

## Efficacy of Weed Control Practices in Soybean Crop Production

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### ABSTRACT

The effect of different weed control methods on weed population, yield and yield attributes of soybean was studied at TNAU, Coimbatore, using pre-emergence application of pendimethalin, fluchloralin and alachlor each @ 1.0 kg/ha as well as integrated application of pre-emergence herbicide+one hand weeding at 35 DAS, and two hand weedings at 20 and 35 DAS. Alachlor @ 1.0 kg/ha+one hand weeding at 35 DAS was found to be the best treatment followed by pendimethalin @ 1.0 kg/ha+one hand weeding at 35 DAS and two hand weedings at 20 and 35 DAS treatments. The quality parameters of soybean seeds were not affected by weed control practices.

**Key words :** Weed-crop competition, complex weed flora, integrated approach

### INTRODUCTION

Soybean is a crop of multiple qualities as it is both a pulse and an oil seed crop. It has very high potential among grain legume crops for combating acute malnutrition. The quality of soy protein is equivalent to that of animal protein and soybean is also a good source of dietary fibre, calcium, magnesium, phosphate, thiamine, riboflavin, niacin, etc. Soybean has also been reported to have medicinal properties in combating diabetes, cancer, heart disease, etc. Another significance of this crop is in its ability to fix atmospheric nitrogen. The productivity of soybean in India is only 857 kg/ha against a world average of 2293 kg/ha (FAO, 2006). One of the major reasons for this poor performance of soybean is inadequate weed control. Weed infestation could reduce the seed yield by 18.83 to 42.37% (Kurmawanshi *et al.*, 1995). The conventional method of weed control is time consuming, expensive and laborious. It is more favourable to use chemicals due to scarcity of human labour during peak season (Jain *et al.*, 2000). Keeping these facts in view, the present investigation was undertaken to study the effect of various weed control methods on weed population in soybean plots as well as the yield attributes, yield and quality parameters of soybean.

### MATERIALS AND METHODS

A field experiment was conducted at the

Agricultural College and Research Institute, Coimbatore with the soybean variety Co 2 under irrigated condition during the year 2001. The soil of the experimental site was clay loam in texture with low available nitrogen (250 kg/ha) and medium available phosphorus (15.7 kg/ha) and potassium (390 kg/ha). The trial consisted of eight treatments (Table 1) in randomized block design with three replications.

The species-wise weed count was taken using a quadrant (0.5 x 0.5 m) on 20, 40, 60 DAS and at harvest. The weed density was expressed in number per m<sup>2</sup>. The weeds present inside the randomly placed quadrant were uprooted at 20, 40, 60 DAS and at harvest and then dried in the hot air oven at 60°C. The dry weight of weeds was expressed in kg/ha. WCE was calculated using the weed count data, using the formula suggested by Mani *et al.* (1993) and weed index was calculated as per the formula given by Gill and Vijayakumar (1969).

Number of pods/plant (60 DAS and at harvest), number of seeds/plant and 1000 seed weight were recorded at harvest. Seed yield was recorded in each plot after harvest. Seed samples were drawn to estimate protein and oil content. The oil content was estimated using NMR analyzer and crude protein content was calculated from the seed nitrogen content. The data were statistically analysed.

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## RESULTS AND DISCUSSION

### Effect on Weeds

#### 1. Weed population

The weed count was recorded species-wise at 20, 40, 60 DAS and at harvest (Tables 1-4).

**Cynodon dactylon** : At 20 DAS, the highest number was recorded in 2 HW treatment (T<sub>7</sub>) which was 43.9 plants/m<sup>2</sup>. The lowest weed density was in pendimethalin+HW treatment which was 95% less compared to T<sub>7</sub> (Table 1). At 40 DAS, the lowest weed population with regard to *C. dactylon* was recorded in pendimethalin+1 HW treatment which showed 81.7% reduction compared to control (Table 2). At 60 DAS, T<sub>4</sub> registered 69% less weed population compared to control (Table 3). At harvest stage, control treatment again recorded

the highest weed count followed by pendimethalin PRE treatment (T<sub>1</sub>) (Table 4). All the treatments were significantly different from each other. The lowest weed count of *C. dactylon* was obtained in alachlor+1 HW treatment (T<sub>6</sub>) which registered 73.4% decrease in weed density compared to control (Tables 1-4).

