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Abstract: There is an urgent need for effective biological control agents for western flower thrips (WFT), *Frankliniella occidentalis* (Pergande) infesting greenhouse ornamentals. We are evaluating potential introduction strategies for the thrips parasitic nematode, *Thripinema nicklewoodi* Siddiqi, which although not lethal causes sterility of female WFT. Laboratory studies show that the nematode can infect and reproduce in WFT over the range of temperatures recorded in a Texas (U.S.A.) commercial greenhouse during thrips outbreak periods. Moreover, greenhouse studies using potted chrysanthemums demonstrate that it may establish within WFT populations following low level inoculation. However, relatively poor transmission and slow speed of kill prevented it from being effective over a single crop cycle. *T. nicklewoodi* may have value in a longer term thrips management strategy and/or in combination with other biological control agents.

Key words: *Thripinema nicklewoodi*, Western flower thrips, nematodes, biological control

Abstract: Five commercial greenhouses near Warsaw were examined for the evaluation of costs of full biological control of tomato culture pests. The total area of greenhouse blocks ranged from 9000 to 20000 m^2. Growers used inert substrate, drip irrigation system, climate regulation and natural pollination system. Natural enemies and the knowledge of usage were supplied by the Dutch Company Koppert B.V. All growers were able to reduce whiteflies, leaf miners, spider mites and aphids with the use of beneficial insects only. No zoocides were applied during the vegetation period. The total costs of biological pest control differed in relation to specific farms and ranged from 0.74 to 1.08 PLN/m^2. In 1998 it was equal to the price of 0.5 kg tomatoes or 1% turnover.

Key words: tomato crops in greenhouses, biological pest control, natural enemies, cost of plant protection, whiteflies, mites, leaf miners

Abstract: Laboratory bioassays with *Stratiolaelaps (Hypoaspis) miles* and *Gaeolaelaps (Hypoaspis) aculeifer* showed that both species had similar daily predation rates on western flower thrips second instar larvae and pupae. A glasshouse experiment with caged pot chrysanthemums indicated that both predators multiplied at similar rates and gave similar reductions in thrips numbers over a 5-week period. Results to date suggest that both predators should have similar potential against ground-dwelling stages of thrips in a ‘push-pull’ biological control strategy being developed for chrysanthemum.

Key words: western flower thrips, *Frankliniella occidentalis*, *Orius laevigatus*, *Stratiolaelaps* (*Hypoaspis*) *miles*, *Gaeolaelaps* (*Hypoaspis*) *aculeifer*, pot chrysanthemum, biological control

Abstract: The use of biological control agents within IPM on protected hardy ornamental nursery stock in the UK is increasing. Examples of IPM methods for the major pests are given, and likely future developments are discussed.

Key words: pests, biological control, integrated control, IPM, hardy ornamental nursery stock

Abstract: Batches of mass-reared phytoseiids (*Phytoseiulus persimilis*, *Neoseiulus cucumeris*) and *Orius* species from different commercial producers were controlled for their quality according to standard test guidelines. In 2 out of 22 controlled batches all quality requirements were fulfilled completely, whereas in the remaining batches at least one quality criterion was not met. *P. persimilis* offered on leaf substrate showed especially a non-compliance with regard to an acceptable predator-prey ratio. In *N. cucumeris* batches the required minimum number of individuals was missed considerably. The main quality problem with *Orius* batches was the short longevity of females and in this connection the low cumulative reproduction per female. Reasons for the observed quality problems are discussed.

Key words: beneficial arthropods, mass-rearing, quality control, Phytoseiidae, Anthocoridae

Abstract: Successive introductions of the phytoseiid species *Neoseiulus californicus* and *Phytoseiulus persimilis* were evaluated as release strategy for both rapid and long-term suppression of *T. urticae* populations in greenhouse cut roses with regard to an economically feasible production. Spider mite control could only be achieved in combination with repeated acaricide treatments at mid of July, when the predator/pest ratio had reached >1 : 10. The percentage of infested rose shoots was variety dependent and declined to zero at the beginning of August for the rest of the growing season. As a main reason for the failure of the biological spider mite control in the first half of the growing season, the quality of the released predatory mites (*P. persimilis*) is discussed.

