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Effect of Organic Input Sources on Quality and Quantity of Finger Millet Production under Natural Farming

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A study was conducted at Agronomy research farm, Faculty of Agriculture, Wadura, Sher- e-Kashmir university of Agriculture sciences & Technology, Effect of Organic input sources on quality and quantity of Finger millet production under Natural farming practices. The field experiment was laid out in split-plot design with 16 treatments replicated thrice. The treatment comprised main plot treatments (soil application) FYM 10 t/ha, Vermicompost 5 t/ha, Poultry manure 3 t/ha, sheep manure 3 t/ha and Sub plot treatment (foliar application) which sprays interval of spray after every 21 days till flowering 3% panchgavya, 10% Vermi-wash Panchgavya, 10% jeevamrithum and, 3%RLB. In this experiment, RLB is my self- made bio-liquid fertilizer which consist of kitchen waste, cow products and medicinal plants also works as bio-pesticide and bio-insecticide. The application of sheep manure 3 t/ha and RLB 3% significantly enhanced effective number of tillers per meter square, Finger length, Finger weight/ shoot, test weight, Grain yield and Straw yield. It also

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increased protein (%), crude fiber (%) and carbohydrate significantly through foliar application. These research findings can assist growers in achieving better and more sustainable finger millet production, thereby enhancing its accessibility among end-users due to its organic cultivation.

Keywords: Organic manure; finger millet; FYM; vermicompost; poultry manure; sheep manure; Panchgavya; vermi-wash; Jeevamrutha; RLB.

1. INTRODUCTION

"Millets are minor cereal of the grass family, Poaceae. Finger millet (*Eleusine coracana*(L).) Gaertn), distinguished by its high productivity and rapid nutrient provision, stands out among millets. Native to India, it is locally Known as Ragi or Bavto, named after its seed head resembling human fingers. In the global scenario, the total area under finger millet production is 4-4.5 million and total production of 5 million tons of grain" (ICRISAT, 2024). "In India, it is cultivated in an area of 1.1 million hectares with the production of 1.6 million tonnes giving an average productivity of 1.5 tonnes per hectare (GOI, 2023). Finger millet is cultivated primarily as grain crops on marginal lands in dry areas in temperate, subtropical and tropical regions. It is highly nutritious crop with is composition of protein (7.3%), Fat (1.3%), Carbohydrate (7.26%), dietary fiber (18%), ash (3.0%), Calcium (325mg/100) and leucine, 594 mg $g^{-1}$of protein" (Shobana et al., 2013). "Finger Millet is considered as wholesome food for diabetic patients. Grain may also be malted and flour of the malted grain is used as cake or porridge and a nourishing food for infants and invalids. Finger Millet is an important crop for drought prone regions because of its outstanding ability to withstand adverse weather condition and grow in marginal and poor soils"

"Intensive cultivation unbalanced and inadequate fertilizers with restricted use of organic manures have made soil deficient in nutrients and health therefore organic farming is gaining importance which mainly involves the use of on- farm resources largely avoiding the utilization of chemical fertilizers. Liquid and solid manures having higher number of beneficial microbes, macro and micro nutrients, essential amino acids, growth parameters substance like IAA, GA may greatly help in increasing soil microbial population and soil fertility further increasing the crop growth, yield and quality" (Sreenivas et al*.,* 2012)

"Globally organic agriculture is practiced in over 24 million hectares. General acceptance of organic farming is not only due to greater demand for pollution free food but also due to natural advantage of organic farming in supporting the sustainability in agriculture. Organic manure not only supply a higher amount of different nutrient elements but also contains beneficial microbes like nitrogen fixing bacteria, mycorrhiza and growth promoting substances for betterment of crops, such as FYM, Vermicompost, Poultry manure and sheep manure" (Barik et al*.,* 2006).

