Integrated pest management as part of a cleaner textile production strategy for cotton in South Africa

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ABSTRACT

Integrated Pest Management (IPM) is the main initiative of the Cleaner Textile Project on the cotton production side. The project is funded by DANIDA, the Danish International Development Assistance and carried out under the auspices of DARUDEC, a Danish consultancy agency. In order to reduce the negative environmental impact of cotton in the cotton-growing phase, initiatives that mainly involve the training of farmers have been started and will be continued. The training is aimed at emerging farmers and at commercial cotton farmers, to implement Integrated Pest Management principles and best management practices in order to promote cleaner production strategies. The activities of the project with regards to IPM, and the dissemination strategies involved are discussed.

Introduction

The Cleaner Textile Production (CTP) project is supported by Cotton SA in Pretoria (SA) and has been ongoing for the past 2.5 years. Other important role-players include the Pollution Research Group, University of Natal, the Water Research Council, the Department of Agriculture, the South African Cotton Producers Organization (SACPO), to mention only a few. The main activity of the cotton-growing phase of the Cleaner Textile Production Project is the training of people to perform scouting, either for themselves, or for farmers. Several training sessions have been held during the past two years, and experience has shown that the training is most effective if it is directed towards the small-scale farmer. The CTP has been initiated during the cotton season of 2000, and training of farmers in Integrated Pest Management (IPM) principles has been ongoing. The concept of IPM is introduced to the farmer through a series of mechanisms that make it easy and desirable to implement. Cleaner Production is a cost-effective way to farm “smartly”, and during these training sessions, the trainee is introduced to adapt to a moderate, careful approach towards hazardous chemicals. All the factors that influence the decision for chemical control of cotton pests are analyzed, and the farmer is taught to question previous methods used, decisions taken and chemicals supplied. The farmer is also encouraged to select certain less hazardous or so-called “softer” chemicals in the farming-environment. IPM has been described by many authors, but under the CTP, the farmer is taught that it comprises of the consecutive monitoring and integration of all factors like plant stage, and inter-, and intra specific interactions of pest species and natural enemies on a crop.

During the period when the project was initiated, training was aimed towards commercial farmers and small-scale farmers. In certain areas, farm scouts were trained that would assist the commercial farmers on a weekly basis during the season. However, it soon became obvious, that the demand for training was higher amongst the small-scale cotton growers. The areas where most of these farmers are present include the Groblersdal-Marble Hall area, under which Elandsdoorn, Moutse-East and Moutse West resort, in the Mpumalanga Province. Other areas include the Tonga-area in Mpumalanga, but the main region is represented by the Makhathini Flats in northern KwaZulu Natal (Table 1).

Training methodology

Training sessions

Six check scouts were selected and were trained in scouting at the Cotton Training Center, Kadoma (Zimbabwe) from the 22nd October to the 2nd November 2001. All six check scouts completed the course successfully. In general, the theme of the training course was to emphasize the cotton pests that can be controlled by protecting the natural enemies or the predators of these pests, together with judicious spraying. This is in agreement with the concept of Integrated Pest Management (IPM) using all available tools and methods to monitor pests and predators, in order to reduce chemical sprays on cotton and to conserve the beneficial insects. Since the employment of the check-scouts, it was realized that these scouts were more successful in scouting for small-scale farmers, and training of these farmers.

