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Bio-potency of *Cassia occidentalis* against *Callosobruchus maculatus* for Sustainable Storage of Pigeon Pea

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Abstract: The agriculture system should be economically and socially sustainable to contribute in economies. Sustainable storage systems are the consequential part of a good agricultural development and demands for a proper management of stored cereals. *Cajanus cajan* commonly called as pigeon pea (Arhar) is a member of family Fabaceae and the most important grain legume crop grown in the semi-arid tropical areas. Grain legumes are susceptible to pest infestation during storage, but if properly stored, they can remain in edible condition for several years. The efficacy of *Cassia occidentalis* leaf powder against *Callosobruchus maculatus* was evaluated on pigeon pea grains under extensive laboratory conditions i.e. 32±0.64°C and 68±3% R.H. Four dosages of *Cassia occidentalis* leaf powder 5 g, 10 g, 15 g and 20 g were separately admixed in 100 g grains of pigeon pea in separate glass jars. Number of adult mortality, laid eggs, hatching of eggs, emergence of adult *Callosobruchus maculatus,* and weight loss from each treatment were comparatively examined with the control treatment. Highest mortality, lowest number of eggs laid, lowest rate of oviposition and lowest egg hatching was recorded at dosage of 20 g. The results concludes that the *Cassia occidentalis* contains valuable properties to control the infestation of *Callosobruchus maculatus* and can be advantageous for the sustainable storage of pigeon pea.

Keywords: Agriculture system, Sustainable storage, Pigeon pea, *Cassia occidentalis, Callosobruchus maculatus,* Leaf powder, Advantageous

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Introduction

As the food provider the agriculture is the cornerstone for the existence of human beings and plays a vital role in economic growth and development of a country. The agriculture system including the storages, should be sustainable to contribute in global economic development. Proper storage of cereals and other agricultural products enables their uniform availability throughout the year specially in case of any emergency. India's rank is high in the pulse

production. Pigeon pea, chickpea, black gram, green gram, lentils and peas are commonly grown and consumed in the country. Among these legumes, pigeon pea is majorly grown and consumed as dhal in India (Talari and Devindra, 2018). *Cajanus cajan* commonly called as pigeon pea (Arhar) is a member of family Fabaceae and the most important kharif legume crop grown in the semi-arid tropical areas (Pal *et al*., 2011). More than 90% production of pigeon pea in the world is contributed by India and it is rich in proteins, all types of vitamin-B, carbohydrates, minerals and important amino acids like methionine, lysine and tryptophan. There are some other bioactive compounds of pigeon pea which are not a part of nutrition but they have antioxidant and anti-carcinogenic effects and have been suggested for their role in modulating the gut microbiota and reducing inflammation (Talari and Devindra, 2018). Pigeon pea is susceptible to infestation by pests during storage, which causes serious deterioration in grain's nutritive value. There are more than 200 insect species recorded as pests on pigeon pea in India, but only few of them are common and cause damages and economic losses (Jadhav *et al.*, 2012). *Callosobruchus maculates* (Coleoptera: Chrysomelidae) commonly called as pulse beetle, is a serious pest of stored legumes and it has cosmopolitan distribution. The shape of adult is oval and colour is reddish-brown, dark stripes are present on each dorsal abdominal side with average fecundity of 74.8±1.8 eggs per female (Sharma *et al*., 2017). During storage, female lays eggs upon the grains and after hatching the larvae infest pigeon pea egregiously and damage whole grain inside. The improper storage of pigeon pea leads a serious infestation and the grains are often completely destroyed by *Callosobruchus maculates* in the very short time period by causing huge weight loss, reduction of its viability and commercial value, making it unfit for human consumption. So there is a huge need of an effective protectant for the management of post-harvest losses in pigeon pea to increase its availability as an important food source. *Cassia occidentalis* is rich in medicinal properties (Singh *et al.*, 2016) due to the presence of its phytochemicals like alkaloids, anthocyanosides, phenolics, phlobatannins, steroids, tannins, flavonoids, terpenes, anthroquinone, saponins, resins, balsams, amino acids, proteins, carbohydrates, sugars and cardiac glycosides etc. (Saganuwan and Gulumbe, 2006; Arya and Yadav, 2011; Daniyan *et al.*, 2011; Veerachari and Bopaiah, 2012). Hence, it can be effective as an eco-friendly bio-pesticide to protect pigeon pea from *Callosobruchus maculates* infestation and will assist in its sustainable storage. In this study the efficacy of *Cassia occidentalis* leaf powder against *Callosobruchus maculatus* was evaluated on pigeon pea grains.

Materials and Methods

Leaves collection and preparation of powder:

Cassia occidentalis leaves were collected and after the identification, the leaves were properly washed and dried in air under the room temperature for 20 days. After it, the dried leaves were ground and the leaf powder was stored for further use.

Pigeon pea collection and preparation:

Whole and un-infested pigeon peas were collected from the cereal market, Kanpur, India. After the collection the seeds were heat sterilized to kill any hidden infesting stage and disinfected seeds were weighed using digital balance and then stored in cool and dried place for further experiment.