"Apart from sign conventional farm- based products there is an increasing demand for organic liquid formulations like Panchgavya, jeevamrutha and vermiwash which help in quick buildup of soil fertility through enhanced activity of soil microflora and fauna. Panchgavya is a mixture of five cow products such as cow dung, cow urine, milk, ghee and curd in proper ratio (5:3:2:2:1) to which banana, jaggery, and coconut water possess. Panchgavya has the ability to stimulate growth and increase immunity of a plant. Vermi-wash, a liquid vermicompost extract, contains micro and macronutrients, plant growth hormones, enzymes, and vitamins, promoting plant growth and productivity. Jeevamrutha, an organic liquid manure with beneficial bacteria, serves as a source of nitrogen, phosphorous, potassium and natural carbon (Sreenivasa et al., 2012). I also use a self -made biofertilizer which is also works as biopesticides named as RLB. It consists kitchen waste, cow products and medicinal plants. Which provides nutrients to plants and protects the plants from pests and disease. Kitchen waste is sustainable practice that converts organic hose hold scraps into nutrient rich compost. Here, Kitchen waste included fruit and vegetable peels, while meat and Dairy is avoided. Fermentation is used for make bio- liquid fertilizer which is good source of macronutrients"

2. MATERIALS AND METHODS

A field experiment was conducted at Agronomy research farm, Faculty of Agriculture, Wadura, Sher-e- Agriculture, wadura, Sher-e- Kashmir university of agriculture sciences and technology, during the kharif 2023 and 2024 where finger millet variety VL 372 was cultivated with natural

farming practices. The experiment was laid out in Split-plot design with 16 treatments replicated three time. The treatment comprised with four main plot treatments (soil application) FYM 10 t/ha, Vermicompost 5 t/ha, Sheep and poultry manure 3 t/ha each and four sub plot treatments (foliar application) Panchgavya 3%, Jeevamrithum and Vermi-wash 10% each, 3% RLB sprays at 21 days interval. RLB is a self-made liquid bio-fertilizer which also work as bio-pesticide. The soil of the experimental field was clay loam with soil pH 6.86, high in organic content (0.70%), available N (293.31 Kg/ha), available P (18.61 Kg/ha), available K (197.49Kg/ha). The total microbial count of the experimental field was Bacterial count 1.1×10^8 cfu, Actinomycetes count 102×10^6, Fungal count 3.6× 10cfu, Phosphate solubilizing bacterial count 1.52×10^6 and count of Nitrogen fixing bacteria (cfu) 2.25×10^7. The data generated were statistically using analysis of variance technique (ANOVA), as applied to Split-plot design (Gomez & Gomez, 1976).

3. RESULTS AND DISCUSSION

3.1 Quality Parameter of Finger Millet

In this study observed that no significant effect on the quality parameters of finger millet such as. Protein (%), Ash (%), Crude fiber (%) and carbohydrate (%) with application of organic manure. However, protein (7.90%, 10.90%) in 2023 and 2024, crude fiber (4.20 %, 4.21 %) in 2023 and 2024, Carbohydrate (72.96%,72.06) in 2023 and 2024 recorded significantly higher value with application of 3% RLB and 3% panchgavya. Only protein (%), crude fiber (%) and carbohydrate (%) had got significant result in this study. Bio- liquid manures can improve finger millet quality by increasing protein content, micronutrients and overall yield. Application of certain bio-liquid manure can lead to significant increase in protein content, crude fiber and carbohydrate. This study shows that using Panchgavy, especially in combination with other organic supplements like poultry manure, leads to higher grain protein and overall improved crop performance. Panchgavya foliar spray activates the plant photosynthesis system, leading to greater biological efficiency and the production of more metabolites. RLB consist kitchen waste, cow urine and medicinal plants which is good source of NPK and having antifungal properties leads to good quality of Finger millet. Similarly, quality parameter viz., iron, calcium and protein content of finger millet (4.86, 3.43 mg 100 gs^{-1}) with the application of EBDLM at 25 kg N equivalent ha^{-1}+ 3 sprays of PG at 3% is superior as compare to other treatment. Protein percentage was not significantly influenced by application of different bio digested liquid manures. But higher protein content and yield with the application of EDBLM@ 50 kg N equi. ha^{-1}+ PG spray @ 3% and jeevamrutha @ 50 kg N equi. ha^{-1} + VW spray @ 3% and jeevamrutha @ 50 kg N equi. ha^{-1}+PG spray@ 3% might be due to increased availability of nutrients particularly nitrogen which is an integral part of protein. (Ananda et al*.,* 2017).

