STUDIES ON THE UTILIZATION OF FERMENTED ORGANIC MANURE (FOM) IN FIELD AND VEGETABLE CROPS



CONSOLIDATED REPORT

Submitted to

Punjab Energy Development Agency

Chandigarh

SCHOOL OF ORGANIC AND NATURAL FARMING

PUNJAB AGRICULTURAL UNIVERSITY

LUDHIANA 141 004, PUNJAB

2026

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STUDIES ON THE UTILIZATION OF FERMENTED ORGANIC MANURE (FOM) IN FIELD AND VEGETABLE CROPS

(2026)

Project Title	**:**	**Studies on the utilization of fermented organic manure (FOM) in field and vegetable crops**
Objectives	**:**	**1. To evaluate the impact of FOM on the productivity and profitability of field and vegetable crops** **2. To assess the effect of FOM on soil health**
Date of Commencement	**:**	***Kharif* 2022**
Name of Institute	**:**	**Punjab Agricultural University, Ludhiana - 141004, Punjab, India**
Department	**:**	**School of Organic and Natural Farming, PAU, Ludhiana**
Report period	**:**	**June 2022-May 2026**
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Studies on the utilization of fermented organic manure (FOM) in field and vegetable crops

Fermented Organic Manure (FOM) is generated as a by-product of rice straw-based Bio-CNG plants and has the potential to serve as an important organic nutrient source for crop production. However, its agronomic effectiveness and long-term benefits need to be systematically evaluated across a wide range of field and vegetable crops. The utilization of crop residue-derived FOM aligns with the principles of sustainable agriculture by recycling nutrients removed through crop harvest back into the soil while maintaining ecological balance and reducing environmental pollution associated with crop residue disposal.

Despite its potential, information regarding the effects of different FOMs on crop productivity and soil health is limited and available only for a few crops, with results often being inconsistent and inconclusive. Therefore, a comprehensive assessment of FOM is required, involving its detailed characterization and extensive field evaluation under diverse cropping systems. Such studies will also help identify any nutrient deficiencies in FOM and determine the need for its fortification to enhance its nutrient composition and agronomic value.

Considering these aspects, the present investigations were undertaken to evaluate the effectiveness of FOM in major field and vegetable crops of Punjab with respect to crop productivity, economic viability, environmental sustainability, and soil health improvement. The study was designed to generate scientific information on the potential of FOM as a sustainable nutrient management option and to achieve the following quantifiable outcomes:

1. To evaluate the impact of FOM on the productivity of field and vegetable crops
2. To assess the effect of FOM on soil health

Table 1: Physio-chemical Profiling of FOM and FYM as per FCO

Macro Nutrients (%)	FOM				FYM				FCO LIMITS
	2022	2023	2024	2025	2022	2023	2024	2025	
Nitrogen (%)	0.40	1.32	1.21	1.51	0.51	0.46	0.58	0.64	≥ 0.5% (5000 mg/kg)
Phosphorous (%)	0.05	1.25	0.86	1.60	0.24	0.54	0.43	0.65	≥ 0.5% (5000 mg/kg)
Potassium (%)	1.10	2.30	3.35	3.05	0.50	0.96	0.85	1.12	≥ 0.5% (5000 mg/kg)

Experiment 1

Response of *kharif* maize-potato-summer moong cropping system to Fermented Organic Manure (FOM)

***Kharif* Maize**

The field experiment was conducted during the *kharif* seasons of 2022, 2023, 2024 and 2025 at the Research Farm, School of Organic and Natural Farming, Punjab Agricultural University, Ludhiana, Punjab (30°54′ N, 75°48′ E; 247 m above mean sea level). The experimental soil was loamy sand in texture with pH 7.2, electrical conductivity (EC) 0.30 dS m^{-1} and medium organic carbon content (0.50%). The available nitrogen, phosphorus and potassium contents of the soil were 288, 26.0 and 335.0 kg ha^{-1}, respectively.

