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STUDIES ON THE NITROGEN MANAGEMENT THROUGH ORGANIC AND INORGANIC SOURCE OF NUTRIENT ON GROWTH AND PRODUCTIVITY OF LATE SOWN WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

The field experiment was conducted during rabi season of 2022-23 at Student's Instructional Farm (S.I.F) of C.S. Azad University of Agriculture & Technology, with objective to find out the effect of nitrogen management through organic and inorganic source of nutrient on growth, yield and economics of late sown wheat. The 9 treatments were tested in Randomized Block Design with three replication T_1 RDN alone though urea, T_2 RDN alone through FYM, T_3 RDN alone through vermicompost, T_4 75% RDN though urea + 25% through FYM, T_5 75% RDN though urea + 25% through vermicompost, T_6 50% RDN through urea + 50% through FYM, T_7 50% RDN through urea + 50% through vermicompost, T_8 25% RDN though urea + 75% through FYM, T_9 25% RDN through urea +75% through vermicompost. The soil of field was sandy loam, low in organic carbon (0.45%) and low in available nitrogen (170.00 kg/ha), available phosphorus (16 kg/ha) and available potash (160.00 kg/ha). The pH of soil was 7.40. The wheat variety unnat halna (k-9423) was sown on 19 of Dec.2022 at row spacing of 20 cm with seed rate of 125 kg/ha. The FYM, Vermicompost and Urea were applied as per treatments. Result showed that the T_5 gave the significantly better growth, yield contributing characters with highest grain yield (52.30 q/ha) and net return (63235.70) in comparison to all other treatments. The minimum grain yield (38.16 q/ha) and net return (30722.40 q/ha) was recorded under the T_2.
Keywords: Wheat, Nitrogen, Organic, Inorganic, growth, yield, quality and economics.

Introduction

Wheat (*Triticum aestivum* L.) is a crucial ancient crop that forms the foundation of our nation's food security system. The term "Dal roti chawal" has come to be recognized as crucial to our sustenance. Straw is considered a significant source of feed for a substantial number of cattle. Therefore, wheat is the most abundant source of protein among dietary grains, ranking second only to pulses. It is used for making bread, cakes, biscuits, noodles, petri-products, and chapatti, among other things. (Rathore, 2001). The wheat crop plays a significant role in ensuring national food security, as it supplies over 50% of the calories consumed by those who heavily rely on it.

From a nutritional point of view, 100 grams of wheat contain around 12.6 grams of protein, 1.5 grams of total fat, 68-70 grams of carbohydrates, 12.2 grams of dietary fiber, and 3.2 milligrams of iron (equivalent to 17% of the daily need). Wheat grain is highly nutritious, containing significant amounts of carbohydrates, minerals, and proteins. Billions of people depend on wheat as a significant component of their diet (Shewry, 2009). According to Kumar et al. (2011), it provides around 20% of the total dietary calories consumed by humans.

Wheat is grown in every state of India except Kerala. Approximately 91% of the total wheat production in India is concentrated in six states, namely Uttar Pradesh, Madhya Pradesh, Punjab, Haryana, Rajasthan, and Bihar. Uttar Pradesh has the largest land area of 9.85 million hectares and produces the highest number of crops, totaling 35.50 million metric tons. However, its crop yield is quite low at 3.60 metric tons per hectare, which is significantly lower than that of Haryana and Punjab. (Anonymous, 2022)

Wheat, an essential cereal crop, necessitates a reasonable supply of nutrients, particularly nitrogen, to support its growth and productivity (Wazir *et al.,* 2019). Nitrogen (N) is a crucial nutrient that plays a significant role in regulating the development, quality, and productivity of wheat worldwide. However, the application rates of nitrogen vary considerably. Farmers have mistakenly been applying excessive amounts of nitrogen (N) through fertilizers due to their lack of understanding and awareness (Ullah *et al.,* 2018). This is done in order to minimize the risk of nitrogen deficiency and ensure improved quality and yield (Peng *et al.,* 2011). The application of nitrogen fertilizers has increased by a factor of 100 in the past century in order to enhance grain production and protein levels (Giambalvo *et al.,* 2010). Excessive and continuous utilization of chemical fertilizers can result in the pollution of watercourses and the degradation of soil health (Chandini *et al.,* 2019), occasionally resulting in negative outcomes instead of positive ones. Hence, a primary obstacle is to meet the nitrogen (N) needs of crops while limiting N wastage in order to preserve a sustainable ecosystem and ensure economic advantages for farmers. It is crucial to provide the crop with a combination of inorganic and organic sources of nutrients (Singh *et al.,* 2017). The progressive degradation of soil quality can be alleviated through the utilization of organic resources (Kumar and Dhar, 2009).

