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Integrated weed management in soybean (*Glycine max* L. Merrill)

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Abstract
The field experiment was carried out during *kharif* 2021 at Experimental Farm of Agronomy Section, College of Agriculture, Latur to study "Integrated weed management in soybean (*Glycine max* L. Merrill)". The soil was clayey in texture and slightly alkaline in (pH 7.8) nature. The experiment was laid out in randomized block design with three replications and nine treatments. The treatments are T1– Weedy check, T2 –Weed free, T3– Soybean + Green gram (2:1) intercropping, T4 – Diclosulam 84% WDG PE 26g/ha +1 Hoeing + Straw mulching, T5– Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS, T6 –Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw mulching, T7 – Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5%EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix), T8 – Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS, T9– Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching. The experimental unit was gross and net plot size divided into 5.4 m x 4.5 m and 4.5 m x 3.9 m respectively. The result showed that weed free (T2) recorded significantly higher growth yield contributing characters followed by application of Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS (T8) and Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS (T5) respectively were found beneficial in comparisons with the other treatments.

Keywords: Soybean, Diclosulam, imazethapyr, quizalofop ethyl, pendimethalin, intercropping, straw mulching

Introduction
In India, oilseed crops constitute the second largest agricultural produce, next to grains and these are the important source of our national economy. The oil economic end product of oilseed crop is an integral part of human diet. Besides dietary needs, the vegetable edible oil has numerous industrial, medical and therapeutic uses too. Soybean (*Glycine max* L. Merrill) is one of India's major pulse and oil seed crops. During the year 2020-21 soybean sown on 12.81 million hectares and give the production of 12.90 million tonnes with the productivity 1007 kg/ha. Among the states, Madhya Pradesh stood first with 6.50 million ha followed by Maharashtra (4.36 million ha), Rajasthan (1.13 million ha) with respect of area (Source-Directorate of Economics & Statistics, DA & Fw) Soybean is a significant source of high-quality protein food and edible vegetable oil, it is crucial to both human and animal nutrition. It contains about 40% quality protein, 23% carbohydrates, and 20% cholesterol-free oil.
Herbicides provide more effective and timely weed control, but the common cultivator cannot afford to apply them. In addition to lowering the cost of herbicides, a well-tank mix of pesticides and cultural weed control approaches would benefit the crop by properly aerating it and conserving moisture. Integrated weed management is becoming more prevalent as a method of weed control around the world as the incidence of herbicide resistant weeds increases. IWM is a method of weed control that uses multiple approaches. Integrated weed management uses knowledge of weed biology, (emergence, growth rate, fecundity) integrated with multiple weed control tools to manage weeds throughout the growing season. IWM is designed to strategically target components of the life cycle of weeds to diminish their growth and development. Keeping in view the present investigation was undertaken with view to study the experiment entitled Integrated weed management in soybean (*Glycine max* L. Merrill).

Material and Methods
A field experiment was conducted during Kharif season, 2021 at Experimental Farm, Department of Agronomy Latur, to study "Integrated weed management in soybean (*Glycine*

max L. Merrill)". The soil was clayey in texture, low in available nitrogen (125.3 kg ha-1), medium in available phosphorus (18.2 kg ha-1), very high in available potassium (498.58 kg ha-1) and slightly alkaline (pH 7.8) nature. The experiment was laid out in randomized block design with three replications and nine treatments. The treatments were T1– Weedy check, T2–Weed free, T3– Soybean + Green gram (2:1) intercropping, T4 – Diclosulam 84% WDG PE 26g/ha +1 Hoeing + Straw mulching, T5– Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS, T6 –Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw mulching, T7 – Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5% EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix), T8 – Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20- 25 DAS, T9– Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching. The experimental unit was gross and net plot size divided into 5.4 m x 4.5 m and 4.5 m x 3.9 m respectively.

Results and Discussion

Effect of different weed control treatments on plant height (cm) of soybean

The data on mean plant height of soybean at various growth stage of the crop growth is presented in Table 1. The mean plant height of soybean was recorded during 30, 45, 60, 75 DAS and at harvest are 16.53, 25.70, 34.02, 37.67 and 40.04 cm respectively. The height of plant was found to be increased at every stage of crop growth till maturity. The rate of increase in plant height was maximum between 30 to 45 days in most of the treatments indicating grand growth period. Thereafter, increase in the plant height at decreasing rate till maturity. The effect of weed control treatment on plant height was found to be significant at all growth stages of the crop except 30 DAS.

