Procedures, advantages and constraints of staggered targeted control programmes on cotton in West Africa

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Abstract

Two main types of staggered targeted control (STC) have been designed by CIRAD in francophone Africa in the past decade in collaboration with national research institutions. In the first (in Benin, Cameroon and Guinea), the spraying calendars extended are used (5 or 6 sprayings at fornightly intervals). Formulations and doses depend on the pests present during scouting on the day before spraying. In the second case (Burkina Faso pre-1996, Mali and Togo), the basic extended calendar programme is applied with a pyrethroid-organophosphorus mixture at half the usual dosage and scouting 6 days after sprayings. Further spraying is performed on the next day if a threshold is attained. Special procedures depend on the country (phytosanitary ecoregions, risk of a particular pest related to the growing season, sampling procedure, plant organs or pests observed). Decision-making procedures, spraying thresholds and products and doses may vary according to these features, and STC programmes match country pest conditions. Ecological and economic benefits include a 40-50% reduction in chemical consumption, lowering costs by CFAF10,000 to 15,000 per ha. Better knowledge of pest biology and damage and better crop management sequence monitoring give 100-200 kg/ha seed-cotton where STC is applied. Many identified constraints remain, including problems of the status and payment of specialised scouts among growers. The real cost of products may form a serious constraint for single active substance formulations.

Introduction

The main pests found on cotton crops south of the Sahara belong to four main groups: bollworms, leaf eating caterpillars, honeydew secreting sucking insects and mites. A calendar spraying programme is recommended in the francophone countries south of the Sahara (Cauquil, 1990).

In the face of crop extension problems related to economic conditions (devaluation of the CFA franc and the halting of subsidies for inputs), the withdrawal of extension services and the risk of the development of resistance to the active substances applied, new protection programmes have been designed in recent years (Cauquil & Vaissayre, 1997a, 1997b).

1) The general principles of STC programmes and specific procedures

The spraying of one or more active substances and the quantity applied depend on the pests actually present in the field and observed just before spraying. These principles have led to the name 'staggered targeted control' (staggered with regard to the doses used and targeted with regard to the pest).

Two main types of STC programmes have been designed in recent years.

In the first category ('D-1' programmes), the number of sprayings is the same as that of pre-established recommended calendar programmes, that is to say 5 or 6 sprayings at fortnightly intervals, depending on the region, and starting at flowering. Scouting observations are made the day before spraying. The countries concerned are Benin (Vodounnon, 1995), Cameroon (Deguine et al., 1993, Deguine & Ekùkole, 1994) and Guinea.

In the second case ('D+7' programmes), the programme performed is based on the recommended programme with the use of a pyrethroid-acaricide organophosphorus mixture applied at half-dosage with or without prior observations. However, scouting is performed 6 days after the calendar spraying dates and, if necessary, complementary spraying is performed the next day with a half or full dose (the case for aphids) of a single active substance. Mali and Togo are concerned by this method (Sognigbe, 1995).

The active substances are applied using the very low volume (VLV) spraying technique with a water-based preparation sprayed at 10 l/ha.

Some advantages are difficult to evaluate in terms of cost such as lessened impact on the environment or the limiting of the risk of development of the resistance phenomenon.

Different types of constraint have been recorded in most of the countries.

In the dry zones in the north, where *H. armigera* attacks are serious, the adoption of 'D+7' programmes makes it possible to provide better protection of the plants from this pest. A special option is envisaged in Mali: if the 'bollworm' threshold is attained in the first 6 plants observed, a further spraying is performed two days later.

In the ecological zones with two rainy seasons, the presence of the lepidopterans *Cryptophlebia leucotreta* and *Pectinophora gossypiella*, whose larvae are difficult to detect with the naked eyen and the frequently long coinciding of maize and cotton before the maize crop requires the design of a programme suitable for these crop sequence conditions.

The development of sampling methods suited to large cultivation blocks remains to be undertaken.

The training and extension requirements naturally led researchers to develop extension aids such as pest and pest damage identification booklets (in French or national languages) and pegboards to facilitate field observations. Pest species are associated with colours corresponding to those of the labels on the insecticide drums. This improves understanding of the link between the pest and the appropriate control product.

In spite of this, the extension of STC programmes also requires substantial training of technical staff at farmers' organisations.

These constraints are accompanied by the problems of the organisation of field spraying operations according to the homogeneity of sowing dates. It is important to take the time constraint into account in the 'D+7' programmes for which the farmers (or scout) must be available every week.

Good management of inputs is essential (carry-over of stocks, orders, storage), with a proper inventory at the end of the season and a good forecast for the following year. Procedures for credit and supplies should be defined perfectly.

Economic constraints are the final factor that slows the development of this type of programme. If scouts are employed, the way in which they are to be paid must be fixed on a case by case basis, with farmers' approval. A 'management advice' type of approach may make operations easier, together with a post-harvest technical and economic evaluation using surveys performed among users of STC methods.

Non-subsidised prices, especially for single products, should make it possible to judge farmers' real interest in the new methods.

4) State of the development of STC programmes in francophone Africa and current trends

The general principles appropriate for the situation in each country have led to a measure of heterogeneity in the programmes. With the exception of Cameroon and Mali where an extension of the areas to 15.000 ha is planned in 1998, these methods have remained at the pre-extension stage in West Africa (Table 1). This may be partly explained by lack of supervision of the cotton crop in some countries. In Benin, a project funded by the *Agence Française de Développement* (French Development Agency) should enhance the extension of this type of programme to 50.000 ha in 5 years. The project includes degressive funding of scouting and supervision training operations.

