

## Short Communication

## Eco-friendly management of pod borer (*Helicoverpa armigera*) in organic chickpea (*Cicer arietinum*)

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### ABSTRACT

The present study investigated the sustainable management of pod borer in chickpea cultivar Gujarat Gram-3. Results indicated that Neem seed kernel extract 5% + cow urine 10% treated plots recorded significantly lower *H. armigera* population with 1.51, 1.13 and 0.95 larval count over three 3 years. The pod borer damage at harvest also clearly indicated that in all the three years NSKE 5% + cow urine 10% showed significantly minimum damage with 3.96%, 2.92% and 4.25%, respectively. The plots treated with NSKE 5% + cow urine 10% gave maximum yield of chickpea seeds during first (1397 kg/ha), second (1217 kg/ha) and third (1083 kg/ha) years. The highest (1:6.13) protection cost benefit ratio also was obtained from NSKE 5% + cow urine 10%.

**Key words:** Chickpea, Organic management, Gram pod borer, Organic farming

Chickpea (*Cicer arietinum* L.) a member of family Fabaceae, is an ancient self-pollinated leguminous crop. Chickpea commonly known as Bengal gram or gram is the most important *rabi* season pulse crop of India. In India it is also known as “king of pulses”. It is the third most important grain legume in world, after dry beans and peas. (Sai *et al.* 2021). In India, the area, production and productivity during 2019-20 was 10.17 m ha, 11.35 m tonnes and 1116 kg/ha respectively and in Gujarat, area, production and productivity 8.16 lakh ha, 14.37 lakh tone and 1762 kg/ha (2020-21). Pod borer, *Helicoverpa armigera* is the important pest of chickpea. It is major pest of gram which feeds voraciously from seedling stage to maturity and causes about 90-95 per cent of total damage (Verma *et al.* 2015). The intensive use of pesticides for managing this pest has evoked many resistance and residue problems. However, these chemicals in many cases invited the problems of secondary pest outbreak, environmental contamination, residual toxicity, Phyto-toxicity and toxicity to beneficial organisms like predator and parasitoids as well as disturbance in homeostasis of natural population (Patil *et al.* 2018). Non-chemical and organic mode of pest management is gaining importance from health and environment hazard point of view. Hence, the some of the plant extracts were evaluated for their efficacy against the insect pests in organically grown chickpea crop.

The study was carried out during the *rabi* seasons from 2018-19 to 2020-21. The experiment was laid out in randomized block design (RBD) with eleven different treatments and three replications on chickpea (variety: Gujarat gram-3) with each plot measuring (4.00 m x 2.70 m) size with plant spacing of 45 cm x 10 cm at Organic Research Farm of Centre of Natural Resource Management, Sardarkrushinagar Dantiwada Agricultural University, Gujarat. The chickpea crop was raised by adopting standard organic agronomical practices like *beejamrut* and *jeevamrut*. All the following organic components or treatments were prepared for 10 litres water. T<sub>1</sub>: Neem seed kernel extract (5%) + Cow urine (10%) : 500 gm + 1 litre, T<sub>2</sub>: Red chilli fruit (*Capsicum annum*) (2%) + Cow urine (10%) : 200 gm + 1 litre, T<sub>3</sub>: Garlic clove (*Allium sativum*) (2%) + Cow urine (10%) : 200 gm + 1 litre, T<sub>4</sub>: Custard apple leaves (*Annona reticulata*) (5%) + Cow urine (10%) 500 gm + 1 litre, T<sub>5</sub>: Bael leaves (*Aegle marmelos*) (5%) + Cow urine (10%) : 500 gm + 1 lit, T<sub>6</sub>: *Naffatia* (Morning glory, *Ipomoea* spp.) leaves (5%) + Cow urine (10%) : 500 gm + 1 litre., T<sub>7</sub>: *Akardo* (Giant milkweed, *Calotropis gigantea*) leaves (5%) + Cow urine (10%) : 500 gm + 1 litre, T<sub>8</sub>: Neem (*Azadiracta indica*) leaves (5%) + Cow urine (10%): 500 gm + 1 litre, T<sub>9</sub>: *Datura* (*Devitrumpets datura*) (5%) + Cow urine (10%) 500 gm + 1 litre, T<sub>10</sub>: Cow urine 10 litre, T<sub>11</sub>: untreated control. The first spray was given on appearance of the egg(s)

