A novel study on efficacy of animal urine against *Helicoverpa armigera* (Hubner) on chickpea at Pantnagar, Uttarakhand

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Abstract

A novel and preliminary field study was conducted on the efficacy of animal urine against gram pod borer, *H. armigera* (Hubner) on chickpea at experimental farm NEBCRC, GBPUA&T Pantnagar, Uttarakhand during *rabi* crop seasons of 2016-17 and 17-18. The pooled data for both the years clearly showed that all the treatments were found significantly superior over control. The data on mean larval population, pod damage and grain yield was obtained for Indoxacarb (14.5 SC) @ 0.9ml/l (3.34larvae/plant, 11.38% and 15.15q/ha) showed that the chemical was performed the best among the treatments followed by Desi cow urine (4.50larvae/plant, 13.00%, 12.92q/ha), Horse urine(4.33 larvae/plant), 13.97%, 12.55q/ha) and Goat urine (5.83larvae/plant,15.65%,12.25q/ha) in comparison to untreated control (19.34larvae/plant, 38.70%, 5.51q/ha). On the other hand, the mean population of pupae of parasitoid, *Campoletis chloridae* was recorded the least (0.78/plant) in Indoxacarb and significantly more per plant (2.42,2.42 and 2.00) in Desi cow urine, Horse urine and Goat urine treated plots, respectively. Thus, the present novel study clearly revealed that animal urine can safely and effectively be incorporated in integrated pest management schedule against *Helicoverpa armigera* on chickpea.

Keywords: Animal urine, cow urine, chickpea, *Helicoverpa armigera*, novel approach, pod damage

Introduction

Chickpea (*Cicer arietinum* Linn., Family- Leguminacae) is generally known as gram or bengal gram is the most important pulse crop in India and is considered as 'King of pulses' (Bhatt and Patel, 2001) [3]. Chickpea seed contains 1.17 percent protein, 5.3 percent fat, 61.2 percent carbohydrates, 3.9 percent fibres and 2.7 percent minerals (Singh et al., 2005) [18]. Globally, chickpea is grown over an area of 13.54 million hectares with a production of 13.10 million tonnes and productivity of 968 kg/ha. Chickpea was cultivated in an area of 8.19 million hectares with a production of 7.35 million tonnes and a productivity of 895 kg/ha in India. Uttarakhand consists of hilly tracts as well as tarai areas where chickpea is an important crop during *rabi*, which is cultivated in an area of 601 hectares with a production of 514 tonnes and a productivity of 810 kg/ha (DES, 2015) [3]. Even though, India occupies first position with respect to area and production, the productivity remained low due to biotic stresses of which the major limiting factor is gram pod borer, *Helicoverpa armigera* (Rummana et al., 2010) [14]. *H. armigera* (Lepidoptera: Noctuidae) is a polyphagous, prolific and wide spread pest known to feed on several crops belonging to different families. This insect occurs as a major pest in many economically important crops such as pigeonpea, cotton, chickpea, blackgram and most of the vegetables (Subramanian and Mohankumar, 2006) [20]. It attacks over 200 crop species belonging to 45 families globally, thus leading to yield loss tune to US $ 2 billion annually. In India the loss tune to 200 million US $ on pigeon pea and chickpea (Rummana et al., 2010) [14]. A single larva can damage several pods and eat always the developing grain resulting in substantial yield losses (Sawar et al., 2011) [16].

In the developing countries like India, pest management mainly depends on the use of chemical pesticides, as they are the most reliable and economical but indiscriminate use of pesticides resulted in development of resistance in *H. armigera against* organophosphorus, carbamates and pyrethroids (Kranthi et al., 2002, Bues et al., 2005, Hossain et al., 2010) [12, 7, 9]. The failure of modern tactics has compelled the scientific community to go back to the traditional and indigenous products for tackling the pest problem.
There is a vast potential in the traditional methods practiced in rural India that can be included for combating the pest problems. Cow urine and cow dung were reported to be effective for insect control as reported by Rankin (1986) [13]. The plant extracts prepared in cow urine were found very effective against *H. armigera* (Gupta, 2007, and Singh et al., 2012, Arora et al. 2014) [8, 17, 4]. According to the literature searched so far, there is no any research work conducted on the efficacy of different types of animal urine for the management of this noxious insect pest. Thus, the present field study is preliminary and novel in context of use of animal urine against gram pod borers, *H. armigera* on chickpea.