Maize hybrid PMH 13 was sown during each *kharif* season using a seed rate of 25 kg ha^{-1} at a spacing of 60 cm × 20 cm. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications and the gross plot size of each treatment was 27 m^2 (6.0 m × 4.5 m). The crop was raised following the recommended package of practices of Punjab Agricultural University and harvested at maturity each year. The quantities of organic nutrient sources were calculated on a nitrogen-equivalent basis to meet the recommended nitrogen requirement of maize. The treatments involving PAU compost (100%), FYM (100%) + FOM (25%) and FYM (100%) + FOM (50%) were evaluated only during the first year and were discontinued thereafter. All other agronomic and plant protection practices were followed uniformly for all treatments throughout the experimental period. The experimental data recorded during the study were subjected to analysis of variance (ANOVA) following the procedure described by Cochran and Cox (1967). The significance of treatment effects was tested at the 5 per cent level of probability and treatment means were compared using the least significant difference (LSD) test.

Results

The grain yield of maize was significantly influenced by different nutrient management treatments during all the years of study (Table 2). During 2022, the highest grain yield (51.5 q ha^{-1}) was recorded with 100% RDF, which was statistically at par with RDF 100% + FOM 25% (51.0 q ha^{-1}), RDF 100% + FOM 50% (50.4 q ha^{-1}) and FOM 25% + RDF 75% (46.8 q ha^{-1}). Among the organic nutrient sources, 100% FYM recorded a higher grain yield (42.8 q ha^{-1}) than 100% PAU compost (35.8 q ha^{-1}) and 100% FOM (28.5 q ha^{-1}). The lowest grain yield (19.2 q ha^{-1}) was recorded under the unfertilized control. In 2023, RDF 100% + FOM 50% recorded the highest grain yield (54.6 q ha^{-1}), which was statistically at par with RDF 100% + FOM 25% (53.5 q ha^{-1}) and 100% RDF (52.2 q ha^{-1}). In contrast, the lowest grain yield (20.5

q ha^{-1}) was recorded under the unfertilized control. Similarly, during 2024, RDF 100% + FOM 50% produced the highest grain yield (56.2 q ha^{-1}), which was statistically at par with RDF 100% + FOM 25% (55.3 q ha^{-1}) and 100% RDF (54.6 q ha^{-1}). Whereas, the lowest grain yield (20.8 q ha^{-1}) was observed under the unfertilized control. During 2025, the highest grain yield (57.5 q ha^{-1}) was recorded with RDF 100% + FOM 25%, which was statistically at par with RDF 100% + FOM 50% (57.1 q ha^{-1}), RDF 100 % (53.6 q ha^{-1}), FYM 100% (52.6 q ha^{-1}) and FOM 25% + RDF 75% (52.2 q ha^{-1}). While, the lowest grain yield (19.5 q ha^{-1}) was recorded under the unfertilized control.

Table 2: Productivity of *kharif* maize as influenced by fermented organic manure (FOM)

Treatments	Grain yield (q ha^{-1})			
	2022	**2023**	**2024**	**2025**
FOM 100%	28.5	43.5	48.5	51.6
FYM 100%	42.8	46.5	49.4	52.6
PAU Compost 100%	35.8	-	-	-
RDF 100%	51.5	52.2	54.6	53.6
FOM 25% + RDF 75 %	46.8	49.2	50.6	52.2
FOM 50% + RDF 50 %	38.5	44.4	49.5	52.0
FOM 75% + RDF 25%	34.5	40.3	45.9	47.6
RDF 100% + FOM 25%	51.0	53.5	55.3	57.5
RDF 100% + FOM 50%	50.4	54.6	56.2	57.1
FYM 100% + FOM 25%	42.2	-	-	-
FYM 100% + FOM 50%	42.0	-	-	-
Unfertilized control	19.2	20.5	20.8	19.5
CD (p = 0.05)	5.7	5.2	4.9	5.4

Potato

A field experiment was conducted during the *rabi* seasons of 2022-23, 2023-24, 2024-25 and 2025-26 at the Research Farm, School of Organic and Natural Farming, Punjab Agricultural University, Ludhiana, Punjab, India (30°54′ N, 75°48′ E; 247 m above mean sea level). The experimental soil was loamy sand in texture with pH 7.2, electrical conductivity (EC) of 0.30 dS m^{-1} and medium organic carbon content (0.50%). The available nitrogen, phosphorus and potassium contents of the soil were 288, 26.0 and 335.0 kg ha^{-1}, respectively.

