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Field efficacy of plant leaf extracts, cow urine and in combination against pod borer complex in pigeonpea (*Cajanus cajan* (L) Millsp.)

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Abstract
An experiment was carried out at experimental field of Department of Entomology, Live Stock Farm, Adhartal, JNKVV, Jabalpur (M.P.) during *kharif* season 2015-2016. To Studied the "Field Efficacy of Plant Leaf Extracts, Cow Urine and in Combination Against Pod Borer Complex in Pigeon pea (*Cajanus Cajan* (L) Millsp.)". Result showed that all the plant leaf extract, cow urine and in combination proved their superiority over control in reducing the pest population by different treatments. Treatments, Madar + Cow urine @ 5% (w/v) followed by Lantana + Cow urine @ 5% (w/v) proved to be the most effective treatments in reducing the damage due to pod borer complex i.e. Pod bug *Clavigralla gibbosa* Spinola, Green stink bug *Nezara viridula* Linn, Gram pod borer *Helicoverpa armigera* (Hub.) and Tur plume moth *Exelastis atomosa* (W.). Other treatments Nirgundi+ Cow urine @ 5% (w/v), Datura+ Cow urine @ 5% (w/v), Cow urine @ 5% (v/v), Madar @ 5% (w/v), Nirgundi @ 5% (w/v), Arusa@ 5% (w/v), Arusa+ Cow urine @ 5% (w/v), Datura@ 5% (w/v), Lantana @ 5% (w/v) are found to be least effective but superior over control.

Keywords: Plant leaf extracts, cow urine, pod borer complex, pigeon pea

Introduction
Pigeonpea (*Cajanus cajan* (L) *Millsp.*) is an important multi-use shrub legume of the tropics and subtropics. The crop originated from India and moved to Africa about 4,000 years ago. Unlike other grain legumes, pigeonpea production is concentrated in developing countries, particularly in a few South and Southeast Asia and Eastern and Southern African countries. It is the preferred pulse crop in dryland areas where it is intercropped or grown in mixed cropping systems with cereals or other short duration annuals without significantly reducing the yield Joshi *et al*. [16]. Its grain is of high nutritional value with high protein content that ranges from 21% to over 25% making it very valuable for improving food security and nutrition for many poor families who cannot afford dairy and meat-based diet Kimani [18].
Pigeonpea has a wide range of products, including the dried seed, pods and immature seeds used as green vegetables, leaves and stems used for fodder and the dry stems as fuel. It also improves soil fertility through nitrogen fixation as well as from the leaf fall and recycling of the nutrients Snapp *et al*. [30]. It is an important pulse crop that performs well in poor soils and regions where moisture availability is unreliable or inadequate.
Pigeonpea a tropical grain legume, mainly grown in India and ranks second in area and production and contributes about 90% of the world's pulse production. In India during 2014 pigeonpea was cultivated in an area of 3.88 million ha and production of about 3.29 million tonnes, with a productivity of 849 kg /ha DES [8].
In the country, the crop is extensively grown in Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Gujarat. Uttar Pradesh has a unique distinction of contributing about 20% production in the country followed by Madhya Pradesh Sahoo and Senapati [24].
In Madhya Pradesh, during 2014 pigeonpea was cultivated in an area of about 0.49 million hectare with production of 0.46 million tonnes and 955 kg/ha productivity DES [8]. In Jabalpur, during 2013-14 it was cultivated in an area of 10,930 hectare with a total production of 9,700 tonnes and 886 kg/ha productivity, www.mpkrishi.org [31].
Though India is the largest producer of pigeonpea, the productivity has always been a great concern, and the productivity of pigeonpea has not increased considerably during last decade. The damage caused by insect pests is one of the major reasons of low productivity.

They key pests include pod borer complex *viz.* gram pod borer (*Helicoverpa armigera* Hubner), plume moth (*Exelastis atomosa* Walsingham*)*, pod fly (*Melanagromyza obtusa* Malloch) and pod bug (*Clavigralla gibbosa* Spinola) which cause considerable losses in grain yield ranging from 30 to 100% Satpute and Barkhade [25].

