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Population Dynamics, Gregarious Behavior and Oviposition Preference of *Neomegalotomus parvus* (Westwood) (Hemiptera: Heteroptera: Alydidae)

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ABSTRACT

Interactions between Neomegalotomus parvus *(Westwood) (Coreoidea: Heteroptera: Alydidae) and host plants were investigated including population monitoring throughout the year, gregarious behavior in the field, and oviposition preference among host plants and one non-host plant in field cages.* Cowpea, Vigna unguiculata *(L.) Walp., soybean,* Glycine max *(L.) Mill. cv. BR 37, pigeon pea,* Cajanus cajan *(L.) Mill., pigeon pea cv. Anão, and lablab,* Dolichos lablab *L. were monitored in the field. N. parvus was found on host plants during 11 months. The shortest period of occurrence was observed on soybean and the longest on lablab. Insects were found mostly on mature pods. Contagious distribution (negative bionomial) was detected, characterizing the aggregation. Greater number of eggs were observed on pigeon pea, followed by soybean and lablab. Eggs were not found on cowpea, on common bean* Phaseolus vulgaris *L., and on rice,* Oryza sativa *L.*

Key words: Hemiptera, Alydidae, host plants, phenology, oviposition

INTRODUCTION

The broadheaded bugs (Coreoidea: Hemiptera: Alydidae), particularly species of the genera *Alydus*, *Riptortus,* *Megalotomus* and *Neomegalotomus*, are seed-sucking insects oligophagous on leguminous plants (Schaefer, 1980; Schaefer and Mitchell, 1983). The genus *Megalotomus* occurs only in the Northern Hemisphere (Schaeffner and Schaefer, 1998). The Neotropical species belonging to *Megalotomus* were grouped in the new genus *Neomegalotomus* (Schaefer and Panizzi, 1998; Schaffner and Schaefer, 1998). Besides the species *parvus*, *N. latifascia* (Berg), *N. pallescens* (Stål), *N. consobrinus* (Westwood), and *N. debilis* (Walker) were transferred to the *Neomegalotomus* genus (Schaefer and Panizzi, 1998; Schaffner and Schaefer, 1998).

N. parvus adapted to the plants introduced in the Neotropical region [e.g., common bean, *Phaseolus vulgaris* L. (Paradela F^{o}. et al., 1972; Chandler, 1984; 1989), soybean, *Glycine max* (L.) Merrill. (Panizzi, 1988), pigeon pea, *Cajanus cajan* (L.) Mill. and lablab, *Dolichos lablab* L. (Santos and Panizzi, 1998b)]. The species has reached pest status on common bean (Paradela Fo. et al., 1972; Chandler, 1984; 1989) and soybean (Santos and Panizzi, 1988a). The insect adaptation on new host plants, mainly soybean, was favoured by the easiness of finding the plants as extensive monocultures, and for the minor incidence of

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natural enemies in relation to wild hosts (Schaefer, 1998). According to this author, the adaptation of *N. parvus* to introduced legumes would be predictable due to the Alydidae association with Leguminosae.

Previous knowledge of the interactions of *N. parvus* with host plants are restricted to laboratory behavioral and biological studies (Panizzi, 1988; Santos and Panizzi, 1998b; Ventura and Panizzi, 2000; Ventura et al. 2000) and damage (Paradela F^{o} et al., 1972; Santos and Panizzi. 1998a). Aiming to study the relationships with its host plants, populations were monitored in the field throughout the year; the gregariousness of the species in the field and the oviposition preference among host plants and one non-host in field cages was also studied.

MATERIAL AND METHODS

Population Dynamics. Once a week from December 1996 to November 1997, nymphs, males and females were monitored on host plants in the Embrapa-Soja experimental fields, Warta County, in Londrina, PR, Brazil (latitude 23^{o} 19'S, longitude 51^{o} 12'W). The observations were carried out on cowpea, *Vigna unguiculata* (L.) Walp.; soybean, cv. BR 37; pigeon pea c.v. 'Anão'; lab-lab, and pigeon pea. Observations were made visually during 10 minutes (carefully for not disturbing the insects) from 9:00 to 10:00 am quantifying the number of insects and plant structures on which they were located. Field monitoring was initiated at the onset of pod because preliminary observations indicated that insects enter the crop field at this time.

