Effect of weed management practices on growth, yield and economics of soybean [Glycine max (L.) Merrill]

Harendra Kumar, RM Savu, Nitish Tiwari, Satyendra Gupta, Aditya Sukla, OP Rajwade and Chandra Shekhar Chandra

Abstract
Experiments were conducted during kharif season of 2019 at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya Raipur (C.G.). The soil of the experimental field was 'Vertisols' locally known as 'Kanhar' with sandy clay loam in texture and pH 7.10. It was low in available nitrogen (220 kg ha⁻¹), medium in available phosphorus (12.54 kg ha⁻¹), and high in potassium (288 kg ha⁻¹). The experiment was laid out in Randomized block design (RBD) with 7 treatments and 3 replications. The result of present experiment conclude that growth attributes viz, plant height, number of branch, dry matter accumulation as well as yield attributes viz, number of pod plant⁻¹, number of seed pod⁻¹, Seed index (100 seed), seed yield, stover yield, harvest index were found maximum under Sodium Acifluarfan (16.5%) + Clodinafoppropargyl (8% EC) @ 1000 MI/ha + MACARENA @ 625 ml/ha which was at par with Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha.

Keywords: Growth attributes, Seed yield, Stover yield, harvest index

Introduction
Soybean [Glycine max (L.) Merrill] is one of the most important oilseed crop in the world and it is also known as wonder crop of the 20th century. It is a cheapest source of vegetable oil and protein. It contains about 40 percent protein, well balanced in essential amino acids, 18-20 percent oil rich with poly unsaturated fatty acids specially Omega 6 and Omega 3 fatty acids, 6-7 percent total mineral, 5-6 percent crude fiber and 17-19 percent carbohydrates. It is able to tolerate mild drought as well as floods. This characteristic has made soybean to fit well in sustainable agriculture. Soybean due to its various uses is rightly called “Golden Gift” of nature to mankind.

Globally soybean is cultivated over an area of 118.3 million hectares with a production of 318.25 million metric tonnes and having a productivity of 2.69 metric tones ha⁻¹ (Anonymous, 2015) [2]. In Chhattisgarh, during 2015-16, soybean occupies an area of 137.53 thousand hectares with productivity of 995 kg ha⁻¹ (Anonymous, 2017) [3]. In Chhattisgarh, major soybean growing districts are Rajnandgaon, Durg, Mungeli, Betanagram and Kabirdham. In chhattisgarh most prominent weeds observed in soybean are Echinochloa, Cyperus rotundus, Euphorbia spp., Commelina benghalensis, Phyllanthus niruri, (Kolhe et al., 1998) [7]. In soybean the weed flora as observed from the unweeded control plots consist of 58 per cent total mineral, 5-6 per cent crude fiber and 17-19 per cent carbohydrates. It is able to leave residual nitrogen effect for succeeding crop equivalent to 35-40 kg N ha⁻¹. Soybean can tolerate mild drought as well as floods. This characteristic has made soybean to fit well in sustainable agriculture. Soybean due to its various uses is rightly called “Golden Gift” of nature to mankind.

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Materials and Methods

The experiment was carried out at Instructional cum Research Farm of IKGV, Raipur situated at latitude of 21°4’ N, longitude of 81°35’ E and altitude of 290.2 m above mean sea level. The climate of Raipur region is sub-humid to semi arid. The source of rainfall is south-west monsoon. The average annual rainfall is 1326 mm (based on 80 years mean), of which mostly concentrated during the period from June to September and very little during October to February. May is the hottest and December is the coolest month of the year. Temperature controls seed germination, tillering, and other plant practices. Through experiments, the weekly mean maximum and minimum temperature varied from 28.01 to 35.67 and 15.23 to 26.22 during the experiments, respectively. The maximum temperature recorded was 35.67 on 02 to 05 July whereas the minimum temperature was 15.23°C from 20 to 22 October. During the soybean-growing season, the weekly average relative humidity varied from 6 to 10% and the total relative humidity ranged from 82.71 to 92.57%.

Soybean variety ‘JS 97-52’ (Jawahar Soybean 97-52) was grown as a test crop. It is released from JNKV, Jabalpur. This variety has potential to provide high yield in varied eco-edaphic situation. It is multiple resistant against major diseases including yellow mosaic virus and root rot, moderately resistant to stem borer and defoliator and tolerant to excessive moisture stress. Plant spacing 30 × 10 cm and plant spacing 20 × 60:40 kg ha⁻¹ N: P₂O₅: K₂O applied through Urea, Diammonium phosphate and Muriate of potash. The treatments comprised of seven weed management practices viz, Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha (T₁), Imazethapyr 10 SL@ 1000 ml/ha + MACARENA @ 625 ml/ha (T₂), Fluzoquinapyr @ 15.4 EC @ 2000 ml/ha + MACARENA @ 625 ml/ha (T₃), Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha (T₄), MACARENA @ 625 ml/ha (T₅), Two hand weeding at 20 and 40 DAS (T₆) and Weedy check (T₇).

