Effects of Cropping System and Insecticide Protection on Insects Associated with Maize (*Zea mays* L.) and Cassava (*Manihot esculenta* Crantz).[1]

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ABSTRACT

The effects of cropping system and insecticide use on agronomic parameters as well as on insect damage, diversity and abundance were measured in a row intercrop of maize and cassava in Costa Rica. No yield response was obtained from insecticide use. Protected and unprotected intercrops had average land equivalent ratios of 1.76 and 1.89, respectively. Insecticide use generally reduced pest damage and incidence, while cropping system effects were mostly limited to soil pest incidence. Insecticide use affected general insect abundance and diversity on two sample dates, while cropping system affected abundance on four and diversity on one date.

COMPENDIO

En una asociación de maíz y yuca en Costa Rica, se evaluó el efecto del sistema de cultivo y el uso de insecticidas sobre varios parámetros agronómicos, así como sobre el daño, diversidad y abundancia de insectos. No hubieron respuestas en rendimiento por el uso de insecticidas. La asociación de cultivos con y sin protección presentó valores promedio de uso equivalente de la tierra de 1.75 y 1.89 respectivamente. En general, el uso de insecticidas redujo la incidencia y daño de plagas, mientras que el efecto del sistema de cultivo estuvo limitado principalmente a la incidencia de plagas del suelo. El uso de insecticidas afectó la abundancia y diversidad de insectos en dos fechas de muestreo mientras que el sistema de cultivo tuvo efecto sobre la agundancia en cuatro fechas y sobre diversidad, en una fecha de muestreo.

INTRODUCTION

Polycultural cropping systems produce a significant proportion of the food produced in developing countries. In El Salvador, for example, 80% of the dry beans, 90% of the grain sorghum, and 30% of the maize are produced by such systems (1, 6) attributed the prevalence of polyculture to a number of generalized advantages over monoculture, including: better land equivalent ratios, more nutrient uptake, higher dry matter production, reduced lodging, better weed control, higher cash return (at lower management levels), higher returns on labor, and more estable long-term yields. Disadvantages included reduced yield per crop species, increased total labor, and increased difficulties with drainage and mechanization.

Crops grown in polyculture have been generally considered to have less insect pest pressure because of increased system diversity and therefore stability. A study of 198 herbivore species revealed that just 53% were less abundant in more diverse systems, while 18% were more abundant (7). The manipulation of crop diversity can, therefore, reduce insect pest abundance but we lack sufficient knowledge to be able to predict the effect of a particular cropping system on the component-crop pests. Especially important are the yield data which permit the design of economically sound systems.

The system that I chose to study was a row intercrop of maize (*Zea mays* L.) and cassava (*Manihot esculenta* Crantz). This system is common in high rainfall areas of Central America where farmers use the rapidly growing maize to protect the soil while the slower growing cassava becomes established. Major Central American pests of these crops are discussed in King and Saunders (2). Insect pests have not been studied in this system, although Moreno (3) found less cassava rust (*Uromyces manihotis*) and more cassava powdery mildew (*Oidium manihotis*) and cassava scab (*Sphaceloma* sp.) on cassava intercropped with maize than on cassava grown alone.

MATERIALS AND METHODS

The six treatments were monoculture maize with and without insecticide protection, monoculture cassava with and without insecticide protection, and a

1 Received for publication on April 3, 1987.

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row intercrop of maize and cassava with and without insecticide protection. Plots were 10 m x 10 m arranged in four replications of a split plot design with insecticide protection as main plots and cropping systems as subplots.

The experiment was planted on June 7, 1982 at the CATIE (Tropical Agriculture Center for Research and Teaching) experiment station in Turrialba, Costa Rica located at 600 m above sea level on the Costa Rican Atlantic slope. This region averages 2631.7 mm rainfall/year and averages 21.5°C with little seasonal fluctuation. Maize and cassava were planted at 37 750 and 10 000 plants per ha, respectively, both in monoculture and intercrop. Fertilization followed standard station practices. Weeds were controlled manually.

