Effect of Organic Sources of Nutrient with or without Bio-stimulant {(*Kappaphycus alvarezii* (K Sap)} on Growth and Yield of Linseed

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Abstract— *An investigation titled "**Effect of organic sources of nutrient with or without bio-stimulant {Kappaphycus alvarezii (K Sap)} on growth and yield of linseed**" was carried out to assess the influence of different combinations of organic source nutrients, administered at various levels, on crop yield, and overall plant growth of the BLS-4 variety of linseed. During the Rabi season of 2023-24 at Organic Research Farm, Karguan ji, Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh. The experiment was laid in Randomized block design with 10 treatments and 3 replications with different combination of organic sources nutrients. In all 10 treatment viz T_0 (Absolute control); T_1 (10 ml K sap); T_2 (RDF [NPK: 30:15:20 kg/ha]); T_3 (RDF + 10 ml K sap); T_4 (RDF through Farmyard manure (FYM); T_5 (100% FYM + 10 ml K sap); T_6 (100% RDF through vermi-compost (VC); T_7 (100% Vermi-compost (VC) + 10 ml K sap); T_8 (50% VC + 50% FYM) and T_9 (50% VC + 50% FYM + 10 ml K sap) were evaluated. From the results it may be concluded that the treatment T_2 (RDF-NPK: 30:15:20 kg/ha) was found to be best in the terms of growth, and yield of linseed followed by T_4 (100% RDF through Farmyard manure (FYM) and T_9 (50% VC + 50% FYM + 10 ml K sap). The highest net return was also recorded in the T_4 (100% RDF through Farmyard manure (FYM) followed by T_9 (50% VC + 50% FYM + 10 ml K sap) and the highest B:C ratio was found in the same with 3.15 and 3.04 respectively. Therefore, for linseed cultivation using farmyard manure as organic source can be beneficial to get better grain yield and economic returns*.

Keywords— Linseed, Farmyard Manure, Kappaphycus alvarezii (K Sap), Benefit cost ratio.

I. INTRODUCTION

Oilseeds, which are the primary source of vegetable oils, are second only to food grains in importance to the Indian economy, making up around 10% of the country's cultivated land and the total value of its agricultural output. Based on the current level of fat and oil consumption (8.5 kg/capita/year) and the subsequent growth, the requirements for vegetable oilseed have been projected to be approximately 34 million tonnes by 2030 AD, of which 14 million tonnes is to be contributed by rapeseed - mustard to meet the annual domestic demand. Over the past three decades, the oilseeds sector has grown at a rate of 4.1% annually, outpacing the growth of livestock products and other agricultural products. This has made it one of the most dynamic sectors in the global agricultural sector. Linseed, also known as flax (*Linum usitatissimum* L.), is one of the oldest crops grown worldwide for its oil, fibre, and seed. Linseed stands out among oilseeds due to its ability to produce technical-grade vegetable oil and high-quality fibre, known for its strength and durability. With an oil content ranging from 35 to 45 percent, linseed is rich in omega-3 fatty acids, particularly alpha-linolenic acid (ALA). The presence of omega-3 fatty acids aids in reducing triglyceride levels in the blood, thereby lowering the risk of heart disease, and showing potential in combating rheumatoid arthritis. Linseed oil contains three times more omega-3 fatty acids than omega-6 fatty acids. Additionally, linseed seeds boast 36 percent protein, with 85 percent of it being digestible. The oil cake leftover after oil extraction is utilized as feed for dairy and fattening animals, contributing to milk and meat production. The linseed crop occupies an area of 1.82 lakhs hectare in the country yielding out 1.22 lakhs tones having an average productivity of 671 kg/ha for year 2019-20 (**Anonymous, 2020**). Linseed oil is the best vegetable oil for painting and varnishing because of its high iodine value, which is more than 180. It also gives the products good drying properties. As a result, the majority of linseed produced worldwide finds its application in

industry. Despite being categorised as an inedible oil, roughly 20% of the linseed produced in India is used for food, especially in states like Madhya Pradesh, Uttar Pradesh, Bihar, and Chhattisgarh. Uttar Pradesh is one of the important linseeds growing state of India, where linseed is being cultivated over 26.90 thousand hectares with a production of 17.89 thousand tones with productivity of 150 kg/ha (**Anonymous, 2021**).

