Chemical Control and Ecological Observations of Fruit Flies of the Genus *Anastrepha* Schiner (Diptera: Tephritidae) on Mango[1]

J. Soto-Manitiu*, L. Jirón*, R. Hernández**

ABSTRACT

A comparative study of the efficiency of two organophosphate insecticides (dipterex and malathion) against fruit flies of the genus *Anastrepha* on two varieties of mango (Irwin and Tommy Atkins) was conducted. A chronology of parasitism was determined by studying the population dynamics of these pests.

The two insecticides were applied separately and a third treatment included both insecticides together. These three treatments showed significantly lower levels of parasitism than the control. Among treatments there were no significant differences in the degree of parasitism.

In the control group (absence of insecticide) the Tommy Atkins variety showed a relatively lower incidence of parasitism than the other variety due to its longer maturation period. After 17 weeks, however, the incidence of parasitism on this variety increased sharply.

It was determined that the principal species of *Anastrepha* associated with mangoes, at least in the Experimental Station Fabio Baudrit, is *A. obliqua* (90%).

Modified McPhail traps placed on trees (Hayden variety) demonstrated the presence of considerable numbers of adult *Anastrepha* two weeks after the initial rains of the wet season. These ecological observations suggest two mechanisms by which *Anastrepha* infests mangoes: a) infestation by adults emerging from pupae which were deposited in the ground; b) infestation by migratory adults.

COMPENDIO

Se evaluó comparativamente la eficiencia de dos insecticidas organofosforados (dipterex y malathion) en el combate de las moscas de las frutas del género *Anastrepha* en las variedades de mango "Irwin" y "Tommy Atkins". Se lograron también determinar algunos aspectos del comportamiento poblacional de esta plaga, así como el registro de la cronología del ataque.

Las evaluaciones se hicieron con base a la aplicación de los dos insecticidas, tanto en forma individual como alterna. Los tres tratamientos en los cuales se utilizó insecticida presentaron una tasa de parasitismo significativamente menor que el testigo. A su vez no hubo diferencia significativa entre los tres tratamientos con insecticida, en ninguna de las dos variedades.

Analizando la evolución del parasitismo en el grupo testigo, la variedad "Tommy Atkins" presentó una tasa comparativamente menor que la otra variedad, debido a que su período de maduración es más largo. Sin embargo, a las 17 semanas, el parasitismo subió bruscamente en ambas variedades.

Se determinó que la principal especie de *Anastrepha* asociada con mango, al menos en la Estación Experimental Fabio Baudrit, es *A. obliqua* (90%).

Observaciones ecológicas, utilizando trampas McPhail modificadas, en árboles de la variedad "Haden", demostraron que la presencia de los adultos de *Anastrepha* aumenta considerablemente a la segunda semana después del inicio del período de lluvias. Se sugiere la existencia de dos mecanismos en el proceso de infestación por *Anastrepha*

a. un porcentaje que proviene de las pupas depositadas en el suelo.
b. otro porcentaje proveniente de los adultos migratorios.

INTRODUCTION

Mango is a fruit tree that was introduced into tropical America several centuries ago and became successfully established in this region, with about fifty varieties known at present (7, 13, 15, 18).

Even though this crop is exploited with considerable technical efficiency in some regions like the Dominican Republic, northern Mexico and in some states of Brazil and Hawaii, its commercial production in Latin America is generally low, mainly because the fruit is heavily attacked by larvae of several species of the genus *Anastrepha* (5, 9, 10).

It has been found that because of the close phylogenetic affinities of *Anastrepha* and the Mediterranean fruit fly *Ceratitis capitata* (Wiedemann), many of the parasitoids released in the field to reduce populations of the latter species are also associated with the genus *Anastrepha*. In 1981, Wharton *et al.* published a comparative study in Costa Rica on the effect of these introduced parasitoids and found that, in some regions of the country where introduced and some endemic parasitoids were established, they

1 Received for publication 2 July 1986

* Museo de Insectos, Facultad de Agronomía, Universidad de Costa Rica, San José, Costa Rica

** Estación Agrícola Experimental Fabio Baudrit, Universidad de Costa Rica, San José, Costa Rica

parasitized 10.58% of *Anastrepha* and 5.55% of *C. capitata*, several years after the releases were made. Although a program of parasitoid release against *Anastrepha* would seem to offer promising results, continued releases have not yet been made to control this tropical American endemic pest.