or larva(e) of *H. armigera*. The observations on larval population were recorded on five randomly selected and tagged plants from each plot. The observations were recorded prior to first spray as well as 3, 7 and 10 days after each spray. Subsequent two sprays were given at 10 days interval. The data analysis was done by BASIC statistical software in the Department of Agril Statistics, C.P. College of Agriculture, Sardarkrushinagar.

The results indicated that there was non-significant difference amongst all the treatments of larval population of *Helicoverpa armigera* during all the three years of experiment (Table 1). During the first year (2018-19), the pooled (Table 1), indicated that the during the first and second sprays, NSKE 5%+ cow urine 10% (T<sub>1</sub>) treated plots recorded significantly lower *H. armigera* larval population with 1.87 and 1.80 larva, which was at par with garlic clove 2% + cow urine 10% (T<sub>3</sub>) and *datura* leaves 5% + cow urine 10% (T<sub>9</sub>). However, during the third spray, *datura* leaves 5% + cow urine 10%

(1.32) surpassed other treatments but was at par with T<sub>1</sub> and T<sub>3</sub>. The pooled over sprays finally (Table 2) made it clear that significantly lower (1.78) larval population was in T<sub>1</sub> and was at par with T<sub>9</sub>. The data of second year (2019-20) revealed that in all the three sprays, NSKE 5%+cow urine 10% (T<sub>1</sub>) treated plots recorded significantly lower *H. armigera* larval population with 0.61, 0.86 and 0.89 larva. The pooled over sprays (Table 2) indicated that significantly lower (0.78) larval population was observed in T<sub>1</sub> only. During the third year (2020-21) NSKE 5% + cow urine 10% (T<sub>1</sub>) treated plots recorded significantly lower *H. armigera* larval population with 0.48, 0.41 and 0.30 larva in all the three sprays. It was at par with garlic clove 2% +cow urine 10% (T<sub>3</sub>) in all the three sprays. Finally, the pooled over sprays (Table 2) also proved the efficacy of T<sub>1</sub> and it was at par with T<sub>3</sub>. The present studies are corroborated with Mallapur and Ladji (2010) evaluated various indigenous materials against chickpea pod borer and found that the combination of pongamia leaf

**Table 1.** Impact of organic management on larval population of *Helicoverpa armigera* infesting chickpea over three years

