The Pharma Innovation Journal 2023; 12(3): 3205-3208

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 3205-3208

www.thepharmajournal.com
Received: 13-01-2023
Accepted: 22-02-2023

Abhishek Kumar
Department of Agronomy, Bihar Agricultural College, BAU, Sabour, Bhagalpur, Bihar, India

SK Choudhary
Department of Agronomy, Bihar Agricultural College, BAU, Sabour, Bhagalpur, Bihar, India

RBP Nirala
Department of Plant Breeding and Genetics, Bihar Agricultural College, BAU, Sabour, Bhagalpur, Bihar, India

Pallavi Shekhar
Department of Agronomy, Bihar Agricultural College, BAU, Sabour, Bhagalpur, Bihar, India

Corresponding Author:
SK Choudhary
Department of Agronomy, Bihar Agricultural College, BAU, Sabour, Bhagalpur, Bihar, India

Effect of nutrient management through exogenous application of water-soluble fertilizers on yield and economics of linseed (*Linum usitatissimum* L.) under utera condition

Abhishek Kumar, SK Choudhary, RBP Nirala and Pallavi Shekhar

Abstract
Field experiment was conducted to find out the effect of exogenous application of water-soluble fertilizers on growth, yield and economics of linseed (*Linum usitatissimum* L.) under Uterus ecology during rabi season of 2020-21 at research farm of Bihar Agricultural University, Sabour, Bhagalpur (Bihar) revealed that two times foliar sprays of NPK 19:19:19 @ 1.0% + ZnSO4 @ 0.5% at flowering and capsule development stage along with recommended dose of fertilizer (RDF) recorded highest seeds/capsule (7.98), test weight (5.56 g), seed yield (996.98 kg ha^{-1}), oil yield (360.60 kg ha^{-1}), gross return(63727₹ ha^{-1}) whereas seed protein content (10.63%) and B:C ratio (1.84) were recorded significantly highest with the treatments of two sprays of Urea @ 2.0% + ZnSO4 @ 0.5% along with recommended dose of fertilizer (RDF) however, CGR (5.21 g/day/m^2) and RGR (17.95‘000 g/g/day) at 60-90 DAS were obtained highest with the treatment of RDF + two sprays of NPK 13:0:45 @ 1.0% + ZnSO4 @ 0.5%. Whereas harvest index is non-significant among the all the treatments.

Keywords: Linseed, yield, oil yield, protein content, zinc sulphate

Introduction
Linseed (*Linum usitatissimum* L) is an important rabi oilseed crop predominantly grown under three ecology namely rainfed, irrigated and Uterus condition. It grown on 2.98 lakh hectare with a production of 1.32 lakh tonnes culminating productivity of 391 kg/ha during 2015-16 (Anonymous, 2017) [2]. In India it is cultivated in Bihar, Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Maharashtra, Rajasthan, West Bengal, Karnataka and Orissa. In Bihar, linseed is cultivated on about 0.17 lakh hectares with a production of 0.14 lakh tonnes and a productivity of 857 kg ha-l (Annual Report, AICRP on linseed, 2017-18) [1]. Uterus crop is defined as the sowing of next crop in standing paddy crop before harvesting in order to utilize moisture efficiently under rainfed agro-ecosystem is called Uterus cropping; Uterus cropping is mainly adopted in rabi season. Uterus or paira is a system of relay cropping in paddy fields, which is done by broadcasting seeds of linseed in standing paddy at dough stage. It is a traditional practice of rainfed cultivation. Growing of linseed in Uterus system is the predominant practice of regions like Bihar, Jharkhand, Orissa, Maharashtra, M.P. Eastern part of Uttar Pradesh and Himachal Pradesh etc.

Nitrogen is one of the most recognized plant nutrient required in abundant put forth more vegetative growth, reproductive parts and also integral part of protein molecule. It plays an important role in synthesis of the plant constituents through the action of different enzymes. Phosphorus requirement is high in young cells, such as shoot and root tips, where metabolism is high and cell division occurs rapidly. Root development, flower initiation, seed and fruit development is aided by phosphorus and it has been shown to reduce disease incidence in some plants and found to improve the quality of certain crops. Potassium is an important macro-nutrient and the most abundant cation in higher plants and essential for enzyme activation Sharifi *et al*. (2018) [15]. Jyothi *et al*. (2013) [6] reported that foliar spray of 2% urea at pod development and flowering stage significantly increased uptake of Zn, N by soybean and also soil application of NPK fertilizer was found to be more beneficial to improve the productivity of soybean than NPK application alone in soybean.