At present, the best alternative that Latin American mango producers have is to use some agricultural chemicals, along with cultural practices. A common control method utilized in this region consists in applying to the foliage a mixture of an insecticide, generally an organophosphate, and a atractant, usually molasses (11, 16). Recently, it was found that the efficiency of this attractant in catching adults of *Anastrepha* in traps was very low, and it was stated that a yeast of the genus *Torula* in solution is 8.4 times more efficient for the same purpose (6). However, this atractant had not been evaluated when applied to mango foliage with the Central American species of the genus *Anastrepha*.

In this paper, we report the evaluation of: a) the efficiency of two organophosphate insecticides, dipterex and malathion separately and alternately applied, mixed with the torula attractant, in the control of *Anastrepha* spp. on mango; and b) some ecological aspects of these species associated with mangoes in Costa Rica.

MATERIAL AND METHODS

Chronological evaluation of parasitism and of treatment effects

The field observations were conducted at the Estación Agrícola Experimental Fabio Baudrit, Alajuela Province, 840 m above sea level.

Two adjacent, flat plots were chosen for this study, each with 20 mango trees of the Irwin and Tommy Atkins varieties, with an approximate area of 4220 m^2. The studied trees are 10 years old, have been well maintained and have had several harvested crops recorded.

In order to determine the beginning of the first and second flowering periods, as well as the fruit set in both varieties, observations were started in November, 1984.

With the purpose of standardizing as much as possible the crop samples of both mango varieties, it was necessary to eliminate the large and medium-sized fruit at the time of the second fruit set (March 10-22).

To evaluate the insecticides, four treatments with four replications were used, as follows:

a. Treatment N° 1: dipterex-malathion in combined from.
b. Treatment N° 2: dipterex.
c. Treatment N° 3: malathion.
d. Treatment N° 4: control.

The organophosphate insecticides dipterex SP 95% and malathion ES 56.5% were used for the tests. Both chemicals were applied to the foliage previously mixed with the attractant, a yeast of the genus *Torula*, prepared eight days before mixing it with the insecticide so its maximum attracting power would be obtained (6, 9). The insecticide dosages used were 2 g/l of water for dipterex and 2 ml/l of water for malathion, both of commercial formulation. The attractant was applied at a concentration of 10 g/l of water. The sprayings were done with a motor pump and a 12 l tank. To avoid the border effect, a 4 x 4 m screen made of vinyl bags was used.

A total of five applications were made beginning on the eighth week after fruit set (May 10, 1985), when the fruits had a mean diameter of 6.6 cm and a mean length of 8.4 cm. In the combined treatment, both varieties were alternately sprayed with both insecticides. For the control of antracnose, two applications were made, the first on June 4 and the second on June 18, using dithane M-45 (50 g/12 l of water) and Benlate (30 g/l of water). The applications of the pesticides and the attractant were made separately from that of the fungicide.

Four evaluations of the percentage of fruits attacked by larvae of *Anastrepha* were made every two weeks alternately with the insecticide applications. The first of these evaluations was made on May 31 (11 weeks after fruit set). The second sampling was done on June 14 (13 weeks after fruit set). The third and fourth evaluations were made on June 28 and July 12, 15 and 17 weeks after fruit set respectively.

The evaluations consisted of systematic random samplings of eight fruit per tree which were dissected later in the laboratory. The presence of only one larva per fruit was considered as a unit in the counting of parasitism.

For the statistical analysis we used an unrestricted randomized design (IRA) with a nested arrangement. The mean numbers of *Anastrepha*-parasitized fruit of the last evaluation data were subjected to a transformation because they composed a binnomial distribution.

