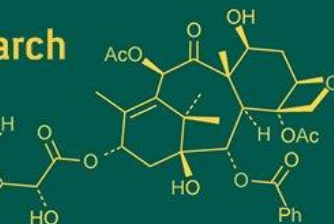
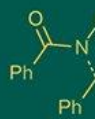


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Impact of jeevamrit and beejamrit application on growth, yield attributes of Indian mustard

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Abstract

This field experiment investigated the effects of natural farming on Indian mustard during the *rabi* season of 2024-25 at the Agricultural Research Farm, Institute of Agriculture and Natural Sciences, Deen Dayal Upadhyay Gorakhpur University, Uttar Pradesh. The objective was to evaluate the impact of natural farming practices-specifically Jeevamrit, Ghanjeevamrit, and mulching on mustard growth, soil health, nutrient availability and economic viability. The experiment employed a Randomized Block Design (RBD) with seven treatments and three replications. Parameters such as plant height, number of primary and secondary branches, siliquae count, seed yield, available nitrogen, phosphorus and potassium in soil were systematically recorded. The treatment combining Ghanjeevamrit + Jeevamrit + Mulching consistently outperformed others, recording the highest plant height (1890 cm), seed yield (17.9 q ha⁻¹), and biological yield (65.9 q ha⁻¹). Significant improvements in soil organic carbon (0.54%), available nitrogen (186 kg ha⁻¹), phosphorus (13.25 kg ha⁻¹), and potassium (113 kg ha⁻¹) were also observed under this treatment. Economically, the same treatment achieved the highest gross returns (Rs. 1, 07, 041 ha⁻¹) and net returns (Rs. 74, 211 ha⁻¹) with a benefit-cost ratio of 2.26. The combined use of Jeevamrit and Ghanjeevamrit with mulching proved most effective for enhancing crop productivity, improving soil fertility, and achieving cost efficiency. These findings suggest that natural farming can be a viable, sustainable, and eco-friendly alternative to conventional chemical-intensive agriculture, especially in regions like Eastern Uttar Pradesh where Indian mustard is a key oilseed crop.

Keywords: Indian mustard, ghanjeevamrit, jeevamrit, mulching, natural farming

Introduction

One of the most significant oilseed crops, Indian mustard (*Brassica juncea* L.), also referred to as Indian mustard, is widely cultivated in India and other South Asian countries. It is grown mostly for its oil-rich seeds, which make a substantial contribution to the nation's output of edible oil. It is a member of the Brassicaceae family. *Brassica juncea* is the most widely planted mustard species because it can withstand a variety of agroclimatic conditions and has a relatively high oil content, averaging between 38 and 42% (Shekawat *et al.*, 2012) [17]. After China and Canada, India is the world's biggest producer of mustard. India produces over 11.5 million tons of mustard from roughly 9.5 million hectares of land, according to the most recent data (2023-24). Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat are the main states that produce mustard. With cultivation dispersed throughout districts like Sitapur, Bahraich, Lakhimpur, and Barabanki, Uttar Pradesh in particular makes a substantial contribution to national production. (Indian Government, 2024) [6] Given its 20-25% output share, the contribution of rapeseed-mustard to the predicted 82-101 MT oilseed demand by 2030 is estimated to be 16.4-20.5 MT. Within ten years, the current 9.26 MT of rapeseed-mustard production will almost double. After cereals, oilseed crops are the second most significant factor influencing the agricultural economy. Every one of the nation's nine annual oilseed crops is cultivated under a variety of ecological conditions. Soybeans, groundnut sunflower, rapeseed-mustard, and castor were the main producers of oilseeds (IGOR, 2015) [5]. Natural farming, also known as Zero Budget Natural Farming, is one strategy to address this growing problem. This is one such substitute for farming, which is reliant on chemical fertilizers and expensive farming operations. "Enhanced soil conditions by managing organic matter and the biological activities of soil, diversifying genetic resources, improving the recycling of biomass, and improving biological interactions" is the