It is predominately grown on marginal and sub marginal land under input starvation conditions thereby reducing the productivity of the nation. The national average productivity of linseed is very low as compared to that of world average.

Low productivity of linseed may be ascribed to many reasons, but inadequate and imbalanced fertilization are the major factor. To enhance the productivity of linseed, must be use of balanced fertilization by the application of chemical fertilizer, along with foliar application of water soluble fertilizers are of great importance in order to improve crop yield. Besides of integrated nutrient management practices, foliar application response of different nutrient is very important, hence testing of foliar response has been taken under the investigation. Foliar application of nutrients to the plants has been successfully used in correction of nutrient deficiency especially micronutrients and quickly counter a mineral unbalance that would inhibit plant metabolism.

Materials and Methods

The experiment was carried and laid out during rabi season of 2020-21 at K-block of the research farm of Bihar Agricultural University, Sabour, Bhagalpur (Bihar). It is located south of the Ganga River. The experimental plot was provided and has sufficient basic infrastructure facilities, with assured irrigation as well as proper drainage facility with uniform slope. Geologically, the geographical location of Bhagalpur comes under the Middle Gangetic plain region of Agro-climatic Zone III A. It is situated between 25°50' N latitude and 87°19' E longitude at an altitude of 52.73 meters above mean sea level. The soil was clay loam in texture with pH (7.4), organic carbon (0.42%), low in available nitrogen (210 kg/ha), medium in available phosphorous (23.0 kg/ha), and medium in available potassium (166 kg/ha). There were eight (8) treatments combination *viz* T_1: RDF + two sprays of NPK 19:19:19 @ 1.0%, T_2: RDF + two sprays of NPK 13:0:45 @ 1.0%, T_3: RDF + two sprays of urea @ 2.0%, T_4: RDF + two sprays of ZnSO4 @ 0.5%, T_5: RDF + two sprays of NPK 19:19:19 @ 1.0% + ZnSO4 @ 0.5%, T_6: RDF + two sprays of NPK 13:0:45 @1.0% + ZnSO4 @ 0.5%, T_7: RDF + two sprays of urea @ 2.0% + ZnSO4 @ 0.5% and T_8: RDF + control (water spray) tested in a randomized block design (RBD) with three replications. The following the recommended seed rate i.e. 25 kg/ha. The size of each plot was 5.0 m x 3.0 m and the no any spacing was adopted i.e. methods of sowing was broadcasting. The estimated quantity of fertilizers was applied plot wise as a basal just after harvest of rice crop. The recommended dose of fertilizer in linseed in Uterus condition are 40, 20, 20 N, P_2O_5, K_2O kg ha^{-1} respectively through urea, DAP and MOP were applied uniformly to all the plots, all fertilizer were applied in a single dose *i.e.* basal application. Intercultural operations were done as and when required. No any irrigation was given i.e. crop was grown in rainfed Uterus condition. The mature crop were harvested when crop colour change from green to brown.

