# Population and levels of damages of the main pests of bean, corn and rice in an agroforestry system in the Amazon Region[1]

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*Key words:* insects, subsistence cultures, vegetable diversification, damages.

## Introduction

As a result of the characteristics present in the definition of alternative land use systems in tropical humid areas, most research actions have focused on achieving a larger knowledge of the consequences of the adoption of agroforestry systems, since they are considered as a "best bet" for the Amazon Region.

Considering the biodiversity studies, within the entomological focus in agroforestry systems, Arias (1987) states that there is a tendency of existing larger populations of herbivores when there is a combination among perennial and annual crops, compared with the systems of mixed crops, composed only of annual plants. Therefore, it is expected that the levels of pest infestation tend to be smaller in agroforestry systems, as long as they do not include annual crops, in comparison with the less diversified systems.

However, in order to minimize the initial costs, as well as to increse land use efficiency in the first two years of establishment, annual crops such as rice, corn and bean are intercropped among the rows of the perennial crops, in the area of Rio Branco, Acre.

This study had the objective of evaluating the behavior of the pests of annual crops, when used as components of an agroforestry system, compared with the individual crops.

## Methodology

The experiment was conducted from January, 1995 to December, 1996, at the Experimental Station of Embrapa Acre, in an area of 0.5 ha. An agroforestry system was established, consisting of: 70 plants of peach palm *(Bactris gasipaes)*, 53 of cupuaçu (*Theobroma grandiflorum*), 36 of coffee (*Coffea arabica* cv. Catuaí), 20 of açaí (*Euterpe oleracea*) and 10 of Brazil-nut (*Bertolletia excelsa*) The seedlings were established in the field in December of 1994, in a 6 m x 6 m spacing, with guandu bean (*Cajanus cajan* L. Mil. cv Midget) being used as shade of the cupuaçu plants, during the first two years of cultivation.

Between the rows of the perennial species, annual crops were seeded, using 1) rice of the lineage CNA 6226 (December,1994) in the whole area and cv. Xingu (November, 1995) in 0.25 ha. In both cases the used spacing was of 0.50m x 0.40m; 2) bean (cv. Carioquinha) in the whole area, in the spacing 0,50m x 0,40m, in April of 1995; and 3) corn of the lineage CMS33, in 0.25ha in the spacing of 1.00m x 0.50m, in October of 1995.

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In the annual crops, weekly evaluations of the population of insects and of the damages of those considered as pests for the area of Rio Branco were accomplished, using the following methodologies: 1) In rice, 100 plants of the 4 central rows were randomly chosen for evaluation of a) *Tibraca limbativentris* (Stal., 1860), by counting the number of plants with symptom of " dead heart" or " white panicle" and by the number of adults and nymphs present in the bunches, and -b) *Mormidea maculata* (Dallas, 1851), *Oebalus poecilus* (Dallas, 1851) and *Oebalus ypsilongriseus* (De Geer, 1773), considering the number of insects captured with light trap (model "Luiz de Queiroz"), and the damages were measured based in the number of plants that presented at least one panícle with grains doddering or stained by the insect); 2) In bean, the evaluation of the damages of *Cerotoma tingomarianus* Bechyné and *Diabrotica speciosa* (Germar, 1824), 30 plants were randomly chosen from the 3 central rows, with grades ranging from 0 to 10 being attributed according to the percentage of leaf area consumed. The measurement of the insect population was accomplished by means of weekly captures of the insects present in the central row of the experimental area, through the application of 10 blows with na enthomological net of 30 cm of diameter, in 10 series, adding up to a 100 hauls; 3) In corn, 4 plots of 2.0m x 8.0m each were demarcated in the experimental area, where the evaluations of *Spodoptera frugiperda* (J.E. Smith, 1797) were accomplished by means of the attribution of gredes from 0 to 3 for the damage level in the cartridge

The populacional behavior and lelvel of damages of the pests was considered within the phenological phases of each crop.

For the bean and corn crops populational assesment and evaluations of damages of the insects pests were accomplished in areas of monocultures, close to agroforestry systems, measuring 0.5 ha, using the same methodology, so that comparisons were made among the two agroecossystems. Also, weekly assesments of pests of bean and rice intercroped with the perennial species were carried using an entomological net of 15 cm of diameter.