Furthermore, due to the ongoing global energy crisis and the rising cost of chemical fertilizers, the utilization of organic manure, either on its own or in conjunction with mineral fertilizers, as a sustainable source of plant nutrients is becoming increasingly significant worldwide.

Application of farmyard manure enhances soil structure and augments its water retention capacity, hence optimizing water consumption. It enhances the chemical and biological state of the soil by augmenting cation exchange capacity and supplying essential hormones and organic acids. These substances are crucial for soil aggregation and support the growth of beneficial soil microorganisms. These microorganisms play a vital role in various biochemical processes and the release of nutrients. The combination of farmyard manure (FYM) with inorganic nitrogen (N) sources enhances the productivity and economic gains of wheat, while also improving soil fertility (Sharma *et al.,* 2007).

Vermicompost is highly regarded as an optimal organic fertilizer for agriculture due to its nutrient density and abundance of high-quality humus, plant growth regulators, enzymes, and compounds that offer protection against pests and diseases. Furthermore, vermicompost exhibits elevated levels of porosity, aeration, drainage, and water-holding capacity. Vermicompost is a finely divided material that resembles peat and has a low C:N ratio. It has high porosity, aeration, drainage, and water holding capacity. It is the end product of the non-thermophilic biodegradation of organic materials, which is achieved through the combined action of earthworms and associated microbes (Edwards and Burrows, 1988). Furthermore, the earthworm casts also contain elevated levels of nutrients such as C, P, K, Ca, and Mg, in addition to enhanced availability of N. Cytokinins and auxins, which are plant growth hormones, are present in organic wastes that have been handled by earthworms. In addition, they excrete certain metabolites, such as vitamin B, vitamin D, and related compounds, into the compost. Earthworms enhance the pace of mineralization and transform manures into castings that have a greater nutritional value and degree of humification compared to the conventional way of composting (Jeyabal & Kuppuswamy, 2001). Vermicomposting is a faster process compared to traditional composting. This is because the material goes through the digestive system of earthworms, undergoing a significant but not fully comprehended transformation. As a result, the earthworm castings, also known as worm manure, become enriched with microbial activity, plant growth regulators, and pest repellent properties. Earthworms possess the ability to convert waste into valuable substances through a process akin to biological transmutation (Vermi, 2001). Additionally, it decreases the concentration of chemical species that are soluble in water, hence reducing the potential for environmental pollution (Mitchell and Edwards, 1997).

Application of organic materials alone or in combination with inorganic fertilizers helped in the proper nutrition and maintenance of soil fertility in wheat crop (Sameen *et al.,* 2002). To find the most effective combination of organic manures and chemical fertilizers, it is necessary to compare them (Thomas Abraham and Lal, 2004). Integration of FYM with inorganic N sources increases productivity and monetary returns of wheat and improves soil fertility (Sharma *et al*., 2007).

Materials and Methods

This experiment was laid out during the *Rabi* season of 2022-23 at Crop Research Farm, Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India. The location is positioned at a latitude of 26° 28' North and a longitude of 80°24', with an elevation of 127 meters above sea level. The experiment was laid out in randomized block design and comprised of organic source (FYM and vermicompost) and inorganic source (Urea) 9 treatment and each was replicated thrice *viz.* T_1 - RDN alone through urea, T2 - RDN alone through FYM, T3 - RDN alone through vermicompost, T4 - 75% RDN Through Urea + 25% N through FYM, T5 - 75 % RDN through Urea + 25% N through vermicompost, T_6 - 50 % RDN Through Urea + 50% N through FYM, T_7 - 50 % RDN through Urea + 50% N through vermicompost, T_8 - 25 % RDN Through Urea + 75% N through FYM, T_9 - 25 % RDN through Urea + 75% N through vermicompost. The soil in the experimental area was Gangatic alluvium with pH (7.4), organic carbon (0.45%), available N (170 kg/ha), available P (16 kg/ha), and available K (180 kg/ha). Seeds are sown at a spacing of 20 cm to a seed rate of 125 kg/ha. The recommended dose of nitrogen (100 kg/ha), phosphorus (60 kg/ha) and potassium (40 kg/ha) were applied as per the treatments. Data recorded on different aspects of crop, *viz.,* growth, yield attributes were subjected to statistically analysis by analysis of variance method. (Gomez and Gomez, 1976). And economic data analysis mathematical method.

