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Eotetranychus carpini: biological control experiments in Tuscan vineyards (Italy)

Marisa Castagnoli, Marialivia Liguori, Sauro Simoni, Giuseppino Sabbatini Peverieri, Donatella Goggioli, Silvia Guidi, Franca Tarchi 1-7

Abstract: Infestations of *Eotetranychus carpini* (Oud.) have increased during recent years in organic as well as IPM vineyards in large, high quality wine producing areas of central Tuscany. We report a triennial experiment, attempting to re-establish a large population of phytoseiids in these vineyards, in order to achieve biological control of the tetranychid pest. Three generalist phytoseiids were compared: a commercialized strain of *Neoseiulus californicus* (McGregor), a laboratory strain of *Typhlodromus exhilaratus* Ragusa and a wild strain of *Kampimodromus aberrans* (Oud.). The phytoseiid species were released on selected vineyards at the highest level suggested in the literature and/or by the producer. *Kampimodromus aberrans* was introduced once per year, when the vines were still dormant (90-180 specimens/tree); *N. californicus* and *T. exhilaratus* were repeatedly released with a density of 80-180 specimens/plant, on an annual basis. Both released populations of *T. exhilaratus* and of *N. californicus* showed great difficulty in colonizing the vineyard. On the contrary, the release of *K. aberrans* during winter, on pruned branches from donor vineyards, was the most convenient strategy in controlling *E. carpini* in the Val d’Orcia. A single high density release was sufficient to establish the species, which limited *E. carpini* outbreaks for two years after the release. Minimal releases of *K. aberrans* carried out in the third year of the experiment gave promising results. A longer time is needed to verify if minimal releases will allow the establishment of the phytoseiid sufficiently to achieve long-term tetranychid control.

Application of pollen for promotion of predatory mite populations in protected basil

Einat Adar, Moshe Inbar, Eric Palevsky 8

Abstract only

Integrated control of bulb-scale mite (*Steneotarsonemus laticeps*) in *Narcissus*

Rosemary Collier, Gordon Hanks, Malcolm Millar 9

Abstract: About 4,000 ha of *Narcissus* are field-grown in the UK, producing an annual saleable output of about 30,000t bulbs and 600m cut-flowers, of which perhaps 30% of bulbs and 40% of flowers are exported. Of three important pests that infest *Narcissus* from time to time, bulb-scale mite (*Steneotarsonemus laticeps* (Halbert)) has received least attention to date.

While symptoms due to *S. laticeps* rarely cause concern in field-grown bulbs or in storage, temperatures in glasshouses, where *Narcissus* bulbs are forced for cut-flowers and grown as pot-plants, favour rapid pest multiplication, resulting in damaged, distorted leaves and stems. There are no approved acaricides to control *S. laticeps* in glasshouse *Narcissus*, or when bulbs are stored, and other than hot-water treatment, there is no non-chemical means of control. The aim of our project is to develop an integrated control strategy for *S. laticeps* based on an understanding of its biology and ecology. It is a collaborative project between the UK government and the horticultural industry and the project consortium includes a number of UK *Narcissus* growers.

The project has several specific objectives. The first is to determine the relationship between the development of *S. laticeps* infestations and temperatures, in order to define the conditions that most favour mite development and reproduction, and to determine whether very low or very high temperatures cause mite mortality. A further objective is to discover how *S. laticeps* originates and spreads in field crops and in bulb storage and thereby determine how

infestations move from crop to crop. Mites may move from bulb to bulb by themselves, either in the field or when harvested bulbs are stored, or they may be transported passively, for example, by winds or by other animals (e.g. insects such as the large narcissus fly (*Merodon equestris*)).

We are examining a number of physical and chemical approaches to mite control and these include the use of acaricides and high- or low-temperature treatments. Although extreme temperatures may kill mites, it is important that the bulbs themselves are unaffected and that their quality is not impaired. We are also considering the options for biological control. We hope to provide *Narcissus* growers with an effective integrated strategy for control of *S. laticeps* that will have minimal impact on the environment.