3.2 Yield and Yield Attributes of Finger Millet

The result of the study revealed that organic inputs natural farming had significant effect on the yield and yield attributes of finger millet. The effect of organic inputs natural farming on finger length and finger weight/shoot was significant. The effective shoot/m^2 and Test weight was also increased significantly. The application of observed significant. Sheep manure 3 t/ha observed has highest observation in finger length (5.86 cm) in 2023 and (6.00 cm) in 2024, Finger weight/shoot (6.33 g) in 2023 and (6.56 g) in 2024, and Effective shoot/m^2(118.86) and (121.99), Test weight (3.51 g) and (3.60 g). Sheep manure positively affects soil by improving its physical and chemical properties such as increasing soil organic matter and cation exchange capacity, which in turns enhances nutrient retention. It also boosts soil health by supporting beneficial microorganisms, reducing, soil acidity, and improving nutrient availability for plants, leading to benefits like increased crop yield and quality. Whereas application of whereas RLB 3% had highest observation in finger length (5.89 cm) in 2023 and (6.04 cm) in 2024, Finger weight/ shoot (7.72g) in 2023 and (7.91g) in 2024, Effective shoot/m^2 (11.93) in 2023 and (127.92) in 2024, Test weight (3.43 g) in 2023 and (3.55g) in 2024. RLB is liquid organic fertilizers made from kitchen waste are effective for improving plant growth, i0ncrease crop yield and improved plant physiology, kitchen waste is a rich source of macronutrients like NPK. In RLB also use medicinal plants and cow urine. Which also increase the nitrogen content in plant and also work as pesticide and larvicide to protect the plant leads to improve the health of plants. It contrasts, composting offers an environment friendly and practical solution by transforming kitchen waste into nutrient- rich compost, often referred to as soil gold, due to its

beneficial properties for soil health and plant growth. Similarly, at harvest maximum no of fingers per plant (5.49) recorded with application of sheep manure@ 2t/ha+ Azosprillium + PSB (seed inoculation @ 25 g/kg) which was statically at par with the application of FYM 10 t/ ha + Azosprillium + PSB (seed inoculation @ 25g/kg) (5.22) and poultry manure 2 t/ha + Azosprillium + PSB (Seed inoculation @ 25g/kg) (5.45) (Reddy et al., 2021).

