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Efficacy of eco-friendly plant products against tur pod borer, *Helicoverpa armigera* (Hubner) infesting pigeonpea under laboratory conditions

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Abstract
The present experiment was conducted to test the efficacy of some bioformulations against tur pod borer, *Helicoverpa armigera* at the laboratory of the department of Entomology, College of Agriculture, IGKV, Raipur, Chhattisgarh, during 2023-25. Observations were recorded after 24, 48 and 72 hours after treatment (HAT). The result at 24 HAT revealed 30.00 percent corrected mortality in neem seed kernel extract and was found to be the best treatment which was on par with neemastra recording 20.00 percent corrected mortality. Highest repellency (85.00%) was recorded in agniastra followed by neemastra (80.00%). The observations recorded at 48 HAT revealed highest corrected mortality (30.00%) recorded in bramhastra followed by neem oil (25.00%) and highest repellency (70.00%) percent recorded in neemastra followed by neem seed kernel extract (65.00%). After 72 HAT, corrected mortality (65.00%) was recorded in agniastra followed by neem seed kernel extract (55.00%) and highest repellency was recorded in neemastra (50.00%).

Keywords: Efficacy, bioformulations, tur pod borer, *Helicoverpa armigera*, pigeon pea, neemastra, agniastra Brahmastra

Introduction
Pigeonpea, [*Cajanus cajan* (L.) Millspaugh] (2n = 22) is an important pulse crop mainly grown under rain-fed condition s in the tropics and subtropics. In Asia, Africa and Latin America, pigeon-pea seeds have become the main source of protein especially for the vegetarians. Guandul in Latin America, Gungo peas in the Anglo Caribbean and Congo pea in Sub Saharan Africa are the names given to the pigeonpea (Carney and Rosomoff, 2009) [4]. In India, it is known by a variety of names including arhar, red gram, tur and tomarapayaru (Anonymous, 2016) [2]. Pigeon-pea appears to have originated in Peninsular India, with its nearest wild relative (*Cajanus cajanifolia*) growing in tropical deciduous woodlands. Pigeonpea is grown in over 25 tropical and subtropical nations, either as a stand-alone crop or in combination with cereals such as sorghum and maize, or other legumes such as peanuts. Pigeonpea is the most adaptable edible legume, with a wide range of use including food, feed, fodder and fuel. Grain comes in a variety of forms, including green seeds as vegetables and reconstituted dried split seeds. It is rich source of protein and fulfils a major protein requirement of vegetarian population of the country. It is a major source of dietary protein in South Asian vegetarian civilizations. Pigeon-pea provides 50% of all protein ingested by Indians in some areas (Ryan *et al*., 1984) [11]. The food value of pigeon-pea is due to its protein content (22.3%) along with iron, iodine and essential amino acids like lysine, cystine arginine, vitamins and minerals. It has better quality of fiber, 7 g/100 g of seeds (Kandhare, 2014) [6].”

A wide range of constraints (abiotic and biotic) are responsible for reduction in productivity of the country's pigeonpea. Among them biotic factors which include insect pests are most notable threat to the crop’s potential yield. The havoc caused by insect pests is critical (Mishra *et al*., 2012) [8]. Though pigeonpea is inundated by more than 250 species of insect pests belongings to 8 orders and 61 families that appear at variousgrowth stages of the crop in India, only a few of these cause consistent and significant damage to the crop (Lateef and Reed, 1990 and Gopali *et al*., 2010) [7, 5]. Worldwide, over 30 species of Lepidoptera feed on pods and seeds of pigeonpea (Shanower *et al*., 1999) [14].

The pod borer complex, which also comprises *Helicoverpa armigera*, *Etiella zinckenella* and *Maruca vitrata*, has been identified as a significant threat to pigeonpea crop causing significant losses in grain yield ranging from 30 to 100 percent by targeting the reproductive sections of the plant. (Srilaxmi and Ravindra, 2010) [15].