Tr. No.	Treatment	No. of larva/5 plant											
		2018-19				2019-20				2020-2021			
		Before Spray	1 <sup>st</sup> spray	2 <sup>nd</sup> spray	3 <sup>rd</sup> spray	Before Spray	1 <sup>st</sup> spray	2 <sup>nd</sup> spray	3 <sup>rd</sup> spray	Before Spray	1 <sup>st</sup> spray	2 <sup>nd</sup> spray	3 <sup>rd</sup> spray
T <sub>1</sub>	Neem seed kernel extract 5% + Cow Urine 10%	2.27 <sup>a</sup> (4.66)	1.54 <sup>f</sup> (1.87)	1.52 <sup>f</sup> (1.80)	1.48 <sup>ef</sup> (1.78)	2.43 <sup>a</sup> (5.42)	1.05 <sup>c</sup> (0.61)	1.17 <sup>c</sup> (0.86)	1.18 <sup>cd</sup> (0.89)	2.53 <sup>a</sup> (5.89)	0.99 <sup>e</sup> (0.48)	0.95 <sup>e</sup> (0.41)	0.89 <sup>f</sup> (0.30)
T <sub>2</sub>	Red chilli fruit 2% + Cow Urine 10%	2.26 <sup>a</sup> (4.63)	2.27 <sup>bc</sup> (4.64)	2.12 <sup>bcd</sup> (4.01)	2.48 <sup>ab</sup> (5.63)	2.37 <sup>a</sup> (5.11)	1.44 <sup>b</sup> (1.57)	1.42 <sup>bc</sup> (1.52)	1.49 <sup>b</sup> (1.73)	2.48 <sup>a</sup> (5.65)	1.51 <sup>bc</sup> (1.78)	1.42 <sup>c</sup> (1.51)	1.46 <sup>cd</sup> (1.63)
T <sub>3</sub>	Garlic clove 2% + Cow Urine 10%	2.34 <sup>a</sup> (4.97)	1.73 <sup>ef</sup> (2.49)	1.75 <sup>ef</sup> (2.56)	1.74 <sup>def</sup> (2.51)	2.38 <sup>a</sup> (5.18)	1.27 <sup>bc</sup> (1.12)	1.34 <sup>bc</sup> (1.28)	1.12 <sup>d</sup> (0.76)	2.44 <sup>a</sup> (5.43)	1.13 <sup>de</sup> (0.77)	1.03 <sup>de</sup> (0.56)	1.02 <sup>ef</sup> (0.53)
T <sub>4</sub>	Custard apple leaves 5% + Cow Urine 10%	2.33 <sup>a</sup> (4.97)	2.16 <sup>bcd</sup> (4.14)	2.17 <sup>bc</sup> (4.20)	2.32 <sup>bc</sup> (4.88)	2.37 <sup>a</sup> (5.11)	1.48 <sup>b</sup> (1.68)	1.57 <sup>b</sup> (1.98)	1.52 <sup>b</sup> (1.80)	2.37 <sup>a</sup> (5.11)	1.60 <sup>bc</sup> (2.05)	1.48 <sup>c</sup> (1.68)	1.54 <sup>cd</sup> (1.88)
T <sub>5</sub>	Bael leaves 5% + Cow Urine 10%	2.34 <sup>a</sup> (4.97)	2.07 <sup>bcd</sup> (3.78)	2.14 <sup>bcd</sup> (4.06)	2.08 <sup>bcd</sup> (3.82)	2.38 <sup>a</sup> (5.15)	1.47 <sup>b</sup> (1.65)	1.41 <sup>bc</sup> (1.49)	1.49 <sup>b</sup> (1.73)	2.35 <sup>a</sup> (5.00)	1.46 <sup>c</sup> (1.63)	1.40 <sup>c</sup> (1.45)	1.37 <sup>cd</sup> (1.39)