Identification of the species of *Anastrepha* associated with two mango varieties

After the last sampling date, larvae from 15 infested fruits from each variety were cultivated. Then, the larvae were placed in 500 ml wide-mouthed glass jars provided with a substrate of clean sand, with the infested fruit. The mouths of the jars were covered with fine muslin cloth. Taxonomical identifications were made using Steyskal's illustrated key (19).

Ecological observations

In order to study some of the aspects of the behavior and ecology of the mango-infesting *Anastrepha*, 10 modified McPhail traps as described by Hedström and Jirón (6) were set up. For these observations, an isolated plot with 10 mango trees of the Hayden variety at the Estación Experimental Fabio Baudrit was chosen. The attractant used was the yeast *Torula* at a concentration of 10 g/l of water. The traps were placed during the middle of March, at the beginning of the fruit set. The observations and the replacement of the attractant were made every 15 days. During each observation we recorded: a) the number of flies collected and their relation to the stage of maturity of the fruit, as well as other probable hosts in the vicinity; and b) the climatic conditions, especially those relating to seasonal changes.

RESULTS AND DISCUSSION

One of the trees in the experimental groups had the first and second flowering periods well in advance of the other trees, so that when the spraying was initiated, its fruit were significantly larger than those of the rest of the trees. It is inferred that, because of this, a high percentage of the fruits of this tree were found to be parasitized by fruit flies in all evaluations. Also, by the time of the last evaluation, this tree had no fruit left.

Identification of the parasite

From the laboratory rearings we determined that parasitism in the mango plots under study was totally by larvae of the genus *Anastrepha*. A total of 69 adults of *Anastrepha* were obtained (37 from the Irwin variety and 32 from the Tommy Atkins). Of these, 62 were *A. obliqua* (Mcquart), five *A. serpentina* (Wied.) and two *A. striata* Schiner. These results agree with data reported for other regions of the country by Jirón and Zeledón (9). Guillo *et al.* (4) also found in Guatemala that the main parasite of mango was *A. obliqua* in 10 at the 11 varieties studied, including Irwin and Tommy Atkins.

Chronology of parasitism

In Fig. 1, the chronological evolution of the attack by fruit flies of the genus *Anastrepha* is shown. Before the eleventh week after fruit set, the parasitism rate is still very low, but it gradually increases and increases abruptly between the fifteenth and sixteenth week after fruit set. The evolution of this parasitism suggests that for control purposes the insecticide applications should be made between the tenth and eleventh week in the case of the Irwin variety and between the fourteenth and fifteenth week for the Tommy Atkins.

Differences in parasitism by *Anastrepha* in the two varieties of mango

The difference between both mango varieties as regards the parasitism rate of the same insect pest during the same period of time is clear, as is shown in Fig. 2.

Even though the first fruit set was approximately coeval, (second half of March) in both varieties, the length of the growing period was different. The physiological state of the mango fruit most attractive for *Anastrepha* also occurs at different times in both varieties, at least during the fruit set period. The Irwin variety reached its physiological maturity at approximately sixteen weeks, and the Tommy Atkins a little later, probably because of its larger fruit size. Guillo *et al.* (4) also found differences between these varieties in the parasitism rate of the fruit by *A. obliqua* for the same sampling period.

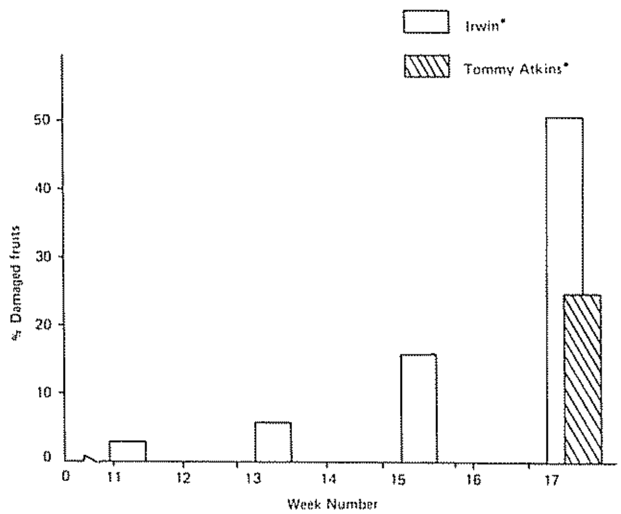

Fig. 1. Chronology of parasitism by *Anastrepha* spp. in two varieties of mango after the fruit set.

