data showed that organic sources at vermicompost @ 2.5 t ha⁻¹ (O₂) were recorded significantly maximum leaf area (cm plant⁻¹) 113, 493.50, 499.33 and 229.67 at 30, 60, 90 DAS and at harvest stage followed by FYM @ 5 t ha⁻¹ (O₁) 112, 483.33, 488.92 and 224.92 at 30, 60, 90 DAS and at harvest stage and minimum leaf area (cm plant⁻¹) 108, 428.08, 433.08 and 199.33 at 30, 60, 90 DAS and at harvest stage were recorded under the treatment of control (O₀). Among the inorganic source of nutrients practices significantly maximum leaf area (cm plant⁻¹) 112, 503.61, 509.50 and 234.33 were recorded under ZnSO₄ @ 5 kg ha⁻¹ + boron @ 2 kg ha⁻¹ (I₁) as compared to without inorganic source treatment (I₀) 110, 433, 438.06 and 201.61 (g plant⁻¹) at 30, 60, 90 DAS and at harvest stage. Bioinoculants practices also significantly influenced by application of *Azotobacter* (B₁) recorded significantly maximum leaf area (cm plant⁻¹) 113, 498.42, 504.33 and 231.92 at 30, 60, 90 DAS and at harvest stage followed by PSB (B₂) 111, 473.50, 478.83 and 220.33 at 30, 60, 90 DAS and at harvest stage and minimum leaf area (cm plant⁻¹) 109, 433, 438.17 and 201.67 at 30, 60, 90 DAS and at harvest stage were recorded under the treatment of control (B₀). This could be attributed to enhanced crop growth and leaf development resulting from an adequate nutrient supply, which promotes higher photosynthetic activity and better utilization of intercepted sunlight. Consequently, this led to an increase in leaf area. Similar results have been reported by Kumar and Niwas (2022) ^[9].

Table 1: Effect of organic and inorganic sources of nutrients on growth parameters

Treatments	Dry matter accumulation (g plant ⁻¹)											
	30 DAS			60DAS			90DAS			At harvest		
	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled
Organic sources (O)												
O ₀	2.14	2.17	2.15	6.36	6.21	6.28	16.80	16.76	16.78	20.19	20.15	20.17
O ₁	2.15	2.17	2.16	7.88	7.72	7.80	18.80	18.77	18.78	22.33	22.33	22.33
O ₂	2.19	2.19	2.19	7.86	7.82	7.84	19.18	19.24	19.21	22.86	22.94	22.90
SEm±	0.010	0.007	0.004	0.028	0.033	0.015	0.088	0.067	0.039	0.099	0.090	0.047
C.D at 5%	0.030	0.019	0.012	0.080	0.095	0.043	0.253	0.194	0.111	0.286	0.260	0.134
Inorganic sources (I)												
I ₀	2.15	2.16	2.16	6.85	6.73	6.79	17.46	17.44	17.45	20.91	20.90	20.90
I ₁	2.17	2.19	2.18	7.89	7.77	7.83	19.06	19.07	19.06	22.68	22.72	22.70
SEm±	0.007	0.004	0.003	0.018	0.022	0.010	0.059	0.045	0.026	0.066	0.060	0.032
C.D at 5%	0.020	0.013	0.008	0.053	0.064	0.029	0.169	0.129	0.074	0.190	0.173	0.089
Biofertilizers (B)												
B ₀	2.13	2.14	2.13	6.92	6.83	6.88	17.41	17.46	17.44	20.81	20.89	20.85
B ₁	2.20	2.24	2.22	7.57	7.66	7.62	18.90	19.03	18.97	22.57	22.71	22.64
B ₂	2.15	2.15	2.15	7.61	7.26	7.43	18.47	18.27	18.37	22.00	21.82	21.91
SEm±	0.010	0.007	0.004	0.028	0.033	0.015	0.088	0.067	0.039	0.099	0.090	0.047
C.D at 5%	0.030	0.019	0.012	0.080	0.095	0.043	0.253	0.194	0.111	0.286	0.260	0.134

Table 2: Effect of organic and inorganic sources of nutrients on growth parameters