Potato variety Kufri Pukhraj was planted during each *rabi* season using a seed rate of 40 q ha^{-1} at a spacing of 60 cm × 20 cm. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The gross plot size of each treatment was 27 m^2 (6.0 m × 4.5 m). The crop was raised following the recommended package of practices of Punjab Agricultural University and harvested at maturity during each year. The quantities of organic nutrient sources were calculated on a nitrogen-equivalent basis to meet the recommended nitrogen requirement of potato. The treatments involving PAU compost (100%), FYM (100%) + FOM (25%) and FYM (100%) + FOM (50%) were evaluated only during the first year and were discontinued thereafter. All other treatments were continued throughout the study period. Standard agronomic and plant protection practices were followed uniformly for all treatments. The experimental data were subjected to analysis of variance (ANOVA) following the procedure described by Cochran and Cox (1967). The significance of treatment effects was tested at the 5 per cent level of probability and treatment means were compared using the least significant difference (LSD) test.

Results

The perusal of data presented in Table 3 revealed that the tuber yield of potato was significantly influenced by different nutrient management treatments during all the years of study. During 2022-23, the highest tuber yield (32.8 t ha^{-1}) was recorded under RDF 100% + FOM 50%, which was statistically at par with RDF 100% + FOM 25% (32.0 t ha^{-1}) and RDF 100% (31.7 t ha^{-1}). Among the organic nutrient sources, FYM 100% recorded significantly higher tuber yield (26.5 t ha^{-1}) than PAU compost 100% (22.1 t ha^{-1}) and FOM 100% (18.4 t ha^{-1}). In contrast, the lowest tuber yield (12.7 t ha^{-1}) was recorded under the unfertilized control. During 2023-24, RDF 100% + FOM 25% recorded the highest tuber yield (32.6 t ha^{-1}), which was statistically at par with RDF 100% + FOM 50% (32.5 t ha^{-1}), RDF 100% (32.4 t ha^{-1}) and FOM 25% + RDF 75% (29.3 t ha^{-1}). In contrast, the lowest tuber yield (13.4 t ha^{-1}) was recorded under the unfertilized control. Similarly, during 2024-25, RDF 100% + FOM 50% produced

the highest tuber yield (32.7 t ha^{-1}), which was statistically at par with RDF 100% + FOM 25% (32.4 t ha^{-1}), RDF 100% (32.0 t ha^{-1}), FYM 100% (30.1 t ha^{-1}) and FOM 25% + RDF 75% (30.0 t ha^{-1}). While, the lowest tuber yield (13.0 t ha^{-1}) was observed under the unfertilized control. During 2025-26, the highest tuber yield (33.5 t ha^{-1}) was recorded under RDF 100%, which was statistically at par with RDF 100% + FOM 50% (33.2 t ha^{-1}), RDF 100% + FOM 25% (33.0 t ha^{-1}), FYM 100% (31.6 t ha^{-1}) and FOM 25% + RDF 75% (31.3 t ha^{-1}). The lowest tuber yield (12.9 t ha^{-1}) was recorded under the unfertilized control.

Table 3: Productivity of potato as influenced by fermented organic manure (FOM)

Treatments	**Tuber yield (t ha^{-1})**			
	2022-23	**2023-24**	**2024-25**	**2025-26**
FOM 100%	18.4	23.5	26.5	29.4
FYM 100%	26.5	28.6	30.1	31.6
PAU Compost 100%	22.1	-	-	-
RDF 100% (Includes FYM 50 t/ha - PAU Recommendation)	31.7	32.4	32.0	33.5
FOM 25% + RDF 75%	28.6	29.3	30.0	31.3
FOM 50% + RDF 50%	22.0	24.0	24.5	27.8
FOM 75% + RDF 25%	20.8	22.8	23.2	25.5
RDF 100% + FOM 25%	32.0	32.6	32.4	33.0
RDF 100% + FOM 50%	32.8	32.5	32.7	33.2
FYM 100% + FOM 25%	27.6	-	-	-
FYM 100% + FOM 50%	28.2	-	-	-
Unfertilized control	12.7	13.4	13.0	12.9
CD (p=0.05)	**3.81**	**3.59**	**3.45**	**3.74**

Summer moong

A field experiment was conducted during the summer seasons of 2023, 2024, 2025 and 2026 at the Research Farm, School of Organic and Natural Farming, Punjab Agricultural University, Ludhiana, Punjab, India (30°54′ N, 75°48′ E; 247 m above mean sea level). The experimental soil was loamy sand in texture with pH 7.1, electrical conductivity (EC) of 0.32 dS m^{-1} and medium organic carbon content (0.50%). The available nitrogen, phosphorus and potassium contents of the soil at the commencement of the experiment were 288.0, 26.2 and 335.5 kg ha^{-1}, respectively.