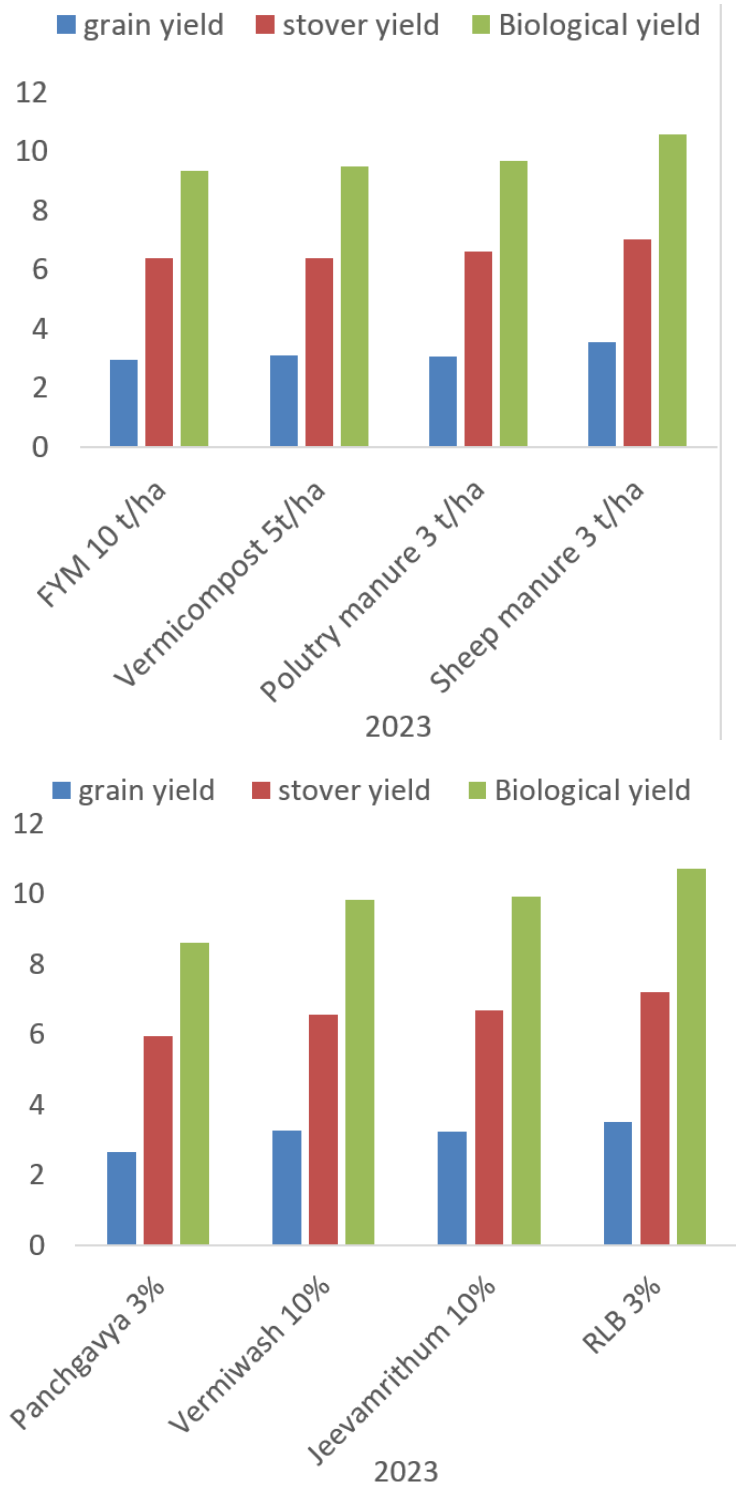

Fig. 1. Effect of organic input under natural farming practices in grain yield, stover yield and biological yield in 2023