Aggregation Behavior. The population distribution was studied on a pigeon pea field. The sample units (n = 103) were defined using a circumference (ray = 1 m). Observations were repeated during five dates. The Index of Morisita was used to characterize the aggregation behavior of the insects and the values were tested using F test (Morisita, 1959).

Oviposition Preference. Oviposition preference was studied comparing eggs deposited on soybean, pigeon pea, lablab, common bean, and rice (*Oryza sativa* L.). Two plants of each species were used. One plant with green pods and the other with mature pods of soybean corresponding to stadia R6 and R8 (Fehr et al., 1971) were used. Plants were arranged at random in cages (2 x 2 x 2 m) (n = 5). Plants were grown in pots and were kept in the greenhouse until the beginning of the experiment, except for mature pigeon pea. Due to the height of these plants, branches were cut (60 cm height) and placed in pots with sand and water. Insects (10 pairs) were placed in the center of each cage and released. Bugs remained in the cages for 1-week. Insects used were reared in the laboratory and fed with pigeon pea, soybean, common bean, and lablab seeds (Ventura and Panizzi, 1997). This test was conducted in a randomized complete block design. Ranks from one (least preferred) to five (favorite) were attributed to each host plant. Percent rank sums in relation to possible maximal score (100%) were calculated. Friedman's test was used to compare results (Conover, 1980).

RESULTS AND DISCUSSION

Population Dynamics. Monitored host plants provided food for *N. parvus* during 11 months of the year (Fig. 1). Adults and nymphs were found in all fields. Only in November insects were not observed on host plants. During this month, pods of some host plants were not available and on pigeon pea and lablab the pods were already deteriorating. However, common bean, sowed at the beginning of the spring/summer season, although not evaluated in this work, would provide food during this month. Other legume plants such as *Canavalia ensiformes* (L.) DC., *Indigofera hirsuta* L., *I. suffruticosa* Millsp., *I. truxillensis* H.B.K., *Lupinus* sp., and *Sesamum indicum* L. are alternative host options (Santos, 1996). Because the oligophagy on legumes and the swiftly flight capacity (Singh and Van Emden, 1979; Schaefer, 1980; Schaefer and Mitchell, 1983), alydids can explore a wide spectrum of host plants. According to Kishino and Alves (1992), *N. pallescens* presents mobility and migration capacity. Aldrich et al. (1993) referred to Alydidae, together with Coreidae, as insects able to migrate by flying and exploring successive cultures. According to Panizzi (1991), the abundance and the readiness of seeds is a fundamental factor in the regulation of the populations of seed-sucking Hemiptera, that must colonize hosts quickly, because seeds are a nutritional ephemeral source. In Northern Paraná, the conditions for development of populations of

N. parvus are favorable because the winter is mild. In warmer conditions, as in central Brazil, high populations of this species are associated with soybean (Panizzi, 1997) and common bean (Chandler, 1984, 1989) crops.

Cowpea, *V. unguiculata* was a suitable food for *N. parvus* populations development (Fig. 1), although not previously reported as host plant. *N. parvus* occurrence on this plant was detected from December 18, 1996 to February 5, 1997. Cowpea could be used as a trap crop management of *N. parvus* due to its reproduction before soybean. Other plant species of the same genus, as *V. unguiculata cylindrica* (L.) Walp., *V. sinensis* L. Sori, and *V. radiatus* L. were suggested as trap crops for soybean insect pests (Naito, 1996). *Riptortus linearis* (L.) (Alydidae) was controlled in Indonesia with *Sesbania rostrata* L. trap crops (Naito, 1996). The simultaneous occurrence of green and mature pods, as well as pigeon pea and lablab, probably favored the development of the insect on cowpea, for the supply of water of green seeds and in other green parts of the plant (Santos and Panizzi, 1998b). When seeds of cowpea were deteriorating insects moved to soybean fields (Fig. 1). Adult displacement related to plant phenology was also verified for *Riptortus dentipes* Fabr. (Alydidae) (Ntonifor et al., 1996).

