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Effect of diverse nutrient sources and liquid organic manures on growth, yield and economics of sesame (*Sesamum indicum* L.)

V Tejaswi, A Upendra Rao, B Jyothi Basu and S Govinda Rao
Department of Agronomy, Acharya N G Ranga Agricultural University,
Agricultural College, Naira, Andhra Pradesh, India

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, yield attributes and seed yield of sesame compared to organic and biofertilizer treatments. Among the foliar sprays, *Jeevamrut* @ 10% proved most effective, enhancing plant height, branching, dry matter, yield attributes and yield. The study concludes that integrating 100% RDN through inorganic fertilizers with foliar application of *Jeevamrut* is the most suitable practice for maximizing productivity and profitability of sesame in the *rabi* season.

Keywords: *Biofertilizers, Jeevamrut, Organics, Panchgavya, Sesame and Vermiwash*

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 also 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, improves 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.

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 18.24^0 N latitude, 83.84^0 E longitude and with an altitude of 27m 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 mean relative humidity of forenoon is 82.88 per cent and 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. Favourable 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). Biometric observations were recorded on five randomly chosen plants from each replication and the mean results were used for statistical analysis. Data was collected on various characters such as the plant height, number of branches per plant, number of capsules plant^{-1}, number of seeds capsule^{-1}, seed yield (kg ha^{-1}), haulm yield (kg ha^{-1}) and test weight (g).

RESULTS AND DISCUSSION

Effect of different nutrient sources and foliar application of liquid organic manures on growth parameters of sesamum

The growth parameters of sesame *viz.,* number of branches and plant height was influenced by different nutrient sources and foliar application of liquid organic manures. Plant height was significantly influenced at all three growth stages (30 DAS, 50 DAS and at harvest). At all these stages, the treatment receiving 100% RDN through inorganic fertilizers (M_1) recorded the tallest plants (18.10 cm, 61.52 cm and 93.19 cm at 30, 50 DAS and at harvest respectively), followed by 100% RDN through organics + biofertilizers (M_2) (13.13 cm, 44.68 cm and 80.10 cm at 30, 50 DAS and at harvest respectively), and the shortest plants were observed under soil application of biofertilizers alone (M_3) (11.32 cm, 38.75 cm and 68.76 cm at 30, 50 DAS and at harvest respectively). The increase in height in 100% RDN through inorganic fertilizers might be due to immediate and ample nutrient availability from inorganic fertilizers, which promoted faster vegetative growth. These findings are in line with those reported by Chandrasekaran *et al.* (2024) and Singh *et al.* (2024), who also observed improved plant height in sesame with sufficient nutrient availability. Regarding foliar application of liquid organic manures, *Jeevamrut* @ 10% (S_3) recorded significantly higher plant height at all three stages (17.01 cm, 57.10 cm and 93.04 cm at 30, 50 DAS and at harvest respectively), followed by Vermiwash (S_1) and *Panchgavya* (S_2). The lowest plant height was consistently recorded under water spray (S_4) (10.49 cm, 39.36 cm and 62.43 cm at 30, 50 DAS and at harvest respectively). The higher plant height under *Jeevamrut* could be attributed to the presence of growth promoting plant hormones and beneficial microbes that improved nutrient absorption and photosynthesis, which agrees with the findings of Gabhane *et al.* (2019).The

Table1: Influence of nutrient sources and foliar application of liquid organic manures on growth parameters of sesamum

