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Journal homepage: <http://www.plantarchives.org>

DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-1.429>

## IMPACT OF INTEGRATED NUTRIENTS MANAGEMENT ON GROWTH AND YIELD OF WHEAT (*TRITICUM AESTIVUM* L.) IN ORGANIC FARMING SYSTEM

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(Date of Receiving : 20-11-2025; Date of Acceptance : 23-01-2026)

### ABSTRACT

A field experiment was conducted during the Rabi season of 2024–25 at the Agronomy Research Farm, School of Agricultural Sciences, Nirwan University, Jaipur (Rajasthan), to evaluate the effect of integrated nutrient management (INM) on growth, phenology, yield attributes and grain yield of wheat (*Triticum aestivum* L.). The experimental site falls under the Semi-arid Eastern Plain Zone (Agro-climatic Zone IIIA) of Rajasthan. The study was laid out in a Randomized Block Design with ten treatments and three replications, involving varying combinations of recommended dose of fertilizers (RDF), farmyard manure (FYM), vermicompost and biofertilizer (*Azotobacter*). The wheat variety Raj-3077 was used as the test crop. The results revealed that integrated application of organic manures and biofertilizers along with inorganic fertilizers significantly influenced wheat growth and productivity. Among all treatments, application of 10 t ha<sup>-1</sup> FYM + 5 t ha<sup>-1</sup> vermicompost in combination with *Azotobacter* consistently recorded superior performance in terms of plant height, dry matter accumulation, leaf area index and plant density at advanced growth stages. This treatment also resulted in earlier flowering and earlier attainment of physiological maturity compared to the control, indicating improved crop vigor and nutrient use efficiency. Yield attributes such as number of spikes per square meter, grains per spike, spike length and 1000-grain weight were significantly enhanced under INM treatments over the control. The highest grain yield (45.9 q ha<sup>-1</sup>) was obtained with the combined application of FYM, vermicompost and *Azotobacter*, followed by treatments involving 50–75% RDF supplemented with organic manures and biofertilizer. Sole application of chemical fertilizers or absence of nutrient input resulted in comparatively lower growth and yield performance. The improvement in wheat yield under integrated nutrient management can be attributed to sustained and balanced nutrient supply, improved soil physical and biological properties, enhanced microbial activity and better nutrient uptake throughout the crop growth period. The study clearly demonstrates that partial substitution of inorganic fertilizers with organic manures and biofertilizers not only enhances wheat productivity but also promotes soil health and sustainability. Therefore, integrated nutrient management emerges as a viable and eco-friendly strategy for achieving higher wheat yields and long-term soil fertility under semi-arid conditions.

**Keywords:** Wheat, Integrated nutrient management, Farmyard manure, Vermicompost, *Azotobacter*, Growth parameters, Yield attributes, Grain yield.

### Introduction

World food security relies on wheat (*Triticum aestivum* L.), the most important staple crop. Making about 35% of global food consumption, it provides calories and important nutrients (Mohammadi Joo *et al.*, 2015). The crop is important to agricultural output throughout areas since it may be grown in a variety of

agro-climatic conditions. Meeting the food needs of India's rising population requires sustainable wheat production. High wheat yields require proper nutrient management. Wheat needs nitrogen (N), phosphorus (P) and potassium (K) for optimal growth. Plant growth depends on nitrogen for chlorophyll formation and photosynthesis. Phosphorus helps create roots,

transport energy and mature crops. Potassium helps plants maintain water balance, build cells and resist pests and illnesses. Wheat's physiological functioning and productivity depend on a balanced and adequate supply of these nutrients. Wheat plants need nitrogen for protein synthesis, chlorophyll formation and growth. Nitrogen deficit stunts growth, yellows foliage and reduces crop production (Safiullah *et al.*, 2018). Farmers in many parts of India use synthetic nitrogen fertilisers to feed wheat crops since soils are often nitrogen-deficient. The use of artificial fertilisers poses sustainability concerns in agriculture. Using organic fertilisers, crop rotation and nitrogen-fixing bio-fertilizers can help manage nitrogen sustainably. These methods promote soil health, reduce fertiliser use and ensure wheat farming productivity. Wheat plants need phosphorus for root development, energy transfer and blooming. A phosphorus deficit can cause weak root systems, stunted growth and delayed flowering, limiting production. Due to its limited solubility and inclination to combine with other minerals, phosphorus in Indian soils is rarely available to plants. To maximise crop growth, this constraint sometimes requires additional phosphorus fertilisation. Wheat plants need potassium to regulate water balance, photosynthesis and protein and sugar synthesis. Low potassium levels might result in decreased disease resistance, poor grain quality and poorer yields. Muriate of potash (MOP) provides potassium, but excessive use can cause soil nutrient imbalances (Tiwari *et al.*, 2019). Compost and farmyard manure (FYM) help preserve soil health and provide potassium for wheat growth. Organic inputs strengthen soil, boost microbial activity and slow nutrient release. A balanced soil fertility technique is integrated nutrient management (INM), which uses organic manures and inorganic fertilisers. Increased nutrient use efficiency