Summer moong variety SML 1827 was sown during each summer season using a seed rate of 30 kg ha^{-1} at a row spacing of 22.5 cm. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The gross plot size of each treatment was 27 m² (6.0 m × 4.5 m). The crop was raised using standard agronomic and plant protection practices and harvested at physiological maturity. The nitrogen content of farmyard manure (FYM) and fermented organic manure (FOM) was considered for calculating the quantities of organic nutrient sources on a nitrogen-equivalent basis to meet the recommended nitrogen requirement of summer moong. All treatments were maintained throughout the study period. Recommended agronomic practices were followed uniformly in all the treatments. The data recorded during the course of investigation were subjected to statistical analysis following the procedure described by Cochran and Cox (1967). The significance of treatment effects was tested at the 5 per cent level of probability, and treatment means were compared using the least significant difference (LSD) test.

Results

The perusal of data presented in Table 4 revealed that the seed yield of summer moong was significantly influenced by different nutrient management treatments during all the years of study. During 2023, the highest seed yield (12.4 q ha^{-1}) was recorded under RDF 100% + FOM 50%, which was statistically at par with RDF 100% + FOM 25% (12.0 q ha^{-1}), FYM 100% (11.6 q ha^{-1}). While, the lowest seed yield (6.1 q ha^{-1}) was recorded under the unfertilized control. During 2024, RDF 100% + FOM 50% recorded the highest seed yield (13.4 q ha^{-1}), which was statistically at par with RDF 100% + FOM 25% (13.2 q ha^{-1}), FYM 100% (12.5 q ha^{-1}), FOM 50% + RDF 50% (12.5 q ha^{-1}). In contrast, the lowest seed yield (6.4 q ha^{-1}) was recorded under the unfertilized control. Similarly, during 2025, the highest seed yield (14.3 q ha^{-1}) was recorded under RDF 100% + FOM 25%, which was statistically at par with RDF 100% + FOM 50% (14.0 q ha^{-1}), RDF 100% (14.0 q ha^{-1}), FYM 100% (13.4 q ha^{-1}), FOM 25% + RDF 75% (13.1 q ha^{-1}) and FOM 50% + RDF 50% (13.0 q ha^{-1}). While, the lowest seed yield

(6.0 q ha^{-1}) was observed under the unfertilized control. During 2026, RDF 100% + FOM 50% recorded the highest seed yield (14.5 q ha^{-1}), which was statistically at par with RDF 100% + FOM 25% (14.0 q ha^{-1}) and RDF 100% (13.6 q ha^{-1}). While, the lowest seed yield (6.5 q ha^{-1}) was recorded under the unfertilized control.

Table 4: Productivity of summer moong as influenced by fermented organic manure (FOM)

Treatments	Seed Yield (q ha^{-1})			
	2023	**2024**	**2025**	**2026**
FOM 100%	9.3	11.6	12.0	12.5
FYM 100%	11.6	12.5	13.4	13.0
RDF 100%	11.0	12.0	14.0	13.6
FOM 25% + RDF 75%	10.6	11.8	13.1	13.0
FOM 50% + RDF 50%	10.2	12.5	13.0	13.4
FOM 75% + RDF 25%	9.8	12.2	12.6	12.6
RDF 100% + FOM 25%	12.0	13.2	14.3	14.0
RDF 100% + FOM 50%	12.4	13.4	14.0	14.5
Unfertilized control	6.1	6.4	6.0	6.5
CD (p = 0.05)	1.3	1.1	1.5	0.9

Soil health

The perusal of data presented in Table 5 revealed that different nutrient management treatments did not significantly influence soil organic carbon, available nitrogen, phosphorus and potassium contents after the completion of the *kharif* maize-potato-summer moong cropping system.

Numerically, the highest soil organic carbon content (0.468%) was recorded under FYM 100%, followed by FOM 100% (0.462%) and FOM 75% + RDF 25% (0.455%), whereas the lowest value (0.448%) was recorded under the unfertilized control. The highest available nitrogen content (272.4 kg ha^{-1}) was recorded under RDF 100% + FOM 25%, closely followed by RDF 100% + FOM 50% (272.0 kg ha^{-1}) and RDF 100% (270.1 kg ha^{-1}), while the lowest available nitrogen content (262.4 kg ha^{-1}) was recorded under the unfertilized control. The available phosphorus content varied from 18.0 to 21.2 kg ha^{-1}. The highest available phosphorus content (21.2 kg ha^{-1}) was recorded under 100% RDF, followed by FYM 100% (21.0 kg ha^{-1}), RDF 100% + FOM 25% (21.0 kg ha^{-1}) and RDF 100% + FOM 50% (21.0 kg ha^{-1}), whereas the lowest available phosphorus content (18.0 kg ha^{-1}) was recorded under the unfertilized control.

