

Effect of Diverse Nutrient Sources and Liquid Organic Manures on Growth Parameters, Weed Count, Weed Dry Weight and Quality Parameters of Sesame (*Sesamum indicum* L.)

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Abstract— A field experiment was conducted to study “Organic nutrient management in rabi sesame (*Sesamum indicum* L.)” during 2024-25 at the Agricultural College Farm, Naira. The experiment was laid out in a split-plot design with three replications. The study consists of three main plot treatments viz., 100% RDN through inorganic fertilizers, 100% RDN through organics with biofertilizers and biofertilizers alone. The sub-plots included four foliar applications: Vermiwash, Panchgavya, Jeevamrut and water spray. The results showed that inorganic nutrient application (100% RDN) significantly improved growth, weed and quality parameters of sesame compared to organic and biofertilizer treatments. Among the foliar sprays, Jeevamrut @ 10% proved most effective, enhancing growth and quality parameters. The study concludes that applying 100% RDN through inorganic fertilizers combined with foliar spraying of Jeevamrut @ 10% is the most effective practice for enhancing growth, oil and protein content of sesame.

Keywords— Sesame, Jeevamrut, Panchgavya, Vermiwash, Biofertilizers and Organics.

I. INTRODUCTION

Sesame (*Sesamum indicum* L.), often referred as the "Queen of Oilseeds," is one of the oldest cultivated oilseed crops known for its high oil (50-52%) and protein (17-19%) content, along with carbohydrates and essential fatty acids (Kahyaoglu and Kaya, 2006). Sesame oil, popularly termed as "poor man's ghee," is highly nutritious and holds several health benefits. The seeds are rich in calcium, magnesium, zinc, antioxidants like sesamin and sesamol and vitamin E, which support heart health, digestion, skin and bone strength. Sesame is versatile in its use as it can be consumed raw, roasted or processed into oil, tahini and it can be used in cosmetics and ayurvedic medicine. In India, sesame is cultivated in an area of 15.31 lakh hectares with a production of 8.47 lakh tonnes and productivity of 553 kg ha⁻¹. However, in Andhra Pradesh, despite its significance, productivity remains low at 376 kg ha⁻¹ due to poor soil fertility, minimal inputs and suboptimal agronomic practices (Indiastat, 2023-2024). Rabi sesame, predominantly grown in the north coastal regions of Andhra Pradesh, often receives only one or two irrigations, making foliar nutrient application more practical than soil fertilization. The limited attention to crop nutrition has contributed to consistently low yields.

Conventional sesame farming relies heavily on synthetic fertilizers, which, though effective in the short term but adversely affect soil health, microbial diversity and the environment. As sesame is particularly sensitive to nutrient imbalances, sustainable alternatives are crucial. Organic nutrient management offers a promising approach by enhancing soil organic

matter, microbial activity and overall fertility while reducing environmental harm. Additionally, organically grown sesame is gaining international demand due to consumer preference for eco-friendly and chemical-free produce. Organic inputs like press mud cake, a byproduct rich in nutrients and organic matter, improve soil structure, water retention and microbial activity. Similarly, vermicompost is rich in plant growth regulators from microbial-earthworm interactions, has been shown to enhance plant growth, flowering and yields (Arancon and Edwards, 2009; Jayashree *et al.*, 2011). Biofertilizers, through phytohormone production and nutrient mobilization, further aid in plant development in an eco-friendly way. Foliar applications of liquid organic manures also play a critical role in boosting crop performance. *Jeevamrut*, *Panchgavya* and Vermiwash are effective natural formulations rich in nutrients, beneficial microbes and plant hormones. *Jeevamrut* improves nutrient availability and soil microbial activity, which boosts sesame growth and yield. Its application produces a healthy, biologically active rhizosphere that increases plant vigor, oil content and seed quality. *Panchgavya*, for instance, supplies key macro and micronutrients along with microbial inoculants like *Azotobacter* and phosphobacteria (Praneeth *et al.*, 2021), while vermiwash contains bioactive compounds and microbial enzymes that stimulate plant metabolism and nutrient uptake. In this context, integrating soil-applied organic and inorganic nutrient sources with foliar sprays of liquid organic manures may serve as an effective strategy to improve the growth, yield and profitability of *rabi* sesame, particularly under low-input conditions.