The shortest period of occurrence of bugs on soybean from February 25 to March 19, 1997 (Fig. 1) was due to the crop maturation, allowing only one generation to develop. The little development of nymphs and poor performance of adults on soybean seeds, compared to pigeon pea and lablab (Santos and Panizzi, 1998b), can be due to the low water content of dry (mature) soybean plants. The seed-sucking hemipterans needed high amounts of water (Panizzi, 1991). Because soybean maturation is uniform in the commercial cultivars, bugs may face precarious conditions for development due to the lack of water, mainly if maturation time coincides with drying seasons. In rainy conditions at harvest, outbreaks of the insect were observed (Ventura, unpublished data) due to both, food and water abundance.

Differences in maturation of soybean fields (different cycles or sowing time) might also favor the development of *N. parvus* populations in the same way as for pentatomids (e.g., Rosseto et al., 1989; Gazzoni and Malaguido, 1996).

On pigeon pea plants, *N. parvus* were observed from July 23 to September 10, 1997. Pigeon pea is frequently found in northern Paraná State. Several soybean heteropterans use this plant as alternative host (e.g., Naito, 1996; Panizzi and Oliveira, 1998). Species of Alydidae, belonging to the genus *Riptortus*, feeds on pigeon pea in India and in Eastern and Western Africa (Singh and Van Emden, 1979).

On lablab, insects were detected from June 18 to October 1st during the fructification period of this culture.

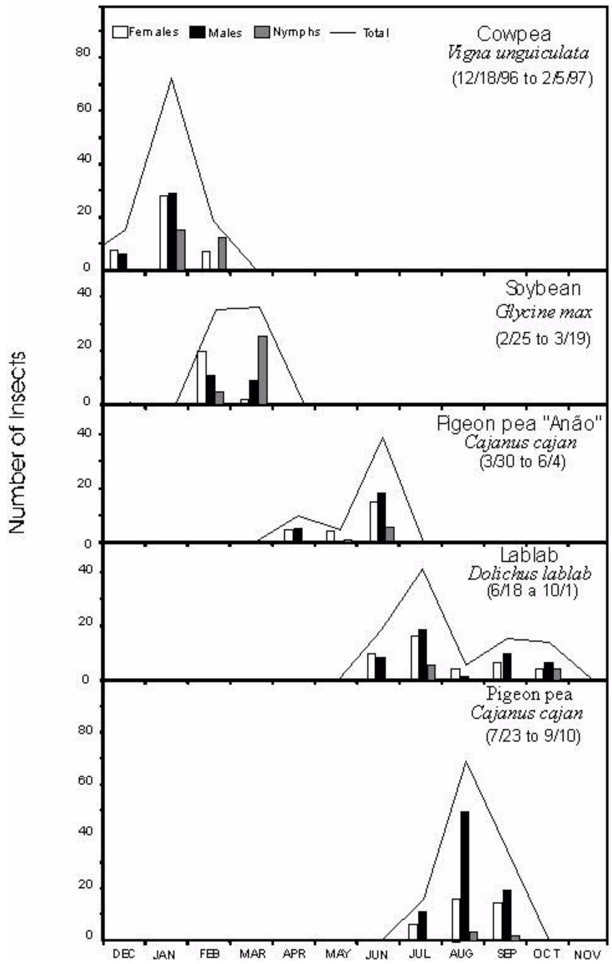

Figure 1 - Population dynamics of *Neomegalotomus parvus* on host plants. Londrina, PR. December 1996 to November 1997.

