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A N I N T E R N A T I O N A L J O U R N A L

Responses of *Neomegalotomus parvus* (Hemiptera: Alydidae) to Color and Male-Lured Traps

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ABSTRACT

In 1998, the relative responses of Neomegalotomus parvus *(Westwood) (Hemiptera: Alydidae) to colors in traps were assessed in the field. Colors were printed in white alkaline paper and covered with transparent plastic. Printed colors were black, green, yellow, red and blue. Treatments also included white paper and aluminum foil. Green traps captured more bugs than the other traps (except yellow). Yellow traps caught significantly more N. parvus males than blue, black and aluminum traps. White, red and blue traps captured significantly more N. parvus males than black traps. In 1999, the same treatments were used and additionally included the factor presence (X absence) of males in cages in the traps. Four males were confined in the cages together with pigeon pea seeds and water. Control traps received only pigeon pea seeds and water. No responses were found for color comparisons. Male-lured traps captured significantly more males than control traps.*

Key words: Insecta, semiochemical, color responses, aggregation pheromone

INTRODUCTION

Perception of form, pattern, contrast, intensity, movement, distance, color and polarized light were demonstrated in insect species (Romoser, 1981). Hue, saturation and intensity are attributes that define color (Moerick, 1969) to which insect responses have been demonstrated (Vernon, 1986). Visual characteristics together with odor and texture are components of the primary attraction. Studies concerning on responses to colors are particularly abundant on Homoptera (e.g., Meyerdirk and Oldfield, 1985; Vaishampayan et al., 1975). For Heteroptera, we did not find reports on positive responses. *Lygus lineolaris* (P. de B.) adults are not visually oriented toward the hue of apple structures on which they feed or rest (Prokopy and Owens, 1978).

Insects also may reach host plants using cues of coespecifics. This is the case of insects that produce aggregation pheromones, what is classified as secondary attraction (Scholz et al., 1997). Production of aggregation pheromone was found in the alydid *Riptortus clavatus* Thunb. (Numata et al., 1990; Leal et al., 1994).
As a component of the primary attraction, responses of *N. parvus* (Weswood) to colors traps were assessed in the field. In addition, we investigated the responses of adults to traps containing males, as an evidence of the production of the aggregation pheromone (secondary selection).

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MATERIAL AND METHODS

Traps were placed in the field at the Embrapa Farm (Londrina County, northern Paraná State, Brazil (latitude 23° S and longitude 51° W).

Responses to Colored Traps

Traps were plastic vessels (20 X 39 X 5 cm) containing water and drops of neutral detergent. Vessels were covered with white alkaline paper (RIPAX Laser 75, Ripasa S.A. Celulose e Papel, Limeira, SP, Brazil), printed with five colors (Table 1). Printed paper was covered with transparent plastic Com-Tact (Vulcan, São Paulo, SP, Brazil). Printed colors were from Microsoft Power Point (Microsoft Corporation).

Table 1 - Characteristics of colors used in traps.

Color	Characteristics[1]					
	Shade	Saturation	Luminosity	Red	Green	Blue
Blue	170	255	128			225
Red		255	128	255		
Green	85	255	128		255	
Black	170					
Yellow	42	255	128	255	255	

[1] From Microsoft Power Point (Microsoft Corporation).

Colors were also printed on transparency film to determine wavelengths in a digital spectrophotometer (Micronal 834211). Treatments also included aluminum foil and alkaline white paper. Traps were placed on the ground [Oxisol, color 2.5 YR 3 (Munsell Soil Color Charts 1988)] in 14 days, from August 8, 1998.

Distance between traps was 5 m. Traps were placed in the field at 5:00 PM, and removed after 24 h. Analysis of variance (ANOVA) was used to compare individual means (SAS Institute 1989). Means and standard errors of means presented are untransformed.

Responses to Colors X Male Lured Traps

A cage made of plastic film vial (cylindrical 3 cm diameter X 5 cm height) placed hung in a nylon line in a inverted “L shape” stake close the water surface. Cages had 4 holes (1 X 3 cm), closed with nylon screen. Four males were confined in the cages together with pigeon pea seeds and water. Control traps received only pigeon pea seeds and water. For each color in the previous experiment, we used a male-lured trap and control one in a split-plot design. Traps were placed in the field for 6 days, from September 5, 1999. Analyses of variance (ANOVA) was used to compare individual means (SAS Institute 1989). Means and standard errors of means presented are untransformed.

RESULTS AND DISCUSSION

Responses to Colored Traps

Wavelengths of printed colors are shown in the Fig. 1. Responses were assessed only for males due to reduced number of females caught (5.8% of total). Green traps captured more bugs than the other traps (except yellow) (Table 2). Yellow traps caught significantly more *N. parvus* males than blue, black and aluminum traps. Green and yellow traps probably mimic plant foliage confirming general pattern of attraction for herbivorous insects (Prokopy and Owens, 1983). White, red and blue traps captured significantly more *N. parvus* males than black probably due to greater contrast with the soil surface. Low captures in aluminum traps corroborated information of the mimicry of sun polarized light determining lack of attraction (Prokopy and Owens, 1978). Contrast perception was reported in the host plant selection for the fruit fly *Rhagoletis pomonella* (Walsh.) (Tephritidae) (Prokopy and Owens, 1978).