Key words: greenhouse roses, biological control, integrated control, *Tetranychus urticae*, *Phytoseiulus persimilis*, *Neoseiulus californicus*

Abstract: About 75 hectares of eggplants are currently grown in glasshouses in the Netherlands. Eggplants are an excellent host plant for many arthropod pests. Therefore biological pest control in eggplants has long been very challenging. More than 90% of the Dutch eggplant growers are currently successfully using biological pest control for control of thrips, whiteflies, aphids, spider mites, leafminers and caterpillars. An overview is given of the current status of biological pest control in eggplants in the Netherlands.

Abstract: Western Flower Thrips (WFT) *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), is worldwide one of the most important pests on vegetables and ornamental crops under greenhouse and field conditions. Conventional chemical and biological control tactics, targeting only at the foliar-feeding stages, usually provide no satisfactory control levels. Thus we investigated the potential of entomopathogenic nematodes (EPNs) and soil inhabiting predacious mites (*Hypoaspis* spp.) against soil-dwelling life stages of WFT. Our results indicate that all soil-dwelling life stages of WFT are susceptible to the tested EPN strains/species. Virulent strains, applied at a dose rate of 400 infective juveniles cm^{-2} resulted in 80 and 40–60% WFT mortality under laboratory and microcosm conditions, respectively. Releases of *H. aculeifer* (Canestrini) at 2,800 mites m^{-2} reduced WFT population by 78%. Combined applications of EPNs and *H. aculeifer* significantly lowered the number of emerging WFT adults compared to the untreated control as well as to individual releases of EPNs and predacious mites. These findings may open up a new venue for biological control of WFT.

Key words: Western Flower Thrips, *Frankliniella occidentalis,* entomopathogenic nematodes, *Hypoaspis* spp., biological control

Abstract: A growing number of biological control programs tend to combine two or more species of natural enemies to reduce populations of arthropod pest species. Recent evidence from field situations indicates that higher-order predators may disrupt biological control by interfering with other beneficial organisms, mainly through intraguild predation. In greenhouse crops, higher-order predators are usually released as a second line of defense, when pest populations have reached high densities. We argue that interference by higher-order predators is less likely to be important in greenhouses than in other agroecosystems. The negative effects of intraguild predation would be reduced by the low probability of establishment of higher-order predators and the periodic releases of high numbers of more specialized biocontrol agents.

Key words: greenhouse crops, biological control, intraguild predation, generalist predators

Abstract: An efficient, cost-effective protocol for rearing the staphylinid *Atheta coriaria* Kraatz on an artificial diet was developed. Laboratory trials showed *A. coriaria* to be highly predatory against fungus gnats, shoreflies and western flower thrips. A naturally occurring population of *A. coriaria* in a commercial greenhouse demonstrated its potential for long-term establishment and survival.

Key words: biological control, *Atheta coriaria*, rearing, predation, monitoring, greenhouses

Abstract: The goal of this project was to develop an IPM program for the twospotted spider mite on greenhouse grown bent cane cut roses. This work was part of a larger project to develop a model IPM program for floriculture crops that incorporated the use of fixed precision sampling, action thresholds, and biological control. Specifically, we used Taylor's power law to quantify twospotted spider mite spatial distribution in order to develop a sampling plan. We also examined the relationship between spider mite density and photosynthesis in the rose plant to develop an action threshold for this pest. Finally, we

looked at a technique to enhance movement of the mite predator, *Phytoseiulus persimilis*, in this crop.

Twospotted spider mite spatial distribution was shown to be highly aggregated on bent cane roses under both chemical and biological control. Using the Taylor's power law coefficients we determined that a sample of 38 plants per 929 m^2 could predict mite density with a precision of 0.25. The relationship between spider mite density and rose plant photosynthesis suggested that our nominal action threshold of 5 mobile stages/leaf/week was too low. We also demonstrated that the use of interplant bridges facilitated predatory mite movement between rose plants in the bent cane system. Implementation of the IPM program developed from this study resulted in key pest densities and control costs that were comparable to or less than those obtained under a conventional control program.

Key words: sampling, thresholds, photosynthesis, biological control, roses, *Tetranychus urticae*, *Phytoseiulus persimilis*

Abstract: Our goal was to develop and implement a pest management program using reduced risk pesticides and biological control agents to manage the key pests of cut roses. This program represents the largest effort to implement an IPM program on floriculture crops in the United States. Eight growers spanning the major rose production areas of California participated. Data were collected at each location from an IPM and a conventional practice greenhouse. We used a comprehensive sampling plan that provided information on the density of insects, mites, and diseases. Based on thresholds developed for each of the pests, we took no action; applied a reduced risk pesticide; or released biological control agents.

