

**Pre-  
Sowing Seed Treatment of Chemicals, Botanicals, Plant growth regulator on Growth, Yield and Yield attributing traits of Linseed (*Linum usitatissimum* L.) var. Uma  
Under Late Sowing conditions var. Uma**

**ABSTRACT**

The experiment was conducted at Field Experimentation and Farm Research Centre Department of Genetics and Plant Breeding, (Rabi season, 2020-21) Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The experimental material for present investigation comprised of thirteen priming treatments on linseed seed. The experiment was conducted in Randomized Block Design (RBD) with three replications. Linseed seeds of variety Uma was subjected to various pre sowing treatments like  $MnSO_4$ ,  $Feso_4$ , Pongamia leaf powder, Arappu leaf powder, Notchi leaf powder, Kinetin at various concentrations along with distilled water control. The study revealed that linseed seeds treated with Pongamia leaf powder  $T_6$  (5%) showed maximum field emergence (97.48%), plant height 60 days (77.46cm) and 90 days (92.69cm) number of primary branches per plant (5.97), number of seeds per capsule (8.95), test weight (9.43), seed yield per plant (4.78gms), seed yield per plot (128.4gms), biological yield (8.26), harvest index (79.53) and reduced days to 50% flowering (65.89), days to maturity (115.89), followed by kinetin  $T_{1250}$  (ppm), in comparison to control  $T_0$ .

**Key words:** Arappu leaf powder,  $Feso_4$ , kinetin,  $Mnso_4$ , notchi leaf powder, pongamia leaf

**Comment [S1]:** Aim of the study should be focus in the first line.

**Comment [S2]:** Authors should add a conclusion.

### Introduction

Linseed (*Linum usitatissimum* L.) is an annual self-pollinated crop with origin in the Middle East or the Indian regions (Vavilov, 1951). The generic name *Linum* derives from Celtic word, 'lin' means, 'thread' and the species name *usitatissimum* (Latin word) means 'very useful'. *Linum usitatissimum*, only cultivated species of the genus *Linum* of family Linaceae is cultivated for oil from the beginning of agriculture eight thousand years ago and somewhat later for fibre (Zohary and Hopf, 1999). India ranks second in area after Canada in the world, but is at fourth place in term of production after Canada, China and U.S.A. In term of productivity India (449kg/ha) is far below to Canada (1492kg/ha), U.S.A (1484 kg/ha), Egypt

(1465kg/ha). (Alukedi et al., (2021). Linseed is a Rabi crop in India which is a member of family Linaceae. Linseed (*Linum usitatissimum* L.) is an erect annual herbaceous plant 30-120cm, in height with slender glabrous, grayish green stem. Flowers are showy, variously shaped regular, hermaphrodite, pentamerous, hypogynous and borne in loose terminal raceme or open cyme with blue, white or pink colour. *Linum usitatissimum* L. is the only species with non-dehiscent or semi-dehiscent capsules for modern cultivation of the family Linaceae. It contains upto 10 smooth, glossy apple pip shaped, light brown color seeds which is 4-7mm long. Linseed is predominantly self-

pollinating. Natural cross pollination can occur at level of 6.75% by insects. (Alemayehu *et al.*, 2019). In recent years, the use of local botanicals has gained much importance, mainly among researchers, because of its high benefits in plant growth, yield and seed quality attributes. Some botanicals like Neem extract, Arappu leaf powder, Notchi leaf powder, Pongamia leaf powder are used for seed treatment and various effect of them can be seen on growth and yield of a plant. Botanical seed treatment is extracted from naturally occurring sources based on botanical ingredients. It has synergistic effect on early and uniform seed germination and enhance tolerance to pest and disease during early crop stage. (Mavi *et al.*, 2015). Hormonal priming can also be done to attain good plant growth and productivity. Hormonal priming refers to treating seeds in hormones such as GA<sub>3</sub>, salicylic acid, ascorbate, kinetin, jasmonic acid etc. which helps in promoting seedling growth. Kinetin is effective in increasing germination rate salt tolerance and early seedling growth in the salt tolerant cultivar when compared with hydro priming under salt stress. It helps to improve seed germination and seedling emergence under various stress conditions. It leads to decline in endogenous levels of hormones. It helps in increasing nutrient reserves through increased physiological activities and root proliferation. The present study was conducted to evaluate the effect of pre-sowing seed treatment of chemicals, botanicals and plant growth regulators on plant growth and yield of

in seed and to find out suitable pre-sowing seed treatment favorable for linseed crop.

## MATERIALS AND METHODS

The experimental material for present investigation comprised of thirteen priming treatments on linseed variety (Uma). The experiment was conducted in Randomized Block Design (RBD) with three replications. Seeds of (Uma) variety was obtained from CSAUAT Kanpur developed for high yield purpose and was subjected to various pre-sowing seed treatments like MnSO<sub>4</sub> T<sub>1</sub> (0.3%) and T<sub>2</sub> (0.5%), FeSO<sub>4</sub> T<sub>3</sub> (0.3%) T<sub>4</sub> (0.5%), Pongamia leaf powder T<sub>5</sub> (3%) T<sub>6</sub> (5%), Arappu leaf powder T<sub>7</sub> (3%) T<sub>8</sub> (5%) Notchi leaf powder T<sub>9</sub> (3%) T<sub>10</sub> (5%) Kinetin T<sub>11</sub> (25 ppm) T<sub>12</sub> (50 ppm) at various concentrations along with distilled water control T<sub>0</sub>.