Treatments	Plant height (cm)			Number of branches plant^{-1}		
	30 DAS	50 DAS	At harvest	30 DAS	50 DAS	At harvest
Main plots: Sources of nutrition						
M_1: 100% RDN through inorganic fertilizers	18.10	61.52	93.19	1.33	2.81	5.24
M_2: 100% RDN through organic (1/3rd each through Press Mud cake + Vermicompost + FYM) + liquid bio fertilizers (*Azospirillum*+ PSB + KRB @ 1.25 Lit ha^{-1}).	13.13	44.68	80.10	1.05	2.12	4.00
M_3: Soil application of liquid bio-fertilizers (*Azospirillum* + PSB + KRB @ 1.25 Lit ha^{-1})	11.32	38.75	68.76	0.93	1.64	3.44
S.Em±	0.39	1.54	1.72	0.02	0.04	0.11
CD (P=0.05)	1.51	6.04	6.76	0.09	0.17	0.43
CV (%)	9.41	11.02	7.39	7.24	6.97	8.94
Sub plots: Foliar application of liquid organic manures						
S_1: Vermiwash spraying twice @ 10% conc. at flower initiation and capsule development	15.10	48.94	85.47	1.13	2.20	4.47
S_2: *Panchgavya* spraying twice @ 3% conc. at flower initiation and capsule development	14.13	47.87	81.85	1.06	2.13	4.17
S_3: *Jeevamrut* spraying twice @ 10% conc. at flower initiation and capsule development	17.01	57.10	93.04	1.32	2.62	4.95
S_4: Water spray	10.49	39.36	62.43	0.90	1.81	3.31
S.Em±	0.48	1.91	1.73	0.03	0.05	0.12
CD (P=0.05)	1.44	5.68	5.13	0.08	0.16	0.35
CV (%)	10.23	11.86	6.42	7.77	7.40	8.40
Interaction						
S.Em±	0.82	3.25	3.11	0.05	0.09	0.21
Interaction (M at S)	NS	10.36	10.15	NS	0.29	0.67
Interaction (S at M)	NS	9.83	8.88	NS	0.28	0.61

interaction effect between sources of nutrition and foliar application of liquid organic manures on plant height was found to be statistically significant at 50 DAS and at harvest. Among all combinations, the treatment M_1S_3 (100% RDN through inorganic fertilizers + *Jeevamrut* spray) recorded the highest plant height at 50 DAS (69.69 cm) and at harvest (103.9 cm). In contrast, the lowest plant height was observed in M_3S_4 (biofertilizers + water spray) at both stages (35.15 cm and 48.45 cm, at 50 DAS and at harvest respectively). These results suggest that the integration of nutrient-rich foliar sprays with adequate basal nutrition plays a vital role in enhancing plant height in sesame.

Regarding the number of branches perplant^{-1}, significant differences were observed due to various nutrient sources and foliar application of liquid organic manures. The highest number of branches at all the stages was recorded in the treatment receiving 100% RDN through inorganic fertilizers (1.33, 2.81 and 5.24 at 30, 50 DAS and harvest respectively), followed by organics + biofertilizers (1.05, 2.12 and 4.00 at 30, 50 DAS and at harvest respectively), and the least number of branches was observed under biofertilizers

Table 2. Interaction effect of different nutrient sources and foliar application of liquid organic manures on plant height of sesame (cm) at 50 DAS

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	68.29	66.06	69.69	42.03	61.52
M_2	42.38	40.33	56.67	39.34	44.68
M_3	39.19	35.72	44.93	35.15	38.75
Mean	49.95	47.37	57.10	38.84	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		1.53	6.03	11.02	
Sub plot		1.91	5.67	11.86	
INTERACTION					
M X S		3.25	10.36	-	
S X M		3.31	9.83	-	

Table 3. Interaction effect of different nutrient sources and foliar application of liquid organic manures on plant height of sesame (cm) at harvest

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	101.40	98.47	103.90	68.92	93.19
M_2	79.44	77.10	93.94	69.93	80.10
M_3	75.38	69.97	81.24	48.45	68.76
Mean	85.42	81.85	93.04	62.43	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		1.72	6.70	7.38	
Sub plot		1.72	5.10	6.41	
INTERACTION					
M X S		3.11	10.15	-	
S X M		2.99	8.88	-	

Table 4. Interaction effect of different sources of nutrition and foliar application of liquid organic manures on the number of branches plant^{-1} of sesame at 50 DAS

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	2.86	2.84	2.97	2.57	2.81
M_2	2.18	2.08	2.73	1.48	2.12
M_3	1.56	1.46	2.17	1.38	1.64
Mean	2.20	2.13	2.62	1.81	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		0.04	0.17	6.97	
Sub plot		0.05	0.16	7.39	
INTERACTION					
M X S		0.09	2.29	-	
S X M		0.09	2.28	-	

Table 5.Interaction effect of different sources of nutrition and foliar application of liquid organic manures on the number of branches plant^{-1} of sesame at harvest

