Integrated Management of Pests Affecting Cruciferous Vegetables

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Abstract

Activities over the past year which were geared towards the development of IPM systems in vegetable crops expanded focus to include cabbage (and other crucifers). This expansion represents a move towards extrapolating the classical research approach used in IPM systems development for callaloo to address pesticide overuse against diamond-back moth a major priority issue among farmers throughout the Caribbean. A regionalization workshop Development of IPM in Leafy Vegetables that currently experience high-pesticide input, held in Trinidad 12-13 June 2002 marked the first step towards conducting in-country research activities in the Caribbean islands other than the Caribbean Site host country Jamaica.

Objectives

- Train researchers in two Caribbean islands in the 'Callaloo Research Model' and its application to other vegetable systems
- Determine major pests on cabbage
- Develop a sampling protocol for two major lepidopterous species on cabbage
- Monitor populations of two major lepidopterous pests on cabbage
- Guide parallel studies (objectives 2-6) in the two selected Caribbean islands

IPM Constraints

Over the past eight years research has been conducted in Jamaica (primary site) which focused on addressing the problem of excessive pesticide use on vegetable amaranth grown for the local and export market. The research approach to the development of an IPM strategy based on rationalized pesticide use, resistance management and the use of new, selective, biorational and botanical pesticides is applicable to other vegetable systems with high pesticide input. One non chemical management tactic, exclusion has also shown potential.

The crucifers have been identified as a vegetable system which is universal to the Caribbean and plagued with pest and pest management problems similar to the vegetable amaranth studied in Jamaica. From among 16 member countries of the Caribbean IPM Network 11 listed the diamond-back-moth on cabbage as a priority pest management issue of their country. The implementation of an effective IPM strategy for this crop would therefore have far reaching impact on pesticide use within the Caribbean Region.

Training of researchers in two Caribbean islands in the Callaloo Research Model and its application to other vegetable systems.

Status

A two-day Regionalisation Workshop***, Development of IPM in Leafy Vegetables that Currently Experience High-pesticide Input*****,** was held 12-13 June 2002 in collaboration with the Ministry of Agriculture, Trinidad and Tobago.

The audience at the opening session represented stakeholders and potential collaborators in the effort of development and implementation of IPM Systems. The organisations represented included FAO, CABI, Ministries of Agriculture-Research and Extension Division (Trinidad and Tobago and Barbados), the European Union IPM CARIFORUM Project and CARDI. Members of the head table included the Chairman, Mr Samuel Rivers, Director of the Research Division, Ministry of Agriculture; Mr Bruce Lauckner, Acting Executive Director, CARDI who gave the official welcome; the Permanent Secretary of the Ministry of Agriculture, Trinidad and Tobago, Mr Swallay Mohammed who gave the opening address; Dionne Clarke-Harris, IPM CRSP Site Coordinator who outlined the objectives of the workshop and Dr Lilory McComie, Deputy Director of Research, who extended the Vote of Thanks.

The workshop was geared towards researchers and involved nine participants from Barbados, Trinidad and Tobago. Resource persons were Dr Shelby Fleischer, *Pennsylvania State University*, Dr Greg Luther, *Virginia Polytechnic Institute and State University*, Mrs Vyjayanthi Lopez *CAB International, Caribbean and Latin America Regional Centre*, and Mrs Dionne Clarke-Harris, *CARDI*.

During the workshop a stepwise approach towards the development of IPM strategies for pesticide-reliant vegetable systems was outlined. This research approach was used in Jamaica to develop IPM systems for the vegetable amaranth (callaloo) which is popular in the Jamaican diet. Research, which has been conducted on the callaloo cropping system, has now come to fruition and the research model is thought to be applicable to other vegetable systems

throughout the region, in which high pesticide input is an important concern.

Work under IPM CRSP represented pioneer efforts in IPM research on this commodity therefore allowing for classical principles for the development of IPM to be employed. The steps in the research model may be extrapolated to other similar systems. The proposal is for this model to be tested on cabbage systems for developing management strategies against the diamond-back moth, *Plutella xylostella.* This is a much researched pest therefore step two of the model would not be applicable.

The Research Model

1.Gathering baseline data (socioeconomic, farm history, Participatory Rural Appraisal)
2. Determination of taxonomy of major pests
3. Development of sampling protocols
- Determination of action threshold
- Monitoring pest populations
- Development of model of pest frequency distributions
- Development of a sequential sampling plan
- Validation of sequential sampling plan

4. Evaluation the efficacy of new biorational chemistries.
Calendar based spraying and other irrational methods of timing pesticide application have led to the development of insecticide resistance and field failures of current synthetic pesticides (lambda cyhalothrin, methomyl diazinon etc.) used. New biorational chemistries with their novel modes of action are less toxic to the user/consumer and the environment and they have been shown to give greater protection from major pests thus reducing insect damaged rejects by 10-fold compared to current grower standard.
5. Development of a decision making tool to guide pesticide applications. This tool is a guide for the farmer in deciding whether or not to take action, based on the pest density in his field at a given time. Our studies have shown up to 60% reduction in pesticide inputs using this tool with contemporary pesticides and with new biorational chemistries, inputs are reduced by up to 90% in some cases.
6. On-farm validation and demonstration of IPM strategy.
On-farm validation/demonstration plots are used in training farmers and extension officers in new techniques.

