CABI'S Expertise in Cotton with Emphasis on Asia

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1 Introduction

CABI International (CABI) is a not for profit, intergovernmental organization of more then 40 member countries We were established in the early part of the 19th century so are approaching our centenary in 2010 and currently have over 400 staff based in 16 countries including in Asia - China, Pakistan, India and Malaysia. In 2007, we worked in 67 countries worldwide.

We aim to improve people's lives worldwide by providing information and applying scientific expertise to solve problems in agriculture and the environment. CABI was established by a United Nations treaty level agreement between our member countries (currently 45 members) countries) who want to promote the advancement of agriculture and allied sciences through the provision of information, scientific and related services on a world-wide basis. Our mission and direction is influenced by our member countries.

We focus our scientific and development activities into global themes, one of which is involving commodity crops such as cotton, coffee and cocoa. CABI aims to improve the livelihoods of smallholder producers of these crops, by improving productivity and increasing their market access.

For further information about CABI's governance, our activities as a major scientific publisher, provider of project and consultancy services including those in the Commodities Theme, please see www.cabi.org

With regard to CABI's involvement on cotton, three of the top producers of cotton lint in 2006 (FAOSTAT, 2008) are members of CABI namely China (25.4%), Pakistan (9%) and India (11.4%). These countries are also amongst the biggest users of cotton and as membership organisation we need to be responsive to our members demands and consequently, cotton is an important crop for CABI.

2 CABI's Experience of Cotton

Globally, we have over 110 person-years of experience in working with this crop. In Asia, we have been working on cotton for over 30 years notably working in Pakistan, India and China but we have also worked in Africa and in South, and Central America. Much of our work has involved IPM, technology transfer and building capacity in a wide range of stakeholders. In this paper, I shall concentrate on CABI's work in Asia notably in Pakistan and in China.

Cotton is often intensively sprayed with pesticides and yet with understanding of the ecology of the crop and of its pests and diseases, significant reductions can be made on expensive inputs, saving the farmer money whilst also lowering the risk of pesticide contamination to the environment and to the farmer (Poswal & Hamid, 2000). Thus, many of our initial projects in Asia involved IPM of cotton such as studying the biology and field behaviour of natural enemies of major pests such as *Pectinophora gossypiella* (Pink Boll Worm) in Pakistan. This project was funded by USAID. Our involvement reflects CABI's long history and reputation in many aspects of IPM and notably, in biological control. Studies were made on biology, phenology and behavior of parasites and predators against the pest. Augmentation of *Bracon gelechiae* (a braconid wasp) as a predator was done on limited scale and the impact of its releases studied. *Bracon kirkpatrickcki* and *chelous blackburni* were also imported, reared and released against *P. gossypiella.* Pesticide spraying and its impact on predator populations was also investigated as

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CABI scientists attempted to understand the ecological interactions of pest- predator relationship and the effect on that relationship of pesticide spraying (CIBC reports, 1972, 1973, 1977, 1981, 1984)

CABI conducted similar work on the ecology of the crop throughout the 1980s. For example, surveying different ecological areas of Pakistan to record whitefly, its parasites and predators and associated host plants. As a result of survey in different ecological zones of Pakistan, thirty nine species of aleyrodids and forty four species of parasitoids (11 species of *Encarsia*, 12 of Eretmocerus, 13 of *Prospaltella*, 2 of Euderomphale, 3 of Tetrastichus, 2 of Amitus and 1 of Comperiella) and ten species of predators (8 Coccinellids and 2 Chrysopids) were recorded. *Bemisia tabaci* was recorded from 98 plant species but severe infestations were found on cucurbitaceous, solanaceous and malvaceous crops. Its infestation was very high and natural parasitism was very low in cotton treated with insecticides compared with untreated fields indicating that the ecological balance had been disrupted (CIBC report, 1984).

Surveys were also conducted for different species of *Heliothis*, their natural enemies such as parasitoids and host plants, preparation of identification keys for various stages of *Heliothis spp* (CIBC reports, 1986, 1987, 1988)

Our increasing reputation in cotton IPM, led us to be involved in a number of IPM projects in Asia over a 12 year period from 1992－2004 working mainly in China, India and Pakistan but also in Bangladesh and Vietnam. Some of these projects are highlighted here as case studies.

Case Study 1: Asian Regional Cotton IPM Project (1992－1996)

CABI's main role in this ADB funded project was to support the development and implementation of IPM methods in cotton in China, India and Pakistan. CABI coordinated a series of validation trials in each of the three countries. Parallel to this, farmer participatory training activities were carried out in each country.