After pre-sowing seed treatments seeds were dried and then sowing was done in the field and following data was recorded field emergence percentage, plant height (cm), number of primary branches per plant, days to 50% flowering, days to maturity, number of capsules per plant, number of seeds per capsule, seed yield per plot (gms), biological yield, harvest index, test weight in (gms), seed yield per plant (gms) data were collected from the field. The data was subjected to statistical analysis.

## RESULTS AND DISCUSSION

**Comment [S3]:** Here authors can add about what the seed priming with its importance with some recent reference <http://dx.doi.org/10.3390/plants10010037> <https://doi.org/10.22271/TPR.2020.V7.I1.012>

**Comment [S4]:** In the text figure citation is necessary. Please cite figure as fig 1.... Discussion need improvement with recent literature

All the treatments significantly affected growth and yield attributes. Here we will see about performance of various treatments depend on data which is recorded.

UNDER PEER REVIEW

**Table1 Mean performance of field parameters of linseed**

Treatments	Chemicals	FM	DFE	PH		NPBPP	DM	NCPP	NSPC	TW	SYPP (g)	SYPLT (g)	BY	HI
				60DAS	90DAS									
T <sub>0</sub>	Control	88.63	77.89	70.89	75.12	4.29	128.67	18.41	6.94	5.98	2.12	48.6	4.56	38.90
T <sub>1</sub>	MnSo <sub>4</sub> (0.3%)	90.12	73.96	62.11	77.34	5.01	123.96	22.14	7.08	6.88	2.88	71.4	5.23	55.07
T <sub>2</sub>	MnSo <sub>4</sub> (0.5%)	92.34	76.55	65.35	80.58	5.41	124.16	23.45	7.51	7.06	2.96	73.8	6.69	44.25
T <sub>3</sub>	Feso <sub>4</sub> (0.3%)	89.14	70.12	72.94	88.17	4.88	120.12	18.46	8.04	8.14	2.69	65.7	5.34	50.37
T <sub>4</sub>	Feso <sub>4</sub> (0.5%)	93.54	69.35	73.21	89.44	4.98	119.35	19.87	8.28	8.41	2.94	73.2	7.48	39.30
T <sub>5</sub>	Pongamia leaf powder(3%)	94.22	76.61	73.83	89.06	5.77	116.56	24.77	8.64	8.77	3.55	81.2	5.78	42.95
T <sub>6</sub>	Pongamia leaf powder(5%)	97.48	65.67	77.46	92.69	5.97	115.89	25.91	8.95	9.43	4.78	128.4	8.26	79.53
T <sub>7</sub>	Arappu leaf powder(3%)	93.64	72.96	60.91	76.14	4.66	122.96	25.33	8.26	8.16	3.35	85.5	7.78	43.06
T <sub>8</sub>	Arappu leaf powder(5%)	94.11	74.65	63.42	78.65	4.84	124.65	25.86	8.46	8.89	3.65	91.5	7.26	42.98
T <sub>9</sub>	Notchil leaf powder(3%)	90.89	69.24	58.66	73.89	5.11	119.24	21.54	7.99	7.56	2.98	74.4	7.66	38.90
T <sub>10</sub>	Notchil leaf powder(5%)	91.49	70.84	61.71	76.94	5.36	120.84	23.55	8.14	8.61	3.19	80.7	7.14	44.68
T <sub>11</sub>	Kinetin(25ppm)	93.47	74.33	65.43	80.66	5.44	124.33	19.38	8.31	8.36	3.06	76.8	7.31	41.86
T <sub>12</sub>	Kinetin(50ppm)	95.55	66.56	74.86	90.09	5.59	127.61	24.88	8.74	9.06	3.85	121.5	8.01	78.72
	MEAN	92.82	72.29	66.83	82.06	5.18	122.18	22.27	8.10	8.10	3.27	83.05	6.71	49.86
	MIN	88.63	65.67	70.89	75.12	4.29	115.89	18.41	6.94	5.98	2.12	48.60	4.56	38.90
	MAX	97.48	77.89	77.46	92.69	5.97	128.67	25.91	8.95	9.43	4.78	128.40	8.26	79.53
	C.D@(5%)	3.26	0.51	4.73	4.17	0.58	0.68	1.85	2.58	4.30	3.13	2.99	3.64	2.04
	SE(d)	1.58	0.25	2.29	2.02	0.28	0.33	0.90	1.25	2.08	1.52	1.45	1.76	0.99
	C.V.	2.60	3.81	7.64	7.64	0.45	3.76	2.64	0.58	0.94	0.69	10.69	1.15	11.25

**Comment [S5]:** Below table please elaborate the following terms

### Field emergence percentage

The maximum field emergence percent (97.48%) was recorded with pongamia leaf powder T<sub>6</sub> (5%), followed by (95.55%) kinetin T<sub>12</sub> (50 ppm). Whereas minimum field emergence percent recorded with T<sub>0</sub> control (88.63%) (Fig. 1).