Results and Discussion

Plant height

At 30 DAS, there was no significant effect of herbicides on the height of crop growth. At 60 DAS T₁- Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha produced significantly taller plants than rest of the treatment, but it was at par with T₄- Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- Two hand weeding at 20 and 40 DAS. At harvest same trend was obtained with two at par i.e. T₁- Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha and T₄-Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- Two hand weeding at 20 and 40 DAS. At harvest as affected by application of herbicides are presented in Table 1. Different treatment of herbicides showed significant impact on number of branches at all the stages of soybean. The result revealed that at 30 DAS there was no significant effect of treatment on soybean. While at 60 DAS treatment T₇-Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha gave significantly higher number of branches than others at 30, 60 DAS and at harvest. However, it was on par to treatment T₇- weedy check and at harvest same trend was observed.

Number of branches (plant⁻¹)
The data on number of branches of soybean recorded at 30, 60 DAS and at harvest as affected by application of herbicides are presented in Table 1. Significant result was observed for number branches plant⁻¹. The maximum number of branches plant⁻¹ was recorded in T₇-Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha which was at par with T₂- Imazethapyr 10 SL@ 1000 ml/ha + MACARENA @ 625 ml/ha, T₄-Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha and T₆- Two hand weeding at 20 and 40 DAS. This was followed by T₃-...
Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha + MACARENA @ 625 ml/ha and T7- MACARENA @ 625 ml/ha. The minimum number of pods plant⁻¹ was recorded in T7- weedy check.

### Number of seeds pod⁻¹

The data on number of seeds pod⁻¹ of soybean as affected by application of herbicides are presented in Table 2.0. There was significant result was observed for number seeds pod⁻¹. The maximum number of seeds pod⁻¹ was noted in treatment T7- Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha which was statistically comparable to T2- Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha. This was followed by T6- Two hand weeding at 20 and 40 DAS and T2- Imazethapyr 10 SL@ 1000ml/+ MACARENA @ 625ml/ha. However, the minimum number of seeds pod⁻¹ was recorded in T7- weedy check.

### 100- Seed weight (g)

Data on 100- seed weight are presented in Table 2.0 Test weight of soybean seeds was influenced due to different herbicides. Data showed that maximum seed index was recorded on T1- Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha which was at par with T2- Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha, T6- Two hand weeding at 20 and 40 DAS, T2- Imazethapyr 10 SL@ 1000ml/+ MACARENA @ 625 ml/ha and T7- Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha + MACARENA @ 625 ml/ha. This was followed by T3- MACARENA @ 625 ml/ha and minimum was recorded under T7- weedy check.

### Seed yield (kg ha⁻¹)

The data on seed yield influenced by different new herbicides application, there was significant result was recorded for seed yield. The maximum seed yield was recorded in T1- Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha and T7- weedy check. The maximum seed index was recorded in T7- weedy check.

The higher stover yield in above treatments might be due to lesser weeds during early crop growth period and give higher yield attributes and pod yield which leads to higher stover yield. While, in weedy check reverse trend was observed and therefore, the lowest stover yield was noted under this treatment. Similar findings were reported by Dhanal et al. (2009) [5].

### Harvest index (%)

The data on harvest index are presented in Table 2.0 Non-significant variation was observed in harvest index due to application of different herbicides.

### Economics

The data on the economics viz, cost of cultivation, gross return, net return, and benefit: cost ratio presented in table 2.0. The cost of cultivation varied according to different herbicide combination and their combinations. Different herbicide combination, hectare⁻¹ cost of cultivation, was minimum with the application of along weedy check (T7) (12,685 Rs/ha⁻¹) and increased with increase in the level of herbicide combinations (17,785 Rs/ha⁻¹) under two hand weeding at 20 and 40 DAS (T6). Gross return increased significantly with each increment in herbicide combination and level. However, further, increase herbicide combination. Maximum gross return (88195 Rs/ha⁻¹) was recorded with the application of Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha and maximum net return (71410 Rs/ha⁻¹) with maximum BC ratio (5.2).

