The Bioscan 16(4): 227-231, 2021
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF SOURCE OF NITROGEN, ITS LEVEL AND CROP DENSITY ON GROWTH AND YIELD OF LINSEED (*Linum usitatissimum* L.)

SUSANA BASAIAWMOIT, *SHIKHA SINGH, NAPHISABET NONGPHLANG, POCHAMPALLY KAVYA AND DHANANJAY TIWARI
Department of Agronomy, Naini Agricultural Institute,
SHUATS, Prayagraj, Uttar Pradesh - 211 007
e-mail: susanawanda@gmail.com

KEYWORDS
Nitrogen
FYM
Spacing
Linseed

Received on :
12.12.2020

Accepted on :
07.09.2021

***Corresponding author**

ABSTRACT
A field experiment was conducted at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Prayagraj (U.P.) in the years 2019–2020. The seeds of linseed cultivars (SHUATS Linseed-6) were sown at row spacing of 10, 20 and 30 cm. Three levels of different nitrogen along with two levels of FYM *i.e.*25 and 50 % were used. The objective was to study the effect of spacing and source of nitrogen on growth and yield of Linseed and to study the economics of all the treatment combination. Results revealed that higher plant height (86.46),plant dry weight (23.61), number of branches plant^{-1} (7.20), number of capsule plant^{-1} (42.13), number of seeds capsule^{-1} (7.47), 1000 grain weight (5.45), seed yield (1221.33kg/ha), stover yield (3111 kg ha^{-1}) which was 23.19 % higher to that of treatment combination 100% Nitrogen through Urea + 10 x 5 cm. This was due to higher plant density, higher number of branches, and higher number of capsules per plant.

INTRODUCTION

Linseed (*Linum usitatissimum* L.) belongs to the family Linaceae. It is a herbaceous plant grown in winter season in India as a *rabi* crop and is sown in first fortnight of October. Linseed is the oldest oil and fibre yielding crop. Every part of Linseed plant has commercial value (Jhala and Hall Linda 2010). Linseed (*Linum usitatissimum* L.) also known as flax. Linseed is an important crop grown both for its seed as well as fiber which is used for manufacture of linen. The seed contains a good percentage of oil varying from 33 to 47 % in different accessions of linseed crop. It contains omega-3-fatty acids (linoleic acid) which are mono unsaturated, that make it edible and it is also helpful for heart patients. India is the second largest (21.21 %) linseed growing country in the world after Canada and production-wise it ranks fourth (8.20 %) in the world after Canada (40.51 %), China (18.68 %), and USA (10.89 %). In Uttar Pradesh, linseed is cultivated in an area of 78.7 ha and production is 39.9 tonnes with a productivity of 507 kg/ha (Hedge and Damodaran, 2005). At present, linseed is cultivated in about 2.63 lakh hectares with contribution of 1.26 lakh tonnes to the annual oilseed production of the country. The average productivity of linseed is 477 kg/ha (2015-16). Major linseed growing states in India are Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Bihar, Rajasthan, Orissa and Karnataka. Madhya Pradesh has largest growing area (1.16 lakh ha) and production (0.55 lakh tonnes) with 474 kg/ha productivity (Ministry of Agriculture and farmers welfare, Government and past Issues, (2015- 2016).

Nitrogen is indispensable for increasing crop production as a constituent of protoplasm and chlorophyll and is associated with the activity of every living cell. Similarly, phosphorus also plays an important role in energy storage and transfer in the plant system. In addition, phosphorus is an important constituent of nucleic acids, phytins, phospholipids and enzymes.

Crop geometry is one of the most important factors which have to be maintained at optimum level to harvest maximum solar radiation and utilize the soil resources effectively. As plant density increases the grain yield improves to a maximum, which remains constant within a range and declines more or less, steeply as population pressure increases still further. Due to high planting density, the integrated nutrient management (INM) practice is important to retain productivity of the soil along with heavy returns. It has been found that no single source of nutrients is capable of supplying the necessary elements in adequate and balanced proportion and the use of inorganic fertilizers being a costly affair also leads to deterioration of soil health and quality of the produce. However, the use of organic sources alone, do not result in spectacular increase in crop yields, due to their low nutrient status and are also not easily available for a large scale use. Therefore, in the present context, a judicious combination of organic manures and chemical fertilizers may help to maintain soil and crop productivity. It also helps in restoring fertility of soil and improves nutrient use efficiency which is essential for improved and sustainable crop production.

