Cumulative Effect of Fertilizer and Organic Spray (Banana Pseudostem Sap or Vermiwash) on Yield, Quality, Uptake and Economics of Linseed (*Linumusitatissimum* L.)

ABSTRACT

The study on linseed aimed to investigate the effectiveness of fertilizer and organic spray of banana pseudostem sap or vermiwash on yield, quality, uptake and economics of the crop was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari during rabi season of 2019-20. The experiment was laid out in Randomized Block Design with four replicates. The experimental field was fairly leveled and uniform. The treatments comprising of T1(50% RDF),T2 (50% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS), T3 (50% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS), T4(75% RDF), T5 (75% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS), T6 (75% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS), T7(100% RDF),T8 (100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS) and T9(100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS).The result indicated significant differences on seed yield, oil yield and nutrient uptake in the seed and stover. Treatment T9 outperformed the other treatments by registering maximum yield, oil yield and nutrient uptake in the seed and stover, gross return of, net return and benefit cost ratio. It could be concluded that to obtain better yield, quality, uptake and economics of rabi linseed crop the crop should be applied with 100% RDF(60-30-00 N-P2O5-K2O kg ha-1) and foliar spray of 1% vermiwash or 1% banana pseudostem sap at 30 and 60 DAS.

Keywords: Linseed; yield; quality; economics; vermiwash; banana pseudostem sap.

1. INTRODUCTION

India is one of the leading oilseeds growing country in the World and fourth largest vegetable oil economy next to USA, China and Brazil. The diverse agro-ecological conditions in the country are favorable for growing many annual oilseed crops which include groundnut, rapeseed, mustard, soybean, sunflower, sesame, safflower, niger, castor and linseed. Linseed also known as flax is one of the oldest oilseed crops grown in almost all the countries of the world. Linseed (*Linumusitatissimum* L.), one of the oldest oilseed crops cultivated either as oilseed crop or fibre crop, is perhaps one of the most antique plant. Linseed is self-pollinated crop which is widely adapted to temperate climate of the world. Linseed is an annual herbaceous plant and grows to a height of 30 to 120 cm. Fiber types are tall growing and less branched than the seed types. The stem is glabrous greyish green with leaves narrow and alternate. Fruit is a capsule, globular in shape mostly indehiscent. Seeds are compressed shinning yellow or light brown. Linseed or flax is one of most important rabi oilseed crop. It contains 35 to 45 % oil.

Fertilizer application is an important option to supply plant nutrients and improve crop yield. Nitrogen is a structural component of chlorophyll and protein therefore, adequate supply of nitrogen is beneficial for both carbohydrate and protein metabolism as it promotes cell division and cell enlargement, resulting in more leaf area and thus ensuring better growth and development of plant and improve yield. Phosphorus is an important plant nutrient which helps in root development and requires for grain formation to maturity of grain and ultimately improve crop yield of linseed [1].

Banana is the heavy nutrient feeder crop and its pseudostem sap (BPS) has been extracted from the outer sheath of pseudostem of banana. The sap is colorless clean water immediately after extraction. These are vital for plant growth and development (Islam et al.). The banana sap contains essential macro and micronutrients, growth promoting substances like cytokinin and Gibberelic Acid(GA3) and this mixture when inoculated with different microbes like Rhizobium, Azatobacter, etc.it plays an important role in enhancing yield.

Vermiwash is a liquid extract produced from vermicompost in a medium where earthworms are richly populated. Vermiwash has micronutrients and composed of beneficial soil microbes and also contain 'plant growth hormones and enzymes'. There is very little information on banana pseudostem sap and vermiwash therefore; the study aims to investigate their effectiveness on linseed production.

2. MATERIALS AND METHODS

Navsari Agricultural University campus is geographically located at 20^{o}57' N latitude and 72^{o} 54' E longitude with an altitude of 10 m above mean sea level. Navsari falls under Agro-ecological situation-III of South Gujarat Heavy Rainfall Zone which is characterized by fairly warm summer, mild winter and warm humid monsoon with heavy rainfall. The week-wise meteorological data pertaining to the maximum and the minimum temperatures,relative humidityand evaporation during the period of experimentation (November-2019 to March-2020) was recorded at the meteorological observatory of college farm, N. M. College of Agriculture, Navsari. The soil of the experimental site was characterized by dark greyish brown type having medium to poor drainage, flat topography and good water holding capacity due to clayey (65.70 %) in texture, low in available nitrogen (180.24 kg ha^{-1}), medium in available phosphorus (35.30 kg ha^{-1}) and high in available potassium (281.50 kg ha^{-1}). The experiment was laid out in Randomized Block Design having nine treatments comprising of T1(50% RDF),T2 (50% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS), T3 (50% RDF + Foliar spray of 1% banana

pseudostem sap at 30 and 60 DAS), T4(75% RDF), T5 (75% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS), T6 (75% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS), T7(100% RDF),T8 (100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS) and T9(100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS)with four replications. Observations recorded during the course of investigation were seed yield (kg ha^{-1}), stover yield(kg ha^{-1}), NPK content and uptake by seed and stover and economics by adopting standard procedure. Oil content of seed was determined by Soxhlet apparatus as per the method suggested by Tiwari et al.[3].