**Echinochloa colona** : At 20 DAS, the lowest number of *E. colona* was recorded in alachlor+1 HW treatment (T<sub>6</sub>) which was on par with alachlor PRE treatment (T<sub>3</sub>) (Table 1). There was 95% reduction in the population of *E. colona* in T<sub>6</sub> compared to control. At all the later stages of observation, the lowest population of the weed was recorded in T<sub>6</sub>, while the highest weed count was in control plot (Tables 2, 3 and 4). At harvest stage, T<sub>6</sub> was on par with pendimethalin+1 HW treatment (T<sub>4</sub>). These treatments showed 57% reduction in weed population compared to control.

Table 1. Weed count (No./m<sup>2</sup>) and WCE (%) at 20 DAS

Treatments	<i>C. dactylon</i>	<i>E. colona</i>	Grasses total	<i>C. rotundus</i>	Grasses+ sedges	<i>P. hysterophorus</i>	<i>D. arvensis</i>	Broad-leaved weeds total	Total weeds
T <sub>1</sub> -Pendimethalin @ 1.0 kg/ha PRE	5.2 (2.39) <b>86.9</b>	6.5 (2.65) <b>84.3</b>	11.7 (3.49)	0.9 (1.18) <b>82.7</b>	12.6 (3.62)	10.6 (3.33) <b>73.4</b>	10.6 (3.33) <b>58.1</b>	21.2 (4.66)	33.8 (5.86) <b>77.7</b>
T <sub>2</sub> -Fluchloralin @ 1.0 kg/ha PRE	6.5 (2.65) <b>83.7</b>	13.3 (3.71) <b>67.8</b>	19.8 (4.51)	10.6 (3.33) <b>0.0</b>	30.4 (5.56)	11.8 (3.5) <b>70.4</b>	13.3 (3.71) <b>47.4</b>	25.1 (5.06)	55.5 (7.48) <b>66.4</b>
T <sub>3</sub> -Alachlor @ 1.0 kg/ha PRE	6.5 (2.65) <b>83.7</b>	3.2 (1.92) <b>92.3</b>	9.7 (3.19)	6.5 (2.65) <b>0.0</b>	16.2 (4.09)	17.3 (4.22) <b>56.6</b>	14.6 (3.89) <b>42.3</b>	31.9 (5.69)	48.1 (6.97) <b>68.3</b>
T <sub>4</sub> -Pendimethalin @ 1.0 kg/ha PRE+HW (35 DAS)	2.2 (1.65) <b>94.5</b>	10.6 (3.33) <b>74.3</b>	12.8 (3.65)	3.2 (1.92) <b>38.5</b>	16.0 (4.06)	13.3 (3.71) <b>66.7</b>	7.7 (2.86) <b>69.6</b>	21.0 (4.64)	37.0 (6.12) <b>75.6</b>
T <sub>5</sub> -Fluchloralin @ 1.0 kg/ha PRE+HW (35 DAS)	6.5 (2.65) <b>83.7</b>	9.2 (3.12) <b>77.7</b>	15.7 (4.02)	6.5 (2.65) <b>0.0</b>	22.2 (4.76)	14.6 (3.89) <b>63.4</b>	15.8 (9.04) <b>37.5</b>	30.4 (5.56)	52.6 (7.29) <b>66.3</b>
T <sub>6</sub> -Alachlor @ 1.0 kg/ha PRE+HW (35 DAS)	9.2 (3.12) <b>76.9</b>	2.2 (1.65) <b>94.7</b>	11.4 (3.45)	6.5 (2.65) <b>0.0</b>	17.9 (4.29)	11.8 (3.5) <b>70.4</b>	9.2 (3.12) <b>63.6</b>	21.0 (4.64)	38.9 (6.28) <b>74.3</b>
T <sub>7</sub> -Two hand weedings (20 and 35 DAS)	43.9 (6.67)	33.7 (5.85)	77.6 (8.84)	5.2 (2.39)	82.8 (9.13)	33.3 (5.81)	25.3 (5.08)	58.6 (7.69)	141.4 (11.9)
T <sub>8</sub> -Weedy check	39.9 (6.36)	41.3 (6.47)	81.2 (9.04)	5.2 (2.39)	86.4 (9.32)	39.9 (6.36)	25.3 (5.08)	65.2 (8.11)	151.6 (12.3)
LSD (P=0.05)	0.9	1.2	2.3	1.2	3.3	0.84	0.79	3.6	6.9

$\sqrt{x+0.5}$  transformed values are given in parentheses. WCE values are given in bold.

