Cocoa pod rot diseases; assesment of crop losses*1/

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COMPENDIO

Con el siempre creciente precio de los fungicidas y el alto costo de la mano de obra, una medida económicamente viable para el control de la enfermedad de la podredumbre del fruto del cacao sólo puede ser desarrollada si las pérdidas pueden ser estimadas con exactitud. Para este propósito se debe hacer una distinción entre la incidencia de la enfermedad y las pérdidas del cultivo. Los registros de incidencia de la enfermedad se refieren sólo a la presencia física del patógeno en las mazorcas, mientras que lo que vale en consideración económica es si las almendras dentro de la mazorca son fementables o no. Siendo esto así, la infección de la mazorca no es de importancia económica sino cuando las almendras están afectadas. La presente investigación muestra que no es siempre que una mazorca es infectada que las almendras se vuelven infermentables y, en consecuencia, no comerciables. Alrededor de 90 por ciento de todas las mazorcas que son infectadas ya sea por Phytophthora palmivora *(Butl.) Butl. o* Botryodiplodia *theobromae se pierden. Por el contrario, menos de un tercio de todas las mazorcas que están infectadas por* Fusarium *spp. se pierden. Un argumento existe así contra hacer una conversión directa de incidencia de la enfermedad a pérdidas del cultivo pues hay un margen de error hasta de 10 por ciento aún en podredumbre negra* (Phytophthora) *y podredumbre parda* (Botryodiplodia), *en que los dos valores se consideran ser cercanos. El margen de error en tal conversión directa también dependerá de las incidencias relativas de las tres enfermedades en la plantación en la que se toman los registros.*

Introduction

MOST of the records on the economic importance of the pod rot diseases of cocoa have been extrapolations based on direct substitutions of disease incidence figures for pod losses. It is common knowledge however that it is not every time there are pod infections that the pods are so rotten that all the beans have to be discarded. Beans in pods which are infected after they have started to ripen physiologically are classified as black pod fermentable. It is recognised also that failure to harvest such pods within a few days of infection can result in total loss of the beans. Judicial note of blackpod fermentables is hardly taken in extrapolating crop losses from disease incidence figures. Opeke and Gorenz (5) recognised the shortcoming in making a straight conversion of disease incidence to crop loss but arbitrarily fixed crop loss at 20 per cent for a disease incidence of 35 - 40 per cent. Their attempt at solving the problem thus appears not based on any known scientific principle. Ashiru and Jacob (2) showed that cherelle wilt caused by insects and diseases account for the greater part of cherelle loss. However, Adebayo (1) showed that most diseased cherelles are never harvested. Such diseased cherelles which would have developed into normal mature pods are automatically left out of the figures for total production and, of course, never feature in records of disease incidence or crop loss. Since records of disease incidence often fail to differentiate between fermentable and non-fermentable beans and since there are evidences that cognisance of diseased cherelles is hardly taken in such records it will appear that the records are not only inadequate but cannot form a reliable basis for a true assessment of crop loss. The present investigation is an attempt at making detailed records of disease incidences and crop losses with the ultimate aim of relating one to the other

* Received for publication November 14th, 1978

1/ The author is grateful to the Cocoa Research Institute of Nigeria for permission to publish these research findings.

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Table 1.—Cocoa pods harvested in farmers plantation

	Number of pods	
	Healthy	Diseased
Farmers's gang	467	87
CRIN harvesters	11	42
Total	478	129

Materials and Methods

On 6th September, 1977 a farmer and his four helpers were requested to harvest all ripe and diseased cocoa pods in a farm. Later that day five trained harvesters were asked to go round the farm to harvest all ripe and diseased pods.

In another experiment 200 mature cocoa trees were selected in each of plot E10 at the Gambari Experimental Station Ibadan (GES) and the 'C' clone plot at Ibule in January 1976. At monthly intervals throughout the year all diseased pods were counted and categorised as young, immature or mature. Diseased pods in each age group were again classified in accordance with the infecting pathogen viz: *Phytophthora palmivora, Botryodiplodia theobromae* or *Fusarium* spp. The number of infections starting from wounded areas of pods was also noted in each case. After harvesting, diseased pods were separated into those whose beans were good enough for fermentation (blackpod fermentables) and non-fermentable ones.