Insecticide-protected maize received 1.15 kg a.i./ha carbofuran 10G at planting, followed by three weekly and two biweekly applications of permethrin 2 E (0.002% solution sprayed to runoff) starting at 15 days after crop emergence. Maize was harvested on October 19, 1982. Ears were shelled, and grain was oven-dried and converted to kg dry grain per ha. Plant population at one month, and at harvest, ears harvested, plant height at maturity, and per cent rotted ears were also determined.

Insecticide-protected cassava received the same treatments as protected maize. The carbofuran was side-dressed at one month after planting, while the five foliar permethrin applications were stated two weeks later. Cassava was harvested during the first week of June, 1983. Yields of commercially acceptable and unacceptable roots were determined, as were plant population at one month and at harvest, and maximum plant height. Total commercial dry matter yield of each system was estimated as maize grain dry weight plus 35% of the cassava commercial root yield. Percent matter in cassava roots was taken from O'Hair (4).

Pest insect populations were evaluated in several ways. Two 25 cm x 25 cm x 25 cm soil samples were taken per plot at one and three months after planting to determine numbers of the adult and nymph *Cyrtomenus bergi* (Hemiptera: Cydnidae) and *Phillophaga* spp. larvae (Coleoptera: Scarabaeidae). Above-ground insects were evaluated by plant damage or visual counts. Aphid damage to maize was evaluated on August 18, 1982 by determining the per cent damage in 25 plants per plot. The percentage of 25 plants per plot with feeding damage by *Diabrotica* spp (Coleoptera: Chrysomelidae) and *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) were determined on June 17, 1982 and July 26, 1982, respectively. Stemboring damage by *Diatraea* sp. (Lepidoptera: Pyralidae) was determined in 10 maize plants per plot at harvest. There was no above-ground damage to the cassava. Insect abundance and diversity was estimated in each cropping system using catches with pitfall traps and yellow pan traps. Two pitfall traps and two yellow pan traps filled with water and a small amount of detergent were placed in each plot. One-day catches were collected from the pitfall traps on July 8, 22 and August 5, 1982. The yellow pan traps were kept at the top of the crop canopy and one-day catches were collected on July 8, 22 and August 5, 19, 29, and September 16, 1982. Total individual insects caught in both trap types were determined as a measure of abundance. Total arthropod species caught in each trap type, estimated by counting morthotypes, was used as the measure of diversity. Actual species present were not determined.

Percentages were transformed by arcsin x and insect counts were transformed by x+1/2 for analysis. Analysis of variance was performed on each parameter. Subplot means were separated by Duncan's Multiple Range Test. Means over insecticide protection control and cropping system are not given, but their statistical effects on each type of data are summarized.

RESULTS AND DISCUSSION

Agronomic Effects

Agronomic data are summarized in Table 1, while the statistical effects on agronomic parameters of insecticide protection and cropping system are summarized in Table 2.

Insecticide protection significantly increased maize plant height in monoculture, while there was no such effect in the intercrops. Abundance of insects affecting plant height may have been reduced in number either by the use of insecticides or by the presence of cassava, but the insect data available do not implicate any particular species. Maize plant population was not affected during the experiment.

The percentage of rotten ears was significantly increased in both protected and unprotected intercrops. This is likely due to the increased relative humidity within the canopy which favored fungal pathogens. Although *Diatraea* sp. damage can also increase ear rots (5), in this experiment insecticide use significantly reduced *Diatraea* damage without reducing ear rot. Total ears harvested per hectare was not affected by any treatment.

Table 1. Agronomic effects of cropping system and insecticide protection on maize and cassava. Turrialba, Costa Rica, 1982-83.