* Mean values including experimental and control groups.

The Irwin variety becomes a suitable oviposition substrate before the Tommy Atkins by maturing first; if the environmental conditions are adequate, *A. obliqua* completes its life cycle. In Fig. 2 it is shown that when the physiological maturity was reached and the fruit maturation period began, the parasitism rate in the control groups was similar in both varieties. It is possible to infer that 17 weeks is enough time for both mango varieties to become equally attractive to the insect pest.

In Fig. 1 it can be seen how, after the first evaluation was made, the Irwin variety had a much higher percentage of fruit attacked by fruit flies than the Tommy Atkins. The latter variety was not parasitized unitl about the tenth week after the fruit set. In the same figure we can also see that parasitism in both varieties occurs with a difference of at least 5 weeks. If it is considered that *A. obliqua*, the most important pest species of mango in Costa Rica, takes from six to seven weeks to complete a generation (1), then it is possible to infer that if both varieties are cultivated in the same area, the infested Irwin fruit could act as a source of inoculum for the Tommy Atkins variety.

Effect of the treatments on parasitism in both mango varieties

The effect of the treatments with insecticide and attractant, as shown in Fig. 2, was significant when compared to the controls in each of the varieties studied. In the case of the Irwin variety, treatment with dipterex and malathion reduced the parasitism rate to about 40%, and to about 15% for Tommy Atkins. Parasitism in the control groups of both varieties was about 70%

The insecticide, applied separately or alternately, did not present any differences in the protection of the fruit against the insect pest. This similarity between dipterex and malathion may be partly explained by the fact that both have a similar residual effect of a little less than two weeks.

In this investigation, the *Torula* yeast attractant was used for control purposes for the first time in Costa Rica. However, only a comparative field experiment would allow us to determine if there is a difference in the attractive power between molasses, the traditional attractant, and *Torula*.

On the other hand, alternation of the separate fungicide applications with the foliage spraying for insect control is also an adequate method. Although these alternate applications are, on a short term basis, less economical for the mango grower, mixing the fungicide, the insecticide and the *Torula* attractant together does not seem to be a logical procedure. It is probable that the action of the yeast is inhibited when mixed with a fungicide.

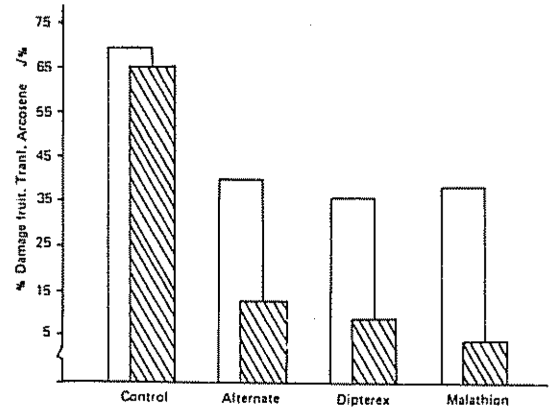

Fig. 2. Effects of four treatments on two varieties of mango in the parasitism by *Anastrepha* spp. seventeen weeks after the fruit set in La Garita, Alajuela, Costa Rica.

Ecological observations

The tropical tephritids are multivoltine species because the majority of them do not rely on only one host. Some of the species of *Anastrepha* may produce up to seven generations per year (2, 3).

Systematic sampling in Colombia (12) showed that *A. striata* remained active throughout the whole year, but with sharp seasonal fluctuations in the population densities. These observations imply that any control methods for *Anastrepha* associated with mango, guava or other perennial crop should consider three aspects:

1. The population dynamics during the host fructification period.
2. The behavior of populations during seasonal changes.
3. The survival of pest species when fruits are not available. That is, secondary hosts in the vicinity and their fructification periods should be determined, as well as the presence of advanced or delayed fruit and pupae in the dripping zone and their elimination.