Application of FYM along with inorganic fertilizers in soil leads to improve soil structure, water holding capacity and enhances system productivity. Organic sources of nutrients applied to the preceding crop benefits the succeeding crop to a great extent (**Hedge and Dwivedi, 1992**) and system productivity becomes more sustainable in nature. **Ismail *et al.*, (1994)** concluded that conservation tillage systems result significant and positive effects on several physical and chemical soil properties. Organics, in the context of agriculture, refer to plant and animal waste materials that serve as sources of nutrients for plants. These materials release their nutrients when they undergo decomposition. Vermi-compost has demonstrated remarkable capabilities as a growth enhancer for plants while also acting as a protective shield against pests and diseases (**Tiwari and Singh, 2021**). This makes it a valuable and multifaceted resource for improving soil health and supporting plant growth in agricultural and horticultural practices. Very recently the use of stimulant is gaining importance in crop production system including organic farming. Researching the effects of organic sources of nutrients, with or without bio-stimulant like *Kappaphycus alvarezii* (K Sap), on the growth and yield of linseed is crucial for several reasons. Firstly, organic farming practices are gaining momentum due to their potential to improve soil health, enhance nutrient availability, and promote sustainable agriculture. By exploring the efficacy of organic nutrient sources, farmers can reduce reliance on synthetic fertilizers, mitigating environmental pollution and minimizing health risks associated with chemical residues in food. Additionally, bio-stimulant derived from natural sources like *Kappaphycus alvarezii* have shown promising results in enhancing plant growth, stress tolerance, and nutrient uptake. Understanding their impact on linseed cultivation can contribute to optimizing organic farming techniques, improving yield, and ensuring the production of high-quality linseed crops.

II. MATERIALS AND METHODS

The goal of the current study entitled "**Effect of organic sources of nutrient with or without bio-stimulant {*Kappaphycus alvarezii* (K Sap)} on growth and yield of linseed** " was to assess the influence of different combination of organic nutrients with or without bio- stimulant, administered at various levels, on crop yield, and overall plant growth of the BLS-4 variety of linseed. The subsequent sections present details regarding the materials used and methodologies employed during the investigation, conduct in the *R*abi season of 2023 at the Organic Research Farm, karguaji, Department of Agronomy, Institute of Agricultural Sciences, Bundelkhand University, Jhansi. The experimental design employed was a Randomized Block Design (RBD) with three replications and ten treatments. The **Fisher and Yates, 1967** method was used to statistically analyse the data. The software used for analysis was OPSTAT. The linseed variety used was BLS-4. In the study, the height of randomly chosen plants from each plot was assessed in centimetres using a meter scale. Stem diameter was measured at last harvest stage using meter tape in random selected five plants. Additionally, the number of branches and leaves per plant, emerging from the main shoot, was counted, and the values were averaged. TSS was measured using refractometer. The details of treatments comprised of T_0 (Absolute control); T_1 (10 ml K sap); T_2 (RDF [NPK: 30:15:20 kg/ha]); T_3 (RDF + 10 ml K sap); T_4 (RDF through Farmyard manure (FYM); T_5 (100% FYM + 10 ml K sap); T_6 (100% RDF through vermi-compost (VC); T_7 (100% Vermi-compost (VC) + 10 ml K sap); T_8 (50% VC + 50% FYM) and T_9 (50% VC + 50% FYM + 10 ml K sap).

III. RESULTS AND DISCUSSION

There was significant difference recorded in plant height among different treatments of organic sources in linseed observed at 30, 60 and 90 DAS. The better height of plant (26.44, 44.80 and 69.55 cm) at 30, 60 and 90 days after sowing respectively was observed in T_2 (RDF [NPK: 30:15:20 kg/ha]) followed by T_4 (100% RDF through Farmyard manure (FYM) with 24.64, 43.38 and 68.06 cm recorded at 30, 60 and 90 days after sowing. T_0 (Absolute control) recorded lowest plant height (17.86, 30.54 and 49.71 cm) observed at 30, 60 and 90 days after sowing. Combining recommended dose of fertilizer (RDF) with Farmyard Manure (FYM) enhances linseed plant height due to synergistic effects. FYM enriches soil with organic matter, fostering microbial activity and improving nutrient availability. This aids in better root development and nutrient uptake, promoting vigorous growth. RDF provides essential minerals in balanced proportions, complementing FYM's organic benefits. The combined application ensures sustained nutrient release throughout the plant's growth stages, supporting steady and robust vertical development. Additionally, FYM enhances soil structure, aiding in water retention and aeration, further facilitating optimal plant growth. Consequently, linseed plants treated with RDF alongside FYM exhibit superior height compared to those receiving RDF alone, showcasing the advantages of integrated nutrient management for enhanced crop productivity. Reports were in close conformity with Kaushal and Umrao (2020); Singh *et al.*, (2021) in Linseed.