Agronomic Parameter	Unprotected Maize	Protected Maize	Unprotected Intercrop	Protected Intercrop	Unprotected Cassava	Protected Cassava
Maize plants/ha (1 month)	32 500	34 625	33 625	37 750	–	–
Maize height at maturity (cm)	172 B	199 A	194 AB	185 AB	–	–
Maize plants/ha (at harvest)	26 500	33 125	30 250	34 375	–	–
Ears harvested/ha	22 125	24 375	24 250	22 750	–	–
Percent rotted ears	8 8 B	9 2 B	13 2 A	15 2 A	–	–
Maize dry grain yield (kg/ha)	1 912	2 301	032	1 964	–	–
Cassava plants/ha (4 months)	–	–	9 750 AB	9 250 B	10 000 A	10 000 A
Cassava height at 3 months (cm)	–	–	178 A	173 A	157 AB	142 B
Total cassava root yield (kg/ha)	–	–	15 050 B	12 894 B	21 125 A	18 575 AB
Percent commercial roots	–	–	66 1	70.7	60 9	56.4
Commercial root yield (kg/ha)	–	–	9 613	8 387	12 763	10 413
Total commercial dry matter (kg/ha)	1 912 C	2 301 C	5 397 A	4 900 A	4 467 AB	3 645 B

Means in the same row followed by the same letter, or by no letter are not significantly different (DMRT, p = 0.05).

Cassava plant populations were significantly lower in the insecticide-protected intercrop, which could perhaps be a combined effect of maize competition and insecticide phytotoxicity. The possibility of phytotoxicity is supported by the tendency of the protected cassava to be shorter than the unprotected in both crop arrangements.

Dry grain yields were similar under all treatments, about 2 MT/ha. Such yields levels are typical for Costa Rican farmers in similar environments, but much lower than might be possible under more intensive management. Total cassava yields were lower in the intercrop. Because of higher percentages of commercially acceptable roots in the intercrop, however, there were no significant differences in commercial root yields Total commercial dry weight was significantly higher in the intercrop. Without adjusting for labor costs or specific crop rices, the intercrop was agronomically and economically more productive than either monoculture. Average land equivalent ratios for the protected and unprotected intercrops were similar, 1.76 and 1.89, respectively.

Pest Insect Counts and Damage

Pest insect counts and damage estimates are summarized in Table 3, while the statistical effects of insect control and cropping system on these parameters are summarized in Table 4.

Aphid damage was significantly higher on protected maize both in monoculture and in the intercrop. This is most likely due to adverse effects of the permethrin treatments on aphid natural enemies. Insecticide treatments significantly reduced *Diabrotica* damage and numbers, *Diatraea* damage, and total soil insects.

Apart from a small increase in internodes damaged by *Diatraea,* significant cropping system effects were limited to soil insects. *Cyrtomenus bergi* counts at 2

Table 2. ANOVA effects of insecticide protection and cropping system on agronomic characters. Turrialba, Costa Rica, 1982-83.

Agronomic Parameter	Insecticide Protection	Cropping System
Maize plants/ha (1 month)	NS	NS
Maize height at maturity (cm)	**	NS
Maize plants/ha (at harvest)	NS	NS
Ears harvested/ha	NS	NS
Percent rotted ears	NS	**
Maize dry grain yield (kg/ha)	NS	NS
Cassava plants/ha (4 months)	NS	**
Cassava height at 3 months (cm)	NS	***
Total cassava root yield (kg/ha)	*	***
Percent commercial roots	NS	*
Commercial root yield (kg/ha)	NS	NS
Total commercial dry matter (kg/ha)	NS	***

NS = not significant; * = significant, p = 0 10; ** = significant, p = 0 05; *** = significant, p = 0 01