and sustainable wheat yields result from such techniques (Kim *et al.*, 1998). Bio-fertilizers fix nitrogen, solubilise phosphorus and decompose organic materials to improve soil fertility and plant growth. These eco-friendly microbial inoculants help plants get necessary nutrients from the natural nutrient cycle. Free-living nitrogen-fixing bacteria like Azotobacter and phosphate-solubilizing bacteria (PSB) are becoming sustainable and cost-effective synthetic fertiliser replacements. Their use boosts soil health, nutrient availability and minimises chemical fertilizer's environmental impact. Free-living nitrogen-fixing bacteria Azotobacter boosts plant development by turning atmospheric nitrogen into plant-usable nitrogen. It produces growth-promoting chemicals to promote early seed germination and root development. By breaking down insoluble phosphate complexes, phosphate-solubilizing bacteria (PSB) boost soil phosphorus availability for crops like wheat. These bio-fertilizers reduce chemical fertiliser use, supporting sustainable farming. They boost soil fertility, plant health and agricultural yield (Kim *et al.*, 1998).

### Materials and Method

A field experiment entitled to "Impact of Integrated Nutrients Management on Yield, Nutrients Uptake and Quality of Wheat (*Triticum aestivum* L.)" was conducted at the Agronomy Research Farm of School of Agricultural Sciences, Nirwan University, Jaipur (Rajasthan) during Rabi season of 2024-25. Geographically, the experimental site is located at approximately 26.9157° N latitude and 75.8205° E longitude, with an altitude of around 431 meters above mean sea level and this region falls under agro climatic zone III A of Rajasthan (Semi-arid Eastern Plain Zone).

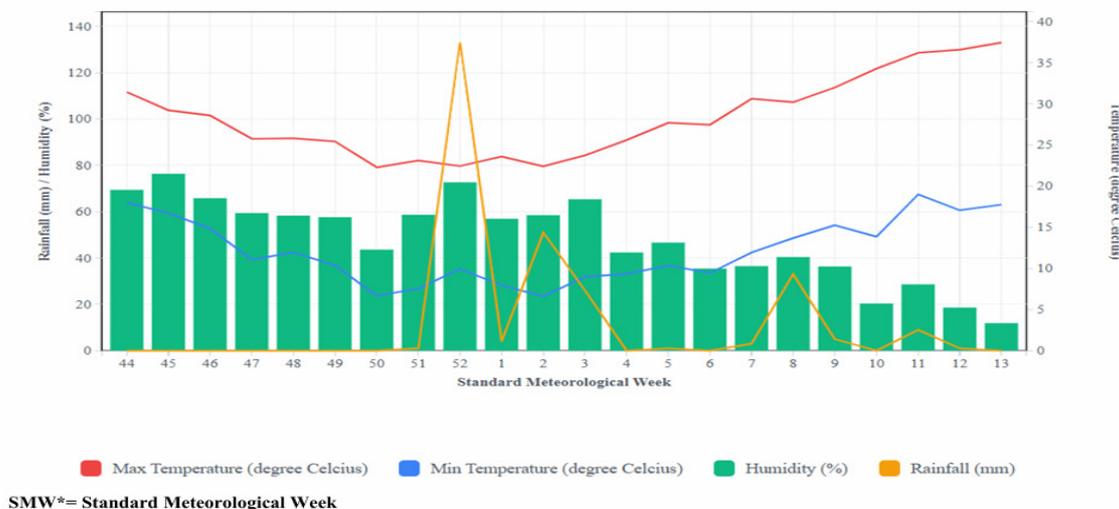


Fig. 1: Class 'B' Meteorological observatory at ARS, Durgapura, Jaipur

### Cropping History of Experimental Field

The different crops grown in successive seasons in the experimental block over the past three years were recorded to gain insights into the crop diversity and species cultivated. The cropping history of the experimental fields for the last three years is presented in Table 1:

**Table 1:** Cropping History of Experimental Field

Years	Kharif	Rabi
2021-22	Pear millet	Mustard
2022-23	Mungbean	Barley
2023-24	Groundnut	Mustard
2024-25	Pearl millet	Wheat*

### Treatment details

The experiment consisted of 10 treatment combinations, replicated thrice in a Randomized Block

Design (RBD). Nitrogen was applied as urea at the prescribed rate for each treatment, with 50% as basal and the remaining 50% split equally at crown root initiation (CRI) and tillering stages. Phosphorus was applied as single super phosphate (SSP) at 60 kg/ha as basal application in relevant treatments. Biofertilizer (azotobacter) was used both as a seed treatment (25 g/kg seed) and as a soil application (5 kg/ha with FYM) to enhance nitrogen fixation and promote plant growth. Organic amendments such as FYM and vermicompost were incorporated into the soil during land preparation. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The treatments were randomly assigned to different plots using the random number table of Fisher and Yates (1963). The list of treatments along with their symbols is presented in Table

**Table 2:** Treatments with their symbols

S. No.	Treatments	Symbol
1.	CONTROL	T1
2.	100% RDF	T2
3.	75% RDF	T3
4.	50% RDF	T4
5.	100% RDF + Azotobacter	T5
6.	75% RDF + 4t/ha FYM + Azotobacter	T6
7.	50% RDF + 8t/ha FYM + Azotobacter	T7
8.	75% RDF + 2t/ha Vermi compost + Azotobacter	T8
9.	50% RDF + 5t/ha Vermi compost + Azotobacter	T9
10.	10t/ha FYM + 5t/ha Vermi compost + Azotobacter	T10

**Table 3:** Details of experiment

Experimental design	Randomized Block Design
Replications	3
No. of treatments	10
Variety	Raj-3077
Row spacing	20
Total number of plot	10 x 3 = 30
Total Number of rows in plot	12
Plot size	3.6 m x 4.0 m = 14.4 m <sup>2</sup>
Season	Rabi 2024-25
Seed rate	100 kg/ha
Experimental Location	Agronomy Research Farm, Nirwan University, Jaipur

**Plant height (cm):** Plant height was observed at 30-day intervals and at harvest. The height was measured from the ground level to the apex of the main stem using a meter scale, with the average computed from five randomly chosen plants per treatment.

**Dry matter accumulation (g plant<sup>-1</sup>):** At each observation interval and at harvest, sample plants were collected, separated into different plant parts (leaves, stems, bulbs) and oven-dried at 70 ± 2°C until a constant weight was achieved. The results were

expressed in grams per plant to reflect dry matter accumulation.

**Plant density (m<sup>-2</sup>):** The number of plants per square meter was counted at 21 DAS and at crop maturity. The data were collected from randomly selected 1 m<sup>2</sup> quadrants in each plot to determine the plant population density.

**Leaf area index (LAI):** Leaf area index was estimated at 30-day intervals and at harvest. It was derived from the total leaf area per plant and the plant density using the formula (Watson, 1947):

$$\text{LAI} = \frac{\text{Leaf area per plant} \times \text{Plant population per m}^2}{\text{Ground area}}$$

Leaf area measurements were performed using a digital leaf area meter or estimated via standard methods.

**Days to 50% flowering:** The time taken from sowing to the stage when half of the plants in each plot initiated flowering was noted. This parameter is crucial for understanding flowering dynamics under different treatments and environmental settings.

**Days to 75% physiological maturity:** Physiological maturity was assessed based on the time required for 75% of the plants to reach maturity, indicated by visible signs such as yellowing of foliage or softening of the bulb neck. This stage marks the completion of nutrient translocation and dry matter accumulation in the plant.

