Bulletin de la Société entomologique de France, **113** (3), 2008 : 355-358.

Seed weight and oviposition site selection in the genus *Caryedon* (Coleoptera, Bruchidae)

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Summary. – Our purpose is to study the effect of seed weight on oviposition site selection by females of two African species of *Caryedon.* Egg distributions among hosts are compared. The results indicate a significant positive correlation between the number of eggs on a seed and its weight.

Résumé. – **Poids des graines et choix du site de ponte dans le genre *Caryedon* (Coleoptera, Bruchidae).** Nous étudions l'effet du poids des graines sur le déterminisme du choix du site de ponte par deux espèces africaines de *Caryedon*. Les distributions des œufs sur les différents substrats de ponte sont comparées. Les résultats révèlent une corrélation positive significative entre le nombre d'œufs sur une graine et le poids de cette graine.

Key words. – Bruchidae, *Caryedon*, oviposition site, seed weight, selection.

The observation of the distribution of herbivorous insects among available hosts plants supplies us with a set of precious information about the strategies operated by females to use available resources with the best possible return. In Seed Beetles (family Bruchidae), it is the female which determines the plant on which its descendants will make its post-embryonic development. Previous observations made in Senegal on several species of beetles belonging to the genus *Caryedon* showed that there is no exact concordance between the possibilities of embryonic development in a given seed and the choice by the female of the seed on which oviposition is performed (DELOBEL *et al.*, 2000). The species, genus or family to which the plant belongs plays an obvious role in the determination of the site of egg laying (see for example JERMY & SZENTESI, 2003). Female bruchids probably identify the seeds which will be convenient for larval development through allelochimical substances produced by the plants. There are cases however when the female oviposits on seeds which do not allow the embryonic development (DELOBEL *et al.*, 1995), even on pebbles (JOHNSON, 1988, SIEMENS *et al.*, 1991, DELOBEL *et al*., 2000). It may therefore be assumed that additional factors play a part in the identification of an object as a possible support of oviposition. Surface texture is classically mentioned (RAINA, 1971 ; DELGADO *et al.*, 1997), but colour, shape or size probably also have their importance.

We tried to identify the perception that females of some species of *Caryedon* have of the weight of their host plants seeds. The weight of the seed was chosen as a criterion of size, rather than the volume of the seed, because of the ease of its evaluation. On the other hand, we noticed that the females of *Caryedon* have a certain perception of the weight of the seed : immature seeds, containing an incompletely developed embryo, are generally rejected by females, which could indicate that the dimensions or the volume of a seed are not the only occurring criterion, but that they are capable of perceiving in a certain way the "density" of seeds.

We present here the results of a study held in the laboratory in order to assess the importance of seed weight as a factor determining the choice of *Caryedon* females.

MATERIAL AND METHODS

Two species of *Caryedon* were involved in the study : *Caryedon dialii* Decelle, consumer of seeds of *Dialium guineense* ; *Caryedon longispinosus* (Decelle, *in litt*.), consumer of seeds of *Acacia raddiana* Savi and *Acacia senegal* (L.)Wild. (DELOBEL *et al.*, 1995). *C. dialii* was

obtained from the seeds of *D. guineense* collected in the Ziguinchor area (12° 34' N, 16° 17' W), *C. longispinosus*, from seeds of *A. raddiana* collected in the Louga area (15° 36' N, 16° 14' W) . *D. guineense* has indehiscent pods and *A. raddiana* dehiscent pods : the pods of *A. raddiana* half-open at maturity, while they are still on the tree.

Seeds samples were sorted out ; seeds broken, infested by a bruchid or a Lepidopteran larva or immature were thrown back ; seeds were kept at -18°C until 1 week before their use. 25 pairs of *C. longispinosus* and 6 pairs of *C. dialii* were respectively brought together with healthy seeds of *A. raddiana* and *D. guineense*, respectively, in plastic boxes (12 cm in diameter and 14 cm in height), with a lid provided with a fine wire netting. As adults were not fed, oviposition continued up to the death of all the females, which occurred in about 12 days. Approximately one week after the death of females, the number of eggs deposited on every seed was recorded. The observed distribution was compared with a theoretical distribution of Poisson having the same mean and a negative binomial distribution having the same mean and variance. We meet the distribution of Poisson when a body has equal chances to be in each of the sampled sites, that is when the presence of an individual in a site does not reduce nor increases the chances of another individual to be in the same site (WADLEY, 1950). The negative binomial distribution corresponds to situations where the aggregation of the bodies occurs in certain sites. Seeds were individually weighed by means of a balance Sartorius™ ME30.

RESULTS

Weight of seeds. – Parameters of the weight of seeds of *A. raddiana* and *D. guineense* are presented in table I. The seeds of *D. guineense*, much heavier, also had much more homogeneous weights.

