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# Optimizing Productivity and Economics of Linseed By Different Organic and Liquid Organic Manures

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## ABSTRACT

*The declining rate of productivity and environmental sustainability is forcing growers to use organic manures as a source of nutrient supplements in linseed farming. The present investigation was conducted during Rabi season of 2021-22, 2022-23 and 2023-24 at AICRP on Linseed and Mustard, college of Agriculture, Nagpur, Dr. PDKV, Akola to evaluate the productivity and economics of linseed influenced by different organic manures and liquid organic manures. In Linseed organic production systems, major challenges like crop-weed competition, nitrogen stress at critical growth stages due to slow mineralization of organic manures, pest infestation impede to the optimal yield of linseed. The experiment was laid out in Randomized Block Design (RBD) consisting of ten treatments and three replications. The results of pooled data of three years indicated that application of FYM to supply 33% RDN + Neem cake to supply 33% RDN followed by foliar spray of vermiwash (10%) at branching, flowering and capsule development stage recorded significantly higher linseed seed yield, gross monetary returns, net monetary returns and benefit-cost ratio. The combined application of FYM to supply 33% RDN + Neem cake to supply 33% RDN followed by foliar spray of vermiwash (10%) at branching, flowering and capsule development stage also registered 7.70% and 16.12% higher seed yield of linseed than the application of FYM to supply 33% RDN + Neem cake to supply 33% RDN followed by foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage and combine application of FYM to supply 33% RDN and Neem cake to supply 33% RDN without foliar spray of liquid organic manures. The combine application of organic manures and foliar spray of liquid organic manures was reflected as an economically viable practice as evidenced from higher yields and monetary benefits.*

***Keywords:*** *linseed, organic manures, liquid organic manures, vermiwash, cow urine, neem cake, seed yield, gross monetary returns, net monetary returns and benefit-cost ratio.*

## Introduction

Linseed (*Linum usitatissimum*) is one of the oldest oilseed crops, grown across the world with an intention of obtaining grain, fiber, oil and animal feed additives. It has the maximum amount of omega-3 fatty acids and linolenic acid, which helps to reduce the risk of heart disease, arthritis and inflammatory bowel disease. It is also rich in a class of phytoestrogen which is known as lignans, which gives protection and against a certain form of cancer due to estrogenic and anti-estrogenic activity in the body due to it linseed appeared as a healthy meal. Canada is the leading producer and exporter of flax (~23%) followed by Kazakhstan and Russia. India, the second-largest linseed producer after Canada, accounting for 21.21% of the total planted area [23]. India largest linseed cultivator in terms of acreage and third in terms of production in world's. In India linseed occupies an area of 1.7 lakh ha with a production and productivity of about 1 lakh tonnes and 574 kg/ha, which is 952 kg/ha in the world, it reflect that productivity of linseed lower in India as compared world respectively. During the quinquennium (2016-21), although linseed area has declined, the productivity has substantially increased from 574 kg/ha to 644 kg/ha and the growth is positive. This is due to the release of improved high-yielding varieties and matching agro-production and protection technologies [1].

In a sustainable agricultural system a major issue will be the management of soil organic matter and the rational use of organic inputs. Food availability can be increased under organic agriculture by integration of inputs rather than the individual approach as it makes strenuous to meet food demand due to the amount of nutrient present per unit of organic manures in less in compared to the inorganic fertilizers. The crop productivity was enhanced when the nutrient supply was continuous in form of manure incorporation followed by foliar spray [24]. A combined applications of manures and liquid organic manures is superior over the application of single organic manures as a nutrient source. Given the critical importance for enhancing resource use efficiency N in organic nutrient sources by combining the application of FYM and neem cake in reduce quantity not only the nutrient supplies the soil with nitrogen that is readily available for a long time but also neem seed cake act as nitrogen inhibitor unique chemical features that suggest its potential for nutrient supply for crop growth minimizing. Besides this, foliar application of liquid organic manures viz., vermiwash and cow urine at different crop growth stages causes a striking effect on plant growth to boost the yield levels. For strategic nutrient management under organic linseed, innovative organic management practices i.e. use of diverse organic nutrient sources including organic manures in reduced quantity and

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foliar application of liquid organic manures (vermiwash and cow urine) at different crop growth stages helps to fulfill the nutritional needs of the linseed. Hence this study was proposed to find the optimal nutrient management practices in organic linseed for enhancing resource use efficiency by utilizing various organic nutrient sources.