The insect pod borer complex has a significant impact on the production of most pulses. Among these the *H. armigera* (Hübner) is the major pest in most parts of the country and it has attained the key pest prominence due to its direct attack on fruiting bodies, voracious feeding habits, high mobility, fecundity, multivoltine and overlapping generation with facultative diapauses, nocturnal "bahaviour, migration host selection and propensity for acquiring resistance against insecticides (Satpute and Sarode, 1995) [12]. It accounts for 90-95% of total damage. A single larva can damage 25-30 pods of gram in its life time. It feeds on tender shoots and young seeds. It makes holes in pods and inserts half of its body inside the pod to eat developing seeds "(Ojha *et al*., 2017) [9].

Materials and Methods

The present experiment was conducted at the laboratory of Department of Entomology, College of Agriculture, IGKV, Raipur (C.G.) during 2023-25 to study the effectiveness of some bioformulations against tur pod borer, *H. armigera* infesting pigeon pea. The solution of bioformulations were prepared in distilled water with desired concentration and the pods of pigeonpea were dipped in the test solution for 30 seconds. Such treated pods were allowed to air dry on clean cloth. Further they were transferred to individual small plastic vials. The fourth and fifth instar larvae were transferred to each plastic vials containing treated pigeonpea pods. Each treatment was replicated three times along with an untreated control at 27±2 °C temperature and 70±10% relative humidity.

Experimental details

The details of experiment are given below:

Location: Laboratory of Entomology department

Design: CRD

No. of replication: Four

No. of treatments: Six

Table 1: Treatments details

S. No.	Treatment number	Treatment name	Composition	Dosage
1	T_1	Neemastra	Neemastra 2% (Cow urine + Cow dung + Neem leaves)	20 ml/lit of water
2	T_2	Bramhastra	Bramhastra 2% (Cow urine + leaves of plant like Neem, Papaya, Pomegranate, Custard apple, and Guava)	20 ml/lit of water
3	T_3	Agniastra	Agniastra 2% (Cow urine + Tobacco + Green chilli + Garlic + Neem leaf)	20 ml/lit of water
4	T_4	Neem seed kernel extract (NSKE)	5 kg neem seed kernel powder + 10 lt of water	5 ml/l (5%)
5	T_5	Neem oil (Check)	-	5 ml/l
6	T_6	Untreated water spray (control)	-	-

Method of preparation of different cow urine based plant products treatment

Treatment-1

A. Neemastra

Materials Required for Neemasatra preparation-

- 5 litres of water
- Cow urine 50 ml per litre of water.
- Cow dung 10 grams per litre of water
- Crushed neem leaves (with thin stems) 50 gm per litre of water.

Preparation method of Neemastra-

A plastic container was taken in which 5 lit of water was filled then all the above ingredients were mixed and the mixture was stirred with the help of wooden stick regularly at an interval of 2 hours in both clockwise and anticlockwise direction. After that the container was covered with jute sack. Then the mixture was kept for 48 hours for fermentation and after 48 hours the mixture was stirred thoroughly and then filtered through a muslin cloth.

Treatment-2

B. Brahmastra

Materials Required for Brahmastra Preparation-

- 5 litres of cow urine
- 500 g of pulp of custard apple leaves
- 500 g pulp of papaya leaves
- 500 g pomegranate leaves pulp
- 500 g guava leaves pulp
- 1 kg crushed Neem leaves pulp

Preparation method of Brahmastra

A mud pot d was taken in which 5 lit of desi cow urine was filled then 1kg of crushed neem leaf pulp was added. After adding, the mixture was kept for 30 min and after 30 minutes the solution was boiled for 5 times in low flame then allowed it to cool down After cooling of the solution the mixture was left to ferment for 24 hrs then the mixture was stirred thoroughly and then filtered through a muslin cloth.

Treatment-3

C. Agniastra

Materials Required for Agniastra preparation-

- 5 litres of cow urine
- 500 g of pulp of Tobacco leaves.
- 500 g pulp of neem leaves
- 250 gm of Green chilly with strong pungency
- 250 Gram Local Garlic

Preparation method of Agniastra-

An earthen pot was taken in which 5 lit of desi cow urine was filled then all the above ingredients were mixed after

mixing the all ingredients the mixture was stirred by the help of wooden stick regularly at an interval of 2 hours in both clockwise and anti clockwise directions, then the mixture was left to ferment for 24 hrs. Then, the mixture was stirred thoroughly and filtered through a muslin cloth.