- Resistance in *Carica papaya* L. Cv. Maradol to the mite *Eotetranychus lewisi* (McGregor) induced by the herbivory of *Estigmene acrea* (Drury)
 Martha E. de Coss, Alexander E. Reyes, Mario E. Cabrera, Rodolfo Flores,
 Leopoldo Cruz 11-12

Abstract only

- Relationships between plant pathogenic fungi and mites in vineyards: implications for IPM
 Carlo Duso, Alberto Pozzebon, Paola Tirello, Mauro Lorenzon, Diego Fornasiero 13-27

Abstract: In this paper we summarize the results of studies aimed at investigating the relationships between fungal diseases and mites occurring in European vineyards. Most of the data originated from observations carried out in commercial and experimental vineyards in north-eastern Italy. Grapevine downy mildew, *Plasmopara viticola*, and grape powdery mildew, *Uncinula necator*, are the most significant grape diseases in several viticultural areas in Europe and throughout the world. The spread of downy mildew in European vineyards may increase the abundance of some species of Phytoseiidae and Tydeidae. *Amblyseius andersoni* responded clearly to the spread of downy mildew symptoms, an effect also observed, but at lower magnitudes, for *Typhlodromus pyri* and *Kampimodromus aberrans*. The beneficial effect of downy mildew on the survival, development and reproduction of phytoseiids and tydeids has a clear impact on their population dynamics. Downy mildew effects varied among phytoseiids, being more relevant for *A. andersoni* than for *T. pyri*. These interactions may have implications for IPM because *T. pyri* is more effective than *A. andersoni* in controlling phytophagous mites in vineyards. The role of powdery mildew as a food source for *A. andersoni* and *T. pyri* was less pronounced than that of downy mildew. The capacity of generalist predatory mites to persist in perennial ecosystems contributes to the successful biological control of phytophagous mites. In vineyards, the persistence of generalist predators in the absence of prey may be improved by their feeding on various food sources. Pollen is probably the most important food source in spring and early summer, whereas mildews increase in importance in late summer. Predatory mite persistence is largely affected by pesticide use. The results of our studies showed that downy mildew availability mediates the effects of fungicides on predatory mites because it represents an alternative food for them. Moreover, downy mildew can enhance the recovery of predatory mite populations after pesticide applications.

- Comparative effectiveness of *Phytoseiulus persimilis* and *P. longipes* in the control of *Tetranychus urticae* on strawberries and roses
 Hans Hoogerbrugge, Yvonne van Houten, Markus Knapp, Karel Bolckmans 29-33

Abstract: The effectiveness of *Phytoseiulus persimilis* and *Phytoseiulus longipes* in the control of *Tetranychus urticae* on roses and strawberries was compared in small cage trials. Release of both predatory mite species led to a significant reduction of the spider mite population. The number of cumulative spider mite days was not significantly different between the two phytoseiid species. However, the population development during the experiment indicated that *P. persimilis* was able to control *T. urticae* slightly faster than *P. longipes*.

- Effect of physiochemical features of different species or cultivars of host plants on the foraging behavior of *Scolothrips longicornis*
Neda Kheradpir, Mohammadreza Rezapanah, Karim Kamali and Yaghoub Fathipour 35-40

Abstract: There is increasing evidence that host plant features can be used as reliable indicators for the location behavior of natural enemies. The predaceous thrips *Scolothrips longicornis* Priesner was used in two release and recapture tests on different host plants, infested by spider mites and clean, and on various cultivars of cucumber, in order to identify its ability to discriminate host plants according to their features under greenhouse condition. The response of the predaceous thrips toward different plants was highly significant and the infested cucumber attracted the most predators; on the other hand, the responses of *S. longicornis* were similar towards eight tested cultivars of cucumber. It was concluded that the predator locates spider mite colonies by host plant signals and has the ability to recognize different host plant species, a finding that should be considered in IPM programs against spider mites when using this predaceous thrips.