Pod infesting insect pests recorded at Jabalpur are gram pod borer (*H. armigera* Hubner*)*, pod bug (*C. gibbosa* Spinola), pod fly (*M. obtusa* Malloch) and plume moth (*E. atomosa* Walsingham). Out of the four pests, *M. obtusa* has established as the most important pest on the basis of pod and grain damage which range from about 55 to 85 and 29 to 63 percent, respectively Landge [20]. Pod fly now has become an important biotic constraint in increasing the production and productivity under subsistence farming conditions, irrespective of agro ecological zones. The survey of Marathwada region of Maharashtra during 2007–08 revealed that the damage by pod fly ranged from 25.5 to 36% Anonymous [1]. The estimates of avoidable losses due to pod borer complex, mainly pod fly and *H. armigera* were 43.5 and 30.2%, respectively Anonymous [2].

The use of synthetic insecticides in crop protection programmes around the world has resulted in disturbances of the environment, pest resurgences, pest resistance to pesticides and lethal effect to non target organisms in the agro-ecosystems in addition to direct toxicity to users.Contrary to the problems associated with the use of synthetic chemicals, botanicals are environmentally non-pollutive, renewable, inexhaustible, indigenously available, easily accessible, largely non-phytotoxic, systemic ephemeral thus readily biodegradable, relatively cost effective and hence find a very promising role as a plant protectant in the strategy of integrated pest management Saxena *et al.* [26].

Traditionally cow urine has been used in medicines in developing and less developed countries. Only recently, its properties as pest control agent have been exploited in plant protection. It is mixed generally with cow dung or plant parts and plant-derived products as these combinations proved effective and cheaper than synthetic pesticides. The action of bioactive constituents is exerted on insect development and survival, cow urine can therefore be considered as a potential biopesticide Gahukar [10].

In fact, cow urine is used by the farmers as an effective indigenous method to control crop pests Banjo *et al.* [4] and spraying of the cow urine has been recommended to minimize the harmful effects of synthetic pesticides Chauhan and Singhal [5].

With advancement in plant protection technology, farmers expect availability of formulated biopesticides from indigenous plants that can be effective and economical as an alternative to costly and hazardous chemical pesticides Gahukar [9].

In the present study indigenous biopesticide formulations comprising of easily accessible botanicals along with cow urine, will be evaluated for its efficacy against insect pests of pigeonpea under field condition.

Keeping in mind the above facts the present investigation was done to observe the “Field Efficacy of Plant Leaf Extracts, Cow Urine and in Combination Against Pod Borer Complex in Pigeonpea (*Cajanus Cajan* (L) Millsp.)”

Methods and Materials

The present investigation entitled, “Field Efficacy of Plant Leaf Extracts, Cow Urine and in Combination Against Pod Borer Complex in Pigeonpea (*Cajanus Cajan* (L) Millsp.)” was carried out at experimental field of Department of Entomology, Live Stock Farm, Adhartal, JNKVV, Jabalpur (M.P.) during *kharif* season 2015-2016.

Table 1: Treatment details

Tr. Nos.	Treatments	Dose
T_1	Arusa (*Adathoda vasiva* L.)	5%(w/v)*
T_2	Madar (*Calotropis gigantea* L.)	5%(w/v)
T_3	Datura (*Datura stramonium* Regel.)	5%(w/v)
T_4	Lantana (*Lantana camara* L.)	5%(w/v)
T_5	Nirgundi (*Vitex negundo* L.)	5%(w/v)
T_6	Cow urine	5%(v/v)**
T_7	Arusa+ Cow urine ($T_1 + T_6$)	5%(w/v)+5%(v/v)
T_8	Madar + Cow urine ($T_2 + T_6$)	5%(w/v)+5%(v/v)
T_9	Datura+ Cow urine ($T_3 + T_6$)	5%(w/v)+5%(v/v)
T_{10}	Lantana+ Cow urine ($T_4 + T_6$)	5%(w/v)+5%(v/v)
T_{11}	Nirgundi+ Cow urine ($T_5 + T_6$)	5%(w/v)+5%(v/v)
T_{12}	Control	-

*w/v: weight (g)/volume (ml) **v/v: volume/volume (ml)

Preparation of leaf extracts 5%:

Fresh leaves of the respective plants were collected and brought to laboratory, washed thoroughly 3-4 times with tap water. After that, they were chopped into small pieces with knife. To get one litre of 5% extract, 50 gram of the chopped material was soaked overnight in1 litre water, squeezed through muslin cloth and residue was smashed in mortar and pestle, again extracted and filtered through muslin cloth and the volume was made up to one litre to get 5 percent leaf extract for spraying.