Similarly, the highest available potassium content (174.6 kg ha^{-1}) was recorded under RDF 100% + FOM 50%, followed by RDF 100% + FOM 25% (174.0 kg ha^{-1}) and RDF 100% (173.8 kg ha^{-1}). While, the lowest available potassium content (164.0 kg ha^{-1}) was observed under the unfertilized control.

Table 5: Soil health as influenced by fermented organic manure (FOM) in *kharif* maize-potato-summer moong cropping system (2025)

Treatments	OC (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
FOM 100%	**0.462**	263.6	20.4	168.0
FYM 100%	**0.468**	267.3	21.0	170.5
RDF 100%	0.451	270.1	21.2	173.8
FOM 25% + RDF 75%	0.450	268.8	19.6	173.0
FOM 50% + RDF 50%	0.453	266.5	19.5	173.2
FOM 75% + RDF 25%	0.455	266.0	19.5	170.0
RDF 100% + FOM 25%	0.451	272.4	21.0	174.0
RDF 100% + FOM 50%	0.451	272.0	21.0	174.6
Unfertilized control	0.448	262.4	18.0	164.0
CD (p = 0.05)	**NS**	**NS**	**NS**	**NS**
Initial Value	**0.449**	**260.5**	**18.4**	**165.4**

Experiment II

Response of rice-wheat cropping system to Fermented Organic Manure (FOM)

Rice

A field experiment was conducted during the *kharif* seasons of 2023, 2024 and 2025 at the Research Farm, School of Organic and Natural Farming, Punjab Agricultural University, Ludhiana, Punjab, India (30°54′ N, 75°48′ E; 247 m above mean sea level). The experimental soil was loamy sand in texture with pH 7.1, electrical conductivity (EC) of 0.32 dS m^{-1} and medium organic carbon content (0.50%). The available nitrogen, phosphorus and potassium contents of the soil at the initiation of the experiment were 289.2, 26.8 and 339.5 kg ha^{-1}, respectively.

Rice variety PR 126 was raised in a nursery and transplanted during each *kharif* season at a spacing of 20 cm × 15 cm. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The gross plot size of each treatment was 27 m^2 (6.0 m × 4.5 m). The crop was raised following the recommended package of practices of Punjab Agricultural University and harvested at physiological maturity during each year. The quantities of FYM and FOM required for different treatments were calculated on a nitrogen-equivalent basis to meet the recommended nitrogen requirement of rice as per the Punjab Agricultural University package of practices. Recommended agronomic and plant protection practices were followed uniformly in all the treatments. The data recorded during the course of investigation were subjected to analysis of variance (ANOVA) following the procedure described by Cochran and Cox (1967). The significance of treatment effects was tested at the 5 per cent level of probability and treatment means were compared using the least significant difference (LSD) test.

Results

The grain yield of paddy was significantly influenced by different nutrient management treatments during all the years of study (Table 6). During 2023, the highest grain yield (74.5 q ha^{-1}) was recorded under RDF 100% + FOM 25%, which was statistically at par with RDF 100% + FOM 50% (74.0 q ha^{-1}) and RDF 100% (73.5 q ha^{-1}). Among the organic nutrient sources, FYM 100% recorded a significantly higher grain yield (53.5 q ha^{-1}) than FOM 100% (40.6 q ha^{-1}). The lowest grain yield (25.6 q ha^{-1}) was recorded under the unfertilized control. During 2024, the highest grain yield (76.0 q ha^{-1}) was recorded under RDF 100% + FOM 50%, which was statistically at par with RDF 100% + FOM 25% (75.0 q ha^{-1}) and RDF 100% (74.0 q ha^{-1}). While, the lowest grain yield (24.2 q ha^{-1}) was recorded under the unfertilized control.

Similarly, during 2025, the highest grain yield (76.9 q ha^{-1}) was recorded under RDF 100% + FOM 50%, which was statistically at par with RDF 100% + FOM 25% (76.4 q ha^{-1}), RDF 100% (75.6 q ha^{-1}) 100% RDF (75.6 q ha^{-1}) and FOM 25% + RDF 75% (73.4 q ha^{-1}). While, the lowest grain yield (23.5 q ha^{-1}) was recorded under the unfertilized control.