The third experiment was conducted in 1977 using three sub-plots of 50 trees each in plot N4/2 at GES. Ripe and diseased pods were harvested at fortnightly intervals between January and December. Diseased pods were separated in accordance with the pathogen involved. As in the preceeding experiment all pods with non-fermentable beans were regarded as lost to the infecting pathogen.

Results

Table 1 shows that the farmer's gang left 11 healthy pods unharvested. This represents 2.3 per cent of all healthy ripe pods. Similarly, 42 diseased pods representing 32.8 per cent of all diseased pods were left on the trees. 38 of those diseased unharvested pods were cherelles or immature.

Table 2 shows that beans in all young and immature *P. palmivora* infected pods were non-fermentable. Similarly, 83.3 per cent of all *P. palmivora* infected mature pods including all pods in which infections started from wounded areas were lost. Beans in all pods in which *B. theobromae* infections started from wounded areas were non-fermentable. Only 2 of all the pods that were infected by *B. theobromae* contained beans that were fermentable. On the contrary beans in all mature pods which were infected by *Fusarium* spp. were fermentable. Beans in 89.7 per cent of all *Phytophthora* infected pods were non-fermentable. Similarly beans in 94.3 per cent of all *Botryodiplodia* infected pods were non-fermentable while beans in only 31.0 per cent of all *Fusarium* infected pods were non-fermentable. Table 2 indicates diasease incidences of

Table 2.—Diseased cocoa pods in plot E10

	P. palmivora			*B. theobromae*			*Fusarium* spp		
	Y	Im	M	Y	Im	M	Y	Im	M
Diseased	1	10	18	8	25	2	72	8	4
	1+(0)	10+(0)	6+(12)	4+(4)	10+(15)	(2)	22+(50)	0+(8)	0+(4)
Fermentable	0	0	3	0	2	0	47	7	4
	0	0	3+(0)	0	2+(0)	0	20+(27)	0+(7)	0+(4)
Non-fermentable	1	10	15	8	23	2	25	1	0
	1+(0)	10+(0)	3+(12)	4+(4)	8+(15)	0+(2)	2+(23)	0+(1)	0
% lost when diseased	100	100	83.3	100	92.2	100	34.7	12.5	0
% lost (Average)		89.7			94.3			31.0	

Y = Young or cherelles; Im = Inmature; M = Mature

( ) denotes infections starting from wounded areas of pod

Table 3.—Diseased cocoa pods in Ibule

	P palmivora			*B theobromae*			*Fusarium* spp		
	Y	Im	M	Y	Im	M	Y	Im	M
Diseased	60 47+(13)	51 45(6)	88 79+(9)	6 5+(1)	3 3+(0)	2 0+(2)	72 14+(58)	16 11+(5)	28 19+(9)
Fermentable	0 0	0 0	20 18+(2)	0 0	1 1+(0)	0 0	61 10+(51)	10 8+(2)	22 19+(3)
Non-fermentable	60 47+(13)	51 45+(6)	68 61+(7)	6 5+(1)	2 2+(0)	2 0+(2)	11 4+ (7)	6 3+(3)	6 0+(6)
% lost when diseased	100	100	77 3	100	66 7	100	15 3	37 5	21 4
% lost (average)		89 9			90 1			19 8	

( ) denotes infections starting from wounded areas of pod

Y = Young or cherelles; Im = Inmature; M = Mature

19 6 per cent, 22.6 per cent and 56.8 per cent for *P palmivora, B theobromae* and *Fusarium* spp respectively Beans in 57 4 per cent of all diseased pods were non-fermentable. Of this amount 30 6 per cent, 38.8 per cent and 30.8 per cent were ascribed to *P palmivora, B theobromae* and *Fusarium* spp. respectively.

