Effect of integrated weed management on weed dynamics of soybean [Glycine max (L.) Merrill] under Chhattisgarh plain

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ABSTRACT

A field experiment was carried out during kharif 2010 at the Instructional-cum-Research Farm, IGKV, Raipur (C.G.). The soil of the experimental field was clay in texture. The soil was neutral in pH and had low nitrogen, medium phosphorus and high potassium content. The experiment was laid out in randomized block design with three replications. Results revealed that the minimum weed growth rate, density and dry matter production of weeds and the highest weed control efficiency were recorded with pre-emergence application of imazethapyr 100 g/ha fb one hoeing at 20 DAS followed by pendimethalin 1000 g/ha supplemented with one hand weeding at 20 DAS. The highest seed yield and harvest index were obtained with application of imazethapyr 100 g/ha fb one hoeing at 20 DAS, while the highest stover yield was obtained with application of pendimethalin 1000 g/ha fb hand weeding at 20 DAS. The highest weed index was recorded under weedy check.

Key words: Soybean, Weed dynamics, Weed management

INTRODUCTION

Soybean is a wonder crop of twentieth century. It is an excellent source of protein and oil besides it contains high level of amino acids such as lysine, leucine, lecithin and large amount of phosphorus. Soybean contains approx 40-45% protein and 18-22% oil (Goyal et al., 2012) and is a rich source of vitamins and minerals. Soybean due to various uses rightly called “Golden Bean” of twentieth century. Soybean is a world’s first rank crop as a source of vegetable oil. There are several constraints in soybean, one of them is weed, which often poses serious problem. Soybean is mainly grown during kharif season in sandy loam to clay loam soils in Chhattisgarh which, by virtue of their water holding capacity, do not turn up in working condition, hindering timely weeding and interculture operation. Weed flush come at same time in almost all the kharif crops, which also restrict the availability of manpower for weeding operation in this crop. The untimely and poor weed management adversely affects proper growth and yield of soybean. Weed management through the herbicidal application remains the only viable option under these situations. Application of herbicides as pre-emergence for effective weed control in soybean are required to be used within very short period (2-3 DAS) of time after sowing. In monsoon season, if rain captures this critical period of application then pre-emergence herbicide cannot be used effectively to control the weeds in soybean.

Integration of weed control methods are effective and workable practices that may be used ecologically and economically viable to the farmers. Unavailability of adequate labour during peak period of weeding and difficulty in use of mechanical weeding in heavy soil as well as receiving heavy rains create problem for effective weed management in soybean crop (Nainwal et al., 2010). Under such condition, mulching, hand hoeing and weed control through herbicides remains the choice for controlling of weeds. Therefore integrated approach of mechanical, cultural and chemical control may be more feasible. Till now no systematic work has been made on integrated weed management in soybean under Vertisols of Chhattisgarh plain. In present investigation an attempt has been made to determine the integrated approaches for the management of weed in soybean under Vertisols of Chhattisgarh.
MATERIALS AND METHODS