- Compatibility of *Amblyseius swirskii* with UV-absorbing nets
Saioa Legarrea, Alberto Fereres, Phyllis G. Weintraub..... 41-43

Abstract: Releases of *Amblyseius swirskii* effectively control the population of the broad mite *Polyphagotarsonemus latus* (Banks) in sweet pepper crops. In the context of an IPM strategy in protected crops, the release of natural enemies joins other tactics like the use of UV-photosensitive covers. However, the effect of these materials on predators still remains unknown. In this study, a choice experiment was designed to test whether UV-absorbing covers negatively affected the mite dispersal behaviour. Over fifty eight percent of the mites were found in the plant placed under the UV-absorbing net showing the compatibility of both IPM tools.

- Notes on the phenology and the biology of *Tydeus caudatus* Dugès (Acari Tydeidae)
Mauro Lorenzon, Alberto Pozzebon, Carlo Duso 45-49

Abstract: Knowledge on the biology and ecology of the Tydeoidea is limited. Regarding feeding habits, tydeids appear as an unspecialized group. of the families Tydeidae and Iolinidae are frequently observed in vineyards associated with eriophyid Members mites, and feeding on pollen or fungi has also been reported. *Tydeus caudatus* Dugès is one of the most common tydeid species occurring in Italian vineyards. *Tydeus caudatus* populations can persist and increase in vineyards when eriophyid levels are low, suggesting that its diet includes non-prey food sources. In this paper, the suitability of pollen and grape downy mildew as food sources for *T. caudatus* has been explored. Some findings on the phenology of *T. caudatus* in vineyards are also reported.

- Biological control of the old world date mite, *Oligonychus afrasiaticus*, using indigenous predatory mites in the Southern Arava Valley of Israel
Alon Lotan, Eric Palevsky, Ido Izhaki 51-52

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- The spider mite *Neotetranychus rubi* (Träg.) a potential prey for the predatory mite *Amblyseius andersoni* (Chant)
Valeria Malagnini, Alberto Grassi, Romano Maines, Gino Angeli, Claudio Ioriatti, Carlo Duso 53-55

Abstract: The spider mite *Neotetranychus rubi* is a phytophagous mite common on raspberries in north-eastern Europe. Recently it has been detected in northeastern Italy on commercial raspberries. The predatory mite *Amblyseius andersoni* can keep *N. rubi* populations at low levels during spring but not during summer when *A. andersoni* seems to prefer the two-spotted spider mite *Tetranychus urticae*. The aim of this study was to evaluate the role of *N. rubi* as a prey for *A. andersoni* as compared to *T. urticae*.

- Integrated pest management of *Oligonychus perseae*: developing action thresholds and the identification and conservation of natural enemies
 Yonattan Maoz, Eric Palevsky, Shira Gal, Miriam Zilberstein, Michael Noy, Yehonatan Izhar, Jonathan Abrahams Samuel Gan-Mor, Moshe Coll 57-60
- Abstract:** Since its entry in 2001, the perseae mite, *Oligonychus perseae*, has become a primary pest of avocado in Israel. Field trials over three consecutive growing seasons were conducted to develop an action threshold for the pest. To identify its indigenous predators and to evaluate methods for their conservation, we monitored populations in orchards and performed trials in three spatial scales: in Petri dishes, on seedlings and in the field. We found that mite populations caused significant foliar damage. Mean tri-annual yield was reduced by 20% when mite populations were high (≥ 250 mites/leaf) in comparison to yields attained when plots were sprayed at a threshold of 50-100 mites per leaf. *Euseius scutalis* was by far the most abundant predatory mite species in Israeli avocado orchards. Laboratory experiments in Petri dishes and on seedlings showed that it significantly reduced adult perseae mite populations. In the seedling experiment and in the field we also found that conservation of this predator through the provisioning of supplemental food (i.e. maize pollen) substantially increased *E. scutalis* populations and enhanced perseae mite control. In addition to *E. scutalis*, we found four generalist insect predators that fed upon and ripped open the nests of perseae mite. The high proportion of torn nests found in the field suggests that these predators are important contributors to the control of the perseae mite.
- The two-spotted mite *Tetranychus urticae* Koch (Acari: Prostigmata) on citrus
 Clementine groves: seasonal trends and control strategies
 María Teresa Martínez-Ferrer, José Miguel Campos, José Miguel Fibla 61
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- The Phytoseiidae in biological control: relevance of taxonomic classification and life style categorization
 James A. McMurtry 62
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- Whitefly-induced plant defences in cucumber and their impact on biological control of spider mites
 Gerben J. Messelink, Arne Janssen 63
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- Failure of methyl bromide fumigations to exterminate mites present on grapes exported to Mexico from Chile
 Gabriel Otero-Colina, Francisco Ramírez y Ramírez, Héctor Enrique Vega Ortiz 64
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- Mutual interference of *Scolothrips longicornis* Priesner (Thysanoptera: Thripidae) with *Tetranychus urticae* Koch (Acari: Tetranychidae)
 Hajar Pakyari, Yaghoub Fathipour 65-68
- Abstract:** The mutual interference of the predatory thrips *Scolothrips longicornis* Priesner on the two-spotted spider mite, *Tetranychus urticae* Koch was studied in 24 h time period at $26 \pm 1^\circ\text{C}$, $60 \pm 5\%$ RH and a photoperiod of 16:8 L:D h. Nicholson's model and linear regression were used to determine per capita searching efficiency and interference coefficient, respectively. The per capita searching efficiency decreased significantly from 0.0397 to 0.0247 as the predator densities increased from one to sixteen. Therefore, different densities of the predator (intraspecific competition) could affect the efficacy of *Scolothrips longicornis*.