Preparation of 5% cow urine solution:

Fresh cow urine was collected from Dairy farm, JNKVV, Jabalpur. 50ml of cow urine was mixed in 1 litre water to get 5% cow urine solution.

Methodology:

Pre treatment observations were recorded 24 hours before spray while post treatment observations were recorded at 3, 7 and 10 days after spraying on 5 plants per treatment per replication. Observations on different insects were recorded as follows:

Gram pod borer larvae, plume moth (larvae and pupae), green stink bug (nymph and adult) on per plant basis whereas pod fly (maggot and pupae), pod bug egg masses on 25 pods / 5 plants. At harvest pod and grain damage caused by different pod borer complex were recorded by destructive method technique .Grain yield of each plot were recorded.

Pods of 5 plants were collected from each plot / treatment per replication at maturity. 110 pods (from pods of 5 plants) were observed and on the basis of symptoms or damage caused by different pod borer complex were identified, counted and percentage pod and grain damage was worked out.

The pigeonpea pods and grains were classified as damage caused by *M. obtusa*, *H. armigera*, *E. atomosa* and *C. gibbosa* on the basis of characteristic distinguishing symptoms as summarized below:

The symptoms of the pod damage caused by *M. obtusa* could be distinguished by the presence of tiny pin head exit holes on the pod, while in case of grain damage, the size of the grains were reduced and galleries were formed on the grains as a result of feeding by the maggot. Pupae or pupal cases were also found embedded with damaged grains Singh and van Emerden [29].

The damage due to *H. armigera* could be distinguished by the presence of large sized holes on the pods. The grains were partially or wholly eaten by the larvae Saxena [27].
The damage due to *E. atomosa* could be distinguished by the presence of tiny irregular holes on the pods and size of the holes was smaller than that caused by *H. armigera*. The damaged grains were covered with fungal growth due to larval faecal deposition Ayyar [3].
The damage due to *C. gibbosa* could be distinguished by the twisting of pods and imparting a sickly appearance with shriveled grains, followed by reduction in the grain size that can be crushed to powder when gently pressed between finger tips Das [6].

Results
Result showed that all the plant leaf extract, cow urine and in combination proved their superiority over control in reducing the pest population by different treatments. Treatments, Madar + Cow urine @ 5% (w/v) followed by Lantana + Cow urine @ 5% (w/v) proved to be the most effective treatments in reducing the damage due to pod borer complex.

Pre- treatment:
Differences in the mean of pod bug *C. gibbosa*, *N. Viridula* population (nymph + adult), *H. armigera* mean larval population and *E. atomosa* mean population (larvae + pupae) per five plants among different treatments were not significant, indicating more or less uniform distribution of the pest in the experimental field.

Tur pod bug, *Clavigralla gibbosa* Spinola (Table 2)
On the basis of overall mean, the differences in the mean pod bug population among different treatments were significant. Among the treatments, Madar + Cow urine @ 5% (w/v) (T_8) was found to be most effective as it recorded lowest bug population (4.04 bugs /5 plants). This was followed by treatment Lantana+ Cow urine @ 5% (w/v) (T_{10}) (4.11 bugs / 5 plants), but both were at par with each other. The next effective treatments were Nirgundi+ Cow urine @ 5% (w/v) (T_{11}) (4.37 bugs / 5 plants) and Datura+ Cow urine @ 5% (w/v) (T_9) (4.48 bugs/5 plants), but they did not differ significantly from each other. The next effective treatments were Cow urine @ 5% (v/v) (T_6) (4.56 bugs / 5 plants) followed by Madar @ 5% (w/v) (T_2) (4.70 bugs /5 plants), but were at par with each other. The next effective treatment was Nirgundi @ 5% (w/v) (T_5) (4.74 bugs/5 plants) and it differed significantly from Arusa@ 5% (w/v) (T_1) (4.96 bugs/5 plants), Arusa+ Cow urine @ 5% (w/v) (T_7) (5.0 bugs / 5 plants) and Datura@ 5% (w/v) (T_3) (5.04 bugs/5 plants). The least effective treatment was Lantana @ 5% (w/v) (T_4) (5.33 bugs/5 plants) and was significantly superior than control (T_{12}) (9.22 bugs/5plants).