**Cyperus rotundus** : The weed count of *C. rotundus* (sedge) at 20 DAS was the highest in fluchloralin PRE treatment (T<sub>2</sub>) and the lowest in control plot (T<sub>8</sub>) (Table 1). At 40 DAS, the highest count was observed in fluchloralin+1 HW treatment (T<sub>3</sub>) and the lowest in 2 HW treatment (T<sub>7</sub>) which was on par with alachlor+1 HW treatment (T<sub>6</sub>) (Table 2). At 60 DAS and at harvest stage (Tables 3 and 4), the lowest weed population was in alachlor+1 HW treatment (T<sub>6</sub>), which showed 95% less weed number compared to control.

**Parthenium hysterophorus** : At 20 DAS, the count of *P. hysterophorus* was highest in control (T<sub>8</sub>) and the lowest in pendimethalin PRE (T<sub>1</sub>) treatment (Table 1). At 40 DAS, the least weed count was in 2 HW treatment (T<sub>7</sub>) which was at par with pendimethalin+1 HW treatment (T<sub>4</sub>) (Table 2). At 60 DAS, the trend was the same (Table 3). At harvest

stage (Table 4), control plot recorded the highest population of *P. hysterophorus* and 2 HW (T<sub>7</sub>) treatment registered the least count which was 69% less compared to control. T<sub>7</sub> was on par with alachlor+1 HW (T<sub>6</sub>) treatment.

**Digera arvensis** : At 20 DAS, the population of *D. arvensis* was highest in control (T<sub>8</sub>) treatment followed by 2 HW (T<sub>7</sub>) treatment and both were on par with each other (Table 1). At 40 DAS, control plot (T<sub>8</sub>) showed the highest count, while alachlor+HW treatment (T<sub>6</sub>) recorded the lowest and it was on par with fluchloralin PRE treatment (T<sub>2</sub>) and pendimethalin + HW treatment (T<sub>4</sub>) (Table 2). At 60 DAS, the highest weed count was observed in T<sub>8</sub> and the lowest in pendimethalin+HW treatment (T<sub>4</sub>) (Table 3). At harvest stage, the highest weed count for *D. arvensis* was observed in fluchloralin PRE treatment (T<sub>2</sub>) and the lowest