This experiment provided information that field emergence percent increases when linseed seeds are treated with pongamia leaf powder (5%) when compared with other treatments. This result showed similar findings of Vakeswarani *et al.*, (2015), Vijay kumar *et al.*, (2013), RJerlin *et al.*, (2011).

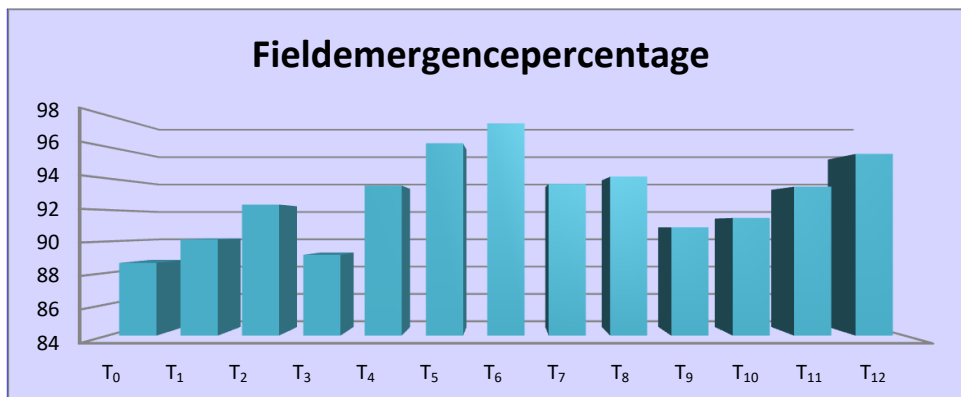


Fig.1 Field emergence as influenced by priming treatments on linseed

### Days to 50% flowering

The minimum days to 50% flowering (65.89) recorded with pongamia leaf powder T<sub>6</sub> (5%), followed by T<sub>12</sub> kinetin (50 PPM). The maximum days to 50% flowering recorded with T<sub>0</sub> control (77.89).

This experiment provided information that days to 50% flowering reduced when linseed seeds treated with pongamia leaf powder (5%) in comparison to other treatments (Fig. 2). This result showed similar findings of Prakash *et al.*, (2013), Mavi *et al.*, (2011), Sajjan *et al.*, (2009).

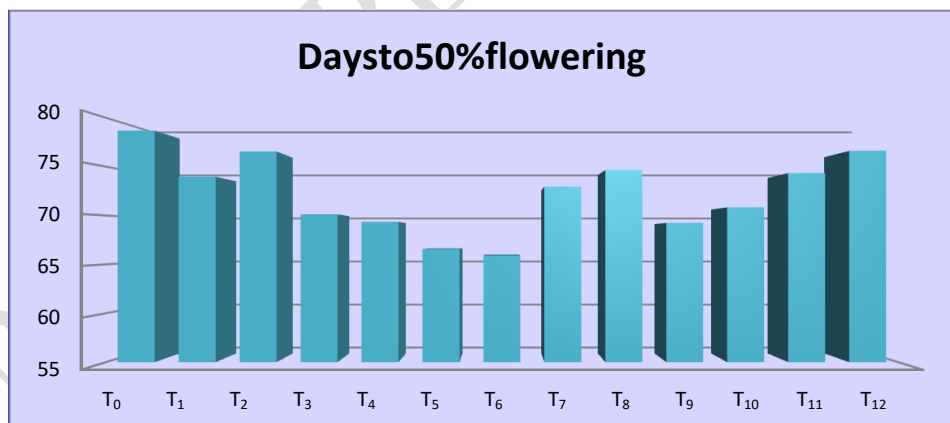


Fig.2 Days to 50% flowering as influenced by priming treatments on linseed

Comment [S6]: Error bar and lettering should be done otherwise, it is very difficult to say which one is significant

Comment [S7]: Error bar and lettering should be done otherwise, it is very difficult to say which one is significant

### Plantheightat60DAS

The maximum plantheight at 60 DAS (77.46 cm) is recorded with pongamia leaf powder  $T_6$  (5%) followed by  $T_{12}$  (50 ppm). And minimum plantheight at 60 days was recorded with  $T_0$  control (70.89 cm) (Fig. 3).

This experiment provided information about plant height at 60 DAS increased when linseed seeds are treated with pongamia leaf powder (5%) in comparison with other treatments. This result showed similar findings of *Rasool et al., (2019)*, *Tassadduq et al., (2017)*, *Riaz et al., (2015)*.