basis for the explanation of agro-ecological principles (Khadse *et al.*, 2018) [9]. Padam Shri Dr. Subhash Palekar defined the four main components of the SPNF method and concentrated on "Subhash Palekar Natural Farming" techniques throughout the country. The phrase Beejamrit, which means "natural seed treatment," is derived from two Sanskrit words: Beeja, which means "seed," and Amrit, which means "nectar." Beejamrit, which is made by combining cow dung and urine with water to create a protective covering for seeds, has several advantages, including improving seed sprouting and maturity, lowering soil-borne illnesses, and improving soil health. The second is a 2006 report by Jivamrita Subhash Palekar, who describes fermented microbial culture as a multipurpose soil amendment that increases earthworm populations, supplies nutrients, and boosts microbial activity. It also activates microorganisms, increasing microbial load and growth hormones, which in turn improves soil fertility and structure and encourages healthy plant growth and development. (Farmers' Welfare & Agriculture Ministry, 2024) [3, 11]. By raising the pH in acidic soils, lowering the pH in alkaline soils, and optimizing nutrient availability at pH 6.5 to 7.8, Jeevamrit soil application creates favorable conditions for nutrient availability. (Kulkarni S.S 2019) [29]. Mulching, the third pillar of natural farming, releases nutrients due to the increased activity of microorganisms with the application of Jeevamrit and increases soil organic matter (after applied crop residues have decomposed). Increased infiltration, greater soil water-holding capacity, decreased weed development, enhanced soil fauna activity, and protection of topsoil from wind and water erosion are further advantages. Aspect four is Whapasa. It describes the soil and the root zone's balanced water and air mixture, which are perfect for a crop's healthy growth. With the use of less irrigation, less tillage, and more soil organic matter from residue mulching and mixture addition, natural farming should help to maintain this state of soil condition. Crop water use can be greatly decreased by preserving Whapasa (Khadse and Rosset 2019) [10]. A crucial part of natural farming, ghanjeevamrit is a nutrient-rich mixture of cow dung, cow urine, jaggery, pulse flour, and forest soil that is put to the soil at the time of sowing. After combining these materials, they are formed into little balls and let to dry in the shade. Ghanjivamrit adds healthy microorganisms to the soil, promoting plant growth and soil health. In Uttar Pradesh Gorakhpur region, natural mustard cultivation has gained popularity as a low-cost and ecological option. This area is ideal for implementing natural agricultural practices because of its rich alluvial soil and sufficient rainfall.

Materials and Methods

Study site description

Our study was executed at Agriculture Research Farm, Institute of Agricultural and Natural Sciences, Deen Dayal Upadhyay Gorakhpur University, Gorakhpur during the Rabi season of 2024-25 Uttar Pradesh, India. The site is geographically located at 26.75°N latitude, 83.38°E longitude, and approximately 69 meters above mean sea level and Precipitation here is about 1169 mm. The region, belonging to the eastern part of Uttar Pradesh, experiences a humid subtropical climate characterized by distinct seasonal variations in temperature, rainfall, and relative humidity.

The soil taxonomically classified as calciorthent and belong to the order of Entisol, suborder Fluvents, great group Ustifluvent.

Table 1: Initial chemical characteristics of the experimental site

Soil Characteristics	Values
pH (1:2.5 Soil-water suspension)	7.2
EC (dSm ⁻¹ at 25 °C)	0.24
Organic carbon (g kg ⁻¹)	0.32
Available N (kg ha ⁻¹)	173
Available P (kg ha ⁻¹)	12
Available K (kg ha ⁻¹)	107

Experimental details

The experiment was conducted in a Randomized Block Design (RBD) with seven treatments, each replicated thrice. The treatments included: T₁-Control; T₂-Ghanjeevamrit + Mulching; T₃-Jeevamrit + Mulching; T₄-Ghanjeevamrit @ 5 q ha⁻¹ in split application; T₅-Ghanjeevamrit + Jeevamrit + Mulching; T₆-Ghanjeevamrit + Jeevamrit; and T₇-Jeevamrit. Nutrient was applied through jeevamrit (1.5N, 0.5 P₂O₅ & 0.15 K₂O), ghanjeevamrit (1.05 N, 0.87 P₂O₅ & 0.68 K₂O as source of N, P₂O₅, K₂O at a recommended dose of 90 kg ha⁻¹, 60 kg ha⁻¹ and 40 kg ha⁻¹, respectively to Indian mustard.

