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**Original Research Article**

# Effects of Botanicals on Mortality of Pulse Beetle, *Callosobruchus* spp. in Stored Pigeon Pea

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Pulse beetle, pigeon pea, botanicals, mortality

**A B S T R A C T**

The laboratory investigation entitled "Efficacy of botanicals against pulse beetle in stored pigeon pea" was conducted at Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS) during the month of June to December 2015. The experiment was laid in Completely Randomized Design with seven treatments, replicated thrice. One kg of pigeon pea seed variety PKV-TARA was taken for each replication of treatment. The treatments included were *Acorus calamus* rhizome powder @ 10gm/kg seed, black pepper seed powder @ 3 gm/kg seed, castor seed oil @ 5 ml/kg seed, ground nut seed oil @ 5 ml/kg seed, turmeric rhizome powder @ 10 gm/kg seed, mustard seed oil @ 5ml/kg seed and untreated control. Result revealed that *Acorus calamus* rhizome powder @ 10gm/kg seed, black pepper powder @ 3 gm/kg seed and turmeric rhizome powder @ 10 gm/kg seed, ground nut seed oil @ 5 ml/kg seed proved best in giving highest per cent morality up to six months storage period. The per cent mortality was significantly maximum (70%) in treatments *Acorus calamus* rhizome powder @ 10 gm/kg seed, black pepper seed powder @ 3 gm/kg seed (63.33), turmeric rhizome powder @ 10 gm/kg seed (30%), in first month while in six month highest mortality was recorded in treatment *Acorus calamus* rhizome powder 10 gm/kg seed (30.00%) followed by black pepper seed powder @ 3 gm/kg seed (30%) and turmeric rhizome powder @ 10 gm/kg seed (10%). The descending order of remaining treatments are, ground nut seed oil, castor seed oil, and mustard seed oil they were also found to be significant in recording percent mortality as compared to control. However, Acorus calamus rhizome powder and black pepper powder recorded the highest percent mortality of the pulse beetle.

## Introduction

Pulses are one of the important group of worldwide crops and play a major role in the daily diet of low-income groups of people. India has the largest producer of pulses in world it has 23.63 million ha area and 14.76 metric ton production (Anonymous, 2015a). Among the pulses, Pigeon pea, *Cajanus cajan (L.)* is one of the important pulse crop. India is the largest producer of Pigeon pea in world with area of 4.09 million hectares with a production of 2.75 million tons. In Maharashtra, Pigeon pea is grown in an area of 10.97 lakh ha with a production of 9758 hundred tonnes (Anonymous, 2015b). In India Gujar and Yadav (1978) recorded 32.2 to 55.7 per cent loss in seed weight and 17.0

to 53.5 per cent loss in protein content. In case of severe infestation 100 per cent damage is caused by the pest (Pruthi and Singh, 1950). It is well known fact that food constituents play a vital role in the survival and reproduction potential of the insects.

The grain characters, which also interfere the normal physiology or feeding of the insect, affects the biology of the pest adversely and these make a variety resistant to insect attack.

Prevention of loss in stored product due to insect's pest is one of most important aspects in Indian agriculture. For the control of stored grain insect pests, the use of insecticidal protectants is a common preventative measure to protect store grain from insect damage, but these chemicals have lost their effectiveness due to development of resistance in *Callosobruchus chinensis*. Moreover, toxic residues of these chemicals maypose risk to human health and the environment. Therefore, botanicals (plant powders) are used as grain protectants as these have insecticidal properties against stored grain insect pests (Bakkali *et al.,* 2008) as well as safer for human health and the environment.

Keeping all those things in the view the following investigation "Efficacy of botanicals against pulse beetle in stored pigeon pea" has been undertaken.

## Materials and Methods

A Laboratory experiment was conducted on "Efficacy of botanicals against pulse beetle in stored pigeon pea" at the laboratory of AICRP on PHET and Seed Technology Research Unit (STRU), Dr.P.D.K.V. Akola (M.S) under laboratory conditions lasting for a period of 180 days during year 2015-16.