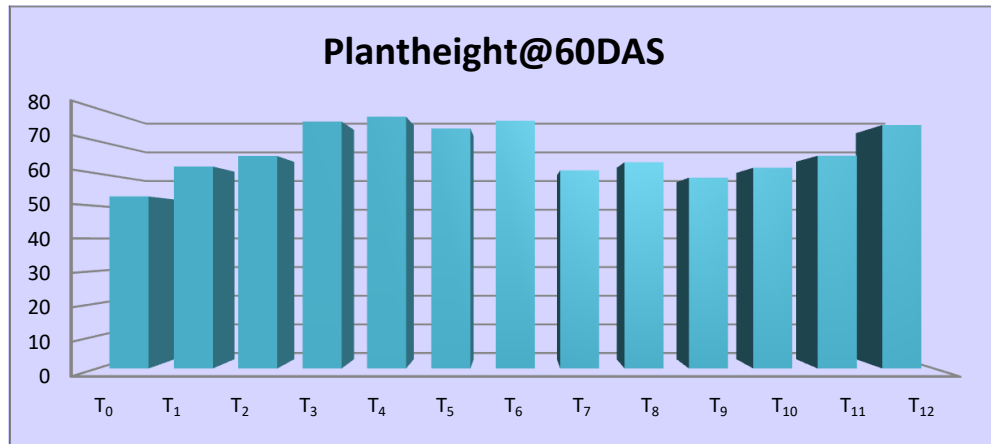


Fig.3 Plantheight at 60 DAS as influence by priming treatments on linseed

### Plantheightat90DAS

The maximum plantheight at 90 DAS (92.69 cm) recorded with pongamia leaf powder  $T_6$  (5%), followed by  $T_{12}$  (50 ppm). Whereas minimum plantheight (75.12 cm) was recorded with  $T_0$  control. The data collected was statistically analysed and

found significant difference among the treatments. This experiment provided information that plantheight at 90 DAS increased when linseed seeds treated with pongamia leaf powder (5%) in comparison to other treatments. This result showed similar findings of *Monda et al., (2019)*, *Sananda et al., (2016)*, *Bandanabose et al., (2014)*.

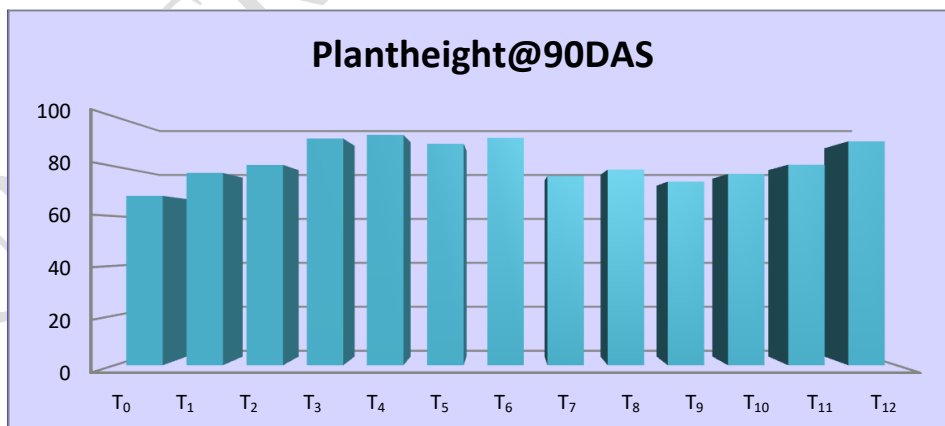


Fig.4 Plantheight at 90 DAS as influence by priming treatments on linseed

Comment [S8]: Statistical analysis needed. Lettering or T test

Comment [S9]: Statistical analysis needed. Lettering or T test

### Number of primary branches per plant

The maximum number of primary branches per plant (5.97) recorded with pongamia leaf powder T<sub>6</sub> (5%) followed by kinetin T<sub>12</sub> (50ppm). And minimum number of primary branches per plant (4.29) was observed in T<sub>0</sub> control. Number of primary branches per plant data was collected and statistically

analysed found significant difference among the traits. This experiment provided information that number of primary branches per plant increased when linseed seeds treated with pongamia leaf powder (5%) in comparison with other treatments. This result showed similar findings of *Chormuleet al., (2018)*, *SR, NM Changadeet al., (2017)*, *JB Patel et al., (2016)*

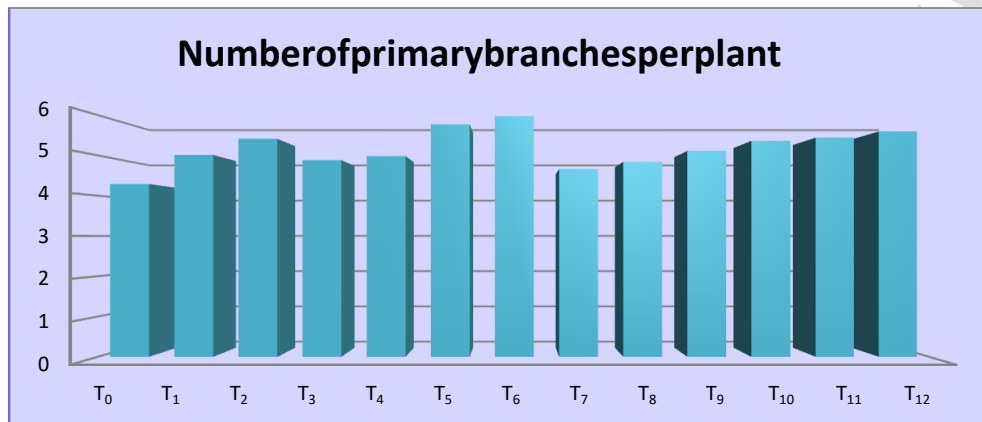


Fig.5 Number of primary branches per plant as influence by priming treatments on linseed

### Daystomaturity

The maximum number of days taken to maturity (128.67) recorded with T<sub>0</sub> control followed by (125.61) kinetin T<sub>12</sub> (50PPM) and reduced daystomaturity to minimum recorded with pongamia leaf powder T<sub>6</sub> (5%). This experiment provided information that Days to

maturity decreased when linseed seed treated with pongamia leaf powder (5%) in comparison with other treatments. This result showed similar findings of *Umeshetal., (2017)*, *KBhanuprakashet al., (2016)*, *J Lakshmi et al., (2014)*.