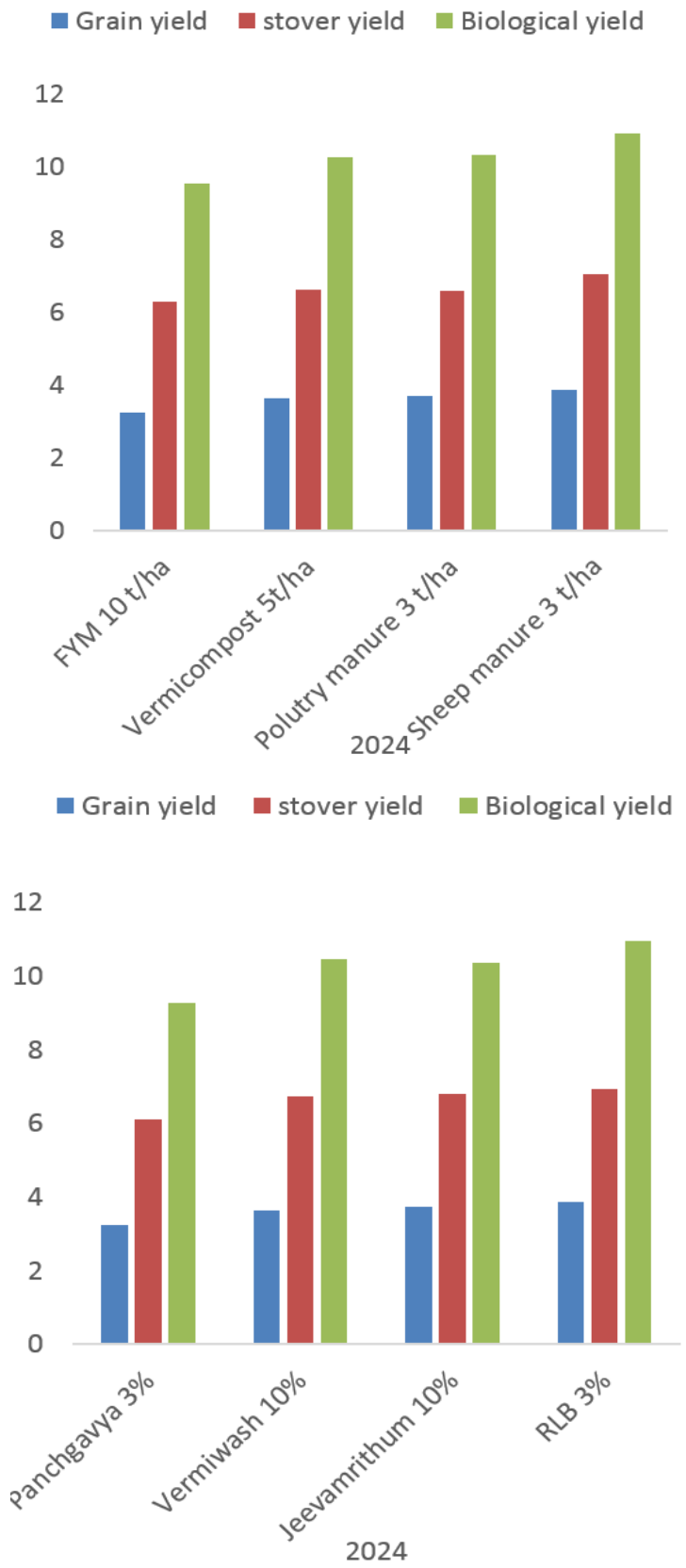

Fig. 2. Effect of organic input under natural farming practices in grain yield, stover yield, biological yield in 2024

Table 1. Quality parameter of finger millet influenced by organic inputs under natural farming practices in 2023 and 2024

Treatments	Protein (%)		Ash (%)		Crude fiber (%)		Carbohydrate (%)	
	2023	2024	2023	2024	2023	2024	2023	2024
Main plot treatment (Soil application)								
FYM 10t/ha	7.54	7.66	2.72	2.76	4.03	4.06	71.32	71.10
Vermicompost 5t/ha	7.69	7.84	2.75	2.80	4.01	4.00	71.64	71.04
Poultry manure 3t/ha	7.85	8.04	2.77	2.80	3.93	3.97	71.14	71.36
Sheep manure 3t/ha	7.80	7.97	2.78	2.85	3.99	4.00	71.93	71.14
S. Ed. (±)	0.11	0.12	0.03	0.03	0.05	0.05	0.54	0.51
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS
Sub plots treatment (Foliar application)								
3% Panchgavay	7.67	9.28	2.72	2.79	3.76	3.78	72.69	72.06
10% Vermiwash	7.57	10.48	2.72	2.79	4.09	4.13	71.85	71.35
10% Jeevamrithum	7.76	10.36	2.77	2.81	3.89	3.92	71.54	71.30
3% RLB	7.90	10.95	2.81	2.84	4.20	4.21	69.96	69.93
S. Ed. (±)	0.07	0.08	0.03	0.03	0.06	0.05	0.72	0.52
C.D. at 5 %	0.21	0.24	NS	NS	0.19	0.16	2.10	1.50

Table 2. Yield attributes of finger millet influenced by organic inputs under natural farming practices in 2023 and 2024

Treatments	Finger length(cm)		Finger weight/shoot(g)		Effective shoot/m^2		Test weight(g)	
	2023	2024	2023	2024	2023	2024	2023	2024
Main plot (Soil application)								
FYM 10t/ha	5.62	5.87	5.75	5.85	108.28	110.43	3.16	3.38
Vermicompost 5t/ha	5.59	5.77	6.48	6.65	117.00	124.28	3.17	3.39
Poultry manure 3t/ha	5.79	5.95	5.99	6.16	114.05	116.29	3.34	3.49
Sheep manure 3t/ha	5.86	6.00	6.33	6.56	118.86	121.99	3.51	3.60
S. Ed. (±)	0.05	0.03	0.04	0.104	1.41	1.41	0.07	0.04
C.D. at 5 %	0.19	0.12	0.13	0.360	4.87	4.88	0.23	0.12
Sub plot treatment (Foliar application)								

Treatments	Finger length(cm)		Finger weight/shoot(g)		Effective shoot/m^2		Test weight(g)	
	2023	2024	2023	2024	2023	2024	2023	2024
3% Panchgavay	5.60	5.81	5.44	5.60	106.16	109.01	3.23	3.44
10% Vermiwash	5.62	5.83	6.17	6.31	116.14	117.43	3.22	3.40
10% Jeevamrithum	5.76	5.91	6.23	6.39	115.96	118.62	3.30	3.47
3% RLB	5.89	6.04	7.72	7.91	119.93	127.92	3.43	3.55
S. Ed. (±)	0.03	0.03	0.05	0.134	2.36	2.76	0.05	0.02
C.D. at 5 %	0.09	0.10	0.15	0.392s	6.89	8.05	0.16	0.06