Treatments	Leaf area (cm plant ⁻¹)											
	30 DAS			60DAS			90DAS			At harvest		
	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled	2024-25	2025-26	Pooled
Organic sources (O)												
O ₀	107.00	109.00	108.00	424.83	431.33	428.08	429.83	436.33	433.08	197.83	200.83	199.33
O ₁	111.00	113.00	112.00	480.00	486.67	483.33	485.50	492.33	488.92	223.33	226.50	224.92
O ₂	112.00	114.00	113.00	490.00	497.00	493.50	495.83	502.83	499.33	228.00	231.33	229.67
SEm±	0.407	0.440	0.212	1.680	1.854	0.885	1.743	2.027	0.945	0.802	0.783	0.396
C.D at 5%	1.169	1.264	0.598	4.829	5.330	2.497	5.009	5.826	2.667	2.304	2.250	1.118
Inorganic sources (I)												
I ₀	109.00	111.00	110.00	429.89	436.11	433.00	434.89	441.22	438.06	200.11	203.11	201.61
I ₁	111.00	113.00	112.00	500.00	507.22	503.61	505.89	513.11	509.50	232.67	236.00	234.33
SEm±	0.271	0.293	0.141	1.120	1.236	0.590	1.162	1.352	0.630	0.534	0.522	0.264
C.D at 5%	0.780	0.843	0.399	3.219	3.553	1.664	3.339	3.884	1.778	1.536	1.500	0.745
Biofertilizers (B)												
B ₀	108.00	110.00	109.00	429.83	436.17	433.00	435.00	441.33	438.17	200.17	203.17	201.67
B ₁	112.00	114.00	113.00	494.83	502.00	498.42	500.67	508.00	504.33	230.17	233.67	231.92
B ₂	110.00	112.00	111.00	470.17	476.83	473.50	475.50	482.17	478.83	218.83	221.83	220.33
SEm±	0.407	0.440	0.212	1.680	1.854	0.885	1.743	2.027	0.945	0.802	0.783	0.396
C.D at 5%	1.169	1.264	0.598	4.829	5.330	2.497	5.009	5.826	2.667	2.304	2.250	1.118

**Fig 1:** Effect of organic and inorganic sources of nutrients on growth parameters

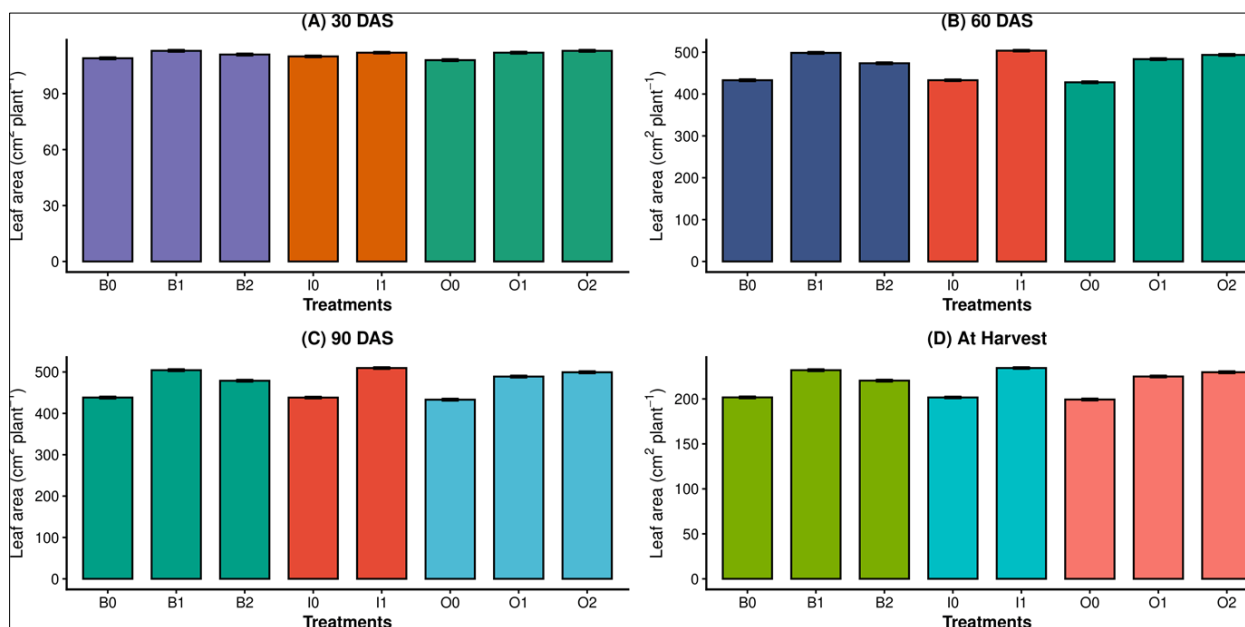


Fig 2: Effect of organic and inorganic sources of nutrients on growth parameters

4. Conclusion

The overall results demonstrated that dry matter accumulation and leaf area of plant growth were improved by combined application of organic source of nutrients, inorganic source of nutrients and bioinoculants over control. Hence, it can be concluded that integration of all the treatment in balance form improve the growth parameters. Finally, the goal is to integrate the use of all natural and manmade sources of plant nutrients, so that crop productivity increases in an efficient and environmentally benign manner, without sacrificing soil productivity of future generations.

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