Results

Specific aspects addressed by resource persons included
- a historical perspective of threshold-based IPM
- information on the biology and current management of diamond-back moth and other pests of crucifers
- sampling
- spray options
- non chemical options
- measurement, monitoring and management of pesticide resistance
- regional monitoring of the diamond-back moth and other pests

Participants from Trinidad, Tobago and Barbados gave descriptions of cabbage production on each island

The initial plans for follow up regionalisation activities in Year 10 of IPM CRSP, which begins September 2002, were geared towards two activities with short-term impact in light of the end of Phase II in September 2003. Medium to long term plans will be tabled for the Renewal Phase.

Trinidad, under the project *Ecological Crop Management Using Farmer Participatory Approaches,* which was developed by CIPMNET with focus on cabbage and tomato, has recently concluded a participatory rural appraisal (PRA) of cabbage farmers. As Participatory Rural Appraisals (PRA's) also form the basis of the IPM CRSP participatory research methodology, the survey instrument used in the study conducted in Trinidad will be modified and administered in Barbados, Tobago and Jamaica. Any gaps in the information already gathered for Trinidad will be filled in.

The second proposed activity is a composite randomized complete block trial to evaluate one biorational pesticide using two action threshold levels for application against diamond-back moth. Exclusion as a non-chemical approach will also be evaluated in this randomized complete block experiment. The experiment will be replicated in Jamaica.

Field visits were made to cabbage and cauliflower farms in Aranguez, an important vegetable growing area in Trinidad. Frequent and injudicious use of pesticides is a major problem among farmers in this area.

Farms visited were known to use chemicals heavily and there was evidence that the populations of diamond-back moth on these farms were likely to be resistant. On one farm, where pesticides were usually applied three times per week, the moth population was extremely high. The farm of a female farmer was also visited. She explained that of all her vegetable crops, cabbage was the most labour intensive due to frequency with which chemicals had to be applied. Chemical companies promote new pesticides among farmers in this area as evidenced by the presence of pesticide trial plots placed by chemical companies on some of these farms.

Determination of the major pests on crucifers in Jamaica

Objective

To conduct baseline surveys in Jamaica to record the incidence and economic importance of major pests on crucifers.

Research Methods

In Douglas Castle, St Catherine three farms were visited and five cabbages were collected randomly from each farm. The samples were taken to the lab and each cabbage head dissected leaf by leaf. Each leaf was examined thoroughly and the number and stage of insects present on the leaves were recorded. Insects were isolated individually in glass tubes plugged with cotton and provided with sufficient food material to sustain their development.

The isolated insects were observed daily and data recorded. Data included pest stage, the parasitism levels and parasitoid emergence.

Results

Field 1 was a mature plot that was being harvested, Field 2 was a plot with young plants and Field 3 was an old abandoned plot. Pests recorded were *Plutella xylostella* and *Trichoplusia ni* (cabbage looper) (Table 1). Parasitoids, which emerged, were *Oomyzus sokolowski* and *Diadegma insulare. Cotesia plutellae* a parasitoid, which was introduced into Jamaica in the late 1980's and had become established in this area was not recovered from any of the fields (Table 2).

In an attempt to control the pests some farmers reported the continued use of Selecron and Karate, while others used Thuricide and Dipel in order to preserve the natural enemies of these cabbage pests. A structured Participatory Rural Appraisal will be conducted in January 2003 to determine current management practices and constraints among farmers in this area.

Table 1: Number of varying pests, parasitoids and predators recorded during field observations on three farms in Douglas Castle

	Field number		
Pests	1	2	3
Plutella	47	22	101
Trichoplusia	1	0	0
Parasitoid and Predators			
Diadegma	1	11	5
Syrphid	15	1	4

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Table 2: Number of parasitoids which emerged from *Plutella* larvae collected from three farms in Douglas Castle

Number of *Plutella* larvae collected	Number of parasitoids emerged from *Plutella* larvae		
	Diadegma	*Oomyzus*	*Cotesia*
170	6	77 adult *Oomyzus* emerged from 7 *Plutella* larvae	0

Development of sampling protocol for two major Lepidoptera species on cabbage

Following from the discussions held among Caribbean researchers during the two-day regionalization workshop in Trinidad and a review of literature a sampling protocol has been drafted for use in the planned RCB experiment proposed to be carried out in Trinidad and Jamaica to evaluate one biorational pesticide using two action threshold levels for application against the diamond-back moth.