Table 3. Yield parameter of finger millet influenced by organic input under natural farming practices in 2023 and 2024

Treatments	Grain yield (t/ha)		Straw yield(t/ha)		Biological yield(t/ha)		Harvest index	
	2023	2024	2023	2024	2023	2024	2023	2024
Main plot treatment (Soil application)								
FYM 10t/ha	2.95	3.25	6.38	6.31	9.33	9.56	31.33	33.58
Vermicompost 5t/ha	3.10	3.63	6.39	6.63	9.49	10.26	32.57	35.38
Poultry manure 3t/ha	3.08	3.72	6.62	6.61	9.70	10.33	31.59	35.76
Sheep manure 3t/ha	3.55	3.87	7.04	7.06	10.59	10.93	33.50	35.29
S. Ed. (±)	0.09	0.09	0.08	0.05	0.15	0.14	0.45	0.52
C.D. at 5 %	0.31	0.32	0.26	0.19	0.52	0.48	1.56	NS
Sub plot treatment (Foliar application)								
3% Panchgavay	2.66	3.16	5.96	6.12	8.62	9.28	30.56	33.58
10% Vermiwash	3.26	3.73	6.56	6.75	9.82	10.48	33.23	35.49
10% Jeevamrithum	3.24	3.57	6.70	6.79	9.94	10.36	32.55	34.40
3% RLB	3.51	4.01	7.22	6.94	10.73	10.95	32.64	36.55
S. Ed. (±)	0.08	0.14	0.12	0.14	0.18	0.28	0.46	0.57
C.D. at 5 %	0.24	0.41	0.34	0.42	0.52	0.81	1.33	1.65

Grain yield and straw yield were superior for finger millet treated with sheep manure 3 t/ha and RLB 3%. The highest grain yield (3.55 t/ha) and (3.87t/ha) in sheep manure 3 t/ha in 2023 and 2024 Where as in sub plot treatment RLB consist highest Grain yield (3.51 t/ha) and (4.04 t/ha) in 2023 and 2024. Also, highest straw yield recorded in sheep manure 3t /ha (7.04t/ha) and (7.06 t/ha) in 2023 and 2024 or (7.22t/ha) and (6.99t/ha) in 2023 and 2024 was highest recorded in 3 % RLB in 2023 and 2024. Sheep manure improves soil structure, aeration, moisture retention has direct impact on crop yield. RLB consist of Kitchen waste, cow urine and other medicinal plants, kitchen waste is a good source of NPK leads to good grain and straw yield. Similarly, 40× 10cm+ Vermicompost 5t/ha no of grain yield (2.79) and 40× 10 cm + sheep manure 2 t/ha no of grains yield (2.61) is statically par with treatment 40×10 cm + poultry manure 2t/ha. But 40×10 cm + poultry manure 2t/ha is superior in straw yield as compared to 40×10 cm+ vermicompost and 40×10 cm+ sheep manure (Kushwaha et al., 2024).

4. CONCLUSION

The conclusive studies of two years conducted on finger millet revealed that when finger millet was broadcasted with the application of Sheep manure at the time of sowing and foliar spray of RLB at 21 days interval resulted in significantly higher grain yield. In organic cultivation of finger millet sheep manure 3t/ha and 3% RLB produces higher grain yield and good quality of finger millet as compare to other factors of organic input. Finger millet responds positively to Organic input enhancing yield, grain quality, soil health and ecosystem sustainability. Given that the results are derived from a two-season's worth of research. To confirm a more accurate result, more trials are required.

5. FUTURE SCOPE

The future of agriculture may experience a transition towards these organic and bio-nutrient management practices, promoting a more sustainable and eco-friendly method of growing crops. Farmers may experience higher net returns by implementing these methods, promoting wider use of organic and bio-based fertilizers. Such methods enhance soil fertility and preserve soil health over the long term.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-s interests or personal relationships that could have appeared to influence the work reported in this paper.

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