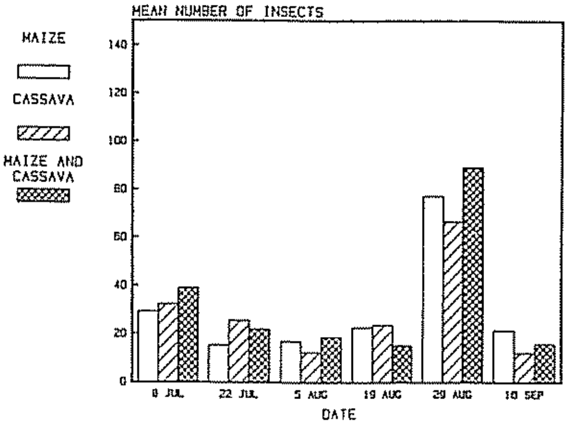

Fig. 1. Abundance of insects trapped in yellow pans in cropping systems protect by insecticides, Turrialba, Costa Rica, 1982.

and 3 months as well as *Phylloghaga* spp. and total soils insects were significantly affected, due mostly to the higher numbers in the intercrop compared to the monoculture cassava.

Abundance and Diversity in Trap Catches

Insect abundance as measured by yellow pan catches are summarized in Figs. 1 and 2 while diversity is summarized in Figs. 3 and 4. Abundance and diversity both peaked in late August, just before the maize reached physiological maturity. There were no significant differences found between subplots for either of these parameters. The statistical effects of insecticide protection and cropping system on insect abundance and diversity in yellow pan catches are

Table 3. Effects of cropping system and insecticide protection on insect pest incidence and damage, Turrialba, Costa Rica, 1982-83.

Insect or Damage	Unprotected Maize	Protected Maize	Unprotected Intercrop	Protected Intercrop	Unprotected Cassava	Protected Cassava
Percent plants damaged by aphids	0.4 B	46.2 A	0.7 B	34.7 A	–	–
Percent plants damaged by chrysomelid beetles	24.9 A	7.4 AB	23.8 AB	2.5 B	–	–
Percent plants damaged by *Diatraea* sp.	65.3 A	24.6 B	69.0 A	18.8 B	–	–
Internodes/plant damaged by *Diatraea* sp	1.1 A	0.3 B	1.4 A	0.3 B	–	–
Percent plants damaged by *Spodoptera frugiperda*	2 1	0 8	0.7	0.0	–	–
Cyrtomenus bergi count at 1 month	0.0	0.4	0.0	0.0	0.0	0.4
Cyrtomenus bergi count at 2 months	4 4 A	1.6 B	3 9 A	0 9 B	0.4 B	0.4 B
Cyrtomenus bergi count at 3 months	12.6 A	3.6 BC	8.4 AB	6.1 ABC	3 6 BC	1.8 C
Diabrotica spp/plant a 1 month	0.4	1.2	1.0	1.0	0.0	–
Diabrotica spp/plant at 3 months	1.2 AB	0.0 B	3.1 A	0 4 B	0 0 B	0 2 B
Phyllophaga spp count at 2 months	0.5	0.9	0.6	0.0	0.0	0.2
Phyllophaga spp count at 3 months	4.2 A	3.3 A	4.1 A	3.3 A	2 1 AB	0.8 B
Total soil insects	26.8 A	12.8 AB	22.0 A	11.3 AB	5 5 B	3.5 B

Means in the same row followed by the same letter, or by no letter, are not significantly different (DMRT, p = 0.05)

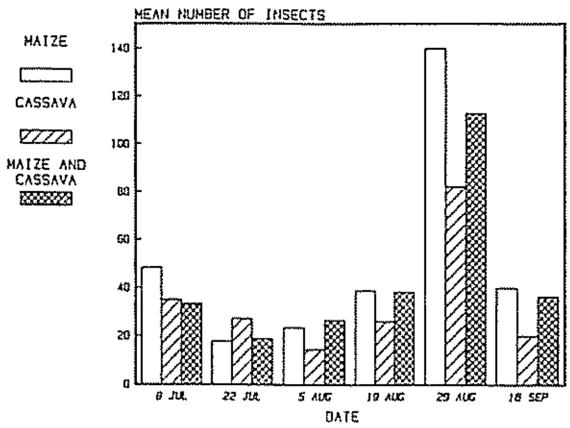

Fig 2. Abundance of insects trapped in yellow pans in cropping systems without insecticide protection, Turrialba, Costa Rica, 1982.