The number of growers trained under the Cleaner Textile Project

The decision of whether farmers or farm scouts were to be trained during presentation of the courses depended on the area where training courses were held. Course material included scouting sheets, posters, slides, video-material, and a booklet that served as a scouting guide, as well as practical experience on cotton plants in the field and in the classroom. The students received intensive scouting training and practical experience daily by visiting cotton fields that had significant numbers of pests and natural enemies to identify. Other specialized training methods included learning by association, by matching wooden blocks with pictures, large posters with numbered pests, damage and different pest stages (egg, larval, adult & pupal stages). Trainees were also exposed to the correct calibration methods, and the chemicals that are available at present that can be used to control pests, but that would least affect the environment. The training is made more valuable with the use of a video on cotton production methods, as well as the recurrent viewing of a training video on the identification of pests and predators. The latter video is extremely valuable especially to educate illiterate farmers. In addition, the trainees were taught about labeling of chemicals, the reading of a label, safety precautions during spraying to avoid human contamination or water source contamination.
and how to dispose of containers. Theoretical work is
followed by practical training sessions in the field, where
the group is divided into smaller groups and where
practical scouting is carried out. A laser disc has been
compiled for use by growers at all levels in need of IPM
Information, once the Cleaner Textile Project ends. The
information can be read on any computer with CD-
Rom capability and is based on the diagnosis of a prob-
lem based on symptoms shown by the plant. Once the
problem is identified, a possible solution or a remedy
is suggested and directions are given to mix, and apply
chemicals, if necessary, and how the environment must
be protected by scouting, timing of sprays and destruc-
tion of empty containers. The information will be up-
dated at least once every three years. Accreditation of
the training modules (National Qualification Frame-
work, Level, 1 (NQF Level 1) by the Primary Agriculture
Education and Training Authority (PAETA) within the
frame work of the Standard Generating Body (SAQU),
has been granted at the end of 2002 for the module
on plant production and insect control.

The potential of building a check-
scout system for South African
small-scale farmers

The aim of a check-scout system is to make
people trained in Integrated Pest Management avail-
able to the farmer to perform weekly scouting activ-
ities. The check scout in the Weipe area was employed
from October 2002 by a commercial farmer in the area,
where he would be of assistance for scouting of cotton
fields of at least 2 farmers. Up to the end of December
2002 three permanent check scouts that were very valu-
able to small-scale farmers were, and still are employed
under the Cleaner Textile Project (CTP) project. The
scouting services, which are run as a non-profit assis-
tance and training service, have continued in two ar-
 eas since 2000. These check-scouts give a monthly
report on farmers visited, thresholds achieved, general
comments on chemicals used, the number of hectares
scouted and any particular problems that they have
encountered. The total number of hectares, which were
scouted during the season of 2001/2002, under su-
 pervision of the check scouts, is in the region of 674 ha
(Table 2), while it has declined in 2002/2003 to be
closer to 180 ha. Most of these hectares were planted
with the transgenic variety NuCOTN 37B (Bollgard),
while only about 19 ha were non-transgenic.

Field reports

Field reports were received on a monthly basis
from the check scouts. These reports included a sum-
marized sheet of farms visited, no of ha scouted, stage
of the crop, number of sprays applied, cultivars/variety
scouted, and other comments. The bollworm treatment
threshold on the transgenic variety was never reached
during the season in all areas, apart from Weipe.
Secondary pests that reached threshold levels included
aphids and stainers. Aphids became a problem on
most farms from the 7th week after planting, and seemed
to continue to be a problem until very late in the sea-
son. Light leafhopper infestations were observed from
the 7th week on at least two farms in the Loskop area.
From about the 17th week, aphids, jassid and stainers
reached the threshold, which emphasizes that scouting
for secondary insects including stainers is important.
The number of hectares scouted varied between 1-4
per small-scale farmer, and problems that they experi-
cenced were generally associated with drought, and the
increase of secondary pest populations like aphids and
leafhoppers, especially on the genetically modified va-
rieties. The farmers were encouraged to focus on IPM
and spraying techniques, and how these could improve
their crop. The monthly reports of the check scouts
supported the continuation of the training, and success
of the scouting that followed training sessions. The
farmers reported on, attended the training sessions at
least once a season.

As a result of the fact that farmers are becoming
more aware of IPM, either by CTP initiatives carried out
under this project or because “cleaner farming” is the
only way to make farming more sustainable and cost-
effective in these drought stricken areas, the need for
extended training is higher. It was decided that more
farmers could be trained if the basic principles of IPM
can be transferred by the check scouts themselves in
the rural areas. It was therefore decided that, in order
to keep the check scouts up to date with recent devel-
opments and best management practices a one-day
workshop should be held for them. The training work-
shop for the check scouts was subsequently held dur-
ing October 2002 at Cotton SA. The scouts were sup-
pplied with a scouting kit, which consisted of a rucksack
with pest and predator identification material (wooden
blocks with mounted pictures), booklets, pamphlets, a
sheet of 1.5 x 1.5 m with an illustration of the develop-
ment of the cotton plant etc., by the trainers. A number
of questionnaires were circulated among growers by
the check scouts.

