

Can Ol' King Cotton kick the habit?

Of all chemical insecticide used on the world's agricultural crops it is estimated that more than one quarter is applied on cotton alone. Drawbacks of such dependency on chemicals, described by Robert van den Bosch (1978) as "the melancholy addiction of Ol' King Cotton", are obvious everywhere. But there are encouraging signs of viable alternatives. Kees Eveleens and Abdel Rahman describe what has been achieved in the Sudan Gezira and what remains to be solved.

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The rivers Blue and White Nile converge at the city of Khartoum, capital of Sudan. Just south of this confluence, in the fork of the two rivers, there is a large, fertile alluvial plain called the Gezira. At present on more than 800,000 hectares there is large-scale irrigation. The Gezira Scheme is centrally administered and cotton is grown by almost 100,000 tenant farmers in a rotational sequence also involving food crops (wheat, sorghum, groundnuts), some vegetables and, in part of the Scheme, a fallow. Tenants are actively engaged in most crop husbandry duties, but not in crop protection. This important aspect is under the authority of the Gezira Board: decision making, selection and purchase of chemicals, pest control operations which consist mostly of aerial application of insecticides.

Insecticide treadmill

Until about 1960, chemical pest control was mostly limited to a single early-season spray with DDT, directed against the main insect pest at that time, the cotton jassid (*Empoasca lybica*). In subsequent years complications arose due to failure of jassid control in conjunction with increasing damage by two other insects, the American bollworm (*Heliothis armigera*) and the cotton whitefly (*Bemisia tabaci*). These latter two species, formerly relatively important, attained pest status due to decimation of their natural enemies by DDT. The response to this aggravation was spraying more frequently and using other insecticides, in addition to DDT and often applied as mixtures of two or more compounds. In spite of this intensification of the chemical control regime, the pest situation continued to get worse. By the 1978-79 growing season, with the average number of sprays raised to more than nine, everywhere in the Scheme whitefly outbreaks of an unprecedented magnitude inflicted heavy damage. Cotton growing appeared thus trapped in an insecti-

cide treadmill with more and more treatments applied with less and less result (Eveleens, 1983).

Battle plan

International experts in cotton pest management pooled their experience to formulate a "battle plan" for alleviating the problem (see box). This proved to be a very timely exercise. The main elements were threefold: prohibition of further use of DDT; abolition of so-called package deals between Scheme management and commercial agrochemical companies and initiation of research on possibilities for upward revision of treatment thresholds and substitution of selective for broad-spectrum insecticidal compounds.

Present situation

The positive results are convincing. In the period 1976-81, lowest yields (1100 kg seed cotton per ha) occurred with highest spraying frequencies (more than 8 times per season), in the time of the whitefly crisis. In the course of the following decade, spraying frequencies were reduced to 4-5 times per season in 1989 and average yields increased to approximately 1500 kg/ha (Gezira Board 1992). However, more could be achieved. As shown in numerous case histories of cotton pest control in other countries, the first of which occurred already 35 years ago in Peru (Brader 1979), the potential of IPM is impressive. In the Gezira, however, IPM still has not completely replaced conventional chemically-based crop protection.

The first spray

The "battle plan" puts the finger on a major constraint to full operation of the biological resources: "...it is the first spray that does the most damage to natural enemies of pests and commits the manager to a season-long sequence of insecticide applications". Remedial action undertaken so far has consisted mainly of postponing, to some extent, this first spray, by adjusting decisions of when to spray. The equally important issue of what to spray has, however, hardly been addressed. The applica-

tion of broad-spectrum mixtures of two or more compounds is still as much in vogue today as it was at the height of the whitefly crisis, notwithstanding increasing availability of target-specific materials with minimal disruptive effects on beneficial insects. Scheme management often sticks to established practices to play it safe. The incompatibility of this approach with the tenets of IPM was recently demonstrated by developments in rice crop protection in Indonesia. Virtually overnight the serious pest problem of brown plant hopper was solved (Kenmore 1991). A recent step in the right direction in Sudan was the decision, in 1992, of the Agricultural Research Corporation that no mixtures of compounds should be recommended for use against a single pest. At least some of the more hardy species, such as the lacewing larva, an important predator, can now be seen again in large numbers.