Statistical procedures appropriate to the randomized block design were as described by Panse and Sukhatme [4] and the mean differences were tested by F- test. Summary table for treatment mean werefurnished with standard error of mean (S.Em.) and co-efficient of variation (%). Critical Difference (C.D.) at 5 % level of probability was also been calculated where the treatment effects were found significant.

3. RESULTS AND DISCUSSION

3.1 Effect on yield

Results in Table 1 showed significant differences on linseed seed and stover yields in treatment T9(100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS). However, treatments T8, T7, T6 and T5 registered equally as T9. High linseed yield (1157 kg ha^{-1}) was recorded with the application of organic spray over other treatments.

The high seed yield could be attributed to high number of capsules and seed per plant and also due to adequate supply of nutrient element at the right time from organic spray and inorganic fertilizers which ultimately helps to improve seed yield as well as stover yield of linseed crop. Similar results were also reported by Meena et al. [5], Khajani et al. [6] and Tanvi patle et al. [7] in linseed crop.

3.2 Effect on quality

The quality of produce in the treatments was judged by oil content and oil yield in the seed. Results in Table 1 showed no significant differences on oil content. However, T9 (100% RDF + foliar spray of 1%banana pseudostem sap at 30 and 60DAS) recorded the maximum oil yield (449 kg ha^{-1}). This was followed by treatment T8 (440 kg ha^{-1}), T7 (402 kg ha^{-1}) and T6 (380 kg ha^{-1}). The oil yield correlated with seed yield and oil content in seed.

The oil yield is correlated with seed yield and oil content in seed. So, this was due to higher seed yield under corresponding treatment. These results are in accordance with the findings of Esmail et al. [8] and Nitin Sood et al. [9] in linseed.

3.3 Effect of NPK content and uptake by crop

The results in Tables 2 and 3 pertaining to nitrogen, phosphorus and potassium content in seed and stover of linseed were not significant. However, treatment (T9) recorded high nitrogen, phosphorus and potassium uptake by the seed of linseed. Treatments (T8) and (T7) recorded figures close to T9. Application of 100% RDF without organic liquid spray recorded 44%, 39.78% and 42.91% nitrogen, phosphorus and potassium respectively compared to 50% RDF which registered 19.45%, 19.66% and 21.64% nitrogen, phosphorus and potassium respectively. 75% RDF registered the lowest figures for nitrogen, phosphorous and potassium. Similar trend was observed in the case of fertilizer levels with foliar spray of 1% vermiwash or foliar spray of 1% banana pseudostem sap at 30 and 60 DAS. The results in Table 3 showed significant differences on the uptake of nitrogen, phosphorus and potassiumby linseed particularly in the stovers. The application of 100% RDF + foliar spray of 1%banana pseudostem sap at 30 and 60DAS (T9) recorded the maximum uptake of nitrogen (15.93 kg ha^{-1}), phosphorus (9.38 kg ha^{-1}) and potassium (17.15 kg ha^{-1}) by stover of linseed. Treatments (T8) and (T7) registered close to T9.

This could be due to the increased uptake the macronutrients in seed or stover yield and the application of inorganic fertilizer with organic liquid spray (banana pseudostem sap or vermiwash) increased the availability of nitrogen, phosphorous and potassium to the plant. The results are in conformity with the findings obtained by Zafar et al. [10] and Nitin Sood et al. [9] in linseed.

3.4 Effect on economics

The regional adaptability of any agronomic practices in any crop is completely based on the highest economic return of a treatment. Therefore, it is necessary to work out economics of different treatments for valid comparison of agronomic practices and sound recommendation. The data presented in Table 4 in respect to cost of cultivation, gross return, net return and benefit cost ratio was not statistically analysed. The results are drawn based on average values. The maximum net return (₹63679 ha^{-1}) was recorded under the treatment T9 (100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS) followed by the treatment T8 (100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS) (₹63579 ha^{-1}) and T7 (100% RDF) (₹57304 ha^{-1}). While in case of BCR, maximum BCR of 3.06 was found under the treatment T9 (100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60

DAS) and T8 (100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS), it might be due to higher seed and stover yield and comparatively lower cost of cultivation.