II. MATERIAL AND METHODS

The present field experiment was conducted during *Rabi*, 2024-25, laid out in block- A, field No.6 of Agricultural College Farm, Naira, Acharya N.G. Ranga Agricultural University, Andhra Pradesh, which is geographically situated at 18.240° N latitude, 83.840° E longitude with an altitude of 27 m above mean sea level in the North Coastal Zone of Andhra Pradesh. The mean maximum and minimum temperatures ranged from 30.1°C to 37.8°C and 16.8°C to 25.6°C, respectively, while the average maximum and minimum temperatures during the crop period were 33.95°C and 14.3°C. During the corresponding period, the mean relative humidity of the forenoon is 82.88 per cent and the afternoon is 56.95 per cent, with an average of 69.91 per cent. A total rainfall of 19.8 mm was received in 2 rainy days during the crop growth period. Favorable weather conditions prevailed for the successful growth of the sesamum. The experiment was laid out in a split-plot design with three main plot treatments involving different nutrient sources: 100% RDN through inorganic fertilizers (M_1), 100% RDN through organics with biofertilizers (M_2) and biofertilizers alone (M_3). The sub-plots included four foliar applications: Vermiwash (S_1), *Panchgavya* (S_2), *Jeevamrut* (S_3) and water spray (S_4). Data was collected on various characters such as the plant population, leaf area index, dry matter production (kg ha^{-1}), days to 50% flowering, days to maturity, weed count, weed dry weight, oil content and protein content.

III. RESULTS AND DISCUSSION

3.1 Growth Parameters:

3.1.1 Plant population (No. m^{-2}):

The plant population of sesame observed at initial and final was unaffected by foliar applications of liquid organic manures and various nutrition sources, as well as their interaction effect. The uniformity in emergence may be due to uniform field preparation and sowing conditions across the plots. These observations are in line with the findings of Singh *et al.* (2024) and Kiruthika *et al.* (2022a), who reported that early plant stand in sesame remains unaffected by fertilizer type when seedbed preparation and irrigation are uniformly optimal.

3.1.2 Leaf area index (LAI):

Application of 100% RDN through inorganic fertilizers (M_1) recorded the highest leaf area index (LAI) at both 30 and 50 DAS, primarily due to enhanced nitrogen availability that stimulated canopy expansion, efficient light interception, and higher

photosynthetic activity. These results are consistent with the findings of Kumar *et al.* (2022) and Pandiyan *et al.* (2020), who reported greater LAI in sesamum under recommended inorganic fertilizer levels. The treatment receiving 100% RDN through organics + biofertilizers (M₂) exhibited moderate LAI, indicating sufficient nutrient supply through gradual mineralization, in agreement with Singh *et al.* (2024) and Kiruthika *et al.* (2022a). The lowest LAI was observed in liquid biofertilizers alone (M₃), likely due to limited availability of essential nutrients restricting leaf expansion. Among foliar applications, *Jeevamrut* @ 10% (S₃) recorded the highest LAI, followed by Vermiwash @ 10% (S₁) and *Panchgavya* @ 3% (S₂), whereas water spray (S₄) consistently registered the lowest values. The superior performance of *Jeevamrut* could be attributed to its rich microbial population and growth-promoting substances that enhanced cell elongation and leaf development, corroborating Gabhane *et al.* (2019) and Prakash *et al.* (2019). The interaction effect between nutrient sources and foliar treatments on LAI at both stages was statistically nonsignificant.

