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FOOD PREFERENCES OF *Acanthoscelides obtectes* (Say)

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ABSTRACT

There are two major post-harvest pests of dry beans world wide- the Bean Weevil, *Acanthoscelides obtectus* (Say) and the Mexican Dry Bean Weevil ,*Zabrotessub fasciatus* (Boheman). Bean Weevil, *Acanthoscelides obtectus* (Say) (Bruchidae). This beetle, *A. obtectus* thought to be indigenous to North America, is the principal pest of stored legumes (kidney beans, peas, lentils) and certain other seeds, attacking them both in the field and in storage if they are stored in a warm place. If the field-infested material is brought into storage, the insects can reinfest the dried seeds. Bean Weevil, *Acanthoscelides obtectus* (Say) (Bruchidae),can be eliminated by destroying infested legumes because it does not attack grains, cereals, or other stored food products. Adult: hibernates inside the seeds, each being able to contain several individuals. It starts to move around in the seed storehouses or in the fields once the temperature reaches 11 °C, and flies in dry and sunny weather (21°C). Lifespan of hibernating adults: 3 to 4 months. Adults are short-lived, and mate and oviposit soon after emergence. Adults live 14 days; female lay about 45 eggs. Sex ratios tend to be 1:1 in both species.

INTRODUCTION:

Despite its name, this pest is not a true weevil; its head is not prolonged into a beak. The adults are 2 to 3 mm long, robust, somewhat triangular (cut off squarely at the rear and narrowing toward the front), almost flat above, and are velvety grey or brown, with pale, linear markings on the elytra, which do not cover the tip of the abdomen. The thorax is covered with fine, yellowish-orange hairs, the legs are reddish yellow, and the antennae have serrate (saw-toothlike) segments.

Biology

Eggs: The eggs are deposited in clusters of 2 to 20 on the pods or inside them, on the inner side or directly on the seeds. Average fecundity: 40 eggs . The female lays an average of 75 eggs, singly, on or near the beans or related seeds. The eggs hatch in 5 to 20 days. Eggs are milky white; 0.60 mm x 0.25 mm.

Larva: The first-instar larva has a yellow head and long legs while the arched second-instar larva isapodous, white with a brownish head. The tiny, legless larvae proceed to bore into the seed; several larvae can develop in a single bean. : the 1st-instar larva moves about on the pods, then enters one of them; after 2 to 3 days, it digs into the seed then moults, and transforms into the 2nd-instar larva. By the end of its growth which lasts about 3 weeks, it cuts an exit operculum in the side of the seed and then pupates. Larvae moult four times before pupating.

Pupa: During the last larval instar, the feeding and pupation cell becomes externally visible as a circular window in the seed where the larvae feed on the lower testa surface. After pupation, the adult may remain in the cell for several days before pushing or biting out the window with its mandibles.

Life Cycle.

The egg stage lasts 6-7 days, combined larval and pupal stage 23 days. The life cycle requires 21 to 80 days, and the newly emerged adult makes an exit hole and leaves the seed. The adults do not eat legume seeds. They fly actively during the day at 70 °F or more.

This beetle belongs to the group of multivoltinebruchids so that if the seeds are stored in a particularly warm place, 2 to 3 generations can follow one another during the year, in addition to the summer generation which occurs in the field.

The adults having hibernated emerge from the seeds in April, do not feed and mate. The first generation adult appears in mid-July. As early as end of July, laying can begin on stored seeds.

Dried beans is a very important and preferred protein source of food for both vegetarians and non-vegetarians in India. Most often in a middle class society home makers in their pursuit of achieving excellence in multitasking are often hard- pressed for time and usually purchase for their home needs

in large quantities or make online purchases. Nevertheless they would not want to incur loss in terms of poor quality or compromise on nutritional needs of the family.

The present study intends to throw light on the degree of infestation of stored product pests on different varieties of stored beans .An attempt has been made to study the biology, life history of the stored product *Acanthoscelides obtectus* pest on different varieties of beans.

The adult bean weevils (*A. obtectus*) used in the experiments were maintained on commercial beans *Lablab purpureus* L. (Motchai seeds in Tamil-M seed variety) at normal room temperature for at least two generations.). They originated from a natural infestation developed on common beans Lablab *purpureus* L.