Structures of the Plants. Insects were located mainly on mature pods of plants (Fig. 2). These results corroborated behavioral and biological studies in which mature seeds were found as favorite foods of *N. parvus* (Santos and Panizzi, 1998b; Ventura et al., 2000).

Aggregation Behavior. The Index of Morisita obtained was of 1.94, larger than the threshold value (= one). Therefore, insects presented contagious distribution (negative bionomial), characterizing the aggregation (Morisita 1959). The values were highly significant (F = 3,28 * *). The value of the variance (2.95) was higher than the mean (2.41). This confirmed the hypothesis that the insects presented gregarious habit (Ludwig and Reynolds, 1988). In nature, high values for the variance reflects aggregation. Males, females, and nymphs starting from the 3rd instar were found in aggregations. In bugs which lay eggs in batches, gregarious behavior is ordinary. However, *N. parvus* lay eggs singly (Panizzi et al., 1996). In Alydidae, heterotypic feeding aggregations of adult *Alydus eurinus* (Såy), *A. pilosolus* (Herrich-Schaeffer) and *Megalotomus quinquespinosus* (Såy) (Schaeffer 1980) were reported.

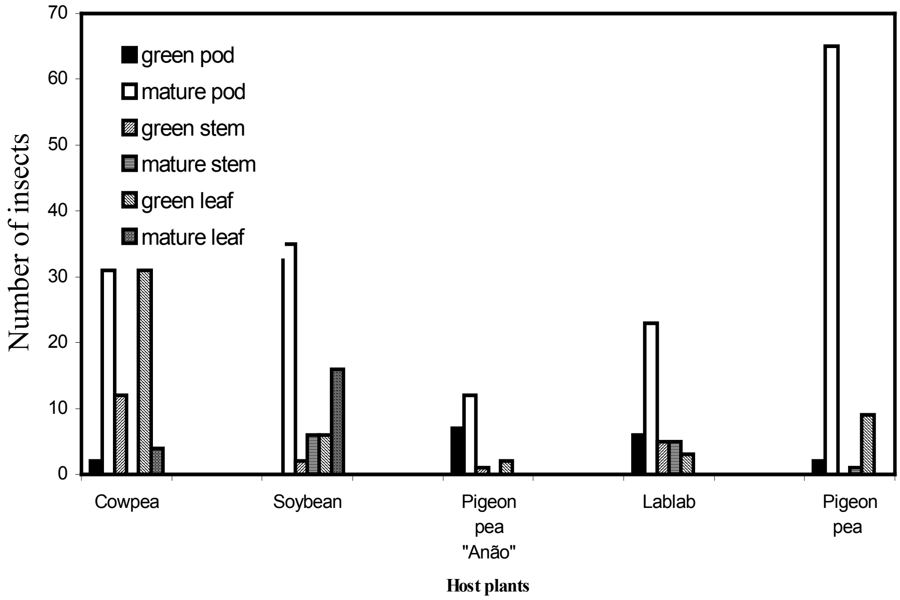

Figure 2 - Total number of *Neomegalotomus parvus* observed during 10 minutes on different structures of host plants. Londrina, PR.