**Number of spikes per m<sup>2</sup>:** Spikes were counted from a randomly selected 1 m<sup>2</sup> area within each plot to determine the spike population density. This metric is a direct indicator of effective tillering and reproductive success under given treatments.

**Number of grains per spike:** Grain number was calculated by randomly selecting ten spikes per plot and averaging the grain count per spike. This parameter reflects the reproductive efficiency and the sink capacity of the plant.

**Spike length (cm):** Spike length was measured using a scale from the base to the tip of the spike on randomly selected ten spikes per plot. Longer spikes often correlate with greater grain number and productivity.

**1000-Grain Weight (g):** The test weight was determined by weighing a random sample of 1000 grains using a precision electronic balance. It is an important grain quality trait that contributes to grain yield.

**Grain yield (q ha<sup>-1</sup>):** Grain yield was recorded from the net harvested area of each plot, adjusted to 12% moisture content and converted to quintals per hectare

(q ha<sup>-1</sup>). It reflects the overall effectiveness of agronomic practices.

## Result and Discussion

### Plant height

Table 4 shows that plant height was affected by different treatments at 30, 60, 90 DAS and at harvest. Application of 10 t/ha FYM + 5 t/ha Vermicompost + Azotobacter at 30 DAS (34.5 cm) was statically at par with 50% RDF + 5t/ha Vermi compost+ Azotobacter (33.6 cm) and 75% RDF + 2t/ha Vermi compost+ Azotobacter (30.5 cm) and remaining treatments. At 60 DAS, table 4 showed that 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter had the highest plant height (85.6 cm), followed by 150% RDF and 75% RDF + 2t/ha Vermi compost+ Azotobacter (76.5 cm) and the rest of the treatments. At 90 DAS, table 4 showed that 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter had the highest plant height (113.5 cm), followed by 150% RDF and 75% RDF + 2t/ha Vermi compost+ Azotobacter (98.3 cm) and the rest of the treatments. Data in table 4 showed that 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter increased plant height at harvest to 115.6 cm, followed by 150% RDF + 5t/ha Vermi compost+ Azotobacter (107.8 cm) and the rest of the treatments. Due to fertiliser addition, main nutrients (N, P and K) may increase plant height. The direct addition of nitrogen in the form of fertiliser in nutrient-deficient soil may increase the number of cells and cell size, resulting in better plant height. Jat *et al.* (2020), Chaudhary *et al.* (2023), Chauhan *et al.* (2022), Jain *et al.* (2021), Ramanandan *et al.* (2020) and Sahu *et al.* (2023) found similar results in wheat

### Dry matter accumulation (g plant)

Table 4 shows how treatments at 30, 60, 90 DAS and harvest affected dry matter accumulation. Data showed that 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter at 30 DAS (33.9 g) had the highest dry matter, followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter and 75% RDF + 2t/ha Vermi compost+ Azotobacter (30.7 g) and the remaining treatments. Table 4 shows that 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter had the highest dry matter (130.3 g) at 60 DAS, followed by 50% RDF and 75% RDF + 2t/ha Vermi compost+ Azotobacter (107.3 g) and the rest of the treatments. Table 4 shows that 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter had the highest dry matter (152.7 g) at 90 DAS, followed by 50% RDF and 75% RDF + 2t/ha Vermi compost+ Azotobacter (142.5 g) and the rest of the treatments. Table 4 shows that 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter had the highest dry matter

(152.8 g), followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter and 75% RDF + 2t/ha Vermi compost+ Azotobacter (142.9 g) and the rest of the treatments. Nitrogen boosts photosynthetic rate and plant glucose supply, which may have enhanced wheat dry matter output. Similar findings in wheat crop by Singh *et al.* (2019), Game *et al.* (2022), Jat *et al.* (2020), Chaudhary *et al.* (2023), Chauhan *et al.* (2022), Jain *et al.* (2021), Ramanandan *et al.* (2020), Sahu *et al.* (2023).