**Material and Methods**

The field experiments, on the bio efficacy of animal urine against *H. armigera* on Chickpea were conducted during *rabi* crop seasons, 2016-17 and 2017-18 at experimental farm NEBCRC, GBPUA&T Pantnagar, Uttarakhand. The trials were laid in Randomized Block Design (RBD) on chickpea variety PG-186 with a plot size of 3x3 m = 9m² and distance from row to row and plant to plant was maintained at 30 cm and 10 cm, respectively. The crop was sown in the mid November 2016 and 2017. There were 09 treatments which were replicated thrice. The treatments included the urine of selected domestic animals i.e. Desi, Jersy and Holstein breed cows, Ox, Buffalo, Goat and Horse which was collected from university campus dairy farm of GBPUA&T, Pantnagar and used @ 20 percent in comparison to Insecticide, Indoxacarb 14.55SC @0.9ml/l against *H. armigera* on chickpea. The 20 percent solution of animal urine was prepared and left for 3 days for fermentation. The 50 ml solution of detergent powder was added to these animal urine formulations just before spray to serve as sticker. These animal urine formulations @20% were sprayed twice on chickpea crop starting from the initiation of pest incidence (ETL) at fortnightly intervals during evening hours (Tiwari et al., 2016) [21]. The observations were recorded by randomly selecting ten plants from each plot and larval population was recorded 1 day before spraying, 3, 7, 14 days after spraying (DAS) on the mean population of larvae. The observations on percent pod damage and yield were recorded at the end of second spraying and after threshing the crop, respectively. Mean population of pupae of Ichneumonid wasp, *Campoletis chloridae*, a natural enemy associated with larvae of *H. armigera* were also recorded at 15 DAS of first and second sprayings.

**Percent pod damage was calculated by using the following formulae (Hussain, 2007)**

\[
\text{Percent pod damage} = \frac{\text{No. of damage pods}}{\text{Total number of pods}} \times 100
\]

\[
\text{Pod damage in control- pod damage in treatment}
\]

\[
\text{Percent reduction in pod damage} = \frac{\text{Pod damage in control}}{\text{Pod damage in control}} \times 100
\]

\[
\text{Grain yield in treatment- Grain yield in control}
\]

\[
\text{Percent increase in yield} = \frac{\text{Grain yield in control}}{\text{Grain yield in control}} \times 100
\]

The data so obtained were transformed to Arc sin, square root, percentage and analyzed statistically. After harvesting the crop, the data on the grain yield were recorded from each plot and analyzed statistically.