## Materials and Methods

The present experiment was carried out during *Rabi* season of 2021-22, 2022-23 and 2023-24 at All India Coordinated Research Coordinated Project on Linseed, college of Agriculture, Nagpur, Dr. PDKV, Akola. The experiment was laid out in Randomized Block Design consisting of ten treatments with which are replicated thrice.

The linseed variety PKV NL-260 was sown at a spacing 30 cm X 05 cm. The recommended dose of NPK for linseed is 60:30:00 kg/ha. Dose of P will be compensated by using Phosphate Rich Organic Manure (PROM). Plant protection measures *viz. Trichoderma sp.*, yellow sticky trap and neem seed kernel extract 0.03% used for management of diseases and pest at different growth stages of linseed as an when it required. Considering that organic manure is a slow process in terms of soil fertility, long-term application may have a better effect on the seed yield and income of linseed and on improvements to soil environments. Hence, this experiment was designed to enhance resource use efficiency in organic linseed production by integrating the slow-releasing and fast mineralizing organic manures to meet out nutrient demand at different growth stages of linseed.

| Sr. No. | Treatments |
|---|---|
| $T_1$ | FYM to supply 33% RDN |
| $T_2$ | Neem cake to supply 33% RDN |
| $T_3$ | FYM to supply 33% RDN + Neem cake to supply 33% RDN |
| $T_4$ | FYM to supply 33% RDN + foliar spray of vermiwash (10%) at branching, flowering and capsule development stage |
| $T_5$ | Neem cake to supply 33% RDN + foliar spray of vermiwash (10%) at branching, flowering and capsule development stage |
| $T_6$ | FYM to supply 33% RDN + Neem cake to supply 33% RDN as basal dose + foliar spray of vermiwash (10%) at branching, flowering and capsule development stage |
| $T_7$ | FYM to supply 33% RDN + foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage |
| $T_8$ | Neem cake to supply 33% RDN + foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage |
| $T_9$ | FYM to supply 33% RDN + Neem cake to supply 33% RDN + foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage |
| $T_{10}$ | Absolute control (No manure or cake application except the common practices of bio-inoculants, preceding legume crop and plant protection) |

***Table 1: Nutrient content in different source***

| Sr. No. | Source | N (%) | P (%) |
|---|---|---|---|
| 1 | FYM | 0.5 | 0.2 |
| 2 | Phosphocompost | - | 10.42 |
| 3 | Neem Cake | 5 | 1.0 |
| 4 | Vermiwash | 1.58 | 0.60 |
| 5 | Cow urine | 0.51 | 0.20 |

***Table 2: Quantity of organic source required for supply of N and P in organic linseed***

| Sr. No. | Source | Doses of nutrient | Quantity (kg /ha) | N (kg/ha) | P (kg/ha) |
|---|---|---|---|---|---|
| 1 | FYM (Farm Yard Manures) | 33% N | 3960 | 19.8 | 7.92 |
| 2 | Neem Cake | 33% N | 396 | 19.8 | 3.96 |
| 3 | Vermiwash @ 10% | - | 25 | 0.40 | 0.15 |
| 4 | Cow urine @ 2.5% | - | 6.25 | 0.03 | 0.013 |
| 5 | Phosphate Rich Organic Manure (PROM) | 100% | 174 | - | 18.12 |

## Results and Discussion

### Growth and Yield Attributes

Among different organic nutrient management practices, treatments supplemented with a combination of FYM to supply 33% RDN and Neem cake to supply 33% RDN followed by foliar spray of vermiwash (10%) at branching, flowering and capsule development stage ($T_6$) recorded significantly higher growth and yield attributes i.e plant height, number of branches plant$^{-1}$ at harvest, no. capsules plant$^{-1}$, dry matter accumulation plant$^{-1}$ which was found to be statistically at par with treatment with combined application of FYM to supply 33% RDN and Neem cake to supply 33% RDN together with foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage of linseed ($T_9$). This may be due to the increased N availability for the plant by combined application of FYM, neem cake and foliar spray of vermiwash or cow urine at different growth stage mitigated the demand of macro and micro nutrients during the entire growth period of linseed had an interactive effect on flowering and fruit production as compared to applying either treatment alone.