### Plant density (m<sup>-2</sup>)

Table 4 shows that nutrition treatments did not alter wheat plant density/m<sup>2</sup> throughout the 21 DAS. Table 4 shows that the various treatments have affected plant density/m<sup>2</sup>, but 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter had the highest DAS (49.2), followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter (45.5), 75% RDF + 2t/ha Vermi compost+ Azotobacter (43.6) and lowest in control. At maturity, plant density/m<sup>2</sup> was 10t/ha FYM + 5t/ha Vermi compost + Azotobacter (55.2), not affected by treatments, except for 50% RDF + 5t/ha Vermi compost + Azotobacter (54.5), 75% RDF + 2t/ha Vermi compost + Azotobacter (50.4) and lowest in control (Table 4). The present study's wheat crop results are similar to those of Chaudhary *et al.* (2023), Chauhan *et al.* (2022), Jain *et al.* (2021), Ramanandan *et al.* (2020).

### Leaf area index (LAI)

Table 4 shows leaf area index data from crop growth stages. Table 4 shows that different nutrition treatments raised leaf area index at 30 DAS. The treatment with the highest leaf area index (0.28) was 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter, followed by 50% RDF (0.27), 75% RDF (0.26) and control (0.26). At 60 DAS, fertiliser treatments gradually raised leaf area index. The treatment with the greatest leaf area index (2.32) was 10t/ha FYM + 5t/ha Vermi compost + Azotobacter, followed by 50% RDF (2.20), 75% RDF (2.09) and the control treatment (min. leaf area index). At 90 DAS, nutritional treatments gradually raised leaf area index. The maximum leaf area index (4.60) was obtained in 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter, followed by 50% RDF (4.42), 75% RDF + 2t/ha Vermi compost+ Azotobacter (4.41) and control treatment, respectively. Various nutrition treatments enhanced leaf area index at harvest. The maximum leaf area index (4.53) was obtained in 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter, followed by 50% RDF (4.49), 75% RDF + 2t/ha Vermi compost+ Azotobacter

(4.46) and control treatment, respectively. The results of this study match those of Vigneshvarraj *et al.* (2020), Chaudhary *et al.* (2023), Chauhan *et al.* (2022), Jain *et al.* (2021), Ramanandan *et al.* (2020) and Sahu *et al.* (2023) in wheat crop.

### Days to 50% flowering

Wheat flowering day was significantly affected by interventions. Day to blooming increased with crop advancement in Table 4 throughout the year. Nutrient treatments exhibited fewer days to blooming than controls throughout the year. The treatment with the lowest day to flowering was 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter (75.5), followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter (77.5) and 75% RDF + 2t/ha Vermi compost+ Azotobacter (78.4) and the control (89.5) had the highest. The results of this study match those of Vigneshvarraj *et al.* (2020), Chaudhary *et al.* (2023), Chauhan *et al.* (2022), Jain *et al.* (2021), Ramanandan *et al.* (2020) and Sahu *et al.* (2023) in wheat crop.

### Days to 75% physiological maturity

The interventions significantly affected wheat day to physiological maturity. Table 4 shows that crop advancement increased day to physiological maturity throughout the year. Data showed that nutrient-treated treatments had a shorter day to physiological maturity than controls during the year. Minimum day to physiological maturity was 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter (108.5), followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter (110.0) and 100% RDF (112.5) and maximum day to physiological maturity in control (139.5) during the year. The results of this study match those of Vigneshvarraj *et al.* (2020), Chaudhary *et al.* (2023), Chauhan *et al.* (2022), Jain *et al.* (2021), Ramanandan *et al.* (2020) and Sahu *et al.* (2023) in wheat crop.

### Number of spikes per m<sup>2</sup>

Nutrient management greatly affected surges throughout the year. Table 4 shows that spikes increased considerably between treatments compared to control. Maximum spike (70.5) was recorded with 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter, followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter (68.5) and 75% RDF + 2t/ha Vermi compost+ Azotobacter (68.0) during the year, substantially greater than the other treatments. Control spiked least (51.4). Organic manure and biofertilizers may improve wheat yield by providing sufficient plant nutrients throughout the growth period, leading to

better nutrient uptake, plant vigour and increased yield. Further inoculation of Azotobacter + PSB may have helped make nutrients available because it fixes nitrogen and phosphorus, increasing wheat production. Present study results match findings with Fazily *et al.* (2020), Jain *et al.* (2021), Ramanandan *et al.* (2020) and Sahu *et al.* (2023) in wheat.