Result and Discussion

Plant population

The initial plant population at early stage found non-significant. The maximum initial plant population at 25-30 days after sowing recorded in the treatment (75 % RDN through Urea + 25 % through vermicompost) followed by the treatment (75% RDN Through Urea + 25% through FYM). The maximum plant population at 45 to 60 days after sowing recorded maximum i.e. 495.66 plants m^{-2} in the treatment (75 % RDN through Urea + 25 % through vermicompost) and minimum was recorded in the treatment (RDN alone through FYM). The similar findings were found by Shwetha *et al.* (2009), Singh and Kushwaha (2013) and Redda and Abay (2015).

Total number of tillers, productive tillers and unproductive tillers

The maximum number of total tillers (469.33), productive tillers (445.50) and minimum unproductive tillers (17.83) were found significant in the treatment (75 % RDN through Urea + 25 % through vermicompost). The minimum total tillers (445.50), productive tillers (328.50) and maximum unproductive tillers (29.66) were found in the treatment (RDN alone through FYM). The similar findings were found by Singh and Kushwaha (2013)

Plant height (cm)

The maximum plant height at harvest (85.50 cm) were found in the treatment (75 % RDN through Urea + 25 % through vermicompost). The minimum plant height at harvest (70.56 cm) in the treatment (RDN alone through FYM). Plant growth not only depends on the acquisition of carbohydrates through photosynthesis but also on nutrient elements taken through absorption and assimilation, and complex interactions occur between the sources of carbohydrates and nutrient elements. Therefore, crop nutrition is an essential factor for obtaining higher yield of wheat through higher photosynthetic activities. Among the entire nutrient element's nitrogen plays most important role in growth, development and final crop yield. Therefore, it is required in large amounts and its short supply causes poor growth and reduces the grain yield and quality of the crop. The result of present investigation found similar with Kumar *et al.* (2017) and Rathwa *et al.* (2018).

Fresh weight and dry weight

The maximum fresh weight (35.26 g) at maturity and dry weight (25.68 g) at maturity found significant with the treatment (75 % RDN through Urea + 25 % through vermicompost) followed by RDN alone through urea. The minimum fresh weight (21.28 g) at maturity and dry weight (14.55 g) at maturity were recorded in the treatment RDN alone through FYM followed by the treatment RDN alone through vermicompost. The nitrogen management with the phosphorus, potassium, FYM, vermicompost positively impact on the fresh weight and dry weight of wheat. The crop grows with regular during the growth stage depends upon the nutrients supply to plants form soil.

Leaf area index

The maximum leaf area index at 90 days (4.39) were recorded best in the treatment 75 % RDN through Urea + 25 % through vermicompost. The minimum leaf area index at 90 days (3.34) were recorded in the treatment RDN alone through FYM. The similar results found by Kumar *et al.* (2017).

Yield attributing character

The significant higher weight of ear (3.42 g), number of grain per ear (40.66), length of ear (13.20 cm), test weight (38.23 g) and grain weight per ear

(2.64 g) were found in the treatment 75 % RDN through Urea + 25 % through vermicompost. The lowest weight of ear (2.56 g), number of grain per ear (28.66), length of ear (8.43 cm), test weight (26.50 g) and grain weight per ear (1.78 g) were recorded in the treatment RDN alone through FYM. The observed increase in crop yield might be attributed to the enhanced availability of nutrients during both the developmental and reproductive phases of the crop. This, in turn, facilitated the transfer of additional photosynthates from the sink to the source. These results are in conformity with the findings of Singh *et al.* (2016), Hadis *et al.* (2018) and Maurya *et al.* (2019).

Yield parameters

The significant grain yield (52.30 q/ha), straw yield (60.49 q/ha) and biological yield (112.81 q/ha) were recorded in the treatment 75 % RDN through Urea + 25 % through vermicompost. The minimum grain yield (38.16 q/ha), straw yield (45.65 q/ha) and biological yield (83.82 q/ha) were obtained in the treatment RDN alone through FYM. The combined use of chemical fertilizer and organic sources of nutrients demonstrated that chemical fertilizer with vermicompost resulted in increased grain and straw production of wheat. The results are in the conformity of the findings of Patel *et al.* (2017), Singh *et al.* (2017a) and Maurya *et al.* (2019).

Economics

The cost of cultivation i.e., 66073.00 Rs. /ha, gross profit (129308.00 Rs. /ha), net profit (63235.00 Rs. /ha) and B:C ratio (1.96) were recorded in the best treatment 75 % RDN through Urea + 25 % through vermicompost. The finding in terms of RDN and vermicompost combination found similar to the findings of Singh *et al.* (2018) and Maurya *et al.* (2019).