Twospotted spider mite and western flower thrips densities were the same or significantly lower in the IPM compared to the conventional practice greenhouses. Biological control of mites was successful at all locations. Pesticide use was generally lower in the IPM greenhouses. Efforts to reduce prophylactic applications of fungicides using a model to predict powdery mildew incidence need further study. Control costs were comparable under the two programs.

Key words: sampling, thresholds, biological control, roses

Abstract: Spain is one of the main vegetable producers in Europe. Due to the mild weather greenhouses are unheated semi-open structures in which pest populations reach high levels. Pest origin is mainly from outdoors but there is also a rich fauna of natural enemies that colonize the greenhouses. This is an important consideration for developing effective biological control programs in this region. Nowadays, peppers are the main success in biological control, in spite of the Tomato Spotted Wilt Virus problem transmitted by the western flower thrips. For tomatoes, biological control is only applied in regions free of inoculums of the Tomato Yellow Leaf Curl Virus, transmitted by *Bemisia tabaci.*

Key words: tomato, peppers, thrips, whiteflies, natural enemies

Abstract: The effect of nitrogen fertilization on the abundance of cotton aphid, *Aphis gossypii* Glover, was studied on chrysanthemum, *Dendranthema grandiflora* Tzvelev var. “Charm”. We tested five fertilization treatments that consisted of 20%, 50%, 75%, 100% and 130% of the recommended nitrogen level. We transferred five apterous aphids to each pot at the beginning of the experiment and counted aphids weekly for 3 weeks. There were

disease transmission. A number of tactics have been implemented with some degree of success such as resistant cultivars, rouging diseased plants, and alternate planting dates. For managing the vector, *B. tabaci,* farmers have adopted improved pest monitoring and control guidelines, mass trapping, exclusion nets, and pesticide rotation to preserve effective pesticides. However, the two tactics most relied on by farmers are chemical controls and exclusion nets to reduce disease transmission by *B. tabaci*. Nowadays, over 98% of greenhouses use insect nets of various mesh gauge sizes to exclude *B. tabaci* from greenhouses. Considering the time and expense devoted to exclusion nets, evaluations were begun to determine the benefits of using insect nets within the overall IPM program. Factors such as the effect of mesh size on disease incidence and *B. tabaci*, impact on biological control, disease management and crop yields are included. The first objective of the program compared the efficacy of two mesh gauge sizes most commonly used by farmers, the 10x14 and the 10x20 gauge mesh. Preliminary field comparisons suggest there may be significant differences in efficacy between the most common mesh gauges and their value to pest management.

Key words: Tomato Yellow Leaf Curl Virus, exclusion nets, physical control, *Bemisia tabaci*

Abstract: The introduction of TYLCV and its insect vector *Bemisia tabaci* have exacerbated crop losses, disrupted IPM programs and have seen the loss of pesticides to insect resistance from overuse. In the Mediterranean and North African regions this pest complex has single-handedly challenged the ability of the region to produce high quality and quantity of horticultural products for the export market. To address this problem, investigations were begun to modify current IPP practices to include more effective management tactics for TYLCV and *B. tabaci*. One focus of this research was the evaluation of alternative pesticides for control of *B. tabaci* populations that would not disrupt current IPM programs. Here we present preliminary results evaluating the efficacy, field performance and user recommendations for one alternative pesticide, AGRI-50 (CAL AGRI PRODUCTS, Los Angeles, California, USA). Evaluations were conducted in the laboratory to ascertain efficacy at all life stages of *B. tabaci*. Further studies were conducted in commercial tomato greenhouses in Morocco to determine optimum application rate, spray volume and compatibility with commercial cultural practices. Laboratory trials have shown AGRI-50 to be effective against the adult and all nymph stages of *B. tabaci*, particularly, the tenacious pupa stage at concentrations from 2500 to 5000 ppm. A single application was found capable of nearly complete control of late *B. tabaci* pupae and prevented emergence of the newly developed adults. In commercial tomato greenhouse trials AGRI-50 was found to achieve economic control equal to or greater than many conventional pesticides. Furthermore, it was found that this level of control could be achieved using standard application equipment and spray volumes. Research examining compatibility of AGRI-50 with current IPM practices have shown that bumble bee pollinators are unaffected by Agri-50 applications and evidence has been accumulated showing relatively low impact on important natural enemies such as *Eretmocerus* sp. and *Diglyphus* sp. parasitoids.