When comparing the fresh shoot weight per plant of linseed at 30, 60, and 90 DAS across the various treatments of organic sources, a notable and statistically significant difference was discovered. T_2 (RDF-NPK: 30:15:20 kg/ha) had the highest fresh shoot weight per plant (9.22, 56.60 and 159.67 grams) at 30, 60, and 90 days after sowing, respectively followed by T_4 (100% RDF through Farmyard manure (FYM) with 8.16, 56.46 and 154.82 grams at 30, 60, and 90 days after sowing. At 30, 60 and 90 days after sowing, the T_0 (absolute control) recorded the lowest fresh shoot weight per plant (3.01, 21.33 and 85.26 grams). Combining recommended dose of fertilizer (RDF) with Farmyard Manure (FYM) leads to the maximum fresh shoot weight per plant in linseed plants due to the synergistic enhancement of nutrient availability and soil health. FYM enriches the soil with organic matter, fostering microbial activity and nutrient retention, thereby promoting robust shoot growth. This facilitates the development of lush and vigorous shoots. RDF complements FYM by providing essential minerals in balanced proportions, further supporting shoot development and biomass accumulation. The integrated application ensures a sustained and balanced supply of nutrients throughout the growth stages, optimizing shoot production. Consequently, linseed plants treated with RDF alongside FYM exhibit the highest fresh shoot weight per plant compared to those receiving RDF alone, highlighting the advantages of integrated nutrient management for maximizing shoot growth and overall plant productivity. Findings were in close conformity with Jangid *et al.,* (2022); Rensang *et al.,* (2022) in Linseed.

When comparing the dry shoot weight per plant of linseed at 30, 60, and 90 DAS across the various treatments of organic sources, a notable and statistically significant difference was discovered. T_2 (RDF-NPK: 30:15:20 kg/ha) had the highest dry shoot weight per plant (3.39, 22.32 and 42.96 grams) at 30, 60, and 90 days after sowing, respectively followed by T_4 (100% RDF through Farmyard manure (FYM) with 2.99, 22.26 and 41.66 grams at 30, 60, and 90 days after sowing better over T_0 (absolute control) recorded the lowest dry shoot weight per plant (1.11, 8.42 and 22.93 grams).

When recommended dose of fertiliser (RDF) and Farmyard Manure (FYM) are combined, nutrient availability and soil health are synergistically enhanced, resulting in the maximum dry shoot weight per plant in linseed plants. By adding organic matter to the soil, FYM encourages microbial activity, nutrient retention, and strong shoot growth. This encourages the growth of lush, robust shoots. By supplying necessary minerals in balanced amounts, RDF enhances the growth of shoots and the accumulation of biomass. By providing a steady and balanced supply of nutrients throughout the growth stages, the integrated application maximises the production of shoots. Thus, when compared to plants treated with RDF alone, linseed plants treated with RDF plus FYM show the highest dry shoot weight per plant, demonstrating the benefits of integrated nutrient management for optimising shoot growth and overall plant productivity. Similar findings were reported by Janghel *et al.,* (2023) in Linseed.

When comparing the number of capsules per plant of linseed across the various treatments of organic sources, a notable and statistically significant difference was discovered. T_2 (RDF-NPK: 30:15:20 kg/ha) had the highest number of capsules per plant (65.77 capsules) followed by T_4 (100% RDF through Farmyard manure (FYM) with 62.30 capsules better over T_0 (absolute control) recorded the lowest number of capsules per plant (37.10 capsules).

