Cotton Integrated Pest Management in Central Sudan

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Abstract


The Integrated Pest Management (IPM) for cotton was investigated during 1979-1992 in large scale trials conducted in the main cotton producing areas in Sudan: the Gezira and Rahad schemes. The main pests which require annual aerial insecticide spraying are Bemisia tabaci (Genn), Aphis gossypii Glov, Helicoverpa armigera (Hb) and Jacobiasca lybica de Berg. Results showed that the indigenous natural enemies of B. tabaci and A. gossypii were capable of controlling the two pests effectively when chemical control of the other pests was delayed until the crop reached an advanced flowering stage. Commercial cotton varieties were found to compensate simulated 100% damage of bollworms. Field trials also revealed that the Economic Threshold Levels (ETLs) for the four pests could be considerably raised without significant effect on yield. Optimizing the cultural practices and not to initiate spraying against H. armigera before advanced flowering were found to be the prerequisite for the implementation of this IPM package.

General

Cotton in Sudan is produced mainly by gravity irrigation (80%). The commercial chemical control against cotton pests has started as early as 1947 against the jassid, Jacobiasca lybica de Berg, executed then by Tractors. Aerial spraying was first used experimentally in the Gezira in season 1950/51 and has been commercialized since then.

The number of sprays on cotton was only one during the fifties, increased to 3-5 sprays per season during the sixties due to resurgence of the whitefly, Bemisia tabaci and the bollworm Helicoverpa armigera. The number of sprays reached 8-9 sprays in the seventies due to the increasing severity of the former three pests in addition to Aphis gossypii which became an all-season pest since then. Despite this escalating number of sprays, cotton yields has remained, more or less, the same during all these decades (Table 1).

The integrated pest management (IPM) project entitled "Development and Application of Integrated Pest Management in Cotton and Rotational Food Crops" was initiated in 1979 and terminated in 1996. The project underwent four phases; the first three were devoted mostly to cotton. The fourth phase was devoted to vegetable IPM. The four phases were generously sponsored by the Government of the Netherlands and executed by FAO and the Agricultural Research Corporation (ARC) of the Sudan.

Cotton IPM

In the first phase of the IPM project, most of the activities were devoted to the study of the seasonal occurrence of the main pests as well as their natural enemies. The effect of the important agronomic practices on the population densities of the key pests were also studied. Cotton breeding by ARC and project staff for resistance to the major pest species resulted in releasing Sudac-K variety (4) a whitefly resistant super-okra glabrous G. hirsutum.

Table 1. Number of sprays and cotton yields in the Gezira Scheme during 1978-1996 (Source: Sudan Gezira Board).

<table>
<thead>
<tr>
<th>Season</th>
<th>No. of sprays</th>
<th>Yield (kant/fed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978/79</td>
<td>9.25</td>
<td>3.27</td>
</tr>
<tr>
<td>1979/80</td>
<td>8.87</td>
<td>2.66</td>
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<tr>
<td>1980/81</td>
<td>8.61</td>
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<td>1981/82</td>
<td>6.78</td>
<td>3.76</td>
</tr>
<tr>
<td>1982/83</td>
<td>5.22</td>
<td>4.70</td>
</tr>
<tr>
<td>1983/84</td>
<td>5.45</td>
<td>4.93</td>
</tr>
<tr>
<td>1984/85</td>
<td>4.14</td>
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<tr>
<td>1985/86</td>
<td>8.60</td>
<td>3.30</td>
</tr>
<tr>
<td>1986/87</td>
<td>5.20</td>
<td>4.93</td>
</tr>
<tr>
<td>1987/88</td>
<td>5.67</td>
<td>4.57</td>
</tr>
<tr>
<td>1988/89</td>
<td>5.27</td>
<td>5.20</td>
</tr>
<tr>
<td>1989/90</td>
<td>4.34</td>
<td>4.14</td>
</tr>
<tr>
<td>1990/91</td>
<td>3.72</td>
<td>3.72</td>
</tr>
<tr>
<td>1991/92</td>
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<tr>
<td>1994/95</td>
<td>2.80</td>
<td>3.30</td>
</tr>
<tr>
<td>1995/96</td>
<td>4.00</td>
<td>4.04</td>
</tr>
</tbody>
</table>

* Sponsored by the FAO Near East Regional Office, Cairo, Egypt.
were thus illuminated and the impact of the insecticides was convincingly demonstrated. The key pest of cotton in the unsprayed cotton fields was again found to be the jassid. Both the whitefly, *Bemisia tabaci* and the bollworm *Helicoverpa armigera* were created by the continuous use of insecticides. The most important finding was that, in the absence of insecticides the indigenous natural enemies were capable of suppressing both whitefly and aphids below the economic threshold levels throughout the season (1).