Key words: IPM, *Bemisia tabaci*, AGRI-50, low risk insecticides, greenhouse

Abstract: A number of different species and isolates of entomopathogenic nematodes were used against cabbage root fly, *Delia radicum*, infesting potted cauliflower under glasshouse conditions. *Steinernema affine* was found to be the most effective isolate tested. This isolate was then compared with a commercial product (*S. feltiae*, marketed as 'Nemasys'®) at a range of doses. *Steinernema affine* gave a significantly higher level of control compared to the commercial strain.

Abstract: *Liriomyza trifolii* (Burgess) is a serious pest of chrysanthemum and other greenhouse crops around the world. The objectives of this study were to determine the possibility of using the Sterile Insect Technique (SIT) against *L. trifolii* infesting greenhouse chrysanthemum. We found that a high level of sterility was achieved with a doze of 155 Gy for both sexes. The copulatory success, longevity, percent emergence and flight ability of irradiated males were similar to that of unirradiated males. The SIT experiments indicated that the release of sterile *L. trifolii* can significantly reduce the reproductive capacity of the normal leafminer population. Our study indicates that sterilization of *L. trifolii* flies is feasible and that sterile males are of high quality and competitive with normal males. Based on these data, we will continue research on the use of SIT against *L. trifolii* populations in greenhouses. We will also determine the feasibility and efficacy of the combination of the SIT with the augmentative release of the parasitoid *Diglyphus isaea* for *L. trifolii* control.

Key words: *Diglyphus isaea*, *Liriomyza trifolii,* SIT

Abstract: Extracts from fresh and dry sage leaves were used to investigate the possibility to apply them for spider mite control on ornamental plants. The tests were conducted on *Hedera helix* leaves. An effect of extracts on fecundity of *T. urticae* females as well as on their longevity was studied. The feeding index for spider mites on *Hedera helix* leaves treated with sage extracts and mortality of all developing stages were also estimated. Significant differences were found between fecundity of females feeding on leaves treated with sage extracts and water. Both extracts made of fresh and dry leaves of *Salvia* reduced by about 35-45% the total number of eggs produced by *T. urticae* females. The female longevity was reduced by about 25%. Activity of females feeding on ivy leaves was strongly affected by sage extracts. The feeding index for mites on leaves previously treated with extracts was 28-35% as compared to control leaves (treated with water). The mortality of preimaginal stages of *T. urticae* was highest on leaves previously treated with extract made of dry *Salvia* leaves, however, in the case of direct use of extracts on mites fresh leaves were more effective.

Key words: sage extracts, *Tetranychus urticae*, biology parameters, *Hedera helix variegata*

Abstract: A great tendency to interspecific predation on two indigenous species of phytoseiid mites was proved for *Neoseiulus californicus* in laboratory experiments. Within six weeks the predator completely displaced *Euseius finladicus* and *Typhloctonus tiliarum* even when primary prey (*Tetranychus urticae*) was abundant.

Key words: *Neoseiulus californicus*, releases, local fauna of phytoseiid mites

Abstract: The use of biological control in Québec ornamental greenhouses is limited by several constraints including structural problems and lack of resources. Despite these limitations, positive results have been achieved on a limited acreage in annuals, potted plants (hibiscus, poinsettia, orchids), cut flowers (roses), perennials, and interior plantscapes.

Key words: ornamental, biological control, Canada (Quebec), greenhouses, interior plantscapes

Abstract: Cabbage whitefly, *Aleyrodes proletella* (L.), has become a serious pest of various cabbage cultivars (in particular kale, Brussels sprouts, cauliflower, broccoli and savoy cabbage) in private garden complexes in The Netherlands. Since early 1999, it is causing some problems too in greenhouse grown gerbera crops (*Gerbera jamesonii*) in some parts of 'De Kring', near Rotterdam, the Netherlands. Occasionally, the strawberry whitefly, *Aleyrodes lonicerae* (L.), is found indoors as well. While evaluating non-target effects of exotic parasitoids released for the biological control of whitefly pests in greenhouses, we surveyed the parasitoid fauna of native *Aleyrodes* species outdoors and used them as test insects in our host specificity tests. An account is given on the whitefly species, their native and exotic natural enemies, prospects for biological control and non-target effects.