Table 6: Productivity of paddy as influenced by fermented organic manure (FOM)

Treatments	Grain Yield (q ha^{-1})		
	2023	2024	2025
FOM 100%	40.6	50.5	58.5
FYM 100%	53.5	57.0	65.5
RDF 100%	73.5	74.0	75.6
FOM 25% + RDF 75%	67.0	71.3	73.4
FOM 50% + RDF 50%	60.4	62.5	67.2
FOM 75% + RDF 25%	52.3	55.5	60.4
RDF 100% + FOM 25%	74.5	75.0	76.4
RDF 100% + FOM 50%	74.0	76.0	76.9
Unfertilized control	25.6	24.2	23.5
CD (p = 0.05)	3.8	4.1	3.6

Wheat

A field experiment was conducted during the *rabi* seasons of 2022-23, 2023-24, 2024-25 and 2025-26 at the Research Farm, School of Organic and Natural Farming, Punjab Agricultural University, Ludhiana, Punjab, India (30°54′ N, 75°48′ E; 247 m above mean sea level). The experimental soil was loamy sand in texture with pH 7.1, electrical conductivity (EC) of 0.32 dS m^{-1} and medium organic carbon content (0.50%). The available nitrogen, phosphorus and potassium contents of the soil at the initiation of the experiment were 289.2, 26.8 and 339.5 kg ha^{-1}, respectively.

Wheat variety Unnat PBW 550 was sown during each *rabi* season using the recommended seed rate and agronomic practices of Punjab Agricultural University. The crop was sown at a row spacing of 22.5 cm. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The gross plot size of each treatment was 27 m^2 (6.0 m × 4.5 m). The crop was harvested at physiological maturity during each year. The nitrogen content of farmyard manure (FYM) and fermented organic manure (FOM) was determined and the quantities of organic nutrient sources required for different treatments were calculated on a

nitrogen-equivalent basis to supply the recommended dose of nitrogen to wheat as per the Punjab Agricultural University Package of Practices. Recommended agronomic and plant protection practices were followed uniformly in all the treatments throughout the crop-growing period. The data recorded during the course of investigation were subjected to analysis of variance (ANOVA) following the procedure described by Cochran and Cox (1967). The significance of treatment effects was tested at the 5 per cent level of probability and treatment means were compared using the least significant difference (LSD) test.

Results

Grain yield

The perusal of data presented in Table 7 revealed that the grain yield of wheat was significantly influenced by different nutrient management treatments during all the years of study. During 2022-23, the highest grain yield (54.8 q ha^{-1}) was recorded under RDF 100% + FOM 50%, which was statistically at par with RDF 100% + FOM 25% (54.0 q ha^{-1}) and RDF 100% (53.5 q ha^{-1}). The lowest grain yield (20.5 q ha^{-1}) was recorded under the unfertilized control. During 2023-24, the highest grain yield (55.6 q ha^{-1}) was recorded under RDF 100% + FOM 50%, which was statistically at par with RDF 100% + FOM 25% (55.1 q ha^{-1}) and RDF 100% (54.1 q ha^{-1}). The lowest grain yield (19.5 q ha^{-1}) was recorded under the unfertilized control. Similarly, during 2024-25, the highest grain yield (55.0 q ha^{-1}) was recorded under RDF 100% + FOM 50%, which was statistically at par with RDF 100% + FOM 25% (54.7 q ha^{-1}), RDF 100% (54.5 q ha^{-1}) and FOM 25% + RDF 75% (53.2 q ha^{-1}). The lowest grain yield (21.5 q ha^{-1}) was recorded under the unfertilized control. During 2025-26, the highest grain yield (55.6 q ha^{-1}) was recorded under RDF 100% + FOM 25%, which was statistically at par with RDF 100% + FOM 50% (55.4 q ha^{-1}), RDF 100% (55.0 q ha^{-1}), FOM 25% + RDF 75% (54.0 q ha^{-1}), FOM 50% + RDF 50% (53.1 q ha^{-1}), FYM 100% (53.0 q ha^{-1}) and FOM 75% + RDF 25% (52.6 q ha^{-1}) and 100% FOM (52.2 q ha^{-1}). While, the lowest grain yield (22.6 q ha^{-1}) was recorded under the unfertilized control.