Results and Discussion

Growth parameters

The crop growth rate (CGR) (5.21g $day^{-1}m^{-2}$) at 60-90 DAS (table 1) was found statistically maximum with the treatment RDF + two spray of 1.0% NPK 13:0:45 + 0.5% ZnSO4 (T_6) which was statistically at par with RDF + two spray of 1.0% NPK 19:19:19 + 0.5% $ZnSO_4$ (T_5) (4.55g $day^{-1}m^{-2}$) and RDF + two spray of 2.0% urea + 0.5% $ZnSO_4$ (T_7) (4.54g $day^{-1}m^{-2}$) and relative growth rate (RGR) of linseed (17.95 g $g^{-1}day^{-1}$) at 60-90 DAS was found statistically maximum with the treatment RDF + two spray of 1.0% NPK 13:0:45 + 0.5% ZnSO4 (T_6) which was which was statistically at par with all treatments except RDF + two spray of 0.5% $ZnSO_4$ (T_4) (12.17 g g^{-1} day^{-1}) and RDF + two spray of water (control) (T_8) (11.79 g g^{-1} day^{-1}). CGR and RGR increased might be due to increase in primary branches, secondary branches, dry matter, leaf area and harvest index, which make better use of light, water and nutrients, as well as increased in vegetative growth produced more photosynthesis and more carbohydrate produced. Similar finding was observed by Thakur *et al.* (1998) [18], Sarkar and Saha (2005) [14]. The maximum number of seed capsules^{-1} of linseed (7.98) was found statistically maximum with the treatment of RDF + two spray of 1.0% NPK 19:19:19 + 0.5% $ZnSO_4$ (T_5), which was statistically at par with RDF + two spray of 1.0% NPK 19:19:19 (T_1) (7.75), RDF + two spray of 1.0% NPK 13:0:45 (T_2) (7.41), RDF + two spray of 1.0% NPK 13:0:45 + 0.5% ZnSO4 (T_6) (7.61) and RDF + two spray of 2.0% Urea + 0.5% $ZnSO_4$ (T_7) (7.66), This variation among treatments might be due to the more number of capsules per plant similar result was revealed by Chopra and Badiyala (2016) [3], the foliar application of N P K along with B enhances seed and seed size development. whereas the test weight of linseed (5.56 g) was found statistically maximum with the treatment of RDF + Two spray of 1.0% NPK 19:19:19 + 0.5% $ZnSO_4$ (T_5), which was statistically at par with all the treatments except RDF + two sprays of $ZnSO_4$ @ 0.5% (T_4) (5.11 g) and RDF + two spray of water (control) (T_8) (5.02 g). This variation of test weight among treatments might be due to the foliar application of water soluble fertilizers direct absorb by plant as a result more bold size seed was produce. Sune *et al.* (2006) [17] and Rana *et al.* (2000) [13] founded that the maximum test weight, at 60 kg N ha^{-1} as split application in linseed. Foliar application of water-soluble fertilizer at two times there is no any significant difference has been observed in harvest index, among the treatments.

Yield

The seed yield (996.98 kg ha^{-1}) of linseed was found statistically maximum under the treatment RDF + two spray of 1.0% NPK 19:19:19 + 0.5% $ZnSO_4$ (T_5), which was statistically at par with all the treatments except RDF + two spray of water (control) (T_8) (749.28 kg ha^{-1}) (table no-2). It might be due to the foliar application of N P K along with Zn enhances seed yield and seed size development. Similar result was revealed by Khan *et al.* (1996), Debbarma *et al.* (2015) [4]. Khan and Khan (2016) [8]. The maximum oil yield of linseed (360.60 kg ha^{-1}) was found statistically maximum under the treatment RDF + two spray of 1.0% NPK 19:19:19 + 0.5% (T_5), which was statistically at par with RDF + two spray of 1.0% NPK 19:19:19 (T_1) (312.27 kg ha^{-1}), RDF + two spray of 1.0% NPK 13:0:45 (T_2) (321.17 kg ha^{-1}), RDF + two spray of 1.0% NPK 13:0:45 + 0.5% ZnSO4 (T_6) (330.25 kg ha^{-1}) and RDF + two spray of 2.0% Urea + 0.5% $ZnSO_4$ (T_7) (312.51 kg ha^{-1}). This variation of oil yield among treatments might be due to the more oil content and similarly more grain yield as a result more oil yield obtained. Kumar *et al.* (2013) [11] reported that the foliar application of soluble starter NPK @ 2 per cent + sulphur spray 2 per cent at 45 DAS and soluble booster NPK 2 per cent + boron spray 0.15 per cent at 65 DAS resulted in significantly higher oil yield and protein content. Similar result was also supported by Singh *et al.* (2013) [16] and Khurana *et al.* (1989) [10]. The statistically maximum seed protein content of linseed (10.63%) was found with the treatment RDF + two spray of

2.0% urea + 0.5% $ZnSO_4$ (T_7), which was statistically at par with all the treatments except RDF + two spray of 0.5% $ZnSO_4$ (T_4) (9.27%). This variation among treatments might be due to the more nitrogen content in these treatments. Similar result was also supported by Rana *et al*. (2000) [13].