The present investigation was carried out during kharif 2010 at the Instructional Farm, IGKV, Raipur (C.G.). The soil of the experimental field was clay in texture. The soil was neutral in pH (7.1) and head low nitrogen (212.4 kg/ha), medium phosphorus (12.3 kg/ha) and high potassium content (262.5 kg/ha). The experiment was laid out in randomized block design and replicated thrice. The treatments consisted of twelve weed management practices viz., unweeded check, hand weeding at 20 DAS, hoeing at 20 DAS, imazethapyr 100 g/ha at 2 DAS, imazethapyr 100 g/ha at 20 DAS, imazethapyr 100 g/ha at 2 DAS + hoeing at 20 DAS, quizalofop-p-ethyl 37.5 g/ha + chlorimuron 12 g/ha at 20 DAS, pendimethalin 1000 g/ha at 2 DAS, pendimethalin 1000 g/ha at 2 DAS fb HW at 20 DAS, mulching (paddy straw 5 t/ha) at 7 DAS, pendimethalin 1000 g/ha at 2 DAS fb quizalofop p-ethyl 37.5 g/ha + chlorimuron 12 g/ha at 20 DAS and imazethapyr 100 g/ha fb quizalofop-p-ethyl 37.5 g/ha + chlorimuron 12 g/ha at 20 DAS. Soybean variety “JS-335” was sown on July 10, 2010 and harvested on October 26, 2010. Sowing was done by maintaining row to row and plant to plant spacing of 30 cm x 10 cm @ 75 kg ha⁻¹ of seed. Weed management practices were adopted as per the treatments. In weedy check plot weeds were permitted to grow without any control measures, throughout the crop growing period and one hand weeding and hoeing was done at 20 DAS as per treatment of weed management. Mulching in inter row space was done by paddy straw at 7 DAS as per treatment of weed management. Herbicides namely pendimethaline 30% EC and imazethapyr 10% SL were applied as pre-emergence (2 DAS) and quizalofop-p-ethyl 10% EC and chlorimuron-ethyl 25% WP were applied as post-emergence (20 DAS) with the help of Knapsack sprayer fitted with flat-fan nozzle using the water 500 litres/ha. Weed growth rate was calculated at interval between 30, 60 and 90 and at harvest by using the formula given below. It denotes overall growth rate of weeds m⁻². It is expressed in g day⁻¹ unit area⁻¹.

\[ WGR = \frac{W_2 - W_1}{t_2 - t_1} \]

Where,

\[ W_2 \text{ and } W_1 = \text{Dry matter production of weeds at time interval, and} \]

\[ t_1 \text{ and } t_2 = \text{Time interval in days} \]

Weed density were recorded at 60, 80 DAT and at harvest stage by quadrate randomly placed at five places in each plot to count the weed species in each plot. The percentage composition of weed flora was estimated from weedy check plot. The weed biomass from different plots under all the treatment was recorded at 15, 30, 45 and 60 DAS and at harvest. The weeds were first sun dried and thereafter kept in paper bags and dried in oven at 60°C for 48 hours and dry weight was recorded till constant weight was achieved. The weed control efficiency was calculated on the basis of reduction in dry matter production of weeds in treated plots in comparison with weedy check and expressed in percentage as suggested by Mani et al. (1973).

\[ \text{WCE} \% = \frac{\text{DWC} - \text{DWT}}{\text{DWC}} \times 100 \]

Where,

\[ \text{WCE} = \text{Weed control efficiency (}) \]

\[ \text{DWC} = \text{Dry matter accumulation in weedy check plot} \]

\[ \text{DWT} = \text{Dry weight of weeds in treated plot} \]

The data obtained on various observations were tabulated and subjected to their analysis by using analysis of variance (ANOVA) and the treatment was tested by F test (Gomez and Gomez, 1984). The data on weed count and weed biomass were subjected to square root transformation, i.e. \( \sqrt{x + 0.5} \) before carrying out analysis of variance and comparisons were made on transformed values.

RESULTS AND DISCUSSION

Weed growth rate: Weed growth rate showed increasing trend up to 60 DAS thereafter decreasing trend (Fig. 1). The maximum weed growth rate was observed under weedy check at all stages. Application of imazethapyr 100 g/ha interculture with one hand hoeing recorded the lowest weed growth rate followed by pendimethalin 1000 g/ha along with hand weeding at 20 DAS. While at 60 DAS - at harvest stage application of pendimethalin 1000 g/ha fb one hand weeding recorded the lowest weed growth rate followed by application of imazethapyr 100 g/ha fb one hoeing. During 15-30 DAS, hand weeding, imazethapyr 100 g/ha and application of pendimethalin 1000 g/ha supplement with one hand weeding at 20 DAS showed negative growth rate. All the weed management practices killed the weeds effectively in early stages of crop growth, hence maintained the higher weed
control. Similar results were reported by Khedkar et al. (2009) and Jadhav et al. (2013).