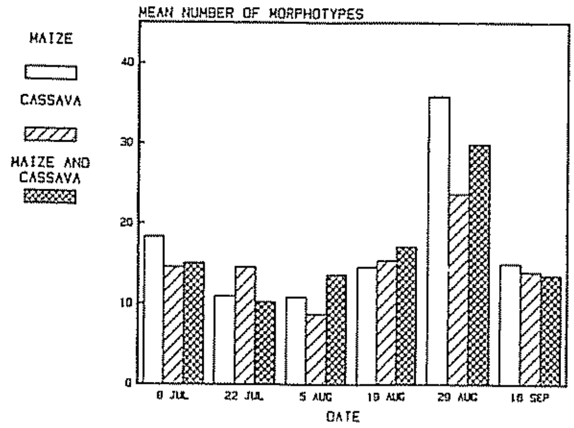

Fig. 4 Diversity of insects trapped in yellow pans in cropping systems without insecticide protection, Turrialba, Costa Rica, 1982.

given in Table 5. The use of insecticides significantly reduced insect abundance as well as diversity in the August 19 and September 16 catches. Cropping system significantly affected abundance on four dates due primarily to low catches in the monoculture cassava, but affected diversity only on July 22 due to relatively high catches in the same system of cassava.

Pitfall traps were discontinued earlier than the pan traps because of problems caused by heavy rainfall. Subplot abundance and diversity, as summarized in Figs. 5 and 6 respectively, show a decline through the trapping period. No significant effect was found from insecticide protection (Table 5). Cropping system affected diversity on July 22 (Table 5) due to high catches in monoculture cassava, as occurred with the yellow pan catches for the same date.

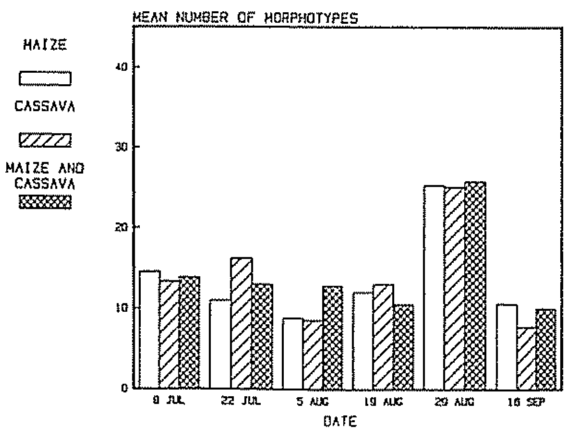

Fig. 3. Diversity of insects trapped in yellow pans in cropping systems protected by insecticides, Turrialba, Costa Rica, 1982.

Table 4. ANOVA effects of insecticide protection and cropping system on insect numbers and damage, Turrialba, Costa Rica, 1982.

Insect or damage	Insecticide Protection	Cropping System
Percent plants damaged by aphids	***	NS
Percent plants damaged by *chrysomelid* beetles	**	NS
Percent plants damaged by *Diatraea* sp.	***	NS
Internodes/plant damaged by *Diatraea* sp.	***	*
Percent plants damaged by *Spodoptera frugiperda*	NS	NS
Cyrtomenus bergi count at 1 month	NS	NS
Cyrtomenus bergi count at 2 months	***	***
Cyrtomenus bergi count at 3 months	NS	**
Diabrotica spp / plant at 1 month	NS	NS
Diabrotica spp /plant at 3 months	**	NS
Phyllophaga spp count at 2 months	NS	NS
Phyllophaga spp. count at 3 months	NS	**
Total soil insects	***	**

NS = not significant; * = significant, p = 0.10; ** = significant; p = 0.05; *** = significant, p = 0.01.