The weed free plot (T2) recorded highest plant height i.e 17.97, 29.30, 38.50, 43.33 and 45.67 at 30, 45, 60, 75 DAS and at harvest respectively it was at par with Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS (T8) and Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS (T5) and found significantly superior over rest of the treatments at 45, 60, 75, 90 and at harvest. Similar kind of result was reported by Kale *et al.* (2013) [13].

In general, weedy check (T1) recorded shorter plant height i.e 15.10, 20.97, 28.03, 30 and 32.17 at 30, 45, 60, 75 DAS and at harvest respectively.

Table 1: Mean plant height (cm) as influenced by various treatments at different growth stages of soybean

Treatments	Days After Sowing				
	30	45	60	75	AH
T1: Weedy check	15.10	20.97	28.03	30.00	32.17
T2: Weed free	17.97	29.30	38.50	43.33	45.67
T3: Soybean + Green gram (2:1) intercropping	15.13	22.60	31.97	35.17	37.67
T4: Diclosulam 84% WDG PE 26 g/ha + 1 Hoeing + Straw mulching	16.53	25.67	33.17	36.67	38.83
T5: Diclosulam 84% WDG PE 26 g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20- 25 DAS	16.97	28.00	36.53	40.67	43.67
T6: Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw mulching	16.90	26.20	34.17	38.00	40.17
T7: Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5%EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix)	16.77	25.87	33.23	37.50	39.67
T8: Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS	17.83	28.47	37.93	42.00	44.67
T9: Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching	15.60	24.27	32.67	35.67	37.83
SE ±	0.64	1.06	1.45	1.60	1.82
CD @5%	NS	3.08	4.21	4.65	5.28
Grand Mean	16.53	25.70	34.02	37.67	40.04

Number of functional leaves plant^{-1}

Data on mean number of trifoliate functional leaves plant-1 of soybean was recorded at various stage of the crop growth and presented in Table 2. The mean number of functional leaves plant-1 were 7.39, 18.32, 21.31 and 18.45 at 30, 45, 60 and 75 DAS respectively.

Data presented in Table 2 revealed that mean number of functional leaves plant-1 was increased up to 60 DAS. Increase in number of functional leaves was rapid during 30 to 45 and declined thereafter. The effect of weed control treatment on mean number of functional leaves plant-1 was found significant at all stages of observations. The highest mean number of functional leaves plant-1 (21.31) was observed at 60 DAS.

Weed free plot recorded highest number of functional leaves plant-1 at all stages of observation it was significantly superior over rest of the treatments except treatments T8 and T5. Similar kind of result was reported by Habimana *et al.* (2014) [11].

Table 2: Mean number of functional leaves per plant as influenced by different treatments at various growth stages of soybean

Treatment	Days After Sowing			
	30	45	60	75
T1: Weedy check	6.24	12.37	15.15	13.00
T2: Weed free	8.97	24.33	28.72	25.80
T3: Soybean + Green gram (2:1) intercropping	6.47	15.19	17.13	13.70
T4: Diclosulam 84% WDG PE 26 g/ha + 1 Hoeing + Straw mulching	6.68	16.69	18.20	15.38
T5: Diclosulam 84% WDG PE 26 g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS	8.55	21.56	24.87	22.42
T6: Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw Mulching	7.30	18.96	22.77	19.96
T7: Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5% EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix)	7.00	17.79	19.87	17.28
T8: Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS	8.71	22.72	26.90	23.51

T9: Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching	6.60	15.29	18.15	14.99
SE ±	0.51	0.88	1.17	1.05
CD @ 5%	1.48	2.56	3.39	3.08
Grand Mean	7.39	18.32	21.31	18.45

Mean number of branches plant^{-1}

Data regarding mean number of branches plant-1 of soybean is presented in Table 3 and showed that the number of branches plant-1 increased gradually from 30 to 75 DAS thereafter remain constant up to harvest.

