UTILIZATION OF BIOLOGY AND COPULATION BEHAVIOUR IN MINIMISATION OF THE POPULATION BUILD UP OF

Caryedon serratus Olivier

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ABSTRACT

Groundnut bruchid(Caryedon serratus Olivier.) report to attack seeds and pods of about 44 leguminous trees and groundnut (Arachis hypogaea, L.). Among which groundnut is an important cultivated oilseed crop. The bruchid is a major pest of stored seeds and pods of tamarind (Tamarindus indica L.) and has become a threat to groundnut which is stored in bulk or bags in India. C.serratus, like other bruchids is unable to copulate in between the inter-granular spaces, when stored in bins or in jute bags. Under bulk storage, both the sexes after emergence from cocoons reach on the top of the seeds or pods and after copulation females start laying eggs on the host. This behaviour of the bruchid is well utilized in the prevention of the infestation as well as multiplication of the pest by applying 2.5 cm mechanical barrier of sand free from soil and grit on the top of the host in the bin which prevented the females to lay eggs as they are unable to penetrate through the sand mechanical barrier and gave cent per cent prevention from the attack of the bruchid.

When the pods and seeds of the host were stored in D.W.plain weave or D.W. Single weave (Hessian) types of jute bags, which are stretched by spiral method, the adults come outside and after copulation females lay eggs on the exposed seeds visible from the outside of the seams or from weaves. When the commodities were stored either B-Twill (Double-Twill) bags or A-Twill stretched with hem-helical method or A.Twill with bitumin paint with polyethelene lining inside and streched with crape paper with two straight lines seaming, it restricted the adults to go out for copulation and egg laying as there was no space left from two sides of seams and multiplication of the pest was checked cent per cent.

INTRODUCTION

Groundnut bruchind or borer, Caryedon serratus Olivier. (C.gonagra F.) report to damage the seeds and pods of numbers of trees mainly belonging to family leguminosae as well as the groundnut (A.hypogaea) under the storage conditions. The bruchid is a major pest of stored tamarind (T.indica) but has become a major threat to stored groundnut in tropical countries including India situated in between the latitute 40^{0} North and 35^{0} South.

Although the seeds of the groundnut under storage condition are damaged by Corcyra cephalonica, Plodia interpuntella, Ephestia cautella, Tribolium castaneum, Oryzaephilus surinamensis and Latheticus oryzae, but no problems of these pests were recorded on pods which are kept for seeds and was not having any mechanical injury. But C.serratus larvae characteristically bore through the dry shell of the nuts and after full development, the last

larval instar comes outside from the pods by making emergence hole and forms cocoons outside. Adults emerged outside start infesting pods or seeds by laying eggs of them. The holes made in the pods by the bruchid results in the secondary infestation of the pests mentioned above. This results in reduction of germination as well as quality of oil. Wightion et al. (1987) identified C.serratus as a potential pest of stored groundnut in India.

Now C.serratus has become a threat to seeds as well as oil industry as these are storing about 12 per cent and 80 per cent of the total production of the groundnut of the Gujarat State, respectively. In the year 1989, it was recorded for the first time infesting groundnut varieties (JL 24, GG 11 and GG 2) stored as pods for seed purposes in 30 kg D.W. single weave (Hessian) type of jute bags stretched with hem-helical method by various seed agencies and farmer's. Dick (1987) reported 20 per cent weight loss during 5 month storage of groundnut in oil factory at Andhra Pradesh.

A survey was made during the year 1965 in different ware-houses of various states of India i.e. Andhra Pradesh, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh, where C.serratus was found as a serious pest of seeds and pods of tamarind but no record of this pest was observed in the ware-houses at Mysore in Karnataka state, where the groundnut is stored after tamarind seeds which is generally infested by C.serratus (Mittal and Khanna, 1967). Balaganur (1988) reported C.serratus now as a potential pest of groundnut in the ware-houses of the Karnataka at Dharwad .

As pods of groundnut and tamarind seeds are mainly stored in containors or loose in heaps as well as in jute bags in India and C.serratus is a serious threat to pest of groundnut and tamarind in bag and bulk storage. Thus it is essential to study the weak points of the biology and copulation and oviposition behaviour of C.serratus those can be utilized in minimisation of build up of the population of the pest under bulk and bag storage. Considering this the present studies has been taken up.