3.1.3 Dry matter production (kg ha⁻¹)

Among nutrient sources, the highest dry matter accumulation was recorded under 100% RDN through inorganic fertilizers (M₁) at all growth stages (30 DAS, 50 DAS and harvest), attributed to the immediate availability of nutrients enhancing photosynthetic efficiency and biomass synthesis. Similar observations were reported by Kranthikumar *et al.* (2025) and Elayaraja Singaravel (2017). The treatment receiving 100% RDN through organics + biofertilizers (M₂) produced moderate dry matter, while biofertilizers alone (M₃) resulted in the lowest values, likely due to inadequate nutrient supply. Among foliar applications, *Jeevamrut* @ 10% (S₃) recorded the highest dry matter accumulation at all growth stages, followed by *Vermiwash* @ 10% (S₁) and *Panchgavya* @ 3% (S₃), whereas water spray (S₄) consistently registered the lowest. The superior performance of *Jeevamrut* could be attributed to its enrichment with beneficial microbes and growth-promoting metabolites that enhance nutrient uptake and metabolic activity, as supported by Veeral *et al.* (2019) and Ranjith *et al.* (2021).

The interaction between nutrient sources and foliar treatments was significant at 50 DAS and at harvest. The highest dry matter accumulation was obtained under M₁S₃ (inorganics + *Jeevamrut*) and among organic treatments, M₂S₃ (organics + *Jeevamrut*) produced the highest dry matter, reflecting the synergistic influence of microbial activity and gradual nutrient release from organics. The lowest dry matter accumulation was observed in M₃S₄ (biofertilizers + water spray), where insufficient nutrient availability restricted vegetative growth and final biomass production.

3.1.4 Days to 50% flowering:

Among the nutrient sources, soil application of liquid biofertilizers (M₃) recorded the earliest flowering, followed by 100% RDN through organics + biofertilizers (M₂). Conversely, the application of 100% RDN through inorganic fertilizers (M₁) took the longest time to reach 50% flowering. The early flowering observed under organic nutrition could be attributed to the moderate and steady nutrient availability through biofertilizers and organic amendments, which promote early physiological activity. Similar trends were reported by Ranjith *et al.* (2021), who observed early flowering in sesame under integrated nutrient management involving biofertilizers. Among foliar sprays, water spray (S₄) resulted in the earliest flowering, whereas *Jeevamrut* @ 10% (S₃) significantly delayed flowering, likely due to enhanced vegetative growth resulting from higher microbial and nutritional activity. The delayed flowering under *Jeevamrut* @ 10% (S₃) might also be due to its hormonal influence and enriched microbial community, which prolongs the vegetative phase. These results align with the findings of Deepak Bawa *et al.* (2024) and Veeral *et al.* (2019), who noted that foliar application of organic liquids delayed flowering while promoting extended vegetative growth. The interaction effect between nutrient sources and foliar sprays of liquid organic manures on days to 50% flowering was found to be non-significant.