The total dry matter accumulation per plant of linseed is a result of photosynthesis, the increase of dry matter due to application of manures and foliar spray of liquid organic manures at the different growth stages of linseed through different organic sources was noticed. The results of the present study also clearly showed a significant increase in dry matter production under the combine use of manure like FYM, neem cake and foliar spray of liquid organic manures like vermiwash and cow urine at critical growth stage of linseed. More vegetative growth due to increased plant height and better leaf production might be the contributing factor for higher dry matter production. It has resulted in the higher rate of photosynthesis and increased photosynthetic capacity, which ultimately resulted in higher dry matter accumulation in plant. Organic manures like FYM, neem cake make easily available of nutrients by acting as slow-releasing nitrogen to crops without any losses (leaching, runoff), nutrient uptake will increase and foliar application of

vermiwash contain the micro and macro nutrients and plant hormones like IAA, gibberellic acid which helps in rapid cell division and multiplication which improves the translocation of photosynthates from leaves via stem to sink i.e capsule to seed which ultimately increases dry matter accumulation per plant. Similar findings reported by [10], [7], [16], [3] in different crops.

**Productivity**

**Seed yield (kg/ha)**

The treatment combination of FYM to supply 33% RDN + Neem cake to supply 33% RDN with foliar spray of vermiwash (10%) at branching, flowering and capsule development stage ($T_6$) recorded the highest seed yield followed by the application of FYM to supply 33% RDN + Neem cake to supply 33% RDN along with foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage ($T_9$). This might be due to the availability and optimum supply of nutrients to plants favorably influenced the flowering and seed formation which ultimately increased the capsules/plant, seeds/capsule and test weight. Higher yield attributing characters in aforesaid treatments is a consequence of increased rate of photosynthesis coupled with efficient translocation of photosynthetes from source (leaf and stem) to sink (seeds) and this may be attributed to significant improvement in the sink size (number of capsules) which could be due to increased number of branches and capsules per plant, which might have resulted in higher seed yield. The organic manures like FYM have slow release of nitrogen due to its steady decomposition and slow mineralization, which helped in the availability of nutrients and neem cake contains alkaloids like nimbin and nimbidin, which have nitrification inhibiting properties and releases nitrogen slowly apart from the nutrient content in the neem cake, the retention capacity of nutrients to a prolonged period results in the release of nutrients through-out the crop growth period coupled with better assimilation of nutrients commensurate with the growth and development of the plants and thus resulted in higher yield. The foliar application of vermiwash and cow urine at the time of branching, flowering and capsule development stages increased growth, development and yield of the crop as their application coincides with higher nutrient demand for the crop might be due to the presence of growth-promoting hormones and nutrients uric acid in vermiwash and cow urine which in turn resulted in better growth and yield. In these study, the initial supply of nutrition by manure incorporation followed by foliar spray of the liquid manure thrice ensured the balanced nutrient supply throughout the growth period. Thus its balanced availability might have resulted in producing better yield. These results were following [25], [4], [8], [24], [7], [14], [20], [27], [12], [5] and [18] who reported increased yields with combined application of organic manures and liquid organic manures.

Treatments supplemented with sole application of FYM and neem cake to supply 33% RDN without foliar application of vermiwash or cow urine resulted in significantly lower linseed seed yield as compared to combined application of FYM and neem cake without foliar application of vermiwash or cow urine ($T_3$) as well as sole application of FYM and neem cake with foliar application of vermiwash or cow urine as a result of slow mineralization of organic manures and lack of sufficient nutrients during the critical growth stage of linseed, which might have may reflect on linseed crop growth and yield. Similar results were noted by [15], [26] in rice and urdbean.

**Economics**

Significantly highest gross monetary returns ( 58455 $ha^{-1}$) were obtained in the treatment with a combination of FYM to supply 33% RDN + Neem cake to supply 33% RDN and foliar spray of vermiwash (10%) at branching, flowering and capsule development stage ($T_6$) during three years study when compared to all other treatments, which was found at par with the application of FYM to supply 33% RDN + Neem cake to supply 33% RDN and foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage ($T_{9)}$ respectively ( 53937 $ha^{-1}$) were due to higher seed yields of linseed in the respective treatments. Other treatments were intermediary in their effect, while the treatment absolute control recorded the lowest net returns ( 28048 ha).

