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Evaluation of botanicals on *Callosobruchus chinensis* (Coleoptera: Chrysomelidae) in stored chickpea

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Abstract
The present investigations were aimed to study the "Evaluation of botanicals on *Callosobruchus chinensis* (Coleoptera: Chrysomelidae) in stored chickpea**"** was carried out during 2020-21 at Post Graduate Institute, Akola. The different botanicals were evaluated at various concentrations *viz*., pepper powder @ 3g/kg, turmeric powder @ 10g/kg, clove powder @ 3g /kg, groundnut oil @ 5ml/kg, castor oil @ 5ml/kg and soybean oil 5ml/kg. The present findings revealed that the highest per cent mortality was recorded on the seeds treated with castor oil (98.33%) and pepper powder (96.67%). The lowest mortality was recorded on the seeds treated with soyabean oil (71.67%) among the different plant products. However, castor oil proved to be the best in managing the pulse beetle.

Keywords: *Callosobruchus chinensis*, chickpea, botanicals and castor oil

Introduction
Chickpea, *Cicer arietinum* L. (Fabales: Fabaceae) is the oldest and native of southwest Asia, most commonly consumed legume in the world as a source of protein and carbohydrate, particularly in tropical and sub-tropical areas. It has various labels across the globe *viz*., chickpea, gram, garbanzo, garbanzo bean and Egyptian pea. Chickpea is highly nutritious containing 17-20% protein, 1.0% fats, 56.6% carbohydrate, Calcium 49g/100g, Phosphorus 291g/100g, Iron (Fe) 2.89mg/100g, Thiamin 0.116 mg/100, Riboflavin 0.063 mg, fibre 6g/100g and provides 164 cal. energy per 100g (Ali and Prasad, 2002). It contains almost three times more protein that of cereals. It is consumed in the form of spilt pulse as well as whole pulse, which is an essential supplement of cereal-based diet. Chickpea seeds are eaten fresh as green vegetables, parched fried, roasted and boiled, as snack food, sweets and condiments. One of the major constraints, post – harvest losses of chickpea is very high in storage conditions at farmer level. One of the main heavy losses is due to pulse beetle (*Callosobruchus chinensis* L.) (Southgate, 1978) [10]. Use of chemicals for the management of bruchid have led to serious problems such as insecticide treated seeds are led to chronic and acute toxicity, while consumption the of insecticides residues is present. However, cost of insecticides is more to manage the pest. In this condition, the alternative methods of insect control have been come by utilizing botanicals products to minimize the post-harvest losses. These methods can be less expensive, safer for the environment and human health, and more efficient. The use of plant products and edible oil as grain protectant is the age-old practice and gaining rapid popularity providing safer condition to human health, more easily biodegradable, have a narrower mode of action, and are simple to use, less dangerous, less costly, and more readily accessible. By keeping these points in view, the present work is carried out for "Evaluation of botanicals against *Callosobruchus chinensis* in stored chickpea".

Materials and Methods
The experiment was carried out in Department of Agricultural Entomology, Post Graduate Institute, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, during 2020 – 2021. A completely randomized design was followed with 7 treatments and three replications. The treatment details are provided below along with concentrations.

Test Botanicals
Seven treatments were selected on the basis of local usage for farmers to manage the storage grain pest on chickpea. These treatments are commonly and easily available in the market. The plant products are *viz*., pepper powder @ 3g/kg, turmeric powder @ 10g/kg, clove powder @ 3g /kg, groundnut oil @ 5ml/kg, castor oil @ 5ml/kg and soybean oil 5ml/kg.

Rearing of Pulse Beetle

The Pulse beetle, *C. chinensis* were used for the existing investigations. A small-scale of the *C. chinensis* beetles and seeds of chickpea were obtained from the Pulses Research Unit, Dr. P.D.K.V., Akola. They were reared and multiply under laboratory conditions, on a diet of chickpea seeds, *C. arietinum*, inside a growth chamber at 25±2ºC and 65±5% RH.

