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Evaluation efficacy of botanicals against gram pod borer, *Helicoverpa armigera* (Hubner) on Pigeonpea

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Abstract
The present investigation on field efficacy of some botanicals viz., Aloevera (*Aloe vera*), Nirgundi (*Vitex negundo*), Datura (*Datura stramonium*), Calotropis (*Calotropis gigantean*), Soapnut (*Sapindus mukoros*), Arusa (*Adathoda vasiva*) @ 5% aqueous extract and Pongamia soap (*Pongamia pinnata*) @ 1% against gram pod borer, *Helicoverpa armigera* on pigeonpea, were carried out during 2016(June)-2017(January), at College of Agriculture, JNKVV, Jabalpur. Result revealed that Nirgundi @ 5% (w/v) was most effective (3.06 larvae / 5 plants) and significantly superior to all other treatments followed by Calotropis @ 5% (w/v), Pongamia soap @ 1% (w/v), Arusa @ 5% (w/v) and Datura @ 5% (w/v), and population ranged between 3.47 to 3.78 larvae / 5 plants, and were at par with each other. The least effective treatment was Ghikavera @ 5% (w/v) (3.98 larvae / 5 plants), but significantly better than control (4.71 larvae/ 5 plants). Overall result revealed that nirgundi leaf extract has good potential to control *H. armigera.*

Keywords: Botanicals, Field efficacy, *Helicoverpa armigera*

1. Introduction
Pigeonpea [*Cajanus cajan* (L.) Millspaugh] is one of the major pulse crops of India next to chickpea [14]. Globally, India ranks first in production and area under pigeonpea cultivation. In the country, the crop is extensively grown in Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Uttar Pradesh and Gujarat. Maharashtra has a unique distinction of contributing about 29.68% production in the country followed by Karnataka, Madhya Pradesh [12]. Attack of insect pests is considered to be one of the major constraints of low yield of Pigeonpea. Major insect pests that include the pod boring Lepidopterans (*Helicoverpa armigera; Maruca vitrata; Etiella zinkenella*), have contributed to the poor productivity [6]. Pod borers namely, *Helicoverpa armigera* and *Maruca vitrata* are the major and devastating insect pests of Pigeonpea in India [11]. The Indian farmers mainly depend heavily on the use of synthetic insecticides to combat these insect pests. Extensive use of synthetic insecticides in crop protection programs around the world has resulted in disturbances of the environment, pest resurgence, pest resistance to pesticides and lethal effect to non-target organisms in the agro-ecosystem in addition to direct toxicity to users [10]. Therefore, it has now become necessary to search for the alternative means of pest control, which can minimize the use of synthetic pesticides. Botanical pesticides are an important alternatives to minimize or replace the use of synthetic pesticides as the crude plant extracts often consists of complex mixtures of active compounds, possess detrimental effects on insects are manifested in several ways, including toxicity, feeding and growth inhibition [13]. Keeping the above facts, it was planned to study the efficacy of botanicals against gram pod borer in pigeon pea crop.

2. Materials and Methods
A field trial was conducted during 2016-17 with redgram variety TJT 501 at College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. The experiment was conducted in randomized block design (RBD) with a plot size of 3.6 x 10 m with 0.60 x 0.20 m spacing, 6 rows / plot 3 spraying are done at flowering / early pod formation stage by using high volume hand operated knapsack sprayer at repeated at 10 days interval.

2.1. Source of material
Fresh leaf materials of Datura and Calotropis were collected from the local field area. Whereas Aloevera, Nirgundi, Arusa were procured from Botanical Garden, JNKVV, Jabalpur, while *Ritha* purchased from local market and Pongamia soap from Indian Institute of Horticulture Research, Hessaraghatta lake post, Bengaluru.

2.2. Method of Extract Preparation
Preparation of leaf extracts: Fresh leaves of the respective plants were collected and brought to the laboratory, washed thoroughly 3-4 times with tap water. Thereafter, they were chopped into small pieces with knife and pounded in mortar with pestle. 50 gram of the pounded material was soaked overnight in one liter water to get one liter of 5% extract. In the morning it was filtered with muslin cloth and the filtrate was used for spraying.

Preparation of soap nut extracts: Dried soap nut were taken and cleaned thoroughly a day before schedule spraying. It was powdered by grinding and 50 gram of the grinded material was soaked overnight in one litre water to get one liter of 5% extract. In the morning it was filtered with muslin cloth and the filtrate was used for spraying.