These three population variables let us infer that the majority of the species of *Anastrepha*:

1. Spend the year in "rotation" among several host species to insure a food source and an oviposition substrate. This implies that adult flies have a high

dispersion capacity. *A. ludens* has been reported as traveling from 17.7 to 19.3 km (17). However, other authors have recorded even greater dispersion distances, 112 km (80 mi) from their breeding areas in Mexico to southern Texas, where they attack citrus crops. Occasionally, dispersion distances for this species of up to 224 km (160 mi) and 245 km (175 mi) have been also recorded (3). The dispersion data for mango-infesting species have not been determined, but if these are similar to those reported for *A. ludens,* it is possible to infer that the colonization of new plots by migrating adults is an important factor in the population dynamics of these species. Therefore, it would be necesary to determine, for control purposes, a migration index for each new crop.

2. That they have a resident population segment that survives in the pupal stage in the ground during the months when fruits are not available. This has been reported in other groups of cyclorrhaphan flies (Sarcophagidae) whose pupae survive in the ground for several months during the dry season, emerging during the first weeks of the wet season (9). During recent studies in the Atlantic zone of Costa Rica (I. González, personal communication, 1985) it was found that a significant percentage of *A. striata* associated with guava survives during the dry season as pupae; adults were collected, in screen cages placed on the ground, near an indigenous guava plantation during the first weeks of the wet season. This mechanism of seasonal survival in *Anastrepha* had been inferred by Picado in 1920, who suggested that releasing hens (pupae predators) in the surrounding grounds of guava trees was an efficient measure to reduce populations of *Anastrepha*. In our study we found that, during the second week after the beginning of the wet season (late May), adults of *Anastrepha,* probably emerged from the resident pupal population of the locality, began to appear in the modified McPhail traps. This population was present even though the fruits had not attained the optimum maturity preferred by the flies. When the fruits reach their physiological maturity and carbohydrates begin to be transformer into sugars, they change from green to yellow, and a series of olfactory and visual stimuli begin, attracting adults of *Anastrepha* from other areas. At this time, the population of fruit flies increases abruptly. The high numbers of adults present are due to their emerging from the ground, plus the migratory adults attracted by the ripe fruit. In the following weeks, higher and higher numbers of *Anastrepha* were found in the traps used to detect this pest (Table 2).

CONCLUSIONS

The most frequent fruit fly species attacking the Irwin and Tommy Atkins (90%) and the Hayden (88%) mango varieties was *A. obliqua.*

The Irwin and Tommy Atkins varieties showed differences in parasitism by *Anastrepha*. The Irwin variety was parasitized earlier and at higher rates than the Tommy Atkins, probably because it takes longer for the latter to reach physiological maturity.

The three insectide treatments showed an *Anastrepha* parasitism rate significantly lower than the

Table 1. Analysis of variance of the effect of varieties and treatments in the incidence of parasitism by *Anastrepha* spp. (Diptera: Tephritidae) on mango, in Alajuela, Costa Rica.

F	g.l.	S.C.	C.M.	Fc.	Ft. 0.05	0.05
Varieties	a–1 = 1	3860.344	3860.344	23.5796	4.26	7.82
Treat/var	a(b–1) = 6	11679.51	1946.585	11.89000	2.51	3.67
Error	ab(r–1) = 24	3929.17	163.71541			
Total		19469.024				

a = varieties
b = treatments
c = replications

control group. However, the results of the treatments differed, probably because of the differences in the fruit maturation period of both varieties under study.

Considering both of the insecticides used in our study, we concluded that the efficiency of a treatment does not depend on the trade name of the pesticide as much as on the three following factors:

a) The attractant used in this study (*Torula*) successfully brought adults of *Anastrepha* in contact with the insecticides, producing a significant difference between the control group of trees and the rest of the treatments.

b) The time of pesticide application should be during the weeks after fruit set. For the Irwin variety, applications could be intiated between the tenth and eleventh week after fruit set, and between the fourteenth and fifteenth week for the Tommy Atkins Variety.

c) The application of the insecticide and attractant should be separate from a fungicide application, as the latter inhibits the *Torula* yeast attractant.