MATERIALS AND METHODS

Five bean varieties were used, their commercial names being Rajma-Sharmili(RS - seed variety), Rajma - Brown(RB- seed variety), Rajma-Red(RR seed variety),Butter Beans (B seed variety) all the four belonging to the genus *Phaseolus* ., And Motchai(M- seed variety) . The adult bean weevils (*A. obtectus*) were reared on all the mentioned bean varieties separately so as to interpret the influence of the rearing medium on the biology of the pest. The adult bean weevils (*A. obtectus*) were also reared on both the B and M seed varieties taken together in order to study if there was any preference of food varieties. In order to study the effect of light on breeding the adult bean weevils (*A. obtectus*) were also reared on RR and B seed varieties on the dark (in closed cupboards) .

At the start of this treatment, 512 beetles were chosen randomly from the base population and reared in 16 separate bottles with 100 bean seeds (that is each bottle contained 32 weevils whose sex ratio was determined by visual observation, generally it is 10 females :01 male). For each test two replicates were maintained. Insects were allowed to lay eggs for 3 days at room temperature. Following the insects were then (alive or dead) removed. Eggs were counted after 1 week. Daily observations were carried out under laboratory conditions concerning incubation period, duration of the evolution of larvae stages, pupal duration, and longevity of new adults. After 3 weeks these bottles were monitored closely until the first eclosion of adults began(the eclosion is recognized by windows on the seed testa). Beans with 1 to 3 windows (indicate low larval density). All the cultures were maintained at 30°C and 70% humidity-normal room conditions[4].

RESULTS:

The preliminary test with five bean varieties indicated that*A. obtectus* females were able to differentiate among different seed mass classes when egg-laying. They number of eggs laid per seed on the RR, RB, RS ,B and M seed varieties were on an average 18, 15 , 14, 05,and 11 respectively (Tables: 1 & 2). The average Incubation period was observed to be 10 days , 09 days , 11days , 16 days and 07 days

respectively .As the larvae were very minute and fed within, the duration of larval period and pupal period has been considered together and was observed to be 41 days , 43days , 46 days, 45 days and 33 days respectively The life cycle was completed within a mean period of 51 days , 52 days, 57 days , 61 days and 40 days likewise for the varieties RR, RB, RS, B and M seeds. Of the five varieties The M variety was the most preferred in terms of the average eggs laid and shortest life cycleand the least preferred was B variety .Of the Rajma –R variety the food preference was in the order RR, RB and RS respectively. The weevils when reared on the RR and B seed under the dark revealed a shorter lifecycle (Tables: 3 &4). The weevils when reared on the M and B seed varieties taken together also revealed a shorter lifecycle when compared to beetles reared on B variety alone (Table :5).The M seed was preferred over the B variety.

TABLE: 1. INFLUENCE OF DIFFERENT REARING SOURCES ON THE BIOLOGY OF *ACANTHOSCECLIDES OBTECTUS* SAY. REARING SOURCES

S. No.	Parameters	Rr Seeds	Rb Seeds	Rs Seeds	B Seeds	M Seeds	Replicates
1	No .Of Eggs Laid/Seed	15	14	12	4	9	Chamber 1
		20	16	16	6	12	Chamber 2
2	Egg Period [Days]	9	8	12	13	6	Chamber 1
		10	10	10	19	8	Chamber 2
3	Larval & Pupal Period [Days]	40	42	45	42	30	Chamber 1
		42	44	47	48	36	Chamber 2
4	Life Cycle[Days]	49	50	57	55	36	Chamber 1
		52	54	57	67	44	Chamber 2

TABLE: 2. INFLUENCE OF DIFFERENT REARING SOURCES ON THE BIOLOGY OF *ACANTHOSCECLIDES OBTECTUS* SAY. REARING SOURCES

S No	Parameters	Rr Seeds	Rb Seeds	Rs Seeds	B Seeds	M Seeds	
		Observed Values (Mean)					Expected Values
1	No .Of Eggs Laid/ Seed	18	15	14	5	11	20-40
2	Egg Period [Days]	10	9	11	16	7	7-20
3	Larval &Pupal Period [Days]	41	43	46	45	33	23-40
4	Life Cycle [Days]	51	52	57	61	40	21-80