Involve tenants

The role of non-technical constraints to the implementation of IPM is even more pronounced in the aspect of using human resources. The fundamental difference between success and failure in IPM programmes is that the successful ones are always 'farmer-focused'. In the case of the Sudan Gezira, however, several factors

MY VIEW

The need for spraying cotton is determined by the occurrence of key pests, i.e. pests which cause unacceptable yield loss if not controlled somehow. The history of the Gezira shows that, under conditions of non-disturbance by insecticides, the cotton jassid is the only key pest. Therefore, a single spray against jassid should be as sufficient for cotton crop protection as it was forty years ago. Provided we don't perpetuate the habit of using non-selective, broad-spectrum insecticides. In the long run, the need for this one spray may also be obviated if effective alternative ways of jassid control (resistant varieties?) are developed.

militate against such focusing on farmers. The dictates of coordinated execution of agricultural practices, imposed by irrigation system and crop rotation schedule, have resulted in a hierarchical chain of command in which relevant information tends to be relayed to tenants by order rather than by extension. Although the receptive attitude of the Scheme management towards alternative methods of pest control has resulted in considerable reduction of insecticide use over the last ten years, efforts have to be initiated to end the tradition of non-involvement of tenants in cotton crop protection.

Photo: Lies Joosten



The ot

Central America has a long history of cotton production. Brown cotton (*Gossypium Mexicanum* Tod.), nowadays a product of increasing interest in the world, is originally from this area. Lies Joosten and Emilio Eweg report on their anthropological study.

Lies Joosten and Emilio Eweg

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Basic questions of the 'battle-plan'

- Can whitefly outbreaks be avoided?
- Can sprays against jassid and American bollworm be manipulated so as to conserve parasites and predators of the whitefly?
- Can planting dates be altered so as to reduce the need for sprays against bollworm or jassid?
- Can the choice of insecticides and dosages used against bollworm and jassids be restricted to selective compounds that do the least damage to natural enemies?
- Can broadcast sprays be avoided so that only infested fields are treated? Regardless, the first spray should be delayed as long as possible.
- Can the application of insecticides be further improved so as to provide better coverage of cotton foliage?

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In the hot coastal area of the Pacific Ocean, bright-white cotton grows on plantations of up to 3,000 ha. To raise production, about 236 kg/ha of (foliar) fertilizers are used. The plant is improved to raise fibre quality, whiteness of fibre and pest resistance. Airplanes spray up to 40 times in the growing season; every 4 days in the last months of the production cycle. In Guatemala, 60% of the inhabitants are indigenous people, descendants of 22 Maya groups. Most of the Maya people are farmers who, during the cotton picking season, suffer from miserable living conditions and work in the fields which are regularly sprayed. The effects cotton production has on human and environmental health may be clear. However, there are other ways to grow cotton.

Fresh and hot

Francisco's farm is an example of diversified local cotton growing. He lives near sugarcane plantations in the hot coastal area of Guatemala. The area is about 300 m asl. The rainy season is from June to October, with an interval in early August. The period between November and May is dry and hot. Most of the land is used for monocultures of cattle, sugarcane, palmoil, soybeans and cotton and depend on seasonal labour. Many small farmers are day labourers earning some cash income. Some are organized in cooperatives, although access to land is difficult. At the beginning of this century, rainforest covered the area. The volcanic soils are fertile and rich in humus. However, the top layer is rapidly wasted because of monocultures.

On the hilly edge lies Francisco's *milpa* (approx. 0.3 ha), where he grows maize, food crops and brown cotton. With his labour, he pays for using this land. Francisco does all the work, with the help of his grandchildren. He proudly produces cotton in the traditional Maya way. Efficient land use is the key. With a natural balance between land, water and light, and between 'fresh' and 'hot', a large number of companion crops can be grown. Everything has either fresh or hot characteristics. The use of chemical inputs (hot) affects the balance. The earth should stay fresh, wet. In combination with the (hot) sun the crops develop well. To obtain strong plants it's important to sow on the right day in the cycle of the moon.

Feeding the family

Francisco uses mulch for fertilisation and leguminous plants like beans, peanuts and chipilin (*Crotolaria pumila*) can be found in his *milpa*. Covercrops like squash and watermelon protect the soil in the dry season and prevent weeds to grow. After 2 years of cultivation, a natural fallow is allowed 'to let the holy Mother Earth rest for one year'. When the maize is almost ready to be harvested the cotton is sown between the rows. After harvesting the maize, the cotton gets all the space and light it needs: 'without sun you get a pale fibre'. In the shadow of the cotton, sweet potato and some medicinal herbs are grown. After picking the cotton and selecting seeds for the next year, he chops away most of the plants and burns them on an edge of the field. The best ones may stay for another