MATERIAL AND METHODS

BIOLOGY AND BEHAVIOURAL ASPECTS OF ADULT OF C.serratus UNDER BAG AND BULK STORAGE

Effect of different types of jute bags on the oviposition of C.serratus

Smll jute bags (22cm long x 10 cm broad) prepared from different types of jute cloth i.e. D.W.Plain weave, D.W. Single weave (Hessian), A-will, A-Twill with bitumin paint with polyethene lining inside and B-Twill, stretched by hem-helical seaming methods were used in the present study. Sterilized tamarind seeds were filled in these stretched bags and afterwards each bag was placed separately in a glass jar (30 cmx 25 cm dia) in which 20 pairs of adult of C.serratus were released in the bottom. The jars were covered by a muslin cloth held with rubber band. After 15 days, observations were made for the number of eggs laid on the seeds exposed through the weaving in different types of jute bags.

Effect of different types of stetchings on the cross infestation of C.serratus

The sides of D.W.Single weave jute bags stretched by spiral method, hem-helical and crape paper with 2 straight line seaming methods were observed. Before stretching, the bags were filled with the infested tamarind seeds. These were having large number of eggs of the bruchid. Observations for the mature grubs and adults emerged out from sides of the stretching were made.

Effect of mechanical barriers on copulation behaviour of C.serratus

Twelve different materials, i.e. seeds of ragi (Eleusine coracona), talc, montmornite, khelsager, kaolin activated, kalin unactivated, tamarind keranel powder, activated clay, sawdust, coal ash,activated carbon and sand free from soil were used to test the mechanical obstruction offered by them to the

penetration of adult C.serratus. In glass jars (23 cm x 7.5cm dia), ten pairs of adults were released in each at the bottom and sterilized tamatind seeds were filled up to 15 cm height. A top layer of 2.5 cm thickness of each material was provided on the top of each jar which was covered by a muslin cloth held by rubber band. Similarly glass jar filled with seeds and 10 pairs of adults were released in the bottom of jar, but it was without mechanical barrier, served as control.

Effect of depth on the oviposition of C.serratus

A glass walled container (10 cms x 10 cms x 65 cms), open at both ends and provided with lids was employed. After closing the lower lid, the tamarind seeds were filled up to the depth of 62.5 cm and the upper lid was closed after releasing 10 pairs of adults. The experiment was repeated thrice. In each trial, after 20 days, seeds of five columns at 12.5 cm variation each was taken out from the lower lid. Total number of eggs laid on the seeds of respective columns were recorded.

RESULTS

BIOLOGY OF Caryedon serratus

The adults were able to copulate in the petri dishes under captivity. Under bulk storage conditions, they come up on the top of the seeds for copulations, as they are unable to copulate in interspace of seeds. In bag storage the adults usually come out from the spaces formed by stretches at both the sides, when the seeds are filled in them.

Under laboratory conditions no copulation was recorded during the day time, and the activities were only noted just at dusk and it was observed that adults of C.serratus copulate usually at dusk. Matings could invriably be observed only during 17.45 to 21.0 hrs., during the different months of year.

BEHAVIOURAL ASPECTS OF LARVAL AND ADULT OF C. serratus

Larvae: The first stage larva borer through the bottom of the egg directly and does not hatch outside. All larval stages confine their activities inside the galleries formed by them in the hosts seeds. The mature larva comes out from the seed by making an emergence hole and then pupate among the seeds or pods. Sometimes it also pupates at the emergence hole in which half of the cocoon is seen protruding out from inside the seed.

Under field conditions, the female lays eggs on the epicarp of tamarind fruit. Mature larvae do not come out of the fruit but spin cocoons in between mesocarp and epicarp of fruits. Sometimes they are found to fall down from the tree to the base of the trees, pupate on or inside the loose soil and form cocoons with soil particles adhered to. Sometimes in Acacia farnesiana, Acacia arabica and cocoons were found to adhere on the lower sides of the fruits hanging on the tree.