Weed density: Integrated weed management practices had a remarkable effect on weed density (Table 1). Maximum density of weeds was observed throughout the investigation period under weedy check. At 15 DAS, minimum density of weeds was observed with application of imazethapyr 100 g/ha, which was closely followed by application of imazethapyr 100 g/ha fb one hoeing at 20 DAS and application of imazethapyr 100 g/ha fb quialofop-p-ethyl 37.5 g + chlorimuron ethyl 12 g/ha at 20 DAS. At 30, 45, 60 DAS and at harvest, application of imazethapyr 100 g/ha fb one hoeing at 20 DAS and application of pendimethalin 1000 g/ha fb one hand weeding at 20 DAS were found more effective in reducing weed density than other treatments. It was observed that the application of pre-emergence herbicides effectively controlled both monocot and dicot weeds whereas, application of post-emergence was found mainly effective to control the grassy weeds (Nainwal et al., 2010). Similar result was reported by Meena et al. (2009).

Weed dry matter production: Weed dry matter production is presented in Table 2 at different time interval. The significantly highest weed dry matter production was recorded in weedy check plot at all the stages of observation, except at 15 DAS. At 15 DAS the highest weed dry matter production was recorded with application of quialofop-p-ethyl 37.5 g + chlorimuron ethyl 12 g/ha at 20 DAS. However, it was statistically on par with weedy check, one hand weeding and hoeing at 20 DAS and imazethapyr 100 g/ha at 20 DAS. The treatments involving the integrated application of imazethapyr 100 g/ha and one hand weeding at 20 DAS recorded significantly less weed dry matter production compared to other treatments. Similar results by Deore et al. (2008) and Meena et al. (2009) also observed.

**TABLE 1:** Total weed density (No. m⁻²) at different time interval as affected by integrated weed management practices in soybean

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose ha⁻¹</th>
<th>Time of application (DAS)</th>
<th>15 DAS</th>
<th>30 DAS</th>
<th>45 DAS</th>
<th>60 DAS</th>
<th>At harvest</th>
</tr>
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<tbody>
<tr>
<td>T₁ Unweeded check</td>
<td>-</td>
<td>-</td>
<td>11.33</td>
<td>14.55</td>
<td>15.50</td>
<td>14.26</td>
<td>11.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(128.00)</td>
<td>(211.33)</td>
<td>(240.00)</td>
<td>(203.00)</td>
<td>(123.00)</td>
</tr>
<tr>
<td>T₂ Hand weeding once</td>
<td>-</td>
<td>20</td>
<td>11.24</td>
<td>7.01</td>
<td>7.74</td>
<td>6.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(126.00)</td>
<td>(48.67)</td>
<td>(75.33)</td>
<td>(59.67)</td>
<td>(44.67)</td>
</tr>
<tr>
<td>T₃ Hoeing once</td>
<td>-</td>
<td>20</td>
<td>11.32</td>
<td>8.22</td>
<td>11.48</td>
<td>10.41</td>
<td>8.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(127.67)</td>
<td>(67.00)</td>
<td>(131.33)</td>
<td>(108.00)</td>
<td>(66.67)</td>
</tr>
<tr>
<td>T₄ Imazethapyr</td>
<td>100 g</td>
<td>2</td>
<td>2.08</td>
<td>5.79</td>
<td>6.86</td>
<td>6.09</td>
<td>4.59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3.00)</td>
<td>(33.00)</td>
<td>(46.57)</td>
<td>(36.67)</td>
<td>(20.33)</td>
</tr>
<tr>
<td>T₅ Imazethapyr</td>
<td>100 g</td>
<td>20</td>
<td>11.37</td>
<td>8.52</td>
<td>8.55</td>
<td>6.04</td>
<td>3.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(129.00)</td>
<td>(33.33)</td>
<td>(46.67)</td>
<td>(25.00)</td>
<td>(14.33)</td>
</tr>
<tr>
<td>T₆ Imazethapyr fb Hoeing</td>
<td>100 g</td>
<td>2 fb 20</td>
<td>2.15</td>
<td>2.12</td>
<td>2.40</td>
<td>2.91</td>
<td>1.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3.33)</td>
<td>(4.00)</td>
<td>(5.33)</td>
<td>(8.00)</td>
<td>(2.33)</td>
</tr>
<tr>
<td>T₇ Quialofop-p-ethyl + Chlorimuron</td>
<td>37.5g+12g</td>
<td>20</td>
<td>11.41</td>
<td>12.89</td>
<td>13.11</td>
<td>12.24</td>
<td>9.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(129.67)</td>
<td>(165.67)</td>
<td>(171.33)</td>
<td>(149.33)</td>
<td>(88.67)</td>
</tr>
<tr>
<td>T₈ Pendimethalin</td>
<td>1000 g</td>
<td>2</td>
<td>6.93</td>
<td>10.02</td>
<td>11.93</td>
<td>10.74</td>
<td>8.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5.00)</td>
<td>(100.00)</td>
<td>(142.00)</td>
<td>(115.00)</td>
<td>(73.33)</td>
</tr>
<tr>
<td>T₉ Pendimethalin fb Hand weeding</td>
<td>1000 g</td>
<td>2 fb 20</td>
<td>7.42</td>
<td>2.48</td>
<td>2.85</td>
<td>3.38</td>
<td>2.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5.67)</td>
<td>(5.67)</td>
<td>(7.67)</td>
<td>(11.00)</td>
<td>(3.67)</td>
</tr>
<tr>
<td>T₁₀ Mulching (Paddy straw)</td>
<td>5 t</td>
<td>7</td>
<td>6.23</td>
<td>6.48</td>
<td>8.43</td>
<td>7.36</td>
<td>5.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(38.33)</td>
<td>(41.50)</td>
<td>(70.67)</td>
<td>(53.67)</td>
<td>(34.00)</td>
</tr>
<tr>
<td>T₁₁ Pendimethalin fb Quialofop-p-ethyl + Chlorimuron</td>
<td>1000 g fb 37.5g+12g</td>
<td>2 fb 20</td>
<td>7.17</td>
<td>9.31</td>
<td>10.12</td>
<td>9.07</td>
<td>7.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(51.00)</td>
<td>(86.33)</td>
<td>(102.00)</td>
<td>(82.00)</td>
<td>(49.33)</td>
</tr>
<tr>
<td>T₁₂ Imazethapyr fb Quialofop-p-ethyl + Chlorimuron</td>
<td>100 g fb 37.5g+12g</td>
<td>2 fb 20</td>
<td>2.15</td>
<td>5.75</td>
<td>6.01</td>
<td>5.40</td>
<td>4.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3.33)</td>
<td>(32.67)</td>
<td>(35.67)</td>
<td>(28.67)</td>
<td>(16.67)</td>
</tr>
</tbody>
</table>