**Results and discussion**

*Bean*

It was verified that, considering the populational variable, *C. tingomarianus* is more important for the bean crop than *D. speciosa*, once the maximum number of captured individuals of that last species corresponds to the minimum value observed for *C. tingomarianus*, with the higher percentage of damage to the leves being attributed, in a general way, to this species.

The higher number of individuals captured for both insect species occurred during the pod formation phase of beans, between the 43$^{rd}$ and 72$^{nd}$ days after seed germination, observing an average of leaf area loss of 60% during the period. This value is high above the level of economic damage, 20% at the most, for the crop during that phase, considered by Nakano et al. (1981) as being tolerable. Preliminary data on leaf area loss of cv Carioquinha at the field level, pointed that this process cause larger reductions in the production of the plants when it occurs between the 20$^{th}$ and 40$^{th}$ day after the germination.

Within the limits considered by these authors, only in the first 20 days after the germination the levels of leaf area loss were inside of the tolerable limits for the bean crop, reaching an average of 47%. Starting from the 30$^{th}$ day the tolerable level is of 33%, being observed, in the studied conditions, levels of 60%, what definitively compromised the production of the plants, still taking into consideration that from the 64$^{th}$ to the 78$^{th}$ day, the phase of pod formation and maturation of grains, respectively, the level of leaf area loss increased from 60% to 80%.

When the results obtained for beans intecropped with perennial crops were compared with those of a bean monoculture in a near by experimental area in the same cropping period, it was observed that, except for the 29th day after the germination, the population of the pest was higher in bean planted in the agroforestry system than in the monoculture.

In relation to the levels of damages, these varied between 40% and 80% in bean planted in the agroforestry system and from 10% to 21% in the bean monoculture

*Corn*

It was observed that the level of damage caused by *S. frugiperda* of value equal to 1, were the predominant ones in relationship the plants with damages in larger levels (2 and 3). This happened mainly 35 days after the germination, and with that damage level the plants recovered emitting new leaves. Those values however, are above the level considered by Nakano et al. (1981) as decisive in determining the level of control of the pest, that is to say at leat 20% of the plants attacked in the 34th day after the germination, 10% in the 49th and 9% in the 64th day after seed germination.

When the percentage of damaged corn plants was compared in an agroforestry system with a monoculture, it was noticed that in that last condition the damage level was just below the control level in the first 34 days after seed germination, and in the 49th e 64th days the levels also came above the level of pest control. In the agroforestry system, the percentage of attacked plants was on average 30% higher when compared with the monoculture.

*Rice*

In the rice lineage CNA 6226), it was observed that the mean percentage of bunchs attacked by *T. limbativentris*, presented increasing values starting from the 14th day after the seed germination (phase of vegetative development), varying from 1,3% to 7,8% until the 71st day (flowering phase). From this point, there was a considerable increment in those values, until the maturation of the grains, reaching 19,5% of the total of bunchs sampled. The presence of adults of the pest was observed up to the beginning of the flowering phase, and from then on only nymphs were present in the plants. The adults populacional pick was verified on the average in the 42nd day, with 45 individuals on average. Considering the level of control for the pest of 3 insects/m2 referred to by Batalha et al. (1997), it can be concluded that this level was not reached in the studied conditions.

In the rice cultivar Xingu, the percentage of bunches that presented attack symptoms varied from 14% to 29%, observing that the largest percentages happened in the 48th and 90th days, vegetative development and flowering phases, respectively. No adults and nynphs of the pest were observed in the sampled bunches up to the 90th day after seed germination, showing that damages were caused by insects atracted from elsewhere. As a result, it can be inferred that during all the phenological phases of the plants of the Xingu cultivar, only attacks of adults took place, and the insects did not ramain in the crop area, since na average population of just 3,5 individuals was observed in the maturation period, which can be considered very low for the level damage caused. Besides that, during the whole period, nymphs of the insect were not verified, probably bacause the insect di not find adequate environmental conditions for its survival, or even, the females didn't find godd conditions for reproduction.

It can also be inferred that although the population of *T. limbativentris* was very low in the second year, when there was a larger influence of the perennial crops, the percentage of rice bunches that presented symptoms of attack was significantly superior to the first year, mainly in the flowering phase.