Key words: *Aleyrodes proletella*, *Aleyrodes lonicerae*, *Encarsia*, *Eretmocerus*, biocontrol, non-target

Abstract: Secondary parasitoids, or hyperparasitoids, have been excluded from releases in biocontrol programs as a standard procedure. Heteronomous hyperparasitoids – parasitoid females that lay eggs in larvae of the same or of other primary parasitoid species to produce male offspring – , however, have been included in biocontrol programs for whitefly pests, but with variable results. The impact these hyperparasitic strategies may have on biological control applications as well as on non-target organisms is evaluated. We suggest that the introduction of any hyperparasitoid, which parasitizes other beneficials, is acceptable or permitted only under strict conditions.

Key words: intraguild predation, hyperparasitism, *Encarsia*, biocontrol, non-target effects

Abstract: Over the past 30 years biological control of greenhouse pests has become a key component of sustainable horticulture in the world. In Europe, more than 100 natural enemy species have been imported and released for biological control of greenhouse pests and billions of exotic beneficials are produced, distributed and released seasonally or inundatively. Although no clear direct adverse effects have been found up till now, the potential non-target effects of these releases have been little emphasised. In this paper we summarise the current state of affairs with respect to selection procedures for importing, mass-rearing and releasing (new) exotic natural enemies. These will be based on protocols for risk assessment that are being developed within the EU funded project “Evaluating Environmental Risks of Biological Control Introductions into Europe” [ERBIC].

Key words: biological control, introductions, exotics, environmental risks, non-target effects

Abstract: Biological control has been used in France, on vegetables since 1980, and on ornamentals since 1988; the result is acceptable because the number of hectares (ha) reached in 2001 1752 for vegetables and 50 ha for ornamentals. This year, about forty-five

Key words: biotechnology, transgenic crops, biological control, IPM

Abstract: The data on the efficiency of biological preparations based on local strains of entomopathogenic fungi and bacteria against greenhouse pests are stated. The efficiency at different initial number of phytophages is studied.

Key words: biological control, greenhouse pests, two-spotted spider mite, *Tetranychus urticae*, greenhouse whitefly, *Trialeurodes vaporariorum*, entomopathogenic fungi, entomopathogenic bacteria, *Paecilomyces fumoso-roseus*, *Bacillus thuringiensis*

Abstract: Organic growing of chrysanthemums was continued for three years without using synthetic insecticides. A complex of 4 aphid species and Western Flower Thrips were the prevailing problems. The lack of natural insecticides for controlling these pests was the bottleneck for compiling a biological control program. Available botanical insecticides are not selective enough for being used in combination with natural enemies. Accepting new microbial insecticides would make organic production feasible for organic growers.

Key words: organic, chrysanthemum, pest, aphid, thrips

Abstract: Control of plant diseases in greenhouse crops is still largely carried out by chemicals. A number of microbial pesticides, however, have been developed and are starting to penetrate the market. An overview of the most important products is given. The development and success of these products are highlighted with regard to the market, the biopesticide industry and governmental factors with emphasis on registration.

The future prospects for microbial fungicides are discussed from the industry point of view.

Key words: biological control, biopesticides, commercialisation, disease, market, registration

Abstract: Short-term fecundity and survival of *Phytoseiulus persimilis* Athias-Henriot were determined on receipt of product from six commercial sources, and after rearing in the laboratory for 30 days (4 generations). In 5 day trials mean fecundity and survival on receipt were 1.6±0.09 eggs per female per day and 4.7±0.05 days, respectively (74% of the females survived to Day 5). After 30 days in laboratory cultures, these values were 1.7±0.12 and 4.2±0.11, respectively (62% of the females survived to Day 5). During lifetime trials, fecundity was about 4 eggs per female per day from Day 2 to 14 (days after mating), after which it declined steadily until Day 23. Survival was close to 100% for 6 days and then declined steadily to 0 at Day 26. The results of a simulation model incorporating these data suggest that there is a biological potential for improved efficacy against spider mites if fecundity and survival of *P. persimilis* released in a greenhouse were closer to that measured for young females.