TABLE 1
INFLUENCE OF NUTRIENT SOURCES AND FOLIAR APPLICATION OF LIQUID ORGANIC MANURES ON GROWTH
PARAMETERS OF SESAMUM

Treatments	Plant population (No. m-2)		Leaf area index (LAI)		Dry matter production (kg ha-1)			Days to 50% flowering	Days to maturity
	Initial	Final	30 DAS	50 DAS	30 DAS	50 DAS	At harvest		
Main plots: Sources of nutrition									
M ₁ : 100% RDN through inorganic fertilizers	35.56	31.93	0.35	3.09	402	1372	2824	36.41	82.16
M ₂ : 100% RDN through organic (1/3rd each through Press Mud cake + Vermicompost + FYM) + liquid bio fertilizers (<i>Azospirillum</i> + PSB + KRB @ 1.25 Lit ha ⁻¹).	35.3	32.18	0.23	2.37	300	1058	2371	31.41	76.91
M ₃ : Soil application of liquid bio-fertilizers (<i>Azospirillum</i> + PSB + KRB @ 1.25 Lit ha ⁻¹)	33.19	30.77	0.14	1.52	257	774	1792	26.68	71.64
S.Em±	0.68	1.01	0.01	0.06	5.67	31.36	51.29	0.9	1.71
CD (P=0.05)	NS	NS	0.02	0.22	22.2	123.1	201.3	3.52	6.7
CV (%)	6.81	11.02	8.59	8.23	6.15	10.17	7.63	9.86	7.69
Sub plots: Foliar application of liquid organic manures									
S ₁ : Vermiwash spraying twice @ 10% conc. at flower initiation and capsule development	34.8	31.24	0.25	2.51	344	1109	2528	32.8	78.85
S ₂ : <i>Panchgavya</i> spraying twice @ 3% conc. at flower initiation and capsule development	34.16	32.01	0.23	2.22	314	1073	2380	30.93	76.43
S ₃ : <i>Jeevamrut</i> spraying twice @ 10% conc. at flower initiation and capsule development	33.91	32.91	0.27	2.84	411	1212	2631	36.27	80.85
S ₄ : Water spray	35.87	30.35	0.19	1.74	209	878	1776	26	71.48
S.Em±	0.97	1.08	0.01	0.06	9.9	27.31	50.46	1.14	2.21
CD (P=0.05)	NS	NS	0.03	0.19	29.4	81.14	149.9	3.39	6.56
CV (%)	8.37	10.27	11.18	8.25	9.3	7.67	6.5	10.86	8.61
Interaction (M at S)	NS	NS	NS	NS	NS	171.4	299.1	NS	NS
Interaction (S at M)	NS	NS	NS	NS	NS	140.5	259.7	NS	NS

TABLE 1.1

INTERACTION EFFECT OF DIFFERENT SOURCES OF NUTRITION AND FOLIAR APPLICATION OF LIQUID ORGANIC MANURES ON DRY MATTER PRODUCTION (kg ha^{-1}) OF SESAME AT 50 DAS

Treatments	S ₁	S ₂	S ₃	S ₄	Mean
M ₁	1466	1457	1483	1082	1372
M ₂	1007	1003	1225	999.1	1058
M ₃	853.6	761.5	928	551.5	774
Mean	1109	1073	1212	878	
		S.E.m $\pm$	CD (P=0.05)	CV (%)	
		31.35	123.1	10.16	
		27.3	81.14	7.66	
INTERACTION					
M X S		51.59	171.4	-	
S X M		47.3	140.5	-	

TABLE 1.2

INTERACTION EFFECT OF DIFFERENT SOURCES OF NUTRITION AND FOLIAR APPLICATION OF LIQUID ORGANIC MANURES ON DRY MATTER PRODUCTION (kg ha^{-1}) OF SESAME AT HARVEST

Treatments	S ₁	S ₂	S ₃	S ₄	Mean
M ₁	3132	2880	3159	2125	2824
M ₂	2574	2543	2609	1759	2371
M ₃	1910	1686	2126	1445	1792
Mean	2539	2369	2631	1776	
		S.E.m $\pm$	CD (P=0.05)	CV (%)	
		51.28	201.3	7.62	
		50.46	149.9	6.05	
INTERACTION					
M X S		91.44	299.1	-	
S X M		87.41	259.7	-	

3.1.5 Days to maturity:

Among the main treatments, soil application of liquid bio-fertilizers (M₃) resulted in the earliest maturity, followed by M₂ (organic sources + biofertilizers). The early physiological maturity in soil application of liquid bio-fertilizers (M₃) may be attributed to regulated, gradual nutrient supply and enhanced microbial activity, which stimulate faster reproductive development. Similar outcomes were documented by Mokariya *et al.* (2021), who found that biofertilizer-enriched vermicompost accelerated crop maturity through improved nutrient assimilation. Among the foliar treatments, water spray (S₄) matured the earliest, where as *Jeevamrut*@ 10% (S₃) took the longest. The longer maturity period with *Jeevamrut* (S₃) could be attributed to prolonged vegetative growth aided by improved nutrient uptake and hormonal stimulation from organic foliar sprays, as suggested by Ranjith *et al.* (2021). The interaction effect of nutrient sources and foliar sprays on days to maturity was determined to be non-significant for days to maturity.