Higher net monetary return were recorded in the combined application of FYM to supply 33% RDN + Neem cake to supply 33% RDN and foliar spray of vermiwash (10%) at branching, flowering and capsule development stage ($T_6$) ( 22568 $ha^{-1}$) at par with treatment with FYM to supply 33% RDN and Neem cake to supply 33% RDN followed by foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage ($T_9$) which were at par with treatment combination of an application of FYM and Neem cake alone to supply 33% RDN followed by foliar spray of vermiwash (10%) or cow urine (2.5%) or at branching, flowering and capsule development stage ($T_4$ and $T_7$). Treatments combination with FYM to supply 33% RDN + Neem cake to supply 33% RDN with foliar spray of vermiwash (10%) at branching, flowering and capsule development stage ($T_6$) resulted in higher net returns due to the higher yields and gross returns. However, these treatments were alone application of FYM and Neem cake to supply 33% RDN followed by foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage ($T_7$ and $T_8$) recorded a higher net monetary return on account of lower cost of cultivation as a result of use of lower quantity of organic manures (33% RDN supplemented followed by foliar spray of liquid organic manures). In case of benefit-cost ratio, higher benefit-cost ratio was recorded with FYM equalized to 33% RDN and foliar spray of cow urine (2.5%) at branching, flowering and capsule development stage (1.89) followed by the treatment FYM equalivent to 33% RDN (1.86) in pooled data. The treatment absolute control recorded lowest benefit-cost ratio compared all other treatments. The lower value of benefit-cost ratio was recorded in treatment combination with combined application of FYM and Neem cake with foliar spray of Vermiwash and cow urine as compared to sole application of FYM and Neem with or without foliar spray of liquid organic manure, due to high cost of cultivation.

For getting higher seed yield and economic returns in organic linseed, from the pooled data it is evident that combined application of FYM to supply 33% RDN + Neem cake to supply 33% RDN along with foliar spray of Vermiwash (10%) at branching, flowering and capsule development stage (T6) recorded highest seed yield and economic returns than combined application organic manures without foliar spray of Vermiwash. Similar results were in line with [9], [19], [28], [11], [6] and [2].

Conclusion

For sustainable production of linseed in organic farming the combination application of solid and liquid organic manures like FYM, neem cake and vermiwash, cow urine greatly boosts linseed growth and production. It is concluded the combined application of organic manures FYM to supply 33% RDN and

Neem cake to supply 33% RDN along with foliar spray of vermiwash (10%) at branching, flowering and capsule development stages found to be best for maximizing seed yield, economic returns as compared to sole application of organic manures alone or in combination with or without liquid organics manures.

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Future Scope of the study: Use of low-cost, readily available alternate sources of nutrients for organic linseed production by optimizing the combination of organic sources and assessing the long-term impacts on soil properties and environment.

*Table 3: Growth parameters and Yield attributes of linseed at harvest as influenced by application of organic manures and liquid organic manures*