Table 3 shows that beans in all *P palmivora* infected young and immature pods at Ibule were non-fermentable As in plot E10 in all *Botryodiplodia* infected young and mature pods were non-fermentable Beans in 85.0 per cent, 62.5 per cent and 78.6 per cent of all *Fusarium* infected young, immature and mature pods respectively were fermentable. Beans in 89 9 per cent and 90 1 per cent of all pods infected by *P. palmivora* and *B. theobromae* respectively were non-fermentable while beans in only 19 8 per cent of all *Fusarium* infected pods were non-fermentable 61.0 per cent, 3 4 per cent and 35 6 per cent of all diseased pods at Ibule were ascribable to *P palmivora, B. theobromae* and *Fusarium* spp respectively

Table 4 shows that 62.5 per cent of all diseased pods in plot N4/2 were infected by *P palmivora* while *B. theobromae* accounted for only 8 0 per cent A total of 6107 pods were harvested in the plot within the experimental period About 7.4 per cent of this number were diseased with annual incidences of 4.6, 0 6 and 2.2 per cent for *P. palmivora, B theobromae* and *Fusarium* spp. respectively. The annual losses were 4.3, 0.5 and 0 6 per cent for *P. palmivora, B. theobromae* and *Fusarium* spp. respectively giving an annual total loss of 5.4 per cent. Differences between the number of pods with fermentable beans and those with non-fermentable beans were severally and collectively significant at 0 1 per cent level

Table 4.—Diseased cocoa pods in plot N4/2

	P. palmivora	*B theobromae*	*Fusarium* spp.
No of diseased pods	280	36	132
No. of fermentable diseased pods	15	4	96
No. of non-fermentable diseased pods	265	32	36
% diseased pods lost	94 6	88 8	27 2
Annual incidence (%)	4 6	0 6	2 2
Annual loss (%)	4 3	0.5	0 6

X^2_2 = ($\sum$piai — pA/pq) = 217 75***

Discussion

Any farmer will naturally want to harvest all healthy ripe pods since the beans in them are products which he will sell to retrieve his capital outlay on the farm. That about 2.3 per cent of such healthy ripe pods were not harvested can be treated as oversight This figure compares favourably with 3.1 per cent which is the level of oversight exhibited by failing to harvest 4 of the diseased mature pods. On the contrary failure to harvest 38 diseased cherelles or inmmature pods could not be due only to overside. Rather, as Adebayo (1) pointed out there is usually no urge on the part of farmers to harvest diseased young and immature pods. The farmer's records gave disease incidence at 18.6 per cent which is considerably lower than the actual figure of 27 0 per cent. With this type of situation it is clear that the farmer is likely to underestimate his losses to the disease His decisions to control the diseases which will normally be based on such under-estimation will in most cases be inappropriate for the situation