Determination of male and female bruchids

The antennae of females and males were used to differentiate them. Males have highly serrated antennae and a pygidium that is free of black spots. Females have pygidium with two black spots, one on either side of the mid-line, and weakly serrate antennae. Females are typically slightly larger than males. (Devi and Devi 2013) [7].

Initially 40 pairs of one- or two-day old beetles were leaved in a plastic jar containing chickpea seeds. The jars were protected with pieces of muslin cloth tie-up firmly by rubber band and a maximum of 5 to 6 days were allowed for oviposition and mating. Then parent adults were removed and seeds of chickpea containing eggs was transferred to fresh chickpea seeds in the multiplying jars that were protected with pieces of muslin cloth with elastic loop to avoid the contamination and runway of insects. The subsequent generations of the pulse beetles were used for all experiments.

Residual Toxicity test

A residual toxicity test was organized according to the methodology of Talukder and Howse (1994) [11] with some minor modifications. For each treatment, one kg of freshly harvested seeds with a high per cent of germination and low moisture content not more than 10% were used. To treat the seeds of chickpea with oils and powders of various plant products, the necessary quantities were weighed and taken. For each treatment, one kg of chickpea seeds was placed in a two kg plastic container, and plant products were mixed thoroughly by shaking the container. For each treatment, the same procedure was repeated thrice. The one kg treated chickpea seeds were placed in a two kg plastic container to held at 25±2 ºC and 65±5% RH. From one kg treated seeds, 0.1 kg of treated seed were taken out in the plastic container of 0.5kg capacity, five pairs of pulse beetle, *C. chinensis* (newly emerged) were released in 100g treated sample and the observations were recorded in every month.

Per cent mortality

For determining percent mortality: The five pairs of adults were released in the starting of first month, second month, third month, fourth month, fifth month and six months in 0.1 kg (in a plastic container of 0.5kg capacity) stored chickpea seeds which were treated at first with botanicals. After release of adults, the plastic container of 0.5 kg capacity was observed daily for the mortality of adults up to five days.

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

Statistical analysis

Data were analyzed using a one factor completely randomized design using the different botanicals. For per cent mortality tests, original data were transformed into percent & arc sine values and then data were analyzed.

Results and Discussion

The results presented in the Table 1. and Fig 1. has significant difference among the different treatments. The highest mortality of pulse beetles was observed in chickpea seeds treated with castor oil (98.33%), continued by seeds treated with pepper powder (96.67%) in the group of botanicals, these two treatments are on uniformity with each other and found more effective. The lowest mortality of pulse beetles observed in chickpea seeds treated with soyabean oil (71.67%), continued by seeds treated with turmeric powder (78.33%) in the group of treatments except untreated one, both were in equivalence with each other and found less effective than other treatments.

The results further revealed that more than 60% mortality was recorded only with castor oil at six months after treatment and proves effective after six months also, 22% mortality was recorded with turmeric powder at six months after treatment, which proves turmeric powder has not much effective after six months. In Fig 1. from 1st month to 6th months after treatment, the cumulative mean of per cent mortality was derived and found that similar order of effectiveness of botanicals on mortality of pulse beetle even after six months.

The results are in accordance with the findings of Aslam *et al.* (2002) [3] reported that only 3.75 days has taken for reaching 100% mortality of adult pulse beetle, when chickpea seeds were treated with clove powder and pepper powder. Chakravarty *et al.* (2020) [6] revealed that the adult mortality has been observed, when chickpea seeds were treated with mahua oil (63.89%) and neem oil (61.89%). Similar findings were corroborating with Poornasundari (2007) [9] reported 100 per cent mortality of pulse beetle in green gram seeds treated with pepper powder. The present findings are in concurrence with the findings of Bhargava *et al.* (2002) [4] reported that castor oil was found to be most effective causing 80.7% mortality of adult pulse beetle in case of cowpea seed treated with 16 vegetable oils. The Present findings are in line with Nisha *et al*. (2019) reported that minimum 7 hours taken for highest mortality was observed in case of mung bean grain treated with sweet flag rhizome powder and neem powder.