The insects *O. poecilus*, *O. ypsilongriseus* and *M. maculata* are the species of larger importance in rice for the area of Rio Branco, presenting similar attack sympthoms, do not allowing the distinction of the damages of the different species. It was observed the existence of damaged inflorescences with spikelets totally empty, atrophic and spotted grains, due to introduction of the probes during the feeding process of those insects, according the description of Gallo et al. (1988).

In the rice lineage CNA 6226, the avearage percentage of attacked bunches reached the value of 20,9% in the 77$^{th}$ day after seed germination, when the plants were already in the 15$^{th}$ day of flowering, and starting from there those values increased until the end of maturation of the grains, when the percentage of attacked bunches was 50%. For cultivar Xingu the occurence of damages caused by these pests started in the 90$^{th}$ day, also corresponding to the 15$^{th}$ day of the beginning of the flowering phase, with 26% of the bunches with attacked panicles, also observing na increase of this value to 47% in the period of grain maturation.

The values of average percentage of attacked bunches observed for cultivar Xingu were slightly inferior to those of the lineage CNA 6226 in the initial phase of flowering, becoming insignificant in the phase of grain maturation.

Although the actual counting of bugs/panicle was not done, and just based on field observations during the evaluation of the damages, we can state that values above 8 adults/1000 panicles, considered by Ferreira & Martins (1984) as the index that affects the quality of the grains, were achieved in the two cultivars studied in the agroforestry system.
In the evaluations made in the perennial species of the agroforestry system, it can be noticed that higher population of insects of the pests of annual crops ocurred associated *B. gassipaes* followed by *E. oleracea, T. grandiflorum*, *C. arabica* and *B. excelsa*.. These results show that these two palm species offer appropriate conditions so that most of the insect species directly related with the annual crops grown in association with the agroforestry system, are attracted to them, at least for a brief landing, before they move on for their preferential hosts, excluding the polyphago species that also feed of them. That tendency can be confirmed by the largest values of the indexes of diversity of species of insects determined for *B. gassipaes* and *E. oleracea*, 17,43 and 12,03, respectively. In this regard *T. grandiflorum* should also be included, they should be included, since although it presented a smaller index (11,31), it was close to those observed for the palm species and higher in comparison with the indexes of *C. arabica* and *B. excelsa*. When it was taken into account all perennial species for obtaining the index of total diversity, for this type of sampling of insects, it was verified that the resulting index (20,92) can be considered low, admitting that there is a diversity of plant species that compose the system, when compared with the value observed in conditions of corn monoculture (26,4) determined by Silveira Neto (1972). In the perennial plants were captured 3,214 insects distributed in 170 different species, and 82 of them (48%) had common occurrence in at least two species of perennial plants. The populational behavior of the *taxa*: *C. tingomarianus*; *D. speciosa*; *Homophoeta aequinoctialis* (L., 1758) (Coleoptera, Chrysomelidae); *M. maculata*; *O. ypsilongriseus; Hyalimenus* sp.; *Oncometopia* sp. (Hemiptera, Cicadellidae); *Molomea* sp. (Hemiptera, Cicadellidae) and *Raphirrinus phosphoreus* (L. ,1758) (Hemiptera, Cicadellidae), present preferentially in *B. gassipae*, *E. oleracea* confirm the complexity of the relationships between insects and plants observed during the period of study, in the proposed model of agroforestry system. Stand out in this list the presence of important pests of the bean and rice, as well as species with potentiality for becoming pests such as *H. aequinoctialis*, considered by King & Saunders (1984) as a leaf eater of bean plants, and several other crops in Central America and the Caribbean. These same authors report the occurrence of *Oncometopia* sp. Sucking the leaves of legume species in general. With relationship to the this last taxon, pratical observations carried in

Rio Branco, lead to the conclusion that this is a polyphago insect which occurs sucking sap of plants of: papaya, citrus, *B. gassipae*. *E. oleracea*. *T. grandiflorum*, lettuce, aguano, bean, cowpea and *Pueraria phaseoliodes*.

**Conclusions**

The majority of the pests of annual crops identified, presented higher populations and levels of damages, sometimes reaching the control level, when grown in association with agroforestry systems as compared with the the monocultures.

The perennial species *B. gassipae* and *E. oleracea* allowed landing and shelter for the main pests of the annual crops, when associated in agroforestry systems.

Plant diversity, at this level of complexity of the agroforestry system, did not reflect in a diversity of insect species as would have been expected.

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