Treatment-4
D. NSKE (Neem seed kernel extract)
Materials Required for preparation:

- Neem seed kernels (well dried)
- Water (reasonably good quality)
- Detergent
- Muslin cloth for filtering

1 kg quantity of neem seed kernel was taken a grinder machine @ 18000-23000 rpm for 3-5 minutes. 50 gm powder was soaked in 1 lit of water for 24 hours and in the next morning the soaked mixture was stirred with wooden stick and filtered with double layer muslin cloth. Then 20 g of detergent powder was added to it. The solution thus prepared was ready for use with required volume of water.

Treatment-5
Neem Oil
Neem Baan 1500 ppm is a bio-pesticide formulation derived from neem oil, containing 1500 ppm of azadirachtin.

Treatment-6
Plain Water Spray (Control)
In control pods only plain water was sprayed.

Method of recording observation-
The mortality and repellency of fourth and fifth instar larvae of *H. armigera* were assessed after 24-, 48-and 72-hours exposure of the larvae to the treated pigeonpea pods. The larvae were considered dead if they gave no response to stimulation by touch. The results were expressed as per-cent mortality with correction for untreated control mortality using Abbott's formula (Abbott, 1925) [1]. Data was analyzed statistically.

Abbott's formula

$$\text{Corrected mortality (\%)} = \frac{\text{\% test mortality-\% control mortality}}{\text{100-\% control mortality}}$$

Results and Discussion
The data recorded on the effectiveness of some bioformulations against tur pod borer, *H. armigera* infesting pigeon pea with corrected mortality (%) and repellency in various bioformulations at 24, 48 and 72 HAT revealed that the neem seed kernel extract exhibited highest mortality (30.00%) at 24 hours, followed by neemastra (20.00%) and bramhastra (15.00%) Again after 48 hours neem seed kernel extractand agniastrashowed highest mortality (30.00%), followed by bramhastra and neem oil (25.00%) while, after 72 hours agniastra exhibited highest mortality (65.00%) followed by neem seed kernel extract (55.00%) and bramhastra (50.00%).Similarly, in repellence, agniastra exhibited the highest repellency (85.00%) at 24 hours, followed by neemastra (80.00%) and neem oil (80.00%). After 48 hours again neemastra showed highest repellency (70.00%) followed by neem seed kernel extract and neem oil (65.00%) while, after 72 hours neemastra exhibited highest repellency (50.00%) followed by neem oil (50.00%) and untreated control 40.00%.
The present findings are supported by Patil *et al*., (2015) [10], who reported NSKE as an effective botanical against *H. armigera* in pigeonpea ecosystem. Similarly, Neem-based products like neem oil and neem leaf extract have been shown to act as feeding deterrents and insect growth regulators by Schmutterer (1990) [13], which corroborates the current findings. The results are also in conformity with the study of Bijewar *et al*., (2018) [3], who observed that indigenous formulations a combination of plant-derived compounds, primarily from neem, tobacco, chilli, and garlic, with the cow based fermentation of desi cow urine acting as the solvent and fermentation agent like Neemastra, Bramhastra, and Agniastra. These plant materials contain vatrious alkaloids, chavicine, capsaicin and allicin that showed considerable effects on pod borer management. The present findings validate their potential role not only as insecticidal agents but also as eco-friendly pest repellents.

Table 2: Corrected mortality and repellence of pigeonpeapod borer, *H. armigera* at 24, 48 and 72 hours after treatment with few plant products