Table 1: Evaluation of botanicals on the adult mortality of *Callosobruchus chinensis* (L.) in chickpea

Sr. No.	Treatments	% Mortality was recorded until 5th day after releasing					
		1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month
1	Pepper powder	96.67 (82.29)	91.67 (73.40)	82.67 (65.88)	70.00 (39.23)	62.33 (52.17)	42.67 (59.15)
2	Turmeric powder	78.33 (62.29)	68.33 (55.77)	66.33 (54.55)	46.67 (40.00)	36.00 (36.72)	22.67 (28.37)
3	Clove powder	83.33 (65.95)	88.00 (73.29)	78.67 (63.38)	63.33 (52.78)	60.10 (50.83)	36.67 (37.22)
4	Groundnut oil	81.67 (64.69)	81.67 (64.69)	74.33 (59.59)	53.33 (46.92)	49.67 (44.81)	32.27 (34.60)
5	Castor oil	98.33 (85.69)	96.67 (79.60)	86.00 (68.44)	83.33 (66.14)	76.00 (60.67)	62.67 (52.36)
6	Soybean oil	71.67 (57.86)	66.67 (54.75)	64.67 (53.54)	40.00 (39.23)	37.00 (37.46)	25.00 (29.80)
7	Control (untreated one)	6.63 (14.90)	7.10 (15.44)	10.00 (18.39)	3.33 (6.14)	0.06 (0.81)	0.06 (0.81)

F' test		Sig	Sig	Sig	Sig	sig	Sig
SE(m)±		2.99	3.36	3.0	3.18	1.86	1.79
CD (P=0.05)		9.06	10.2	9.09	9.54	5.63	5.42
CV		8.32	9.78	9.47	12.37	7.94	9.68

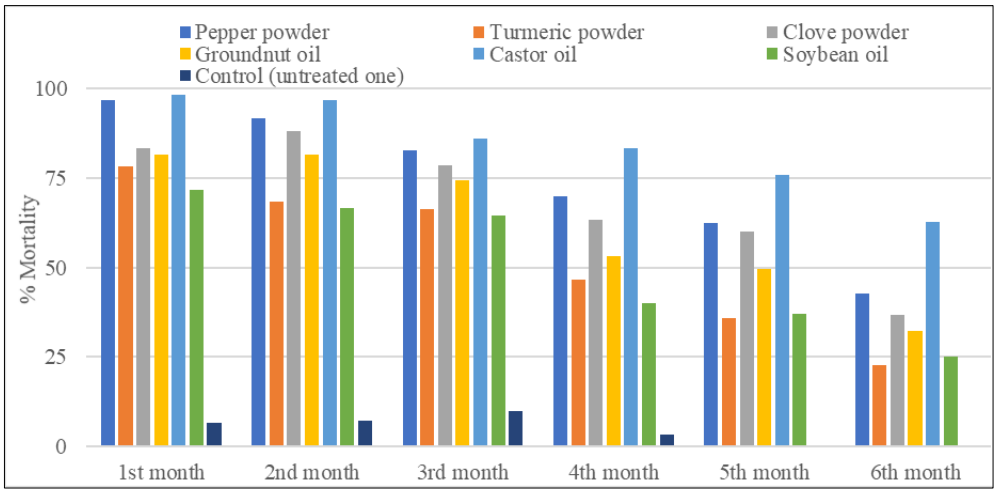

Fig 1: Effect of various botanicals on the mortality of *Callosobruchus chinensis* (L.) in chickpea

Conclusion

It can be concluded that the chickpea seeds treated with various botanicals has statistically significant differences. So, chickpea seeds treated with castor oil @ 5ml/kg and pepper powder @ 3gm/kg has highest mortality and proves effective in management of pulse beetle in storage condition.

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