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Integrated Weed Management in *Rabi* Sunflower (*Helianthus annuus* L.)

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A B S T R A C T

A field experiment was conducted during *rabi* of 2020-21 at Experimental Farm, Agronomy section, Oilseeds Research Station, Latur to study the "Integrated weed management in *rabi* sunflower (*Helianthus annuus* L.)". The soil was clavey in texture, neutral in nature (7.02 pH), low in organic carbon (0.30 %), very low in available nitrogen (231 kg ha-1), low in phosphorus (8.57 kg ha-1) and very high in potassium (580 kg ha-1). The highest net monetary returns (₹ 47612 ha-1) and benefit: cost ratio (2.29) was recorded with the application of Quizalofop-ethyl 10 % EC @ 40 g a.i. ha-1at 20 DAS (POE) + one hand weeding at 35 DAS (T7). Among different chemical weed control methods lowest weed index, dry weed weight and higher weed control efficiency were observed with the application of Quizalofop-ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS (POE) + one hand weeding at 35 DAS (T7).

Introduction

Vitamins Sunflower (*Helianthus annuus* L.) is the most important oilseed crop in world, popularly known as '*surajmukhi*'. The name 'Helianthus' is derived from 'Helios' meaning 'sun' and 'anthos' meaning 'flower'. It is one of the member of family Asteraceae.

Sunflower is probably originated in Southern united states and Mexico from where it was introduced into Europe and later into former USSR. Majority of the present day varieties grown all over the world is originated from USSR. In India sunflower as an ornamental crop introduced in 1969 and commercial cultivation started during the year 1972-73.

The yield and nutritive value of sunflower depends on fertility status of the soil, rate of application manuring, water management and cultural practices. Among the cultural practices weed management is one of the most important practice for attaining higher yields and better quality. In India productivity is very low (886 kg ha- 1) as compared

to world average (1948 kg ha-1) among the reasons one of reason, *i.e.* weed competing with the crop for nutrient, water, sunlight and space.

Wide row spacing and slow initial growth of sunflower provides enough space for weeds to establish and to take advantage of slower initial growth of the crop. Uncontrolled weed growth reduced seed yield of sunflower up to extent of 55 %.

Weed competition is one of the most important stresses during crop period. They not only compete with crop plants for nutrients, soil moisture, space and sunlight but also serve as alternate host for several insect pest and diseases and causes yield reduction to be as high as 81% (Jaykumar *et al.,* 1988).

The conventional method of weed control is laborious, insufficient and costly hence, neither herbicide nor cultivation practices are adequate for consistent and acceptable weed control.

Therefore, integrated weed management is the best for higher productivity, using pre and post emergence herbicides in combination with hand weeding or inter cultivation with implements.

Integrated weed management (IWM) is sustainable approach to the management of weeds by combining all available weed control techniques, including preventative measures, monitoring, crop rotation, tillage, crop competition, mechanical and physical control, herbicide rotation, herbicide mixtures, biological control, nutrition, irrigation, flaming, etc. in a way that minimizes economic, health and environmental risks (Swanton *et al.,* 2002). Integrated weed management is gaining importance in management of weed for preventing losses and higher input efficiency in sunflower.

Materials and Methods

A field experiment was conducted during *rabi* of 2020-21 at Experimental Farm, Agronomy section, Oilseeds Research Station, Latur to study the "Integrated weed management in *rabi* sunflower (*Helianthus annuus* L.)". The experiment was laid out in Randomized Block Design with three replication and seven different weed control treatments *viz.*, T1 - Unweeded, T2 - One hand weeding at 20 DAS + one hand hoeing at 30 DAS, T3 -Three hand weeding at 15, 30, 45 DAS, T4 - Propaquizafop 10 % EC @ 62 g a.i. ha-1 at 20 DAS (POE), T5 - Propaquizafop 10 % EC @ 62 g a.i. ha-1 at 20 DAS (POE) + one hand weeding at 35 DAS, T6 - Quizalofop-ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS (POE), T7 - Quizalofop-ethyl 10 % EC @ 40 g a.i. ha- 1 at 20 DAS (POE) + one hand weeding at 35 DAS.

The experimental unit was gross plot size of each 5.4 m x 4.8 m and net plot size 4.2 x 4.2 m2, respectively. The sunflower cultivar LSFH-171 sowing was done by dibbling method on 13th Nov. 2020 at spacing 60 cm row and between the plants 30 cm. The RDF 90:45:45 NPK kg ha-1 was applied, half dose of nitrogen along with full dose of phosphorous and potash was applied as basal dose and reaming dose of nitrogen was applied at 30 DAS. The crop was harvested on17th Feb. 2021.

Weed index (WI) was calculated by using the following as given by Gill and Kumar (1969).

$$WI = \frac{\text{Yield from best treatment} - \text{Yield from treated plot}}{\text{Yield from best treatment}} \times 100$$

Weed control efficiency (WCE) was calculated by using the formula suggested by Umrani and Boi (1982).

$$WCE = \frac{\text{Dry matter of weeds in Unweeded plot (g m}^{-2}\text{)} - \text{Dry matter of weed in treated plot (g m}^{-2}\text{)}}{\text{Dry matter of weeds in unweeded plot (g m}^{-2}\text{)}} \times 100$$

Results and Discussion

Economics of sunflower cultivation

Gross Monetary Returns (₹ ha-1)

The gross monetary returns of sunflower was differed significantly due to different weed control treatments are presented in Table-1.1. The weed free treatment (T3) recorded highest gross monetary returns (₹ 85974 ha-1) of sunflower over application of Quizalofop- ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS as POE (T6), Propaquizafop 10 % EC @ 62 g a.i. ha-1 at 20 DAS as POE (T4) and unweeded (T1) and found on par with rest of the treatments. The unweeded treatment (T1) was recorded significantly lowest gross monetary returns (₹ 51744 ha-1).The application of Quizalofop- ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T7) was best treatment followed by application of Propaquizafop 10 % EC @ 62 g a.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T5) and both were equally effective in producing higher gross monetary return of sunflower as that of weed free (T3) treatment.

