

FOOD PREFERENCE OF *CALLOSOBRUCHUS MACULATUS* (F.) TO SIX TYPES OF GRAINS OF FABACEAE

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ABSTRACT

Dry pulses, rich sources of proteins for good health, are highly infested by several stored grain pests. The food preferences of pulse beetle, *Callosobruchus maculatus* (F.) on six types of pulses studied under laboratory conditions showed 5% attractions in *Cajanus cajan* (red gram), 7.14 % in *Lens esculenta* (lentils), 27.6 % in *Phaseolus mungo* (blackgram), 31.9 % in *Vigna catjung* (cowpea), 7.35 % in *Cicer arietium* (kalachana) and 9.25% in *Vigna aconitifolia* (matki). *Vigna catjung* (cow pea) and *Phaseolus mungo* (black gram) were most preferred food for this species while *Cajanus cajan* (red gram) was comparatively less preferred for oviposition and further growth. Highest mean number of eggs were deposited on *Vigna catjung* (61.56), while in *Cajanus cajan* least number of eggs were deposited (10.09). Eggs deposited on *Lens esculenta* (lentils) were 15.57, on *Phaseolus mungo* (blackgram) were 50.09, on *Cicer arietium* (kalachana) were 20.09 while in *Vigna aconitifolia* (matki) were 25.75. *Vigna catjung* (cow pea) and *Phaseolus mungo* (black gram) were most preferred food and for oviposition and hence are suitable to prepare baits.

INTRODUCTION

Legumes cultivated since more than 6000 years in the world produces nutrient rich dry pulses which contains proteins (20-40%), carbohydrates (50-60%), small amount of fats, phosphorus, calcium, iron and a number of essential vitamins and necessary fats (Shanmugas, 1988).

Legumes have a wide range of usage; some are used as fodder or green manure and some are used as silage, while others are extracted for their oil, notably soyabean and groundnut (COPR, 1981). According to the FAO study, world - wide loss in store approximates 10% of all stored grain, i.e., 13 million tons of grain lost due to insects or 100 million tons due to failure to store properly (Wolpert, 1967).

Insects are the most numerous and successful animals on earth and well known for their beneficial and harmful effects in agriculture. They cause heavy losses to stored grains throughout the world and their impacts are more devastating in developing countries (Ekeh *et al.*, 2013). Female adults are particularly important for their high fecundity through their profuse egg-laying ability immediately after emergence. Brier and Collins (2010) reported that it is a common stored legume pest found on every continent except Antarctica. Considerable physical and nutritional losses sustained in these countries are due to infestation of stored food products by weevils, bruchids and other insects.

Both the crop in field and the grains in stores are infested by a large number of insect pests. The storage pests cause colossal damage to the commodity which reduces not only the quantity but also the quality of stored grains.

India is the largest producer of pulses in the world, in 23.63 million ha area, India produces 14.76 metric ton pulses (Anonymous, 2007-2008).

The genus *Callosobruchus* attacks grain legumes during both pre and post-harvest stages all over the world; but in India, *C. maculatus*, *C. analis* and *C. chinensis* are predominant pest species of the genera (Dias, 1988 and Jat *et al.*, 2013).

Callosobruchus maculatus (F.) a cosmopolitan bruchid beetle, is a continuous pest from the field to the store (Jiao *et al.*, 2011). It starts infestation in the field but heavy damage is done in storage (Swell and Mushobozy, 2007). The infested seeds may be almost completely hollowed by the feeding activities of the larvae, and characteristic emergence holes or 'windows' are evident after the adults leave the seeds (Giga and Smith 1983). The proportion of loss caused by this pest is 25-30% in the field and 80% in store within 6-8 months in temperate zone (Hill, 1990). Southgate (1979) reported about 83 species of leguminaceous plants as the hosts of beetles. Cowpea seed beetle, *Callosobruchus maculatus* (Fab.) is a major insect pest of stored legumes, in Africa and Asia (Mohamed *et al.*, 2009). *Callosobruchus maculatus* consumed 50 to 90% of cowpea in storage annually (IITA, 1989).