### Rearing of test Insect in the laboratory

To obtain adequate culture of *Callosobruchus chinensis.* The adults were collected from the Pulses Research Unit, Dr. PDKV, Akola along with pulses on which eggs were laid by pulse beetle. These eggs laid seeds were kept in plastic container covered with muslin cloth and allowed the adult to emerge from the seeds. Adults thus collected, were directly introduced into pigeon pea variety PKV-TARA in eight plastic containers and allowed them to lay eggs for seven days. Then adults were transferred into another set of containers and such procedure was repeated. At the time of release of beetle in treatments, the cultures were sieved before four days to obtain 0-4 day's old beetles. These cultures were grown in laboratory conditions of temperature 27±2'C and relative humidity 70-80 %.

### External determination of male and female bruchids

Males and females can be identified on the basis of their antennae. Males are having strongly serrate antennae and pygidium without dark patches. While females are having weakly serrate antennae and pygidium with two dark patches, one on each side of the mid-line. Generally female is slightly larger than male. The length of male adult measured with an average 3.25 ± 0.23 mm and breadth is 2.16 ± 0.05 mm whereas the length and breadth of female adult measured with an average 3.60 ± 0.08 mm and 2.02 ± 0.04 mm respectively (Devi and Devi, 2013).

### Application of treatment

Mass culture of *C. Chinensis* was maintained in the laboratory for experimental purpose. One kg of freshly

harvested certified seed with very high percentage of germination and low moisture content (<10%) was taken for each treatment. Required quantity of botanicals and oils were taken. To treat the seed with oil and powder of various plant products 1000 g of seeds for each treatment were filled in high density polythene bag of 1 kg capacity and the plant products were mixed thoroughly by shaking the polythene bag. The procedures were repeated thrice for each treatment. One kg of treated seed was packed in two kg capacity gunny bag and was stored under ambient condition.

The observation were recorded at monthly interval on seed germination, percent pulse grain damage, percent grain weight loss and seed vigour. 100 gm of pigeon pea seed were taken out from treated seed. To study the different observation 5 pairs of adult bruchid (newly emerged) were released in 100 gm treated sample and the observations were recorded in each month.

First observation was recorded 48 hours after release of insects on per cent mortality of beetles. Moribund insects were taken as dead. After 14 days of release of insects, the plastic container of 250 gm capacity were observed and eggs laid on seeds were recorded. Again plastic container of 250 gm capacity were made close and after the 20 days of release, the vials were observed daily and recorded adult emergence till no emergence.

### Per cent mortality

Number of survived and dead insects were collected, counted and recorded after 48 hrs after release of insects. Moribund insects were taken as dead. Per cent mortality of *Callosobruchus chinensis* was calculated with the help of following formula.

$$\text{Per cent mortality} = \frac{\text{No. of insect died}}{\text{Total no. of insect released}} \times 100$$

## Results and Discussion

### Effect of botanicals on per cent mortality of *Callosobruchus chinensis*

The test insects were released at 30 days, 60 days, 90 days, 120 days, 150 days and 180 days in stored pigeon pea seeds which were treated initially with botanicals. Per cent mortality was recorded at 48 hours after release of insects in each replication of treatment. The data on per cent mortality is presented in table 2 and fig. 1 and discussed under different subheading as follows.

### 30 Days after treatment

Result presented in table 2 revealed that significantly maximum mortality of pulse beetle was observed in *Acorus calamus* rhizome powder @ 10 gm/kg seed (70%) which was found to be statistically at par with black pepper seed powder @ 3 gm/kg seed (63.33%) However, these two treatments were found to be significantly superior over rest of the treatments. The next best treatment in respect of recording maximum mortality was turmeric rhizome powder @ 10 gm/kg seed (50.00%), followed by ground nut seed oil @ 5 ml/kg seed (40.00%), castor seed oil @ 5 ml/kg seed (30.00%) and mustard seed oil @ 5 ml/kg seed (20.00%). Significantly minimum mortality of pulse beetle was recorded in untreated control (3.33%).