Key words: *Phytoseiulus persimilis*, fecundity, survival, model, efficacy

Abstract: The influence of humidity on the infection level of the entomopathogenic fungus, *Beauveria bassiana,* was determined for three greenhouse pests (*Aphis gossypii*, *Trialeurodes vaporariorum* and *Frankliniella occidentalis*) using small-scale research and commercial greenhouse trials. The trials were conducted on greenhouse cucumber and tomato using the commercial formulation Botanigard ES. The bioassay method consisted of using screened cages to confine the sprayed insects to the bottom side of plant leaves and assaying the sprayed insects for infection levels of the fungus after various post-spray application periods. Greater infection levels occurred at the top of the crop canopy compared to the middle of the canopy. Infection levels ranged from 65-91% depending upon the pest species under humidity conditions of 64-81% RH in commercial production greenhouses.

Key words: *Beauveria bassiana,* greenhouse pests, humidity, greenhouse vegetables

Abstract: A combined experimental and modelling framework has been produced to allow rapid development of stochastic, spatially explicit models for biological control in ornamental crops. Application of this framework to the simulation of the dynamics of spider mites, *Tetranychus urticae*, and predatory mites, *Phytoseiulus persimilis*, has shown that the movement and dispersal of mites are crucial to the success of biological control. This paper describes the application of the novel technology of virtual plants to modelling of mite movement within the complex plant canopies associated with ornamental crops.

Key words: biological control, natural enemy, movement, dispersal, virtual plants

Abstract: A phytoseiid mite indigenous to Australia shows promise as an effective predator of thrips in warm greenhouse conditions. *Typhlodromips montdorensis* has a high rate of thrips consumption and intrinsic rate of natural increase, does not diapause under normal greenhouse conditions, colonises crops rapidly at temperatures over 20^{o}C, and operates effectively on a range of ornamental and vegetable crops. In Australia it has shown promise in chrysanthemum, gerbera, capsicum, strawberry and cucumber crops. It also has potential against broad mite and tomato russet mite. Information on biology, usage, sensitivity to pesticides and crop usage is detailed.

Key words: phytoseiid mite, thrips, integrated control

Abstract: Western flower thrips, *Frankliniella occidentalis* (Pergande), causes major losses in greenhouse cucumbers in Australia through leaf and fruit damage. A newly developed indigenous phytoseiid mite species, *Typhlodromips montdorensis* (Schicha) provided excellent control of both western flower thrips and onion thrips, *Thrips tabaci* Lindeman, when introduced into a cucumber crop at a weekly rate of $10/m^2$ over a seven-week period. Western flower thrips was detected in low numbers on yellow sticky traps but was essentially eliminated within six weeks. Maximum larval thrips population density (onion thrips) reached only 4/leaf on lower leaves, despite trap catches of as many as 40 adults/trap. Other pests were also controlled successfully by natural enemies, with no chemical intervention necessary.

Key words: cucumber, thrips, phytoseiid mites, integrated control

Abstract: Thrips annually cause major crop losses in field and greenhouse strawberry crops in several States in Australia. A three-year study has made good progress in establishing damage caused by thrips and action threshold levels, and in identifying phytoseiid mites that are effective against thrips within an IPM program. Western flower thrips, *Frankliniella occidentalis* (Pergande) and plague thrips, *Thrips imaginis* are the two most important species. In a hydroponic crop in the third year of study, targeted sprays of spinosad when thrips populations reached a level of 40% of flowers with 10 or more adult thrips has been effective in keeping fruit damage to below economic threshold levels. Only two applications were necessary in four months. This strategy was combined with releases of the native predatory mite *Typhlodromips montdorensis* (Schicha), which establishes good populations on strawberries under summer conditions. It was effective in maintaining low thrips numbers on fruit during mid to late summer. Environmental factors impacting on degree of damage were also determined.