Results in Tables 2 and 3 appear to show that there is total loss whenever cherelles or immature pods are infected by *P. palmivora*. Similarly, only a few of those pods which were infected at maturity became ripe enough for the beans in them to be fermentable. The situation is no less serious with the charcoal *(Botryodiplodia)* pod rot which causes beans in almost all diseased pods to be non-fermentable irrespective of the age at infection. The high loss level exhibited by these two diseases can be traced to the fact that *P. palmivora* and *B theobromae* invade tissues of susseptible cocoa pods very quickly. Usually tissues of infected pod are completely permiated by the pathogens within 10 days. Full coverage is in fact accomplished in less than five days any time infections start from wounded areas of pods Thus only beans in pods that have become physiologically ripe before they are infected usually remain fermentable Even in such cases pods must be harvested and the beans removed for fermentation within a few days of infection It is thus desirable that weekly inspection tours of plantations be undertaken during the rainy season when all diseased pods should be harvested to save beans in physiologically ripe pods from becoming non-fermentable. This practice will also go a long way in reducing the build-up of inoculum for secondary spread of the diseases in the plantation Contrary to the rapid tissue colonisation observed for *P. palmivora* and *B theobromae* tissue invasion is usually very slow in fusarial rot except when infections start from wounded areas of the pods. Unfortunately as shown in Tables 2 and 3 most fusarial infections started from wounded areas and since young pods are usually most vulnerable infections of this category of pods accounted for more than 60 per cent of all fusarial infections in each of the two locations. There are usually two types of wound infections In the first group the pathogen is restricted to a small area. This is common in infections which start from shallow wounds caused by mealybugs or mirids which feed on pods. Such infections do not appear to be of serious economic problems excepting in cases where there are numerous feeding wounds on a single pod and especially when the insects feed on the pod at cherelle stage In such cases the cherelle becomes badly deformed and withers although in some cases the diseased condition persists till the pods eventually ripen and the beans therein are reasonably fermentable though fewer in number than in healthy pods. It is thus clear that heavy mealybug or mirid spots infections results in loss of yield but this is not easy to estimate without carrying out artificial inoculations of simulated or real mealybug or mirid wounds on pods of various age groups and assessing the resultant reduction in bean number and/or bean weight per pod. Entwistle (4) showed that by feeding on pods mirid can reduce yield by as much as 25 per cent. The situation could be worse if the mirid feeding spots are infected by any of the common pod rotting pathogens No matter what the age of the pod is all the beans are lost when fusarial infections start from wounds or holes made by the cocoa husk miner, *Marmara* sp.: Lithocolletides or by the larvae of the moth *Characoma stictigrapta* Noctuidae Such burrowing and tunnelling activity of *Characoma* has been reported to greatly dispose cocoa to attack by *P. palmivora* and other related disorders (2) Loss is generally heavy in this second group of wound infections.

Table 2 shows that more pods carried fusarial rot than *Phytophthora* rot in plot E10 giving the erroneous impression that the former is a more important disease than the latter A closer look at the data shows however that equal number of pods, 26, were lost to each of the two pathogens. That figure represents 89 7 per cent of the *Phytophthora* infected pods but only 31 0 per cent of the *Fusarium* infected pods. A similar situation was observed in Ibule where 89 9 per cent of all *Phytophthora* infected pods were lost as against a loss of 19 8 per cent in *Fusarium* infected pods. It is apparent therefore that although records of disease incidence seem to suggest that fusarial rot is a more important disease than *Phytophthora* pod rot the reverse is in fact true when one considers crop loss A consideration of results in Table 4 makes the situation even clearer. While incidence of fusarial rot and charcoal rot in the plot is 2 2 and 0 6 per cent respectively crop losses are only 0 6 and 0 5 per cent respectively. The two diseases were thus at about the same level of economic importance *Phytophthora* pod rot was however economically more important (4.6 per cent crop loss) than the other two diseases combined.

There is not much difference between disease incidence (4 6 per cent) and crop loss (4 3 per cent) in *Phytophthora* pod rot infections The corresponding figures which suggest a similar trend for the charcoal pod rot are 0 6 and 0.5 per cent On the contrary there is a wide margin between disease incidence (2.2 per cent) and crop loss (0 6 per cent) in fusarial pod rot infections Records of disease incidence will thus not give a true assessment of crop loss which should form the basis of any form of disease control. There is thus no doubt that the age long practice of equating disease incidence to crop loss is defective As desirable as it is, the separation of diseased pods into blackpod fermentables and blackpod non fermentables is a laborious exercise and almost impracticable for a farmer with large acreages of cocoa However, for the purpose of estimating annual crop losses for the country, it is desirable that such distinctions be made This will entail taking records in a number of selected sample plantations in the cocoa growing areas over a number of years after which a correction factor can be calculated for each of the pod rot diseases As an example results of the present investigation seem to suggest a correction factor of 0 9 for *P palmivora* and *B theobromae* and 0.25 for *Fusarium* spp. A general or overall factor of 0 7 is indicated for a combination of the three diseases. As pointed out above more detailed recordings will be necessary before definite correction factors can be obtained.