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	5.4	5.26	5.80	4.55	5.24
M_2	4.25	4.19	4.42	3.14	4.00
M_3	3.81	3.07	4.64	2.25	3.44
Mean	4.47	4.17	4.95	3.31	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		0.10	0.42	8.94	
Sub plot		0.11	0.35	8.40	
INTERACTION					
M X S		0.21	0.67	-	
S X M		0.21	0.61	-	

alone (0.93, 1.64 and 3.44 at 30, 50 DAS and at harvest respectively). The highest number of branches in 100% RDN through inorganic fertilizers (M_1) might be due to higher nitrogen availability leading to rapid vegetative development, as earlier noted by Bhavana *et al.* (2021). Among the foliar application of liquid organic manures, *Jeevamrut* @ 10% (S_3) performed the best, recording the maximum number of branches (1.32, 2.62 and 4.95 at 30, 50 DAS and at harvest respectively), followed by Vermiwash (S_1) and *Panchgavya* (S_2).

The lowest number of branches was recorded under water spray (S_4) (0.90, 1.81 and 3.31, at 30, 50 DAS and at harvest respectively), highlighting the necessity of external nutrient supplementation for branch proliferation. The enhanced branching under *Jeevamrut* can be attributed to growth-promoting substances like auxins and cytokinins, which agrees with the findings of Gabhane *et al.* (2019) and Prakash *et al.* (2019).The interaction effect between nutrient sources and foliar organic manures on number of branches was significant at 50 DAS and at harvest. Among all combinations, M_1S_3 (inorganics + *Jeevamrut*) recorded the highest number of branches at 50 DAS (2.97) and at harvest (5.80), followed by M_1S_1 (inorganics + Vermiwash) and M_1S_2 (inorganics + *Panchgavya*). In the organic group, M_2S_3 (organics + *Jeevamrut*) recorded the maximum branching at 50 DAS (2.73) and at harvest (4.42). On the other hand, the lowest number of branches was found in M_3S_4 (biofertilizer + water spray) at 50 DAS (1.38) and at harvest (2.25), due to poor nutrient availability. These observations are in close agreement with

Table 6: Influence of nutrient sources and foliar application of liquid organic manures on yield attributes and yield of sesamum

Treatments	Number of capsules plant^{-1}	Number of seeds capsule^{-1}	Test weight (g)	Seed yield (kg ha-1)	Haulm yield (kg ha-1)	Harvest index (%)
Main plots: Sources of nutrition						
M_1: 100% RDN through inorganic fertilizers	65.89	86.43	3.02	704.00	2119.00	25.37
M_2: 100% RDN through organic (1/3rd each through Press Mud cake + Vermicompost + FYM) + liquid bio fertilizers (*Azospirillum* + PSB + KRB @ 1.25 Lit ha^{-1}).	54.64	75.26	2.32	604.00	1767.00	25.24
M_3: Soil application of liquid bio-fertilizers (*Azospirillum* + PSB + KRB @ 1.25 Lit ha^{-1})	42.04	52.70	2.02	386.00	1406.00	21.36
S.Em±	1.80	2.32	0.08	12.81	32.23	-
CD (P=0.05)	7.09	9.12	0.30	50.31	126.50	-
CV (%)	11.54	11.26	10.95	7.86	6.33	-
Sub plots: Foliar application of liquid organic manures						
S_1: Vermiwash spraying twice @ 10% conc. at flower initiation and capsule development	56.61	81.47	2.58	607.00	1921.00	23.80
S_2: *Panchgavya* spraying twice @ 3% conc. at flower initiation and capsule development	55.57	66.52	2.48	567.00	1810.00	23.69
S_3: *Jeevamrut* spraying twice @ 10% conc. at flower initiation and capsule development	63.11	86.41	2.77	656.00	1975.00	24.91
S_4: Water spray	41.46	51.46	1.97	427.00	1349.00	23.56
S.Em±	1.35	2.07	0.05	11.73	39.06	-
CD (P=0.05)	4.01	6.16	0.16	34.86	116.00	-
CV (%)	7.47	8.70	6.61	6.23	6.64	-
Interaction						
Interaction (M at S)	9.20	12.86	0.38	71.89	213.50	-
Interaction (S at M)	6.94	10.67	0.28	60.38	201.00	-