2.3. Method of observation and analysis
Pretreatment observations were recorded 24 hours before the spray while post treatment observations were recorded at 3, 7 and 10 days after spraying on 5 plants per treatment per replication. Observations on *H. armigera* larval population were assessed by counting number of larvae per 5 plants.

The formula used to calculate the percent infestation of pods was

$$\text{Pod Infestation (\%)} = \frac{\text{Number of infested pods}}{\text{Total number of pods}} \times 100$$

The mean original data of percentage pod damage was calculated as percentage reduction over control with the following formula [1].

$$\text{Percent Reduction} = \frac{C-T}{C} \times 100$$

Where,
C: Percentage pod damage of control of larval population on control
T: Percentage pod damage of treated plot or larval population on treatments

Statistical Analysis: The data on incidence *H. armigera* were subjected to square root transformation, these transformed values are analyzed with RBD design. Then analysis of co-variance is done, to find significance between the treatments.

Grain yield
Yield was calculated for different treatments as per formula:
Yield (kg / ha) = Factor x Grain yield/ plot (kg)
Where, Factor = (10000)/ (Net plot size) in sq.m

3. Results
The results on the efficacy of botanicals on incidence of *H. armigera* revealed that at 3 DAS (Days after Spraying), significant minimum number of *H. armigera* larvae (3.07 larvae/ 5 plants) were recorded in Nirgundi. Same trend has been recorded at 7 and 10 DAS (3.25 and 2.87 larvae/ 5 plants, respectively), which confirmed the superiority of Nirgundi @ 5% over other treatments. Followed by calotropis (Table 1).
There was a significant difference in grain yield among different treatments. Highest grain yield was recorded in Nirgundi treated plots (1149.21 kg/ha), which was significantly superior to the rest of the treatments and was followed by Calotropis @ 5% (w/v) (904.50 kg/ha). However, all the treatments were found to be superior over untreated plot (Table 2). Maximum net profit and CBR was obtained from Nirgundi treated plots (Rs 29546.12/ha and 1:9.22), followed by Calotropis @ 5% (w/v) (19212.63/ha and 1:5.99), respectively (Table 2).

4. Discussion
All the plant leaf extract proved their superiority over control in reducing the pest population. It is clear that all the treatments effectively reduced the damage and registered higher grain yield than control. Among treatments, Nirgundi @ 5% (w/v) followed by Calotropis @ 5% (w/v) proved to be the most effective treatments in reducing the damage due to gram pod borer and also recorded higher grain yield (1149.21 and 904.05 kg/ha, respectively). The minimum mean larval population was recorded with nirgundi @ 5% (w/v) at 3, 7, and 10 DAS of 3.07, 3.25, 2.87 larvae/ five plants at 3 sprays with being 35.03 mean percent of population reduction over control. Which is significantly superior to all other treatments. Followed by calotropis @ 5% (w/v), pongamia soap @ 1% (w/v) and arusa @ 5% (w/v), with 26.32, 24.84, 24.41 mean percent of population reduction over control respectively and having population range between (3.47- 3.56 larvae/five plants). The present experimental findings are supported by [2], who reported that 5% extract of *Azadiracta indica*, *Vitex nigundo* and *Adathoda vasica* cause high mortality against *H. armigera*, results are also in agreement with [9], who reported that calotropis followed by nirgundi was the most effective in reducing the larval population of *H. armigera* in groundnut with population reduction 55 and 45 percent respectively. Which also given highest cost benefit ratio. Mehta *et al*.,[5] reported persistence of *V. negundo* against insect pest due to their insecticidal, feeding deterrent and growth inhibition effect. These insecticidal effect due to presence of some active ingredients, like vitricin, flavonoid-pendicularisin, nigundoside in *V. negundo* and adhavasinone in *A.vasica* reported by [7, 8]. These are some other previous studies supporting the present experimental findings, Matharu KS *et al*. [4] reported that 5% leaf extract of *V. negundo* was effective as it reduce the mean population (42.75%) of tomato fruit borer larvae. Yankanchi *et al*. [15] reported that leaf extract *V. negundo* (1%) significantly reduced 40 percent larval population of *H. armigera* in cabbage. Ledji *et al*. [3] reported that nirgundi + cow urine used to control *H*. armigera in chickpea with 67.06% of mortality over control. All the supporting previous studies showed population reduction over control of *H. armigera* by nirgundi range between (40-67.06%) which is higher than present experimental findings, population reduction over control of *H. armigera* by nirgundi is 35.03%