The purpose of the questionnaires was to deter-
mine what the status of knowledge about IPM is amongst
farmers, and to identify problems that could be ad-
ressed in future training sessions. The check scouts
circulated these questionnaires to farmers that they
worked with, or visited on occasions, and 72 question-
naires were completed and returned. Fifty-four farm-
ers out of the 72 that completed the forms scouted their
cotton on a regular basis. Several chemicals were listed
to determine their level of use by cotton growers. From
Table 3 it was clear that monocrotophos was widely
used in the Makhathini. This is a matter of concern,
and training will be aimed at teaching farmers not to
use such hazardous chemicals that harm the environ-
ment.

Fortunately the chemical monocrotophos will be
withdrawn from the market in the near future is the
only chemical used in cotton production, which pro-
hibits farmers from qualifying to obtain the Eco-label
for their cotton). The CTP project will aim to promote chemicals like acetamiprid, and endosulfan that have lower persistence or no affect on some of the natural enemies of cotton pests. It was clear that the availability of chemicals and the level of knowledge about these substances play an important role in the decision taken whether to use it or not. In the case of fertilizers, very few small-scale farmers make use of synthetic fertilizers, and it is in this area, that the CTP project can play an important role to encourage farmers to make use of organic fertilizers or to use organic sources from their own fields, like cow manure. Valuable information was gathered for further training sessions to through this information.

The response through the questionnaire to CTP-related questions (Figure 1) indicated that very few farmers knew about cleaner production, and everybody wanted more training, and assistance with extension. This confirms the importance of the training session and the importance of informing farmers about the concept of cleaner production. Few apply CTP techniques like crop rotation, intercropping and conservation tillage, while some IPM (CTP) techniques like the burning of cotton stalks at the end of the season are nevertheless carried out to avoid further pest build-up.

Scouting as major IPM principle

Scouting forms the basis of applying IPM principles. Under the CTP project, farmers are taught that farming without scouting is ineffective. Scouting is demonstrated as the consecutive monitoring of pests and predators, from the beginning of the season to at least 20 weeks after planting. Scouting requires accurate checking of all plant parts, starting at the top of the plant and working towards soil level, to check for pests, pest damage, eggs or predator presence on all plant parts. In addition to bollworms, which are the main pests, other pests like leafhoppers (Jacobiella fasciata Jac.), whitefly (Bemisia tabaci Gennadius), aphids (Aphis gossypii Glover), spidermites (Tetranychus telarius), thrips (Thrips tabaci Lind.), the cotton stem weevil (Apion soleatum Wagner), the black cotton beetle (Sygrus rugifrons Baly) are also monitored during scouting. In the case of these secondary pests, more emphasis is placed on leaves than on the fruiting bodies, while in the case of the stainer complex, cotton bolls ripe and unripe, and presence on the soil is noted.

Pegboard system

In general, the scouting was easily understood by the trainees, but the actual recording of the findings created some difficulty, especially since many of the small-scale farmers are illiterate. It was then decided that a scouting system by means of a peg-board should be introduced to enable people who are illiterate to be able to scout. The peg-board system entails the marking of pests by means of moving matchsticks in corresponding lanes on a wooden block to a point where the threshold is reached, and thus a management decision should be taken. The results can then be transferred to paper by coloring corresponding circles on a sheet that can be kept as a record by the cotton grower. The peg-board system was explained and identified as the most appropriate system for scouting, since it is easy to handle, practical and could be used by anyone, illiterate or literate. The thresholds used on which decisions for spraying is based, are derived from conventional methods used over the past years in SA, and in neighboring countries, like Zimbabwe and Zambia. The main pests on cotton are the bollworm complex, consisting of the American or African bollworm Helicoverpa armigera, red bollworm Diparopsis castanea and the spiny bollworm species Earias biplaga and E. insulana. They are able to cause serious economic damage to the crop.

Integrated farming and best management practices

Farmers are encouraged to accept the modern idea of following best management practices. Good examples or these are those listed by Australian cotton growers. The main concepts that can be applied for the SA cotton grower, is probably the idea of conservation tillage and IPM. Minimum tillage is to the advantage of the small-scale farmer, farming in semi-arid regions since the benefits includes limiting of soil erosion, weed control, limited chemical use by less soil disturbance, etc. In other crops like maize, conservation tillage as been popular. In combination with intercropping of other crops, like wheat it proves to have potential for further development.