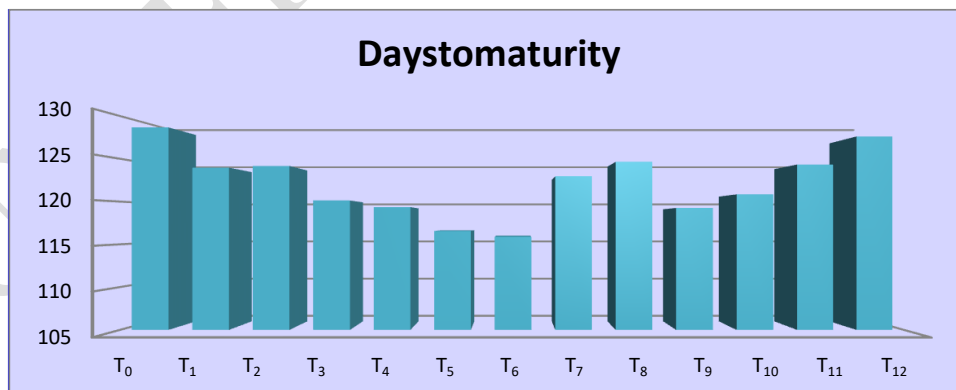


Fig.6 Daystomaturity as influence by priming treatments on linseed

Comment [S10]: Statistical analysis needed. Lettering or Ttest

Comment [S11]: Statistical analysis needed. Lettering or Ttest

### Number of capsules per plant

The maximum number of capsules per plant (25.91) recorded with pongamia leaf powder T<sub>6</sub> (5%), followed by (24.84) kinetin T<sub>12</sub> (50 ppm). Where as minimum number of capsules per plant (18.41) recorded with T<sub>0</sub> control.

This experiment provided information that number of capsules per plant increased when linseed seeds treated with pongamia leaf powder (5%) when compared with other treatments. This result showed similar findings of **Rehman et al., (2015), H Muhammad et al., (2013), Shahzad Maqsood et al., (2011).**

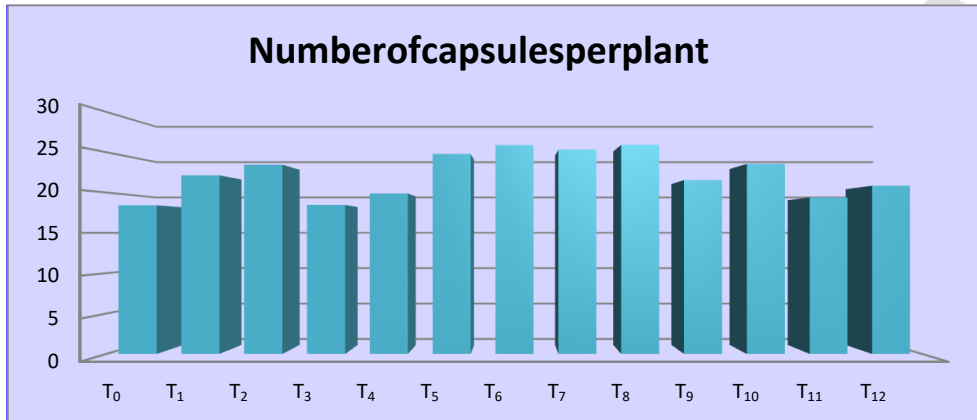


Fig.7 Number of capsules per plant as influence by priming treatments on linseed

Comment [S12]: Statistical analysis needed. Lettering or T test

### Number of seeds per capsule

A range of 6.94 to 8.95 of number of seeds per capsule with 8.10 mean value were obtained. The maximum number of seeds per capsule (8.95) recorded with pongamia leaf powder T<sub>6</sub> (5%), followed by (8.74) kinetin T<sub>12</sub> (50 PPM). Whereas minimum number of seeds per capsule (6.94) recorded with T<sub>0</sub> control.

This experiment provided information that number of seeds per capsule increased when linseed seed treated with pongamia leaf powder (5%) when compared with other treatments. This result showed similar findings of **Prabha et al., (2016), Deepti et al., (2015), Swati Negi et al., (2014).**