Table 2. Weed count (No./m<sup>2</sup>) and WCE (%) at 40 DAS

Treatments	<i>C. dactylon</i>	<i>E. colona</i>	Grasses total	<i>C. rotundus</i>	Grasses+ sedges	<i>P. hysterophorus</i>	<i>D. arvensis</i>	Broad-leaved weeds total	Total weeds
T <sub>1</sub> -Pendimethalin @ 1.0 kg/ha PRE	19.9 (4.51) <b>68.9</b>	23.9 (4.94) <b>47.2</b>	43.8 (6.66)	6.5 (2.65) <b>15.6</b>	50.3 (7.13)	18.6 (4.37) <b>56.3</b>	5.2 (2.39) <b>73.9</b>	23.8 (4.93)	74.1 (8.64) <b>56.3</b>
T <sub>2</sub> -Fluchloralin @ 1.0 kg/ha PRE	60.0 (7.78) <b>6.25</b>	5.2 (2.39) <b>88.5</b>	65.2 (8.11)	3.2 (1.91) <b>58.4</b>	68.4 (8.30)	26.6 (5.21) <b>37.6</b>	0.9 (1.18) <b>95.5</b>	27.5 (5.29)	95.9 (9.82) <b>43.4</b>
T <sub>3</sub> -Alachlor @ 1.0 kg/ha PRE	25.3 (5.08) <b>60.5</b>	27.9 (5.33) <b>38.4</b>	53.2 (7.33)	2.2 (1.65) <b>71.4</b>	55.4 (7.48)	25.3 (5.08) <b>40.6</b>	6.5 (2.65) <b>67.3</b>	31.8 (5.68)	87.2 (9.36) <b>48.6</b>
T <sub>4</sub> -Pendimethalin @ 1.0 kg/ha PRE+HW (35 DAS)	11.7 (3.49) <b>81.7</b>	5.2 (2.39) <b>88.5</b>	16.9 (4.17)	3.7 (2.04) <b>51.9</b>	20.6 (4.59)	3.2 (1.91) <b>92.5</b>	0.9 (1.18) <b>95.5</b>	4.1 (2.14)	24.7 (5.02) <b>85.4</b>
T <sub>5</sub> -Fluchloralin @ 1.0 kg/ha PRE+HW (35 DAS)	21.3 (4.67) <b>66.7</b>	11.7 (3.49) <b>74.2</b>	33.0 (5.79)	10.6 (3.33) <b>0.0</b>	43.6 (6.64)	10.6 (3.33) <b>75.1</b>	3.2 (1.91) <b>83.9</b>	13.8 (3.78)	57.4 (7.61) <b>66.1</b>
T <sub>6</sub> -Alachlor @ 1.0 kg/ha PRE+HW (35 DAS)	14.6 (3.89) <b>77.2</b>	0.3 (0.88) <b>99.3</b>	14.9 (3.92)	0.9 (1.18) <b>88.3</b>	15.8 (4.04)	6.5 (2.65) <b>84.7</b>	0.9 (1.18) <b>95.5</b>	7.4 (2.81)	23.2 (4.87) <b>86.3</b>
T <sub>7</sub> -Two hand weedings (20 and 35 DAS)	14.6 (3.89) <b>77.2</b>	2.2 (1.65) <b>95.1</b>	16.8 (4.16)	0.3 (0.88) <b>96.1</b>	17.1 (4.19)	3.2 (1.91) <b>92.5</b>	2.2 (1.65) <b>88.9</b>	5.4 (2.43)	22.5 (4.79) <b>86.7</b>
T <sub>8</sub> -Weedy check	64 (8.03)	45.3 (6.77)	109.3 (10.48)	7.7 (2.86)	117.0 (10.8)	42.6 (6.57)	19.9 (4.51)	52.5 (7.28)	169.5 (13.04)
LSD (P=0.05)	0.6	0.9	5.8	1.2	2.9	1.3	1.6	3.8	7.6

$\sqrt{x+0.5}$  transformed values are given in parentheses. WCE values are given in bold.

in pendimethalin+HW treatment (T<sub>4</sub>) which registered 51% reduction compared to T<sub>2</sub> (Table 4).

## 2. Weed dry matter accumulation

The dry matter accumulation (DMA) by individual weeds was recorded at 20, 40, 60 DAS and at harvest (Table 5). The control plot recorded the highest dry matter of weeds at all the stages.

At 20 DAS the treatment involving herbicide application (T<sub>1</sub> to T<sub>6</sub>) registered significantly lesser weed dry matter compared to treatments T<sub>7</sub> and T<sub>8</sub> which were unweeded upto that stage (Table 5). The highest weed DMA i. e. 192.24 kg/ha was recorded in control plot (T<sub>8</sub>) which was statistically on par with T<sub>7</sub> (186.40 kg/ha). In other treatments, the weed DMA ranged from 39.66 kg/ha in T<sub>4</sub> to 50.42 kg/ha in T<sub>2</sub> and all were on par among themselves.

At 40 DAS, the treatments involving the integrated application of herbicide and manual weeding (T<sub>4</sub>, T<sub>5</sub> and T<sub>6</sub>) and the 2 HW treatment (T<sub>7</sub>) recorded significantly less weed DMA values compared to other treatments (Table 5). The lowest weed DMA of 11.3 kg/ha was registered in alachlor+1 HW treatment (T<sub>6</sub>) and this was on par with pendimethalin+1 HW (T<sub>4</sub>) treatment (16.4 kg/ha), fluchloralin+1 HW (T<sub>5</sub>) treatment (13.8 kg/ha) and 2 HW treatment (13.9 kg/ha). The highest weed DMA was in control plot which recorded 489.8 kg/ha followed by fluchloralin PRE treatment which registered 312.6 kg/ha.