Table 1: Efficacy of botanicals against Gram pod borer, *Helicoverpa armigera* larvae Hub. infesting pigeon pea

Tre. Code	Treatments	Dose	Mean population of *Helicoverpa armigera* larvae /plant					
			Pre-treatment	Day's after spraying			Mean	Mean population reduction over control (%)
				3	7	10		
T_1	Datura (*Datura stramonium* Regel.)	5%(w/v)	3.53 (2.01)	3.62 (2.03)	4.09 (2.14)	3.62 (2.03)	3.78 (2.07)	19.74
T_2	Ghikavera (*Aloe vera* Mill.)	5%(w/v)	4.00 (2.12)	4.02 (2.13)	3.93 (2.11)	3.98 (2.12)	3.98 (2.11)	15.49
T_3	Nirgundi (*Vitex negundo* L.)	5%(w/v)	4.20 (2.17)	3.07 (1.89) L	3.25 (1.94) L	2.87 (1.83) L	3.06 (1.89) L	35.03
T_4	Ritha (*Sapindus mukorossi* L.)	5%(w/v)	4.20 (2.17)	4.00 (2.12)	3.87 (2.09)	3.93 (2.11)	3.93 (2.10)	16.56
T_5	Calotropis (*Calotropis gigantean* L.)	5%(w/v)	4.00 (2.12)	3.76 (2.06)	3.42 (1.98)	3.24 (1.94)	3.47 (1.99)	26.32
T_6	Pongamia (*Pongamia pinnata*)soap	1%(v/v)	4.13 (2.15)	3.82 (2.08)	3.64 (2.04)	3.16 (1.91)	3.54 (2.00)	24.84
T_7	Arusa (*Adathoda vasiva* L.)	5%(w/v)	4.33 (2.20)	3.64 (2.04)	3.67 (2.04)	3.38 (1.97)	3.56 (2.01)	24.41
T_8	Control	5%(w/v)	4.87 (2.37)	4.73 (2.29) H	4.60 (2.26) H	4.80 (2.30) H	4.71 (2.28) H	
	SEM±		0.09	0.04	0.04	0.04	0.03	
	CD at 5%		NS	0.12	0.11	0.17	0.08	

Figures in parentheses are √**x** square root transformed values, NS = Non-significant, **L**- Lowest, **H**- Highest
***** Mean of three sprayings

Table 2: Efficacy and economics of botanicals, against pigeonpea pod borer complex

Tr. Code	Treatments	Dose	Grain yield (kg/ha)	Increase in yield over control (Kg/ha)	Cost of treatment*	Cost of increased yield over control @4215/-Quintal	Net profit (Rs/ha)	Cost Benefit Ratio (CBR)
T_1	Datura (*Datura stramonium* Regel.)	5% (w/v)	878.41	506.19	3204	21335.90	18131.90	1:5.65
T_2	Ghikavera (*Aloe vera* Mill.)	5% (w/v)	493.33	121.11	3204	5104.78	1900.78	1:0.59
T_3	Nirgundi (*Vitex negundo* L.)	5% (w/v)	1149.21	776.99	3204	32750.12	29546.12	1:9.22
T_4	Ritha (*Sapindus mukorossi* L.)	5% (w/v)	614.44	242.22	3204	10209.57	7005.57	1:2.18
T_5	Calotropis (*Calotropis gigantean* L.)	5% (w/v)	904.05	531.83	3204	22416.63	19212.63	1:5.99
T_6	Pongamia (*Pongamia pinnata)* soap	1% (w/v)	721.67	400.00	5079	16860.00	11781.00	1:2.31
T_7	Arusa (*Adathoda vasiva* L.)	5% (w/v)	733.81	361.59	3204	15239.75	12035.75	1:3.75
T_8	Control		372.22	-	-	-	-	-

*Labour rate per day = Rs. 267/-
2 labours required for spraying 1 ha of pigeonpea crop in 1 day
2 labours required for preparation of different treatments for 1 ha
Cost of pongamia soap = Rs. 125 /- per kg
1kg per ha is recommended dose of pongamia soap.
Remaining botanical raw materials are available at free of cost.

5. Conclusion

From the above study it can be concluded that nirgundi @ 5% leaf extract have grater potent to control gram pod borer. Further, the present work sufficiently gives an indication that the botanicals have been found to be very promising. This work should be further continued so as to study the efficacy of botanicals against the major insect pests and their impact on potent parasite/s and predator/s so that they can be incorporated in the Integrated Pest Management modules.

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