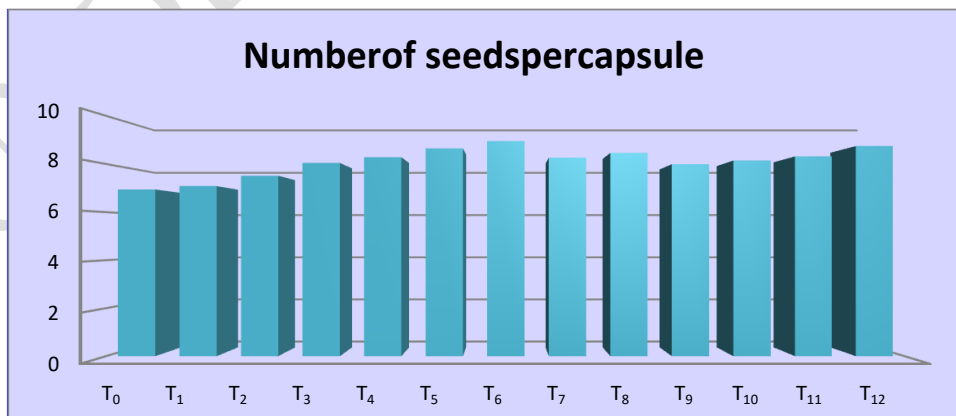


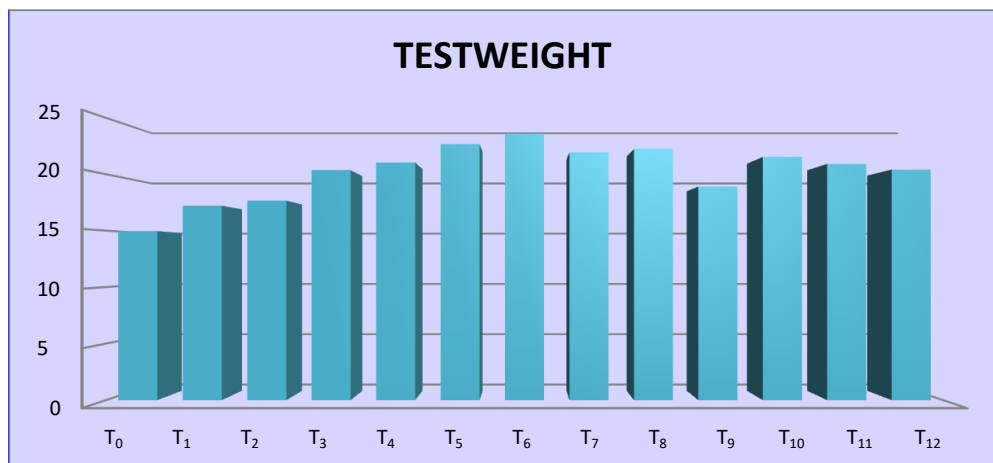
Fig.8 Number of capsules per plant as influence by priming treatments on linseed

Comment [S13]: Statistical analysis needed. Lettering or T test

### Testweight

The maximum test weight (9.43 gms) recorded with pongamia leaf powder T<sub>6</sub> (5%) followed by (9.06 gms) kinetin T<sub>12</sub> (50 ppm). Where a minimum test weight was recorded with (5.98) T<sub>0</sub> control. This experiment provided information that test w

eight increased when linseed seeds are treated with pongamia leaf powder (5%) in comparison with other treatments. This result showed similar findings of **Singh et al., (2015), Harmeet et al., (2010), Rupinder kaur et al., (2009).**



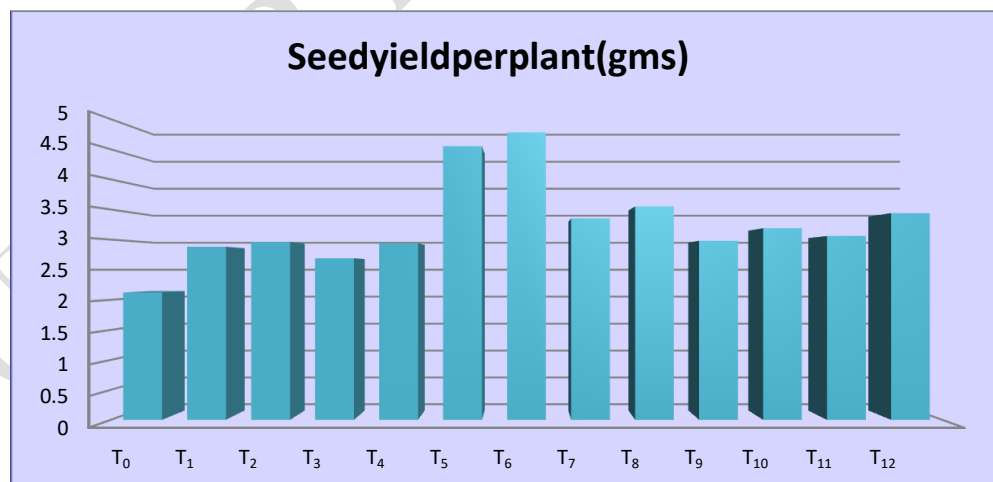
**Comment [S14]:** Statistical analysis needed. Lettering or T test

**Fig.9** Test weight as influence by priming treatments on linseed

### Seed yield per plant (gms)

The maximum seed yield per plant (4.78 gms) recorded with pongamia leaf powder T<sub>6</sub> (5%), followed by (3.85 gms) kinetin T<sub>12</sub> (50 ppm). Whereas minimum seed yield per plant recorded with (2.12 gms) T<sub>0</sub> control. This experiment provided

information about seed yield per plant that it increased when linseed seeds treated with pongamia leaf powder (5%) in comparison to other treatments. This result showed similar findings of **Umesh et al., (2017) Zohary et al., (2015), Ashok et al., (2014).**