In terms of specific achievements, the validation trials were very successful reducing pesticide inputs. At all sites, the number of insecticide applications in IPM plots was at least half of that applied to plots managed by calendar applications, while yields were maintained or even increased. Net profits, largely as a result of savings on pesticides, varied from site to site. In most places, increases were 5-10%. Through the training activities, the project built up a cadre of potential Farmer Field School (FFS) facilitators within participating countries, and generated enthusiasm and interest in participatory approaches to training in both Pakistan and India (see http://www.expresstextile.com/20031002/edit02.shtml)

One of the key strengths of CABI is the provision of information in different formats depending on the audience whether this is book production for the academic market (Matthews & Tunstall, 1994), electronic material such as compendia or the provision of simple messages for farmers through training manuals. Linked to this is our considerable experience in training different types of stakeholders along the cotton supply chain. In many parts of the world extension services are woefully inadequate to get messages across to farmers. This can be due to a number of constraints and disincentives including a lack of required skills, lack of capacity building and lack of public investment in extension. In addition, it has also been demonstrated that the linear model (research to extension to producers) is generally low farmer uptake. Messages from research are simply not communicated to farmers and producers so resulting in low farmer uptake. Where extension services do exist, they have tended to place the emphasis on message-based technology transfer methods, but fail to provide farmers with the rationale behind the recommended practices or an understanding of the ecology of their cotton field. Consequently, on a global basis, CABI and partners have been at the forefront of developing participatory methods of training and of farmer participatory research in cotton and in other commodities and a number of learning manuals containing training exercises have been produced eg Learning to Cut the Chemicals in Cotton (CABI Bioscience , 2000)

Many training programmes involving IPM of cotton have been undertaken by CABI worldwide and source material for the training courses were produced eg Cotton Integrated Production and Pest

management: an Ecological Approach (1998). This publication was a trainers manual written for the FAO and Government of Zimbabwe whilst in Peru, our manuals containing training exercises developed in Asia, were translated into Spanish for use with farmers there.

One example of such a training programme from Asia is given in Case Study 2.

Case Study 2: **Integrated Pest Management of Cotton (Training for the Pakistan Food Security Programme, 1999－2000)**

In this project, funded by the Catholic Relief Service, CABI was asked to help build capacity in NGO staff and in marginalized farming communities on sustainable cotton and wheat production practices. The NGOs (Caritas Pakistan, Agriculture Extension Program, Doctorwala Agri. Extension Program, Social Development Organization and Yasir Welfare Society) were working with marginalized communities in the Khanewal, Vehari and Sahiwal districts of the Punjab and concerned the use of irrigation water (in very low quantity and of erratic supply). These communities were situated at the very ends of the irrigation canals and were facing acute shortages of irrigation water. Initially, we developed a cotton pest management system that was appropriate for the crop system using a conservation of natural enemies approach. We then trained more than 30 NGO staff and extension workers by developing training curricula, methods, and exercises. CABI also conducted season-long Training of Facilitators (TOF) and Farmer Field Schools (FFS) for the cotton crop as well as training the farmers in management strategies for water use in the crop.

As a consequence of our work, training farmers on better water management practices, CABI was then approached by WWF–Pakistan to use our expertise in training (especially the Farmer Field School approach) to train cotton farmers in freshwater management (Case Study 3).

Case Study 3: Freshwater Management in Cotton Ecosystems through Farmer Field Schools funded by WWF-Pakistan (2003－2007)

Pakistan used to be a water surplus country but now is a water deficit country. Extended droughts have reduced fresh water supplies so highlighting the importance of adopting water conservation measures for the judicious use of this resource. Here, we studied the qualitative and quantitative impacts of cotton production on the freshwater ecosystem and identified good management practices to ensure sustainable cotton production with a minimum threat to the freshwater ecosystem. We empowered farming communities to identify and adopt the sustainable cotton production technologies with long term benefits for water resources. This work included developing water requirements of the cotton plant and farmers studied water use patterns on cotton. We conducted research on different water saving techniques on the farmer's field school plots in conjunction with other integrated crop management techniques and developed plant water requirement monitoring criteria such as :

- The cotton leaves showing water stress at 9－10 a.m.
- Less soil moisture near the plant below 5～6 inches.
- Flower appearance at the top portion of the plant.
- Inter-nodal distance decreases.
- Reddish/pinkish streak on the main stem reaches 5～6 inches below the top during early growing season.
- The upper tender shoot does not break up easily.