*SEM: CD (P=0.05)*

Figure in parentheses are oroginal value, data transformed to \( \sqrt{x + 0.05} \)
TABLE 2: Total weed dry matter (g m⁻²) at different time interval as affected by integrated weed management practices in soybean.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose ha⁻¹</th>
<th>Time of application (DAS)</th>
<th>Total weed dry matter (g m⁻²)</th>
<th>WCE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>15 DAS</td>
<td>30 DAS</td>
<td>45 DAS</td>
</tr>
<tr>
<td>T₁</td>
<td>Unweeded check</td>
<td>-</td>
<td>-</td>
<td>5.57 (30.57)</td>
</tr>
<tr>
<td>T₂</td>
<td>Hand weeding</td>
<td>-</td>
<td>20</td>
<td>5.66 (31.50)</td>
</tr>
<tr>
<td>T₃</td>
<td>Hoeing once</td>
<td>-</td>
<td>20</td>
<td>5.50 (29.84)</td>
</tr>
<tr>
<td>T₄</td>
<td>Imazethapyr</td>
<td>100g</td>
<td>2</td>
<td>0.95 (8.40)</td>
</tr>
<tr>
<td>T₅</td>
<td>Imazethapyr</td>
<td>100g</td>
<td>20</td>
<td>5.58 (30.72)</td>
</tr>
<tr>
<td>T₆</td>
<td>Imazethapyr fb Hoeing</td>
<td>100g</td>
<td>2 fb 20</td>
<td>0.91 (10.44)</td>
</tr>
<tr>
<td>T₇</td>
<td>Quincloxol-p-ethyl + Chlorimuron</td>
<td>37.5g+12g</td>
<td>20</td>
<td>5.59 (30.75)</td>
</tr>
<tr>
<td>T₈</td>
<td>Pendimethalin</td>
<td>1000g</td>
<td>2</td>
<td>3.31 (10.44)</td>
</tr>
<tr>
<td>T₉</td>
<td>Pendimethalin fb Hand weeding</td>
<td>1000g</td>
<td>2 fb 20</td>
<td>3.03 (10.44)</td>
</tr>
<tr>
<td>T₁₀</td>
<td>Mulching (Paddy straw)</td>
<td>5 t</td>
<td>7</td>
<td>2.33 (10.44)</td>
</tr>
<tr>
<td>T₁₁</td>
<td>Pendimethalin fb Quincloxol-p-ethyl + Chlorimuron</td>
<td>1000g fb</td>
<td>2 fb 20</td>
<td>3.01 (10.44)</td>
</tr>
<tr>
<td>T₁₂</td>
<td>Imazethapyr fb Quincloxol-p-ethyl + Chlorimuron</td>
<td>37.5g+12g</td>
<td>2 fb 20</td>
<td>0.93 (10.44)</td>
</tr>
</tbody>
</table>