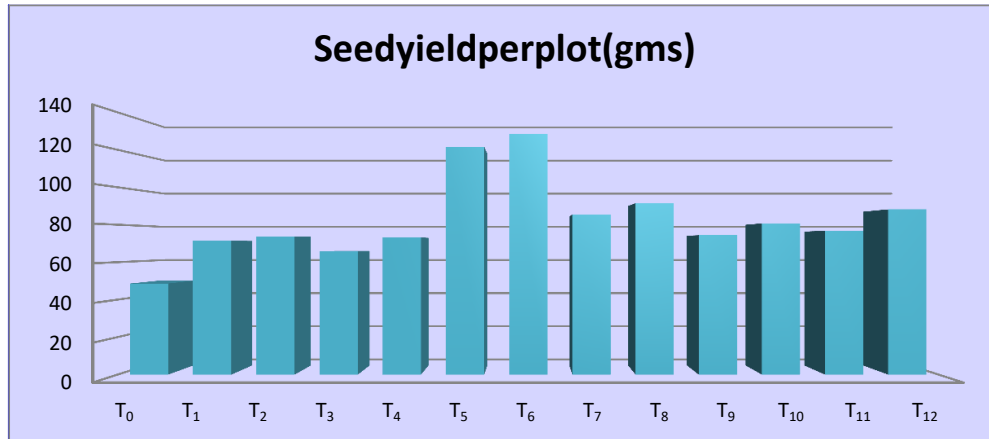
**Comment [S15]:** Statistical analysis needed. Lettering or T test

**Fig.10** Seed yield per plant (gms) as influence by priming treatments on linseed

### Seed yield per plot (gms)

The maximum seed yield per plot (128.4 gms) recorded with pongamia leaf powder T<sub>6</sub> (5%), followed by (121.5 gms) kinetin T<sub>12</sub> (50 ppm). Whereas minimum seed yield per plot recorded with (48.6 gms) T<sub>0</sub> control

This experiment provided information that seed yield per plot increased when linseed seeds are treated with pongamia leaf powder (5%) in comparison with other treatments. This result showed similar findings of *Sajjan et al., (2017)* *SS Sandhu et al., (2016)*, *RB Jolluet et al., (2014)*.



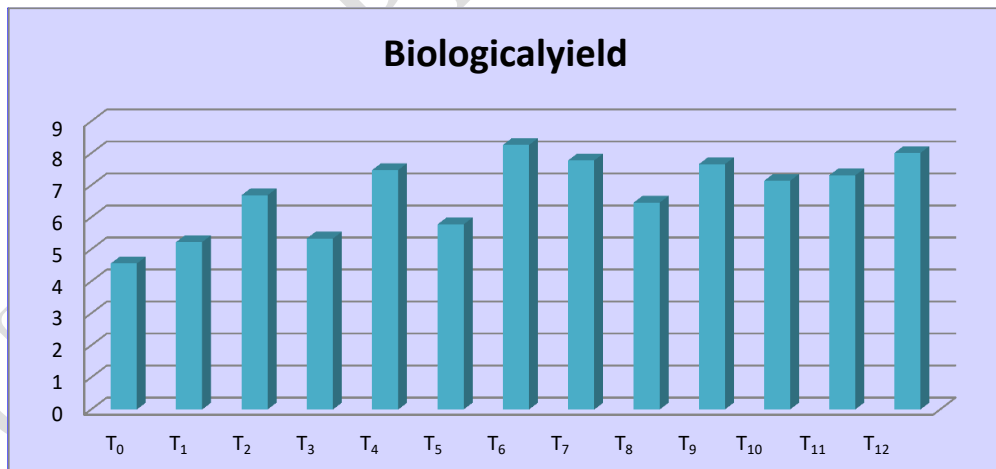
**Comment [S16]:** Statistical analysis needed. Lettering or T test

**Fig.11** Seed yield per plot (gms) as influence by priming treatments on linseed

### Biological yield

The maximum biological yield recorded with (8.26) pongamia leaf powder T<sub>6</sub>, followed by Kinetin T<sub>12</sub> 50 ppm (8.01). Whereas minimum biological yield recorded with (4.56) T<sub>0</sub> control. This experiment provided information that Biolo

gical yield increased when linseed seed treated with pongamia leaf powder (5%) in comparison with other treatments. This result showed similar findings of *Prabha et al., (2016)*, *Reza et al., (2014)*, *Rehman et al., (2012)*.



**Comment [S17]:** Statistical analysis needed. Lettering or T test

**Fig.12** Biological yield as influence by priming treatments on linseed

### Harvest index

The maximum harvest index (79.53) recorded with pongamia leaf powder  $T_6$  (5%), followed by (78.72) kinetin  $T_{12}$  (50 ppm) and minimum harvest index (38.90) recorded with  $T_0$  control. This experiment provided information about

harvest index that increased when linseed seeds are treated with pongamia leaf powder (5%) when compared with other treatments. This result shows similar findings of Singh *et al.*, (2015), Jassalet *al.*, (2013), Someshet *al.*, (2012).