The insecticides dipterex and malathion, separately applied, yielded good results, and it is not necessary to use them alternately. The sprayings can be done every 15 days. Thus, the number of insecticide applications is reduced to three or four in the case of the Irwin variety and from two to three in the case of the Tommy Atkins. The crop should be harvested before the seventeenth week after the fruit set, just before the increase in infestation by *Anastrepha*.

It would be convenient to test, for comparative and control purposes, the tradicional attractant (molasses) and *Torula*, sprayed with one or several insecticides with different residual effects. The insecticide applications could be spaced, as the *Torula* is known to maintain its attractant action for up to three weeks, according to Hedström and Jirón (6).

Table 2. Number of adults of *Anastrepha* spp. trapped in modified McPhail traps on mango (Hayden var.) in Alajuela, Costa Rica.

Evaluation	Number of *Anastrepha* *A. obliqua*	*A. serpentina*	*A. striata*
1 (May 31)	1	–	–
2. (June 14)	3	–	–
3. (June 21)	8	1	–
4. (July 12)	16	2	1

LITERATURE CITED

1. ALUJA, M.; MARTINEZ, I. 1984. Manejo integrado de las moscas de la fruta. Programa mosca del Mediterráneo. Dirección General de Sanidad Vegetal. México. 279 p.

2. BERG, G.H. 1959. Mosca de las frutas. I parte. Manual Entomológico para Inspectores de Cuarentena Vegetal. San Salvador, OIRSA. 66 p.

3. CHRISTENSON, L.D., FOOTE, R. 1960. Biology . f the fruit flies. Annual Review of Entomology 5:171-193.

4. GUILLO SOSA, M.; ESKAFI, F.M.; MANUEL, F.J. 1984. Identificación de especies del género *Anastrepha*, sus enemigos naturales y su preferencia a diferentes variedades de mango en el Departamento de Retalhuleu. Guatemala. Tikalia 3(1):16-27.

5. HANSEN, M. 1983. Mango. In Costa Rican natural history. Ed by D.H. Jansen University of Chicago Press. p. 95-97.

6. HEDSTROM, I.; JIRON, L.F. 1985. Evaluación de campo de sustancias atrayentes en la captura de *Anastrepha* Schiner spp. (Diptera: Tephritidae) plaga de frutales en América Tropical: 1. Melaza y Torula. Revista Brasileira de Entomología 29(3/4): 515-520.

7. HERNANDEZ, R.L. 1984. Actualización y perspectivas de la fruticultura. VI Congreso Agronómico Nacional. Sesiones de Actualización y Perspectivas. Vol. 2. Universidad de Costa Rica, Facultad de Agronomía. p. 19-29.

8. JIRON, L.F.; BOLAÑOS, R. 1986. Biology and larval morphology by electron microscopy (SEM) of *Patonella intermutans* Walker (Diptera, Sarcophagidae). Revista Brasileira de Entomología 30(2): (en prensa).

9. JIRON, L.F.; ZELEDON, R. 1979. El género *Anastrepha* (Diptera: Tephritidae) en las principales frutas de Costa Rica. Revista Biología Tropical 27(1):155-161.

10. MALAVASI, A.; MORGANTE, J.S.; ZUCCHI, R.A. 1977. Biologia de "moscas-das-frutas" (Diptera; Tephritidae). I. Lista de hospedeiros e ocorrencia. Revista Brasileira de Biología 40(1):9-16.

11. NASCA, A.J.; FERNANDEZ, R.V.; DE HERRERO, A.J.; MANZUR, B.E. 1983. Incidencia de los tratamientos químicos para el control de moscas de las frutas (Trypetidae) sobre crisópidos hemeróbidos (Neuroptera) en plantas cítricas. CIRPON. Revista de Investigación. (Tucumán) 1(2):47-73.