Economics

The statistically maximum gross return (63727 ₹ ha^{-1}) was observed with the treatment RDF + two spray of 1.0% NPK 19:19:19 + 0.5% $ZnSO_4$ (T_5), which was statistically at par with all the treatments except RDF + two spray of water (control) (T_8) (47809 ₹ ha^{-1}) whereas the statistically maximum B:C ratio (1.84) was observed with the treatment RDF + two spray 2.0% urea + 0.5% $ZnSO_4$ (T_7), which was statistically at par with all of the treatments except RDF + two sprays of NPK 13:0:45 @ 1.0% (T_2) (1.31). The variation in result is might be due to higher economical yield and lower cost of cultivation in concern treatments similar result was also reported by Kashyap TL (2018) [7], Kumar *et al*. (2017) [12] and Husain *et al*. (2009) [5].

Table 1: Growth and yield attributes of linseed under Uterus condition as influenced by exogenous application of water-soluble fertilizers

Symbol	Treatments	CGR(g/day/m^2) at 60-90 DAS	RGR ('000 g/g/day) at 60-90 DAS	Seeds/ capsule	1000 seed wt. (g)	Harvest Index (%)
T_1	RDF + Two sprays of NPK 19:19:19 @ 1.0%	3.50	14.61	7.75	5.44	33.40
T_2	RDF + Two sprays of NPK 13:0:45 @1.0%	3.47	14.54	7.41	5.30	33.65
T_3	RDF + Two sprays of Urea @ 2.0%	3.62	14.77	7.15	5.27	32.08
T_4	RDF + Two sprays of $ZnSO_4$ @ 0.5%	2.75	12.17	6.99	5.11	31.86
T_5	RDF + Two sprays of NPK 19:19:19 @ 1.0% + $ZnSO_4$ @ 0.5%	4.55	16.50	7.98	5.56	33.77
T_6	RDF + Two sprays of NPK 13:0:45@1.0% + $ZnSO_4$ @ 0.5%	5.21	17.95	7.61	5.35	34.04
T_7	RDF + Two sprays of Urea @ 2.0% + $ZnSO_4$ @ 0.5%	4.54	16.28	7.66	5.24	30.99
T_8	RDF + Two sprays of water (control)	2.51	11.79	6.62	5.02	34.40
	S.Em (±)	0.42	1.53	0.23	0.13	1.96
	CD(P=0.05)	1.27	4.63	0.70	0.40	NS

Table 2: Seed yield (kg ha^{-1}), oil yield (kg ha^{-1}), seed protein content (%) and economics of linseed under Uterus condition as influenced by exogenous application of water-soluble fertilizers

Symbol	Treatments	Seed yield (kg ha^{-1})	Oil yield (kg ha^{-1})	Seed protein content (%)	Gross return (₹ ha^{-1})	B:C ratio
T_1	RDF + Two sprays of NPK 19:19:19 @ 1.0%	928.97	312.27	10.21	59466	1.68
T_2	RDF + Two sprays of NPK 13:0:45 @1.0%	909.02	321.17	10.15	58145	1.31
T_3	RDF + Two sprays of Urea @ 2.0%	884.64	294.68	10.58	56839	1.83
T_4	RDF + Two sprays of $ZnSO_4$ @ 0.5%	847.28	289.47	9.27	54465	1.62
T_5	RDF + Two sprays of NPK 19:19:19 @ 1.0% + $ZnSO_4$ @ 0.5%	996.98	360.60	10.31	63727	1.78
T_6	RDF + Two sprays of NPK 13:0:45@1.0% + $ZnSO_4$ @ 0.5%	951.28	330.25	9.65	60780	1.34
T_7	RDF + Two sprays of Urea @ 2.0% + $ZnSO_4$ @ 0.5%	924.45	312.51	10.63	59628	1.84
T_8	RDF + Two sprays of water (control)	749.28	235.54	9.65	47809	1.55
	S.Em (±)	56.26	17.76	0.37	3438.04	0.17
	CD(P=0.05)	170.66	53.88	1.11	10428.22	0.50

Conclusion

On the basis of one season of experiment in linseed it may be concluded that the exogenous application of water-soluble fertilizers under the of treatment RDF + two spray of 1.0% NPK 19:19:19 + 0.5% $ZnSO_4$ (T_5), showed superiority in seed yield (996.98 kg ha^{-1}) as well as economically more profitable such as gross return (63727 ₹ ha^{-1}), hence it is more desirable and preferable to farmers.