Table 7. Interaction effect of different nutrient sources and foliar application of liquid organic manures on the number of capsules plant^{-1} of sesame

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	65.61	64.20	78.25	55.50	65.89
M_2	56.41	55.34	63.24	43.58	54.64
M_3	47.80	47.18	47.84	25.32	42.04
Mean	56.61	55.57	63.11	41.46	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		1.80	7.08	11.53	
Sub plot		1.34	4.00	7.46	
INTERACTION					
M X S		2.71	9.20	-	
S X M		2.34	6.94	-	

Table 8. Interaction effect of different nutrient sources and foliar application of liquid organic manures on number of seeds capsule^{-1} of sesame

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	88.10	83.99	100.20	73.44	86.43
M_2	83.85	74.32	84.59	58.30	75.26
M_3	72.47	41.24	74.42	22.65	52.70
Mean	81.47	66.52	86.41	51.46	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		2.32	9.12	11.26	
Sub plot		2.07	6.15	8.70	
INTERACTION					
M X S		3.88	12.86	-	
S X M		3.59	10.67	-	

Table 9. Interaction effect of different nutrient sources and foliar application of liquid organic manures on test weight (g) of sesame

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	3.06	2.97	3.20	2.85	3.02
M_2	2.51	2.37	2.79	1.62	2.32
M_3	2.16	2.10	2.34	1.44	2.01
Mean	2.58	2.48	2.77	1.97	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		0.07	0.30	10.95	
Sub plot		0.05	0.16	6.61	
INTERACTION					
M X S		0.11	0.38	-	
S X M		0.09	0.28	-	

Table 10. Interaction effect of different nutrient sources and foliar application of liquid organic manures on seed yield (kg ha^{-1}) of sesame

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	727	708	783	597	704
M_2	677	625	700	412	604
M_3	417	369	486	273	386
Mean	607	567	656	427	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		12.81	50.31	7.86	
Sub plot		11.73	34.86	6.23	
INTERACTION					
M X S		21.77	71.89	-	
S X M		20.32	60.38	-	

Table 11. Interaction effect of different nutrient sources and foliar application of liquid organic manures on haulm yield (kg ha^{-1}) of sesame

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	2373	2261	2434	1409	2119
M_2	1886	1837	1908	1438	1767
M_3	1505	1332	1584	1202	1406
Mean	1921	1810	1975	1350	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		32.23	126.50	6.33	
Sub plot		39.06	116.00	6.64	
INTERACTION					
M X S		66.88	213.50	-	
S X M		67.66	201.00	-	

Kranthikumar *et al.* (2025) and Deotale *et al.* (2019), who reported improved shoot proliferation with balanced nutrient supply and organic foliar supplementation.

Effect of different nutrient sources and foliar application of liquid organic manures on yield attributes and yield of sesamum

The number of capsules per plant, seeds per capsule and **test weight** in sesame were significantly influenced by both nutrient sources and foliar organic inputs. The highest capsule number (65.89), seeds per capsule (86.43) and test weight (3.02 g) were recorded with 100% RDN through inorganic fertilizers (M_1), followed by organics + biofertilizer (M_2), while biofertilizers alone (M_3) recorded the lowest values. Among foliar applications, *Jeevamrut* @ 10% (S_3) was most effective, improving capsule count (63.11) and seeds per capsule (86.41) and test weight (2.77 g) outperforming Vermiwash (S_1), *Panchgavya* (S_2) and water spray (S_4). These improvements can be attributed to the synergistic effect of balanced nutrition and bioactive compounds in enhancing reproductive traits, as supported by Singh *et al.* (2024).