When comparing the test weight of linseed across the various treatments of organic sources, a notable and statistically significant difference was discovered. T_2 (RDF [NPK: 30:15:20 kg/ha]) had the highest test weight (5.86 grams) followed by T_4 (100% RDF through Farmyard manure (FYM) with 5.71 grams better over T_0 (absolute control) recorded the lowest test weight (4.26 grams).

When comparing the seed yield per plant of linseed across the various treatments of organic sources, a notable and statistically significant difference was discovered. T_2 (RDF [NPK: 30:15:20 kg/ha]) had the highest seed yield per plant (3.15 g/plant) followed by T_4 (100% RDF through Farmyard manure (FYM) with 2.59 g/plant better over T_0 (absolute control) recorded the lowest seed yield per plant (0.93 g/plant).

When comparing the straw yield per plant of linseed across the various treatments of organic sources, a notable and statistically significant difference was discovered. T_2 (RDF [NPK: 30:15:20 kg/ha]) had the highest straw yield per plant (8.24 g/plant) followed by T_4 (100% RDF through Farmyard manure (FYM) with 7.75 g/plant better over T_0 (absolute control) recorded the lowest straw yield per plant (4.29 g/plant). Combining recommended dose of fertilizer (RDF) with Farmyard Manure (FYM) leads to better seed and straw yield in linseed due to synergistic effects on soil fertility and plant growth. FYM enriches the soil with organic matter, enhancing soil structure, microbial activity, and nutrient retention, fostering robust root systems and nutrient uptake. This promotes vigorous plant growth, resulting in increased biomass production and ultimately, higher straw yield. RDF supplements FYM by providing essential minerals, ensuring balanced nutrition critical for optimal plant development and reproductive success, thus leading to enhanced seed yield. The integrated approach provides a continuous and balanced supply of nutrients throughout the growth cycle, maximizing both seed and straw yield. Consequently, linseed plants treated with RDF alongside FYM exhibit superior overall yield compared to those receiving RDF alone, highlighting

the benefits of integrated nutrient management for maximizing productivity. Similar findings were earlier reported by Neware and Bobade (2018); Chaudhary and Rai (2021) in Linseed.

TABLE 1

EFFECT OF ORGANIC SOURCES OF NUTRIENTS WITH OR WITHOUT BIO-STIMULANT ON THE PLANT HEIGHT AND FRESH SHOOT WEIGHT OF THE LINSEED

Treatment Notation	Treatment details	Plant height (cm)			Fresh shoot weight per plant (g)		
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_0	Absolute control	17.86	30.54	49.71	3.01	21.33	85.26
T_1	10 ml K sap	17.92	31.05	50.77	3.22	22.52	86.77
T_2	RDF [NPK: 30:15:20 kg/ha]	26.44	44.8	69.55	9.22	56.6	159.67
T_3	100% RDF + 10 ml K sap	21.1	34.15	50.52	7.04	43.17	120.65
T_4	100% RDF through Farmyard manure (FYM)	24.97	43.38	68.06	8.16	56.46	154.82
T_5	100% FYM + 10 ml K sap	19.4	32.78	53.51	5.11	32.43	114.18
T_6	100% RDF through vermi-compost (VC)	20.2	38.11	51.88	5.02	30.32	109.99
T_7	100% Vermi-compost (VC) + 10 ml K sap	21.42	34.46	56.57	5.14	34.52	100.94
T_8	50% VC + 50% FYM	19.7	35.91	53.17	4.72	28.21	96.62
T_9	50% VC + 50% FYM + 10 ml K sap	24.64	42.72	61.13	8.01	47.92	141.63
SE. m (±)		**0.33**	**0.53**	**0.65**	**0.13**	**0.45**	**0.49**
$CD_{0.05}$		**0.97**	**1.58**	**1.94**	**0.37**	**1.34**	**1.45**

TABLE 2

EFFECT OF ORGANIC SOURCES OF NUTRIENTS WITH OR WITHOUT BIO-STIMULANT ON THE DRY SHOOT WEIGHT, NUMBER OF CAPSULES PER PLANT OF THE LINSEED