S. No.	Treatments	Dose	Corrected mortality (%)			Repellence (%)		
			24h	48h	72h	24h	48h	72h
1	Neemastra	20 ml/lt.	20.00 (26.57)	20.00 (26.57)	35.00 (36.20)	80.00 (63.43)	70.00 (56.79)	50.00 (45.00)
2	Bramhastra	20 ml/lt.	15.00 (22.79)	25.00 (30.00)	50.00 (45.00)	75.00 (60.00)	60.00 (50.77)	30.00 (33.21)
3	Agniastra	20 ml/lt.	10.00 (18.43)	30.00 (33.21)	65.00 (53.73)	85.00 (67.21)	60.00 (50.77)	30.00 (33.21)
4	NSKE	5 ml/l (5%)	30.00 (33.22)	30.00 (33.21)	55.00 (47.87)	60.00 (50.77)	65.00 (53.73)	35.00 (36.27)
5	Neem oil (Check)	5 ml/l	15.00 (22.79)	25.00 (22.79)	30.00 (33.21)	80.00 (63.43)	65.00 (53.73)	50.00 (45.00)
6	Untreated control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	55.00 (47.87)	55.00 (47.87)	40.00 (39.23)
S.Em.±	-	-	1.52	1.32	0.72	0.91	1.28	1.13
CD (P=0.05)	-	-	4.12	3.95	2.16	2.77	3.58	2.98

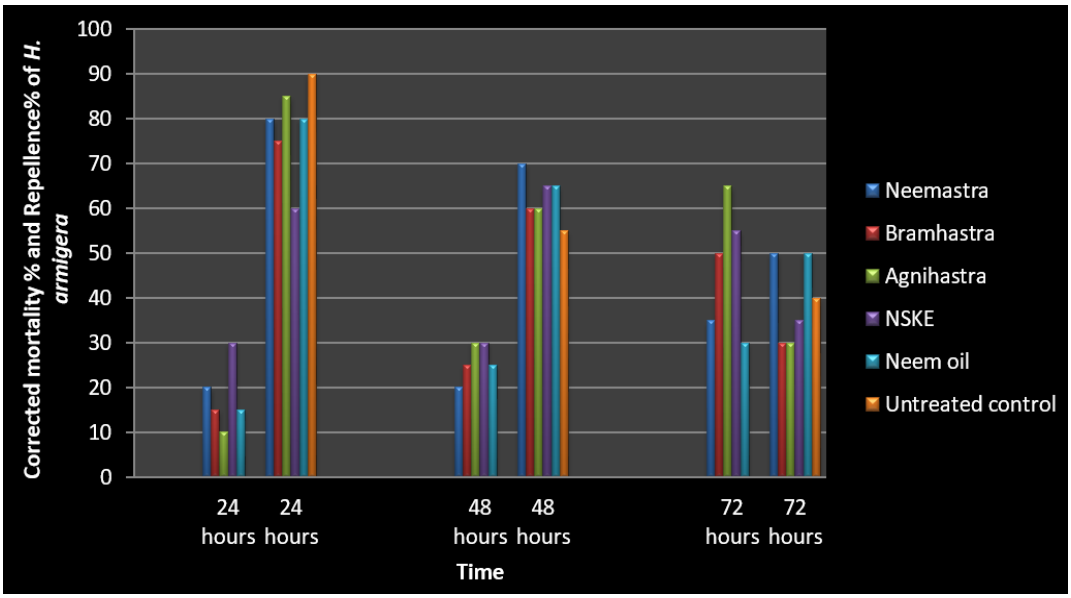

Fig 1: Corrected mortality and repellence of pigeonpeapod borer, *H. armigera* at 24, 48 and 72 hours after treatment with few plant products

A. Collection of leaves

B. Cutting and drying of leaves

C. Boiling with cow urine and dung

D. Mixing the materials

E. Extraction of products

F. Bottling the products

Fig 2: Preparation of Bramhastra, Agniastra and Neemastra

A. Preparation of formulation of Plant based products

B. Soaking of pods in the Formulation (5 min)

C. Releasing 4th and 5th instar larvae of *H. armigera*

D. Repellence of larva

E. Mortality of larvae

Fig 3: Eco-friendly management of *H. armigera* using plant-based products under laboratory conditions

Conclusion

Thus, from the present investigation in which few plant-based bioformulations were evaluated against *H. armigera*, after 24, 48 and 72 hours after treatment in terms of mortality (%) and repellency (%), resulted, highest mortality in neem seed kernel extract and neemastra, whereas, highest repellency was observed in agniastra and bramhastra. Hence, these bioformulations can be included as an effective IPM strategy for the management of *H. armigera*. However, it is felt necessary to test the efficacy of bioformulations against the pest under field conditions.

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