In bag storage, the mature larvae tend to accumulate near the seams or on the bags or migrate in cracks and cravices of the doors and form cocoons. In case they are unable to come out from the side of seams large number of cocoon spuned near the seams in side the bag. When the tamarind fruit stored in bamboo baskerts or crates it pupate by forming cocoons in the interspaces of thebamboo strips or wooden salbs. In bulk storage, the mature larvae penetrated mostly upto 10 cm depth and were unable to penetrate beyond 25 cm. depth of the seeds. Often times the seeds are held together so firmly by the cocoons form a hard, thick crust on the top of the container. In conditions of shade, the cocoons are attached outside the heap of seeds but in open sunny situations mature grubs migrate from the heaps to spun cocoons and pupate in some shady, cool place.

Adults: The adults have feign death, when touched or distrubed and have a tendency of taking shelter inside the empty cocoons shells for long periods. In general, they are good fliers and are thus able to lay eggs under field conditions on pods as high as 35 feet on the trees. Copulation is affected only in open or on the top layer of the seeds and not in the intergranular spaces, usually after dusk (vide

infra). Thus inbag-storage, adults coming out for copulation, oviposition the seeds exposed by stretched openings along seams or interwoven spaces, being unable to re-enter the bags.

Effect of different types of jute bags on the oviposition of Caryedon serratus

No eggs were laid in B-Twill, A-Twill with bitumin paint with polyethene lining but maximum number eggs 320.66 were laid per 20 females in D.W. Plain weave egg followed by D.W. Single wap(61.33) eggs.

Effect of different types of stretching on the cross infestation of C.serratus

When sides of D.W. Single weave jute bags stretched different method i.e. spiral method, hem-helical and crape paper with 2 straight line seaming methods. It was observed that adults and mature grub of C.serratus could come out from spaces made from the side of bag in case of spiral method but none could come out from bags stretched either by the hem-helical method or by crape paper with 2 straight line seaming.

Effect of mechanical barrier on copulation of C.serratus

In all the twelve material i.e. seeds of Ragi (Eleusine coracana), talc, montmornite, khelsager, kaolin, activated, kaolin unactivated, tamarind kernel seed powder, activated clay, sawdust, coal ash and activated carbon and sand free from soil and grit used as mechanical barrier. The bruchid could come on the top of the seeds and pass the 2.5 cm layer of mechanical barrier for copulation in open, but were unable to reenter through the barrier to reach the seeds for oviposition and eventually died on the surface of the barrier. No eggs were recorded on the seeds having mechanical barrier. In control, the adults copulated and oviposited normally.

Effect of varying depth in bulk storage on oviposition of C.serratus (Table 1)

Table 1. *Effect of varying depth in bulk storage on the oviposition of C.serratus*

Sl. No.	Depth range(cms)	No. of seeds in the column				Total No.of egges laid in the column				Percentage of total eggs
		I	II	III	Total	I	II	III	Total	
1.	12.5	188	179	192	539	140	196	137	473	85.5
2.	12.5-25.0	184	190	189	563	10	22	16	48	8.7
3.	25.0-37.5	181	182	195	556	5	8	7	20	3.6
4.	37.5-50.0	186	186	182	554	3	3	6	12	2.2
5.	50.0-62.5	188	185	181	554	-	-	-	-	0.0
Total		923	922	939	2268	158	139	226	553	100.0

DISCUSSION

In the present studies adults of C.serratus were found sextually mature just after emergence from cocoons and upto sixty per cent of adults copulation on the day of emergence and eighty per cent within 4 days of emergence from cocoons.Corby (1941) reported that the adults of C.serratus adults are unable to move freely during mating in between in the granular spaces. Davey (1958) found that the copulation of bruchid is not possible in confined place and it is only possible on the surface of nuts. Conway (1983) found that adult emergence, mating and oviposition occured at considerable depth within bulk or bag stacks but fabric of jute bags greatly restricted the movement of adults into and out of bags. During the

present studies it was found that the adults of C.serratus under bulk storage, were unable to copulate in between the inter granular spaces and has to come out on the top of the seeds or pods for copulation and after copulation the female goes inside for egg laying.