T <sub>6</sub>	Naffatia leaves 5% + Cow Urine 10%	2.33 <sup>a</sup> (4.97)	1.92 <sup>de</sup> (3.17)	1.85 <sup>de</sup> (2.91)	1.94 <sup>cde</sup> (3.26)	2.32 <sup>a</sup> (4.87)	1.38 <sup>b</sup> (1.39)	1.31 <sup>bc</sup> (1.21)	1.44 <sup>bc</sup> (1.57)	2.43 <sup>a</sup> (5.41)	1.37 <sup>cd</sup> (1.37)	1.39 <sup>c</sup> (1.44)	1.33 <sup>d</sup> (1.26)
T <sub>7</sub>	Akardo leaves 5% + Cow Urine 10%	2.26 <sup>a</sup> (4.59)	1.90 <sup>de</sup> (3.11)	1.97 <sup>cde</sup> (3.37)	1.95 <sup>cde</sup> (3.31)	2.41 <sup>a</sup> (5.32)	1.39 <sup>b</sup> (1.42)	1.38 <sup>bc</sup> (1.40)	1.49 <sup>b</sup> (1.73)	2.48 <sup>a</sup> (5.65)	1.35 <sup>cd</sup> (1.32)	1.28 <sup>cd</sup> (1.14)	1.93 <sup>b</sup> (3.22)
T <sub>8</sub>	Neem leaves 5% + Cow Urine 10%	2.34 <sup>a</sup> (4.97)	1.97 <sup>cde</sup> (3.38)	1.95 <sup>cde</sup> (3.30)	2.32 <sup>bc</sup> (4.89)	2.34 <sup>a</sup> (4.99)	1.42 <sup>b</sup> (1.51)	1.42 <sup>bc</sup> (1.52)	1.40 <sup>bcd</sup> (1.46)	2.54 <sup>a</sup> (5.95)	1.34 <sup>cd</sup> (1.29)	1.19 <sup>cde</sup> (0.91)	1.28 <sup>de</sup> (1.15)
T <sub>9</sub>	Dhatura leaves 5% + Cow Urine 10%	2.28 <sup>a</sup> (4.70)	1.71 <sup>ef</sup> (2.43)	1.79 <sup>ef</sup> (2.70)	1.35 <sup>f</sup> (1.32)	2.44 <sup>a</sup> (5.43)	1.46 <sup>b</sup> (1.62)	1.38 <sup>bc</sup> (1.41)	1.27 <sup>bcd</sup> (1.12)	2.35 <sup>a</sup> (5.04)	1.39 <sup>cd</sup> (1.43)	1.26 <sup>cd</sup> (1.09)	1.32 <sup>d</sup> (1.25)
T <sub>10</sub>	Cow urine 10%	2.38 <sup>a</sup> (5.18)	2.33 <sup>b</sup> (4.93)	2.35 <sup>b</sup> (5.01)	2.31 <sup>bc</sup> (4.81)	2.34 <sup>a</sup> (4.99)	1.49 <sup>b</sup> (1.71)	1.42 <sup>bc</sup> (1.52)	1.50 <sup>b</sup> (1.76)	2.41 <sup>a</sup> (5.31)	1.75 <sup>b</sup> (2.56)	1.80 <sup>b</sup> (2.74)	1.64 <sup>c</sup> (2.20)
T <sub>11</sub>	Untreated control	2.24 <sup>a</sup> (4.54)	2.55 <sup>a</sup> (7.15)	2.79 <sup>a</sup> (7.33)	2.86 <sup>a</sup> (7.69)	2.38 <sup>a</sup> (5.16)	2.33 <sup>a</sup> (4.90)	2.29 <sup>a</sup> (5.10)	2.19 <sup>a</sup> (4.30)	2.54 <sup>a</sup> (5.95)	2.53 <sup>a</sup> (5.88)	2.54 <sup>a</sup> (5.94)	2.40 <sup>a</sup> (5.26)
SEM±	T	0.14	0.10	0.09	0.15	0.15	0.08	0.08	0.09	0.08	0.08	0.09	0.09
	P	-	0.03	0.03	0.03	-	0.02	0.02	0.03	-	0.02	0.02	0.02
	T X P	-	0.10	0.08	0.10	-	0.06	0.08	0.09	-	0.06	0.07	0.06
	CV (%)	10.88	8.24	7.36	8.15	6.53	6.70	9.90	10.24	5.85	6.82	8.00	7.63