Farm Yard Manure (FYM) is a valuable soil improver which enhances and restores a range of natural properties of the soil. It increases soil fertility, adds humus and slow releasing nutrients to the soil, aids water and nutrient retention, attracts worms to the soil, ideal for mulching. Farmyard manures are the major source of nutrient supply on small farm holdings Fageria, (2012). Manure has long been considered a desirable soil amendment, and reports of its effects on soil properties are numerous. According to Dunjana *et al. (*2012), the addition of FYM resulted in significant (P< 0.01) increases in soil organic carbon (SOC).Keeping these points in view an investigation on "Response of Nitrogen levels and Row spacing on growth and yield of Linseed *(Linum usitatissimum* L.)", has been undertaken with the hypothesis that whether application of nitrogen at different levels along with organic source of nutrient can compensate the fertilizer requirement in linseed with following objectives.

(a)To study the effect of spacing and nitrogen levels on growth and yield of Linseed.

(b)To study the economics of all the treatment combination.

MATERIALS AND METHODS

The experiment was conducted during the *rabi* season 2019-20, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture , Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25º39′ 42′′N latitude, 81º67′ 56" E longitude and 98 m altitude above the mean sea level (MSL). Recommended dose of NPK *viz*., 80 kg N,30 kg P_2O_5 and 30 kg K_2O /ha was applied uniformly through DAP and MOP, respectively. Nitrogen was applied through Urea, and FYM as per treatment. Quantity of fertilizer for each plot was calculated on the basis of gross plot size. Split dose of N was applied as basal dressing at the time of sowing and split was applied at 60 DAS. As per treatments, total amount (quantity) of Sulphur and Potassium was given at the time of sowing through basal application.

Soil in experimental Site Information

The soil of experimental plot was sandy loam in texture, neutral in soil reaction (pH 7.6), low in organic carbon (0.42%), available N (0.028 %), available P (13.50 kg/ha) and available K (257.04 kg/ha). Experiment was laid out in RBD. There were 9 treatments, and replicated three times. The treatment consisted of three levels of Nitrogen *i.e.* 100%, 75% and 50% N through Urea and 25 and 50% of N replaced through FYM. Crop (SHUATS Linseed-6) was sown in 10, 20 and 30 cm of row spacing where as plant to plant spacing is uniform *i.e.* 5 cm.

RESULTS AND DISCUSSION

Plant height

At 120 DAS, highest plant height (86.46 cm) was recorded with application of 50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm which was significantly superior over the rest of the treatments except with application of 50% Nitrogen through Urea +50% Nitrogen through FYM + 10 x 5cm (86.0 cm), 50% Nitrogen through Urea +50% Nitrogen through FYM + 20 x 5cm (85.46cm), 75% Nitrogen through Urea + 25% Nitrogen through FYM + 10 x 5cm (85.06 cm). Obtaining higher plant height with the application of 50% Nitrogen through Urea +50% Nitrogen through FYM +30 x 5cm might be due to sufficient availability of sunlight and nutrient which increased plant growth and development. Tiwari *et al*.(2018) also this can be attributed to the fact that N level can differentially affect the yield and its component, due this fact that N can affect numerous growth processes, including organ development, fertilization, seed formation, and development Lafond *et al*. (2008).