In Heteroptera improvement of the feeding efficiency was related to gregariousness in nymphs (Bongers, 1968; Bongers and Eggerman, 1971) due to more efficient use of the saliva on groups (Bongers and Eggermann, 1971; Derr and Ord, 1979) and was determined by visual stimulus (Youdeowei, 1966). Aggregations of males, females and nymphs of 5th instar were reported in *Nezara viridula* (L.) (Harris and Todd, 1980). The males attracted the coespecifics through pheromone. Males attracted adults of both sexes in *R. clavatus* Thunb. (Numata et al., 1990). Besides favoring the sexual intercourse for the individuals' proximity (Harris and Todd, 1980) aggregations work as defense because the mortality is less than when nymphs are isolated (Hokyo and Kiritani, 1963). Preys, in groups, generally detect predators approach more quickly than solitary individuals (Pulliam and Caraco, 1984). Sillén-Tullberg and Leimar (1988) pointed out that this behavior could be disadvantageous in insects because they are small and slow in relation to many predators. This would suggest, aggregation as an evolutionarily favorable characteristic if unpalatability was developed before. However, this generalization is not applied to *N. parvus*. In this insect, we observed that after an individual of the group flight the others also will fly away and the nymphs fall in the soil (Ventura, personal observation). Probably, instead of unpalatability, behavior associated to escape was developed in *N. parvus*. So aggregation became an evolved favorable trait. Defensive secretions in high concentrations, as the n-tridecane for *N. viridula*, might also become aggregations favorable trait (Todd, 1989). Adults and nymphs of *N. parvus*, when disturbed, exhale strong unpleasant smell, as well as other Alydidae (Underhill, 1943). The aggregation is particularly advantageous if the members developed alarm when a predator is noticed (Pulliam and Caraco, 1984). Probably, the escape of many insects of the group after the individual's flight might be associated with some alarm pheromone or visual stimulus. Alarm pheromone was verified for the Alydidae *R. clavatus* (Leal and Kadosawa, 1992). The selection pressure by predators on *N. parvus* and on other Alydidae also conditioned the mimicry development in nymphs which acquired aspects of ants (Younke and Medler, 1968; Oliveira, 1985).

Oviposition Preference. Higher number of eggs of *N. parvus* were observed on pigeon pea plants, followed by soybean and lablab (Table 1). Eggs were not found on common bean and on rice. Probably, the poor development of the nymphs on common bean, in relation to pigeon pea, lablab and soybean (Panizzi, 1988; Santos and Panizzi, 1998b) determined the smallest number of eggs. The highest number of eggs laid on pigeon pea might be reflecting the suitability of the plant for the development of the insect (Santos and Panizzi, 1988b).

Eggs were placed mainly on dry, but also on green pods of pigeon pea, soybean and lablab. The feeding activity of females occurs simultaneously to the oviposition in *N. parvus* (Ventura and Panizzi, 2000). Therefore, feeding preference might influence the choice of the oviposition site, as well as physic characteristics of the substratum (Ventura and Panizzi, 2000).

In conclusion, the host plants monitored in this study provided favorable conditions for the development of *N. parvus* almost throughout the entire year. Bugs were located mainly in dry pod and presented gregarious behavior on pigeon pea plants. Greater number of eggs was laid on pigeon pea.

Table1 - Oviposition preference of *Neomegalotomus parvus* by hosts plants in multiple-choice tests, expressed by percent of rank sums in relation to maximum possible score (100%) in cages. Ranks from 1 (least) to 5 (most eggs deposited).

Host Plant	Percent[a]
Pigeon pea	100 a
Soybean	72 b
Lablab	68 b
Common bean	30 c
Rice	30 c

Percent at each group with a common letter do not differ significantly using Friedman's test (percent obtained with 5 blocks).

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RESUMO

Interações entre *Neomegalotomus parvus* (Westwood) e plantas hospedeiras foram estudadas em relação ao monitoramento da população durante o ano, comportamento gregário no campo e preferência para oviposição entre plantas hospedeira e não hospedeiras em gaiolas no campo. Feijão-de-corda, *Vigna unguiculata* (L.) Walp., soja, *Glycine max* (L.) Merr. cv. BR 37, guandu, *Cajanus cajan* (L.) Millsp., guandu cv. Anão, e lab-lab, *Dolichos lablab* L. foram monitorados no campo. *N. parvus* foi encontrado em plantas hospedeiras durante 11 meses. O período mais curto de ocorrência foi observado em soja e o mais longo em lab-lab. Insetos foram encontrados principalmente em vagens secas. Distribuição contagiante (bionomial negativa) foi detectada, caracterizando a agregação. Maior número de ovos foi observado em guandu, seguido pela lab-lab e soja. Ovos não foram encontrados em feijão-de-corda, em feijão *Phaseolus vulgaris* L., e arroz, *Oryza sativa* L.

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PÁGINA

EM

BRANCO