Summary

With the ever increasing prices of fungicides and high cost of labour an economically viable measure for the control of the pod rot disease of cocoa can only be worked out if crop losses are accurately assessed. For this purpose a distinction should be made between disease incidence and crop loss. Records of disease incidence refer only to the physical presence of the pathogen on the pods whereas what counts in economic consideration is whether or not the beans within the pods are fermentable. That being so, infection of the pod is of no economic consequence except the beans are affected. The present investigation shows that it is not every time a pod is infected that the beans become nonfermentable and consequently unmarketable. About 90 per cent of all pods that are infected by either *Phytophthora palmivora* (Butl.) Butl or *Botryodiplodia theobromae* Pat. are lost. On the contrary less than a third of all pods that are infected by *Fusarium* spp. are lost. A case is thus made against making a straight conversion of disease incidence to crop loss for there is up to 10 per cent margin of error even in *Phytophthora* pod rot and charcoal rot where the two values are considered to be close. The margin of error in such a straight conversion will also depend on the relative incidences of the three diseases in the plantation where the records are taken.

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Notas y Comentarios

Los bancos y la transferencia de tecnología

Como secuela de la Conferencia de las Naciones Unidas sobre la Ciencia y Tecnología para el Desarrollo (UNCSTD), está tomando forma lentamente un proyecto internacional para determinar el papel preciso de los bancos de desarrollo internacionales y locales, y las firmas de capital de riesgo, en la tranferencia de tecnología al Tercer Mundo. En una reunión reciente en París, organizada por la Organización de Cooperación y de Desarrollo Económico (OCDE), los economistas del Banco Mundial, agencias de ayuda, como por ejemplo el Centro Internacional para la Investigación y Desarrollo (CIID) de Canadá, y la Organización de Estados Americanos, discutieron la forma en que instituciones financieras tales como el Banco de Desarrollo Industrial de la India pueden impulsar el desarrollo de tecnología mediante sus políticas de préstamos. Jairam Ramesh, consultor del OCDE y coordinador del proyecto informó que uno de los objetivos del estudio será ayudar a los bancos locales de desarrollo del Tercer Mundo a promover el crecimiento de la tecnología en sus propios países, estudiando los esfuerzos realizados en el pasado (*New Scientist*, Vol. 84, p. 331).

El estudio se enfocará sobre los países en desarrollo que han avanzado bastante en el camino del desarrollo industrial: Argentina, Brasil, Colombia, Corea del Sur, Costa de Marfil, India, Malasia, México y Perú. Equipos nacionales de economistas evaluarán hasta qué nivel las instituciones financieras nacionales e internacionales han promovido el desarrollo de empresas tecnológicas nuevas. De mayor importancia es el hecho de que los equipos verán si estos organismos han estimulado el crecimiento de los mecanismos financieros necesarios, el adiestramiento de la mano de obra especializada y la administración necesaria para llevar a cabo una revolución tecnológica basada en recursos locales. La formación de esa confianza en sí mismos para adquirir y manejar nuevas tecnologías fue una de las muy pocas demandas del Tercer Mundo calurosamente acogidas por los países desarrollados en la UNCSTD.

Ramest afirma que el papel crítico que han desempeñado los bancos de desarrollo y comerciales, y las firmas de inversiones, en el desarrollo de la tecnología del Tercer Mundo es considerable pero "no reconocida, aun por las mismas instituciones financieras". Por ejemplo, estima que en la India, aproximadamente el 50 por ciento de los activos fijos de las compañías anónimas públicas medianas y grandes viene de instituciones financieras y del gobierno cada año. Si la India es representativa del Tercer Mundo, como parece serlo, entonces un 50 por ciento, o sean 150 mil millones de dólares, de los 300 mil millones estimados como la inversión total anual en el Tercer Mundo, está canalizada a través de los bancos.