Collection of soil samples and processing

Soil samples were collected from 0-15 depth. Composite soil samples were collected from five (5) different spots by moving in a zig-zag manner from individual experimental plots followed by reduction of samples to 500 g by quartering method. Soil samples were air dried in shade followed by sieving to fine particles with 2.0 mm sieve.

Plant Growth, yield attributes and determination of Soil Analysis

Growth parameters including plant height, number of branches plant⁻¹ were recorded at 30, 60, and 90 days after sowing (DAS), and at harvest. Yield attributes like number of seed /siliqua, seed yield, 1000-grain weight, biological yield, straw yield, and harvest index were measured at maturity. Soil organic carbon (SOC) was determined according to the wet digestion method of Walkley and Black as described by Jackson (1967) [7]. For determination of available nitrogen in soil alkaline permanganate method was followed using KEL PLUS system (Subbiah and Asija, 1956) [24]. The distilled ammonia gas released from five gram of processed soil sample via oxidation by 25 ml of 0.32% KMnO₄ solution and alkalisation by 25 ml of 2.5% NaOH solution in the distillation unit was absorbed by 25 ml of 4% boric acid containing mixed indicator, adjusted to pH 4.5 giving a greenish colour to the solution. Available phosphorus of the soil samples was estimated by Olsen's extractant, i.e. 0.5 M sodium bicarbonate (NaHCO₃) adjusted to pH 8.5 (Olsen *et al.* 1954). Available potassium of the soil sample was estimated by extraction with neutral normal ammonium acetate (1 N NH₄CH₃CO₂) as outlined by Jackson (1973) [8]. The cost of cultivation was calculated for each treatment based on prevailing input and labor costs. Gross return was estimated based on market prices of mustard grain and straw, and net return was computed by

subtracting total cost from gross return. The Benefit-Cost (B:C) ratio was also calculated.

Statistical Analysis

All collected data were subjected to statistical analysis using Analysis of Variance (ANOVA) as described by Gomez and Gomez (1984). The treatment means were compared using the Critical Difference (CD) at 5% probability level ($p \leq 0.05$) to determine the significance of variation among treatments.

Results and Discussions

Plant Growth

The plant height data showed significant variation among treatments at all growth stages. The combined application of Ghanjeevamrit + Jeevamrit + Mulching consistently produced the tallest plants (25.65 cm at 30 DAS to 190 cm at harvest), followed by Ghanjeevamrit + Jeevamrit and Ghanjeevamrit + Mulching. Individual applications of Jeevamrit or Ghanjeevamrit were less effective, while the control recorded the lowest height (15.35 cm at 30 DAS to 118.7 cm at harvest). These findings align with earlier reports by Singh *et al.* (2019) [23] and Sharma and Verma (2021) [19], who observed that integrated organic inputs, particularly when combined with mulching, enhance vegetative growth by improving soil moisture retention and nutrient availability. Branching pattern differed significantly among treatments at 60 DAS and maturity. The highest primary (8.23) and secondary (18.14) branches were obtained with Ghanjeevamrit + Jeevamrit + Mulching, followed by Ghanjeevamrit + Jeevamrit and Ghanjeevamrit + Mulching. Jeevamrit + Mulching also exceeded single applications, while the control had the fewest branches (5.15 primary, 11.35 secondary). These results corroborate earlier studies by Singh *et al.* (2019) [23] and Meena *et al.* (2021) [15], which reported that integrating organic inputs with mulching improves soil nutrient status and moisture retention, thereby stimulating branch development in mustard (Table 2).