**Efficacy of animal urine against *H. armigera* on chickpea**

The results presented in Table-1 revealed that 3 days after first spray, Indoxacarb was most effective showing minimum larval population of 0.34, followed by Desi cow urine 0.50, HF cow urine 0.67, and Ox urine 1.00. The next best treatments were Jersy cow urine and Horse urine (1.17 each) followed by Buffalo urine (1.34), Goat urine (1.50). Seven days after first spray, Indoxacarb, Desi cow urine and Ox urine were the best treatments with 1.34, 2.00 and 2.00, respectively. The next best treatments were HF cow urine, Goat urine (2.34 each) followed by Jersy cow urine and Horse urine (2.50 each) with significantly higher larval counts in Buffalo urine (2.84) treated plots. Fourteen days after first spray, Indoxacarb recorded with lowest larval population of 3.84, followed by Desi cow urine (4.34) and Horse urine (4.33). The next best series of treatments were Goat urine, Ox urine, Jersy cow urine with 6.34, 6.50 and 6.67 larvae, respectively. However, HF cow urine (7.00) and Buffalo urine (7.67) observed with higher number of larvae. Three, seven and fourteen days after first spray untreated control were recorded with highest number of larvae respectively as 5.83, 7.84 and 8.84. The results revealed 3 days after second spray; Indoxacarb was most effective showing minimum larval population 2.50, followed by Horse urine (3.34), Desi cow urine (3.67) and Buffalo urine (3.84). HF cow urine (4.50), Jersy cow urine (4.83) and Goat urine (5.00) recorded with higher larval counts. Seven days after second spray also similar trend was followed with lowest larval population in Indoxacarb (4.17), followed by Goat urine (4.17), Desi cow urine (5.34), Ox urine (5.83) and Horse urine (5.84). Fourteen days after second spray also revealed, Indoxacarb was best treatment with 3.34 larval populations, followed by Horse urine (4.33), Desi cow urine (4.50) and Ox urine (5.00). As in the case of after first spray, three, seven and fourteen days after second spray also untreated control were recorded with highest number of larvae respectively as 13.00, 15.80 and 19.34. Overall mean larval population of *H. armigera* after two sprays showed significantly less number 2.59larvae/plant in Chemical, Indoxacarb treated chickpea plots followed by Desi cow urine (3.39larvae/plant), Horse urine (3.59larvae/plant) and Goat urine (4.06 larvae/plant) with more number 5.41larvae/plant was recorded in Jersy Cow urine whereas the mean larval population (11.78/plant) was recorded in untreated control.

After the first spray results revealed that, untreated control was recorded with highest mean number of *C. chloridae* population (3.84) followed by Horse urine (2.34), Desi cow urine, Buffalo urine (2.17 each), HF cow urine and Goat urine (1.50 each). Again untreated control was recorded with highest mean number *C. chloridae* population (4.00) even after second spray. The next best treatment series after second spray were Horse urine (2.67), Jersy cow urine, Ox urine and Buffalo urine (2.50 each). After the both sprays, the highest overall mean *Campoletis* pupae (2.42pupae/plant) was recorded in Desi cow urine treated chickpea plots which was at par with Horse urine (2.41pupae/plant), Buffalo urine (2.26pupae/plant) and Goat urine (2.00pupae/plant) with significantly different from Chemical, Indoxacarb where the least (0.76pupae/plant) was observed in comparison to the highest *Campoletis* population (3.12pupae/plant) was recorded in untreated control.
The data presented in Table-2 showed that after two sprays, Indoxacarb 14.5 SC@ 0.9 ml/l gave the least pod damage (11.38%) followed by Desi cow urine (13.00%) and Horse urine (13.97%). The next best treatments with lower percent pod damage were Goat urine (15.65%), Ox urine (22.57%), Buffalo urine (22.60%), cow urine HF (23.43%) and Jersy cow urine (23.18%). All the treatments were found to be significantly superior over control with pod damage (38.70%) percent. In terms of yield of chickpea, highest yield (15.15 q/ha) was recorded in Indoxacarb treated plot whereas lowest (5.51 q/ha) yield was recorded in untreated control plot. Among the different animal urine formulations evaluated Desi cow urine (12.92 q/ha), Horse urine (12.55 q/ha) and Goat urine (12.25 q/ha) were recorded with significantly higher grain yield. The next best treatments were HF cow urine (9.76 q/ha), Buffalo urine (8.68 q/ha) and Jersy cow urine (8.55 q/ha).

Two sprays of Indoxacarb 14.5 SC @ 0.9 ml/l was found to be more effective than other animal urine formulations where percent pod damage reduction was recorded the highest (70.59%) followed by Desi cow urine, Horse urine, Goat urine, Ox urine, Buffalo urine, Jersy Cow urine and HF Cow urine which were recorded the percent pod damage reduction by, 66.41, 63.90, 59.56, 61.48, 41.60, 40.10 and 39.46, respectively. Cow urine HF @20% was recorded least effective among the treatments but significant and superior over control. All the treatments were found to be significantly superior over control. Similarly, increase in grain yield over control was also significantly more for insecticide treatment, Indoxacarb (63.63%) followed by desicc cow urine (57.35%), horse urine (56.0%) which was at par with goat urine (55.02%) with the least value recorded in Jersy cow urine (35.56%).