Figures in parentheses are retransformed values of  $\sqrt{x + 0.5}$  transformation,

Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance, Significant parameters and its interaction: T, P, T x P

extract + NSKE + aloe extract + cow urine recorded higher (55.71-56.11%) larval reduction. Similarly, Ladj *et al.* (2011) also reported that pongamia leaf extract (10%) +NSKE (10%) + aloe vera (0.5%) + cow urine (30%), green chilli aqueous extract (2%) + green chilli kerosene extract (0.5%) and vitex leaf extract (20%) + Clerodendrum extract (4%) + cow urine (17%) by recorded maximum reduction in chickpea pod borer larval population 56.11, 46.85 and 46.85 percent, respectively.

The data on per cent pod borer damage at harvest also clearly indicated that in all the three years T<sub>1</sub> (NSKE 5% + cow urine 10%) showed significantly minimum damage at harvest with 3.96%, 2.92% and 4.25%. This was at par with garlic clove 2% + cow urine 10% during 2019-2020 and 2020-21. The pooled result also proved the significant supremacy (3.69%) of T<sub>1</sub>. The present findings are in agreement with Dindor and Panickar (2020) evaluated different organic insecticides against *H. armigera* on chickpea,

**Table 2.** Impact of organic management on *Helicoverpa armigera* infestation in chickpea

Tr. No.	Treatment	*No. of larva/ 5 plant				**Pod borer damage (%)			
		2018-19	2019-20	2021-22	Pooled	2018-19	2019-20	2020-21	Pooled
T <sub>1</sub>	Neem seed kernel extract 5% + CU 10%	1.51 <sup>s</sup> (1.78)	1.13 <sup>d</sup> (0.78)	0.95 <sup>s</sup> (0.40)	1.20 <sup>f</sup> (0.94)	11.47 <sup>f</sup> (3.96)	9.84 <sup>c</sup> (2.92)	11.89 <sup>s</sup> (4.25)	11.07 <sup>s</sup> (3.69)
T <sub>2</sub>	Red chilli fruit 2% + CU 10%	2.29 <sup>b</sup> (4.74)	1.45 <sup>b</sup> (1.60)	1.46 <sup>cd</sup> (1.63)	1.73 <sup>bc</sup> (2.49)	17.11 <sup>c</sup> (8.65)	16.18 <sup>b</sup> (7.77)	16.85 <sup>bcd</sup> (8.41)	16.72 <sup>bc</sup> (8.27)
T <sub>3</sub>	Garlic clove 2% + CU 10%	1.74 <sup>ef</sup> (2.53)	1.24 <sup>cd</sup> (1.04)	1.06 <sup>s</sup> (0.62)	1.35 <sup>ef</sup> (1.32)	13.72 <sup>e</sup> (5.63)	11.96 <sup>bc</sup> (4.29)	12.57 <sup>fg</sup> (4.74)	12.75 <sup>f</sup> (4.87)