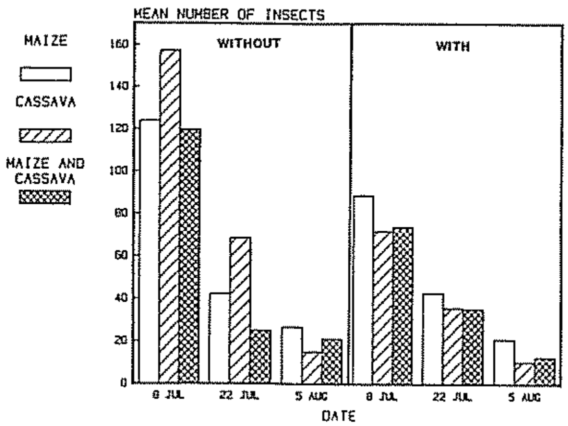

Fig. 5. Abundance of insects trapped in pitfalls in insecticide-protected and unprotected cropping systems, Turrialba, Costa Rica, 1982.

Table 5. ANOVA effects of insect control and intercropping on diversity and abundance of insects trapped in pitfalls and yellow pans. Turrialba, Costa Rica, 1982.

Trap Type and Date	Insecticide Protection	Cropping System
July 8 abundance in yellow pan	NS	NS
July 8 diversity in yellow pan	NS	NS
July 8 abundance in pitfall	NS	NS
July 8 diversity in pitfall	NS	NS
July 22 abundance in pan trap	NS	*
July 22 diversity in pan trap	NS	*
July 22 abundance in pitfall	NS	NS
July 22 diversity in pitfall	NS	*
August 5 abundance in pan trap	NS	**
August 5 diversity in pan trap	NS	NS
August 5 abundance in pitfall	NS	NS
August 5 diversity in pitfall	NS	NS
August 19 abundance in pan trap	***	NS
August 19 diversity in pan trap	**	NS
August 29 abundance in pan trap	NS	**
August 29 diversity in pan trap	NS	NS
September 16 abundance in pan trap	**	**
September 16 diversity in pan trap	**	NS

NS = not significant; * = significant, p = 0 10; ** = significant, p = 0 05; *** = significant, p = 0 01

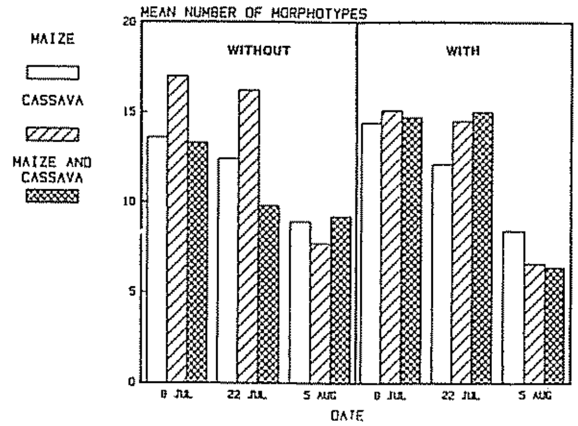

Fig 6. Diversity of insects trapped in pitfalls in insecticide-protected and unprotected cropping systems, Turrialba, Costa Rica, 1982.

CONCLUSIONS

With land equivalent ratios greater than 1.75, the maize and cassava intercrop was productive enough to explain its wide use by Central American farmers. Although insecticide protection did reduce some pest incidence and damage, the lack of yield response is most likely due to a combination of low pest pressure and low crop yields. Under this level of pest pressure, intercropping did not afford any benefit in terms of reduced pest incidence or damage. Cropping system did affect general insect abundance on four sample dates and diversity on one date, but these effects were mostly due to relatively high or low catches in monoculture cassava, rather than intercropping effects.

Greater differences might also have occurred if the system had been more intensively managed. Greater yield potentials might have made it possible to demonstrate a benefit from insecticide use and yield depression from intercropping.

Maize and cassava plants are similar in size, although very different in other architectural aspects. Other crop combinations with component species more dissimilar in size might have resulted in greater cropping system effect on pest incidence, pest damage, insect abundance or insect diversity.

