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Effect of organic and inorganic sources of nutrients on productivity and profitability of wheat (*Triticum aestivum* L.)

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Abstract
The present experiment was carried out at Experimental farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan (Mohali) during *Rabi* season, 2020-21 to investigate the "effect of organic and inorganic source of nutrients on productivity and profitability of wheat". The experiment consisted of 2 moisture regimes *i.e.* irrigated and rainfed in main plots and 8 treatments comprising of 4 nutrient management practices, *i.e.* organic nutrient management [seed inoculation with Azotobacter (5 g kg^{-1} seed) + vermicompost (10 t ha^{-1})], inorganic nutrient management (recommended dose of NPK), integrated nutrient management [vermicompost (5 t ha^{-1}) + 50% of recommended dose of NPK)] and farmer's practice [vermicompost (2.5 t ha^{-1}) + 25% of recommended dose of NPK]. Results revealed that yield attributes, grain and straw yield of wheat were increased with irrigated condition and nutrient management practices. Integrated nutrient management recorded maximum grain yield followed by inorganic nutrient management, organic nutrient management and farmer's practice. Integrated nutrient management recorded maximum net returns per rupee invested (1.66) but it was statistically at par with inorganic nutrient management (1.62).

Keywords: economics, organic, inorganic, integrated, wheat

Introduction
Wheat (*Triticum aestivum* L.) is the second most important cereal crop in the world after rice. It has great nutritional value and contains 60-90% starch, 11-13.2% protein, 1.5-2% fat, and vitamins. Wheat is use for making diverse types of local food recipes and beverages. Wheat straw is also a good source of nutrition in animals. Plant nutrient management gained momentum and importance in recent years. The objective of this approach is efficient, judicious and economic use of all major sources of plant nutrients in an integrated manner so as to maximize yield of a crop or a cropping system without any adverse effect on the agro-ecosystem. Integrated nutrient management (INM) means judicious and efficient use of mineral fertilizers, organic manures and bio-fertilizers in an integrated manner, to get the maximum productivity and maintain soil fertility. Addition of organic manures along with chemical fertilizers sustained the yield through increased nutrients availability and nutrient use efficiency. Use of organic manures in INM helps in mitigating multiple nutrient deficiencies (Chauhan *et al*, 2014) [2]. The concept of INM should be followed to prevent severe health hazards and to protect the environment. INM refers to the combination of all possible sources of nutrients like organic sources, inorganic sources and biological sources or components in a judicious way for obtaining an ecologically sound environment and economically optimal farming system (Jat *et al*, 2015) [5]. Integrated use of organic and inorganic nutrient sources helps in gaining sustainable yield and improved soil quality for enhanced production (Brar *et al*, 2015) [1], (Choudhary *et al*, 2013) [3]. Therefore, an experiment was conducted during *Rabi* 2020-21 to study the effect of organic and inorganic source of nutrients on productivity and profitability of wheat.

Materials and Methods
A field experiment was conducted during the *Rabi* season of 2020-21 at the Experimental farm of University Institute of Agricultural Sciences, Chandigarh University, Gharuan, Mohali (Punjab). The experiment consisted of 2 moisture regimes *i.e.* irrigated and rainfed in main plots and 8 treatments comprising of 4 nutrient management practices, *i.e.* organic nutrient management [seed inoculation with Azotobacter (5 g kg^{-1} seed) + vermicompost (10 t ha^{-1})], inorganic nutrient management (recommended dose of NPK), integrated nutrient management [vermicompost (5 t ha^{-1}) + 50% of recommended dose of NPK)] and farmer's practice [vermicompost (2.5 t ha^{-1}) + 25% of recommended dose of NPK]. The experimental fields were prepared with the help of power tiller. The layout of experiment was carried out manually and plots were prepared and then leveled. 100 kg ha^{-1} seed of 'Unnat PBW-343' variety of wheat was used for sowing. Sowing of wheat was done keeping row spacing of 22.5 cm. The vermicompost was incorporated in soil at the time of sowing of crop as per the treatment with nutrient composition of 1.5 per cent nitrogen, 1 per cent phosphorus and 0.60 per cent potassium. The recommended dose of NPK used in wheat crop was N: P_2O_5: K_2O 80: 40: 40kg ha^{-1} in rainfed condition and N: P_2O_5: K_2O 120: 60: 40kg ha^{-1} in irrigated condition, respectively. Half dose of nitrogen and whole P_2O_5 and K_2O were incorporated in soil, as per the treatments, as basal dose and remaining half dose of nitrogen was top dressed at tillering stage of the wheat crop. To obtain the true treatment effects, four outer rows (two on each side) and 0.25 m on either side of each row were removed and then net plot of 6.0 m x 2.5 m was harvested manually with the help of sickles.

Results and Discussion

Yield attributes

Data on different yield attributes of wheat presented in Table 1 revealed that number of effective tillers and 1000 grain weight were significantly higher due to irrigated condition over rainfed condition. It might be due to the optimum moisture regime which is very important for the balanced metabolic activities of the plants which in turn might have resulted in enhancing these characters. The other yield attributes *viz*. spike length and number of grains per spike did not vary significantly due to rainfed / irrigated condition.