### 60 Days after treatment

All the treatments were found significantly superior over untreated control. Significantly maximum per cent mortality

(70.00%) of pulse beetle were observed in the seed treated with *Acorus calamus* rhizome powder @ 10 gm/kg seed which was found to be statistically at par with black pepper seed powder @ 3 gm/kg seed (60.00%). The next best treatment in respect of recording maximum mortality was turmeric rhizome powder @ 10 gm/kg seed (46.67%) which was found at par with ground nut seed oil @ 5 ml/kg seed (36.67%) followed by at par with castor seed oil @ 5 ml/kg seed (30.00%). The next second best treatment of recording maximum mortality in mustard seed oil @ 5 ml/kg seed (20.00%). Significantly minimum mortality of pulse beetle was recorded in untreated control (6.67%).

### 90 Days after treatment

Mortality observed due to all botanical treatments was found significantly superior over untreated control. Significantly maximum per cent mortality (60.00%) of pulse beetle was observed in the seed treated with *Acorus calamus* rhizome powder @ 10 gm/kg seed which was found to be statistically at par with black pepper seed powder @ 3 gm/kg seed (50.00%) followed by at par with turmeric rhizome powder @ 10 gm/kg seed (40.00%), ground nut seed oil @ 5 ml/kg seed (30.00%) and castor seed oil @ 5 ml/kg seed (30.00%). The next best treatment in order of their efficacy in term of per cent mortality was recorded due to mustard seed oil @ 5 ml/kg seed (26.67). Significantly minimum per cent mortality was recorded in untreated control (6.67%).

### 120 Days after treatment

All the treatments were found to be statistically superior over untreated control and proved effective in bringing about significantly greater mortality of pulse beetle as compared to untreated control (6.67%). Significantly maximum per cent mortality (50.00%) was recorded in the seeds treated with *Acorus calamus* rhizome powder @ 10 gm/kg seed. The next best effective treatment in order of their efficacy in term of per cent mortality were recorded in black pepper seed powder @ 3 gm/kg seed (40.00%), followed by turmeric rhizome powder @ 10 gm/kg seed (30.00%). The next best treatment of recording maximum mortality in treatment ground nut seed oil @ 5 ml/kg seed (20.00%) which was found statistically at par with castor seed oil @ 5 ml/kg seed (20.00%) followed by mustard seed oil @ 5 ml/kg seed (16.67%).

**Table.1** Treatment details

| Sr. No. | Treatment | Dose/kg seed |
|---|---|---|
| 1. | *Acorus calamus* rhizome powder | 10 g |
| 2. | Black pepper seed powder | 3 g |
| 3. | Castor seed oil | 5 ml |
| 4. | Groundnut seed oil | 5 ml |
| 5. | Turmeric rhizome powder | 10 g |
| 6. | Mustard seed oil | 5 ml |
| 7. | Untreated control | - |

**Table.2** Effect of botanicals on per cent mortality of *Callosobruchus chinensis* on pigeon seeds

| Sr. No. | Treatments | Doses gm or ml /kg seed | Average per cent mortality after 48 hours | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 30 days after treat | 60 days after treat | 90 days after treat | 120 days after treat | 150 days after treat | 180 days after treat |
| 1 | *Acorus calamus* rhizome powder | 10 gm | 70.00 (56.79) | 70.00 (56.79) | 60.00 (50.77) | 50.00 (45.00) | 40.00 (39.23) | 30.00 (33.21) |
| 2 | Black pepper seed powder | 3 gm | 63.33 (52.78) | 60.00 (50.77) | 50.00 (45.00) | 40.00 (39.23) | 30.00 (33.21) | 30.00 (33.21) |
| 3 | Castor seed oil | 5 ml | 30.00 (33.21) | 30.00 (33.21) | 26.67 (31.00) | 20.00 (26.57) | 20.00 (26.57) | 10.00 (18.43) |
| 4 | Ground nut seed oil | 5 ml | 40.00 (39.23) | 36.67 (37.22) | 30.00 (33.21) | 20.00 (26.57) | 20.00 (26.57) | 10.00 (18.43) |
| 5 | Turmeric rhizome powder | 10 gm | 50.00 (45.00) | 46.67 (43.08) | 40.00 (39.23) | 30.00 (33.21) | 30.00 (33.21) | 20.00 (26.57) |
| 6 | Mustard seed oil | 5 ml | 20.00 (26.57) | 20.00 (26.57) | 16.67 (23.86) | 16.67 (23.86) | 10.00 (18.43) | 10.00 (18.47) |
| 7 | Untreated control | - | 3.33 (6.14) | 6.67 (12.29) | 6.67 (12.29) | 6.67 (12.29) | 3.33 (6.14) | 3.33 (6.14) |
| | F' test | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. | Sig. |
| | SE(m) ± | | 1.78 | 2.18 | 12.18 | 1.78 | 1.25 | 1.25 |
| | CD at 5 % | | 5.40 | 6.61 | 6.61 | 5.40 | 3.82 | 3.82 |
| | CV | | 7.80 | 9.79 | 11.50 | 10.01 | 9.96 | 8.92 |