Mean number of branches plant-1 of soybean recorded 3.58, 6.16, 7.15, 7.63 and 7.63 at 30, 45, 60, 75 DAS and at harvest respectively. The rate of increase in number of branches plant-1 was rapid between 30 to 45 DAS and was very slow in 60 to 75 DAS.

The treatment T2 recorded highest mean number of branches plant-1 (8.93) at 75 DAS, which was at par with treatments T8 and T5 respectively and significantly superior over rest of the treatments. Similar trend was observed at all remaining growth stages. Similar kind of result were reported by Kale *et al.* (2013) [13] and Yadav *et al.* (2017) [27].

In general, weed free i.e T2 plot recorded highest mean number of branches plant-1 and weedy check recorded lowest number of branches plant-1 at all stages of observation. Among the chemical treatments, Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS (T8) recorded highest mean number of branches plant-1 of soybean.

Table 3: Mean number of branches plant-1 of soybean as influenced by different treatments at various growth stages of crop

Treatments	Days After Sowing				
	30	45	60	75	AH
T1: Weedy check	2.73	4.67	5.60	5.93	5.93
T2: Weed free	4.83	7.43	8.87	8.93	8.93
T3: Soybean + Green gram (2:1) intercropping	2.93	5.47	6.07	6.67	6.67
T4: Diclosulam 84% WDG PE 26g/ha + 1 Hoeing + Straw mulching	3.30	5.77	7.13	7.47	7.47
T5: Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS	3.90	6.90	7.83	8.40	8.40
T6: Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw mulching	3.67	6.27	7.47	7.70	7.70
T7: Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5%EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix)	3.43	6.07	7.27	7.67	7.77
T8: Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS	4.30	7.23	7.93	8.70	8.70
T9: Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching	3.13	5.63	6.20	7.20	7.20
SE ±	0.23	0.37	0.41	0.37	0.37
CD @5%	0.66	1.08	1.19	1.06	1.06
Grand Mean	3.58	6.16	7.15	7.63	7.63

Mean number of effective nodules plant^{-1}

Data on mean number of effective nodule plant-1 of soybean as influenced by different treatments at various crop growth stages in presented in Table 4. The mean number nodules plant-1 at 30, 45, 60, 75 DAS and at harvest were 21.93, 38.15, 51.33, 36.33 and 25.44 respectively.

The mean number of nodules plant-1 of soybean were increased up to 60 days and decreased gradually there after due to drying of nodules. The mean number nodules plant-1 was significantly influenced due to weed control treatments at all growth stages of crop.

At all growth stages weed free plot (T2) recorded highest mean number nodules plant-1 of soybean which was at par with T8 and T5 respectively and significantly superior over rest of the treatments.

In general, weed free plot recorded highest mean number nodules plant-1 and weedy check recorded lowest mean number nodules plant-1 at all growth stages of crop. Similar kind of result was reported by Toppo *et al.* (2018) [25].

Table 4: Mean number of effective nodules plant-1 as influenced by different treatments at various growth stages of soybean

Treatments	Days After Sowing				
	30	45	60	75	AH
T1: Weedy check	18.00	33.67	45.33	29.67	21.00
T2: Weed free	26.00	43.33	58.33	43.33	31.33
T3: Soybean + Green gram (2:1) intercropping	19.33	35.00	47.00	31.33	23.00
T4: Diclosulam 84% WDG PE 26g/ha + 1 Hoeing + Straw mulching	21.00	37.00	50.00	35.33	24.00
T5: Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS	24.00	40.67	54.00	38.67	27.67
T6: Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw mulching	22.33	37.67	51.33	36.67	25.67
T7: Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5%EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix)	21.33	37.33	51.00	36.00	24.67
T8: Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS	25.67	42.67	55.67	41.67	28.00
T9: Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching	19.67	36.00	49.33	34.33	23.67
SE ±	1.22	1.79	2.16	2.01	1.71
CD @5%	3.56	5.19	6.28	5.83	4.98
Grand Mean	21.93	38.15	51.33	36.33	25.44

Mean total dry matter plant^{-1}

Data in respect of periodical accumulation of mean total dry matter plant-1 (g) of soybean as affected by various treatments are presented in Table 5. The mean total dry matter production plant-1 (g) at 30, 45, 60, 75 DAS and at harvest were 2.04, 6.19, 9.66, 14.92 and 18.14 respectively.

