sernus manihotii as well as the capacity to form rubber is presented here. Seeds of these materials have been made available to breeders of IITA and CIAT.

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Fewer beetle pests on beans and cowpeas interplanted with banana in Costa Rica

Resumen. Se estudió la densidad de los escarabajos *Diabrotica balteata* y *Cerotoma ruficornis rogersi* en monocultivo de frijol común y de frijol de costa (caupí) así como en el cultivo asociado de estas dos especies con banano. El trabajo se realizó en Costa Rica, haciendo el muestreo de campo con la ayuda de una red. La población en Costa Rica, fue aproximadamente tres veces más alta en los monocultivos que en los cultivos asociados, lo que quizá permita explicar las diferencias en rendimiento obtenidas cuando se intercalan leguminosas en el trópico

Beans and cowpeas are frequently interplanted with other crops throughout the subtropics and tropics. What are the advantages of growing the crops in polycultures? Although much speculation has focused on the possibility that there are fewer insect pests on these crops when interplanted, there has been little empirical work. Studies in annual cropping systems in the netropics have shown that there are fewer beetle pests on bean when interplanted with corn (1) or with corn and squash (2). This communication demonstrates that there are significantly fewer bettles (*Diabrotica balteata* and *Cerotoma ruficornis rogersi*) on beans and cowpeas when interplanted with banana. Both *D. balteata* and *C. ruficornis* are important pests throughout Central America. The adults eat the leaves and flowers of the plants and transmit viral diseases. The larvae eat the roots.

Material and methods

The beetles were sampled from bean and cowpea plants in three monocultures of bean (*Phaseolus vulgaris*; CATIE-1), three monocultures of cowpea (*Vigna unguiculata*; V-44), three polycultures of bean-banana, and three polycultures of cowpea-banana. In each case, one monoculture was planted immediately adjacent to a comparable polyculture so that there were three pairs of bean monoculture/bean-banana polyculture, and three pairs of cowpea monoculture/cowpea-polyculture. Each plot was 10 m x 10 m. Beans and cowpeas were planted at the same density in all plots. The work was conducted in July, 1976, at the Tropical Agriculture Research and Training Center at Turrialba, Costa Rica.

The beetles were sampled with a standard sweep net 38 cm in diameter when the beans and cowpeas were approximately six weeks old and about 35 cm in height. It is at this stage of plant growth that there is the highest number of beetles per plant. The banana was approximately 3 m in height and provided considerable shade, yet the bean and cowpea plants appeared to be, if anything, larger and more luxuriant in the polycultures than the monocultures.

Sweeping was done in roughly straight lines and the same vegetation was never swept twice. The sweep net was swung in an arc covering approximately 1.5 m, with the net coming into intact with vegetation for a distance of 0.75 to 1 m and to a depth of about 15 cm. During the daylight hours, at which time the sweep sampling was done, nearly all the beetles are in the top 15 cm of the plants. One hundred forty sweeps were taken in each plot.

Results and discussion

Table 1 shows the number of *D. balteata* and *C. ruficornis* sampled from bean and cowpea plants in monocultures and polycultures. There were significantly more beetles of each species in monocultures than polycultures ($P < .05$, paired t test).

While there was considerable variability in the monoculture-polyculture difference from one pair of plots to another, there were usually at least three times as many beetles in the monocultures than the interplanted treatments.

Whether or not such large differences in beetle population translate into yield differences will depend to some extent on when the differences first appear. The beetles do most of their damage when the plants are quite young (probably during the first four weeks) by directly reducing photosynthetic surface area and by infecting the plant with viral disease. Previous work has shown that one of the reasons that there are fewer beetles in polycultures is due to shade created by overstory crops; beetles prefer to feed in unshaded areas (3). In annual cropping systems in which corn provides the shade, the understory beans don't benefit from the shade until approximately 45 days after planning-after most of the damage to beans has been done. However, in an intercropped system with a perennial such as banana, sufficient shade can be provided at the start of the season to deter beetle colonization of beans and cowpeas. Yet this will obviously require the use of legume varieties that are somewhat shade tolerant.

Table 1. – **Numbers of beetles obtained in sweep samples of beans and cowpeas in monocultures and in dicultures with bananas. ( ) = numbers in diculture. 140 sweeps per sample.**

	Plot No.	*D. balteata*	*C. ruficornis rogersi*
BEAN	1	319 (76)	29 (18)
	2	212 (79)	19 (8)
	3	123 (16)	24 (3)
COWPEA	1	92 (1)	61 (24)
	2	57 (23)	37 (27)
	3	22 (1)	39 (0)

Beans and cowpeas can also benefit from being intercropped with shade-producing annuals such as corn, despite the fact that the corn does not produce enough shade to deter beetles until fairly late in the season. If very large areas are planted to these polycultures over a number of seasons, there will be a gradual decline in beetle numbers over time. This will occur because the effect of decreased beetle abundance on the legumes towards the end of one season will be felt by the new legume seedlings in the next season. As long as the area planted to polyculture is large enough, high numbers of beetles would not be likely to immigrate into the area during the first few weeks of the season. Using annuals such as corn as opposed to perennials to provide the beetle-deterring shade would eliminate the need for careful selection of shade-tolerant legume varieties. It would, however, require agricultural planning (i.e., planting of only polycultures) on a scale larger than is typical in the tropics.

