

ECOLOGICAL STATUS OF STORE BRUCHIDS AND ITS
BEARING ON PHYLOGENY

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Available information on the breeding pattern of common species of store bruchids throws important light on their ancestral history and phylogenetic relationships. *Callosobruchus maculatus* (Fabr.), well known for its dimorphism, is a cosmopolitan species and breeds in the field or in the store in different parts of the world. The two morphs also show variable behaviour in these areas. *C. chinensis* (Linn.) conforms to a similar breeding pattern. Both these species are strictly restricted to stores in India, but their capability of breeding in the green pods under experimental conditions reflects their original field relations. *Zabrotes subfasciatus* (Boh.) and *Caryedon serratus* (OL.) can also breed in the field as well as in the store. *C. analis* (Fab.), on the contrary, does not attack its host plant in the field even under experimental conditions. Its general resemblance and close relationship with *C. maculatus*, coupled with its restriction to the store, is a clear indication of its origin from the versatile *C. maculatus* in the store. Whereas other species of bruchids appear to have migrated from the field to the store and show a tendency of returning to field breeding, *C. analis* seems to have speciated in the store itself.

INTRODUCTION

Edible legumes are attacked in India by four species of bruchids viz., *Callosobruchus maculatus* (Fabr.), *C. analis* (Fab.), *C. chinensis* (Linn.) and *Zabrotes subfasciatus* (Boh.). A number of observations have been made on the biology and ecology of these species in this laboratory (Arora and Pajni, 1957, 1959; Arora *et al.*, 1967; Pajni and Singh, 1970; Pajni and Jit, 1976; Pajni and Mann, 1979; Kapoor, 1980; Pajni and Tewari, 1986; Sharma, 1983; Nanda, 1983; Pajni and Jabbal, 1986) as well as a few others (Khan *et al.*, 1942a, 1942b; Ishii, 1952; Srivastava and Bhatia, 1959; Rajak and Pandey, 1965; Teotia and Singh, 1966; Gokhale and Srivastava, 1969, 1973, 1975; Raina, 1970; Gokhale, 1973, 1976; Yadav and Pant, 1978; Southgate, 1979; Vir, 1980; Vir and Jindal, 1981; Decelle, 1981; Hariri, 1981; Yadav, 1985). These observations have revealed a general similarity in the biological characteristics of the three *Callosobruchus* species and their distinct status from *Zabrotes subfasciatus*. Among the species of *Callosobruchus*, *C. maculatus* and *C. analis* show clear relationship and their appreciable differences from *C. chinensis*. A critical analysis of the biological, ecological and morphological characteristics of these species throws important light on their phylogenetic relationship which are detailed in the present communication.

MATERIAL AND METHODS

These studies have been conducted on laboratory bred cultures and numerous samples collected from all over the country during last 33 years. Specific observations were however, largely made during 1982 - 1986, under a four year research project financed by Department of Science and Technology.

RESULTS AND DISCUSSION

Callosobruchus maculatus is a widely spread species which attacks a large range of host seeds (Pajni, 1986). The species is strongly dimorphic and appears in two distinct forms. One of the forms is dominant in the dry and hot months and is completely sterile (Arora and Pajni, 1957, 1959). Its activities are restricted to the stores and there is no record of its development in the field. *Callosobruchus chinensis*, though morphologically very different from *C. maculatus*, shows a broad resemblance in its activities. The polymorphism in this species is restricted to the females only with the morphs showing differences in appearance and fecundity but without occurrence of complete sterility in any form.

It has been observed that under experimental conditions both *C. maculatus* and *C. chinensis* can breed successfully on their hosts in the field. The eggs are laid on the pods and the adults emerge by making holes in the seeds as well as in the pods. The capability of these species to breed successfully in green host seeds coupled with the reports of their field activity in other areas (Decelle, 1981; Taylor, 1981), confirms the original field connection of these two species. Moreover it has been also reported that in certain regions like Africa (Taylor, 1974) and Japan (Utida, 1976), the flight form of *C. maculatus* is more active, less fecund and migrates from the store to the fields where it breeds on the standing host plant. Accordingly the recurrent visits of these two store species to the fields confirms the general view that most of the pests of stored products have originally shifted from the field and established in the stores (Levinson, 1984).