The seed yield of sesame was significantly impacted by different nutrient sources and foliar application of liquid organic manures. Application of 100% RDN through inorganic fertilizers (M_1) produced the maximum seed yield (704 kg ha^{-1}), outperforming organic nutrient sources (M_2) (603 kg ha^{-1}) and soil-applied liquid biofertilizers (M_3) (386 kg ha^{-1}). The seed yield of 100% RDN through inorganic fertilizers was **16.6 % higher** than 100% RDN through organic sources combined with liquid biofertilizers and 82.1 % **higher** than biofertilizers alone. This could be linked to the fast availability of nutrients in inorganic fertilizers, which promotes vegetative growth and effective seed filling. This was shown through the higher growth and yield attributes with100% RDN through inorganic fertilizers. Similar patterns were also observed earlier by Kranthikumar *et al.* (2025) and Apagu *et al.* (2023), who reported higher seed yield with RDF due to improved nutrient utilization and plant metabolism. The treatment comprising 100% RDN from organic sources combined with liquid biofertilizers (M_2) produced considerably greater seed yield (56.18 %) than simply soil application of liquid biofertilizers (M_3). This implies that the use of FYM, vermicompost and press mud cake, as well as biofertilizers such as *Azospirillum*,

Table 12. Influence of nutrient sources and foliar application of liquid organic manures on the economics of sesamum

Treatments	Gross Returns (₹. ha-1)	Net Returns (₹. ha-1)	B:C ratio
Main plots: Sources of nutrition			
M_1: 100% RDN through inorganic fertilizers	77404	54092	2.33
M_2: 100% RDN through organic (1/3rd each through Press Mud cake + Vermicompost + FYM) + liquid bio fertilizers (*Azospirillum* + PSB + KRB @ 1.25 Lit ha^{-1})	66386	39264	1.44
M_3: Soil application of liquid bio-fertilizers (*Azospirillum* + PSB + KRB @ 1.25 Lit ha^{-1})	42503	20391	0.91
S.Em±	1410	973	0.06
CD (P=0.05)	5534	3821	0.22
CV (%)	7.86	8.89	12.58
Sub plots: Foliar application of liquid organic manures			
S_1: Vermiwash spraying twice @ 10% conc. at flower initiation and capsule development	66785	39665	1.45
S_2: *Panchgavya* spraying twice @ 3% conc. at flower initiation and capsule development	62389	39519	1.72
S_3: *Jeevamrut* spraying twice @ 10% conc. at flower initiation and capsule development	72193	47573	1.93
S_4: Water spray	47025	24905	1.13
S.Em±	1291	680	0.05
CD (P=0.05)	3835	2021	0.16
CV (%)	6.23	5.38	10.22
Interaction			
S.Em±	2235	1410	0.10
Interaction (M at S)	7907	4830	0.32
Interaction (S at M)	6642	3450	0.27

Table 13. Interaction effect of different nutrient sources and foliar application of liquid organic manures on gross returns of sesame

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	79991	77848	86128	65651	77404
M_2	74521	68724	76958	45341	66386
M_3	45841	40596	53493	30082	42503
Mean	66785	62389	72193	47025	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		1409	5534	7.86	
Sub plot		1290	3834	6.23	
INTERACTION					
M X S		2394	7907	-	
S X M		2235	6641	-	

Table 14. Interaction effect of different nutrient sources and foliar application of liquid organic manures on rupee rained of sesame

Treatments	S_1	S_2	S_3	S_4	Mean
M_1	1.98	2.44	2.54	2.00	2.24
M_2	1.43	1.60	1.73	0.77	1.38
M_3	0.79	0.90	1.31	0.46	0.86
Mean	1.40	1.65	1.86	1.08	
		S.Em±	CD (P=0.05)	CV (%)	
Main plot		0.05	0.19	11.48	
Sub plot		0.05	0.15	10.72	
INTERACTION					
M X S		0.09	0.31	-	
S X M		0.09	0.28	-	