Insect Rearing:

Mass rearing of *Callosobruchus maculatus* was carried out under laboratory conditions under controlled temperature (30±2 °C) and relative humidity (65±5%). For initiation of the experiment, in a glass container having capacity of 500 ml, 250 g of sterilized healthy pigeon peas were taken into which 50 pair adults of *Callosobruchus maculatus* (ratio of male and female was 1:1) were introduced. The mouth of the container was covered with muslin cloth and secured with help of a rubber band for proper aeration. The culture was periodically examined

Table 1: Bio-potency of *Cassia occidentalis* against *Callosobruchus maculatus*

S. No.	Quantity of grains (g)	Quantity of leaf powder (g)	%age of eggs laid	%age of hatched eggs	%age of adults emerged	%age of contact mortality	%age of grain weight loss
1.	100	05	99.22	82.13	64.02	33.99	17.61
2.	100	10	98.21	77.52	46.89	36.00	17.48
3.	100	15	94.84	75.57	43.32	36.29	16.94
4.	100	20	87.03	71.89	39.19	38.01	15.26
5.	100	00 (Control)	100	83.33	64.30	0.00	21.03

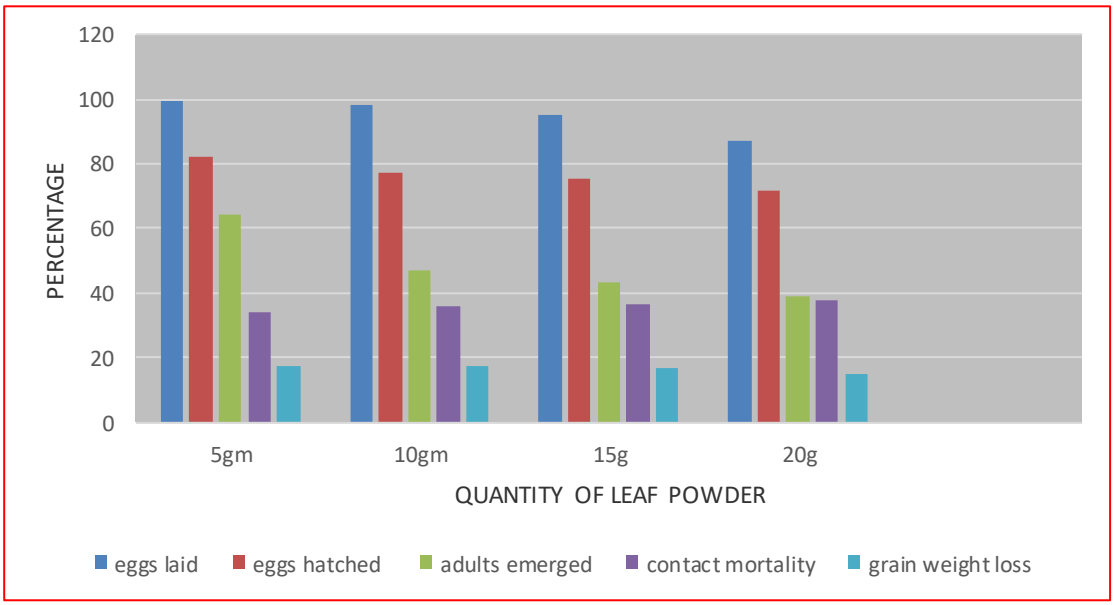

Fig. 1: Bio-potency of *Cassia occidentalis* against *Callosobruchus maculates.*

with precautions throughout the whole period of study. Newly emerged insects were considered as new generation for further study.

Contact toxicity:

100 g of non-infested pigeon pea seeds were placed in different glass petri-dishes and four dosages of leaf powder: 5 g, 10 g, 15 g and 20 g were mixed in seeds within these petri-dishes along with a control treatment. Ten pairs of *C. maculatus* insects were introduced into each petri-dish and then covered to prevent insect escaping. Adult mortality was observed and counted after 48 hours and the mortality percentage was calculated by using the formula by Omotosho and Oso (2004).

Rate of oviposition, hatching and adult emergence:

100 g clean pigeon pea seeds were kept in different jars (300 ml capacity) and treated with 5 g, 10 g, and 15 g and 20 g plant powder dosages, respectively and then 1 pair *C. maculatus* adults were released inside every jar along with control. After 14 days, the number of eggs laid by the female were counted, and the number of hatched eggs and adult emerged out were counted after 20 and 35 days of treatment, respectively.

Effect on damage and losses:

Experiment was carried out in glass jars having 300 ml. capacity. 100g grains were kept inside the jars with mixed 5 g, 10 g, 15 g and 20 g leaf powder along with control. After the completion of all experiments 50 fresh and 50 damaged grains

of each of the treatment i.e. with protectant doses and control were taken out for valuation and their final weight were taken and the percentage weight loss was calculated for every treatment.

$$\text{Weight loss (\%)} = \frac{\text{weight loss of grains}}{\text{total weight of grains}} \times 100$$

Statistical analysis:

Data collected from the laboratory experiments were statistically analyzed. Statistical design was Complete Randomized Design (CRD). Tabulated data was transformed into percentages (%) and analyzed. Tables and graphs were prepared using Microsoft Office Excel.

Results and Discussion

The effect of *Cassia occidentalis* leaves powder showed a significant effect on pigeon pea, the higher dose 20 g caused higher contact mortality (38.01%), reduced egg laying (87.03%), reduced egg hatching (71.89%), reduced adult emergence (39.19%) and most significantly the powder reduced the damage and grain weight loss that was only 15.26%, which was 5.77% less in comparison with the damage and losses caused in control (Table 1; Fig. 1). Therefore, *Cassia occidentalis* can be considered as a locally available medicinal plant and can be used for the control of various storage pests. This can also be used as medicinal plants as bio-protectants and in pest management programmes. *Cassia occidentalis* can also be used by our local farmers for the sustainable storages of their cereal grains.

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