At 60 DAS, the lowest weed DMA was observed in 2 HW treatment (T<sub>7</sub>) which was on par with alachlor+1 HW treatment and pendimethalin+1 HW treatment. The DMA values were 178.9, 184.8 and 198.9 kg/ha, respectively. The highest weed DMA (710.5 kg/ha) was recorded in weedy check (T<sub>8</sub>) followed by

Table 3. Weed count (No./m<sup>2</sup>) and WCE (%) at 60 DAS

Treatments	<i>C. dactylon</i>	<i>E. colona</i>	Grasses total	<i>C. rotundus</i>	Grasses+ sedges	<i>P. hysterophorus</i>	<i>D. arvensis</i>	Broad-leaved weeds total	Total weeds
T <sub>1</sub> -Pendimethalin @ 1.0 kg/ha PRE	54.7 (7.43) <b>42.2</b>	22.6 (4.81) <b>50.1</b>	77.3 (8.82)	5.2 (2.39) <b>80.5</b>	82.5 (9.11)	37.3 (6.15) <b>15.0</b>	5.2 (2.39) <b>72.0</b>	42.5 (6.56)	125.0 (11.2) <b>45.4</b>
T <sub>2</sub> -Fluchloralin @ 1.0 kg/ha PRE	53.3 (7.34) <b>43.7</b>	13.3 (3.71) <b>70.6</b>	66.6 (8.19)	10.6 (3.33) <b>60.2</b>	77.2 (8.81)	38.6 (6.26) <b>12.1</b>	5.2 (2.39) <b>72.0</b>	43.8 (6.66)	121.0 (11.0) <b>47.2</b>
T <sub>3</sub> -Alachlor @ 1.0 kg/ha PRE	45.3 (6.77) <b>52.2</b>	25.3 (5.08) <b>44.2</b>	70.6 (8.43)	7.7 (2.86) <b>71.1</b>	78.3 (8.88)	42.6 (6.57) <b>2.9</b>	5.2 (2.39) <b>72.0</b>	47.8 (6.95)	126.1 (11.3) <b>44.9</b>
T <sub>4</sub> -Pendimethalin @ 1.0 kg/ha PRE+HW (35 DAS)	29.3 (5.46) <b>69.1</b>	15.8 (4.04) <b>65.1</b>	45.1 (6.75)	6.5 (2.65) <b>75.6</b>	51.6 (7.22)	13.3 (3.71) <b>69.7</b>	0.9 (1.18) <b>95.2</b>	14.2 (3.83)	65.8 (8.14) <b>71.3</b>
T <sub>5</sub> -Fluchloralin @ 1.0 kg/ha PRE+HW (35 DAS)	34.6 (5.93) <b>63.5</b>	15.8 (4.04) <b>65.1</b>	50.4 (7.13)	7.7 (2.86) <b>71.1</b>	58.1 (7.65)	17.3 (4.22) <b>60.6</b>	6.5 (2.65) <b>65.1</b>	17.9 (4.29)	81.9 (9.08) <b>64.3</b>
T <sub>6</sub> -Alachlor @ 1.0 kg/ha PRE+HW (35 DAS)	30.6 (5.58) <b>67.7</b>	0.3 (0.88) <b>99.3</b>	30.9 (5.60)	3.2 (1.91) <b>87.9</b>	34.1 (5.88)	15.7 (4.02) <b>64.2</b>	2.2 (1.65) <b>88.2</b>	23.8 (4.93)	52.0 (7.25) <b>77.3</b>
T <sub>7</sub> -Two hand weedings (20 and 35 DAS)	31.9 (5.69) <b>66.3</b>	3.2 (1.91) <b>92.9</b>	35.1 (5.97)	7.7 (2.86) <b>71.1</b>	42.8 (6.58)	13.3 (3.71) <b>69.7</b>	5.2 (2.39) <b>72.0</b>	18.5 (4.36)	61.3 (7.86) <b>73.2</b>
T <sub>8</sub> -Weedy check	94.7 (9.75)	45.3 (6.77)	140.0 (11.85)	26.6 (5.21)	166.6 (12.9)	43.9 (6.67)	18.6 (4.37)	62.5 (7.94)	229.1 (15.2)
LSD (P=0.05)	0.5	1.1	4.6	1.4	5.2	0.5	1.2	3.4	8.7

$\sqrt{x+0.5}$  transformed values are given in parentheses. WCE values are given in bold.

fluchloralin PRE treatment which recorded 510.9 kg/ha (Table 5).

At harvest stage, 2 HW treatment (T<sub>7</sub>) recorded the lowest weed DMA of 306.3 kg/ha which was on par with alachlor+1 HW treatment (T<sub>6</sub>) which registered 313.8 kg/ha and pendimethalin+1 HW treatment T<sub>4</sub> with 325.7 kg/ha (Table 5). Control plot recorded the highest weed DMA of 964.0 kg/ha followed by 740.9 kg/ha in fluchloralin PRE treatment (T<sub>2</sub>).