Table I. – Weight of *Acacia raddiana* and *Dialium guineense* seeds.

	Mean weight (mg ± standard variation	**Median**	**Minimum**	**Maximum**
A. raddiana	77,5 ± 14,4	75	24	126
D. guineense	167,8 ± 22,6	171,5	99	207

Table II. – Distribution of *Caryedon longispinosus* eggs on *Acacia raddiana* seeds.

Number of eggs	**Number of seeds**	**Mean of seed weight**	**Poisson**	**Negative Binomial**
0	636	72,42	595,1	629
1	265	83,65	325,3	278,7
2	90	88,62	88,9	88,2
3	31	94,94	16,2	24,2
4	6	94,67	2,2	8,0

Table III. – Distribution of *Caryedon dialii* eggs on *Dialium guineense* seeds.

Number of eggs	**Number of seeds**	**Mean of seed weight**	**Poisson**	**Negative Binomial**
0	18	160,4	21,7	22,8
1	33	165,5	25,4	24,5
2	14	177,5	14,9	14,2
3 to 6	5	181,6	8,0	8,5

Distribution of eggs. – Oviposition of *Caryedon longispinosus* on *A. raddiana.* On the whole, 562 eggs were laid by 25 females on 1028 seeds, that is on average 0.547 eggs per seed (table II). The observed distribution (fig. 1) differed significantly (χ^2 = 34,0 ; P = 0,001) from a Poisson distribution with same mean. It did not depart significantly (χ^2 = 3,23 ; P = 0,05) from a negative binomiale distribution of same mean and variance. There was a highly significant positive correlation between the number of eggs on a seed and the weight of this seed (r = 0,465 ; critical value for P = 0,001 and 1026 d.d.l. < 0,254).

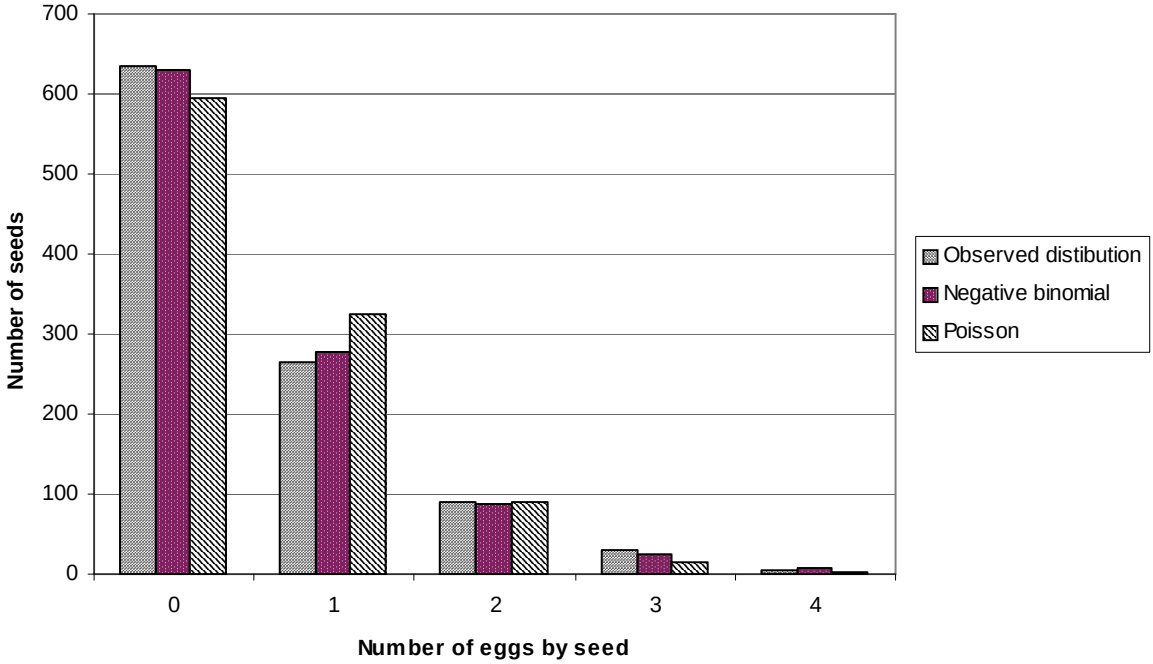

Fig. 1. – Eggs distribution by the 25 females of *Caryedon longispinosus* on 1028 *Acacia raddiana* seeds, compared to Poisson and negative binomial distributions.