Dry matter accumulation

Dry matter accumulation was increased with crop age and was found maximum at 60, 80, 100 and 120 DAS, the dry weight accumulation recorded in treatment T_1 (100% Nitrogen through Urea + 10 x 5 cm) and T_4 (75% Nitrogen through Urea + 25% Nitrogen through FYM + 10 x 5cm) were statistically at par with that recorded under treatment T_9 (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm).The reason for obtaining highest dry matter with the application of (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) may be due to the application of Nitrogen through urea which significantly improved the dry matter accumulation in the plants over lower nitrogen level Sharma *et al*. (2005) also plants treated with combination of 50% FYM and 50% Urea turned out to be the highest yielding plants with more branches, higher number of capsules, highest plant dry weight and maximum number of seeds. Since the application of FYM has been proved to be efficient in promoting the root formation, plant height and plant biomass Singh *et al*. (2008)

Number of branches plant^{-1}

At 20, 40 and 60 DAS.There was no significant difference among all treatment combinations.At 80, 100 and 120 DAS maximum number of branches/ plant 6.26, 7.20 and 7.20 respectively was recorded with application of 50% Nitrogen through Urea +50% Nitrogen through FYM + 30x5cm. There was no significant difference among all treatment combinations.The highest Number of branches plant^{-1} with the application of (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) may be due to sufficient availability of sunlight and nutrient which increased plant growth and development Ganvit *et al*. (2018) also each successive increase in the level of N from 30-90 kg ha^{-1} significantly increased the plant height, number of branches per plant, capsules per plant, test weight, seed and straw yield Singh and Verma (1999) and plants treated with combination of 50% FYM and 50% Urea turned out to be the highest yielding plants with more branches, higher number of capsules, highest plant dry weight and maximum number of seeds. Since the application of FYM has been proved to be efficient in promoting the root formation, plant height and plant biomass Singh *et al*. (2008).

Yield attributes and yield

Yield parameters presented in Table 4 *viz*. the highest number of number of capsule plant^{-1} (42.13) ,highest number of number of seeds capsule^{-1} (7.47),maximum test weight (5.45),maximum

Table 1: Effect of levels and sources of Nitrogen and Spacing on Plant Height (cm) of Linseed

	Plant height (cm)					
Treatments	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS
100% Nitrogen through Urea + 10 x 5 cm	12.16	22	34.93	59.54	74	81.46
100% Nitrogen through Urea + 20 x 5cm	11.61	22.4	35.9	65.53	74.7	77.06
100% Nitrogen through Urea +30 x 5 cm	11.69	21.66	34.23	62.04	80.93	75.12
75% Nitrogen through Urea + 25% Nitrogen through FYM + 10 x 5cm	11.51	21.83	34.16	60.01	82.83	85.06
75% Nitrogen through Urea + 25% Nitrogen through FYM + 20 x 5cm	12.59	22.13	34.6	64.94	73.73	82.4
75% Nitrogen through Urea + 25% Nitrogen through FYM + 30 x 5cm	12.36	21.83	35.86	63.34	76.06	76.45
50% Nitrogen through Urea +50% Nitrogen through FYM + 10 x 5cm	11.5	21.23	36.4	60	81.4	86
50% Nitrogen through Urea +50% Nitrogen through FYM + 20 x 5cm	12.56	22.13	37.8	63.38	81.25	85.46
50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm	12.05	21.24	36.06	66.83	83.86	86.46
SEm (±)	0.36	0.43	1.27	2.19	4.44	3
CD (5%)	NS	NS	NS	6.57	8.31	9

Table 2 : Effect of levels and sources of Nitrogen and Spacing on Dry matter accumulation (g/m²) of Linseed

	Dry matter accumulation (g/m²)					
Treatments	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS
100% Nitrogen through Urea + 10 x 5 cm	103.15	87.75	107.11	1174.22	3932.26	4126.22
100% Nitrogen through Urea + 20 x 5cm	41.11	27.85	63.44	553.72	2075.21	2159
100% Nitrogen through Urea +30 x 5 cm	31.84	29.75	58.91	343.75	1461.7	1529.1
75% Nitrogen through Urea + 25% Nitrogen through FYM + 10 x 5cm	92.66	96.88	117.55	1153.84	3931.55	4119.11
75% Nitrogen through Urea + 25% Nitrogen through FYM + 20 x 5cm	41.66	22.92	53.55	534.78	2133.88	2229.66
75% Nitrogen through Urea + 25% Nitrogen through FYM + 30 x 5cm	33.25	24.38	50.44	356.19	1363.19	1427.78
50% Nitrogen through Urea +50% Nitrogen through FYM + 10 x 5cm	31.64	27.16	42.59	341.45	1522.95	1573.91
50% Nitrogen through Urea +50% Nitrogen through FYM + 20 x 5cm	51.7	32.97	73.96	504.75	2060.88	2160.33
50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm	98.66	70.53	122.48	1188.84	4223.77	4400.44
SEm (±)	14.29	13.76	13.58	30.47	121.12	124.01
CD (5%)	42.85	41.26	40.72	91.37	363.14	371.78
CV	42.38	51.05	30.55	7.72	8.31	8.148