El Banco Mundial ha hecho cada vez más uso de las corporaciones financieras de desarrollo locales, especialmente para constituir empresas de pequeña escala. Desde fines de los novecientos sesenta, 6 mil millones, o sea un sorprendente 10 por ciento de todo lo prestado por el Banco Mundial desde su formación, ha ido a esas instituciones financieras locales para empresas pequeñas.

El estudio de 18 meses se iniciará en marzo de 1980, siempre que se encuentren los fondos necesarios. La meta es US $ 500 000 que puede venir del Banco Mundial, las agencias de ayuda y los mismos gobiernos del Tercer Mundo que participan. Esto puede resultar no ser tan difícil, y es la idea ha recibido ya un fuerte apoyo entre los senadores de los Estados Unidos.

Notas y Comentarios

Un cambio importante en el comercio internacional

Por primera vez, en 1978, el comercio total de los Estados Unidos con países en Asia oriental (incluyendo Australia y Nueva Zelandia) excedió su comercio total con Europa occidental. La brecha probablemente se hará más ancha gracias a las altas tasas de crecimiento económico de muchos países asiáticos (Cf. *Turrialba* vol. 29, p. 9). En la primera mitad de 1979, las exportaciones de EE.UU. al Asia oriental subieron en casi 30 por ciento; las importaciones, sin embargo, se elevaron en sólo 7 por ciento (*The Economist*, December 1st, 1979).

Naturalmente, los países agrupados en Asia oriental tienen una amplia variación en sus esquemas de comercio. Estados Unidos y Japón son comerciantes globales. Corea del Sur y Formosa están tratando de hacerlo. Nueva Zelandia y Australia están forjando rápidamente lazos con sus vecinos geográficos. En 1978, más de la mitad de las exportaciones de Australia fueron a Asia oriental; una tercera parte de sus importaciones vienen de allí, reemplazando su tradicional dependencia de Europa.

Los países recientemente industrializados de la región (Corea del Sur, Formosa, Hong Kong, Singapur) son todavía parcialmente dependientes del comercio con la región, pero conforme se eleva la calidad de sus productos, están dependiendo menos. Los países menos desarrollados (Malasia, Tailandia, Indonesia y Filipinas) permanecen más grandemente dependientes de la cuenca del Pacífico.

China puede haberse reincorporado a la comunidad internacional pero, en 1978, el 70 por ciento de sus exportaciones todavía fue con los otros países de Asia oriental y la mitad de sus importaciones vino de allá. Esto puede estar ahora cambiando. En los primeros siete meses de 1979, las exportaciones de EE.UU. a China fueron de 1000 millones de dólares, contra 874 millones en todo el año de 1978.

Los dirigentes de Estados Unidos están luchando por convencer a los hombres de negocios que hay mayor provecho en comerciar e invertir en países con economías en rápido crecimiento, que el que hay en erigir barreras proteccionistas contra sus exportaciones. El caso de Corea del Sur se usa como ejemplo. El déficit comercial de Estados Unidos con Corea del Sur de 600 millones de dólares en 1978 se convirtió en un superavit de 200 millones en los primeros seis meses de 1979.

Publicaciones

Food and Nutrition Bulletin. El Programa Mundial contra el Hambre, de la Universidad de las Naciones Unidas está distribuyendo una publicación trimestral, *Food and Nutrition Bulletin*. Incorpora y continúa el *PAG Bulletin* del Protein-Calorie Advisory Group de las Naciones Unidas. El número 3 del volumen 1, que tenemos a la mano, contiene nueve artículos, sobre los campos de Política de Alimentos y Nutrición, y de Conservación de Alimentos Poscosecha, además de notas y noticias. Notamos que la mayor parte de los trabajos son adaptados o resumidos de publicaciones previas. El primer artículo, de Lowell Lynch del MIT, hace una revisión interesante de metodología de planificación nutricional. No hay "abstracts" que faciliten el examen rápido del valor de los trabajos. Aun algunas de las conclusiones son poco informativas: un trabajo del jefe del grupo de trabajo sobre tecnología de poscosecha, sobre el beneficio inesperado de un proyecto lechero, en la conclusión sólo expande el título sin revelar cuáles fueron esos logros no esperados. La dirección es: United Nations University, 29th floor, Toho Seimei Building; 15-1, Shibuya 2-chome, Sibuya-ku; Tokio 150, Japón.