Table.1 Areas (in ha) protected by STC programmes

Country	Cameroon	Mali	Benin	Burkina Faso	Togo	Guinea
Area						
1994	92 640	105	102	1 000	-	-
1995		260	606		100	-
1996	76 000	2 120	1 270	500	1 200	40
1997		5 310	730	-	3 000	150

Depending on the pest groups, use is made of pyrethroids aimed mainly at bollworms, organophosphorus compounds with an acaricide effect (isoxathion, chlorpyriphos-ethyl, profenofos and triazophos) that are generally effective on bollworms or with an aphicide effect (dimethoate and omethoate). The latter are sometimes replaced by carbamates when the effect is considered to be inadequate.

When the cotton zone is located in a country with different types of climate in the north and the south and with one and two rainy seasons (Benin and Togo) the pest complexes are different and a special STC programme can be set up in each region.

Taking into account for a given pest the risk related to the period of the protection cycle may result in a change in the dosage during the cycle for a certain active ingredient. It may also lead to a change in the threshold levels for a certain pest, as was the case in Cameroon (Deguine et al., 1993).

The dosage specified can be larger when the risk of pest damage is high, in the case of acariosis at the beginning of the cycle for example. It is thus possible to define periods of lesser risk with regard to each pest and to apply the appropriate active substance at a smaller dose (Vodounnon, 1995).

2) Observation and decision-making procedures

The sampling procedure and the setting of spraying thresholds vary according to the country. In Cameroon, sampling is performed on a quarter of a hectare for each hectare grown. When large cropping blocks are concerned (50 to 150 ha), 15% of the total area can be sampled.

A single sampling operation is generally performed in a cultivated field with a maximum area of 5 ha when the cotton plants are homogeneous. The number of plants observed can range from 60 in Benin to 25 in the other countries. The plants are selected 'at random' along the diagonals. The number of leaves observed to examine aphid infestation may be 5 x 60, i.e. 300 leaves (Benin), 5 x 25 (125) or 4 x 25, i.e. 100 leaves (Togo) per field.

The pests, the damage observed and the scouting procedures can vary. Whitefly was observed in Cameroon. Mites are counted on leaves in Cameroon but plants with typical acariosis symptoms are recorded in Benin and in Togo. 'Aphid thresholds' are established using the number of infested leaves or plants depending on the case.

Ongoing studies concern the best compromise between ease of performance of the sampling method, the time required for this and the risks run according to the pests (Gozé & Deguine, this conference, Gozé, Nibouche & Deguine, this conference).

Decision-making procedures in Cameroon consist of the grouping of field results by cropping block. An average is calculated and then the figure is compared with the figure for each pest at the threshold values (Deguine & Ekukolé, 1994). This system may result in the spraying of one or more fields in which the threshold has not been attained.

3) Advantages and constraints involved in the implementation of STC programmes

The differences between the yields obtained with use of the recommended programme or farmers' practices and the STC programme were analysed. A 40 to 50% saving in products was achieved with STC according to the country. The annual protection cost per hectare thus varied from CFAF 10,000 to 15.000 ($US20 to 30) according to the country and the year. However, case by case examination may shows that there has been no reduction in cost in some fields.

In addition to the gain resulting from a reduction in the use of insecticides, there is a 100 to 200 kg/ha increase in seed cotton production. This gain should probably also be related to better respect of the crop management sequence. Another advantage lies in the payment of scouts, estimated to total CFAF57 million in Cameroon.

The frequency used with the 'D-1' programme means that the farmers do not have to go into the fields every 7 days. The disadvantage is that it results in poor monitoring of the sanitary condition of the cotton plants and of caterpillar attacks.

The advantage of the 'D+7' programme is that it enables better management of certain types of infestation, such as that of the bollworm *Helicoverpa armigera*. Complementary spraying with the binary formulations already extended makes it possible to avoid the problem of ordering special inputs (single component insecticides) and the management of stocks of these.

The present trend is for the simplification of this type of programme to enhance their extension. This means that studies on sampling and thresholds should be continued. In Cameroon, only bollworms are counted (threshold of 6 bollworms per 25 planting hole observed). Aphids are observed only in July and August (threshold of 13 planting holes infested out of 25 observed) and there is no longer any variation in threshold according to the period. In Guinea, thresholds are only defined for non-boll caterpillars. A systemic insecticide (imidacloprid) is applied at sowing.

Another trend is for the abandoning of certain substances like dimethoate that are no longer considered to be aphicides (Cameroon and Mali) or for not taking aphids into account in spraying decisions.

Conclusions

In the present economic context of real prices and the privatisation of national cotton companies, 'inputs' subsectors and state withdrawal from supervision of cotton growing, the STC programmes proposed can achieve the best possible management of the pest problems encountered while limiting risks of the development of resistance to insecticides. They give farmers better knowledge of crop protection.

The results are encouraging but a number of constraints should be removed. Training in the identification of pests and their damage is required together with the establishment of new organisation patterns.

The cost of crop protection observed when these methods are used is among the lowest in the world. They have undoubted advantages with regard to the environment, although these are difficult to measure.

However, experimental studies (on sampling and thresholds) should still be undertaken or performed in parallel with the development of farmers' knowledge, a process requiring the approval and participation of all supervisory structures.

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