Responses to Colors X Male Lured traps

No significant differences were detected among colors (Tables 3 and 4). In this case only 6 replicates were used while in the previous 14 (Table 4). We observed that sometimes insects landed in the trap edges but did not fall in the water. These insects could exert effect on coespecifics what could be particularly true for *N.*

parvus due to its aggregation behavior (Ventura et al., 2000; Ventura and Panizzi, 2003). The probable emanation of defensive secretions when insects fell in the water and even after dead can also repeal insects (Millar, J. Personal communication for M.U.Ventura).

Interaction between colors and male-lured traps was not significant ($p \leq 5\%$) (Table 3). Interaction was significant just at 10% level. In treatments with low color captures, lured traps (except aluminum) tended to equilibrate level of captures with the more attractive color traps (green and yellow) (Fig. 2). More attractive colors could mask responses to volatile attractants (Andersen and Wilkin 1986).

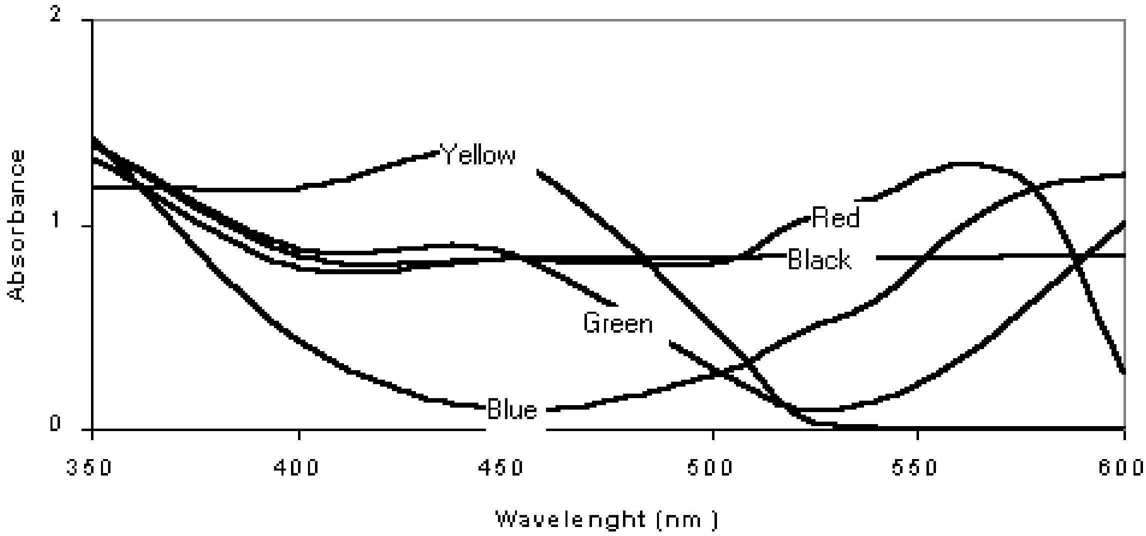

Figure 1 - Absorbance curves of printed colors in transparency film used in traps to capture of *Neomegalotomus parvus.*

Male-lured traps captured significantly more beetles than control traps (Tables 3 and 5). The probable explanation included the production of pheromone by *N. parvus*. This pheromone also may be related with gregarious behavior (Ventura and Panizzi, 2003). Males of *Riptortus clavatus* Thunb. also attract coespecifics (Numata et al. 1990) due to the aggregation pheromone (Leal et al. 1994). Hexyl butyrate, hexyl valerate and hexyl hexanoate were extracted from *N. parvus* and the mixture was attractive for adults (mostly males) (W.S. Leal and A.R. Panizzi, unpublished data). Captures of *N. parvus* females were reduced (3.5%) in opposition to females of *R. clavatus* which were caught in greater number than males (Numata et al. 1990). In the field, males of *N. parvus* land on people and objects. Males of *Dysdercus bimaculatus* Stal (Pyrrhocoridae) are the principal colonizers in new seeds sites (Aldrich 1995). Probably the exploratory behavior of *N. parvus* males determine greater trap captures.

In conclusion, males were attracted differently to color traps and more attracted by male-lured traps than control traps.

Table 2 - Mean number (± SEM) of males of *Neomegalotomus parvus* caught in colored traps 24 h later (n = 14).

Color	Captured Insects[a]	Percent[b]
Blue	6.7 ± 1.5 c	42.1
Red	7.3 ± 1.2 bc	45.9
Green	15.9 ± 3.2 a	100.0
Black	2.9 ± 0.6 d	18.2
Yellow	11.5 ± 2.6 ab	72.3
White	7.8 ± 2.0 bc	49.0
Aluminum	4.8 ± 0.9 cd	30.2

[a] Means in the same column with different letter are significantly different based on Tukey's studentized range test ($P < 0.05$), n =4.

