Faba bean (Vicia faba L.) is a potential crop for nutritional security. However, it is still treated as an underutilized crop in India. Its seeds are very low in saturated fat, cholesterol, and sodium and having good source of dietary fibre, protein (20-41%), P, Cu and Mn (Singh et al. 2014). Currently 58 countries produce this bean on large scale, and in India it is cultivated in 25000 ha (Singh et al. 2013). Faba bean is poor competitor with weeds at initial stages of crop growth, thus, this makes an integrated weed management (IWM) essential for successful production. Research finding reveals that weeding at 30 and 45 days after sowing (DAS) proven effective for weed management (Ram et al. 2012). Hand weeding is a most followed practice to manage weeds in faba bean. However, it is labour intensive and account for~25% of total labour requirement that is 90–1200 man-hr/ha (Yadav and Pund 2007, Yadav et al. 2019). Delayed in weeding reduces crop yield by 40-60% and sometimes complete crop failure (Singh 1988). Hence, timely weeding is an important aspect for achieving the optimum yield (Singh et al. 2019). Use of improved weeder is a viable option to reduce time and drudgery (Sarkar et al. 2016). Managing weeds with use of improved weeding tools / implements not only uproots weed between crop rows but also keeping surface soil loose, ensuring better soil aeration and water intake capacity. There are many types of weeder available in India for weeding but all these designs are the region specific to meet the requirement of soil type, crops and availability of the local resources (Goel et al. 2008). Hence, in the present study different weeder (khurpi (hand hoe), grubber, wheel hoe, and power weeder) were evaluated in faba bean for comparing the weeding efficiency under the irrigated ecosystem of Indo-Gangetic plains of Eastern India.

Comparative performance of different weeding tools in faba bean was evaluated in triplicate during the winter season of 2017 at the Institute farm, ICAR-Research Complex for Eastern Region, Patna, Bihar. Results revealed that actual field capacity of 0.0046±0.002, 0.0086±0.0002, 0.0189±0.0003, 0.0696±0.003 ha/h had associated with khurpi, grubber, wheel hoe and power weeder, respectively. Khurpi had recorded the maximum weeding efficiency (98.9%) and lowest in case grubber (74%). Similarly, power weeder contributed to higher plant damage (1.94%). Operational of khurpi had recorded maximum (Rs.6793/ha). A reasonable amount of savings of weeding operation were observed using grubber, wheel hoe, and power weeder as compared to khurpi.
trails were analyzed to determine the actual field capacity, field efficiency, weeding efficiency and plant damage.

**Field capacity:** Effective actual field capacity was calculated using eqn. (Mehta et al. 2005)

\[
\text{Effective field capacity} = \frac{A}{T_p + T_{np}}
\]

Where, \(A\) = Area, ha, \(T_p\) = productive time, hr, \(T_{np}\) = non productive time, hr

**Weeding efficiency**

The weeder used during the study were measured for weeding efficiency by using following formula as suggested by Rangasamy et al. (1993).

\[
\text{Weeding efficiency} = \left(\frac{W_1 - W_2}{W_1}\right) \times 100
\]

Where, \(W_1\) = No. of weeds before weeding, \(W_2\) = No. of weeds after weeding

Data were analyzed statistically as per standard method (Panse and Sukhatme 1978). Test of the significance of treatment differences were done on basis of t-test. Significant difference between treatments mean were compared with critical differences at 5% levels of probability.

**Weed flora**

Major weed flora present in experimental block was *Solanum nigrum*, *Chenopodium album*, *Rumex retroflexus*, *Vicia sativa*, *Anagalis arvensis*, *Barbara vulgaris* (Table 1). Total weed density was the lowest in *khurpi* (3.02/m²) and the highest with wheel hoe (4.94/m²) during the experimentation.

**Field capacity**

Field capacity of power weeder was found to be maximum 0.0696 ha/h higher than *khurpi* (0.0046 ha/h) and area coverage by gruber (0.0086 ha/h) and wheel hoe (0.0189 ha/h), which was more than *khurpi* (Table 2). Results revealed that power operated weeder was the most effective weeding tools as compared to hand weeding tools. Wide difference in field capacity of different tools/ implements might be due to width of soil cutting as well as forward speed. Shekhar et al. (2010) found that similar results of area coverage with power operated weeder (0.670 ha/h) followed by wheel hoe (0.009 ha/h), gruber (0.008 ha/hr) and *khurpi* (0.002 ha/ha). Sarkar et al. (2016) also reported in winter maize that field capacity of wheel hoe was maximum (0.008 ha/hr), whereas spade had the minimum (0.0002 ha/hr).