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Reseña de Libros

K. Wada. Ando Soils in Japan, ed. Kyushu University Press, Fukuoka-shi, 812, Japan, 1986. 276 p.

En el planeta Tierra, los andosuelos cubren más de 124 millones de hectáreas y un 27% de los suelos cultivables, del Japón. Como consecuencia, en este país, son muchos y de muy buena calidad los estudios hechos sobre estos suelos, publicados principalmente en las revistas japonesas. Para recopilar la reciente información de numerosos trabajos presentados a investigadores que no dominan el japonés, el Profesor K. Wada coordinó un equipo de nueve expertos, ocho de las universidades y uno de la Estación Experimental Nacional de Hokhaido, para que, en cinco capítulos, resuman una porción apreciable de esta información. Estos cinco capítulos constituyen la Parte I.

Al volumen lo complementa una Parte II, que presenta descripciones detalladas y datos analíticos de muchos de los principales suelos volcánicos de Japón. Un cuadro de datos meteorológicos, temperatura y precipitación, permite comprender mejor las condiciones bajo las cuales se han formado los perfiles descritos.

En el primer capítulo, el profesor Otawa resumió mucha información reciente sobre morfología y clasificación de los Andosoles, la cual es discutida en el marco de la clasificación de suelos de Japón. Un cuadro que correlacionó 40 pedones con la propuesta de Andisoles aclara la relación entre esta propuesta y el sistema de Japón.

En el segundo capítulo, el Profesor Shoji resume los hallazgos sobre caracteres mineralógicos de los minerales primarios y el Profesor Yoshinaga sobre minerales de arcilla. Los dos subcapítulos presentan bibliografías muy amplias y recientes de no menos de 140 referencias.

En el tercer capítulo, de solamente una docena de páginas, se resume la información sobre las características del humus en suelos volcánicos; 32 referencias concluyen el capítulo.

Las propiedades químicas se resumen en el cuarto capítulo, a cargo del Profesor Inoue. Este capítulo, el más largo y con casi 100 referencias, presenta muchos datos y relaciones entre propiedades de Andisoles. Se discute con considerable detalle las principales propiedades químicas, como la acumulación de humus, los complejos de cambios iónicos, las reacciones con fosfato y fluoruro y la acidez de estos suelos. También en este capítulo se discute las relaciones entre las propiedades químicas y la forma de clasificar a estos suelos.

El quinto capítulo trata sobre las propiedades físicas de los Andisoles considerando su densidad aparente y capacidad de retención de agua, su plasticidad y los cambios que sufren estos suelos cuando se secan. En este capítulo se estudian las relaciones entre la clasificación de Andisoles y sus propiedades físicas

La segunda parte del libro, que corresponde a un poco más que su mitad, describe y da datos sobre 25 pedones seleccionados de diferentes partes de Japón. Esto permitirá a los lectores familiarizarse con los suelos de este país.

El texto del volumen es bastante claro y se puede estudiar si se tienen conocimientos medianos de inglés y un dominio razonable sobre la materia suelos. Se recomienda este valioso volumen a todas las bibliotecas que presten servicios en regiones volcánicas y a los estudiosos de los suelos volcánicos.

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Notas y Comentarios

Comerás el pan con el sudor de tu rostro

El hombre ha estado comiendo pan desde antes de que supiera que era hombre. Pero 12.000 años no han hecho nada, al parecer, para que el precio de uno de los más básicos y emotivos alimentos sea más uniforme en todo el globo. Ciertamente, algunas personas sentadas a tomar su desayuno de baguete, "schwartzbrot", baladi, o pan blanco en rebanadas, están pagando por su pan de cada día hasta 17 veces más que personan que desayunan con versiones del mismo producto en otros países. La razón es política: los gobiernos consideran que el pan mismo, o la sustancia de la que está hecho, son demasiado sensitivos para dejar que el simple mercado fije su precio. Algunos gobiernos subsidian al productor, algunos al consumidor, y algunos hacen dinero con los subsidios de otros.