Key words: strawberries, thrips, integrated control

Abstract: Mycostop was efficient against root rot in greenhouse ornamentals and vegetables and it did not differ in efficiency in comparison with Previcur. The study was done on species composition of micromycetes and their spreading in greenhouse substrate, reaction to chemical component propamokarb hydrochloride (Previcur 607 SL) and interaction with the antagonistic microorganism *Streptomyces griseoviridis* (Mycostop). Both chemical and biological treatments changed the number and composition of micromycetes in substrates. From infected and non-treated substrate there were isolated and identified 52 fungi species belonging to 28 genera. Most prevailing fungi species were from *Alternaria, Aspergillus, Cladosporium, Fusarium, Mucor, Penicillium, Pythium, Rhizoctonia* and *Verticillium* genera. The systemic fungicide Previcur reduced and inhibited the development and spreading of micromycetes in the substrate most efficiently. The biofungicide Mycostop suppressed many pathogenic fungi species. The similarity and disparity coefficient by Sörensen of microflora in comparison with the non-treated substrate is reliable: in tests with Previcur – 30.38%, with Mycostop – 38.04%.

Key words: cucumber, gerbera, root rot, soil-borne fungi, Sörensen coefficient, *Streptomyces griseoviridis* (Mycostop), propamokarb hydrochloride (Previcur)

Abstract: Denmark was one of the first European countries to implement biological control in ornamentals starting in 1987 with the introduction of *Verticillium lecanii* in cuttings. In 2001 the number beneficial organisms had increased to about 50-60 biological products. Today biological control is used on 30-35% of the area producing ornamentals. The complex pest-system in ornamentals makes a demand for a large range of biological/integrated solutions and more beneficial species are sought for to solve specific pest problems. Two new candidates in ornamentals, the ladybird *Stethorus punctillum* and the gallmidge *Feltiella acarisuga*, may have a promising potential in ornamentals. Factors influencing successes and challenges in Danish ornamentals are discussed.

Key words: biological control, integrated control, ornamentals, interactions, monitoring, successes, challenges, monitoring, new beneficials, *Stethorus punctillum, Feltiella acarisuga*, Denmark

Abstract: The functional response of the predatory bug *Macrolophus caliginosus* to the twospotted spider mite *Tetranychus urticae* was studied. Adults and nymphs of the predator were offered increasing numbers of spider mite deutonymphs or adults. The number of attacked mites increased when prey density increased. The predation rate at high prey densities was very high. When *T. urticae* and *Trialeurodes vaporariorum* preys are offered simultaneously to *M. caliginosus* females, the latter attack proportionally more spider mites than whitefly larvae at any proportion of the 2 prey species. The high predation rate and the affinity of *M. caliginosus* for *T. urticae* in the presence of greenhouse whitefly larvae may explain why *T. urticae* populations in greenhouse tomatoes are not able to expand, when growers use the predatory bug for whitefly control.

Key words: *Macrolophus caliginosus, Tetranychus urticae, Trialeurodes vaporariorum*, functional response, prey preference

Abstract: An overview is given of experiences with IPM in nursery stock in The Netherlands. So far, the most important use of natural enemies are the entomophagous nematodes *Steinernema* spp. against Sciaridae and *Heterorhabditis* spp. against the black vine weevil. On a smaller scale the predatory mites *Amblyseius californicus* and *Phytoseiulus persimilis* are being introduced against spider mites, and *Aphidius* spp., *Aphelinus* spp. and *Aphidoletes aphidimyza* against aphids. In outdoor crops natural control is of more importance. Other experiences are reviewed and some future expectations are outlined. The experience with biological control in glasshouses and the observation of natural control in crops outdoors seems of mutual benefit.

Key words: pests, diseases, integrated control, natural enemies

Abstract: Trials in spring bedding plant crops in 2000 and 2001 in Massachusetts and New York commercial greenhouses measured the ability of *Neoseiulus* (*Amblyseius*) *cucumeris* to control western flower thrips, *Frankliniella occidentalis*. In 2000, the effect of formulation (mites in bran vs. sachets) was examined at three businesses. At all three sites, we found that sticky card catches of adult thrips were lower in greenhouses receiving mites formulated in bran vs. sachets. In 2001, we compared western flower thrips densities in greenhouses in which *N. cucumeris* releases were made either via hand application (sprinkle) of mites formulated in bran or mechanical application of the same material with a battery powered air blower ("mite gun"). Results suggested that the two application methods did not differ in their ability to suppress thrips populations.