Figures in parenthesis are corresponding Arc Sine transformation value

### 150 Days after treatment

All treatments were found significantly superior over untreated control. Among the various treatments *Acorus calamus* rhizome powder @ 10 gm/kg seed (40.00%) was recorded maximum per cent mortality. The next best treatment of bringing mortality of bruchids were recorded in black pepper seed powder @ 3 gm/kg seed ( 30.00%) which was found to be statistically at par with turmeric rhizome powder @ 10 gm/kg seed (30.00%). The next best treatment of recording maximum mortality of pulse beetle in the seed treated with ground nut seed oil @ 5 ml/kg seed (20.00%) which was found at par with castor seed oil @ 5 ml/kg seed (20.00%). The next second best treatment of recording mortality of pulse beetles in mustard seed oil @ 5 ml/kg seed (10.00%). Significantly minimum per cent mortality (3.33%) was recorded in untreated control.

### 180 Days after treatment

All the treatments were found statistically superior over untreated control in respect of per cent mortality of pulse beetle. Maximum mortality was recorded in the seeds treated with *Acorus calamus* rhizome powder @ 10 gm/kg seed (30.00%) which was found to be

statistically at par with black pepper seed powder @ 3 gm/kg seed (30.00%). The next best treatments of recording maximum mortality due to turmeric rhizome powder @ 10 gm/kg seed (20.00%). The next second best treatment of bringing mortality in seeds treated with ground nut seed oil @ 5 ml/kg seed (10.00%) which was found at par with castor seed oil @ 5 ml/kg seed (10.00%) followed by mustard seed oil @ 5 ml/kg seed (10.00%). Significantly minimum per cent mortality 3.33%) was recorded in untreated control.

In the present investigation it was found that per cent mortality ranged from 3.33% to 70 % in first month to 3.33 % to 30.00% in six month. The per cent mortality was significantly maximum (70%) in treatments *Acorus calamus* rhizome powder @ 10 gm/kg seed, black pepper seed powder @ 3 gm/kg seed (63.33), turmeric rhizome powder @ 10 gm/kg seed (30%), in first month while in six month highest mortality was recorded in treatment *Acorus calamus* rhizome powder 10 gm/kg seed (30.00%) followed by black pepper seed powder @ 3 gm/kg seed (30%) and turmeric rhizome powder @ 10 gm/kg seed (10%). In all the six month of storage it was found that *Acorus calamus* rhizome powder @ 10 gm/kg seed, black pepper seed powder @ 3 gm/kg seed, turmeric rhizome powder @ 10 gm/kg seed, ground nut seed oil @ 5 ml/kg seed, castor seed oil @ 5 ml/kg seed, mustard seed oil @ 5 ml/kg seed were found effective for bringing mortality.

The finding of present investigation are in close conformity with the finding of Devi and Kalita (2011) who observed that highest mortality of pulse beetle (70% to 75 %) was with treatment of *Acorus calamus* rhizome powder in stored pigeon pea.

Thakur and Pathia. (2013) also reported the maximum mortality of *Callosobruchus spp.* due to black pepper seed powder (50% to 60%) and mustard oil (38.00%) in stored pigeon pea.

Islam saiful Md. (2013) reported the maximum mortality of pulse beetle due to black pepper (65.00%) in stored pigeon pea.

Asawalam (2014) also reported the (80.00%) the maximum mortality of adult pulse beetle due to turmeric powder stored cowpea.

From the present study, it can be concluded that *Acorus calamus* rhizome powder @ 10g/kg green gram seed and black pepper powder @ 3g/kg green gram seed recorded highest percent mortality and can be used for successful protection of green gram seeds up to six months of storage.

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