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Scientific Report

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Title - Biocontrol of Insect Pests Using *Aschersonia* Species

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Section I

Publication

Cohen, E., Joseph, T., Kahana, F. and Magdassi, S. 2003. Photostabilization of an entomopathogenic fungus using composite clay matrices. Photochem. Photobiol. 77, 180-185. The support of CDR-CAR by Grant TA-MOU-97-CA to the above research was acknowledged. A reprint of the above publication is appended.

A) Research Objectives

The main objectives of the project were to find the range of insect pests sensitive to the entomopathogen, as well as to provide measures of protection to photosensitive spores. As the fungus was isolated from homopteran species, insect pests taxonomically related to this group were selected for bioassay. To overcome environmental constraints like UV radiation, the photolabile spores were protected using a composite matrix composed of clay, a positively charged biopolymer like the aminosugar chitosan and toxicologically-safe anionic photostabilizers like FG and NYS.

B) Research Accomplishments

The previous report (September 1999 - December 2001) mostly covered research accomplished by the Israeli partner. Extension of the grant period was asked as the Georgian partner did not get any money for conducting their part of the research, for reasons discussed later in the report. Nevertheless, the Georgian team has accomplished to carry out some experiments and the results are summarized below.

The investigations were conducted in the Guria region. In this region, which is neighboring Adjara (Batumi), heavy infestation of the Japanese scale was observed in citrus groves of Ozurgeti, Shroma, Thvermagala, Natanebi and other places.

The results (Table 1) establish that the entomopathogenic fungus *Aschersonia* is pathogenic to a different degree to the five species of armored scale: *Lopholeucapsis japonica* Ckll., *Chrysomphalus dictyosspermi* Morg., *Aonidiella citrina* Coq., *Lepidosaphes gloveri* Pack., and *L. becki* Newn. It is noteworthy that the last species should be recorded as a new host for the entomopathogen.

Although abundant among other scales, *C. dictyospermi* is the least infected by *Aschersonia.* (8.4%). In contrast, the Japanese scale, *Lopholeucapsis japonica*, is a less abundant and, comparatively, can be regarded as a minor pest, is 100% infected by the fungus. It was also observed that *A. citrina* was appreciable infested (by 57.2%) by the entomopathogen.

Table 1. Distribution of armored scale and infestation by *Aschersonia* in the Guria region[1].

Species of insects	Distribution (numbers of trees with scales)	Scales (No. per leaf)	Scales infested with *Aschersonia*	
			No. per leaf	%
Chrysomphalus dictyosperma	50	16.7	1.4	8.4
Aonidiella citrina	65	20.1	11.5	57.2
Lepidosaphes becki	45	20.2	3.8	19.0
Lepidosaphes gloveri	25	16.9	3.2	19.0
Lopholeucapsis japonica	25	11.5*	11.5*	100.0

*Number per cm^2 of tree trunk
[1]Thvermagala

In 2002 results obtained from Guria and Adjara regions are summarized in Table 2. The Japanese scale *Lopholeucapsis japonica* has become a major pest of many crops along the Black sea coast of Georgia including citrus, tea and ornamental and wild plants. Since the heavy infestations that were observed in the 1980', an increase in biodiversity and efficacy of natural enemies occurred that resulted in reducing the pest populations below the economic threshold of 25 scales per cm^2 of tree trunk. In particular, the importance of the entomopathogenic fungus *Aschersonia* as the leading biocontrol factor has emerged.

Table 2. Distribution of the Japanese scale *Lopholeucapsis japonica* and the entomopathogenic fungus *Aschersonia* spp. in citrus groves

Location	Date*	Number of scales/ cm^2 of tree trunk	Number of scales infected by fungus	% mortality of scales
Guria, Shorma farm	19.07	35.2	13.3	37.6
Guria, Shroma farm	21.10	9.2	6.2	67.3
Adjara, Akhalsheni farm	25.02	22.5	7.0	31.1
Adjara, Akhalsheni farm	05.08	19.4	7.3	17.0

*2002

The density of the Japanese scale in the summer of 2002 in the Guria farm was high (35.2 insects per cm2). This number, which dropped to 9.2 per cm^2, was parallel with

the high mortality rate of 67.3% due to the entomopathogen. In the Adjara farm *Aschersonia* was ineffective.