When four of the above stages reached, the cotton field should be irrigated (farmers' groups decision). These criteria helped improve farmer decision making. 300 farmers were trained in water management strategies for their crop (CABI Final Technical Report ,2003)

From 2000 to 2005, we were also involved in large regional IPM projects in Asia (Case Study 4).

Case Study 4: Regional Projects Funded by the EU. A) EU/FAO 'Integrated Pest Management Programme for Cotton in Asia' (2000－2004) and the Associated EC Inco-Dev Project (COTRAN)

Entitled an 'Assessment of the Environmental and Agronomic Appropriateness of Bt Transgenic Cotton in Small-producer IPM Systems in China (2001－2005)

The European Union provided funds (through FAO) to implement a regional project covering Pakistan, India, China, Bangladesh, and Vietnam. CABI was involved in various activities both in this project and in the linked EU funded (INCO-DEV) project. CABI was contracted by FAO to provide all technical backstopping to Pakistan's IPM programme. Under this project, a national focal point for IPM was established which was later institutionalized as National IPM Programme. CABI's role was to conduct Training of Facilitator (TOF) training and to facilitate season-long Farmer Field School activities in Sind province.

CABI assisted in establishment of National IPM Programme, and provided mentoring and all technical backstopping for its development and growth. We established and conducted two season-long Training of Facilitators (TOF) and 20 Farmer Field Schools (FFS) in Khairpur and Sakrand (Sind province) on cotton management and production and developed quality monitoring and assurance systems for TOF/FFS programmes for the regional project. In addition, to training materials for trainers and farmers, we produced a curriculum for a university course on Integrated Pest Management using TOF/FFS approach and provided research support on taxonomic and biological control aspects in pest management.

The COTRAN project made an assessment of environmental and agronomic appropriateness of Bt transgenic cotton in small producers in China and was a multi partner project involving a partnership between the Chinese national extension system (The National Agro-technical Extension and Service Centre-NATESC), the Biological Control Institute of the Chinese Academy of Agricultural Sciences (BCICAAS), Nanjing Agricultural University (NAU) and a grouping of European institutions with relevant skills including NRI, DIAS and CIRAD as well as CABI. A FFS ecological guideline book (including all exercises developed on Bt cotton FFS) and a guide manual on farmer participatory methods were developed with NATESC, printed in Chinese and distributed to the major ten cotton production provinces before the start of 2005 cotton season. CABI and NATESC Developed A Manual "*Discovery Learning: Bt Cotton In China" (*Grossrieder et al, 2005) which included exercises to inform farmers of the different approaches needed with Bt cotton including the reduction in pesticide usage. This manual and training exercises will be of use to many countries who are interested in working with farmers to assess the value of Bt cotton in their own agricultural systems. Field methods for the assessment of ecological impacts of Bt cotton were also produced in association with BCICAAS (COTRAN, 2005)

3 Some of CABI's current work on cotton in Asia

CABI's collaboration with Chinese partners such as NATESC has continued and in 2007 we worked together on a short DFID funded study to investigate the initial benefits of Bt cotton and sustainability of these benefits over the long term, with the aim of identifying risk factors associated with Bt resistance in cotton bollworm in China. These findings will be used to support the development of a larger project to monitor and manage bollworm resistance to Bt cotton in China. This larger project will have particular focus on (a) the development of a Bt resistance detection protocol and (b) participatory training of farmers for area wide application of the protocol.

We are also managing a project on cotton mealy bug (2008－2011) funded by the Government of Pakistan. Our partners are the Ayub Agricultural Research Institute, Faisalabad; Agricultural Research Institute, Tando Jam; Agricultural Research Institute, Quetta; Nuclear Institute for Agriculture and Biology, Faisalabad. The project aims to use an introduced beetle ,the mealybug destroyer (*Cryptolaemus montrouzieri*) as a biological control of the mealy bug. This beetle has been introduced into Pakistan from

the USA but was originally introduced into the USA from Australia. CABI scientists have also isolated a native parasitoid from Pakistan and attempts are underway to identify this parasitoid.

CABI is also undertaking a study of the cotton value chain in Pakistan and this work is the subject of a separate presentation my colleague, Ghulum Ali.

4 Conclusions

CABI has a wealth of expertise in working in cotton providing different sorts of training and building capacity in various stakeholders, be they academic books for students and researchers, to curriculum development for farmer trainers and participatory exercises for small holder cotton farmers.

Much of our work is based on our long history of biological control and of using ecological approaches in order to develop integrated pest management regimes for cotton producers but we have also adapted our FFS approach to deal with other producer constraints such as water management.

We are extending our approach now to not only understand producer constraints but to seek where knowledge gaps lay along the cotton value chain.

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