Yet some of the stored-product pests are highly mobile and temporarily and spatially patchy in distribution (Campbell *et al.*, 2002); therefore, information on pest population occurrence, ecology and behavior in the vicinity of storage facilities is important, both for effective monitoring and controlling of stored-product pests.

Pulses are considered as most nutritious and play an important role in fulfilling the protein deficiency in the daily diet of the

people and also they maintain soil fertility through biological nitrogen fixation in soil and thus play a vital role in sustainable agriculture (Kannaiyan, 1999 and Maji *et al.*, 2014).

In man, protein helps in the repair of body tissue, synthesis of enzymes and hormones and also in the supply of energy. In children, the consumption of pulses should be encouraged, particularly where animal protein is scarce and expensive, as this would help to furnish the child with the necessary amino acids required for growth.

The present study was under taken to determine the food preference of *Callosobruchus maculatus* to six types of beans (red gram, lentils, black gram, cowpea, kalachana and matki) to find most preferred grains for the preparation of baits for its control.

MATERIALS AND METHODS

Callosobruchus maculatus (F.) were obtained from local market on cowpea seeds and further reared to get pure culture under controlled laboratory conditions on various kinds of leguminous grains. The healthy grains of pulses, *Cajanus cajan* (red gram), *Lens esculenta* (lentils), *Phaseolus mungo* (black gram), *Vigna catjung* (cowpea), *Cicer arietinum* (kalachana) and *Vigna aconitifolia* (matki) were collected from local market, cleaned and dried to kill pre-existing pests if any.

Callosobruchus maculatus (F.) food preference and egg laying of adults

To study preference of adults to six different types of beans method of Hameed *et al.* (2013) was used. The plastic circular box having diameter 18.2 cm was divided into six equal parts (sections) same in shape and size with a central circular chamber of radius 6.8 cm to put the adult pests. The central circular chamber was perforated for the entry of adult pests in to each of the surrounding chamber, each containing one of the six different pluses belonging to the fabaceae family (red gram, lentils, black gram, cow pea, kalachana and matki). Ten

pairs of freshly emerged *Callosobruchus maculatus* adults were released in the central circle. All chambers were closed from the upper side. Adults from each section were counted after 24 hours to know the behavior of the insect in the free choice. The experiment was repeated 3 times each in seven sets.

The number of eggs laid by females in each chamber, having different types of pulses was counted daily, and the total number of eggs laid on the grains was determined.

RESULTS AND DISCUSSION

Usually female *Callosobruchus maculatus* were attracted on the grains. Table (1) shows the average of the adult insects (females) attracted on various pulses. The proportion of adults attracted to the *Vigna catjung* (cow pea) was highest (6.38 adults) amongst the remaining pulses while the average number of the adults attracted to *Phaseolus mungo* (black gram), *Vigna aconitifolia* (matki), *Cicer arietinum* (kalachana) and *Lens esculenta* (lentil) was 5.52, 1.85, 1.47 and 1.42 respectively while *Cajanus cajan* (red gram) was having least attraction (1).

The number of eggs deposited on pulses is shown in table (2). The highest mean number of eggs was deposited on the *Vigna catjung* (cowpea) grains (61.56), while the least number of eggs was deposited on *Cajanus cajan* (red gram) grains (10.09). According to Applebaum *et al.* (1970), Cow pea is the main host of *Callosobruchus maculatus*, and is preferred to feed and for development.