Table 3: Effect of levels and sources of Nitrogen and Spacing on Number of Branches of Linseed

	Number of Branches					
Treatments	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	120 DAS
100% Nitrogen through Urea + 10 x 5 cm	2.73	2.66	4.53	5.73	6.46	6.46
100% Nitrogen through Urea + 20 x 5cm	2.4	2.66	4.6	4.93	6.6	6.6
100% Nitrogen through Urea +30 x 5 cm	2.81	2.8	4.66	6.13	6.73	6.73
75% Nitrogen through Urea + 25% Nitrogen through FYM + 10 x 5cm	2.77	3.06	4.6	5.03	6.66	6.66
75% Nitrogen through Urea + 25% Nitrogen through FYM + 20 x 5cm	2.33	3.2	4.66	6.13	6.05	6.05
75% Nitrogen through Urea + 25% Nitrogen through FYM + 30 x 5cm	2.57	2.86	4.6	6	6.66	6.66
50% Nitrogen through Urea +50% Nitrogen through FYM + 10 x 5cm	2.41	2.73	4.8	5.8	6.8	6.8
50% Nitrogen through Urea +50% Nitrogen through FYM + 20 x 5cm	2.94	3.13	4.93	6.06	6.53	6.53
50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm	2.47	3.13	4.93	6.26	7.2	7.2
SEm (±)	0.22	0.26	0.18	0.1	0.21	0.21
CD (5%)	NS	NS	NS	0.32	0.63	0.63

seed yield (1221.33 kg ha^{-1}) and highest stover yield (3111 kg ha^{-1}), was observed in 50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm which is significantly superior over rest of the treatments.

Table 4: Effect of levels and sources of Nitrogen and Spacing on Yield attributes of Linseed

Treatments	Yield attributes and yield					
	Number of capsule plant^{-1}	Number of seeds capsule^{-1}	1000 grain weight	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest Index (%)
100% Nitrogen through Urea + 10 x 5 cm	34.47	7.13	5.2	938	2402.66	27.98
100% Nitrogen through Urea + 20 x 5cm	40.07	6.87	5.13	1009	2568	28.2
100% Nitrogen through Urea +30 x 5 cm	38	7.33	5.18	1116.66	2783.66	28.62
75% Nitrogen through Urea + 25% Nitrogen through FYM + 10 x 5cm	36.6	6.53	5.17	1120	2638.66	29.83
75% Nitrogen through Urea + 25% Nitrogen through FYM + 20 x 5cm	32.33	6.2	5.16	1156	2965.66	28.21
75% Nitrogen through Urea + 25% Nitrogen through FYM + 30 x 5cm	38.53	6.45	5.01	1111.33	2607.33	29.94
50% Nitrogen through Urea +50% Nitrogen through FYM + 10 x 5cm	35.08	7.41	5.14	1158	2581	30.95
50% Nitrogen through Urea +50% Nitrogen through FYM + 20 x 5cm	39.73	6.33	5.26	1152.66	2626.66	30.51
50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm	42.13	7.47	5.45	1221.33	3111	28.39
SEm (±)	2.18	0.46	0.09	45.17	116.72	0.89
CD (5%)	6.56	1.39	0.27	135.42	349.92	2.67
CV	9.9	10.55	3.1	7.0	7.0	5.2

Table 5: Effect of levels and sources of Nitrogen and Spacing on Economics of Linseed

Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C Ratio
100% Nitrogen through Urea + 10 x 5 cm	28,896.95	54108	25211.05	0.87
100% Nitrogen through Urea + 20 x 5cm	28,896.95	58154	29257.05	1.01
100% Nitrogen through Urea +30 x 5 cm	28,896.95	64184.33	35287.38	1.22
75% Nitrogen through Urea + 25% Nitrogen through FYM + 10 x 5cm	29,076.31	63916	34839.69	1.2
75% Nitrogen through Urea + 25% Nitrogen through FYM + 20 x 5cm	29,076.31	66697	37620.69	1.29
75% Nitrogen through Urea + 25% Nitrogen through FYM + 30 x 5cm	29,076.31	63388.67	34312.36	1.18
50% Nitrogen through Urea +50% Nitrogen through FYM + 10 x 5cm	29,255.67	65643	36387.33	1.24
50% Nitrogen through Urea +50% Nitrogen through FYM + 20 x 5cm	29.255.67	6551333	36257.66	1.24
50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm	29,255.67	70399.67	41143.99	1.41

The reason for obtaining highest number of capsule plant^{-1} with the application of (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) may be due to which the plants were treated with combination of 50% FYM and 50% Urea turned out to be the highest yielding plants with more branches, higher number of capsules, highest plant dry weight and maximum number of seeds Singh *et al*.(2008).

The reason for obtaining highest number of seeds capsule^{-1} with the application of (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) may be due to plants grown narrow spacing produce more branches, which stimulate the formation of a larger number of capsules and seeds on the stems Ganvit *et al*. (2018).

Reasons for recording higher 1000 grain weight may be due to the balanced system of Nitrogen nutrition in which the plants were treated with combination of 50% FYM and 50% Urea turned out to be the highest yielding plants with more branches, higher number of capsules, highest plant dry weight and maximum number of seeds Singh *et al*. (2008) .

Higher seed yield might be the result of cumulative effect of improvement in growth and yield attributes such as number of branches/plant, number of capsules/plant, number of seeds/ capsule as well as 1000 seed weight. The treatment (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) recorded significantly higher seed yield (1221.33 kg/ha) of linseed. Higher seed yield might be more number of plants per unit area resulted in higher yield per unit area. As narrow spacing sown crop have more number of plants per unit area and reduction in yield per plant might be compensated with yield from more number of plants per unit area. But there is an optimum plant population level at which yield per plant decrease with narrow spacing is compensated with yield from more number of plants per unit area. This equilibrium plant population where yield per unit area is higher with given plant population is considered optimum crop spacing. These results lend support to those reported by Kushwaha *et al*. (2006) at Kanpur; Saoji *et al*. (2007) at Gondia and Gohil *et al*. (2016) at

Navsari.

Significantly higher straw yield (3111 kg/ha) was recorded under the treatment (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm). Higher straw yield might be due to healthy vegetative growth in terms of plant height obviously resulted into more straw yield. These findings are related with the results of Kushwaha *et al.* (2006); Chaudhary (2009) and Gohil *et al.* (2016)

Effect of levels and sources of Nitrogen and Spacing on Economics of Linseed

The highest gross return (70399.67 ha^{-1}) was obtained in treatment T_9 (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) and highest cost of cultivation (29,255.67 ha^{-1}) was obtained in treatment T_9 (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) same as benefit cost ratio. From economic point of view, the treatment T_9 (50% Nitrogen through Urea +50% Nitrogen through FYM + 30 x 5cm) followed by T_5 (75% Nitrogen through Urea + 25% Nitrogen through FYM + 20 x 5cm) with B:C ratio 1.41 and 1.29 respectively were found to be more profitable than the rest of treatment combinations.

REFERENCES

Al-Doori, S.M. 2012. Influence of sowing dates on growth, yield and quality of some flax (*Linum usitatissimum* L.) genotypes. *College of Basic Education Researchers J.* **12(1):**733-746.

Chaudhary, S. 2009. Study on row spacing for different varieties of Linseed (*Linum usitatissimum* L.). *International J. Plant Science*. **4 (2):**373-374.