The proposed protocol is as follows:

Cabbage will be transplanted in small test plots using standard agricultural practices for soil preparation, fertility, weed management, irrigation, plant spacing, etc. that are relevant to a particular island; and these practices will be constant for all test plots on an island. Plots will be four rows wide, with the two outer rows acting as unsprayed guard rows, and the two inner rows used for applying the treatments and taking the data. There will be five treatment plots established for each replicate, and there will be five replicates, for a total of 25 plots. These plots will be arranged in a randomized complete block (RCB) design.

The five treatments will consist of a grower standard (Cascade) and a microbial insecticide (SpinTor), each applied on either a weekly schedule or according to a threshold, and an untreated control. Thus, the five treatments will be:

1. Cascade (flufenoxuron) at the manufacturer's rate, applied weekly
2. Cascade (flufenoxuron) applied according to threshold
3. SpinTor 2SC (Spinosyn) applied at 4 fl oz/acre, applied weekly
4. SpinTor (Spinosyn) applied at 4 fl oz/acre, applied according to threshold
5. Untreated control

All treatments will include a spreader-sticker added to the spray tank.

When making applications according to a threshold, the thresholds will be those taken from the 2002 Commercial Vegetable Recommendations used in the mid-Atlantic states. These thresholds are:

1. From transplant to beginning of head formation: 20 % of plants infested.
2. From heading to harvest: 5 % of plants infested

Plants will be sampled weekly. Ten plants per plot will be examined. On each plant, upper and lower leaf surfaces will be examined. On seedlings, workers will make sure to look inside unfolded heart leaves. On heading cabbage, workers will examine the outer 2 head leaves, as well as all wrapper and frame leaves. The number of larvae per plant will be recorded.

The average percent of plants infested among all five replicates of a treatment will be used to determine if treatments exceed thresholds. This average will be calculated by determining the percent infestation for each of the five plots in a treatment, and then averaging among those five plots.

When making applications according to weekly schedules, the sprays will be initiated one week following transplanting, and ending one week before harvest. When making applications according to thresholds, the sampling will start one week following transplanting and ending one week before harvest, but may be adjusted according to the application schedule used.

Data will be analyzed separately for each week using ANOVA, and means compared with Tukey's HSD test. Both diamondback moth larval infestation density (larvae per plant) and percent infested plants will be compared.

At harvest, 20 heads per plot will be collected, weighed, graded for quality, and dissected to determine total number of larvae per head. These data will also be subjected to ANOVA.

The number of insecticide applications will be compared between the plots using a threshold and plots using a weekly spray.

Networking

Workshop/Meetings/Seminars
Shelby Fleischer, Vegetable Entomologist of the Pennsylvania State University, USA visited the CARDI Jamaica Unit 18 – 25 March 2002. While in Jamaica, Dr Fleischer met with CARDI, Rural Agricultural Development Authority and Ministry of Agriculture officials to discuss progress of IPM CRSP activities specifically callaloo and hot pepper research and in the development of the IPM CRSP work plan for Year 10.

Researcher Investigator Exchanges
During the regional workshop, resource persons Greg Luther, Shelby Fleischer and Dionne Clarke-Harris, IPM CRSP Co PI's and local scientists in Trinidad and Tobago discussed and shared information and experiences towards the development of regional project activities.

Impact

The decision to tackle the problem of over-reliance on pesticides in cabbage and crucifer production is from all indications a well needed and timely one. The two activities planned will give valuable information in the short term and will also assist in the identification of critical areas to be addressed and in the formulation of proposals to address these needs in the expected renewal phase of the IPM CRSP. The nexus between the activities of the project *Ecological Crop Management Using Farmer Participatory Approaches* and the participatory approach of the IPM CRSP will facilitate close linkage and synergy between the two projects.

Scientists who participated in the workshop got first hand information on the IPM CRSP research carried out in Jamaica and on the applicability to their respective countries.

Publications and Presentations

Reports
Clarke-Harris, D. and Fleischer, S. (2001). IPM systems development of pests affecting callaloo. IPM CRSP 8th Annual Report, 1999-2000. (Management Entity, Ed.) Virginia Polytechnic Institute and State University, Blacksburg, VA.

Presentations
Clarke-Harris. Development of an IPM model: the callaloo example in Jamaica.
S Fleischer. A historical perspective of threshold-based IPM Diamondback Moth.
Greg Luther. Life cycle, biology, current management, phermone, cultural control and biological control of Diamondback moth.
S. J Fleischer. Pests in Northeastern US (*Pieris rapae, Trichoplusia ni*, thrips, cabbage maggot).
S. J. Fleischer. The sampling unit, and fitting the sampling unit to a frequency distribution model.
S. J. Fleischer. Development of sequential sampling.
Clarke-Harris. Implementing a sequential sampling plan in the Caribbean.

Project Highlights

A two-day Regionalisation Workshop*, Development of IPM in Leafy Vegetables that Currently Experience High-Pesticide Input*, was held 12-13 June 2002 in collaboration with the Ministry of Agriculture, Trinidad and Tobago. Nine researchers from Barbados, Trinidad and Tobago were trained in a stepwise approach towards the development of IPM strategies for a pesticide-reliant vegetable system.