Esta disparidad en los precios del pan se revela en datos recientes del Consejo Internacional del Trigo, sobre precios locales del pan, convertidos en dólares norteamericanos al promedio de tasas de cambio para mayo de 1986, y que comenta recientemente **The Economist** (vol. 303, No. 7501, p. 58)

Los amantes del pan en la Comunidad Económica Europea y en los Estados Unidos pagan bastante por sus hogazas, que llevan en parte, la carga de subsidiar a sus agricultores y el costo de abaratamiento anormal (**dumping**) del trigo en el mercado mundial. Nadie protesta mucho, sin embargo: los alimentos básicos representan una parte demasiado pequeña en los presupuestos de la gente de paises ricos.

El gobierno japonés, no sus consumidores, cosecha el beneficio de las exportaciones baratas de trigo europeo y norteamericano. Los japoneses producen menos de un millón de toneladas de su propio trigo, pero el consumo de pan ha estado aumentando. Vendido en pequeñas pastelerías, responde a la moda por las cosas occidentales. La Agencia Estatal de Alimentación importa cerca de seis millones de toneladas de trigo barato y lo vende a los molineros por unas cuatro veces su precio de importación. Los japones terminan así comiendo el pan más caro del mundo (231 centavos de dólar por kilogramo).

Los rusos, por otro lado, gastan 1.5 mil millones de rublos cada año (US$ 2.5 mil millones a la tasa de cambio oficial, bastante menos en realidad) subsidiando su pan. El precio de la hogaza más barata no ha subido desde los novecientos veinte (20 a 24 US cents. por kilo), aunque los consumidores se quejan de que las variedades "nuevas y mejoradas" que se introducen frecuentemente en el mercado son un simple subterfugio para elevar el precio. Se considera que el pan escapará al incremento general de los precios que se espera para el presente año: los rusos recuerdan muy bien los disturbios sobre el precio del pan en Polonia, en 1980.

Los egipcios, asimismo, comprenden la política del pan, después de que las alzas de precios condujeron a violencia en 1977 y 1984. El año pasado lo hicieron calladamente: la nueva hogaza de dos piastras resultó un poco menos de dos veces el tamaño de la hogaza de una piastra a la que reemplazó. Pero el pan egipcio sigue siendo el más barato del mundo (13 centavos de dólar por kilogramo). Otros precios actuales por kilogramo son el del Brasil (22 c.), Zimbabwe (37 c), Gran Bretaña (79 c), Alemania Occidental ("mischbrot", 139), Francia (baguette, 150 c), Estados Unidos (blanco, 176) y Sudáfrica (blanco, 216 c). Hemos calculado que en Costa Rica, a comienzos de 1987, el precio del pan es de alrededor de 77 centavos de dólar por kilo.

En los países ricos y en Rusia el consumo de pan está disminuyendo: el pueblo tiene suficiente alimento, y conforme aumentan sus ingresos, vuelven sus ojos hacia la carne, por ejmplo. El pueblo en los paises pobres está comiendo más pan, aún cuando no aumenten sus ingresos: el pan está poniéndose más barato. En el Africa negra, el pueblo consume 50 por ciento más trigo que hace 10 años.

Conforme la gente del tercer mundo se mueve hacia las ciudades, se vuelve hacia el pan: es fácil de obtener, es más conveniente que cocinar maiz o sorgo, y es a menudo barato. Las importaciones de trigo, anormalmente barato (procedente del **dumping**), particularmente cuando la moneda local está sobrevaluada, proveen alimento barato para los trabajadores. Los gobiernos inestables, preocupados por los inquietos habitantes de las ciudades, están encantados de mantener los estómagos de sus habitantes llenos de grano importado, aún a expensas de los agricultores locales. Algo que la humanidad ha conseguido aprender en 12 milenios es cómo hacer complicado un simple alimento. **A.G.**