La okra como productora de aceite

La okra (*Hibiscus esculentus*) puede ser un día una potente fuente de proteína y aceite para los países de la zona tropical (*Agricultural Research*, July 1979). La Universidad de Puerto Rico y el Departamento de Agricultura de los Estados Unidos han encontrado que la okra tiene un potencial de producción de proteína superado sólo por el trigo y la soya. La okra también podría competir con el alazor (*Carthamus tinctorious*) en la producción de aceite.

La mayoría de los estudios sobre producción de okra se ocupan de la cápsula inmadura, usada como verdura. El primer estudio para determinar los efectos del espaciamiento sobre la producción de semilla, proteína y aceite de okra tuvo lugar en Puerto Rico. Allí, Gerardo Mangual Crespo y F. W. Martin encontraron que la producción de semilla era comparable a la de muchos cultivos oleaginosos de las zonas templadas y tropicales.

En producción de aceite, el cultivar 'Clemson Spineless', con 612 kg por hectárea era superado sólo por la palmera aceitera africana (2200), que es reconocida como la planta que más aceite produce por unidad de superficie. Los cultivares 'Evergreen Velvet' y 'Red Okra' compitieron o superaron a la soya, girasol, sésamo, maní y ricino.

Las plantas de okra crecen hasta llenar el espacio que se les ha asignado, expresa Martin. Las plantas que tienen hasta un metro de espacio de crecimiento se vuelven muy grandes y producen muchos frutos. Conforme la densidad del cultivo aumenta, se incrementa el rendimiento total de frutas pero disminuye el rendimiento por planta. Por consiguiente, debe encontrarse una densidad de plantío óptima.

Los máximos rendimientos de semilla pueden ser obtenidos, en el caso de 'Clemson Spineless', con 58 mil a 86 mil plantas por hectárea. 'Clemson Spineless' puede tolerar los espaciamientos más estrechos y es la variedad de mayor rendimiento, variando desde un mínimum de 1,18 hasta 4 toneladas por hectárea en Puerto Rico, es decir 25 por ciento más que en Louisiana, donde se cultiva la okra en gran escala.

En algunos países, como en Brasil, la okra es tan libre de males que se conoce como el cultivo que siempre paga. Las semillas de okra se producen en abundancia y es fácil cosecharlas, limpiarlas y almacenarlas, ya sea en pequeña como en gran escala. Pueden ser molidas y cernidas para producir un alimento útil para los animales, o después del molido pueden ser tratadas con agua. La proteína y el aceite pueden entonces precipitarse mediante técnicas simples.

Publicaciones

Resumen de Investigaciones en Café

Aunque ya hemos comentado la aparición del primer número de este anuario (*Turrialba*, Vol. 29, p. 19), desearíamos hacer constar que el segundo número (Año II, N° 2, 1978-79), aparecido en octubre de 1979, constituye una mejora en relación con el primero. El Instituto Salvadoreño de Investigaciones del Café (ISIC), de Sta. Tecla, se ha esmerado en presentar, clara y oportunamente, los últimos logros de la investigación en el país. Se nota una preocupación por la adecuación de los cafetales, mediante pruebas de variedades e híbridos resistentes a la roya, y de insecticidas que se usan para la broca, para un eventual control de *Hemileia* y de *Hypothenemus*, cuando aparezcan en El Salvador. En el caso de la roya esto ha sucedido al escribirse esto (diciembre 1979), conforme lo ha anunciado el ISIC.

Una innovación que se nota en este número es el poner los nombres de los responsables de cada investigación, lo que facilitará la intercomunicación entre los especialistas del hemisferio (y más allá por cierto). Felicitamos al ISIC, en la persona de su Director General, Francisco A. Fischnaler, por mantener y mejorar esta útil publicación.