The data presented in Table 5 showed that the mean total dry matter plant-1 (g) accumulation was increasing continuously up to harvest. At initial stage up to 30 DAS rate of increasing in respect of mean total dry matter plant-1 was very slow and it was highest between 45 to 75 DAS and there after rate of dry matter production was increased but at decreasing rate.

The total dry matter production plant-1 (g) of soybean was found to be significant at all growth stages of crop.

At all the growth stages of the crop weed free plot T2 recorded maximum mean total dry matter plant-1 which was at par with treatments T8 and T5 respectively and significantly superior over rest of the treatments. Similar kind of result was reported by Kale *et al.* (2013) [13].

In general, weed free plot recorded highest mean total dry matter and weedy check recorded lowest mean total dry matter at all growth stages of crop. Similar kind of result was reported by Raghuwanshi *et al.* (2005) [8].

Table 5: Mean total dry matter production plant^{-1} as influenced by different treatments at various growth stages of soybean

Treatments	Days After Sowing				
	30	45	60	75	AH
T1: Weedy check	1.43	4.13	6.40	11.20	15.00
T2: Weed free	3.10	7.23	12.33	17.63	21.17
T3: Soybean + Green gram (2:1) intercropping	1.47	5.57	7.10	13.27	15.50
T4: Diclosulam 84% WDG PE 26g/ha + 1 Hoeing + Straw mulching	1.57	6.17	9.30	14.67	17.90
T5: Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS	2.83	6.87	11.20	16.47	19.10
T6: Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw mulching	1.93	6.30	10.27	14.97	18.60
T7: Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5%EC @ 0.075 kg a.i/ha POE at 20-25 DAS	1.63	6.23	10.13	14.87	18.20
(Tank Mix)					
T8: Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS	2.90	7.17	11.33	17.53	20.13
T9: Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching	1.50	6.03	8.83	13.70	17.67
SE ±	0.11	0.28	0.57	0.82	0.86
CD @5%	0.32	0.82	1.65	2.38	2.51
Grand Mean	2.04	6.19	9.66	14.92	18.14

Effect of different weed control treatments on Seed yield plant^{-1} (g), Seed yield (kg ha-1), Straw yield (kg ha-1) and Test weight (g) of soybean

Seed yield plant-1 (g)

Data presented in Table 6 indicated that the mean seed yield plant-1 of soybean was (5.22) and it was significantly influenced by different weed control treatments.

The treatment weed free (T2) recorded highest seed yield plant-1 (6.07), which was at par with treatments (T8) and (T5) respectively and found significantly over rest of the treatments.

Among the chemical weed control treatments, application of Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS (T8) recorded highest seed yield plant-1. Similar kind of result were reported by Samudre *et al.* (2019) [20, 21] and Yadav *et al.* (2017) [27].

Seed yield (kg ha^{-1})

The data on seed yield presented in Table 6. Data showed that the seed yield of soybean has significantly influenced due to different weed control methods.

The mean seed yield was 1647 kg/ha. The treatment weed free (T2) recorded highest seed yield and treatment weedy check (T1) recorded lowest seed yield.

Among the different chemical weed control methods, application of Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS (T8) recorded highest seed yield which was found at par with remaining chemical weed control treatments. Similar kind of result were reported by Samudre *et al.* (2019) [20, 21] and Yadav *et al.* (2017) [27].

Straw yield (kg ha-1)

The data in respect to straw yield are presented in Table 6. The data indicated that weed control treatments differed significantly with each other in respect of straw yield.

Data showed that the mean straw yield was 2630 kg ha-1, the lowest straw yield obtained in weedy check plot.

Test weight (g)

Data presented on test weight is presented in Table 6. The maximum test weight (115.20) was obtained with the weed free treatment (T2) which was closely followed by T8 and T5 treatments respectively. The test weight did not significantly influenced of due to different weed control treatments.