Finally the results pertaining to overall mean population of larvae of *H. armigera*, pod damage and yield data as shown in Tables 1 and 2, clearly revealed that minimum larval population (2.59/plant), pod damage (11.38%) and higher yield (15.15q/ha) was obtained from insecticide, Indoxacarb treated plots. Though Indoxacarb was found effective, it showed deleterious effect against natural enemy of *H. armigera*, a parasitoid wasp, *Campeolites chloridae* as only 0.76 pupae/plant of it were recorded. Whereas in animal urine treated chickpea plots where mean population of *Campeolites* pupae were recorded in Desi cow urine (2.42pupae/plant) followed by Horse urine (2.41pupae/plant), Buffalo urine (2.62pupae/plant) and Goat urine (2.00pupae/plant).

All the treatments were found significantly superior over control and Indoxacarb (14.5 SC) @ 0.9ml/l was performed the best among the treatments followed by Desi cow urine, Horse urine and Goat urine. The present finding are also according with the finding of Jayshri et al. (2008) [10] and Anandhi et al. (2011) [11] who reported that the, indoxacarb recorded the highest reduction of pod borer population and grain damage in first and second spray in comparison to biopesticides. On the other hand, Sadawarte and Sarode (1997) [15] reported that a mixture of cow urine, NSKE (5%) and cow dung (5%) acts as an oviposition deterrent to moths and antifeedant to caterpillars and thereby the damage to maturing pods is minimized. Boomathi et al. (2006) [6] tested the combined action of neem seed kernel extract and cow excreta on botanicals against the diamondback moth, *Plutella xylostella* under field conditions. The plot treated by the urine-mix had the least number of cabbage leaves damaged, followed by the plot treated with cow urine and then the plot treated with goat urine. Singh et al. (2012) [17] evaluated that neem seed kernel extract in cow urine @5% recorded highest reduction of pod borer population (73.9%). Arora et al. (2014) [4] studied about the efficacy of the indigenous biopesticide formulation (BPF) comprising of botanicals along with cow urine, and evaluated that BPF controlled 70 to 80 percent of fruit borers resulting in enhanced tomato fruit yield of 35 tons per ha as compared to 15 tons per ha in the check plots.

Thus the present novel study clearly demonstrated the potential and possibilities of using animal urine against larval population of *H. armigera* with less pod damage, high grain yield, and with no any adverse effect on natural enemy population. Thus, it can be concluded from this present field study that animal urine can open new avenues for eco-friendly management of this noxious pest of international importance and can easily be incorporated in Integrated Pest management programme against *H. armigera* on chickpea crop as it is eco-friendly, cost effective easily available at farmers’ level, but as being novel and preliminary study, further in depth study is essentially required to come to the final conclusions.

Table 1: Effect of Animal urine on mean population of larvae of *H. armigera* and its natural enemy *Campeolites chloridae* during 2016-17 and 2017-18 at Pantnagar Uttarakhand (Pooled Data)