Conclusion

Based on the above findings it can be concluded that Wheat with the application of 75 % RDN through Urea + 25 % through vermicompost was observed highest seed yield and benefit- cost ratio.

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Table 1 : Influence of nitrogen management through organic and inorganic source of nutrient on growth of late sown wheat.

Treatment Symbol	Treatment combinations	Maximum plant population (m^{-2}) at 45-60 DAS	Total number of tillers (m^{-2})	Productive tillers (m^{-2})	Unproductive tillers (m^{-2})	Plant height (cm) at harvest	Fresh weight (g) at Maturity	Dry weight (g) at Maturity	LAI at 90 DAS
T_1	RDN alone through urea	480.50	454.66	429.66	19.00	82.97	33.48	24.38	4.28
T_2	RDN alone through FYM	378.66	345.50	328.50	29.66	70.56	21.28	14.55	3.34
T_3	RDN alone through vermicompost	394.33	362.33	343.33	26.50	73.04	23.62	15.21	3.51
T_4	75% RDN Through Urea + 25% through FYM	468.33	438.83	413.33	20.65	80.68	32.11	22.12	4.15
T_5	75 % RDN through Urea + 25 % through vermicompost	495.66	469.33	445.50	17.83	85.50	35.26	25.68	4.39
T_6	50 % RDN Through Urea + 50% through FYM	439.50	414.66	383.50	23.66	78.33	29.23	19.87	3.88
T_7	50 % RDN through Urea + 50 % through vermicompost	453.66	430.49	399.66	22.50	79.07	31.42	21.42	4.02
T_8	25 % RDN Through Urea + 75 % through FYM	406.50	379.66	356.50	25.66	73.62	25.64	17.17	3.67
T_9	25 % RDN through Urea + 75 % through vermicompost	422.33	398.33	370.33	24.33	76.81	27.85	18.52	3.73
	SEm(±)	10.82	6.34	8.26	0.52	1.46	0.57	0.39	0.08
	CD (p=0.05)	23.14	13.57	17.67	1.13	3.13	1.23	0.84	0.18

Table 2 : Influence of nitrogen management through organic and inorganic source of nutrient on productivity of late sown wheat.

Treatment Symbol	Treatment combinations	Weight of ear (g)	Number of grain per ear	Length of ear (cm)	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ ha)	Biological yield (q/ha)
T_1	RDN alone through urea	3.29	40.00	12.44	37.55	50.45	57.37	107.83
T_2	RDN alone through FYM	2.56	28.66	8.43	26.50	38.16	45.65	83.82
T_3	RDN alone through vermicompost	2.68	31.66	9.75	29.20	42.24	49.35	91.59
T_4	75% RDN Through Urea + 25% through FYM	3.16	38.49	12.06	35.62	49.62	56.40	106.03
T_5	75 % RDN through Urea + 25 % through vermicompost	3.42	40.66	13.20	38.23	52.30	60.49	112.81
T_6	50 % RDN Through Urea + 50% through FYM	3.00	36.33	11.28	33.84	47.52	54.56	102.08
T_7	50 % RDN through Urea + 50 % through vermicompost	3.09	36.65	11.60	35.19	48.24	55.72	103.97
T_8	25 % RDN Through Urea + 75 % through FYM	3.32	33.33	10.35	30.36	43.74	50.80	94.55
T_9	25 % RDN through Urea + 75 % through vermicompost	2.93	35.49	10.87	31.77	45.29	52.14	97.44
	SEm(±)	0.07	0.69	0.18	0.77	0.84	0.88	2.24
	CD (p=0.05)	0.14	1.48	0.40	1.66	1.79	1.89	4.79

Table 3 : Influence of nitrogen management through organic and inorganic source of nutrient on economics of late sown wheat.

S. No.	Treatment	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
1	RDN alone through urea	68402.90	124420.90	56017.30	1.82
2	RDN alone through FYM	64065.60	94788.00	30722.40	1.48
3	RDN alone through vermicompost	67938.30	104565.00	36626.60	1.54
4	75% RDN Through Urea + 25% through FYM	69952.80	122383.70	52430.90	1.75
5	75 % RDN through Urea + 25 % through vermicompost	66073.00	129308.70	63235.70	1.96
6	50 % RDN Through Urea + 50% through FYM	70684.30	117348.00	46663.60	1.66
7	50 % RDN through Urea + 50 % through vermicompost	70182.90	119247.20	49064.40	1.70
8	25 % RDN Through Urea + 75 % through FYM	68487.60	108190.50	39702.80	1.58
9	25 % RDN through Urea + 75 % through vermicompost	69502.10	111886.20	42384.10	1.61

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