Table 6: Effect of different treatments on yield attributing characters and yield of soybean

Treatments	Seed yield plant-1 (g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Test weight (g)
T1: Weedy check	4.07	950	1833	108.60
T2: Weed free	6.07	2049	2784	115.20
T3: Soybean + Green gram (2:1) intercropping	4.56	1462	2700	109.60
T4: Diclosulam 84% WDG PE 26g/ha + 1 Hoeing + Straw mulching	5.03	1652	2687	112.07
T5: Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 xkg/ha at 20-25 DAS	5.79	1840	2709	114.33
T6: Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS +1 Hoeing at 25 DAS + Straw mulching	5.32	1718	2661	113.80
T7: Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5%EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix)	5.21	1671	2776	113.13
T8: Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS	5.90	1890	2692	114.67
T9: Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing +Straw mulching	4.86	1595	2829	110.60
SE ±	0.25	107	110	0.56
CD @5%	0.74	310	319	NS
Grand Mean	5.22	1647	2630	112.44

Weed Studies

To assess the effect of various weed control methods on weed dry weight (g m2), weed control efficiency (%) and weed index (%) were recorded.

Dry matter of weed (g m-2)

Data on weed dry matter at harvest in gram are presented in Table 7. The mean dry weight of weed was 82.06 g m-2. The highest dry weight of weed recorded in weedy check plot (T1) i.e 256 g m-2 which was significantly superior over rest of the treatments and lowest dry weight of weed recorded in weed free plot (T2) i.e 4.50 g m-2. Similar kind of result was obtained by Samudre *et al.* (2019) [20, 21].

Table 7: Effect of different treatments on weed dry matter (g), weed control efficiency (%) and weed index (%) in soybean.

Treatments	Weed dry matter (g)	Weed control efficiency (%)	Weed index (%)
T1: Weedy check	256.00	0.00	53.63
T2: Weed free	4.50	98.36	0.00
T3: Soybean + Green gram (2:1) intercropping	121.00	52.87	28.64
T4: Diclosulam 84% WDG PE 26g/ha + 1 Hoeing + Straw mulching	90.00	64.80	19.37
T5: Diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS	14.67	94.25	10.20
T6: Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS + 1 Hoeing at 25 DAS + Straw mulching	62.00	75.73	16.15
T7: Imazethapyr 10% SL @ 0.10 kg/ha POE + Quizalofop ethyl 5% EC @ 0.075 kg a.i/ha POE at 20-25 DAS (Tank Mix)	80.00	68.65	18.44
T8: Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS	9.00	96.48	7.75
T9: Pendimethalin 38.7% CS @ 1.0 kg a.i/ha + 1 Hoeing + Straw mulching	101.33	60.31	22.15
SE ±	5.34	-	-
CD @5%	15.53	-	-
General mean	82.06	67.94	19.59

Weed control efficiency (%)

The data on weed control efficiency (%) for different treatments presented in Table 7. The mean weed control efficiency (%) was recorded 67.94%. The highest weed control efficiency (%) recorded in weed free treatment (T2) i.e 98.36% and lowest weed control efficiency (%) observed in weedy check plot. Among the chemical treatments, the highest weed control efficiency (%) observed in Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS (T8) i.e 96.48% followed by diclosulam 84% WDG PE 26g/ha + POE Imazethapyr 10% SL @ 0.10 kg/ha at 20-25 DAS (T5) i.e 94.25%. Similar kind of result was obtained by Samudre *et al.* (2019) [20, 21].

Weed index (%)

Data in respect of weed index (%) for different treatments showed in Table 7. Weed index showed the losses due to weed in different treatments. Thus, it indicates how much loss in yield is occurred due to presence of weeds.

The data showed that the mean weed index (%) was 19.59%. The highest weed index recorded in weedy check plot (T1) i.e 53.63% followed by T3. The lowest weed index recorded in weed free plot followed by Pendimethalin 38.7% CS @ 0.75 kg a.i/ha + Imazethapyr 10% SL @ 0.10 kg/ha POE at 20-25 DAS (T8) i.e 7.75%. Similar kind of result was obtained by Samudre *et al.* (2019) [20, 21].

Conclusion

The study showed that the highest growth attributes seed yield, weed control efficiency, economics returns and lowest weed index were obtained in soybean crop kept with weed free condition followed by T8 and T5 treatments.

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