In all the tested mechanical barriers non copulated adults released in the bottom of seeds, reached on the top through barrier for copulation but unable to re-enter through the barrier to reach the seed of oviposition, eventually died on the surface. In control, adults copulated and oviposited normally. Out of mechanical barriers used, recommendation for the use of 2.5cm thick sand mechanical has been made as it is easily available, economically cheap, can be easily seperated from nuts or seeds not adhering to them, and also not absorbing moisture from atmosphere. This also helps in protecting nuts and seed form infestation and further build of the bruchid population.

Under bulk storage the adults of C.serratus laid most of the eggs on the top layer of tamarind seed and about 85.5 per cent of the total laid upto 12.5 cm depth, while the eggs laid upto 25 cm depth constituted 94.2 per cent of the total eggs laid. Adults were found upto the 50 cm. In Gambia infestation of C.serratus in the heap of groundnut upto 15 to 20 cm depth and 59 per cent surface were recorded. Samples below 25 cm depth were having only 30 per cent infestation by eggs and 1.8 per cent by matured grubs. Th infestation in groundnut was recorded upto the depth of 91.44 to 182.44 cm in Gambia (Green 1960) and Giard (1957) found adults of the bruchid upto 50 cm depth.

In case of bag storage, when the seeds of tamarind infested by C.serratus are filled in jute bags stretched by spiral method of seaming, the adults and matured grubs come outside from the spaces from both the sides of seam. Adults after coming out side, start copulation and females lay eggs on the visible seeds on the side of seams. Similarly the matured grubs also come outside and form cocoons mainly on the side of seams or on the bags. The adults as well as matured larvae are unable to come out from the bags, those are stretched by hem-helical or crape paper with two straight seamings methods from which the adults after emergence from cocoons in side bags, remain inside the bag and are unable copulate as they are not able to go out of the bag due to which oviposition is completely ceases and population build up and multiplication of the pest is completely stops. The matured larvae after emergence from seeds forms cocoons near the seams inside. Type of jute bag used for storing the pods or seeds also play an important role in the oviposition of C.serratus. Maximum oviposition 320.66 eggs per 20 females of the pest was recorded in the bags made from D.W.Plain weave followed by D.W. Single was (Hessian) (161.33 eggs/20 females). In case of B-Twell, A-Twell or A-Twell with bitumin paint and polythene lining inside, no eggs were laid and all these restricted the oviposition of C.serratus and helped in minimisation and multiplication of the pest and build up its population. Paintel and Yacink (1979) reported that the bruchid infestation in Senegal mostly on the edges of stock of groundnut.

Thus from above two experiments it is clear that B-Twell, A-Twell or A-Twell with polythene lining bag stretched with hemhelical method of or crape paper with two straight seamings will give complete protection of from the infestation as well as further population build up of C.serratus. Further the seed agencies those are generally using D.W.Plain weave type of jute bags, if replace it by B-Twell or A-Twell stretched hem-helical method of seaming is able save their seed from infestation of the bruchid as these bag not only obstracting in egg laying as well as in the emergence of adults and matured larvae from the side of seams and avoid further multiplication of pest which will minimise the population build up of the pest.

A.farnesiana found to have all stages of development of C.serratus from April to December and it is a potential source of infestation for groundnut pods as the adults emerge from the cocoons, can infest the pods by laying the eggs on them under field conditions when the groundnut is left in the field for drying purposes in the month of September and onward. Up rooting of A.farnesiana bush in groundnut growing areas will help in avoiding the field infestation of groundnut pod by C.serratus. Bridwell (1919) from Hawaii also reported A.farnesiana pods to harber the infestation of the bruchid, C.serratus. While the field infestation of tamarind pods by the insect was recorded (Cotes, 1896), Ghosh (1919), Sagot and Bouffil (1935), Mittal and Khanna (1967) on Bauhinia pod in month of March and April (Stebbing, 1914) and also on