### Number of grains per spike

The quantity of grains per spike was dramatically affected by different treatments throughout the year (see Table 4). Compared to control, wheat plants produced under different treatments had more grains per spike. In the year, 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter produced the most grains per spike (50.7), followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter (47.8) and 75% RDF + 2t/ha Vermi compost+ Azotobacter (47.4). Over the year, control had the fewest grains per spike (36.4). Inorganic nutrients organic manure and biofertilizers may improve wheat yield by providing enough plant nutrients throughout the crop's growth period, improving nutrient uptake, plant vigour and yield. Further inoculation of Azotobacter + PSB may have helped make nutrients available because it fixes nitrogen and phosphorus, increasing wheat production. Present study results match findings with Fazily *et al.* (2020), Jain *et al.* (2021), Ramanandan *et al.* (2020) and Sahu *et al.* (2023) in wheat.

### Spike length (cm)

Treatments significantly affected wheat spike length during the year. Table 4 showed that all treatments had longer spikes than controls during the year. Maximum spike length (12.4 cm) was achieved with 10t/ha FYM+ treatment. The study found that the shortest spike length (6.8 cm) was observed in the control group, followed by 50% RDF + 5t/ha Vermi compost+ Azotobacter (11.3 cm) and 75% RDF + 2t/ha Vermi compost + Azotobacter (11.3 cm) in the study year. Inorganic nutrients organic manure and biofertilizers may improve wheat yield by providing enough plant nutrients throughout the crop's growth period, improving nutrient uptake, plant vigour and yield. Further inoculation of Azotobacter + PSB may have helped make nutrients available because it fixes nitrogen and phosphorus, increasing wheat production. Present study results match findings with Fazily *et al.* (2020), Jain *et al.* (2021), Ramanandan *et al.* (2020) and Sahu *et al.* (2023) in wheat.

### 1000-Grain Weight (g)

Wheat test weight varied significantly between treatments during the year. Table 4 shows wheat test weight. Wheat grain test weight varied somewhat between treatments throughout the year. In 2024-25, the 1000-grain weight ranged from 34.8 to 41.2 g, with control being the lowest and 10t/ha FYM + 5t/ha Vermi compost+ Azotobacter (41.2 g) being the highest, followed by 50% RDF + 5t/ha Vermi Inorganic nutrients organic manure and biofertilizers may improve wheat yield by providing enough plant nutrients throughout the crop's growth period, improving nutrient uptake, plant vigour and yield. Further inoculation of Azotobacter + PSB may have helped make nutrients available because it fixes nitrogen and phosphorus, increasing wheat production. Present study results match findings with Kumar *et al.* (2020), Fazily (2021), Jain (2021), Chauhan (2022), Sahu (2023) and Kumar (2021) in wheat.

### Grain yield (q ha<sup>-1</sup>)

Treatments greatly affected wheat grain yield. Various treatments boosted grain yield over control. Table 4 shows that the 10t/ha FYM + 5t/ha Vermi compost + Azotobacter (45.9 q/ha) yielded the highest grain yield, followed by 50% RDF + 5t/ha Vermi compost + Azotobacter (43.3 q/ha) and 75% RDF + 2t/ha Vermi compost + Azotobacter (39.8 q/ha) during the years and the lowest grain yield in the control Azotobacter inoculation may have made nutrients available because it fixes nitrogen and phosphate, increasing wheat output. The present study's findings in wheat are similar to Singh and Kushwaha (2020), Jain *et al.* (2021), Chauhan *et al.* (2022), Sahu *et al.* (2023).

### Conclusion

The current field experiment proves that integrated nutrition management (INM) improves wheat development, phenology, yield characteristics and grain yield in semi-arid eastern Rajasthan. Combining organic manures, biofertilizers and less inorganic fertilisers worked better than using simply chemicals or no nutrients. The combination of 10 t ha<sup>-1</sup> FYM, 5 t ha<sup>-1</sup> vermicompost and Azotobacter outperformed other treatments in almost all growth and yield parameters. In subsequent growth, this treatment considerably increased plant height, dry matter accumulation, leaf area index and density. This indicates better plant growth and biomass. Organic nutrients were more accessible and delivered slowly, improving crop physiological efficiency. In addition,

Azotobacter biologically fixed nitrogen. Early flowering and physiological maturity under INM treatments indicated strong crop growth and nitrogen usage. Integrated nutrient treatments increased spikes per square metre, grains per spike, spike length and 1000-grain weight. This greatly increased grain production. FYM + vermicompost + Azotobacter treatment yielded the highest grain yield (45.9 q ha<sup>-1</sup>), indicating that using organic and biological inputs may result in more yield with less chemical fertiliser.