Dalal, L.P. and Nandkar, P.B, 2001. Effect of NPK fertilizers in relation to seed yield in *Brassica juncea* (L) var.pusa bold. *The Bioscan*. **6(1):**59-60

Dordas, C. and Sioulas, C. 2008. Dry matter and nitrogen accumulation, partitioning, and retranslocation in safflower (*Carthamus tinctorius* L.) as affected by nitrogen fertilization. Field Crops Research. **110:** 35-43

Dordas, C 2008. Dry matter, nitrogen and phosphorus accumulation, partitioning and remobilization as affected by N and P fertilization and source–sink relations. *European J. Agronomy*. **30:** 129-139.

Dordas, C. A., Lithourgidis, A. S., Matsi Th., Barbayiannis, N. 2008. Application of liquid cattle manure and inorganic fertilizers affect dry matter, nitrogen accumulation, and partitioning in maize. *Nutrient Cycle Agro ecosystem*.**80**: 283-296.

El-Mohsen, A.A., Abdallah, A.M., Mahmud, G.O. 2013. Optimizing and describing the influence of planting dates and seeding rates on flax cultivars under *Middle Egypt region conditions. World Essays J.* **1 (2):**2839.

Ganvit, P., Singh, R.K., Singh, A., Singh, K. 2018. Growth, yield and nutrient uptake and quality of Linseed (*Linum usitatissimum* L.) Varieties as Affected by Varying Sowing Dates. *Environment and Ecology*. **33 (1):**271-274.

Gohil, J.R., Kamani, M.D., Kumar D., Arvadiya, L.K. 2016. Performance of linseed (*Linum usitatissimum* Linn.) to different dates of sowing, seed rate and row spacing. *Advances in Life Science*. **5 (5):**1755-1759.

Kalita, H., Bora, P.C., Debnath, M.C. 2015. Effect of sowing date and tillage on soil properties, nutrient uptake and yield of linseed (*Linum usitatissimum* L.) grown in winter rice (*Oryza sativa* L.) fallows. *Indian J. Agronomy*.**50(1):**70-72.

Kumari, A., Singh, R.P. and Yeshpal, 2012. Productivity, nutrient uptake and economics of mustard hybrid (*Brassica juncea* L.) under different planting time and row spacing. *Indian J. Agronomy*.**57 (1)**: 61-67.

Kumari, A., Joshi, P.K, Mohd. Mohsin, Arya, M.C. and Ahmed, Z 2015. Studies of effect of spacing and nitrogen on false flax (*Camelina sativa cv calena*)under central western Himalayas of India. *The Bioscan*. **10(3)**:1321-1326.

Kushwaha, C. L., Prasad, K., Kushwaha, S.P. 2006.Effect of row spacing and nitrogen doses on yield attributes and yield of linseed (*Linum usitatissimum* L.) varieties under irrigated conditions of Bundelkhand. Plant Archives. **6(2):**741-743. ~ 392 ~ *J. Pharmacognosy and Photochemistry*.

Lafond, G. P., Loeppky, H. A. and Dirksen, D. A. 2008. The effects of tillage systems and crop rotations on soil water conservation, seedling establishment and crop yield. *Canadian J. Plant Science*. **72:**103-115.

Makeen,Y., Murthy, I.Y.L.N, Reddy, K.P.C, Reddy, B.N, Chandranath, H.T. 2008. Response of sunflower to phosphorus application in vertisols Helia. **26:** 147-154.

Maurya, A.C., Raghuveer, M., Goswami, G., Kumar, S. 2017. Influences of date of sowing on yield attributes and yield of linseed (*Linum usitatissimum* L.) varieties under dry land condition. *International J. Current Microbiology and Applied Sciences*. **6 (7):**481-487.

Sharma, V. K., Chakraborty, A and Bela, B. 2005. Response of sunflower to crop geometry and N and P application on rice fallow Gangetic alluvial soil. *Indian J. Agronomy*. **40:** 657-659.

Singh, P.U., Pohare, V.B., Shinde, L. D. 2008. Response of different linseed varieties under extended sowing dates. *International J. Tropical Agriculture*. **33(4):**