Cassia sp. (Fletcher, 1914), A.arabica pods, Mittal and Khanna (1967) Newly harvested crop of groundnut were found infested by C.serratus in Senegal (Corbey, 1941) and in Gambia (Green, 1960). In Gujarat the infestation of the groundnut bruchid was recorded for the first time in year 1989 on pods of groundnut which were kept for seed in D.W.Plain weave stretched by hem-helical method. The question arises from which source the infestation of C.serratus reached to these pods, when the bag used for filling material were new, no infestation of the pest was recorded in the store, where the bags were kept, nor in the stores the tamarind infestated by the bruchid was kept. Only possible source of infestation which left is the field infestation C.serratus which might have come from field after laying of eggs on new harvested pod of groundnut, kept for drying in the field and reached stores after harvest. As the infestation in the pods of the bruchid reaches from the field, it is necessary to fumigate new arrival of tamarind seeds and pods of groundnut with aluminium phosphide to check the further multiplication of the C.serratus (Mittal and Gupta 1978).

During the present studies the adults were not found copulating during the day time, but copulation was only found at dusk in different of the months of year from February to December in between 17.45 hrs. to 21.0 hrs. As the large numbers of adults of C.serratus come out during dusk, outside on the bags it is advisible to spray insecticide i.e. fenthion, endosulfan, lindane, malathion, aldrin, dichlorovos those were reported 82.41, 53.72, 48.24, 39.67, 67.11, 60 and 11.47 times more toxic than carbaryl to the adults of C.serratus Gupta et al. (1976).

CONCLUSION

Destruction of Acacia farenciana bushes and harvesting of pods of Tamarindus indica and Acacia arbica before the month march will avoid the field infestation in groundnut in the field. Before storing in bulk or bags storage the pod of groundnut pod or seeds of tamarind be fumigated by aluminium phosphide. In bag storage the pods or seeds should be filled in A-Twell or B-Twell or A-Twell with polyethene lining stretched with hem-helical or crape paper with two straight seamings. Avoid storing nuts in D.W. Plain of the weave r D.W. Single wap (Hessian) bags. In none of the types of jute bags spiral method of seaming be used. In bulk storage application of 2.5 cm mechanical barrier of sand free from soil grit on the top of the host in the bin is recommended. Further treatment of top 50 cm layer with insecticides and spraying of the recommended insecticide at dusk can be useful in decreasing infestation and further multiplicate and population build up of the C.serratus.

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LA CONNAISSANCE DE LA BIOLOGIE ET DU COMPORTEMENT DE *CARYEDON SERRATUS* (BRUCHIDAE : COLEOPTERA) POUR EN REDUIRE LES INFESTATIONS

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RESUME

La bruche des arachides (*Caryedon serratus* Fab.) est réputée pour attaquer les semences et les gousses d'à peu près 44 légumineuses et arachides représentant d'importantes récoltes d'oléagineux. La bruche est un des principaux parasites des semences et des gousses de tamarin (*Tamarindus indica* L.) et devient une menace pour les arachides (*Arachis hypogea*) qui, en Inde, se stockent en vrac ou en sacs. *C. serratus*, est incapable de pénétrer dans les semences pour s'accoupler, lorsque les stocks sont constitués par des caisses ou des sacs en jute. Dans le cas des stocks en vrac, les deux sexes, après émergence, atteignent le sommet des tas de graines ou de cosses et, après accouplement, les femelles commencent à pondre sur l'hôte. Dans le cas de sacs en jute, en tissage D.W. simple ou d'une seule épaisseur (Hessain), renforcés par la méthode hémispiralée, les adultes en sortent. Après accouplement, les femelles pondent sur les semences exposées, visibles à travers les coutures ou la toile. Ce comportement de la bruche est utilisé dans la prévention de son infestation ainsi que de sa multiplication, en interposant un barrage mécanique de 2,5 mm de sable non contaminé par de l'huile, sur la couche supérieure des caisses, ce qui empêche les femelles de pondre, puisqu'elles sont dans l'impossibilité de traverser le barrage, et ce qui autorise une prévention 100 % efficace. Lorsque les stocks sont, soit en sacs B-T Will (sacs doubles T Will), soit en sacs A-T Will renforcés par une peinture au bitume contenant une couche de polyéthylène interne ainsi qu'un renforcement en papier avec deux coutures en ligne droite, les adultes ne peuvent sortir pour s'accoupler parce qu'il ne reste plus de place sur le bord des coutures. Ainsi, l'infestation et la multiplication sont éliminées à 100 %.