Summary

Pest beetles were sampled with a sweep net from beans and cowpeas growing in monoculture plots and in polyculture plots with banana in Costa Rica. There were approximately three times as many *Diabrotica balteata* and *Cerotoma ruficornis rogersi* on beans and cowpeas in monocultures than polycultures. Such large differences might account for some of the benefits of legume interplanting.

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Leaf area in relation to petiole length in cassava

Resumen. Se encontró una correlación positiva entre la longitud del pecíolo y el área foliar de la yuca. Se propone un método simple y rápido para estimar el área foliar cuando se efectúan evaluaciones genéticas de nuevos especimenes

Total leaf area exposed by a plant determines largely its capacity for photosynthesis and transpiration. Hence leaf area index is gaining more importance while assessing the productivity of crop plants. Attempts were made in the present study to work out the relationship between petiole length and leaf area in order to develop a simple method for measurement of leaf area particularly for larger population of cassava as the linear measurement methods developed for this crop (1, 2) are more time consuming.

Fully expanded leaves were marked at random separately for 1) broad and medium leaf type and 2) for narrow leaf type. The leaves were collected at monthly intervals between second to eighth month stages and their actual leaf area with the corresponding petiole length were measured separately for both the leaf types. The petiole length of fully expanded leaves varies from 15 to 40 cm and their leaf area ranges from 130 to 540 cm^2 (Fig. 1). Maximum values were recorded during the active period of plant growth (2 to 6 months) which normally coincides with the rainy seasons. More reduction in leaf and petiole length were noticed during dry period. Following the regression equations, it would be interesting to see the prediction equations of the areas, on the basis of petiole length, both for the strains of wide and narrow lobed

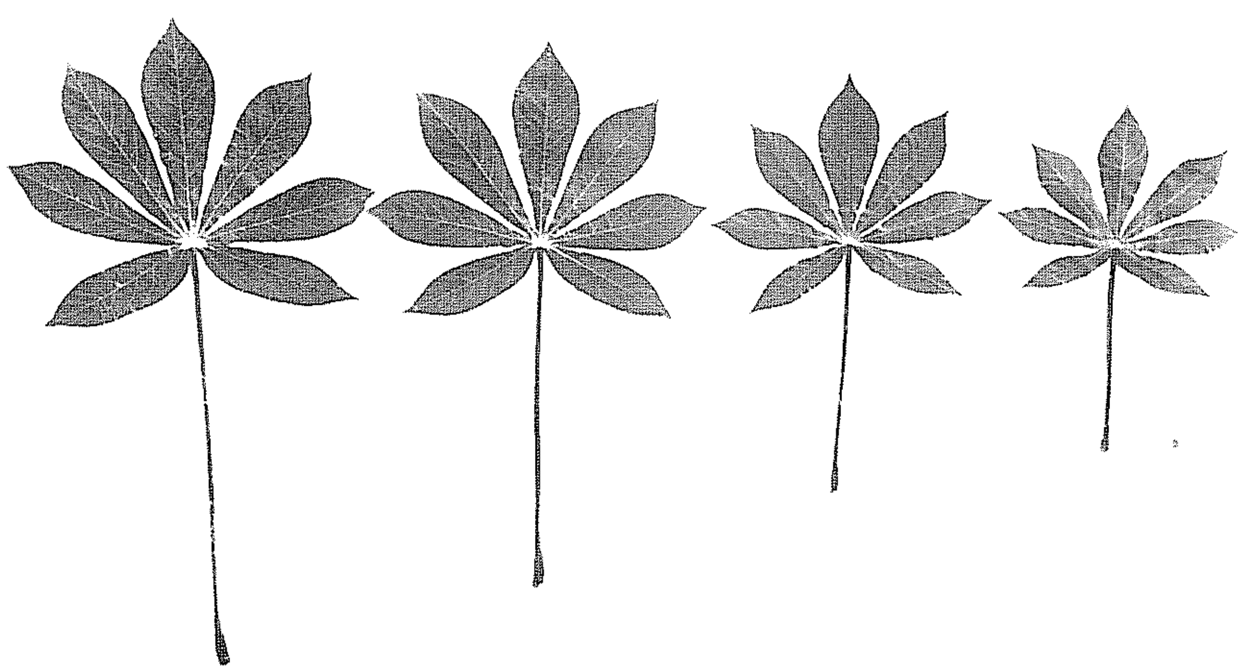

Fig. 1. Variation in petiole length and leaf in fully expanded leaves of cassava (Var H–2304)