[b] Percent in relation to maximum captures treatment.

Table 3 - Analysis of variance of captures of males of *Neomegalotomus parvus* in colored traps lured or no with males. (n = 6).

Source of variation	D.F.	F	P
Blocks	5	2.55	0.0486
Colors	6	1.28	0.2951
Blocks X colors	30	1.69	0.0672
Males	1	12.18	0.0013
Colors X Males	6	1.81	0.1263

Table 4 - Mean number (± SEM) of males of *Neomegalotomus parvus* caught in colored traps 24 h later (n = 14).

Color	Captured Insects[a]	Percent[b]
Blue	2.5 ± 0.5 a	54.3
Red	2.9 ± 0.9 a	63.0
Green	4.2 ± 0.7 a	91.3
Black	2.0 ± 0.6 a	43.5
Yellow	4.6 ± 1.3 a	100.0
White	2.5 ± 0.7 a	54.3
Aluminum	2.5 ± 0.5 a	54.3

Means in the same column with different letter are significantly different based on Tukey's studentized range test ($P < 0.05$), n =4.

[b] Percent in relation to maximum captures treatment.

Table 5 - Mean number (± SEM) of males of *Neomegalotomus parvus* caught per traps lured or no with males, after 24h (n = 42).

Treatment	Insect caught	Percent
Male-lured traps	3.9 + 0.5 a	100
Control traps	2.3 + 0.4 b	59

[a] Means in the same column with different letter are significantly different based on Tukey's studentized range test ($P < 0.05$), n =4.

[b] Percent in relation to maximum captures treatment.

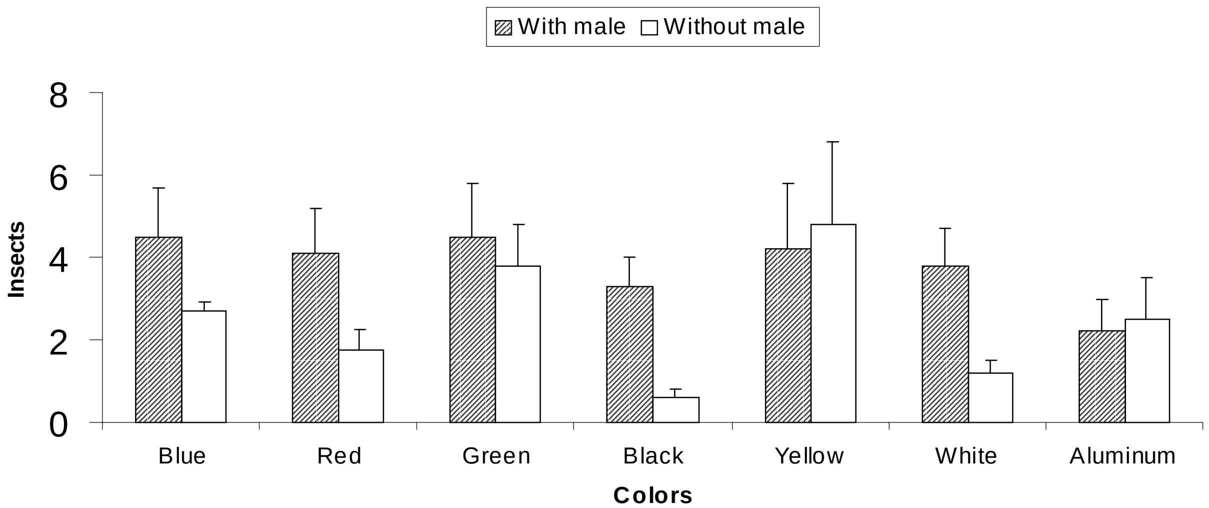

Figure 2 - Captures of males of *Neomegalotomus parvus* by different color traps, male-lured or not. (N = 6).

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RESUMO

Em 1998, as respostas relativas de *Neomegalotomus parvus* (Westwood) (Hemiptera: Alydidae) a cores em armadilhas foram avaliadas no campo. As cores foram impressas (preto, verde, amarelo, vermelho e azul), em papel alcalino branco e coberto com plástico transparente. Também se incluiu papel branco e folha de alumínio, como tratamentos. Armadilhas verdes capturaram mais insetos que outras armadilhas (exceto amarelo). Armadilhas amarelas capturaram significativamente mais machos de *N. parvus* do que armadilhas azuis, pretas e alumínio. Armadilhas brancas, vermelhas e azuis capturaram significativamente mais machos de *N. parvus* do que armadilhas pretas. Em 1999, os mesmos tratamentos foram usados e também se incluiu fator presença (X ausência) de machos em gaiolas nas armadilhas. Quatro machos foram confinados nas gaiolas junto com sementes de guandu e água. Testemunhas receberam somente sementes de guandu e água. Não foram obtidas respostas significativas à cores. Armadilhas com machos capturaram significativamente mais machos que armadilhas testemunhas.

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