SEµ±: 0.10 0.11 0.22 0.23 0.24 - 0.32 0.33 0.64 0.68 0.72 -

CD (P=0.05)

Figure in parentheses are original value, data transformed to \((\sqrt{x + 0.05})\)

Weed control efficiency: The highest weed control efficiency was witnessed under imazethapyr 100 g/ha fb one hoeing at 20 DAS followed by pendimethalin 1000 g/ha fb hand weeding at 20 DAS (Table 2). The lowest weed control efficiency was found under quizalofop-p-ethyl 37.5 g + chlorimuron ethyl 12 g/ha at 20 DAS. This is due to less dry matter production and density of weeds which reduced by successful checking the weed growth in the above treatments. Similar result was also reported by Deore et al. (2007).

Seed and stover yield: Under different weed management practices application of imazethapyr 100 g/ha fb hoeing at 20 DAS recorded significantly highest seed yield (2.39 t/ha) than any other treatments (Table 3). However, it was at par with application of pendimethalin 1000 g/ha fb hand weeding at 20 DAS (2.37 t/ha). On the other hand, the minimum seed yield was recorded under weedy check (1.07 t/ha). Esquedea and Tosquy (2006) reported the similar result that highest soybean yield was obtained from the treatment with imazethapyr 75 g/ha. Kushwah and Vyas (2005) also reported the similar findings which stated that imazethapyr 10% SL 75 g/ha resulted in higher yield of soybean. The capacity of plants to produce seed yield depends not only the size of photosynthetic systems, its efficiently and length of time for which it is active but also on translocation of dry matter into economic sink. The final build up of yield is cumulative function of yield components. Lower weed population and higher weed control efficiency also resulted in higher seed yield (Habimana et al., 2013).

As regard to the different level of weed competition, the highest stover yield was recorded in pendimethalin 1000 g/ha fb one hand weeding at 20 DAS (2.72 t/ha), which was superior over all other treatments. However, it is at par with imazethapyr 100 g/ha fb one hoeing at 20 DAS (2.70 t/ha) and rest of the treatments shows significant differences. The minimum stover yield was recorded in unweeded check plots (1.81 t/ha). The minimum yield of stover in weedy check plot was due to the less dry matter accumulation of soybean, less LAI, less CGR, high weed infestation and high competition during the critical periods, which does not allow the crop to grow their potential, and vice-versa. Similar results were also reported by Meena et al. (2009) and Jhadhav et al. (2013).