3.2 Weed Parameters:

3.2.1 Weed count (No. m⁻²):

Among the nutrient sources, application of 100% RDN through inorganic fertilizers (M₁) resulted in the highest weed count at both 20 and 40 DAS, which could be attributed to increased nutrient availability that promoted the growth of both crops and weeds. Application of 100% RDN through organics + biofertilizers (M₂) showed a moderate weed count, whereas biofertilizers (M₃) alone recorded the lowest, likely due to reduced initial nutrient availability and improved crop shading during early establishment. Sukhadia *et al.* (2004) also observed that timely weeding at 20 and 40 DAS substantially reduced weed infestation. Among foliar sprays, *Jeevamrut* (S₃) recorded the highest weed count at both 20 and 40 DAS, possibly due to its stimulatory effect on overall soil microbial activity, which indirectly supported weed growth. Conversely, water spray (S₄)

recorded the lowest weed count, likely due to reduced crop vigour, which limited weed establishment. The interaction effect between nutrient sources and foliar applications of liquid organic manures on weed count at 20 and 40 DAS in sesame was found to be non-significant.

3.2.2 Weed dry weight (kg ha^{-1}):

Among the nutrient sources, application of 100% RDN through inorganic fertilizers (M_1) recorded the highest weed dry weight at both 20 and 40 DAS. The lowest weed dry weight was observed under soil application of liquid biofertilizers (M_3), indicating a suppressive effect on weed growth under low-nutrient input systems. Moderate weed biomass was recorded with 100% RDN through organics + biofertilizers (M_2), suggesting that gradual nutrient release from organic inputs influences early weed establishment differently than inorganic sources. These findings suggest that higher fertilizer inputs without weed control can enhance weed biomass, which aligns with the observations of Sahu *et al.* (2019) and Ismail *et al.* (2015), who reported greater weed proliferation under nutrient-rich conditions. Regarding foliar applications, *Jeevamrut* (S_3) recorded the highest weed dry weight at both 20 and 40 DAS, likely due to enhanced microbial activity and nutrient cycling that favored weed growth. It was followed by *Vermiwash* (S_1) and *Panchgavya* (S_2), whereas water spray (S_4) consistently recorded the lowest weed biomass, reflecting limited nutrient stimulation for weed development. The interaction effect between nutrient sources and foliar application of liquid organic manures on weed dry weight at 20 and 40 DAS was found to be non-significant.

TABLE 2

INFLUENCE OF NUTRIENT SOURCES AND FOLIAR APPLICATION OF LIQUID ORGANIC MANURES ON WEED AND QUALITY PARAMETERS OF SESAMUM

Treatments	Weed count (No. m ⁻²)		Weed dry weight (kg ha^{-1})		Oil content (%)	Protein content (%)
	20 DAS	40 DAS	20 DAS	40 DAS		
M_1 : 100% RDN through inorganic fertilizers	5.37 (28.35)	7.0 (48.56)	7.59 (57.14)	11.66 (135.4)	48.79	20.69
M_2 : 100% RDN through organic (1/3rd each through Press Mud cake + Vermicompost + FYM) + liquid bio fertilizers (<i>Azospirillum</i> + PSB + KRB @ 1.25 Lit ha^{-1}).	4.60 (20.62)	6.04 (36.03)	6.60 (43.04)	10.55 (110.7)	47.64	19.42
M_3 : Soil application of liquid bio-fertilizers (<i>Azospirillum</i> + PSB + KRB @ 1.25 Lit ha^{-1})	4.04 (15.82)	5.17 (26.28)	5.65 (31.38)	9.48 (89.32)	44.15	17.93
S.Em $\pm$	0.74	0.67	1.2	3.73	0.82	0.37
CD (P=0.05)	2.92	2.63	4.72	14.66	3.23	1.44
CV (%)	11.93	6.28	9.5	11.56	6.09	6.59
Sub plots: Foliar application of liquid organic manures						
S_1 : Vermiwash spraying twice @ 10% conc. at flower initiation and capsule development	5.05 (25.01)	6.46 (41.24)	6.94 (47.71)	11.07 (122)	48.06	20.14
S_2 : <i>Panchgavya</i> spraying twice @ 3% conc. at flower initiation and capsule development	4.78 (22.30)	6.37 (40.06)	6.85 (46.46)	10.69 (113.8)	47.49	18.86
S_3 : <i>Jeevamrut</i> spraying twice @ 10% conc. at flower initiation and capsule development	5.34 (28.02)	6.85 (46.36)	7.35 (53.56)	11.51 (132)	48.76	22.36
S_4 : Water spray	3.40 (11.05)	4.55 (20.17)	5.31 (27.70)	8.95 (79.52)	43.13	16.01
S.Em $\pm$	0.74	1.43	1.68	3.79	1.04	0.64
CD (P=0.05)	2.21	4.25	5	11.25	3.1	1.89
CV (%)	10.31	11.61	11.52	10.16	6.67	9.87
Interaction (M at S)	NS	NS	NS	NS	NS	NS
Interaction (S at M)	NS	NS	NS	NS	NS	NS

