Review Article

Weed management in linseed (*Linum usitatissimum* L.) – a review

Abstract

Slow initial growth makes linseed crop more vulnerable to weed infestation, which requires proper attention to obtain expected plant growth and yield. Control of weeds at early stages play a vital role for attaining robust plant growth that results in higher yield. Depending on location and method of cultivation, various types of weeds such as broad leaf, sedges and grasses are found in linseed field. In linseed crop, weeds can be controlled by manual, chemical or both the methods. As manual weeding is labour intensive and needs more time, chemical method of weed control is preferred to enhance profitability of the crop. Pre-emergence application of herbicide controls the weeds from the initial stage of plant growth that culminates with higher yield and more profit.

Key words: Linseed, weed management, chemical weed control, manual weed control

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Introduction

Linseed (*Linum usitatissimum*) is one of the oldest oilseed crop, grown across the world with an intention to obtain grain, fibre and oil (Dwivedi and Puhup, 2019). Linseed occupies an imperative place among the oilseed crops due to its diversified use as oil, fibre and industrial raw material. It occupies a vital position among oilseed crops grown during rabi season in India.

Usually, linseed is grown in less fertile, degraded land and with minimum care; which has resulted in substantial reduction of yield. Non application of fertilizer, poor weed management and lack of cultural practices are the major causes of low yield of linseed in India. It is said that this crop is cultivated under input deficient condition in various agro-climatic situations of the country. (Singh *et al*., 1992).

Less competitive ability of linseed against weed infestation is a major challenge for this crop. Slow initial growth coupled with low spread of foliages makes the crop vulnerable to dominance by weed (Siddesh *et al*., 2016). Effective management of weeds at proper time can ensure expected yield. Excess weed growth results in reduction of seed quality and increase in risk of disease and pest infestation.

Weeds associated

Depending on agro-climatic situation and soil characteristics, several weed species are found in the field of linseed. The cropping pattern, crop management practices and availability of irrigation also influence the prevalence of weeds in linseed crop. Various types of weeds such as broad leaf, sedges and grasses are associated with this crop. Meleta *et al.* (2018) observed more occurrences of broad leaf and grassy weeds in linseed under Ethiopia condition. Some of the predominant weed species found in linseed are *Chenopodium album*, *Amaranthus spp.*, *Avena fatua*, *Plantago lanceolata*, *Guizotia scabra*, etc. Puhup and Dwivedi (2019) observed prevalence of weeds like *Medicago denticulata, Convolvulus arvensis, Parthenium hysterophorus,* etc. at different growth stages. Under Patna situation, Acharya *et al.* (2017) reported presence of diversified weed flora comprising of broadleaf, grasses and sedges.

Effect of weeds on growth and yield

Weeds are major threat to crop production, if appropriate control measures are not taken at proper time. The weed population, type of weeds and their growth pattern vary depending on local climatic condition, cropping pattern and soil characteristics. Based upon the types of weed, weed density and competitiveness of the crop; the effect of weed on plant growth and yield is different at different places.

The competitive ability of plant to utilize the growth determining resources such as light, water and nutrients plays a vital role in determining crop yield (Dwivedi and Puhup, 2019). Several authors have assessed the influence of various weeds on plant growth and yield of linseed crop. Meleta *et al.* (2018) reported that weeds cause serious concern for growth and yield of linseed resulting in loss of seed yield and deterioration of oil quality because of severe competition for plant nutrients. As reported by Kumara et al. (2007) there was more competition between crop and weed in weedy check control plot resulting in higher dry matter accumulation of weeds and more nutrient uptake by weed.

Presence of weeds has visible effect on the performance of linseed crop and the growth of plant is affected by weeds at all stages. Chhaganiya *et al.* (2017) reported that the growth, yield attributes and yield of linseed were inversely proportional to weed count. Similarly, Shaheen (2017) reported that plant height, yield attributes and yield of linseed are substantially affected by various weed control treatments. Mańkowski and Pudelkp (2015) reported that weed control practices are vital for reducing crop-weed competition and enhancing quality and quantity of production. Acharya *et al.* (2017) recorded taller plants (53.2 cm) with more number of primary branches/plant (4.73), capsules per plant (39.55) and seeds per capsule (8.03) under hand weeding condition as compared with control plots because of reduced weed competition for resources like sunlight, plant nutrient and space. As observed by Meseret *et*

al. (2008), the pod count per plant thousand grain weight and yield of grain were visibly influenced by time of weeding and frequency of weed control.