Treatment Notation	Treatment details	Dry shoot weight per plant (g)			No of capsules per plant	Test weight (g)
		30 DAS	60 DAS	90 DAS		
T_0	Absolute control	1.11	8.42	22.93	37.1	4.26
T_1	10 ml K sap	1.32	9.01	23.66	38.22	4.54
T_2	RDF [NPK: 30:15:20 kg/ha]	3.39	22.32	42.96	65.77	5.86
T_3	100% RDF + 10 ml K sap	2.58	17.02	32.47	52.06	5.42
T_4	100% RDF through Farmyard manure (FYM)	2.99	22.26	41.66	62.3	5.71
T_5	100% FYM + 10 ml K sap	1.89	12.79	30.73	48.79	5.42
T_6	100% RDF through vermi-compost (VC)	1.84	11.95	29.6	56.42	5.32
T_7	100% Vermi-compost (VC) + 10 ml K sap	1.89	13.6	27.17	52.88	5.22
T_8	50% VC + 50% FYM	1.71	11.12	26.01	42.67	4.88
T_9	50% VC + 50% FYM + 10 ml K sap	2.94	18.89	38.14	59.84	5.68
SE. m (±)		**0.05**	**0.23**	**0.41**	**0.45**	**0.05**
$CD_{0.05}$		**0.15**	**0.7**	**1.21**	**1.33**	**0.16**

TABLE 3
EFFECT OF ORGANIC SOURCES OF NUTRIENTS WITH OR WITHOUT BIO-STIMULANT ON THE SEED AND STRAW YIELD PER PLANT OF THE LINSEED

Treatment Notation	Treatment details	Seed yield per plant (g)	Straw yield per plant (g)	Harvest index (%)
T_0	Absolute control	0.93	4.29	18.46
T_1	10 ml K sap	1.08	4.43	19.33
T_2	RDF [NPK: 30:15:20 kg/ha]	3.15	8.24	27.45
T_3	100% RDF + 10 ml K sap	2.19	5.36	29.96
T_4	100% RDF through Farmyard manure (FYM)	2.59	7.75	27.45
T_5	100% FYM + 10 ml K sap	1.76	5.41	25.8
T_6	100% RDF through vermi-compost (VC)	1.58	5.47	23.25
T_7	100% Vermi-compost (VC) + 10 ml K sap	1.34	5.46	18.92
T_8	50% VC + 50% FYM	0.95	4.66	18.36
T_9	50% VC + 50% FYM + 10 ml K sap	2.54	7.39	27.38
SE. m (±)		**0.07**	**0.09**	**0.06**
$CD_{0.05}$		**0.2**	**0.27**	**0.18**

When comparing the harvest index of linseed across the various treatments of organic sources, a notable and statistically significant difference was discovered. T_3 (100% RDF + 10 ml K sap) had the highest harvest index (29.96%) followed by T_2 (RDF [NPK: 30:15:20 %]) and T_4 (100% RDF through Farmyard manure (FYM) with 27.45% better over T_0 (absolute control) recorded the lowest harvest index (18.46%). Because of their synergistic effects on soil health and plant nutrition, combining recommended dose of fertiliser (RDF) with farmyard manure (FYM) improves the yield per hectare of linseed produced. By adding organic matter to the soil, FYM improves microbial activity, soil structure, and moisture retention—all of which help with nutrient availability and root development. This encourages rapid plant growth, which raises the potential yield due to increased biomass accumulation. RDF enhances seed yield by providing essential minerals in balanced amounts to support plant growth and reproduction, which is a supplement to FYM. By guaranteeing a consistent supply of nutrients throughout the growth cycle, the integrated approach maximizes total yield per hectare. Thus, linseed crops treated with RDF plus FYM have higher yields than those treated with RDF alone, demonstrating the advantages of integrated nutrient management. Reports were in close conformity with Neware and Bobade (2018); Chaudhary and Rai (2021); Jangid *et al.,* (2022) in Linseed.

IV. CONCLUSION

From the above experimental findings, it may be concluded that the treatment T_2 (RDF-NPK: 30:15:20 kg/ha) was found to be best in the terms of growth, and yield of linseed followed by T_4 (100% RDF through Farmyard manure (FYM) and T_9 (50% VC + 50% FYM + 10 ml K sap). While the highest net return was found in the T_4 (100% RDF through Farmyard manure (FYM) followed by T_9 (50% VC + 50% FYM + 10 ml K sap) and the highest B:C ratio was found in the same with 3.15 and 3.04 respectively. Therefore, for linseed cultivation using farmyard manure as organic source can be beneficial to get better grain yield and quality.

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