Green stink bug, *Nezara viridula* Linn. (Table 3)
On the basis of overall mean, the differences in the mean green stink bug population among different treatments were significant. Among the treatments, Madar + Cow urine @ 5% (w/v) (T_8) was found to be most effective as it recorded lowest bug population (6.81 bugs / 5 plants) and was significantly superior than other treatments. This was followed by Lantana+ Cow urine @ 5% (w/v) (T_{10}) (8.0 bugs / 5 plants), but they differed significantly from each other. The next effective treatments were Datura+ Cow urine @ 5% (w/v) (T_9) (8.70 bugs / 5 plants) and Nirgundi+ Cow urine @ 5% (w/v) (T_{11}) (8.70 bugs / 5 plants), but were at par with each other. The next effective treatments were Cow urine @ 5% (v/v) (T_6) (9.37 bugs / 5 plants), Madar @ 5% (w/v) (T_2) (9.41 bugs / 5 plants) and Nirgundi @ 5% (w/v) (T_5) (9.52 bugs / 5 plants), but they did not differ significantly from each other. The next effective treatments were Datura @ 5% (w/v) (T_3) (9.89 bugs / 5 plants) and Arusa@ 5% (w/v) (T_1) (9.93 bugs / 5 plants), but significant differences were not observed between them. The least effective treatments were Lantana @ 5% (w/v) (T_4) (10.33 bugs / 5 plants) and Arusa+ Cow urine @ 5% (w/v) (T_7) (10.37 bugs / 5 plants), but non - significant differences were observed between them, but both were significantly superior to control (T_{12}) (13.85 bugs / 5 plants).

Gram pod borer, *Helicoverpa armigera* Hub. (Table 4)
On the basis of over all mean, the differences in the mean *H. armigera* larval population among different treatments were significant. Among the treatments, Madar + Cow urine @ 5% (w/v) (T_8) was found to be most effective as it recorded lowest larval population (2.81 larvae / 5 plants) and was significantly superior than other treatments. This was followed by Lantana+ Cow urine @ 5% (w/v)(T_{10}) (3.19 larvae / 5 plants), but they differed significantly from each other. The next effective treatments were Nirgundi+ Cow urine @ 5% (w/v) (T_{11}) (3.63 larvae / 5 plants) and Datura+ Cow urine @ 5% (w/v) (T_9) (3.67 larvae / 5 plants), but they did not differ significantly from each other. The next effective treatments were Cow urine @ 5% (v/v) (T_6) (3.93 larvae / 5 plants) and Madar @ 5% (w/v) (T_2) (3.96 larvae / 5 plants), but both were at par with each other. The next effective treatments were Nirgundi @ 5% (w/v) (T_5) (4.22 larvae / 5 plants), Arusa@ 5% (w/v) (T_1) (4.30 larvae / 5 plants) and Datura @ 5% (w/v) (T_3) (4.30 larvae / 5 plants), but they did not differ significantly from each other. The next effective treatment was Arusa+ Cow urine@ 5% (w/v) (T_7) (4.44 larvae / 5 plants) and was significantly superior them Lantana @ 5% (w/v) (T_4) (4.63 larvae / 5 plants) and control (T_{12}) (5.0 larvae / 5 plants).

Tur plume moth, *Exelastis atomosa* Wals. (Table 5)
On the basis of overall mean, the differences in the mean Tur plume moth population among different treatments were significant. Among the treatments, Madar + Cow urine @ 5% (w/v) (T_8) was found to be most effective as it recorded lowest moth population (1.81 plume moth larvae +pupae / 5 plants). This was followed by Lantana+ Cow urine @ 5% (w/v) (T_{10}) (2.07 plume moth larvae +pupae/ 5 plants), but they differed significantly from each other. The next effective treatments were Datura+ Cow urine @ 5% (w/v) (T_9) (2.37 plume moth larvae +pupae/ 5 plants) and Nirgundi+ Cow urine @ 5% (w/v) (T_{11}) (2.37 plume moth larvae +pupae/5 plants), but non - significant differences were observed between them. The next effective treatments were Cow urine @ 5% (v/v) (T_6) (2.59 plume moth larvae +pupae / 5 plants) and Madar @ 5% (w/v) (T_2) (2.63 plume moth larvae +pupae/ 5 plants), but were at par with each other. The next effective treatments were Nirgundi @ 5% (w/v) (T_5) (2.81 plume moth larvae +pupae/5 plants), Arusa@ 5% (w/v) (T_1) (2.85 plume moth larvae +pupae/5 plants) and Datura @ 5% (w/v) (T_3) (2.85 plume moth larvae +pupae/5 plants), but they did not differ significantly from each other. The least effective treatments were Lantana @ 5% (w/v) (T_4) (3.11 plume moth larvae +pupae / 5 plants) and Arusa+ Cow urine@ 5% (w/v) (T_7) (3.11 plume moth larvae +pupae/ 5 plants), but non -

significant differences were observed between them, but both were significantly superior to control (T_{12}) (4.11 plume moth larvae+pupae/5plants).