As per Singh *et al*. (1992), weeds are the major constraints in linseed production with yield loss of about 36 per cent. Meleta *et al*. (2018) observed that delayed weeding in linseed at 50-60 days after crop emergence led to reduction of seed yield by more than 18 per cent. Presence of weeds during crop growth period resulted in 45.5 per cent loss in grain yield as compared with one hand weeding (Mishra *et al.*, 2003). Similar result was also reported by Tomar *et al.* (1990), who observed 37.9 per cent yield reduction due to effect of weeds on the crop.

Weed management practices

Linseed cannot compete with weeds at early stages of the crop due to slow initial growth. So, it is imperative to complete weeding as early as possible to allow the plants for attaining robust growth. Weeding the crop before flowering is very much important, because there may be yield loss up to 56 per cent in linseed due to presence of weeds at initial stages of plant growth (Rezene, 1992). Meleta *et al.* (2018) opined that linseed crop cannot effectively compete with weeds at early growth stages, especially up to two months after sowing. Mahere *et al*. (2000) also opined that the early growth phases of linseed crop more particularly from 25 to 45 days after sowing is critical for weed competition, which caused yield loss to the tune of 30-40 per cent in absence of weed control practices.

Weeds can either be controlled manually or by application of chemical herbicides or both. Manual weeding requires more human labour and comparatively more time consuming, hence it necessitates an alternative and cost-effective weed management practice through application of herbicide. Researchers have observed remarkable effect of various weed management

practices on presence of weed, weed density, weed biomass and the influence of weeds on crop yield. Several authors (El-Hariri *et al.,* 2002; Dange *et al.,* 2007; Devendra *et al.,* 2016;) have established the superiority of various weed control practices over weedy check plot with respect to yield and yield attributing characters of linseed. Dwivedi and Puhup (2019) recorded lowest value of weed density and weight of weed biomass with the treatment two hand spraying, which was statistically comparable with pre-emergence application of pendimethalin @ 1 kg ha^{-1}. Siddesh *et al.* (2016) reported that application of pre-emergence herbicide followed by application of post emergence herbicide or hand weeding around 25 to 30 DAS controlled the weeds in linseed and augmented the yield. Kalal *et al.* (2019) observed that the yield of grain increased under weed free condition maintained during critical growth stage of the crop.

Chemical weed control

As compared with the cumbersome manual weeding, chemical methods of weed control have been proven to control weeds more efficiently in linseed crop. Pre-emergence application of herbicides is more efficient for controlling weeds at the early growth stage and gives the crop a vigorous start. Kalal *et al.* (2019) opined that in linseed crop pendimethalin is widely used as pre-emergence herbicide for control of weeds, however, the effectiveness of this herbicide varies depending upon type of soil, availability of moisture and type of weeds present. Chhaganiya *et al.* (2017) reported that imazethapyr inhibit amino acid synthesis resulting in interruption in synthesis of protein and DNA, which resulted in death of weeds shortly after application of the chemical mix. Similar result was also reported by Siddesh *et al.* (2016), who advocated application of pre-mixed mixture of pendimethalin 30 EC + imazethapyr 2 EC @ 1.0 kg a.i. ha^{-1} to obtain maximum weed control efficiency (68.9 % at 30 DAS and 65.2 % at 90 DAS) and higher crop yield.

Shaheen (2017) substantiated that application of pendimethalin 30 EC along with imazethapyr 2 EC @ 1.0 kg a.i. ha^{-1} produced the lowest quantity of weed biomass at early stages of plant growth, while use of isoproturon 75 WP @ 1.0 kg a.i. ha^{-1} resulted in minimum weight of weed biomass (1.18 g 0.25 m^{-2}) at 90 days after sowing. As per findings of Amare *et al.* (2014), there was significant reduction in weed density and weed dry weight with application of isoproturon @1.50 kg ha^{-1} due to effective control of various types of weeds.

