Feeding preference of *Diabrotica speciosa* (Ger.) (Coleoptera: Chrysomelidae) by broccoli leaves from natural, organic and conventional farming systems

Preferência alimentar de *Diabrotica speciosa* (Ger.) (Coleoptera: Chrysomelidae) por folhas de brócolos cultivado em sistema natural, orgânico e convencional

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Abstract

Multiple-choice laboratory tests were achieved to compare feeding preference of *Diabrotica speciosa* (Ger.) to leaves of broccoli (*Brassica oleraceae* L. var. *italica*) from natural, conventional and organic farming systems. Natural farming systems included incorporation of the elephant grass *Pennisetum purpureum* Schumacher cv. Napier (50 ton/ha), Bokashi compost (1.5 ton/ha) and spray of EM 4 (Natural 1), or the incorporation of the Bokashi compost (1.5 ton /ha) and spray of EM 4 (Natural 2), and in the conventional, NPK + borax were incorporated in the planting + dressing N and organic compost (1 kg/plant) was incorporated in the organic system. Organic compost was prepared using crop residues of corn (*Zea mays* L.), soybean [*Glycine max* (L.) Mer.], and cattle manure. Leaf discs were collected and placed in cages in multiple-choice tests. Beetles preferred mostly broccoli leaves from conventional farming system than leaves from Natural (1 and 2) and Organic farming systems. Feeding on leaves from Natural 1, Natural 2 and Organic farming system were 68, 67 and 57% of the feeding on leaves from Conventional farming system.

Key words: Insecta, farming system, feeding, host plant

Resumo

Testes de múltipla escola foram realizados para comparar a preferência alimentar de *Diabrotica speciosa* (Ger.) por folhas de brócolos (*Brassica oleraceae* L. var. *italica*) cultivado em sistema natural, convencional e orgânico. No sistema natural de cultivo houve a incorporação de capim elefante *Pennisetum purpureum* Schumacher cv. Napier (50 ton/ha), composto Bokashi (1,5 ton/ha) e pulverização de EM 4 (Natural 1), ou a incorporação do composto Bokashi (1,5 ton/ha) e pulverização do EM 4 (Natural 2), no sistema convencional houve a incorporação do NPK + borax + N em cobertura, e no sistema orgânico incorporou-se composto orgânico (1 kg/planta). O composto orgânico foi preparado utilizando-se resíduos de milho (*Zea mays* L.) e soja [*Glycine max* (L.) Mer.] e esterco de gado. Folhas foram retiradas das plantas das quais foram separados discos, e colocados em gaiolas em testes de múltipla escolha. Os insetos preferiram folhas do sistema convencional. A alimentação nas folhas do sistemas Natural 1, Natural 2 e Orgânico foi 68, 67 e 57% daquela registrada nas folhas do sistema convencional de cultivo.

Palavras-chave: Insecta, sistemas de cultivo, alimentação, planta hospedeira

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Due to environmental and health concern, several lines of agriculture have been proposed as alternatives to the conventional farming system. Basically they follow the same principles using different tactics to reach the same objectives. Principles of organic agriculture include to protect the environment minimizing soil degradation and erosion by using natural compounds and cover crops, crop rotation, inter-cropping, green manure, recycled plant refuse and animal manure; maintaining diversity within and surrounding the farm and conserving the biological diversity which is essential for agroecosystems stability and the sustainability. Natural farming uses the same rules, however the greatest difference is related to application of Bokashi efficient microorganisms (EM) which is described as a mixture of microorganisms (20 genus and 80 species) sprayed to the soil that creates a favorable environment to plant development which increases yields, quality and plant sanity (HIGA; WIDIDANA, 1989). These information were confirmed by (YAN; XU, 2002) in peanut (*Arachis hypogaea* L.) which found significant higher nodule number per plant, fresh weight per nodule, total pod number and dry weight in the EM Bokashi fertilizer treatment than chemical fertilizer treatment.

Farmers advocate that pests and diseases incidence are lower in organic and similar farming systems. Insect incidence has been reported as influenced by crop management (ALTIERI; SILVA; NICHOLS, 2003). Aphids were less abundant on broccoli in farming systems that received cover crops and compost in opposition to synthetic fertilizers (COSTELLO; ALTIERI, 1994). Cabbage, *Brassica oleracea* var. *capitata*, was also less infested by pests [*Trichoplusia ni* (Hübner), *Frankliniella* spp. and *Brevicoryne brassicae* L.] when grown in rye in comparison with bare soil (ROBERTS; CARTWRIGHT, 1991).

Alternative farming systems have greater plant diversity which in general reduces insect incidence and damages. Several studies also reported different insect responses to levels of nutrients (mostly nitrogen). However, reports on comparisons of insect feeding preference on plants from conventional and alternative farming systems were not found. Hence, the responses of the polyphagous leaf beetle *Diabrotica speciosa* (Ger.) to leaves of broccoli from different farming systems in multiple-choice tests were studied.