Mixing organic manures with 50–75% of the needed fertiliser yielded yields comparable to or better than 100% RDF. This proves that fertiliser savings don't impact yields. The study reveals that growing wheat with FYM, vermicompost, biofertilizers and less chemical fertilisers is long-term and cost-effective. This strategy boosts crop yield, grain quality, soil health and the longevity of semi-arid wheat-based farming systems.

**Table 4:** Quality and yield parameters of wheat in organic farming

Symbol	Plant Height (cm)				Dry matter accumulation (g/m <sup>2</sup> )				Plant Density (m <sup>2</sup> )		Leaf Area Index				Day to flowering (50%)	Day to physiological maturity (75%)	Number of spikes m <sup>2</sup>	Number of grains per spike	Spike length (cm)	1000-grain weight	Grain yield (q/ha)
	30 DAS	60 DAS	90 DAS	At Harvest	30 DAS	60 DAS	90 DAS	At Harvest	21 DAS	At Maturity	30 DAS	60 DAS	90 DAS	At Harvest							
<b>T1</b>	23.1	62.9	86.6	88.5	23.5	85.9	96.9	97.8	38.5	40.6	0.20	1.76	3.36	3.39	89.5	139.5	51.4	36.4	6.8	35.8	26.3
<b>T2</b>	27.8	66.3	80.8	93.3	25.8	104.1	124.4	125.3	42.0	47.9	0.23	1.93	3.91	3.98	85.5	112.5	56.5	41.2	9.0	36.9	35.4
<b>T3</b>	27.3	66.1	78.8	90.8	24.7	101.3	117.8	118.2	41.9	46.5	0.23	1.92	3.87	3.89	85.8	128.5	53.5	38.9	8.5	36.2	34.1
<b>T4</b>	26.3	65.8	77.3	90.3	24.3	98.2	101.4	102.3	41.3	45.5	0.21	1.88	3.78	3.82	88.5	135.0	51.8	37.2	7.9	35.9	32.3
<b>T5</b>	28.7	72.3	98.1	99.7	27.8	104.4	129.7	130.9	43.1	48.2	0.24	1.99	3.99	4.05	84.5	121.5	60.8	42.8	9.3	37.3	36.1
<b>T6</b>	30.1	71.1	99.3	101.1	27.3	105.3	135.3	135.8	42.7	48.6	0.25	2.00	4.03	4.11	80.5	117.5	63.4	43.2	10.2	37.8	37.3
<b>T7</b>	30.3	74.5	98.1	101.3	27.7	105.4	139.5	140.1	43.3	50.2	0.26	2.03	4.23	4.29	78.8	117.0	66.5	44.8	10.5	38.2	38.3
<b>T8</b>	30.5	76.5	98.3	107.8	30.7	107.3	142.5	142.9	43.6	50.4	0.26	2.09	4.41	4.46	78.4	113.5	68	47.4	11.1	38.4	39.8
<b>T9</b>	33.6	79.5	101.5	111.3	31.7	126.7	144.5	144.7	45.5	54.5	0.27	2.20	4.42	4.49	77.5	110.0	68.5	47.8	11.3	39.1	43.3
<b>T10</b>	34.5	85.6	113.5	115.6	33.9	130.3	152.7	152.8	49.2	55.2	0.28	2.32	4.60	4.53	75.5	108.5	70.5	50.7	12.4	39.5	45.9
<b>SEm (±)</b>	0.33	0.89	1.86	1.36	0.30	1.37	1.49	1.69	0.45	0.52	0.01	0.03	0.05	0.05	0.95	1.89	0.71	0.55	0.13	0.47	0.58
<b>C.D. (P=0.05)</b>	0.98	2.64	3.16	4.04	0.89	4.07	4.43	5.01	1.32	1.55	0.01	0.08	0.15	0.14	2.82	5.62	2.12	1.64	0.40	1.39	1.17

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