Bali *et al.* (2015) recorded higher plant population with post emergence application of isoproturon + metsulfuron-methyl (1 kg + 4 g ha^{-1}), of course, statistically comparable with post emergence application of metsulfuron-methyl (4 g ha^{-1}). Siddesh *et al. (*2016) recorded taller plants (62.2 cm) with more number of primary branches (5.6) and capsules $plant^{-1}$ (48.0) with pre-emergence application of pendimethalin 30 EC along with imazethapyr 2 EC @1.0 kg a.i. ha^{-1} because of waning in weed competition.

Abou-Zied *et al.* (2015) reported that application of Brominal along with Select Super could result in more grain yield. Application of Fluazifop butyl in linseed crop controlled the weeds in an effective manner and augmented crop yield as reported by Osman *et al.* (2010). Singh *et al.* (2014) recorded significant reduction in weed density with application of imazethapyr @ 100 g ha^{-1} and higher weed control efficiency with pre-emergence application of pendimethalin and imazethapyr than post-emergence application of clodinafop and isoproturon.

Manual weed control

In conventional method, manual weeding is adopted to control weeds in linseed crop. Traditionally, manual weeding is done by removing the weeds by hand or doing intercultural operation in the standing crop. It requires more expenditure and ample of time in case of manual method of weed control as

compared with chemical method. Due to delay in manual weeding, the crop suffers from substantial reduction in plant growth at early stage. However, various authors have reported positive effect of manual weeding on plant growth and yield of linseed crop. Meleta *et al*. (2018) recorded more pods per plant and higher grain yield with two hand weeding at 30-35 and 55-60 days after emergence when compared to unweeded plots. The intensity and types of weed in crop field is also affected by manual weeding methods at various places. Devendra (2016) had reported minimum density of weeds, lowest weed dry weight, maximum weed control efficiency (87.2%), the highest yield and maximum profit with two hand weeding at 20 and 40 DAS.

Economics

The economics of cultivation is the single most deciding factor for sustainable cultivation of any crop. It is required to enhance the profitability of a crop to make it more competitive for its sustenance in an ecosystem. Siddesh *et al.* (2016) reported that unweeded check recorded the lowest net profit and minimum benefit-cost ratio. However, more net profit and higher benefit-cost ratio was recorded with pre-emergence application of pre-mixed formulation of pendimethalin 30 EC + imazethapyr 2EC @1.0 kg a.i. ha^{-1} as compared with other treatments. Dwivedi & Puhup (2019) reported that post-emergence application of metsulfuron @ 4 g ha^{-1} resulted in the maximum benefit-cost ratio due to higher yield of grain along with low cost of cultivation. Compared with chemical method of weed management practices, manual weeding does not support to obtain higher profit due to increased cost of cultivation. As per Dwivedi & Puhup (2019), the cost of cultivation was the highest under two hand weedings at 21 and 45 days after sowing due to higher cost involved in labour wages. Weed management is an important aspect of growing linseed crop to harvest more quantity of good quality produce.

References

Abou–Zied KA, Hassan Sanaa S, Khalil HE and Nawar AL. Effect of seeding rates and weed control treatments on productivity and weed suppression in linseed cultivar Sakha 4. Alex. J. Agric. Res. 2015. 60(3), 221-228.

Acharya SS, Nirala1 RBP, Roychowdhury A, Ghosh Mainak and Haque Mizanul. Bio-efficacy of herbicides against complex weed flora in linseed (*Linum usitatissimum* L.) in Indo-Gangetic plain of Bihar. Res. on Crops. 2017.18 (1) : 49-56

Amare T, Sharma JJ and Zewdie K. Effect of weed control methods on weeds and wheat (*Triticum aestivum* L.) yield. World J. Agril. Res., 2014. 2(3): 124-128.

Bali A, Bazaya BR, Chand L and Swami S. Weed management in soybean. International Quarterly Journal of Life Science. 2015. 11(1): 255–257.

Chhaganiy HJ, Patel AP and Patel VD. Efficacy of cultural method of weed control on growth, yield and quality of linseed (*Linum usitatissimum* L.). Inte. J. Curr. Microbiol. App. Sci. 2017. 7(2), 2711-2717.

Dange RB, Pawar WS, Khawale VS and Choudhary RL. Effect of weed management practices on growth and yield of linseed (*Linum usitatissimum* L.). J. Soils and Crops, 2007. 17 : 411-15.