4. CONCLUSION

Based on the findings of the experiment, it can be concluded that to obtain higher and profitable yield as well as better quality, uptake of nutrient and economics of rabi linseed, the crop should be fertilized with 100% RDF (60-30-00 N-P2O5-K2O kg ha^{-1}) and carry out foliar spray of 1% vermiwash or 1% banana pseudostem sap at 30 and 60 DAS.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Table 1. Impact of nutrient management practices on yield and quality of linseed

Treatment	Yield		Quality	
	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Oil Content (%)	Oil Yield (kg ha^{-1})
T_1 - 50% RDF	690	1305	35.54	247
T_2 - 50% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	819	1491	36.12	297
T_3 - 50% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	806	1513	36.63	296
T_4 - 75% RDF	891	1679	36.81	328
T_5 - 75% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	1006	1819	37.73	379
T_6 - 75% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	1012	1872	37.57	380
T_7 - 100% RDF	1060	1944	37.93	402
T_8 - 100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	1156	2031	38.07	440
T_9 - 100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	1157	2051	38.85	449
SEm±	55.32	85.67	1.15	23.80
CD at 5%	162	250	NS	69
CV%	11.58	9.81	6.20	13.31

*NS – Non significant

Table 2. Impact of nutrient management practices on content and uptake of nutrient by seed of linseed

Treatment		Nutrient content (%)			Nutrient uptake (kg ha^{-1})		
		N	P	K	N	P	K
T_1	- 50% RDF	2.08	0.58	1.37	14.42	3.98	9.39
T_2	- 50% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	2.21	0.60	1.38	18.01	4.96	11.16
T_3	- 50% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	2.28	0.63	1.43	18.39	4.70	11.33
T_4	- 75% RDF	2.34	0.60	1.46	20.95	5.31	12.89
T_5	- 75% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	2.36	0.63	1.58	23.82	6.36	15.87
T_6	- 75% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	2.33	0.65	1.57	23.95	6.60	15.92
T_7	- 100% RDF	2.45	0.62	1.55	26.01	6.61	16.45
T_8	- 100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	2.47	0.65	1.62	28.60	7.49	18.73
T_9	- 100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	2.49	0.66	1.65	28.67	7.64	19.04
	SEm±	0.10	0.02	0.06	1.49	0.42	0.83
	CD at 5%	NS	NS	NS	4.36	1.24	2.44
	CV%	9.10	9.02	9.11	13.30	14.25	11.54

*NS – Non significant

Table 3. Impact of nutrient management practices on content and uptake of nutrient by stover of linseed

Treatment	Nutrient content (%)			Nutrient uptake (kg ha^{-1})		
	N	P	K	N	P	K
T_1 - 50% RDF	0.71	0.39	0.76	9.17	5.10	9.97
T_2 - 50% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	0.73	0.43	0.78	10.82	6.44	11.64
T_3 - 50% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	0.73	0.42	0.77	11.02	6.35	11.66
T_4 - 75% RDF	0.72	0.45	0.78	12.10	7.49	13.11
T_5 - 75% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	0.74	0.42	0.79	13.44	7.60	14.31
T_6 - 75% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	0.73	0.44	0.82	13.61	8.56	15.27
T_7 - 100% RDF	0.74	0.45	0.80	14.48	8.99	11.49
T_8 - 100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	0.75	0.44	0.81	14.95	8.85	16.25
T_9 - 100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	0.77	0.46	0.83	15.93	9.38	17.15
SEm±	0.02	0.01	0.03	0.73	0.51	0.92
CD at 5%	NS	NS	NS	2.13	1.50	2.68
CV%	6.39	9.21	10.03	11.41	13.50	13.27

*NS – Non significant

Table 4. Impact of different treatments on economics of linseed

Treatment	Gross return (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
T_1 - 50% RDF	56505	28363	28142	1.99
T_2 - 50% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	67011	29855	37156	2.24
T_3 - 50% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	65993	29855	36138	2.21
T_4 - 75% RDF	72959	28904	44055	2.52
T_5 - 75% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	82299	30396	51903	2.71
T_6 - 75% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	82832	30396	52436	2.73
T_7 - 100% RDF	86744	29440	57304	2.95
T_8 - 100% RDF + Foliar spray of 1% vermiwash at 30 and 60 DAS	94511	30932	63579	3.06
T_9 - 100% RDF + Foliar spray of 1% banana pseudostem sap at 30 and 60 DAS	94611	30932	63679	3.06

*Selling price: Linseed seed – 80 ₹ kg^{-1}

*Cost of Input: Linseed 120 ₹ kg^{-1}, Urea-5.93 ₹ $kg^{-1}$and SSP-7.44 ₹ kg^{-1}