Net Monetary Returns (₹ ha-1)

The net monetary returns of sunflower was differed significantly due to different weed control treatments are presented in Table-1.1. The application of Quizalofop- ethyl 10 % EC @ 40 ga.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T7) was recorded significantly higher net monetary returns ₹ 47612 ha-1 over application of Quizalofop- ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS as POE (T6), Propaquizafop 10 % EC @ 62 g a.i. ha-1 at 20 DAS as POE (T4), and unweeded (T1) and found on par with rest of the treatments. Similar kind of results were reported by Suryavanshi *et al.*, (2015).

Table.1 Seed yield (kg ha^{-1}) and economics (₹ ha^{-1}) of sunflower as influenced by different treatments

Treatments		Economics (₹ ha^{-1})				
		Seed yield (kg $^{-1}$)	**GMR (₹ ha^{-1})**	**Cost (₹ ha^{-1})**	**NMR (₹ ha^{-1})**	**B:C Ratio**
T1	- Unweeded (Control)	1232	51744	31250	20494	**1.65**
T2	- One hand weeding at 20 DAS + One hand hoeing at 30 DAS*	1977	83034	38450	44584	**2.15**
T3	- Three hand weeding at 15, 30, 45 DAS (Weed free)	2047	85974	44750	41224	**1.92**
T4	- Propaquizafop 10 % EC @62 g a.i. ha^{-1} at 20 DAS (POE)	1740	73080	33410	39670	**2.18**
T5	- Propaquizafop 10 % EC @62 g a.i. ha^{-1} at 20 DAS(POE) + One hand weeding at 35 DAS	1983	83286	37910	45376	**2.19**
T6	- Quizalofop-ethyl 10 % EC@ 40 g a.i. ha^{-1} at 20 DAS (POE)	1747	73374	32350	41024	**2.26**
T7	- Quizalofop-ethyl 10 % EC @ 40 g a.i. ha^{-1} at 20 DAS (POE) + One hand weeding at 35 DAS	2011	84462	36850	47612	**2.29**
S.E.m. ±		75	2834	-	1889	-
C.D. at 5%		209	7856	-	5237	-
General Mean		**1816**	**76296**	**36424**	**39851**	**2.09**

DAS*- Days after sowing

Table.2 Weed control efficiency (%) at various growth stages and weed index(%) of sunflower as influenced by different treatments

Treatments	Weed control efficiency (%)			Weed Index (%)
	30 DAS	60 DAS	AH*	
T1 - Unweeded (Control)	0.00	0.00	0.00	39.81
T2 - One hand weeding at 20 DAS + One hand hoeing at 30 DAS*	78.16	69.32	68.03	3.41
T3 - Three hand weeding at 15, 30, 45 DAS (Weed free)	100	100	96.32	0.00
T4 - Propaquizafop 10 % EC @ 62 g a.i. ha^{-1} at 20 DAS (POE)	73.70	53.56	53.32	14.99
T5 - Propaquizafop 10 % EC @ 62 g a.i. ha^{-1} at 20 DAS (POE) + One hand weeding at 35 DAS	76.15	79.68	78.06	3.12
T6 - Quizalofop-ethyl 10 % EC @ 40 g a.i. ha^{-1} at 20 DAS (POE)	74.10	61.37	61.21	14.65
T7 - Quizalofop-ethyl 10 % EC @ 40 g a.i. ha^{-1} at 20 DAS (POE) + One hand weeding at 35 DAS	77.67	82.51	80.14	1.75
S.E.m. ±	2.45	2.30	2.45	-
C.D. at 5%	6.80	6.28	6.80	-
General Mean	68.54	63.78	62.44	11.10

DAS* - Days after sowing, AH* - At harvest

Benefit: Cost ratio

Data pertaining to Benefit: Cost ratio of sunflower as influenced by different treatments are presented in Table-1.1. The application of Quizalofop- ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T7) recorded higher benefit cost ratio (2.29) of sunflower which was closely followed by application of Quizalofop- ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS as POE (T6), Propaquizafop 10 % EC @ 62 g a.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T5). Similar kind of results reported by Suryavanshi *et al.*, (2015).

Weed control efficiency (%)

The data on weed index as influenced by different weed control treatments are presented in Table 1.2. The weed free treatment (T3) recorded highest weed control efficiency at 30, 60 DAS and at harvest. Among different chemical weed control treatments application of Quizalofop- ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T7) recorded highest weed control efficiency which was closely followed by application of Propaquizafop 10 % EC @ 62 g a.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T5). Similar kind of results were reported by Selvakumar *et al.*, (2018).

Weed index (%)

Weed index showed the losses due to weeds over the best treatment. Thus, it indicates how much loss in yield is occurred due to inefficient control of weeds. Data on weed index as influenced by different weed control treatments are presented in Table 1.2. Application of Quizalofop- ethyl 10 % EC @ 40 g a.i. ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T7) recorded lowest weed index (1.75) as compared to other treatments which was closely followed by application of Propaquizafop 10 % EC @ 62 g a.i**.** ha-1 at 20 DAS as POE + one hand weeding at 35 DAS (T5) and one hand weeding at 20 DAS + one hand hoeing at 30 DAS (T2) and highest weed index was observed with the unweeded treatment T1 (39.81). Similar kind of results were reported by Selvakumar *et al.,* (2018).

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