Discussion

Several workers have also reported similar findings, that application of botanical and cow urine and in combination effectively reduced the insect pest damage *viz.* mustard aphid Gupta [13], soybean stem fly Gupta and Yadav [12], sorghum shoot fly Shekharappa and Balikai [28], diamond back moth Yankanchi and Patil [32], tobacco caterpillar Khetagoudar and Kandagal [17], *Spilarctia oblique* Geetanjaly and Tiwari [11], tea mosquito bug Deka *et al.* [7] and gram pod borer Gupta [14], Ramya *et al.* [23], Hegde and Nandihalli [15], Ramya and Jayakumararaj [22], Ladji *et al.* [19] and Prasad and Purohit [21], respectively with increased grain yield than control.

The present findings are in conformity with the findings of Shekharappa and Balikai [28] and Ladji *et al.* [19]. They also reported that combination of botanicals with cow urine were found to be most effective treatments in reducing sorghum shoot fly and *H. armigera* damage, respectively and obtained higher yields.

Table 2: Efficacy of plant leaf extracts, cow urine and in combination against Pod bug, *Clavigralla gibbossa* infesting pigeonpea

Tr. Code	Treatments	Dose	Mean population of pod bug *Clavigralla gibbossa* (nymph + adult) /5 plants				
			Pre-treatment	Days after spraying*			Mean
				3	7	10	
T1	Arusa (*Adathoda vasiva* L.)	5%(w/v)	4.00 (2.11)	5.22 (2.38)	5.11 (2.36)	4.56 (2.24)	4.96 (2.33)
T2	Madar (*Colotropis gigantean* L.)	5%(w/v)	5.00 (2.34)	5.22 (2.39)	4.89 (2.32)	4.00 (2.10)	4.70 (2.27)
T3	Datura (*Datura stramonium* Regel.)	5%(w/v)	4.00 (2.11)	5.67 (2.48)	5.11 (2.36)	4.33 (2.18)	5.04 (2.34)
T4	Lantana (*Lantana camara* L.)	5%(w/v)	4.33 (2.19)	5.56 (2.45)	5.33 (2.41)	5.11 (2.36)	5.33 (2.41)
T5	Nirgundi (*Vitex negundo* L.)	5%(w/v)	4.33 (2.19)	5.11 (2.36)	5.00 (2.34)	4.11 (2.12)	4.74 (2.27)
T6	Cow urine	5%(v/v)	4.00 (2.12)	5.11 (2.37)	4.67 (2.27)	3.89 (2.07)	4.56 (2.23)
T7	Arusa+ Cow urine	5%(w/v)+5%(v/v)	3.67 (2.04)	5.11 (2.36)	5.11 (2.36)	4.78 (2.29)	5.00 (2.34)
T8	Madar + Cow urine	5%(w/v)+5%(v/v)	4.33 (2.20)	4.89 (2.32)L	4.11 (2.14)L	3.11 (1.84)L	4.04 (2.10)L
T9	Datura+ Cow urine	5%(w/v)+5%(v/v)	4.00 (2.11)	5.22 (2.39)	4.67 (2.27)	3.56 (1.97)	4.48 (2.21)
T10	Lantana+ Cow urine	5%(w/v)+5%(v/v)	4.67 (2.26)	4.89 (2.32)L	4.22 (2.17)	3.22 (1.88)	4.11 (2.12)
T11	Nirgundi+ Cow urine	5%(w/v)+5%(v/v)	4.33 (2.20)	4.89 (2.32)L	4.67 (2.27)	3.56 (1.97)	4.37 (2.18)
T12	Control	-	4.67 (2.27)	8.56 (2.95)H	9.11 (3.04)H	10.00 (3.20)H	9.22 (3.06)H
	SEM ±		0.10	0.04	0.13	0.15	0.06
	CD at 5%		NS	0.13	0.38	0.46	0.17

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

Table 3: Efficacy of plant leaf extracts, cow urine and in combination against Green stink bug, *Nezara viridula* infesting pigeonpea