**Weeding efficiency**

The highest weeding efficiency was recorded with the *khurpi* (98.9%) followed by power weeder (83%), wheel hoe (80%) and gruber (74%), respectively (Table 2). A similar result was reported by Shekhar et al. (2016) in maize with *khurpi* (99.4%) and power weeder (89.7%). Rajak et al. (2018) also reported that weeding efficiency was maximum in gruber (93.1%) followed by *khurpi* (96.8%) and the lowest with herbicides (83%).

**Plant damage**

Higher percentage of plant damage was found in power weeder (1.94±0.038%) followed by wheel hoe (1.24±0.043%), gruber (1.21±0.041%) and *kurphi* (0.84±0.008%), respectively. Highest plant damage for power weeder may be attributed to higher speed of blades and operator skill (Singh et al. 2017).

**Cost of operation**

*Khurpi* had attributed the maximum cost of operation (~6793/ha) followed by gruber (~3906/ha), power weeder (~1674/ha) and wheel hoe (~1653/ha). Operational cost of *khurpi* increased and resulted in minimum field capacity (Table 2). But operational cost of power weeder had minimum compared to other weeding tools. Cost of power weeder is much expensive and thus, the small and marginal land holding farmers cannot effort initial investment in spite of high field capacity. Results revealed that amongst four weeding tools, wheel hoe was the most economic and efficient weeding tools as compared to other weeding tools in row spaced crops.

### Table 1. Weed density (no./m²) as influenced by different treatments (mean value)

<table>
<thead>
<tr>
<th>Weeding tools</th>
<th><em>Solanum nigrum</em></th>
<th><em>Chenopodium album</em></th>
<th><em>Rumex retroflexus</em></th>
<th><em>Vicia sativa</em></th>
<th><em>Anagalis arvensis</em></th>
<th><em>Barbara vulgaris</em></th>
<th>Others</th>
<th>Total weed density (no./m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Khurpi</em></td>
<td>1.10(1.7)</td>
<td>0.60(0.9)</td>
<td>1.10(1.7)</td>
<td>0.50(0.7)</td>
<td>0.60(0.9)</td>
<td>0.40(0.7)</td>
<td>2.10(4.9)</td>
<td>3.02(9.6)</td>
</tr>
<tr>
<td>Grubber</td>
<td>4.16(17.6)</td>
<td>0.71(1.0)</td>
<td>0.71(1.0)</td>
<td>0.71(1.0)</td>
<td>0.71(1.0)</td>
<td>0.71(1.0)</td>
<td>3.29(11.3)</td>
<td>3.82(15.1)</td>
</tr>
<tr>
<td>Wheel hoe</td>
<td>3.60(13.5)</td>
<td>1.50(2.7)</td>
<td>1.80(3.7)</td>
<td>4.10(17.3)</td>
<td>2.30(5.8)</td>
<td>2.30(5.8)</td>
<td>4.10(17.5)</td>
<td>4.94(24.9)</td>
</tr>
<tr>
<td>Power weeder</td>
<td>3.20(10.7)</td>
<td>1.10(1.7)</td>
<td>1.50(2.7)</td>
<td>2.80(8.3)</td>
<td>1.60(3.1)</td>
<td>1.80(3.7)</td>
<td>3.10(10.1)</td>
<td>4.39(19.8)</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>0.24</td>
<td>0.08</td>
<td>0.11</td>
<td>0.23</td>
<td>0.12</td>
<td>0.14</td>
<td>0.21</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Weed density figures are transformed to \(\sqrt{x+0.5}\) and actual figures are given in parentheses
Table 2. Operational parameters of different weeding tools in faba bean

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Khurpi</th>
<th>Grubber</th>
<th>Wheel hoe</th>
<th>Power weeder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field capacity (ha/hr)</td>
<td>0.0046 ±0.0002</td>
<td>0.0086 ±0.0002</td>
<td>0.0189 ±0.0003</td>
<td>0.0696 ±0.003</td>
</tr>
<tr>
<td>Weeding efficiency (%)</td>
<td>98.90 ±7.86</td>
<td>74.00 ±3.98</td>
<td>80.00 ±6.21</td>
<td>83.00 ±6.52</td>
</tr>
<tr>
<td>Cost of operation (`/ha)</td>
<td>6793/-</td>
<td>3906/-</td>
<td>1653/-</td>
<td>1674/-</td>
</tr>
</tbody>
</table>

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REFERENCES