### 3. Weed control efficiency

The weed control efficiency (WCE) was worked out for individual weed species as well as for all the weeds together at 20, 40, 60 DAS and at harvest (Tables 1-4). At 20 DAS, the pre-emergent application of pendimethalin 1.0 kg/ha (T<sub>1</sub> and T<sub>4</sub>) recorded the highest WCE with regard to *C. dactylon*, *C. rotundus*, *P.*

*hysterophorus* and *D. arvensis*. Alachlor PRE application @ 1.0 kg/ha was most effective in controlling *E. colona*. With respect to all the weeds, the highest WCE was registered under T<sub>1</sub> (pendimethalin PRE).

At 40 DAS, 2 HW treatment recorded the highest WCE for controlling *C. rotundus* (96.1%) and *P. hysterophorus* (Table 2). T<sub>4</sub> was also the most effective in controlling *C. dactylon* and *D. arvensis*, T<sub>2</sub>, T<sub>4</sub> and T<sub>6</sub> recorded 95.5% WCE against *D. arvensis* and *E. colona* was most effectively controlled by alachlor+1 HW (T<sub>6</sub>) treatment (99.3%), followed by 2 HW treatment. For overall weed control, 2 HW treatment recorded the highest WCE of 86.7%.

At 60 DAS, pendimethalin+1 HW (T<sub>4</sub>) treatment recorded the highest WCE against *C. dactylon*, *P. hysterophorus* and *D. arvensis* (Table 3). Two HW treatment was equally effective in controlling *P. hysterophorus*. Alachlor+1 HW treatment recorded

Table 4. Weed count (No./m<sup>2</sup>) and WCE (%) at harvest

Treatments	<i>C. dactylon</i>	<i>E. colona</i>	Grasses total	<i>C. rotundus</i>	Grasses+ sedges	<i>P. hysterophorus</i>	<i>D. arvensis</i>	Broad-leaved weeds total	Total weeds
T <sub>1</sub> -Pendimethalin @ 1.0 kg/ha PRE	70.7 (8.44) <b>29.3</b>	31.9 (5.69) <b>47.9</b>	102.6 (10.2)	17.3 (4.22) <b>13.1</b>	119.9 (10.97)	31.9 (5.69) <b>53.1</b>	11.8 (3.5) <b>31.8</b>	43.7 (6.65)	163.6 (12.8) <b>38.6</b>
T <sub>2</sub> -Fluchloralin @ 1.0 kg/ha PRE	60.0 (7.78) <b>40.0</b>	38.6 (6.26) <b>37.0</b>	98.6 (9.95)	17.3 (4.22) <b>13.1</b>	115.9 (10.79)	41.3 (5.47) <b>39.3</b>	18.6 (4.37) <b>0.0</b>	59.9 (7.77)	175.8 (13.28) <b>34.0</b>
T <sub>3</sub> -Alachlor @ 1.0 kg/ha PRE	57.2 (7.59) <b>42.8</b>	27.9 (5.33) <b>54.5</b>	85.1 (9.25)	17.3 (4.22) <b>13.1</b>	102.4 (10.14)	31.9 (5.69) <b>53.1</b>	17.3 (4.22) <b>0.0</b>	49.2 (7.05)	151.6 (12.3) <b>43.1</b>
T <sub>4</sub> -Pendimethalin @ 1.0 kg/ha PRE+HW (35 DAS)	31.9 (5.69) <b>68.1</b>	26.6 (5.21) <b>56.7</b>	58.5 (7.68)	10.6 (3.33) <b>46.7</b>	69.1 (8.34)	22.6 (4.81) <b>66.8</b>	9.2 (3.12) <b>46.8</b>	31.8 (5.68)	100.9 (10.1) <b>62.1</b>
T <sub>5</sub> -Fluchloralin @ 1.0 kg/ha PRE+HW (35 DAS)	37.3 (6.15) <b>62.7</b>	33.3 (5.81) <b>45.7</b>	70.6 (8.43)	9.2 (3.12) <b>53.8</b>	79.8 (8.93)	22.6 (4.81) <b>66.8</b>	14.6 (3.89) <b>15.6</b>	37.2 (6.14)	117.0 (10.8) <b>56.1</b>
T <sub>6</sub> -Alachlor @ 1.0 kg/ha PRE+HW (35 DAS)	26.6 (5.21) <b>73.4</b>	26.6 (5.21) <b>56.7</b>	53.2 (7.33)	0.9 (1.18) <b>95.5</b>	54.1 (7.39)	21.3 (4.67) <b>68.7</b>	11.8 (3.5) <b>31.8</b>	33.1 (5.79)	87.2 (9.36) <b>67.3</b>
T <sub>7</sub> -Two hand weedings (20 and 35 DAS)	33.3 (5.81) <b>66.7</b>	38.6 (6.26) <b>37.0</b>	71.9 (8.51)	9.2 (3.12) <b>53.8</b>	81.1 (9.03)	21.3 (4.67) <b>68.7</b>	10.6 (3.33) <b>38.7</b>	31.9 (5.69)	113.0 (10.7) <b>57.6</b>
T <sub>8</sub> -Weedy check	100.0 (10.0)	61.3 (7.86)	161.3 (12.72)	19.9 (4.51)	181.2 (13.48)	68.0 (8.27)	17.3 (4.22)	85.3 (9.26)	266.5 (16.3)
LSD (P=0.05)	0.55	0.6	7.2	1.0	8.2	0.6	0.9	3.1	14.6