PSB and KRB, increased microbial activity and nutrient availability over time which contributed for better growth characters and yield parameters thereby increasing seed yield. Singh *et al.* (2024) and Kiruthika *et al.* (2022) found similar results of enhanced yield with integrated organic nutrient management approaches. Regarding foliar application of liquid organic manures, the yield improvement was very impressive, as *Jeevamrut* @ 10%, Vermiwash @ 10% and *Panchgavya* @ 3 % increased the seed yield by 31.5%, 69.9% and 78.0% respectively compared to water spray. Application of *Jeevamrut* @ 10% (S_3) (656 kg ha^{-1}) outperformed other liquid organic manures, generating the highest seed yield, perhaps due to its microbial diversity and growth-promoting chemicals. Seed yield with *Jeevamrut* @ 10% (S_3) application was 8.1 % higher than Vermiwash @ 10 % (S_1), 15.7 % higher than *Panchgavya* @ 3 % (S_2) and 53.5 % higher than water spray (S_4). Gabhane *et al.* (2019) and Prakash *et al.* (2019) supported the efficacy of foliar application of liquid organic manures such as *Jeevamrut* in increasing sesame yields. Application of Vermiwash @ 10% (S_1) (607 kg ha^{-1}) proved as second best followed by *Panchgavya* @ 3% (S_2) (567 kg ha^{-1}). On the other hand, water spray (S_4) (427 kg ha^{-1}) had the lowest production, indicating the importance of nutrient-rich foliar inputs during reproductive phases. Application of liquid organic manures enhanced physiological processes and seed development due to rapid nutrient availability and microbial stimulation (Kranthikumar *et al.,* 2025 and Deotale *et al.,*2019). The interaction between nutrient sources and foliar application of organic manures significantly influenced the seed yield. The highest seed yield was obtained under application of 100% RDN *via* inorganic fertilizers with *Jeevamrut* (M_1S_3) (783 kg ha^{-1}), followed by inorganics + Vermiwash (M_1S_1) (727 kg ha^{-1}) and inorganics + *Panchgavya* (M_1S_2) (708 kg ha^{-1}) demonstrating that optimal combinations of soil and foliar nutrient sources can enhance sesame productivity synergistically. Combined effect of application of 100% RDN *via* inorganic fertilizers with *Jeevamrut* (M_1S_3), increased the seed yield by 186.8 % over application of liquid biofertilizers and water spray (M_3S_4). Regardless of the source, the *Jeevamrut* foliar application significantly improved productivity compared to other liquid biofertilizers. The lowest yield was observed with application of liquid biofertilizers and water spray (**M_3S_4**) (273 kg ha^{-1}), where limited nutrient input from biofertilizers and water spray led to poor crop performance (Bhavana *et al*., 2021).

Haulm yield and harvest index were also significantly affected by both nutrient sources and foliar organic inputs. The highest haulm yield (2119 kg ha^{-1}) and harvest index (25.37%) were recorded under 100% RDN through inorganic fertilizers (M_1). The treatment organics + biofertilizer (M_2) followed closely, while biofertilizers alone (M_3) recorded the lowest. Among foliar sprays, *Jeevamrut* (S_3) again leads with the highest haulm yield (1975 kg ha^{-1})

Effect of different nutrient sources and foliar application of liquid organic manures on the economics of sesamum

The economic analysis confirmed that the most profitable nutrient sources in sesame was 100% RDN using inorganic fertilizers, which realized the highest B:C ratio (2.33), net returns (¹ . 54,092 ha^{-1}) and gross returns (¹ . 77,404 ha^{-1}). The second best treatment was the 100% RDN through organic manures + biofertilizers, with a B:C ratio of 1.44 and moderate gross (¹ . 66,386 ha^{-1}) and net returns (¹ . 39,264 ha^{-1}). The sole application of biofertilizers showed the least economic advantage. Among foliar application of liquid organic manures, the highest net returns (¹ . 47573 ha^{-1}) and B:C ratio (1.93) were obtained by spraying with *Jeevamrut* @ 10% followed by *Panchgavya* @ 3% with a B:C ratio of 1.72 and Vermiwash @ 10% with 1.45. On the other hand, water spray consistently yielded the lowest economic returns. The interaction effect between sources of nutrition and foliar organic manures on economic returns was also significant. These results highlight the economic feasibility of combining microbial-rich foliar sprays with organic or inorganic nutrient sources to maximise profitability in sesame cultivation.

CONCLUSION

The study concluded that application of 100% RDN through inorganic fertilizers along with foliar spray of *Jeevamrut* @ 10% (M_1S_3) significantly improved sesame growth, yield attributes and yield, while also delivering the highest economic returns making it a better option for higher yields in *rabi* sesame in North coastal Andhra Pradesh. Though organics with

biofertilizers enhanced soil microbial activity, their yield performance was comparatively lower.

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