Tr. Code	Treatments	Dose	Mean population of *Nezara viridula* (nymph + adult) /5 plants				
			Pre-treatment	Days after spraying*			Mean
				3	7	10	
T1	Arusa (*Adathoda vasiva* L.)	5%(w/v)	10.33(3.29)	11.00(3.39)	9.89(3.21)	8.89(3.02)	9.93(3.21)
T2	Madar (*Colotropis gigantean* L.)	5%(w/v)	10.00(3.24)	10.44(3.30)	9.33(3.11)	8.44(2.95)	9.41(3.12)
T3	Datura (*Datura stramonium* Regel.)	5%(w/v)	11.00(3.38)	10.78(3.35)	9.89(3.21)	9.00(3.04)	9.89(3.20)
T4	Lantana (*Lantana camara* L.)	5%(w/v)	11.33(3.44)	11.22(3.42)	10.33(3.28)	9.44(3.12)	10.33(3.28)
T5	Nirgundi (*Vitex negundo* L.)	5%(w/v)	11.67(3.49)	10.67(3.34)	9.33(3.10)	8.56(2.96)	9.52(3.13)
T6	Cow urine	5%(v/v)	10.67(3.34)	10.33(3.29)	9.56(3.15)	8.22(2.89)	9.37(3.11)
T7	Arusa+ Cow urine	5%(w/v)+5%(v/v)	10.33(3.29)	11.11(3.40)	10.44(3.30)	9.56(3.14)	10.37(3.28)
T8	Madar + Cow urine	5%(w/v)+5%(v/v)	11.67(3.49)	8.11(2.90)L	6.89(2.64)L	5.44(2.32)L	6.81(2.62)L
T9	Datura+ Cow urine	5%(w/v)+5%(v/v)	10.67(3.34)	10.00(3.23)	8.56(2.97)	7.56(2.75)	8.70(2.98)
T10	Lantana+ Cow urine	5%(w/v)+5%(v/v)	11.00(3.39)	9.22(3.10)	8.11(2.88)	6.67(2.53)	8.00(2.84)
T11	Nirgundi+ Cow urine	5%(w/v)+5%(v/v)	10.67(3.34)	9.89(3.21)	8.67(2.99)	7.56(2.74)	8.70(2.98)
T12	Control	-	11.33(3.43)	13.11(3.68)H	13.67(3.75)H	14.78(3.88)H	13.85(3.77)H
	SEM ±		0.10	0.08	0.08	0.11	0.06
	CD at 5%		NS	0.23	0.33	0.32	0.17

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

Table 4: Efficacy of plant leaf extracts, cow urine and in combination against Gram borer pod, *Helicoverpa armigera* infesting pigeonpea

Tr. Code	Treatments	Dose	Mean population of *Helicoverpa armigera* larvae /5 plants				
			Pre-treatment	Days after spraying*			Mean
				3	7	10	
T1	Arusa (*Adathoda vasiva* L.)	5%(w/v)	4.33(2.19)	4.66(2.25)	4.33(2.19)	4.00(2.09)	4.30(2.17)
T2	Madar (*Colotropis gigantean* L.)	5%(w/v)	4.33(2.20)	4.44(2.21)	3.89(2.08)	3.56(2.0)	3.96(2.09)
T3	Datura (*Datura stramonium* Regel.)	5%(w/v)	4.67(2.27)	4.56(2.24)	4.33(2.18)	4.00(2.11)	4.30(2.18)
T4	Lantana (*Lantana camara* L.)	5%(w/v)	4.33(2.20)	4.78(2.29)	4.67(2.26)	4.44(2.22)	4.63(2.25)
T5	Nirgundi (*Vitex negundo* L.)	5%(w/v)	4.00(2.12)	4.67(2.27)	4.11(2.14)	3.89(2.08)	4.22(2.16)
T6	Cow urine	5%(v/v)	4.33(2.20)	4.33(2.19)	3.89(2.08)	3.56(2.0)	3.93(2.09)
T7	Arusa+ Cow urine	5%(w/v)+5%(v/v)	3.67(2.04)	4.67(2.27)	4.44(2.22)	4.22(2.17)	4.44(2.22)
T8	Madar + Cow urine	5%(w/v)+5%(v/v)	4.33(2.19)	3.33(1.94)L	2.78(1.79)L	2.33(1.65)L	2.81(1.79)L