Devendra, Jain, N. and Jain, V. Weed management with pre- and post-emergence herbicides in linseed. Indian Journal of Weed Science. 2016. 48(1): 93–94.

Dwivedi, Sanjay K. and Puhup, CS. Weed dynamics, growth pattern, yield and economics of linseed under different weed management practices. *Indian Journal of Weed Science*. 2019.51(1): 36–39.

El-Hariri DM, Hassanein MS and Hussein HF. Effect of weed control treatments and nitrogen sources on linseed plants associated weeds in a newly reclaimed land. Egypt. J. Agron. 2002. 24, 1-22.

Kalal PH, Desai LJ, Mitra S and Chaudhari DI. Effect of Integrated Weed Management on Growth, Yield, Yield Attributes and Economics 0f Linseed (*Linum usitatissimum* L.) under South Gujarat Condition. Int. J. Curr. Microbiol. App. Sci. 2019. 8(07): 1265- 1271 doi: https://doi.org/10.20546/ijcmas.2019.807.150

Kumara O, Venugopal N., Prasad TVR, Reddy SS and Kumar ND. Effect of nitrogen levels and weed management practices on nutrient uptake by sunflower and weeds. Karnataka J. Agric. Sci., 2007. 20: 123 -25.

Mahere Jitendra, Yadav PK and Sharma RS. Chemical weed control in linseed with special reference to Cuscuta. Indian J. Weed Sci., 2000. 32: 216-217.

Mañkowski J and Pudelkp K. Evaluation of the effect of the tillage system and weed control on the yield of linseed fiber and its quality. Fibers, Textiles in Eastern Europe, 2015. 23(3), 111-117.

Meleta T, Dargie R, Wakweya K. Assessment of linseed (Linum usitatissimum L.) yield loss due to weed in Sinana, highland condition of Bale, South Eastern Ethiopia. Scientific Journal of Pure and Applied Sciences. 2018. 7(1) 729-734. doi: 10.14196/sjpas.v7i1.2504

Meseret N, Tadesse B, Teshome B. Effect of frequency and time of hand weeding in haricot bean (*Phaseolous vulgaris* L.) production at Bako. Ethiop. J. Weed Management. 2008. 2, 59-69.

Mishra JS, Singh VP and Yaduraju NT. Bio-efficacy and economics of herbicidal weed control in irrigated linseed (*Linum usitatissimum* L.). Indian Journal of Weed Science. 2003. 35(1&2): 154–155.

Osman MS, Okaz AM, Hasanein EE and El-Ninny EM. Effect of linseed varieties, weed control methods under two different sowing methods on weed and linseed crop and its quality. Egypt. J. Agric. Res. 2010. 88(4), 1293-1310.

Puhup CS and Dwivedi SK. Effect of herbicides on weed dynamics, phytotoxicity and seed yield of linseed (*Linum usitatissimum* L.) Journal of Crop and Weed, 2019. 15(1): 164-169.

Rezene F. Weed science research on noug, linseed and rapeseed in Ethiopia. In: Oilseeds Research and Development in Ethiopia, First National Oilseeds Workshop, 3-5 December 1991, A.A., Ethiopia. 1992. 136-148.

Shaheen Fatma EM. Effect of planting methods and weed control on linseed yield. M.Sc. Thesis, Fac. Agric. Kafrelsheikh Univ., Egypt. 2017.

Siddesh G, Chittapur BM, Biradar SA, Koppalkar BG and Swamy M. 2016. Bio-efficacy of herbicides for weed management in linseed. Journal of Farm Sciences 29(1): 19–22.

Singh D, Dagar JC and Gangwar B. Infestation by weeds and their management in oilseed crops – review. Agricultural Reviews (Karnal). 1992. 13(3): 163-175.

Singh RK, Thakur PNS, Singh Aarti and Singh Kanchan. Weed management in linseed with herbicides. p. 268. In: Proceedings of Biennial Conference of Indian Society of Weed Science on “Emerging Challenges in Weed

Management" February 15-17, 2014. Directorate of Weed Science Research, Jabalpur, Madhya Pradesh, India.

Tomar SS, Bajpai RP and Bisen CR. Chemical weed control in linseed. Indian J. Weed Sci. 1990. 22: 23-27.