3.3 Quality Parameters:

3.3.1 Oil content (%)

Among the nutrient sources, application of 100% RDN through inorganic fertilizers (M_1) recorded the highest oil content, while 100% RDN through organics + biofertilizers (M_2) was statistically on par with it. Both treatments were significantly superior to the soil application of liquid biofertilizers (M_3), which recorded the lowest oil content. The higher oil content under inorganic nutrition may be attributed to better nutrient availability and uptake, particularly nitrogen and potassium, which play crucial roles in oil biosynthesis in oilseed crops. Regarding foliar organic inputs, significant variations were observed. Foliar application of *Jeevamrut* @ 10% (S_3) at flower initiation and capsule development stages recorded the highest oil content and the lowest oil content was recorded under water spray (S_4). The improvement in oil content with organic foliar inputs might be due to the presence of microbial metabolites, growth-promoting substances and micronutrients in *Jeevamrut* and other organic formulations that enhance plant metabolism and oil accumulation in seeds. Similar observations were reported by Chakraborty *et al.* (2021). The interaction between soil and foliar treatments was statistically non-significant for oil content in sesame.

3.3.2 Protein content (%):

Among the nutrition sources, application of 100% RDN through inorganic fertilizers (M_1) recorded the highest protein content, followed by 100% RDN through organics + biofertilizers (M_2) and soil application of liquid biofertilizers (M_3). The superiority of 100% RDN through inorganic fertilizers (M_1) could be due to the efficient availability of nitrogen in inorganic form, which plays a pivotal role in protein synthesis. These findings align with those of Shathi *et al.* (2023), who observed enhanced protein content in sesame under balanced chemical fertilization. Regarding foliar sprays, *Jeevamrut* @ 10% (S_3) once again recorded the highest protein content, followed by Vermiwash (S_1) and *Panchgavya* (S_2). The treatment water spray (S_4) recorded the lowest protein content. The higher protein content under *Jeevamrut* treatment may be due to the presence of amino acids, enzymes and beneficial microbes that facilitate nitrogen assimilation and protein formation in plants. The interaction effect between nutrient sources and foliar applications was statistically not significant for protein content.

IV. CONCLUSION

The study revealed that 100% RDN through inorganic fertilizers significantly enhanced growth, biomass accumulation and seed quality of *rabi* sesame compared to organic and biofertilizer treatments. Among foliar applications, *Jeevamrut*@ 10% was most effective in improving nutrient uptake, leaf development, oil and protein content and overall crop vigor. Organic sources with biofertilizers provided moderate benefits, while biofertilizers alone were least effective. The integration of inorganic fertilization with *Jeevamrut* foliar spray maximized sesame growth and quality, indicating its suitability as an efficient and sustainable nutrient management strategy.

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