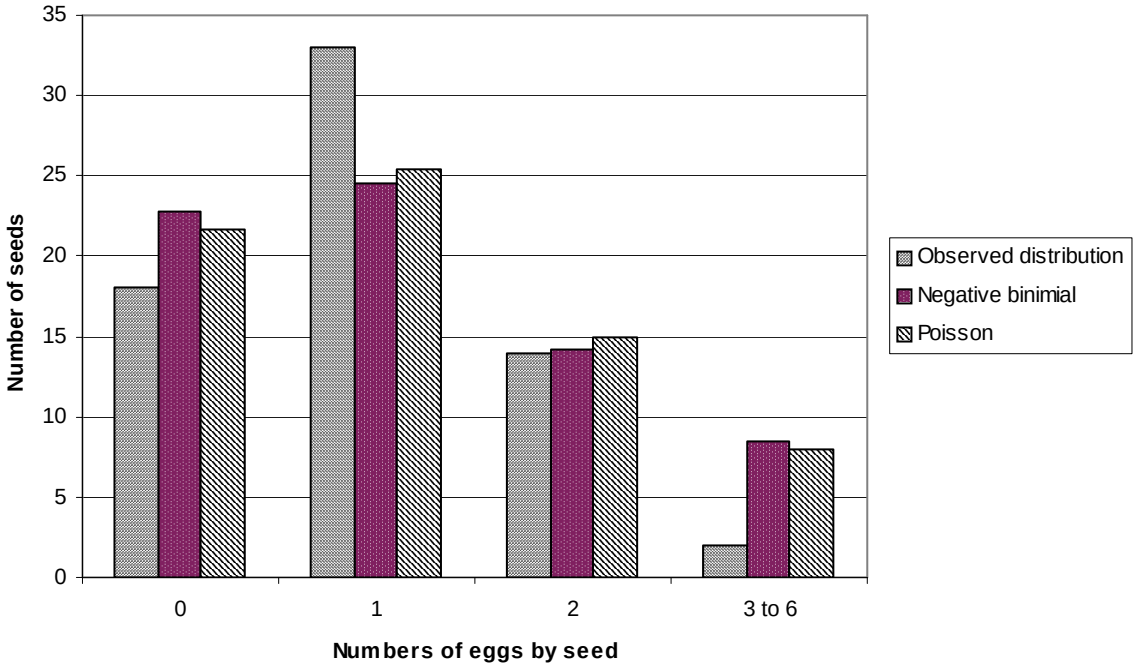

Fig. 2. – Eggs distribution by the 6 females of *C. dialii* on 70 *D. guineense* seeds, compared to Poisson and negative binomial distributions.

Oviposition of *Caryedon dialii* on *Dialium guineense.* 82 eggs were laid by six females on 70 seeds, that is on average 1.171 eggs per seed (table III). The observed distribution (fig. 2) did not differ significantly (χ^2 = 4,1 ; P = 0,05) from a Poisson distribution having the same mean. It did not depart significantly either (χ^2 = 5,4 ; P = 0,05) from a negative binomial distribution with same mean and variance. There was a significant positive correlation

between the number of eggs on a seed and the weight of this seed (r = 0.285 ; critical value for P = 0,05 and 68 d.d.l. : 0,232). We noted that 13 seeds weighing over 184 mg (that is 18.6 % of seeds) bear at least an egg ; the smallest seeds (weighing 99 and 117 mg) bear each an egg.

DISCUSSION

In *Caryedon longispinosus*, the distribution of eggs is in accordance with a binomial distribution, and not with a distribution of Poisson. With regard to the latter (random distribution), we indeed observe in this species an excess of seeds bearing no egg or more than two eggs, and on the contrary a deficit of seeds bearing one or two eggs. This indicates that the distribution of eggs on seeds given to the females is not regular, because in that case females would tend to deposit only a single egg by seed. Such a behaviour is associated to the possibility of identification of seeds already bearing an egg, possibly thanks to a pheromone of marking of eggs. It was put in evidence in certain Bruchidae, as *Callosobruchus maculatus* (F.) (MESSINA & RENWICK, 1985). We note on the other hand that eggs are not laid randomly on all the seeds, because certain seeds are preferred to the others. The examination of oviposition according to the weight of seeds shows that, in both species, heavier seeds receive an abnormally high number of eggs.

The distribution of eggs of *C. dialii* differs neither from a Poisson, nor from a negative binomial distribution. This absence of significance may be related to the weakness of samples. However, the examination of tab. III reveals an excess of seeds bearing only one egg, and a deficit of seeds bearing no egg or no more than two eggs. This seems to indicate in females of *C. dialii* a certain capacity of discrimination of seeds already bearing an egg. The fact that the seeds of *D. guineense* show a narrower weight range than is the case in acacias may also be important : in the absence of very small or very large seeds, oviposition divides up more regularly on all available seeds than in the case of *C. longispinosus* and *C. mauritanicus*.

ACKNOWLEDGEMENTS. – The authors thank S. Piry for helpful collaboration. This study is partially supported by International Fondation of Science (IFS).

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