The most common natural enemies of cotton pests are:

(a) **Predators:**
- *Chrysoperla carnea*
- *Chrysoperla pudica*
- *Chrysoperla zaslawi*
- *Coccinellidae*
  - *Hippodamia variegata*
  - *Cydonia spp.*
  - *Scymnus spp.*
- *Nabidae*
  - *Nabir spp.*
  - *Tropiconobis capsiforms*
- *Myrmeleidae*
  - *Campylomma spp.*
- *Anthocoridae*
  - *Orius spp.*
- *Syrophidae*
  - *Ischidiob aegypticus*
- *Spiders*

(b) **Parasitoids:**
- *Aphelinidae*
  - *Encarsia lutea* (whitefly)
  - *Eretmoseurus mundus* (whitefly)
  - *Aphelinus sudanensis* (aphids)
- *Braconidae*
  - *Apanteles rufricus* (*H. armigera*)
  - *Chelonus spp.* (*H. armigera*)
  - *Microbracon kirkpatrickiy* (*H. armigera*)
- *Eulophidae*
  - *Euplectrus spp.* (*H. armigera*)

The importance of delaying the first insecticide application which was suggested by Eveleens and Abdelrahman (3) was verified. As a result, during the third phase (1985-1992) a series of trials to raise the ETLs for the four pests were conducted in different localities (5). Another series of experiments were also conducted to reveal the maximum age of the cotton plant at which it can still fully compensate simulated 100% damage of bollworms in the Gezira environment. It was found that all the commercial cotton varieties could compensate 100% of such damage up to four weeks after the initiation of the flowering (2). The newly proposed higher ETLs were accepted by the National pests and Diseases Committee and were released for all cotton growing areas. These new ETLs, which were fully adopted in all cotton areas in the Sudan since the 1993/94 season are shown in Table 2.

The economic impact since 1993/94 season in which the new ETLs have been adopted in all cotton areas in Sudan two sprays have been annually saved. The mean cost of pesticide + application per one spray is about 12.8 US Dollars per feddan (calculated from the records of Gezira of the last 15 years). The monetary value of saving two sprays in 500,000 feddans of cotton is 12.8 million US $ annually. The cotton quality has also improved as judged by the increase in the percentage of the higher lint grades which mean...
The reduction of insecticide applications on cotton must have had a positive impact on the promotion of the role of the natural enemies in the cotton-based agroecosystem in the Rahad and Gezira schemes. This impact is evaluated now through comprehensive studies in both schemes. There are at present some indications to this positive impact. The wheat crop which is part of the rotation in both schemes is usually given two sprays per season against aphids. The number of sprays on wheat has dropped in the Gezira during the last three seasons Wheat in Rahad received no spraying since its introduction in the rotation in season 1992/93. This coincided with the adoption of the IPM package of cotton in Rahad scheme.

In phase IV (1993/94) the project introduced the Farmers Field Schools (FFSs) approach to develop and promote vegetable IPM. Sudan has been the first country in Africa to adopt this system. The success of FFSs approach in addressing the problems of vegetable production (and at a later stage all the field crops) has won widespread recognition among both farmers and policy makers. The idea of FFS is now adopted and declared as the sole extension approach in the Gezira scheme, Rahad scheme and Gezira State. At present there are about 300 FFSs operating in Sudan.

Perhaps the most prominent and significant achievement of the IPM project is its dissemination and promotion of the IPM philosophy and approach among all those who are involved in agricultural production in Sudan. This will be an effective tool for the sustainability of IPM in Sudanese agricultural policies.

References