Considerable number of eggs was also laid on grains of black gram, matki, kalachana and lentils as 50.09, 25.75, 20.09, 15.57 respectively. No grains in this study were totally rejected for oviposition by the cow pea beetles. Yadav and Pant (1974) observed that *Callosobruchus* spp. will oviposit egg on any seed, even though the seed may not be suitable for the development of these insects. On seven different legumes studied, Seifelnase (1991) reported the highest total oviposition by *Callosobruchus maculatus* (F.) on cowpea followed by

Table 1: Food preference of *Callosobruchus maculatus* on pulses

Pulses	Adults attracted in seven repeats							Average	Percentage%
	I	II	III	IV	V	VI	VII		
<i>Vigna catjung</i>	6.66 ± 1.15	6.66 ± 3.78	9.00 ± 4.35	5.66 ± 3.05	4.33 ± 0.57	6.66 ± 1.15	5.66 ± 2.08	6.38 ± 1.43	31.9
<i>Lens esculenta</i>	2.33 ± 2.08	1.00 ± 1.00	0.66 ± 1.15	1.66 ± 1.52	1.33 ± 1.52	1.00 ± 0.00	2.00 ± 1.73	1.42 ± 0.60	7.14
<i>Phaseolus mungo</i>	4.00 ± 1.00	6.33 ± 1.52	6.66 ± 2.30	7.00 ± 3.60	4.66 ± 4.72	4.33 ± 3.21	5.66 ± 1.15	5.52 ± 1.19	27.6
<i>Cicer arietinum</i>	2.66 ± 2.51	2.33 ± 2.08	1.33 ± 1.15	0.66 ± 0.75	0.66 ± 1.15	1.33 ± 1.15	1.33 ± 0.57	1.47 ± 0.76	7.35
<i>Cajanus cajan</i>	0.33 ± 0.57	1.33 ± 1.52	0.66 ± 1.15	1.33 ± 1.52	0.66 ± 1.15	1.00 ± 1.00	1.66 ± 1.52	1.00 ± 0.47	5
<i>Vigna aconitifolia</i>	2.66 ± 1.52	2.33 ± 2.08	1.00 ± 0.00	0.33 ± 0.57	1.33 ± 1.52	2.66 ± 0.57	2.33 ± 0.57	1.85 ± 0.91	9.25

± indicates standard deviation of three repetitions

Table 2: The average number of eggs laid by *Callosobruchus maculatus* adult on pulses.

Pulses	Eggs laid in seven days							Mean	Percentage %
	I	II	III	IV	V	VI	VII		
<i>Vigna catjung</i>	72.3 ± 7.50	64.33 ± 6.65	69.00 ± 16.52	66 ± 6.00	49.66 ± 2.08	55.66 ± 3.05	54 ± 2.51	61.56 ± 6.38	43.79
<i>Lens esculenta</i>	14.33 ± 1.52	15.33 ± 0.57	19.00 ± 1.00	14 ± 3.46	14.33 ± 4.04	14 ± 2.64	18 ± 3.00	15.57 ± 1.42	11.12
<i>Phaseolus mungo</i>	49.00 ± 1.00	54.66 ± 3.78	54.00 ± 5.29	49.66 ± 1.52	42.66 ± 2.51	50.66 ± 2.08	50 ± 3.00	50.09 ± 5.52	35.77
<i>Cicer arietinum</i>	18.66 ± 1.52	21.00 ± 2.64	20.33 ± 0.57	16.66 ± 2.88	17.33 ± 5.03	21.66 ± 4.72	25 ± 5.00	20.09 ± 1.47	14.35
<i>Cajanus cajan</i>	11.00 ± 1.73	8.66 ± 1.52	11.33 ± 3.21	9 ± 2.64	10.33 ± 1.52	9 ± 2.00	11.33 ± 3.21	10.09 ± 1.00	7.20
<i>Vigna aconitifolia</i>	26.33 ± 3.21	26.33 ± 3.78	24.66 ± 6.35	24 ± 5.29	22.33 ± 2.51	27.33 ± 2.51	29.33 ± 6.02	25.75 ± 1.85	18.39