| Treatments | Plant height (cm) | | | | No of branches/plant at harvest | | | | No. of seeds/ capsule | | | | Dry Weight of plant | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2021-22 | 2022-23 | 2023-24 | Pooled | 2021-22 | 2022-23 | 2023-24 | Pooled | 2021-22 | 2022-23 | 2023-24 | Pooled | 2021-22 | 2022-23 | 2023-24 | Pooled |
| **T1** | 58.0 | 54.3 | 56.9 | **56.4** | 19.0 | 17.6 | 18.6 | **18.4** | 53.4 | 48.6 | 49.6 | **50.5** | 13.3 | 12.4 | 12.9 | **12.9** |
| **T2** | 57.0 | 53 | 55.3 | **55.1** | 23.7 | 18.4 | 20.2 | **20.8** | 51.3 | 46.8 | 47.8 | **48.6** | 12.9 | 12 | 12.5 | **12.5** |
| **T3** | 61.1 | 57.4 | 59.9 | **59.5** | 20.7 | 20.6 | 22.8 | **21.4** | 70.2 | 62.8 | 62.1 | **65.0** | 15.6 | 14.4 | 15 | **15.0** |
| **T4** | 60.7 | 55.3 | 57.4 | **57.8** | 23.7 | 21.6 | 23.6 | **23.0** | 59.9 | 54.9 | 56.1 | **57.0** | 14.3 | 13.2 | 13.7 | **13.7** |
| **T5** | 62.4 | 58.4 | 61 | **60.6** | 27.7 | 23.3 | 25.2 | **25.4** | 66.7 | 60.5 | 61.2 | **62.8** | 15.2 | 14 | 14.6 | **14.6** |
| **T6** | 64.2 | 61.9 | 64.6 | **63.6** | 19.8 | 26.1 | 28.4 | **24.8** | 72.4 | 66.5 | 69.8 | **69.6** | 16 | 15 | 16.2 | **15.7** |
| **T7** | 59.4 | 54.1 | 56.4 | **56.6** | 21.6 | 21.2 | 23.2 | **22.0** | 56.1 | 55 | 56.1 | **55.7** | 13.6 | 12.6 | 13.1 | **13.1** |
| **T8** | 61.7 | 56.8 | 59.3 | **59.3** | 24.4 | 22.7 | 24.6 | **23.9** | 64.3 | 58.3 | 59.4 | **60.7** | 14.9 | 12.7 | 13.3 | **13.6** |
| **T9** | 62.2 | 59 | 61.6 | **60.9** | 13.5 | 24.8 | 26.8 | **21.7** | 69 | 63.8 | 65.1 | **66.0** | 15.5 | 14.8 | 15.4 | **15.2** |
| **T10** | 46.4 | 43.6 | 45.4 | **45.1** | 10.5 | 13.1 | 14.6 | **12.7** | 41.3 | 39.3 | 38.8 | **39.8** | 10.5 | 9.6 | 10 | **10.0** |
| SE (m) ± | 1 | 2.3 | 2.4 | **0.4** | 1.7 | 1.5 | 1.4 | **1.7** | 2.4 | 2.7 | 2.8 | **0.7** | 0.9 | 0.6 | 0.5 | **0.2** |
| CD at 5% | 3 | 6.7 | 7 | **1.1** | 4.9 | 4.3 | 4 | **5.1** | 7.1 | 7.7 | 7.9 | **2.1** | 2.8 | 1.8 | 1.1 | **0.5** |

*Table 4: Yield and economics of linseed at harvest as influenced by application of organic manures and liquid organic manures*

| Treatments | Seed yield (kg/ha) | | | | GMR (Rs./ha) | | | | CoC (Rs./ha) | NMR (Rs./ha) | | | | B:C ratio | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2021-22 | 2022-23 | 2023-24 | Pooled | 2021-22 | 2022-23 | 2023-24 | Pooled | | 2021-22 | 2022-23 | 2023-24 | Pooled | 2021-22 | 2022-23 | 2023-24 | Pooled |
| **T1** | 719 | 640 | 790 | **716** | 43143 | 38395 | 47424 | **42987** | 23087 | 20056 | 15308 | 24337 | **19900** | 1.87 | 1.66 | 2.05 | **1.86** |
| **T2** | 713 | 656 | 873 | **747** | 42754 | 39358 | 52365 | **44826** | 25587 | 17167 | 13771 | 26778 | **19239** | 1.67 | 1.54 | 2.05 | **1.75** |
| **T3** | 767 | 693 | 990 | **817** | 46046 | 41558 | 59407 | **49004** | 30587 | 15459 | 10971 | 28820 | **18417** | 1.51 | 1.36 | 1.94 | **1.60** |
| **T4** | 732 | 688 | 914 | **778** | 43905 | 41285 | 54812 | **46667** | 25587 | 18318 | 13698 | 29225 | **21080** | 1.59 | 1.50 | 2.14 | **1.74** |
| **T5** | 741 | 702 | 995 | **813** | 44472 | 42137 | 59720 | **48776** | 28087 | 16385 | 12050 | 31633 | **20689** | 1.48 | 1.40 | 2.13 | **1.67** |
| **T6** | 784 | 799 | 1339 | **974** | 47054 | 47958 | 80354 | **58455** | 33087 | 13967 | 12871 | 47267 | **25368** | 1.34 | 1.37 | 2.43 | **1.71** |
| **T7** | 724 | 696 | 865 | **762** | 43442 | 41745 | 51893 | **45693** | 24837 | 18605 | 17908 | 27056 | **20856** | 1.82 | 1.75 | 2.09 | **1.89** |
| **T8** | 735 | 704 | 937 | **792** | 44120 | 42213 | 56195 | **47509** | 27337 | 16783 | 15876 | 28858 | **20172** | 1.68 | 1.60 | 2.06 | **1.78** |
| **T9** | 747 | 749 | 1201 | **899** | 44833 | 44914 | 72065 | **53937** | 32337 | 12496 | 13577 | 39728 | **21600** | 1.43 | 1.43 | 2.23 | **1.70** |
| **T10** | 456 | 427 | 519 | **467** | 27352 | 25645 | 31147 | **28048** | 18087 | 9265 | 7558 | 13060 | **9961** | 1.51 | 1.42 | 1.72 | **1.55** |
| SE (m) ± | 29 | 31 | 72 | **50** | 1744 | 1874 | 4337 | **2993** | - | 1744 | 1874 | 4337 | **2251** | - | - | - | - |
| CD at 5% | 86 | 93 | 215 | **148** | 5183 | 5567 | 12887 | **8893** | - | 5183 | 5567 | 12887 | **6688** | - | - | - | - |