T <sub>4</sub>	Custard apple leaves 5% + CU 10%	2.21 <sup>bc</sup> (4.38)	1.52 <sup>b</sup> (1.81)	1.54 <sup>c</sup> (1.87)	1.76 <sup>bc</sup> (2.60)	17.43 <sup>c</sup> (8.98)	16.23 <sup>b</sup> (7.82)	17.28 <sup>bc</sup> (8.83)	16.98 <sup>bc</sup> (8.53)
T <sub>5</sub>	Bael leaves 5% + CU 10%	2.09 <sup>cd</sup> (3.87)	1.46 <sup>b</sup> (1.63)	1.41 <sup>de</sup> (1.49)	1.65 <sup>bcd</sup> (2.22)	14.14 <sup>de</sup> (5.97)	14.09 <sup>b</sup> (5.93)	14.52 <sup>ef</sup> (6.29)	14.25 <sup>ef</sup> (6.06)
T <sub>6</sub>	Naffatia leaves 5% + CU 10%	1.90 <sup>de</sup> (3.11)	1.37 <sup>bc</sup> (1.38)	1.36 <sup>def</sup> (1.35)	1.55 <sup>cde</sup> (1.90)	17.43 <sup>c</sup> (8.98)	15.31 <sup>b</sup> (6.97)	16.40 <sup>cde</sup> (7.97)	16.38 <sup>cd</sup> (7.95)
T <sub>7</sub>	Akardo leaves 5% + CU 10%	1.94 <sup>d</sup> (3.26)	1.42 <sup>b</sup> (1.52)	1.27 <sup>f</sup> (1.11)	1.55 <sup>cde</sup> (1.90)	15.70 <sup>cd</sup> (7.32)	13.62 <sup>bc</sup> (5.55)	14.70 <sup>def</sup> (6.44)	14.67 <sup>e</sup> (6.42)
T <sub>8</sub>	Neem leaves 5% + CU 10%	2.08 <sup>cd</sup> (3.83)	1.41 <sup>b</sup> (1.49)	1.27 <sup>f</sup> (1.11)	1.59 <sup>bcd</sup> (2.03)	16.77 <sup>c</sup> (8.32)	14.57 <sup>b</sup> (6.33)	15.50 <sup>cde</sup> (7.15)	15.61 <sup>cde</sup> (7.24)
T <sub>9</sub>	Dhatural leaves 5% + CU 10%	1.62 <sup>fg</sup> (2.12)	1.37 <sup>bc</sup> (1.38)	1.32 <sup>ef</sup> (1.24)	1.44 <sup>def</sup> (1.57)	14.14 <sup>de</sup> (5.97)	14.63 <sup>b</sup> (6.38)	15.84 <sup>cde</sup> (7.45)	14.87 <sup>de</sup> (6.59)
T <sub>10</sub>	Cow urine 10%	2.33 <sup>b</sup> (4.93)	1.47 <sup>b</sup> (1.66)	1.73 <sup>b</sup> (2.49)	1.84 <sup>b</sup> (2.89)	19.35 <sup>b</sup> (10.98)	16.32 <sup>b</sup> (7.90)	18.90 <sup>b</sup> (10.49)	18.19 <sup>b</sup> (9.74)
T <sub>11</sub>	Untreated control	2.75 <sup>a</sup> (7.06)	2.09 <sup>a</sup> (3.87)	2.49 <sup>a</sup> (5.70)	2.44 <sup>a</sup> (5.45)	25.83 <sup>a</sup> (18.98)	22.15 <sup>a</sup> (14.22)	25.05 <sup>a</sup> (17.93)	24.34 <sup>a</sup> (16.99)
SEm±	T	0.21	0.09	0.08	0.10	0.61	1.33	0.70	0.51
	P	0.15	0.12	0.17	0.01	-	-	-	0.28
	S	NS	NS	0.03	0.01				
	Y	-	-	-	0.02				
	S x P	0.08	0.07	0.05	0.03				
	S x T	0.16	NS	0.10	0.04				
	T x P	0.22	NS	0.10	0.05	-	-	-	0.94
	Y x S	-	-	-	0.07				
	Y x P	-	-	-	0.02				
	Y x T	-	-	-	0.02				
	SxPxT	0.27	0.26	NS	0.05				
	YxSxP	-	-	-	0.06				
	YxSxT	-	-	-	0.03				
YxPxT	-	-	-	0.07					
YxSxPxT	-	-	-	0.05					
CV (%)		8.34	11.27	7.51	9.38	6.39	15.40	7.48	10.19