Plants were grown in the field at the Universidade Estadual de Londrina School Farm (Oxisol, latitude 23° 19' S, longitude 51° 12' W) from April 22 to August 9, 1999. Field received no crops in the 2 years before. Broccoli cv. Legacy was sown on April 22. Plant substratum was Plantimax (Paulínea, SP). Soil was covered with crop residues (elephant grass *Pennisetum purpureum* Schumacher cv. Napier). Treatments were chosen in order to simulate farmers technologies used for broccoli production, as follow:

Natural: Incorporation of the elephant grass (50 ton/ha) and Bokashi compost (FUNDAÇÃO MOKITI OKADA, 1998) (1.5 ton/ha) and spray of EM 4 (FUNDAÇÃO MOKITI OKADA, 1998) (Natural 1); Incorporation of the Bokashi compost (1.5 ton/ha) and spray of EM 4 (Natural 2);

Conventional: NPK in the planting + borax + dressing N, according to soil analysis and propositions of (VAN RAIJ et al., 1996);

Organic: organic compost (1 kg/plant). Organic compost was prepared using corn (*Zea mays* L.) and soybean [*Glycine max* (L.) Mer.] residues and cattle manure. Composts and EM 4 were applied 20 days before planting. EM 4 was also sprayed on the seeds before planting and on the plants weekly (1: 1000). Before EM 4 spraying, water was kept in opened bucket for chlorine evaporation (FUNDAÇÃO MOKITI OKATA, 1998). Plants were sprayed in the afternoon. Plant substratum was also treated with EM 4 and molasses for 7 days.

Insects were collected in a common bean (*Phaseolus vulgaris* L.) field. Circles of leaves (6.3 cm diameter) from the four cultivation systems were offered to 100 beetles in cages (50 X 50 X 50 cm) where remained during 24 hours (n = 5). Feeding was measured 24h later. Images of leaves were digitized and the area fed upon was determined using Siarcs[â] software (JORGE, 1997).

Due to the lack of independence of treatments (multiple-choice) ranks from one (least preferred) to four (favorite) were attributed. Percentage rank sums in relation to possible maximal score (100%) were calculated. Friedman's test was used to compare results (CONOVER, 1980; PETERSON; RENAUD, 1989; HORTON, 1995; VENTURA; MONTALVÁN; PANIZZI, 2000).

Beetles preferred broccoli leaves from Conventional farming system than leaves from Natural and Organic farming systems (Table 1). Feeding on leaves from Natural 1, Natural 2 and Organic farming system were 68, 67 and 57%, respectively, of the feeding on leaves from Conventional farming system.

Table 1. Preference of *Diabrotica speciosa* adults (leaf area consumed) on broccoli leaves from different farming systems in multiple-choice tests (cages in the laboratory), expressed by percent of rank sums in relation to maximum possible score (100%). Ranks from 1 (least) to 4 (most fed).

Cultivation system	Leaf area consumed (cm^2) [a]	Preference (%) [b]
Natural 1	5.7 ($\pm$ 1.25)	60 b
Natural 2	5.6 ($\pm$ 1.45)	55 b
Conventional	8.4 ($\pm$ 2.24)	90 a
Organic	4.8 ($\pm$ 1.47)	45 b

[a] Means (+ SE) of 5 replicates.

[b] Percent with a common letter do not differ significantly using Friedman's test.

These results corroborate field observations of less damaged crops on alternative farming systems. Different farm system may have produced different plant composition and variations in the preferences of *D. speciosa* beetles may be related with plant nutrient amounts, allelochemicals or both. Further investigations may establish which plant parameters are affected by farming systems and had as a result insect feeding. Increasing levels of N and consequently greater plant foliar biomasss determined greater abundance of the most important Lepidoptera pest of cabbage [*Plutella xylostella* L., *Trichoplusia ni* (Hübner 1803), *Hellula phidilealis* (Walker), *Artogeia rapae* (L.) [*Pieris rapae*] and *Evergestis rimosalis* (Guenée)] (JANSSON et al., 1981). *Artogeia rapae* (L.) oviposition was significantly higher on collards and kale (*B. oleracea* var. *acephala*) with high N than those with low N on small-scale field experiments. However in larger scale experiments (collards), correlation was not repeated (LETOURNEAU; FOX, 1989).

Glucosinolates are particular allelochemicals from Brassicaceae (= Cruciferae) family. This group works in preingestive and postingestive phases of insect host plant selection (PANDA; KLUSH, 1995). In the former insects are repelled and in the latter components act toxically. The principal action of this group is against polyphagous insects in which *D. speciosa* beetle is included. Availability of soil nutrients (mostly sulfate levels) are positively correlated with plant glucosinolates levels (BERNAYS; CHAPMAN, 1994). The flea beetles, *Phyllotreta cruciferae* (Goeze) fed actively on rape, *Brassica napus* L. cotyledons depleted of glucosinolates and severely damaged many of them (BODNARYK; PALANISWAMY, 1990).

The results reported here showed that *D. speciosa* preference is lesser in alternative than conventional farming systems and this is favorable approach in the cost : profit relationship. This means that *D. speciosa* damage probably would be lesser in the alternative crops. Hence, additional strategies allowed in organic systems (insect traps, biological control, crop diversification etc) may control more easily the pest.

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