Conclusion

The CTP project has succeeded in creating an awareness of IPM amongst emerging farmers, and has made the concept of Cleaner Production more prominent. It does not only mean farming cost-effectively, but by using less chemicals and spraying only when it is necessary it protects the environment and it is therefore in the interest of everyone.

The demand for further training has now arisen and the CTP project has successfully assisted with requirements for the development of appropriate training aids. The project has exposed some farmers to export, although still on a small scale. Training can now aim to suit individual needs of farmers, and the need for publicizing and information transfer on IPM is already prominent amongst the farmers.

Acknowledgements

DANIDA (Danish International Development Assistance) is thanked for funding the project. The support given by Mr. Hennie Bruwer (CEO, Cotton SA) not only in the form of assisting in the logistics of the daily running of the project, but also in supporting Cleaner Production and especially the training, has been in-
Table 1. The total number of people trained under the CTP project, for the period of May 2000 to February 2003.

<table>
<thead>
<tr>
<th>Location</th>
<th>Total</th>
<th>Zimbabwe</th>
<th>KwaZulu-Natal</th>
<th>North West</th>
<th>Pretoria</th>
<th>Limpopo</th>
<th>Western Cape</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>271</td>
<td>6</td>
<td>13</td>
<td>13</td>
<td>3</td>
<td>4</td>
<td>38</td>
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<td></td>
<td></td>
<td>31</td>
<td>34</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>26</td>
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<td></td>
<td></td>
<td>16</td>
<td>26</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>97</td>
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</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Grand Total</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>97</td>
<td></td>
</tr>
</tbody>
</table>

Note: The total number of people trained under the CTP project for the period of May 2000 to February 2003.
Table 2. The number of hectares and farmers served by check scouts employed under the cleaner textile project.

<table>
<thead>
<tr>
<th>Areas</th>
<th>No of farmers served</th>
<th>Hectares scouted</th>
<th>Bollgard (ha)</th>
<th>Non-Bollgard (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loskop</td>
<td>16</td>
<td>83</td>
<td>47</td>
<td>12</td>
</tr>
<tr>
<td>Makhathini</td>
<td>19</td>
<td>42</td>
<td>35</td>
<td>7</td>
</tr>
<tr>
<td>Weipe</td>
<td>4</td>
<td>549</td>
<td>549</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>674</td>
<td>631</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 3. Chemicals used by cotton growers (Makhathini).

<table>
<thead>
<tr>
<th>Insecticides (I) /Herbicides (H)</th>
<th>Makhathini</th>
<th>Dennilton/Moute area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Do they use them?</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>Sometimes</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Monocrotophos (I) &amp; Nuvacron</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Thioflo (I)</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>Mospilan (I)</td>
<td>44</td>
<td>0</td>
</tr>
<tr>
<td>Cypermethrin/Decis (I)</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>Marshall (carbosulfan) (I)</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>Carbaryl (I)</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>Metasystox (I)</td>
<td>47</td>
<td>0</td>
</tr>
<tr>
<td>Rogor (I)</td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>Perfektion (I)</td>
<td>47</td>
<td>1</td>
</tr>
<tr>
<td>Wuxal (Foliar fertilizer)</td>
<td>43</td>
<td>1</td>
</tr>
<tr>
<td>Nuvacron (I)</td>
<td>31</td>
<td>14</td>
</tr>
<tr>
<td>Decitab (I)</td>
<td>35</td>
<td>11</td>
</tr>
<tr>
<td>Any synthetic fertilizers</td>
<td>46</td>
<td>2</td>
</tr>
<tr>
<td>Dual (H)</td>
<td>48</td>
<td>1</td>
</tr>
<tr>
<td>Cotogard (H)</td>
<td>48</td>
<td>1</td>
</tr>
<tr>
<td>Roundup (H)</td>
<td>13</td>
<td>21</td>
</tr>
<tr>
<td>Dropp (defoliant)</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>Pix (plant growth regulator)</td>
<td>46</td>
<td>1</td>
</tr>
<tr>
<td>Irrigation (drip/canals)</td>
<td>47</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 1. Response of small-scale farmers to CTP related questions.