\*Figures in parentheses are retransformed values of  $\sqrt{x + 0.5}$  transformation, 2. Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance 3. Significant parameters and its interactions: T, Y, S x T, Y x S, Y x P, Y x T, Y x S.

\*\*Figures in parentheses are retransformed values of arc sin transformation. Treatment means with the letter(s) in common are not significant by DNMRT at 5% level of significance, Significant parameters and its interaction: T, P, T x P.

**Table 3.** Impact of organic management on chickpea yield.

Tr. No.	Seed yield (kg/ha)				Net realization over control (Rs/ha)	Net gain (Rs/ha)	ICBR
	2018-19	2019-20	2021-22	Pooled			
Neem seed kernel extract 5% + Cow Urine 10%	1396.67 <sup>a</sup>	1216.67 <sup>a</sup>	1083.33 <sup>a</sup>	1232.22 <sup>a</sup>	39333	33813	1:6.13
Red chilli fruit 2% + Cow Urine 10%	845.00 <sup>cd</sup>	916.67 <sup>c</sup>	825.00 <sup>bcd</sup>	862.22 <sup>bcd</sup>	17133	12363	1:2.59
Garlic clove 2% + Cow Urine 10%	1302.00 <sup>a</sup>	1143.67 <sup>ab</sup>	910.33 <sup>b</sup>	1118.67 <sup>a</sup>	32520	25500	1:3.63
Custard apple leaves 5% + Cow Urine 10%	835.00 <sup>cd</sup>	892.59 <sup>c</sup>	793.33 <sup>bcd</sup>	840.31 <sup>bcd</sup>	15819	11799	1:2.93
Bael leaves 5% + Cow Urine 10%	1073.00 <sup>b</sup>	950.00 <sup>bc</sup>	866.67 <sup>bc</sup>	963.22 <sup>b</sup>	23193	19173	1:4.77
Naffatia leaves 5% + Cow Urine 10%	851.67 <sup>cd</sup>	885.00 <sup>c</sup>	751.67 <sup>cde</sup>	829.44 <sup>cd</sup>	15166	11146	1:2.77
Akardo leaves 5% + Cow Urine 10%	950.00 <sup>bc</sup>	998.33 <sup>bc</sup>	883.33 <sup>bc</sup>	943.89 <sup>bc</sup>	22033	18013	1:4.48
Neem leaves 5% + Cow Urine 10%	1016.67 <sup>b</sup>	933.33 <sup>c</sup>	850.00 <sup>bcd</sup>	933.33 <sup>bc</sup>	21400	17380	1:4.32
Dhatura leaves 5% + Cow Urine 10%	1041.67 <sup>b</sup>	861.67 <sup>c</sup>	698.33 <sup>de</sup>	867.22 <sup>bcd</sup>	17433	13413	1:3.34
Cow urine 10%	808.33 <sup>d</sup>	833.33 <sup>c</sup>	683.33 <sup>e</sup>	775.00 <sup>d</sup>	11900	7880	1:1.96
Untreated control	665.00 <sup>e</sup>	615.00 <sup>d</sup>	450.00 <sup>f</sup>	576.67 <sup>e</sup>	0	0	-
	40.38	63.75	47.11	39.39			
SEm±	-	-	-	15.48			
	-	-	-	51.36			
CV (%)	7.13	11.85	10.20	9.84			

Treatments means with the letter(s) in common are not significant by DNMRT at 5% level of significance.

NSKE + cow urine, jimson weed leaves + cow urine and garlic clove and cow urine proved significantly more effective against the pod borer. Similarly, Shekhara *et al.* (2014) reported that the different bio-rational used for management of *H. armigera* on chickpea, azadiractin 3% WSP @ 400 g/ha sprayed plot recorded lowest larval population of 0.33, 0.50 per ten plants at seven days after first spray, second and third sprays, respectively with lowest of 9.55 percent pod damage.

The plots treated with T<sub>1</sub> (NSKE 5% + cow urine 10% @ 500 gm + 1 lit per 10 liters water) gave maximum yield of chickpea seeds during first (1396.67 kg/ha), second (1216.67 kg/ha) and third (1083.33 kg/ha) years (Table 3). This was at par with garlic clove 2% + cow urine 10% during first two years of study. Finally, the pooled results proved the supremacy of T<sub>1</sub> (1232.22 kg/ha) and was at par with T<sub>3</sub>. It was also found to be in relation to the findings of Dindor and Panickar (2020) reported that significantly higher seed yield was obtained when crop was treated with NSKE + cow urine (1574 kg/ha) and per cent increase in yield over control was maximum in plots treated with NSKE + cow urine (90.56%) followed by jimson weed leaves + cow urine (87.53%) and garlic clove + cow urine (83.05%).

Maximum net gain was obtained from T<sub>1</sub> (Neem seed kernel extract 5% + cow urine 10% @500gm + 1lit) followed by garlic clove 2% + cow urine 10% (Table 3). The highest (1:6.13) protection cost benefit ratio (PCBR) was obtained from T<sub>1</sub>.

Similar result were obtained by Singh *et al.* (2020) reported that the Incremental Cost Benefit Ratio (ICBR) was obtained when field pea was treated with cow urine (1:13.52) similar trend in per cent increased yield over control. Similarly, Dindor and Panickar (2020) reported that the highest protection cost benefit ratio (PCBR) was obtained when chickpea was treated with jimsonweed leaves + cow urine (1:24.55) followed by NSKE + cow urine (1:16.84). Based on the larval population of *H. armigera*, percent pod borer damage, seed yield and net gain, it can be concluded that Neem seed kernel extract 5% + cow urine 10% @ 500 gm + 1 lit and garlic clove 2% + cow urine 10% were effective in managing the gram pod borer in organically grown chickpea crop.

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