Key words: western flower thrips, predacious mites, formulation method, application method, *Neoseiulus* (*Amblyseius*) *cucumeris, Frankliniella occidentalis*, biological control, bedding plants

Abstract: Greenhouses are susceptible to invasions from local species pools. Some such invaders have characteristics permitting them to be moved readily by the shipment of plant materials between businesses within the greenhouse industry, allowing species to become internationally distributed pests, sometimes in relatively brief periods. Such new pests disrupt pest control systems and require new responses. Greenhouse operators need to predict, prevent and remediate such invasions by deliberate collective action. Prediction should flow from crop-specific, country-specific inventories of current greenhouse pests to identify pests of greenhouse crops still confined to local areas, but which have features conducive to further spread. Prevention should be fostered by

development of sophisticated, web-based identification systems focused on the high risk potential invaders identified in the prediction phase. Remediation requires application of classical biological control, an approach not familiar to greenhouse operators. This approach requires search for new natural enemies in the native ranges of new pests, study of host ranges of new agents, obtaining legal permissions for release of new agents in multiple countries, and finally development of systems for production of new species. Production of some species will be uneconomical for insectaries, but might be achieved through mutual aid networks of entomologists at conservatories and other facilities. These activities require the development of a new body, an international consortium of greenhouse operators, which can pool contributions of member businesses and hire staff with appropriate technical expertise to conduct the activities mentioned above. Such a coordinated effort to confront invasive species in greenhouses is likely to be more effective than the current fragmented system of local response.

Key words: greenhouses, invasive species, prevention, forecasting, classical biological control

Abstract: In the past 30 years many exotic natural enemies have been imported, mass reared and released as biocontrol agents for greenhouse pests. Negative effects of these releases for greenhouse biological control have not been reported yet. The current popularity of biological control may, however, result in problems, as an increasing number of projects will be executed by persons not trained in identification, evaluation and release of biocontrol agents. Therefore, a working group of OECD is developing a guidance document for registration requirements of exotic natural enemies. This guidance document is based on protocols for risk assessment that are being developed within the EU project "Evaluating Environmental Risks of Biological Control Introductions into Europe" [ERBIC]. In this paper, the state of affairs concerning these developments is summarized.

Abstract: Ten different predators: *Franklinothrips vespiformis*, *Franklinothrips orizabensis*, *Amblyseius limonicus*, *Macrolophus caliginosus, Orius laevigatus, Orius majusculus, Aeolothrips tenuicornis*, *Dicyphus hesperus, Geocoris punctipes* and *Chrysoperla carnea* were tested as potential biological control agents against *Echinothrips americanus.* All predators had their impact on the thrips population, however *M. caliginosus* had the strongest and most long lasting effect. This corroborates with field observations that growers who use *M. caliginosus* never have problems with *E. americanus.* The 50% survival of *E. americanus* at 5 and 10 degrees was one and three weeks, respectively. This indicates that a good sanitation between crop change is very important.

Key words: *Echinothrips americanus*, *Franklinothrips vespiformis*, *Franklinothrips orizabensis*, *Amblyseius limonicus*, *Macrolophus caliginosus*, *Orius majusculus*, *Aeolothrips tenuicornis*, *Dicyphus hesperus, Geocoris punctipes*, *Orius laevigatus*, *Chrysoperla carnea*, sweet pepper, survival

Abstract: *Neoseiulus cucumeris* is the most commonly used thrips predator in greenhouses, despite that it may not be the best option on all crops. We tested the performance of this mite against the Western Flower Thrips (WFT) on cut roses in spring/summer conditions of Finland. Biweekly application rates of 1000-2000 predators per m^2 (from controlled release sachets, or CRS) in four 38 m^2 greenhouse compartments in May-September resulted in a cumulative flower crop (Escimo) that was 72-89% free of thrips damage in three compartments of four. In a commercial greenhouse, predators applied

Abstract: Recent studies about life history and predation of Japanese indigenous *Orius* spp. are reviewed in relation to their mass rearing and evaluation of their potential for biological control of thrips. *O. sauteri* has been studied in detail. The minimum amount of *Ephestia kuehniella* eggs to rear one individual of *O. sauteri* from egg to adult emergence and for oviposition and adult survival was estimated as fundamental information for economic rearing. Life history studies of *O. sauteri* suggest that it cannot control thrips effectively under low temperature or short photoperiod. Another species, *O. strigicollis*, which shows low diapause incidence, is preferred for commercial use.

Key words: *Orius* spp., life history, predation, mass rearing, thrips, biological control