## References


1. Anonymous. (2024). AICRP report 2. https://aicrp.icar.gov.in/linseed/pc-massage/ (May 13 2024).
2. Boraiah. (2013). Effect of organic liquid formulations and manures on growth and yield of capsicum, Ph. D. Thesis, Univ. Agric. Sci., Bangalore (India).
3. Channabasanagowda, N., K.P. Biradar, B.N. Patil, J.S. Awaknavar, B.T. Ninganur and R. Hunje. (2008). Effect of organic manures on growth, seed yield and quality of wheat. Karnataka J. Agric. Sci., 21: 366–368.
4. Devanda P, Lakhawat SS, Pilania S, Sharma SK, Mordia A, Dudi DPS et al. Effect of organic manures and liquid formulations on growth, yield and quality of okra (Abelmoschus esculentus (L.) Moench) cv. Arka Anamika. International Journal of Current Microbiology and Applied Sciences. 2021;10(6):426-433.
5. Gopakkali, P. D., Channanaik, G. A., Rajanna, H. G., Sannathimmappa, Veeresha and Manjunatha, K. B. (2011) Growth and yield of rice (Oryza sativa L.) as influenced by various levels of FYM and cattle urine application in Bhadra Command Area of Karnataka. Int. J. Forest Crop Improv., 2(1), 40-43.
6. Gowthamchand, N. J., Ganapathi and Soumya, T. M. (2019). Effect of bulky manures and fermented liquid organics on growth, yield, nutrient uptake and economics of french bean (*Phaseolus vulgaris* L.) under rainfed condition. Int. J. Agric. Environ. Biotechnol., 12(4), 361-368.
7. Gurwinder Singh, Santosh Kumar, Gurjagdeep Singh Sidhu and Ramandeep Kaur. (2018). Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.) under irrigated conditio ns. Int. J. Chem. Stud. 6: 904-907.

8. Hardik Patel, Vijay Parmar, Priyanka Patel and Vipul Mavdiya. (2018). Effect of organic fertilizers on growth, yield and yield attributes of cluster bean (*Cyamopsis tetragonoloba* L.). Int. J. Chem. Stud. 6: 1797-1799.

9. M. Vinutha, E. Somasundaram, S. Sanbagavalli, U. Sivakumar, K. Ganesan, R. Sunitha. (2023). Effect of Organic and Liquid Manures on Productivity and Profitability of Blackgram. Agricultural Science Digest, Volume 43 Issue 4: 466-471.

10. M. Yasmin, M. S. Rahman, M. A. Rahman, F. S. Shikha, M. K. Alam. (2021). Effect of Foliar Application of Vermiwash on Growth and Quality of Brinjal. Journal of Wastes and Biomass Management, 3(1): 31-34.

11. Masu, K.R., Singh, T. and Namdeo, K. (2019). Influence of integrated nutrient management on growth, yield, quality and economics of blackgram (Vigna mungo L.). Annals of Plant and Soil Research. 21(3): 289-292.