TABLE: 3. INFLUENCE OF DIFFERENT REARING CONDITIONS ON THE BIOLOGY OF *ACANTHOSCECLIDES OBTECTUS* SAY. REARING SOURCES

S. No	Parameters	Rr Seeds	B Seeds	Replicates (Dark Conditions)
1	No .Of Eggs Laid/ Seed	18	8	Chamber 1
		21	10	Chamber 2
2	Egg Period [Days]	8	13	Chamber 1
		6	11	Chamber 2
3	Larval & Pupal Period [Days]	36	40	Chamber 1
		40	41	Chamber 2
4	Life Cycle [Days]	44	53	Chamber 1
		46	52	Chamber 2

TABLE: 4. INFLUENCE OF DIFFERENT REARING CONDITIONS ON THE BIOLOGY OF *ACANTHOSCECLIDES OBTECTUS* SAY. REARING SOURCES

Sr No.	**Parameters**	**RR Seeds**	**B Seeds**	**Rearing Conditions**
		Observed Values [Mean]		
1	NO .OF EGGS LAID/SEED	14	5	LIGHT
		20	9	DARK
2	EGG PERIOD [DAYS]	11	16	LIGHT
		7	12	DARK
3	LARVAL & PUPAL PERIOD [DAYS]	46	45	LIGHT
		38	41	DARK
4	LIFE CYCLE [DAYS]	57	61	LIGHT
		45	53	DARK

TABLE: 5 INFLUENCE OF DIFFERENT REARING SOURCES (COMBINED) ON THE BIOLOGY OF *ACANTHOSCECLIDES OBTECTUS* SAY.

Sr. No.	Parameters	Rearing Source Combined		
1	No .Of Eggs Laid Per Seed	B Seed	M Seed	Replicates
		2	8	Chamber 1
		3	12	Chamber 2
2	Egg Period (Days)	7		Chamber 1
		8		Chamber 2
3	Larval & Pupal Period (Days)	34		Chamber 1
		33		Chamber 2
4	Life Cycle (Days)	41		Chamber 1
		41		Chamber 2

DISCUSSION:

According to Săpunaru[5] the investigative research on evolution of bean weevil for 6 years (during 1994-1999) in the fields of the Laboratory for Plant Protection from the Agricultural Research Station of Podu-Iloaiei, Iaşi County and subsequent observations conducted on bean varieties Magna, Star and Avans, the duration of development stages (adult, egg, larva and pupa) was established, according to sum of necessary effective temperatures for each stage. The duration of the evolution cycle for a generation was established.

The evolution of the attack caused by bean weevil (*Acanthoscelides obtectus* Say) was investigated in six districts from Moldavia (Bacău, Botoşani, Iaşi, Vaslui and Suceava). The duration of egg-laying stage was between 8 and 10 days (1994), 9 – 12 days (1995), 9 – 17 days (1996), 8 – 12 days (1997), 9 – 15 days (1998) and 9 – 16 days (1999). The evolution of larva stage was comprised between 21 and 32 days (1994), 19 – 20 days (1995), 17 – 20 days (1996), 18 – 20 days (1997), 21 – 23 days (1998) and 19 – 23 days (1999). The pupa stage was between 13 – 15 days (1994), 13 – 15 days (1995), 10– 16 days (1996), 12 – 16 days (1997), 11 – 13 days (1998) and 13 – 15 days (1999).The period of new adults development was between 16 – 25 days (1994),15 – 20 days (1995), 13 – 15 days (1996), 16 – 18 days (1997), 13 – 15 days (1998) and 13 – 15 days (1999) .

The evolution cycle of species Acanthoscelides obtectus Say. comprised between 58 and 72 days (1994), 54 – 74 days (1995), 49 – 68 days (1996), 53 – 66 days (1997), 54 – 61 days (1998) and 54 – 69 days (1999).All these differences have been caused by the influence of abiotic factors, which acted on the population of bean weevil, under conditions of the Agricultural Research Station of Podu-Iloaiei , Iaşi County. The new adults were smaller in size[6]. For most of the seed weevils (Coleoptera: Chrysomelidae: Bruchinae), the ability to survive environmental stresses and reproduction is variable and depends on the host. The susceptibility of *A. obtectus* to the commercial pyrethroiddeltamethrin and clove and cinnamon essential oils as potential alternative insecticides was assessed and its reproductive performances (e.g., oviposition and emergence rates) on both host measured was . The females of *A. obtectus* reared on kidney beans were less susceptible to both deltamethrin and clove essential oil. Thus, with a change in hosts, a trade-off between reproductive fitness and the susceptibility to insecticides was demonstrated for *A. obtectus.* The results should affect the management of *A. obtectus* in storage units and also impart understanding of these insects' host adaptativeness[7].