$\sqrt{x+0.5}$  transformed values are given in parentheses. WCE values are given in bold.

highest WCE for *E. colona* and *C. rotundus*. Considering overall WCE, alachlor+1 HW was the best treatment (77.3%), followed by 2 HW treatment (73.2%).

At harvest, alachlor +1 HW ( $T_6$ ) registered the highest WCE with respect to *C. dactylon*, *E. colona*, *C. rotundus* and *P. hysterophorus* (Table 4). Pendimethalin+1 HW ( $T_4$ ) treatment was equally effective in controlling *E. colona*, while 2 HW ( $T_7$ ) treatment recorded similar WCE as that of  $T_6$  against *P. hysterophorus*. *D. arvensis* was best controlled by pendimethalin+1 HW treatment. In the case of all weeds considered together, alachlor+1 HW ( $T_6$ ) recorded the highest WCE (67.3%) followed by pendimethalin+1 HW treatment (62.1%).

#### 4. Weed index

The weed index was calculated for the different treatments after harvest and the results are given in Table 5. The highest WI (0.61) was recorded in the control treatment ( $T_8$ ). The least WI was observed in 2 HW treatment (0.07) considering alachlor+1 HW treatment ( $T_6$ ) as the minimum weed

competition treatment. Pendimethalin+1 HW treatment ( $T_4$ ) registered a WI of 0.09.

#### Yield and Yield Attributes

##### 1. Pods/plant

The number of pods per plant was recorded at 60 DAS and at harvest (Table 6). At 60 DAS, the highest number of pods per plant (26) was recorded in 2 HW treatment ( $T_7$ ). It was 77% increase over control ( $T_8$ ) treatment.  $T_7$  was on par with alachlor+1 HW treatment ( $T_6$ ) and pendimethalin+1 HW ( $T_4$ ). The lowest number of 14.7 pods per plant was recorded in control treatment.

At harvest stage, the highest number of pods per plant was registered in 2 HW treatment ( $T_7$ ) which was statistically on par with alachlor+1 HW ( $T_6$ ) and pendimethalin+1 HW ( $T_4$ ) treatments (Table 6). The values were 30.3, 29.7 and 29.3, respectively.  $T_7$  showed 75% increase over control. The lowest number of 17.3 pods per plant was recorded in untreated weedy check.

Table 5. Effect of treatments on weed dry matter accumulation (kg/ha) and weed index

Treatments	20 DAS	40 DAS	60 DAS	At harvest	Weed index
$T_1$ –Pendimethalin @ 1.0 kg/ha PRE	42.9	268.4	436.8	628.3	0.31
$T_2$ –Fluchloralin @ 1.0 kg/ha PRE	50.4	312.6	510.9	740.9	0.36
$T_3$ –Alachlor @ 1.0 kg/ha PRE	40.3	284.3	412.3	602.6	0.30
$T_4$ –Pendimethalin @ 1.0 kg/ha PRE+HW (35 DAS)	39.7	16.4	198.9	325.7	0.09
$T_5$ –Fluchloralin @ 1.0 kg/ha PRE+HW (35 DAS)	49.6	13.8	240.3	355.4	0.17
$T_6$ –Alachlor @ 1.0 kg/ha PRE+HW (35 DAS)	42.4	11.3	184.8	313.8	0.00
$T_7$ –Two hand weedings (20 and 35 DAS)	186.4	13.9	178.9	306.3	0.07
$T_8$ –Weedy check	192.2	489.8	710.5	964.0	0.61
LSD (P=0.05)	7.6	13.1	36.8	28.6	