12. OLARTE, W. 1980. Dinámica poblacional del complejo constituido por las moscas de las frutas *Anastrepha striata* Schiner-*Anastrepha fraterculus* Wiedemann en el medio ecológico del sur de Santander. Bucaramanga, Colombia, VIS-COLCIENCIAS. p. 46-54.

13. OPEKE, L.K. 1982. Tropical tree crops. Binghamton New York, Varl-Ballou Press. p. 288-293.

14. PICADO, C. 1920. Historia del gusano de la guayaba. San José, C.R. Colegio Superior de Señoritas, 28 p. (Serie A, No. 2)

15. PURSEGLOVE, J.W. 1968. Tropical crops: Dicotyledons. New York John Willey. Vol. 1. 719 p.

16. RIVERA, S. 1978. Investigación sobre atrayentes venenosos (cebos) para el control de la mosca de la fruta *Anastrepha* spp. y *Ceratitis capitata* (Wied.). Memor. CENTA, San Salvador, (E.S.), 3 p. (Mimiografiado)

17. SHAW, J.G.; SANCHEZ, R.; SPISHAKOFF, L.M.; TRUJILLO, G.; LOPEZ, D. 1967. Dispersal and migration of Tepa-sterilized Mexican fruit flies. Journal of Economic Entomology 60(4):992-994.

18. SINGH, L.B. 1960. The mango: Botany, cultivation and utilization. London. Leonard Nill, 438 p.

19. STEYKAL, G.C. 1977. Pictorical key to species of the genus *Anastrepha* (Diptera: Tephritidae). Publication Society of Entomology (Washington) 35 p.

20. WHARTON, R.; GILSTRAP, F.E.; RHODE, R.M.; FISCHEL, M.; HART, W.G. 1981. Hymenopterous egg-pupal and larval-pupal parasitoids of *Ceratitis capitata* and *Anastrepha* spp. (Dipt.: Tephritidae) in Costa Rica. Entomophaga 36(3):285-290.

Reseña de Libros

MAUNDER, ALLEN AND RENBORG, Ulf, Eds. Agriculture in a turbulent world economy. Proceedings of the Ninteenth International Conference of Agricultural Economists, 1985. Málaga, Spain. Grover Press, 1986. 820 p.

Este libro contiene las actas de la Conferencia Mundial de la Asociación Internacional de los Economistas Agrícolas, realizada en Málaga, España, 1985. Incluye los trabajos presentados por invitación y un resumen de las discusiones de cada sesión. Los mejores trabajos seleccionados serán publicados más adelante.

El tema de la conferencia, "la agricultura dentro de una economía mundial turbulenta" tenía importancia en 1985, pero es aún mayor hoy en día. Las perturbaciones en los mercados internacionales de capital y de los productos agrícolas, los problemas de pobreza, desnutrición y hambre en subregiones del mundo y dentro de subsectores de la población de los países, no han disminuido e inclusive han aumentado seriamente. La tendencia de los países desarrollados hacia una mayor protección de su agricultura nacional frente a esta situación, es preocupante. Tal política perjudica a los países en desarrollo porque contribuye a aumentar la inestabilidad de los mercados.

Amartya Sen, en la conferencia Memorial Elmhirst, argumenta que el problema del hambre en el mundo radica en la habilidad de adquisición de lo producido. Depende del ejercicio de los derechos del individuo a los medios de adquisición. La ausencia de estos derechos contribuye al hambre y a la desnutrición. El autor analiza las implicaciones de este argumento en la política agrícola.

Segundo, el Dr. Glenn Johnson, presidente de la Asociación Internacional de Economistas, discute los intereses de los miembros de la asociación y concluye que éstos son multidisciplinarios, con una tendencia a la práctica. Define la política que debe seguir la nueva revista de la asociación (Agricultural Economics: The Journal of the International Association of Agricultural Economists).

El libro está dividido en nueve secciones seguido por una conferencia sobre el status y el estado de la profesión de la economía agrícola presentada por el Presidente Electo de la Asociación, Michel Petit. Las conferencias incluyen caracterizaciones generales sobre los temas abarcados y estudios de casos de países desarrollados y en desarrollo, principalmente en Asia y en el Africa del sub-Sahara.