T9	Datura+ Cow urine	5%(w/v)+5%(v/v)	4.33 (2.19)	4.22(2.16)	3.56(2.0)	3.22(1.90)	3.67(2.02)
T10	Lantana+ Cow urine	5%(w/v)+5%(v/v)	4.33(2.19)	3.78(2.06)	3.11(1.88)	2.67(1.73)	3.19(1.89)
T11	Nirgundi+ Cow urine	5%(w/v)+5%(v/v)	4.00(2.11)	4.11(2.14)	3.56(1.99)	3.22(1.90)	3.63(2.01)
T12	Control	-	4.00(2.11)	5.00(2.34)H	5.00(2.34)H	5.00(2.33)H	5.00(2.34)H
	SEM±		0.16	0.05	0.05	0.04	0.02
	CD at 5%		NS	0.15	0.14	0.12	0.08

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

Table 5: Efficacy of plant leaf extracts, cow urine and in combination against Tur plume moth, *Exelastis atomosa* infesting pigeonpea

Tr. Code	Treatments	Dose	Mean population of tur plume moth(larvae + pupae) / 5 plants				
			Pre-treatment	Days after spraying*			Mean
				3	7	10	
T1	Arusa (*Adathoda vasiva* L.)	5%(w/v)	2.67(1.77)	3.00(1.86)	2.89(1.81)	2.67(1.75)	2.85(1.81)
T2	Madar (*Colotropis gigantean* L.)	5%(w/v)	2.33(1.68)	2.78(1.79)	2.67(1.76)	2.44(1.70)	2.63(1.75)
T3	Datura (*Datura stramonium* Regel.)	5%(w/v)	2.00(1.56)	3.00(1.86)	2.89(1.82)	2.67(1.77)	2.85(1.81)
T4	Lantana (*Lantana camara* L.)	5%(w/v)	2.33(1.68)	3.22(1.92)	3.11(1.89)	3.00(1.87)	3.11(1.89)
T5	Nirgundi (*Vitex negundo* L.)	5%(w/v)	2.00(1.58)	3.00(1.86)	2.78(1.81)	2.67(1.77)	2.81(1.81)
T6	Cow urine	5%(v/v)	2.33(1.66)	2.78(1.79)	2.56(1.74)	2.44(1.70)	2.59(1.74)
T7	Arusa+ Cow urine	5%(w/v)+5%(v/v)	2.00(1.58)	3.22(1.92)	3.11(1.88)	3.00(1.86)	3.11(1.89)
T8	Madar + Cow urine	5%(w/v)+5%(v/v)	2.33(1.7)	2.11(1.60)L	1.78(1.49)L	1.56(1.42)L	1.81(1.50)L
T9	Datura+ Cow urine	5%(w/v)+5%(v/v)	2.33(1.68)	2.56(1.73)	2.33(1.68)	2.22(1.64)	2.37(1.68)
T10	Lantana+ Cow urine	5%(w/v)+5%(v/v)	2.67(1.77)	2.22(1.63)	2.11(1.60)	1.89(1.53)	2.07(1.59)
T11	Nirgundi+ Cow urine	5%(w/v)+5%(v/v)	2.00(1.58)	2.56(1.74)	2.33(1.66)	2.22(1.65)	2.37(1.68)
T12	Control	-	2.33(1.68)H	3.78(2.06)H	4.33(2.19)H	4.22(2.17)H	4.11(2.14) H
	SEM ±		0.11	0.03	0.03	0.04	0.02
	CD at 5%		NS	0.08	0.11	0.13	0.06

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

Conclusion: Result of the experiment all the plant leaf extract, cow urine and in combination proved their superiority over control in reducing the pest population by different treatments. Treatments, Madar + Cow urine @ 5% (w/v) followed by Lantana + Cow urine @ 5% (w/v) proved to be the most effective treatments in reducing the damage due to pod borer complex i.e. Pod bug *Clavigralla gibbosa* Spinola, Green stink bug *Nezara viridula* Linn, Gram pod borer *Helicoverpa armigera* (Hub.) and Tur plume moth *Exelastis atomosa* (W.). Other treatments Nirgundi+ Cow urine @ 5% (w/v), Datura+ Cow urine @ 5% (w/v), Cow urine @ 5% (v/v), Madar @ 5% (w/v), Nirgundi @ 5% (w/v), Arusa@ 5% (w/v), Arusa+ Cow urine @ 5% (w/v), Datura@ 5% (w/v), Lantana @ 5% (w/v) are found to be least effective but superior over control.

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