Acknowledgement

Authors are thankful to ICAR-AICRP programme on linseed for providing financial assistance and other support.

References

1. Annual Report, AICRP on linseed, 2017-18.
2. Anonymous, 2017.
3. Chopra, Pankaj, Badiyala D. Influence of nitrogen fertilization on performance of linseed (*Linum usitatissimum* L.) under Uterus system. Himachal Journal of Agricultural Research. 2016;42(1):91-93.
4. Debbarma D, Rai KP, Meghawal DR. Response of linseed (*Linum usitatissimum* L.) Genotype towards plant growth promoting Rhizobacteria (PGPR) and PH stress. The Ecoscan Special issue. 2015, 143-146.
5. Husain K, Chandra R, Srivastav RL, Dubey SD, Singh K, Saxena MC. Effect of zinc and farmyard manure on productivity and profitability of rice (*Oryza sativa*) - linseed (*Linum usitatissimum*) crop sequence. Indian Journal of Agronomy. 2009;54(4):395-400.
6. Jyothi CN, Ravichandra K, Babu SK. Effect of Foliar Supplementation of Nitrogen and Zinc on Soybean (Glycine max. L.) Yield, Quality and Nutrient Uptake. Indian J Dryland Agric. Res. Dev. 2013;28(2):46-48.
7. Kashyap TL. Economics Analysis of Linseed (*Linum usitatissimum L.*) Grown After Rice in Alfisols of Chhattisgarh Plain. Int. J Curr. Microbiol. App. Sci Special Issue. 2018;6:1061-1067.
8. Khan R, Khan N. Effect of plant growth regulators on physio-logical and biochemical parameters in soybean (*Glycine max* L.). M.Sc. (Ag.) Thesis, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. 2016. p. 103.
9. Khare JP, Sharma RS, Dubey MP. Effect of row spacing and nitrogen on rainfed linseed. Indian J Agron. 1996;41(1):116-118.
10. Khurana DK, Dubey DP, Rai RK. Response of linseed to nitrogen and phosphorus. Indian Journal of Agronomy. 1989;34(1):142-144.
11. Kumar CV, Vaiyapuri K, Amanullah MM, Gopalaswamy

G. Influence of Foliar Spray of Nutrients on Yield and Economics of Soybean (Glycine max L. Merill). J Bio.l Sci. 2013;13(6):563-565.
12. Kumar S, Singh BP, Lawania TK, Singh SK, Gupta D. Effect of nitrogen, sulphur and boron on seed yield and quality parameters of linseed (*Linum usitatissimum* L.). Journal of Rural and Agricultural Research. 2017;11(1):88-89.
13. Rana DS, Ganga, Saran, Pachauri DK. Effect of level and time of irrigation and nitrogen on the yield attributes, seed yield and water use of linseed (*Linum usitatissimum* L.). Annals of Agricultural Research. 2000;21(1):37-41.
14. Sarkar RK, Saha Anita. Analysis of growth and productivity of sesame (*Sesamum indicum*) in relation to nitrogen, sulphur and boron. Indian J plant physiol. 2005;10(4):333-337.
15. Sharifi SK, Lalitha BS, Prajwal Kumar GK and Qasimullah R. Effect of foliar application of water soluble fertilizer on nutrient uptake and economics of soybean (*Glycine max* L. Merrill) International Journal of Chemical Studies. 2018;6(4):2306-2309.
16. Singh DN, Bohra JS, Singh JK. Influence of NPK, S and variety on growth, yield and quality of irrigated linseed (*Linum usitatissimum* L.). Indian Journal of Agricultural Sciences. 2013;83(4):456-458.
17. Sune SV, Deshpande RM, Khawale VS, Baviskar PK, Gurao BP. Effect of phosphorus and sulphur application on growth and yield of linseed. Journal of Soils and Crops. 2006;16(1):217-221.
18. Thakur DS, Patel SR, Lal N. Yield and quality of sesame (*Sesamum indicum*) as influenced by nitrogen and phosphorus in light textured inceptisols. Indian J. Agron. 1998;43:325-328.