Yield attributes

Yield attributes differed significantly among treatments. The maximum siliques per plant (297.15), seeds per silique (12.65), and test weight (4.19 g) were recorded with Ghanjeevamrit + Jeevamrit + Mulching, followed by Ghanjeevamrit + Jeevamrit and Ghanjeevamrit + Mulching. Jeevamrit + Mulching also outperformed single applications, while the control had the lowest values (190 siliques, 8.65 seeds per silique, 3.15 g test weight). These findings are consistent with reports by Meena *et al.* (2018) [14] and Singh *et al.* (2020) [21], who found that integrated organic amendments with mulching improve nutrient uptake, pod formation, and seed development in mustard. The study recorded significant differences in mustard yield attributes under various organic treatments. The combined

application of Ghanjeevamrit + Jeevamrit + Mulching produced the highest biological yield (65.87 q ha⁻¹) and seed yield (17.95 q ha⁻¹), outperforming all other treatments and the control (51.50 q ha⁻¹ and 13.55 q ha⁻¹, respectively). Ghanjeevamrit + Jeevamrit (64.21 q ha⁻¹) and Jeevamrit + Mulching (58.36 q ha⁻¹) also performed well. Straw yield trends were similar, with the highest under the combined treatment (47.92 q ha⁻¹). Interestingly, Ghanjeevamrit + Mulching recorded the highest harvest index (45.27%), indicating better biomass partitioning to seed. These results align with earlier findings by Sharma *et al.* (2018) [20] and Singh & Meena (2020) [21], who reported that integrated organic inputs, especially when combined with mulching, enhanced mustard yields by improving soil moisture retention, nutrient availability, and crop biomass allocation efficiency (Table 2).

Soil chemical properties

Post-harvest analysis indicated that natural farming practices exerted no significant influence on soil pH, which remained nearly neutral (6.88-7.09). This stability supports earlier findings by Yadav *et al.* (2018) [14] and Singh *et al.* (2020) [21], who reported that organic amendments generally maintain soil reaction within the neutral range. A slight but significant rise in electrical conductivity (0.24-0.29 dS m⁻¹) was observed under organic treatments, with the highest values recorded in Ghanjeevamrit + Jeevamrit + Mulching and Ghanjeevamrit + Jeevamrit, consistent with Sharma *et al.* (2017) [18]. Soil organic carbon improved appreciably (0.32-0.54%), in agreement with Meena *et al.* (2016) [12] and Choudhary *et al.* (2019) [1], who demonstrated that integrated organic inputs and mulching enhance soil carbon sequestration. Nutrient availability also increased significantly, with maximum nitrogen (186 kg ha⁻¹), phosphorus (13.25 kg ha⁻¹), and potassium (113 kg ha⁻¹) recorded in Ghanjeevamrit + Jeevamrit. These results corroborate earlier reports by Verma *et al.* (2015) [25] and Das *et al.* (2021) [2] on the nutrient-enriching potential of organic formulations (Table 3).

Economics

Economic analysis showed that Ghanjeevamrit + Jeevamrit + Mulching achieved the highest gross return (₹1, 07, 041 ha⁻¹) and net return (₹74, 211 ha⁻¹) with a B-C ratio of 2.26, while Ghanjeevamrit + Jeevamrit recorded the highest efficiency (B-C 2.30) and strong profitability, aligning with Sharma *et al.* (2018) [13] and Singh *et al.* (2021) [22] who reported enhanced returns from integrated organic inputs. Jeevamrit + Mulching (B:C 2.07) and Jeevamrit alone (B:C 2.14) also showed good economic viability, similar to findings by Meena *et al.* (2017) [13] that bio-formulations can be profitable even when used individually. The control recorded the lowest returns (B:C 1.96), confirming earlier reports by Yogananda *et al.* (2016) [28] that absence of organic amendments limits profitability (Table 4).