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Treatments</th>
<th>Conc. (%)</th>
<th>Mean Number of larvae/plant</th>
<th>Overall mean No. of larvae/plant</th>
<th>Mean no. of <em>Campeolites</em> pupae</th>
<th>Overall mean No. of <em>Campeolites</em> pupae/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Before Spray</td>
<td>Days After 1st Spray</td>
<td>Days After 2nd Spray</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>Cow urine- Desi</td>
<td>20</td>
<td>3.17 (1.91)</td>
<td>0.50 (1.07)</td>
<td>2.00 (1.57)</td>
<td>4.34 (2.19)</td>
</tr>
<tr>
<td>2</td>
<td>Cow urine-HF</td>
<td>20</td>
<td>2.17 (1.63)</td>
<td>0.67 (1.03)</td>
<td>2.34 (1.67)</td>
<td>7.00 (2.74)</td>
</tr>
<tr>
<td>3</td>
<td>Cow urine-Jersy</td>
<td>20</td>
<td>3.00 (1.87)</td>
<td>1.17 (1.25)</td>
<td>2.50 (1.67)</td>
<td>6.67 (2.68)</td>
</tr>
<tr>
<td>4</td>
<td>Ox urine</td>
<td>20</td>
<td>2.84 (1.83)</td>
<td>1.00 (1.19)</td>
<td>2.00 (1.57)</td>
<td>6.50 (2.65)</td>
</tr>
<tr>
<td>5</td>
<td>Buffalo urine</td>
<td>20</td>
<td>2.50 (1.73)</td>
<td>1.34 (1.33)</td>
<td>2.84 (1.79)</td>
<td>7.67 (2.86)</td>
</tr>
<tr>
<td>6</td>
<td>Goat urine</td>
<td>20</td>
<td>3.00 (1.87)</td>
<td>1.50 (1.35)</td>
<td>2.34 (1.63)</td>
<td>6.34 (2.59)</td>
</tr>
</tbody>
</table>

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Table 2: Effect of Animal urine on overall mean population of larvae of H. armigera and its natural enemy Campoletis chloridae, pod damage and grain yield during 2016-17 and 2017-18 at Pantnagar Uttarakhand (Pooled Data)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Treatments</th>
<th>Conc. (%)</th>
<th>Overall mean No. of larvae/plant</th>
<th>Overall mean No. of Campoletes pupae/plant</th>
<th>Pod damage (%)</th>
<th>Reduction in pod damage over control (%)</th>
<th>Pooled grain yield (q/ha)</th>
<th>Increase in yield over control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cow urine- Desi 20</td>
<td>3.39</td>
<td>2.42</td>
<td>13.00 (21.08)</td>
<td>66.41</td>
<td>12.92 (3.66)</td>
<td>57.35</td>
<td></td>
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<tr>
<td>2</td>
<td>Cow urine- HF 20</td>
<td>5.09</td>
<td>1.84</td>
<td>23.43 (28.90)</td>
<td>39.46</td>
<td>9.76 (3.20)</td>
<td>43.55</td>
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<tr>
<td>3</td>
<td>Cow urine- Jerzy 20</td>
<td>5.41</td>
<td>1.42</td>
<td>23.18 (28.74)</td>
<td>40.10</td>
<td>8.55 (3.61)</td>
<td>35.56</td>
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<tr>
<td>4</td>
<td>Ox urine 20</td>
<td>5.31</td>
<td>1.84</td>
<td>22.57 (28.33)</td>
<td>41.68</td>
<td>10.89 (3.37)</td>
<td>49.40</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Buffalo urine 20</td>
<td>4.70</td>
<td>2.26</td>
<td>22.60 (28.32)</td>
<td>41.60</td>
<td>8.68 (3.03)</td>
<td>36.52</td>
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</tr>
<tr>
<td>6</td>
<td>Goat urine 20</td>
<td>4.06</td>
<td>2.00</td>
<td>15.65 (23.26)</td>
<td>59.56</td>
<td>12.25 (3.57)</td>
<td>55.02</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Horse urine 20</td>
<td>3.59</td>
<td>2.41</td>
<td>13.97 (21.90)</td>
<td>63.90</td>
<td>12.55 (3.61)</td>
<td>56.09</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Indoxacarb 14.5 SC 0.9ml/l</td>
<td>2.59</td>
<td>0.76</td>
<td>11.38 (19.67)</td>
<td>70.59</td>
<td>15.15 (3.96)</td>
<td>63.63</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Untreated Control</td>
<td>-</td>
<td>11.78</td>
<td>3.17</td>
<td>38.70 (38.47)</td>
<td>-</td>
<td>5.51 (2.45)</td>
<td>-</td>
</tr>
</tbody>
</table>

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