Among different nutrient management treatments, integrated nutrient management recorded significantly more number of effective tillers per meter square spike length, number of grains per spike and 1000 grain weight as compared to other treatments and was also statistically at par with inorganic nutrient management except number of effective tillers per meter square. The beneficial effect of nitrogen and vermicompost on crop growth influenced the yield attributes characters positively. The increase in number of tillers per meter square and grains per spike could be attributed to the fact that balanced nutrients from integrated nutrient sources increased the nutritional environment and hence, resulted in more nutrient uptake and improved the meristematic activity of the plant. Similar finding were also reported by (Kachroo and Razdan, 2006) [6].

Yield of wheat crop

The data on grain yield as influenced by moisture regimes and nutrient management have been presented in Table 2. The data revealed that irrigated condition significantly increased the grain yield of wheat over rainfed condition by 12%. (Deo *et al*, 2017) [4] reported that the grain yield of wheat was significantly influenced due to different irrigation schedules and found that the highest grain yield was recorded under irrigation applied at critical stages. Among nutrient management treatments, integrated nutrient management produced significantly higher grain yield and was statistically at par inorganic nutrient management. It produced 5.1, 12.9 and 42.4% higher grain yield over inorganic, organic and farmer's practice, respectively. The organic and inorganic nutrient management practices produced statistically similar grain yield which were significantly higher over the farmer's practice of nutrient management. (Mohan *et al*, 2018) [8] reported that the maximum grain yield was recorded with combination of RDF and vermicompost. The straw yield presented in Table 2 revealed that irrigated condition significantly increased the straw yield by 2.5% over rainfed condition. All the four nutrient management levels differed significantly from each other and integrated nutrient management resulted in 2.9, 7.1 and 15.6% higher yield over inorganic, organic and farmer's practice treatments, respectively. However, it remained statistically at par with inorganic nutrient management. The different moisture regimes and nutrient management practices did not significantly influence the harvest index of the wheat crop**.**

Economics

Data presented in Table 3 revealed that irrigated condition recorded higher cost of cultivation, gross returns, net returns and net returns per rupee invested as compared to rainfed condition. Among nutrient management, organic nutrient management recorded higher cost of cultivation over other treatments. However, integrated nutrient management recorded maximum gross returns, net returns and net returns per rupee invested. However, net returns per rupee invested remained statistically at par with inorganic nutrient management in all economic feasibility. Similar findings were observed by (Kaur *et al*, 2018) [7] who reported that application of 75% NPK + vermi compost @2.5 t ha^{-1} gave maximum net returns per rupee invested

Conclusion

Irrigated condition significantly increased the grain yield and net returns per rupee invested of wheat by 12.7 and 7.9 %, respectively over rainfed condition. Integrated nutrient management recorded maximum net returns per rupee invested (1.66) but it was statistically at par with inorganic nutrient management (1.62). Integrated nutrient management recorded maximum yield of wheat crop followed by inorganic nutrient management, organic nutrient management and farmer's practice.

Table 1: Effect of moisture regimes and nutrient management on yield contributing characters of wheat

Treatments	No. of effective tillers m^{-2}	Spike length (cm)	No. of grains $spike^{-1}$	1000 grain weight (g)
Moisture regimes				
Irrigated	257.05	11.24	51.37	42.53
Rainfed	249.29	10.48	48.28	39.98
SEm (±)	0.80	0.22	0.53	0.29
CD (P=0.05)	4.87	NS	NS	1.79
Nutrient management				
Organic	250.09	10.64	48.50	40.26
Inorganic	255.65	11.32	51.59	42.82
Integrated	262.95	11.55	52.65	43.70
Farmer's practice	243.97	9.94	46.56	38.24
SEm (±)	1.72	0.27	0.54	0.42
CD (P=0.05)	5.31	0.82	1.67	1.30

Table 2: Effect of moisture regimes and nutrient management on grain yield, straw yield, biological yield and harvest index of wheat

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index
Moisture regimes				
Irrigated	4288	6402	10690	0.40
Rainfed	3806	6247	10052	0.38
SEm (±)	18	21	36	0.001

CD (P=0.05)	109	128	219	NS
Nutrient management				
Organic	4050	6265	10315	0.39
Inorganic	4352	6522	10874	0.40
Integrated	4573	6709	11282	0.40
Farmer's practice	3212	5801	9013	0.36
SEm (±)	67	75	119	0.004
CD (P=0.05)	207	230	368	NS

Table 3: Effect of moisture regimes and nutrient management on economics of wheat

Treatments	Cost of cultivation (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	Net returns per rupee invested
Moisture regimes				
Irrigated	48223	119896	71673	1.50
Rainfed	46195	109516	63321	1.39
SEm (±)		442	442	0.01
CD (P=0.05)		2692	2692	0.05
Nutrient management				
Organic	54990	114445	59455	1.08
Inorganic	46515	121815	75300	1.62
Integrated	47855	127217	79362	1.66
Farmer's practice	39475	95347	55872	1.41
SEm (±)		1542	1542	0.03
CD (P=0.05)		4751	4751	0.10

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