12. Patil, S. V., Halikatti, S. I., Hiremath, S. M., Babalad, H. B., Sreenivas, M. N., Hebsur, N. S. and Somanagouda, G. (2012). Effect of organics on growth and yield of chickpea. Karnataka J. Agric. Sci. 25: 326-31.

13. Priyadharshini, A.S., Singh, V., Tiwari, D., Karthik, B., Mahesh, K., (2021). Influence of spacing and organic manures on growth, yield and economics of mung bean (Vigna radiate L.). Biological Forum-An International Journal 13(1), 617–621.

14. Rajanand Hiremath (2018). Productivity and soil health of rice based cropping systems under organic management. Ph.D. Thesis, Kerala Agril.Univ, Thrissur (India).

15. Rajashree , Satyanarayana Rao , B. K. Desai , B. G. Mastana Reddy , Mahadev Swamy , Vishwanath, J and S. B. Goudar. (2024). Effect of different innovative nutrient management strategies on productivity and profitability of transplanted rice under organic production system. AATCC Review journal. Vol. 12 (1): 57-61.

16. Sahare Divya and Mahapatra Avinash. (2015). Effect of organic manures & liquid organic manures on growth, yield & economics of aerobic rice cultivation. Internat. J. agric. Sci. Vol. 11, Issue 1: 183-188.

17. Shweta, Kumar, M., Kumar, A., Sewhag, M., Neelam, Chaudhary, K., (2021). Assessing mungbean productivity under organic management. Legume Research 44(3), 349–352.

18. Shwetha, B.N. and Babalad, H.B. (2008). Effect of nutrient management through organics in soybean wheat cropping system. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad, Karnataka.

19. Somasundaram, E., Ganesan, K., Ganesh, R., Sunitha, R. and Udhaya Nandhini, D. (2020). Nutrient management techniques for organically grown finger millet. Madras Agricultural Journal. 107(7/9): 248-253.

20. Sreeja, Y., Effect of nutrient management in organic rice. (2015). M.Sc. Thesis, Tamil Nadu Agric, Univ., Coimbatore (India).

21. Sweta, S. M., Sunitha, N., Reddi, R.V. and Prasanthi, A., (2017). Efficacy of different organic nutrient management practices on growth and yield of finger millet. Andhra Pradesh J. Agril. Sci., 3(3), 165-170.

22. Tandon Kalyani, HK Awasthi, PK Pandey and SK Dwivedi. (2021). Problems faced by the linseed farmers during the adoption of recommended linseed production technology in Kanker district of Chhattisgarh. Journal of Pharmacognosy and Phytochemistry; Sp 10(1): 560-562.

23. Thiagarajan, M. and Somasundaram, E. (2019). Residual effect of organic manures on growth and yield of black gram in rice blackgram sequence. Madras Agricultural Journal. 106(4/6): 369-373.

24. Vala, F. G., Vaghasia, P. M., Zala, K. P. and Buha, D. B. (2018). Effect of integrated nutrient management on productivity of summer groundnut. Int. J. Curr. Microbiol. App. Sci. 6: 1951-957.

25. Verma Singh Ram, Yadav S.S, Umesh Kumar Singh, Anju Kanwar Khangarot, Srivastava Hritik and Disha Joshi. (2022). Effect of Organic and Liquid Manures on Yield, Yield Attributes and Economics of Urdbean. Int. J. plant soil sci., vol. 34, no. 24, pp. 511-518.

26. Verma Singh Ram, Yadav S.S, Umesh Kumar Singh, Anju Kanwar Khangarot, Srivastava Hritik and Disha Joshi. (2024). Evaluation of the Effect of Organic and Liquid Manures on Growth and Yield Attributes of Urdbean in Semi-Arid Region. Int. J. Environ. Clim. Change, vol. 14, no. 4, pp. 194-202.

27. Yadav, Subhash, M., Kalyan Singh, G., Yadav, S. and Suresh, P. (2013). A review of organic farming for sustainable agriculture in Northern India. Int. J. Agron., pp.8.

28. Yogananda, S. B., Timmegowda, P. and Shruthi, G. K. (2020). Performance of cowpea (*Vigna unguiculata* L.Walp) under organic production system in Southern dry zone of Karnataka. Legume Res., 43(2), 229-234.