Table 6. Yield, yield attributes and quality parameters of soybean

Treatments	Pods/plant		Seeds/plant	1000-seed weight (g)	Seed yield (kg/ha)	Seed protein content (%)	Seed oil content (%)
	60 DAS	At harvest					
$T_1$	20.3	23.7	52.0	99.9	1103	38.7	18.7
$T_2$	15.7	19.7	45.7	90.1	1036	38.2	18.9
$T_3$	21.0	26.7	47.0	94.1	1122	39.0	18.4
$T_4$	24.3	29.3	61.3	102.7	1461	40.2	18.7
$T_5$	23.0	25.7	47.0	98.4	1343	39.4	18.9
$T_6$	25.3	29.7	54.0	117.0	1610	40.6	18.4
$T_7$	26.0	30.3	54.7	106.9	1495	40.1	18.6
$T_8$	14.7	17.3	35.0	76.6	625	37.6	18.9
LSD (P=0.05)	1.8	2.2	2.1	3.3	102.0	NS	NS



## 2. Seeds/plant

The highest number of seeds per plant was recorded in pendimethalin+HW treatment ( $T_4$ ) which had registered 61.3 seeds per plant (Table 6). It was followed by 2 HW treatment ( $T_7$ ) which registered 54.7 seeds per plant and then alachlor+1 HW ( $T_6$ ) which recorded 54.0 seeds per plant.  $T_7$  and  $T_6$  were statistically on par. The lowest number of seeds per plant was recorded in control ( $T_8$ ) treatment which had 35 seeds per plant. The increase in seeds per plant under  $T_4$  treatment was 75% over control.

## 3. 1000-seed weight

The highest 1000-seed weight was registered in alachlor+HW treatment ( $T_6$ ) which was 111.03 g (Table 6). It was 53% higher than control. The next best treatment was 2 HW ( $T_7$ ) that recorded 106.9 g. The lowest 1000-seed weight was recorded in control treatment (76.63 g).

## 4. Seed yield

The soybean seed yield was recorded in all the plots after harvest (Table 6). The seed yield for the different treatments ranged between 625 and 1610 kg/ha. Among the treatments alachlor+1 HW treatment ( $T_6$ ) had registered the highest seed yield of 1610 kg/ha. This was significantly superior to all other treatments, and the seed yield increase was 158% compared to control ( $T_8$ ). The next best treatment was 2 HW ( $T_7$ ) which recorded 1495 kg/ha and it was on par with pendimethalin+1 HW ( $T_4$ ) treatment. The lowest yield of 625 kg/ha was recorded in weedy check. Among the treatments which received herbicide application alone, alachlor PRE ( $T_3$ ) had registered higher seed yield of 1122 kg/ha; however, the seed yield under this treatment was not significantly higher when compared to pendimethalin PRE ( $T_1$ ) and fluchloralin PRE ( $T_2$ ). The results are in conformity with the earlier findings of Angiras and Rana (1995), Nayak *et al.* (2000) and

Kushwah and Vyas (2005).

The seed protein content ranged between 37.63 ( $T_8$ ) and 40.6% ( $T_6$ ) (Table 6). The different treatments had no significant influence on the seed protein content of soybean. The seed oil content varied between 18.99 ( $T_2$ ) and 18.24% in  $T_6$ . All the treatments were statistically on par with each other with respect to seed oil content (Table 6). Kumar *et al.* (1996) had reported that weed control treatments did not affect the protein and oil contents in soybean seeds. From the results of the present investigation, it could be concluded that alachlor @ 1.0 kg/ha+1 HW at 35 DAS, pendimethalin @ 1.0 kg/ha+1 HW at 35 DAS and 2 HW at 20 and 35 DAS were the most suitable measures for satisfactory weed control in soybean.

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