Table 2: Effect of natural farming practices on plant height, number of primary and secondary branches, number of siliquae per plant, number of seeds per siliqua, test weight, biological yield, straw yield and harvest index

Treatment	Plant height (cm)				Number of branches		Yield Attributes			Yield (q ha ⁻¹)			
	30 DAS	60 DAS	90 DAS	At Harvest	Primary	Secondary	Number of siliquae per plant	Number of seeds per siliqua	Test weight	Biological yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Seed yield (q ha ⁻¹)	Harvest index (%)
Control	15.35	60.62	109.75	118.7	5.15	11.35	189.96	8.65	3.15	51.5	37.95	13.55	26.31
Ghanjeevamrit + Mulching	22.9	90.44	163.54	169.4	7.35	16.2	265.48	11.3	3.8	42.73	26.45	16.28	45.27
Jeevamrit + Mulching	21.25	83.92	151.75	157.18	6.82	15.03	246.3	10.49	3.56	58.36	42.96	15.4	26.39
Ghanjeevamrit	20.05	79.18	143.2	148.32	6.44	14.19	232.5	9.95	3.5	57.31	42.21	15.1	26.35
Ghanjeevamrit + Jeevamrit + Mulching	25.65	101.3	183.1	189.65	8.23	18.14	297.15	12.65	4.19	65.87	47.92	17.95	27.25
Ghanjeevamrit + Jeevamrit	24.1	95.18	172.15	178.31	7.74	17.1	289.35	12.25	4.05	64.21	46.86	17.35	27.02
Jeevamrit	18.2	71.88	129.97	134.62	5.84	12.87	215.95	9.2	3.45	56.96	41.99	14.97	26.28
S Em (±)	0.75	2.96	5.36	5.56	0.24	0.53	8.79	0.38	0.13	1.96	1.41	0.56	1.14
CD ($p \geq 0.05\%$)	2	9	17	17	1	2	27	1	0.4	6	4	2	4

Table 3: Effect to their natural farming practices on physio-chemical observation as influenced by different treatments on Indian Mustard after harvesting of crop

Treatment	Physical properties			Chemical properties		
	pH	EC (ds m ⁻¹)	SOC (%)	N (kg ha ⁻¹)	P (kg ha ⁻¹)	K (kg ha ⁻¹)
Control	6.88	0.24	0.32	173.75	12.16	107.48
Ghanjeevamrit + Mulching	7.02	0.28	0.5	171.58	12.07	106.83
Jeevamrit + Mulching	7.01	0.26	0.48	180.26	13.06	112.37
Ghanjeevamrit	7	0.25	0.44	178.65	12.84	111.37
Ghanjeevamrit + Jeevamrit + Mulching	7.09	0.29	0.54	174.26	12.23	109.56
Ghanjeevamrit + Jeevamrit	7.08	0.29	0.51	185.56	13.25	113.27
Jeevamrit	7	0.25	0.44	170.45	11.69	105.12
S Em (±)	NS	0.01	0.02	6.32	0.45	3.92
CD ($p \geq 0.05\%$)	NS	0.03	0.05	19.46	1.39	12.07

Table 4: Effect of natural farming practices on Economics as influenced by different treatments on Indian Mustard.

Treatment	Economics			
	Total cost of cultivation (Rs ha ⁻¹)	Gross returns (Rs ha ⁻¹)	Net returns (Rs ha ⁻¹)	B:C
Control	27280	80811	53531	1.96
Ghanjeevamrit + Mulching	31700	96998	65298	2.05
Jeevamrit + Mulching	29910	91844	61934	2.07
Ghanjeevamrit	30200	90056	59856	1.98
Ghanjeevamrit + Jeevamrit + Mulching	32830	107041	74211	2.26
Ghanjeevamrit + Jeevamrit	31300	103466	72166	2.3
Jeevamrit	28410	89280	60870	2.14

Conclusion

The study highlights that the integrated application of Ghanjeevamrit, Jeevamrit, and mulching significantly enhanced mustard growth, yield, soil fertility, and profitability compared to individual or control treatments. This combination produced the tallest plants, maximum branching, highest seed and biological yields, and improved soil organic carbon while ensuring sustainable nutrient availability. Economically, it achieved the highest net return and B:C ratio, proving to be the most viable option. Thus, Ghanjeevamrit + Jeevamrit + Mulching can be recommended as a sustainable, eco-friendly practice for mustard farmers to maximize productivity and income while maintaining soil health.

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