As in the present study the bean weevil (*Acanthoscelides obtectus* Say.) has affected all bean varieties, the most affected ones being M seeds followed by S, RS, RB and RR *Phaseolus* sp. varieties respectively. The number of eggs laid was in accordance to the earlier observations that bigger the

seeds more the eggs laid .But since the weevils were taken from the parent culture raised on M seed variety there was a clear preference for M seeds ant the extent of damage was severe on M seeds. In a combination of M and S seeds the beetles clearly indicated a food preference of M seeds. The weevils laid 35 eggs on a single 260–270mg seed, and 13 eggs on a 60–70mg seed, many more than theseeds can support. Nevertheless the Soya seeds were also attacked. In the dark verses light treatment, this study indicated more infestation in the dark when compared to light. Larvae caused damages, by eating the inner side of grains. According to their size,1-26 larvae could develop in the grains. Grains became useless for consumption and sowing.

Acanthoscelides obtectus females were found to use seeds (discrete resource patches) differentially when different sizes were offered in multiple-choice tests. Females, either as a group or as individuals, laid significantly (two to six times) more eggs on large seeds than on those of five times smaller mass. In contrast, seed shape (flattened or spherical) did not contribute to clutch-size adjustment. Thus, *A. obtectus* females seem to measure only relative seed size when a comparison is possible. Nevertheless, females overload seeds with eggs and this can result in larval competition, so that, whereas resource size assessment and a robust egg-load adjustment indicate a trade-off between resource use and female fitness, it does not seem to provide much benefit for the progeny in stored dry beans. Several features, like the use of oviposition markers and its consequences, may counterbalance the possible negative effects. It is assumed that, due to life cycle differences,females in the bean field may realise different fitness gains in comparison with those living in stores[8].

The results indicate that *Aobtectus* females, either as a group or as individuals, discriminate between small and large seeds in a choice situation, and adjust clutch size accordingly: they lay significantly more eggs on large seeds and less on small ones[9].

Likewise in the present study the bean weevil females attach eggs to the surface only slightly, if at all; batches of eggs are laid randomly under seeds. The first-instar larvae have legs and move around to find a suitable site to enter a seed, it is important that the mother's decision as to site is governed by resource density, suitability of host and density of larvae. The adults of both sexes deposit oviposition-marking substances to cause a more uniform distribution of both eggs and first-instar larve. Yet over loading seeds with eggs, and as a consequence larval competition, is common in stored seeds. In contrast, some seedbeetles, and *A. obtectus* in particular, do respond to increased larval population level per unit resource with remarkable decrease in adult size[8]. The number of eggs laid was also reduced when combination of preferred food was provided. The findings is in accordance to the fact that the chance to select among a variety of available resources may not always beneficial.

It was found that a threefold increase in larval population resulted in 10% decrease in adult weight[10] .This was in accordance to the findings in the present study.

Food preference is only single criteria in assessing the suitability of stored product insects to various food fractions. Nonetheless it can be valuable in determining the probability that an insect will choose particular food product.

Thus it appears that texture may play an important role in an insects choice of one product over another. Other factors such as particle size and nutritional values may also play an important role in food preference[11.]

SUMMARY

Good Store hygiene plays an important role in limiting infestation by this species. The removal of infested residues from last season's harvest is essential. When lots of beans are stored, daily turning of the storage container can significantly reduce infestation .The storage container when maintained in dark revealed severe infestation. However this has to be statistically evidenced. The Butter bean seeds are less preferred and can be stored for a longer duration

Reducing storage temperature to < 10 º C significantly affects bruchid growth and reproduction because most are adapted to higher temperatures of 20-32 ° C. So storing beans in the freezer compartment of a refrigerator completely eliminates the insect in any of its stages.

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