C) Scientific Impact of Collaboration

The team in Georgia continued with the field studies and confirmed the finding of last year relative to the range of pests sensitive to the entomopathogen and proceeded in identifying target pests for future biocontrol. The laboratory at Rehovot completed the research on photostabilization using composite matrices based on conversion of negative charge of clays to positive (with the aminosugar polymer chitosan), thus, enabling adsorption of toxicologically-benign anionic photoprotectants.

D) Description of Project Impact

The rigorous study involving clay-based photostabilizing matrices is essential for improved field performance of photolabile biocontrol agents such as *Aschersonia.* We anticipate that by the end of the project a viable formulation that includes a clay-chitosan-dye matrix mixed with spores of the entomopathogen, will be ready for use in large field experiments. For this purpose, two scientists from the Georgian team will arrive in the Summer of 2003 to prepare the above formulations.

E) Strengthening of Developing Country Institutions

The research served well the Georgian institute. These efforts included extensive training of two senior Georgian scientists at Rehovot; purchase of equipment, supplies, computer and accessories; and participation and presenting abstracts on research conducted in Georgia at the International Congress of Plant Protection (IPPC) that took place in Jerusalem (July 1999). We believe that the combination of the above have had a profound scientific impact on labs and colleagues at the Georgian Kanchaveli Institue of Plant Protection. This impact should be manifested in a sustainable capacity to independently perform research of similar nature.

F) Future Work

Extension of the project was requested so that field experiments in Georgia will be completed. Field studies in Georgia can be conducted only in late Spring, Summer and early Fall. Adding another season of research in the Batumi region should gain more useful data concerning biocontrol of pests like coccids and diaspidids and will contribute for achieving the goals of the project. In addition, as mentioned before, photostabilized formulations using composite clay-polymer-dye matrices will be prepared by two visiting scientists from the Tbilisi Institute.

Section II

A. Managerial Issues

During the whole project we have experienced the grave problem of money transfer to Georgia. This problem influenced the scope and volume of research that could have been accomplished should this issue been resolved. Only recently (Winter of 2003!) the Georgian team received $3,000, and most of their previous research was conducted with practically minimal financial resources. Also in my previous reports I raised the above serious issue and time and again I have informed the relevant authorities of my institute. As a result, I asked for extensions so that the project, as far as Georgia is concerned, could be completed as planned.

B. Budget

No changes were made in budget except for shifting money between items.

C. Special Concerns

No changes related to "Special Concerns".

D. Collaboration, Travel, Training and Publications

Training of the team from Tbilisi occurred in the first year of the project so that research could be carried out in Georgia according to the plans outlined in the research proposal. In the second year of the project, the Georgian PI and one of her team traveled to Israel to attend the International Congress of Plant Protection (IPPC). Presenting abstracts and being exposed to the international community of scientists who study various aspects of plant protection were of tremendous importance. Part of the research using *Aschersonia* was published in the journal Photochemistry and Photobiology (2003) - Photostabilization of an Entomopathogenic Fungus Using Composite Clay Matrices. 77, 180-185. The publication describes our innovative research on photostabilization of an entomopathogenic fungus using clays in which their negative surface charge was converted to positive by adsorption of chitosan. This positive matrix served for the adsorption of toxicologically-safe, negatively charged photostabilizers. Such composite matrices were extremely potent for photoprotection of the photolabile entomopathogen spores. Two scientists from Tbilisi will arrive this year to complete the project by preparing formulations based on the photostabilizing matrices.

E. Requests for A.I.D. or BOSTID Actions

It is noteworthy that exchange of data and managerial issues via fax and electronic mail is reliable. The staff at the U.S. Embassy in Tel-Aviv have competently handled all A.I.D. matters, and overall has been very helpful.