Harvest index and weed index: The data revealed that there was significant variation on harvest index due to the weed competition (Table 3). As regards to the treatment effects, the maximum harvest index was recorded with application of imazethapyr 100 g/ha fb one hoeing at 20 DAS (47.02 %). However, it was at par with the mulching 5 t/ha (46.68%).
TABLE 3: Seed yield, stover yield, harvest index and weed index of soybean as affected by integrated weed management practices.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Dose ha⁻¹</th>
<th>Time of application (DAS)</th>
<th>Yield (t ha⁻¹)</th>
<th>Harvest index (%)</th>
<th>Weed index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ Unweeded check</td>
<td>-</td>
<td>-</td>
<td>1.07</td>
<td>1.81</td>
<td>35.52</td>
</tr>
<tr>
<td>T₂ Hand weeding once</td>
<td>-</td>
<td>20</td>
<td>1.75</td>
<td>2.35</td>
<td>42.76</td>
</tr>
<tr>
<td>T₃ Hoeing once</td>
<td>-</td>
<td>20</td>
<td>1.64</td>
<td>2.23</td>
<td>42.52</td>
</tr>
<tr>
<td>T₄ Imazetapry</td>
<td>100g</td>
<td>2</td>
<td>1.89</td>
<td>2.49</td>
<td>43.08</td>
</tr>
<tr>
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<td>100g</td>
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<td>1.92</td>
<td>2.28</td>
<td>45.66</td>
</tr>
<tr>
<td>T₆ Imazetapry fb Hoeing</td>
<td>100g</td>
<td>2 fb 20</td>
<td>2.39</td>
<td>2.70</td>
<td>47.02</td>
</tr>
<tr>
<td>T₇ Quizalofop-p-ethyl + Chlorimuron</td>
<td>37.5g+12g</td>
<td>20</td>
<td>1.40</td>
<td>1.94</td>
<td>43.57</td>
</tr>
<tr>
<td>T₈ Pendimethalin</td>
<td>1000g</td>
<td>2</td>
<td>1.58</td>
<td>2.26</td>
<td>41.10</td>
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<tr>
<td>T₉ Pendimethalin fb Hand weeding</td>
<td>1000g</td>
<td>2 fb 20</td>
<td>2.37</td>
<td>2.72</td>
<td>46.63</td>
</tr>
<tr>
<td>T₁₀ Mulching (Paddy straw)</td>
<td>5 t</td>
<td>7</td>
<td>1.96</td>
<td>2.24</td>
<td>46.68</td>
</tr>
<tr>
<td>T₁₇ Pendimethalin fb Quizalofop-p-ethyl + Chlorimuron</td>
<td>1000g fb 37.5g+12g</td>
<td>2 fb 20</td>
<td>1.72</td>
<td>2.45</td>
<td>41.21</td>
</tr>
<tr>
<td>T₁₂ Imazetapry fb Quizalofop-p-ethyl + Chlorimuron</td>
<td>100g fb 37.5g+12g</td>
<td>2 fb 20</td>
<td>1.98</td>
<td>2.28</td>
<td>46.44</td>
</tr>
<tr>
<td>SE±m</td>
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<td></td>
<td>0.08</td>
<td>0.10</td>
<td>1.06</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
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<td>0.23</td>
<td>0.30</td>
<td>3.12</td>
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</tbody>
</table>

pendimethalin 1000 g/ha fb one hand weeding at 20 DAS (46.63%), imazethapyr 100 g/ha at followed by quizalofop-p-ethyl + chlorimuron 37.5 g + 12 g/ha at 20 DAS (45.66%) and imazethapyr 100 g/ha at 20 DAS (44.42%). The minimum harvest index was recorded in weedy check plot (35.52%). The possible reason for lowering harvest index may be the more competition during the critical periods which results in lower number of branches, leaves, leaf area, less number of pods, seeds and lower translocation of photosynthates towards the reproductive parts of the crop plant and act as a barrier for lower economic as well as biological yield. Similar results were noticed by Khedkar et al. (2009).

The maximum seed yield reduction (Table 3) was found under weedy check (55.23%) followed by quizalofop-p-ethyl 37.5 g + chlorimuron ethyl 12 g/ha at 20 DAS due to the fact that there was minimum seed yield. Whereas, minimum reduction were registered under pendimethalin 1000 g/ha fb one hand weeding at 20 DAS. The weed index was influenced due to all weed management practices. Similar result also reported by Pria et al. (2009) they found that the highest weed index (0.61) was computed in the unweeded check treatment and lowest was obtained in pendimethalin + hand weeding treatment (0.09). The maximum weed index under weedy check was due to the fact that the minimum yield reported under this treatment due to high infestation of weeds at critical crop-weed competition period, which reduces the availability of yield components. It confirms the findings of Kushwah and Vyas (2005).

REFERENCES