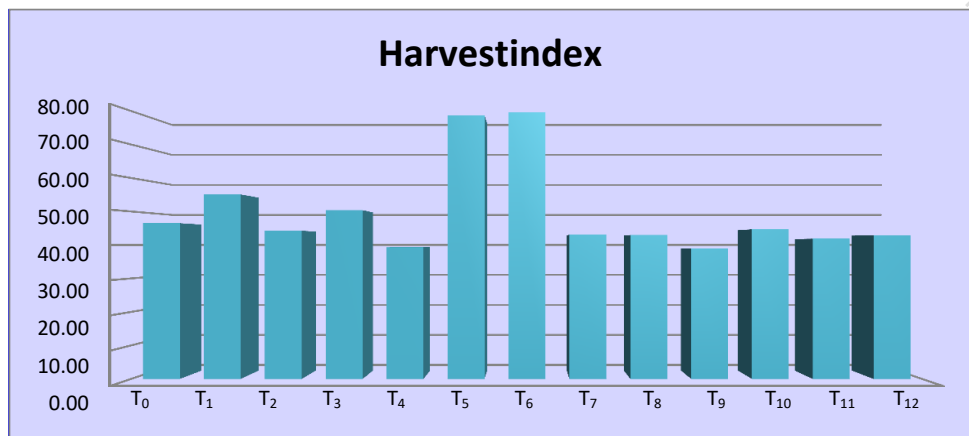


Fig.13 Harvest index as influenced by priming treatments on linseed

Comment [S18]: Statistical analysis needed. Lettering or T test

### CONCLUSION

It is concluded from the present study that pongamia leaf powder 5% treated with linseed seeds variety Umacan significantly effect growth, yield and yield attributing traits. And lower down days to 50% flowering and day to maturity. Followed by kinetin  $T_{12}$  (50 ppm), in comparison with other treatments  $T_0$  control.

### REFERENCES

Alemayehu, Nigussie, and Gemechu Keneni. "Genetic Consequences of Failure to Control Outcrossing in Breeding Often Cross-Pollinated Pulse and Oil Crops" Alukedi, Ahmed O, Ahmed A Almarie, Ma Alaloussi, Ss Farhan, and Alif Almehe mdi. (2021). "Effect Of Laser Exposure As Pre Sowing Seed Priming In Three Flax Cultivars (*Linum Usitatissimum* L.)." *Plant Cell Biotechnology and Molecular Biology*: 43-52 Chormule, SR, NM Changade, and

JB Patel. (2018). "Effect of seed treatments on storability of vegetable seeds: a review." *Plant Archives*: 18(1): 28-32. Mavi, Reza Kiani. (2015). "Green supplier selection: a fuzzy AHP and fuzzy ARAS approach." *International Journal of Services and Operations Management*: 22(2): 165-188. Mondal, Sananda, and Bandana Bose. (2019). "Impact of micronutrient seed priming on germination, growth, development, nutritional status and yield aspects of plants." *Journal of plant nutrition*: 42(19): 2577-2599. Prabha, Deepti, Swati Negi, Poonam Kumari, Yogesh Kumar Negi, and JS Chauhan. (2016). "Effect of seed priming with some plant leaf extract on seedling growth characteristics and root rot disease in tomato." *International Journal of Agriculture System*: 4(1): 46-51. Prakash, M, GSathiya Narayanan, BSunil Kumar, and A Kamaraj. (2013). "Effect of seed hardening and

- pelleting on seed quality and physiology of rice in aerobic condition." *Agricultural Science Digest* 33(3):172-177.
- Rasool, Tassadduq, Riaz Ahmad, and Muhammad Farooq. (2019). "Seed priming with micronutrients for improving the quality and yield of hybrid maize." *Gesunde Pflanzen* 71(1):37-44.
- Rehman, H, Muhammad Kamran, Shahzad Maqsood Ahmed Basra, Irfan Afzal, and Muhammad Farooq. (2015). "Influence of seed priming on performance and water productivity of direct seeded rice in alternating wetting and drying." *Rice Science* 22(4):189-196.
- Sajjan, Ashok S, MSD Hanelappagol, and RBJolli. (2017). "Seed quality enhancement through seed priming in pigeon pea [*Cajanus cajan* (L.) Millsp.]." *Legum Res* 40(1):173-177.
- Singh, Harmeet, Rupinder Kaur Jassal, JS Kang, SSSandhu, Harrajdeep Kang, and Kamaljit Grewal. (2015). "Seed priming techniques in field crops- A review." *Agricultural Reviews* 36(4):
- Umesha, BC, KBhanuprakash, JLakshmi, and Soumya S Desai. (2017). "Influence of Seed Fortification on Crop Growth and Seed Yield in Cluster Bean [*Cyamopsis tetragonoloba* (L.) Taub.] var Pusanavbahar." *Environment & Ecology* 35(3C):2232-2236.
- Vakeswaran, V, AVijayakumar, and R Jerlin. (2003). "Effect of Seed Priming in Pea (*Pisum sativum* L.) Seeds." *Seed Technology*:203-203.
- Vavilov, Nikolai Ivanovich. (1951). *The origin, variation, immunity and breeding of cultivated plants*. Vol. 72: LWW.
- Zohary, Daniel. (1999). "Monophyletic vs. polyphyletic origin of the crop on which agriculture was founded in the Near East." *Genetic Resources and Crop Evolution* 46(2):133-142.