± indicates standard deviation of three repetitions

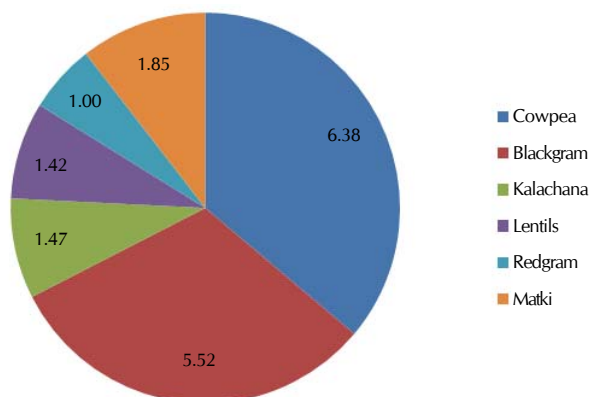


Figure 1: The average number of adults attracted in seven days on grains of fabaceae

garden pea, while the lowest was on chicken pea.

Some types of beetles of the family Bruchidae behave differently in food preference depending in their nature. The number of eggs deposited by *Callosobruchus* spp. was found to be affected by seed size, curvature of the seed, colour of the seed, thickness of the coat and smoothness of the seeds (Nwanze et al., 1975, Mphuru, 1981).

Blumer and Beck (2008) mentioned that adult prefer laying eggs on the seeds having larger surface area; Messina (1984) also mentioned the oviposition preferences of *Callosobruchus maculatus* strongly influenced by the surface texture of potential oviposition sites.

Dias and Yadav (1988) reported oviposition preference of female *Callosobruchus chinensis* on the four leguminous seeds of which cowpea, chickpea and green mung were preferred. Parajulee et al. (1989) also reported that the adult female laid more eggs on soyabean than others while Dwivedi and Sharma (1993), tested seven different legumes of which cowpea was the most preferred and soyabean was the least preferred host to *Callosobruchus chinensis*.

The ability of the larva to penetrate the seed coat appears to be influenced by the physical properties of the seed coat such as thickness, hardness and roughness (Manohar and Yadava, 1990).

Mehta and Chandel (1990) who reported that the *Callosobruchus analis* were provided with a mixture of the seeds of various grain most of the *C. analis* preferred cowpeas (15.33 eggs/seed), peas (8.17 eggs/seed), green gram [Vignaradiata] (5.67 eggs/seed) and V. mungo (5.07 eggs/seed) for egg laying, per cent weight loss and per cent adult survival.

Girrish (1974) observed that *C. maculatus* was guided in its oviposition where preferences had been shown towards the smoothness of the seed coat and the size of the grain. However, the smoothness of the seed coat may not be the only factor responsible for high oviposition by the cowpea beetle. Combinations of several factors such as seed texture, seed size and shape, weight and volume of the seed and the seed colour have been suggested to be responsible for the ovipositional preference of bruchids to different pulses

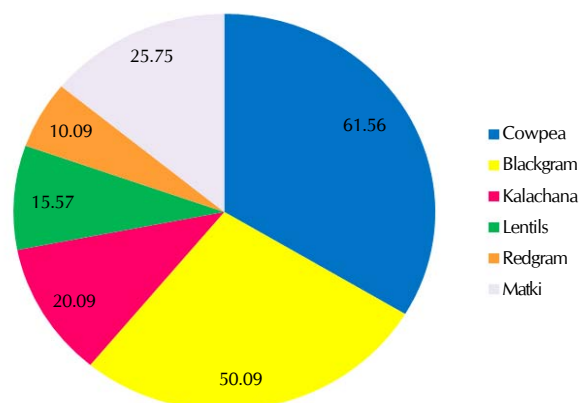


Figure 2: The average number of eggs laid by *Callosobruchus maculatus* adult on pulses.

(Nwanze, 1975; Mitchel, 1975; Satya Vir and Jindal, 1981; Manohar Yadava, 1990).

From this study, it can be concluded that cowpea and black gram are the most suitable grains for *Callosobruchus maculatus* (F.) oviposition and further development, while red gram is least preferred.

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