Table 7: Productivity of wheat as influenced by fermented organic manure (FOM)

Treatments	Grain Yield (q ha^{-1})			
	2022-23	2023-24	2024-25	2025-26
FOM 100%	29.5	42.5	46.7	52.2
FYM 100%	43.5	46.0	47.3	53.0
RDF 100%	53.5	54.1	54.5	55.0
FOM 25% + RDF 75%	47.3	49.5	53.2	54.0
FOM 50% + RDF 50%	41.5	45.8	48.5	53.1
FOM 75% + RDF 25%	35.6	43.3	47.6	52.6
RDF 100% + FOM 25%	54.0	55.1	54.7	55.6
RDF 100% + FOM 50%	54.8	55.6	55.0	55.4
Unfertilized control	20.5	19.5	21.5	22.6
CD (p = 0.05)	4.5	4.7	4.1	4.3

Soil health

The perusal of data presented in Table 8 revealed that different nutrient management treatments did not significantly influence soil organic carbon, available nitrogen, phosphorus and potassium status after completion of the rice-wheat cropping system. However, numerical variations among treatments were observed. Soil organic carbon content varied from 0.430 to 0.445 per cent, with the highest value recorded under FYM 100% (0.445%) followed by FOM 100% (0.441%), while the lowest value (0.430%) was observed under FOM 75% + RDF 25% and the unfertilized control. The available nitrogen content ranged from 245.0 to 260.4 kg ha^{-1}, with the highest recorded under RDF 100% + FOM 50% (260.4 kg ha^{-1}), followed by RDF 100% + FOM 25% (258.5 kg ha^{-1}) and RDF 100% (256.2 kg ha^{-1}), whereas the lowest value was recorded under the unfertilized control (245.0 kg ha^{-1}). Similarly, the available phosphorus content ranged from 16.8 to 20.8 kg ha^{-1}, with the highest value recorded under RDF 100% + FOM 50% (20.8 kg ha^{-1}), followed by RDF 100% + FOM 25% (20.5 kg ha^{-1}) and RDF 100% (20.1 kg ha^{-1}), whereas the lowest value was observed under the unfertilized control (16.8 kg ha^{-1}). Available potassium content varied from 160.0 to 173.0 kg ha^{-1}, with the highest recorded under RDF 100% + FOM 50% (173.0 kg ha^{-1}), followed by RDF 100% + FOM 25% (172.6 kg ha^{-1}) and RDF 100% (170.6 kg ha^{-1}), while the lowest was recorded under the unfertilized control (160.0 kg ha^{-1}). Although numerical differences were observed among the treatments, the variations were statistically non-significant.

Table 8: Soil health as influenced by fermented organic manure (FOM) in rice-wheat cropping system (2025)

Treatments	OC (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
FOM 100%	0.441	247.3	18.6	164.0
FYM 100%	0.445	250.2	19.4	167.4
RDF 100%	0.434	256.2	20.1	170.6
FOM 25% + RDF 75%	0.435	253.0	19.5	169.8
FOM 50% + RDF 50%	0.435	252.5	19.2	170.0
FOM 75% + RDF 25%	0.430	252.0	18.7	169.0
RDF 100% + FOM 25%	0.436	258.5	20.5	172.6
RDF 100% + FOM 50%	0.435	260.4	20.8	173.0
Unfertilized control	0.430	245.0	16.8	160.0
CD (p = 0.05)	**NS**	**NS**	**NS**	**NS**
Initial Value	**0.432**	**245.5**	**17.5**	**160.6**

Conclusion

Complete replacement of chemical fertilizers with Fermented Organic Manure (FOM) did not achieve crop yields comparable to those obtained with the recommended dose of chemical fertilizers (RDF) in *kharif* maize, potato, summer moong, rice, and wheat. However, substituting 25% of the recommended chemical fertilizer dose with FOM produced crop yields comparable to 100% RDF by the fourth year of the experiment in *kharif* maize, potato, summer moong, and wheat. In addition, the additional application of FOM along with the recommended dose of chemical fertilizers consistently improved crop productivity across all the evaluated crops. As FOM serves as an organic nutrient source, its long-term influence on crop productivity and soil health warrants further investigation through extended field studies. Moreover, the application of FOM should comply with the latest specifications and quality standards prescribed under the Fertilizer Control Order (FCO).

7/7/26

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