Sección I: "Forces Shaping the Future". Presenta tres conferencias que ofrecen una perspectiva sobre los factores que están determinando el futuro de los países en desarrollo con respecto a la pobreza y la desnutrición. Plantea acciones y estrategias potenciales para el mejoramiento del futuro de la humanidad y señala problemas que podrían acompañar este mejoramiento. Enfatiza el concepto de que el hambre y la desnutrición deberían ocupar un lugar de importancia en los programas y políticas de desarrollo

Sección II: "Growing Interdependencies and Uncertainties". Caracteriza la creciente interdependencia de la economía mundial y la resultante volatilidad e incertidumbre en los mercados internacionales y nacionales. Incluye estudios de casos sobre el impacto de esta situación en los sectores agrícolas y el comportamiento del sector frente a ella. Discute sus consecuencias para la política agrícola; una conferencia discute la cooperación regional como forma de mejorar la seguridad alimenticia.

Sección III: "Balancing Overproduction and Malnutrition". Caracteriza la ocurrencia simultánea de la producción excesiva de productos alimenticios en los paises desarrollados y la desnutrición en varias regiones del mundo y sectores de la población de los paises en desarrollo. Analiza factores que explican esta situación y discute el rol del mercado y las políticas nacionales en la búsqueda de soluciones.

Sección IV: "Pressure on Natural Resources". Presenta los problemas del ambiente que resultan del creciente desarrollo económico, la aguda destrucción y agotamiento de los recursos naturales, y las politicas que contribuyen a la presión sobre los recursos naturales. Se advierte acerca de los peligros y ofrece pautas para un uso más económicamente racional de tales recursos.

Sección V: "Human Capital, Technology and Institutions". Trata sobre tópicos interrelacionados con el tema de cambios en la tecnología, las instituciones y la política agrícola y sus impactos sobre las economías agrícolas. Discute el desarrollo de las nuevas tecnologías las instituciones involucradas en su desarrollo y la necesidad de analizar el impacto de la biotecnología en las economías nacionales. También, presenta alternativas de estructuras institucionales para la formulación de la política agrícola, estrategias para el mercadeo de los productos de los países en desarrollo y el rol de los grupos sociales en la formulación de la política agrícola. Analiza el aprovechamiento del recurso humano como medio potencial de cambiar la estructura de producción a favor de los más pobres.

Sección VI: "Structure of Agriculture and People in Rural Societies". Describe la estructura agrícola actual y su impacto en las poblaciones de los paises desarrollados y en desarrollo. Sugiere que, posiblemente, la incertidumbre juega un papel crítico en la transformación de la agricultura tradicional hacia una agricultura moderna y discute las consecuencias que este cambio significa para la política agrícola, cuyo propósito es disminuir dicha incertidumbre.

Sección VII: "Markets and Trade". Analiza el rol de la política de precios de los paises desarrollados sobre la inestabilidad de los mercados internacionales y sus impactos indirectos a los paises en desarrollo, y la relación entre las compañías multinacionales y los gobiernos de los países en desarrollo

Sección VIII: "Theoretical Developments". Presenta acontecimientos nuevos y su relevancia dentro de la agricultura mundial. Incluye varios temas, tales como la incertidumbre en los mercados, la interrelación entre el desarrollo agrícola y los precios agrícolas; los impactos de la política sobre las tasas de cambio y el comercio; el riesgo y la incertidumbre a nivel de finca; la necesidad de establecer el seguro agropecuario; finanzas, producción y crédito, y el rol de los recursos naturales en el desarrollo integral de una nación. Analiza el potencial de las microcomputadoras en el proceso de toma de decisiones, a escala de finca.

Sección IX: "Implications for Policy and Research". Incluye resúmenes selectos de todas las exposiciones de la conferencia y ofrece conclusiones sobre política agrícola y dirección que se debiera dar a la investigación futura.

JAMES FRENCH
CATIE, TURRIALBA