The case of *Callosobruchus analis* is quite different from the other two species of this genus. This species has not been so reported so far attacking any

grain host plant in India or any other country. Most significantly the species fails to breed on green host plants even under experimental conditions. It is, therefore, obvious that this species has no field history and has instead speciated in the store. The noted dominance of *C. analis* in the south and south east Asia, perhaps indicates the area of its origin (Decelle, 1981). It is also felt that *C. analis* is closely related to *C. maculatus* not only in general morphology but also in the biological and ecological characteristics. It can thus be concluded that *C. analis* has perhaps originated from the store cultures of *C. maculatus* and is therefore, relatively a much later phenomenon than *C. maculatus*.

One morphological feature in the genus *Callosobruchus*, absent in the abnormal form of *C. maculatus*, is a point of great importance. As a rule, the saccus region of the endophallus bears a pair of differently dented oval plates (Arora, 1977 ; Arora and Pajni, 1959). However these paired plates occur only in the so called abnormal or sterile morphs of *C. maculatus* and not in the normal morphs. This is an indication that the present day normal morph of *C. maculatus* is a more adaptive mutant of the original form which is losing reproductive capacity on account of overcrowding and inbreeding.

Zabrotes subfasciatus, supposed to be of neotropical origin (Decelle, 1981), is quite widespread in India. In this country it attacks its major host seed, *Phaseolus vulgaris*, but it restricts its activities to the store only. In other areas, the pest known is known to breed both in the field as well as in the stored seeds of *Phaseolus vulgaris* and several other legumes from genera *Phaseolus* and *Vigna* (Pierre and Pimbert, 1981).

The restriction of the pest to the store indicates that the species has entered during recent times and it might ultimately also establish in the field in other parts of the world.

The reproductive behaviour of *Caryedon serratus* (OL.) also points to the earlier field activity and the present day breeding in the store. This pest attacks a number of *Cassia* and *Acacia* spp. in the field (Arora, 1977). It also attacks *Tamarindus indica* in the field but breeds equally well in the stored host seeds (Pajni and Mann, 1979). The same species is a major pest of stored groundnuts in Africa (Davey, 1958), but there is no record of its attack on groundnuts in this country. At the same time, the pest breeds both on whole and shelled groundnuts under experimental conditions in the Laboratory. It is therefore, evident that, originally a pest of field legumes, *Caryedon serratus* is slowly exploiting the stored materials.

The ecological relationship and biological characteristics of these five species of stored bruchids thus throw important light on their origin and migration to other areas. The strict adherence of *C. analis* to the stored legumes reveals that it has possibly speciated in such conditions.

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LE STATUT ECOLOGIQUE DES BRUCHES DES DENRES STOCKEES ET SON ASPECT PHYLOGENIQUE

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RESUME

L'information disponible concernant les aspects du développement d'espèces communes de la bruche des denrées stockées met en évidence leur cycle de vie ancestral et leurs relations phylogénétiques. *Callosobruchus maculatus* (Fabr.), bien connue pour son dimorphisme, est une espèce cosmopolite qui se développe dans les champs et dans les stocks dans de nombreuses parties du monde. Les deux formes font preuve de comportements différents dans ces mêmes zones. *C. chinensis* (Linn.) se conforme aussi à de tels schémas. En Inde, ces deux espèces se limitent strictement aux stocks. Mais leur capacité à se multiplier sur les gousses vertes en milieu expérimental reflète leur appartenance à leur milieu naturel d'origine. *Zabrotes subfasciatus* (Boh.) et *Caryedon serratus* (O1) peuvent se développer dans les champs comme en stocks. *C. analis* (Fab.), au contraire, ne s'attaque pas à son hôte en champ, même en milieu expérimental. Son aspect général se rapprochant de *C. maculatus* ainsi que sa limitation aux stocks, indiquent clairement qu'elle provient de la très adaptative *C. maculatus* de stock. Tandis que d'autres espèces apparaissaient après avoir migré du champ au stock et montrent une tendance à y retourner, *C. analis* semble s'être spécialisée dans les stocks seuls.