Table 1: Evaluation of bio-efficacy of MACARENA (bio-stimulant) along with herbicides on plant height, Number of branches plant⁻¹ and Dry matter accumulation of soybean

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
<th>Number of branches plant⁻¹</th>
<th>Dry matter accumulation (g plant⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 DAS</td>
<td>60 DAS</td>
<td>At harvest</td>
</tr>
<tr>
<td>T1- Sodium Acifluarfan (16.5%) + Clodinafop propargyl (8% EC) @ 1000 ml/ha + MACARENA @ 625 ml/ha</td>
<td>48.27</td>
<td>72.27</td>
<td>81.53</td>
</tr>
<tr>
<td>T2- Imazethapyr 10 SL@ 1000 ml/ha + MACARENA @ 625 ml/ha</td>
<td>36.27</td>
<td>61.13</td>
<td>73.13</td>
</tr>
<tr>
<td>T3- Fluazifop-p-butyl 13.4 EC @ 2000 ml/ha + MACARENA @ 625 ml/ha</td>
<td>35.93</td>
<td>60.00</td>
<td>73.13</td>
</tr>
<tr>
<td>T4- Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000 ml/ha + MACARENA @ 625 ml/ha</td>
<td>36.60</td>
<td>71.00</td>
<td>79.07</td>
</tr>
<tr>
<td>T5- MACARENA @ 625 ml/ha</td>
<td>35.93</td>
<td>59.87</td>
<td>72.93</td>
</tr>
<tr>
<td>T6- Two hand weeding at 20 and 40 DAS</td>
<td>36.47</td>
<td>62.27</td>
<td>73.40</td>
</tr>
</tbody>
</table>
Table 2: Evaluation of bio-eficacy of MACARENA (bio-stimulant) along with herbicides on number of seed pod⁻¹, seed index, Seed and Stover yield, Harvest index (%), Gross and net return (Rs/ha) and B:C ratio

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pods plant⁻¹ (No.)</th>
<th>Seed pod⁻¹ (No.)</th>
<th>Seed index 100 seeds (g)</th>
<th>Seed yield (kg ha⁻¹)</th>
<th>Stover yield (kg ha⁻¹)</th>
<th>Harvest index (%)</th>
<th>Gross return (Rs/ha)</th>
<th>Net returns (Rs/ha)</th>
<th>B:C ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁: Sodium Acitluaarten (16.5%)+ Clodinafop propargyl (8% EC) @ 1000ml/ha + MACARENA @ 625ml/ha</td>
<td>53.80</td>
<td>2.77</td>
<td>12.15</td>
<td>1930</td>
<td>3870</td>
<td>33.28</td>
<td>88195</td>
<td>71410</td>
<td>5.2</td>
</tr>
<tr>
<td>T₂: Imazethapyr 10 SL @ 1000ml/ha + MACARENA @ 625ml/ha</td>
<td>49.53</td>
<td>2.33</td>
<td>11.23</td>
<td>1600</td>
<td>3560</td>
<td>31.01</td>
<td>75485</td>
<td>59200</td>
<td>4.6</td>
</tr>
<tr>
<td>T₃: Fluchitop-p-butyl 113.4 EC @ 2000ml/ha + MACARENA @ 625ml/ha</td>
<td>47.13</td>
<td>2.32</td>
<td>11.13</td>
<td>1470</td>
<td>3410</td>
<td>30.12</td>
<td>70275</td>
<td>54390</td>
<td>4.4</td>
</tr>
<tr>
<td>T₄: Propaquizafop 2.5% EC + Imazethapyr 3.7% ME @ 2000ml/ha + MACARENA @ 625ml/ha</td>
<td>50.20</td>
<td>2.63</td>
<td>11.53</td>
<td>1830</td>
<td>3860</td>
<td>32.16</td>
<td>84495</td>
<td>67710</td>
<td>5.0</td>
</tr>
<tr>
<td>T₅: MACARENA @ 625ml/ha</td>
<td>46.00</td>
<td>2.27</td>
<td>10.20</td>
<td>1350</td>
<td>2920</td>
<td>31.62</td>
<td>65235</td>
<td>49950</td>
<td>4.2</td>
</tr>
<tr>
<td>T₆: Two hand weeding at 20 and 40 DAS</td>
<td>49.60</td>
<td>2.57</td>
<td>11.44</td>
<td>1650</td>
<td>3280</td>
<td>33.47</td>
<td>78835</td>
<td>61050</td>
<td>4.4</td>
</tr>
<tr>
<td>S. Em⁻</td>
<td>1.65</td>
<td>0.06</td>
<td>0.37</td>
<td>43</td>
<td>89</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CD(P=0.05)</td>
<td>4.91</td>
<td>0.19</td>
<td>1.08</td>
<td>124</td>
<td>262</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Reference