- Predator-prey dynamics and strategies for control of the red palm mite (*Raoiella indica*) (Acari: Tenuipalpidae) in areas of invasion in the Neotropics
 Jorge E. Peña, Jose Carlos V. Rodrigues, Amy Roda, Daniel Carrillo and Lance S. Osborne 69-79
- Abstract:** The red Palm mite, *Raoiella indica* (Acari: Tenuipalpidae) invaded the new world around 2004 and is now reported from the Caribbean islands, Florida, USA and northern South America (Venezuela). Surveys to determine generalist fauna prior to its arrival during the end of 2007 in Florida, reported the predators *Amblyseius largoensis*, *Stethorus utilis*, *Chrysoperla* spp., *Aleurodothrips fasciapennis* and *Bdella distincta* in association with diaspidids, aleyorids and tetranychids. Predator density increase was not observed until 6 months after the arrival of *R. indica* in Florida. Studies on predator composition after the initial detection in 2006 of *R. indica* in Trinidad and Tobago, indicated that the predaceous mite, *A. largoensis* increased its densities as the red palm mite grew and spread to new locations. Other reported predators were *A. fasciapennis*, *Bdella* spp., *Cheletomimus* sp., and species of the families Cecidomyiidae and Chrysopidae. *Amblyseius largoensis*, while preying on the red palm mite in Puerto Rico, has not substantially reduced the high numbers of *R. indica*. Studies to find exotic and more effective predators of the red palm mite should be intensified.
- The association between the red palm weevil *Rhyncophorus ferrugineus* (Olivier) and its phoretic mites: *Centrouropoda almerodai* Hiramatsu & Hirschmann and *Uroobovella (Fuscuropoda) marginata* (Koch)
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- How homogeneous are *Tetranychus urticae* populations in citrus orchards?
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- Spider mite control in California vineyards with conventional acaricides
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- Multiple predators, intraguild interactions and biological control of a single spider mite species
 Maurice W. Sabelis, Rachid Hanna, Alexis Onzo, Angelo Pallini, Ibrahim Cakmak and Arne Janssen 83-94
- Abstract:** To test whether biological control of spider mites is promoted by the use of multiple instead of a single predator species, experiments have been published that employed either an additive design (initial density of each predator is kept constant) or a replacement design (initial density of all predators together is kept constant). The variable under test is usually some measure of pest abundance. We argue that such tests are not always adequate to infer positive or negative effects among multiple predator species and their impact on the pest. Instead, there is a need for experiments elucidating predator-predator interactions and their impact on the pest at a mechanistic level, using a series of experiments ranging in focus from the individual level to the population level, from the laboratory to the field, from short-term to long-term and from small scale to large scale. To illustrate this, two experiments will be discussed, the first based on a replacement design and the second on an additive design: (1) Combined releases of *Phytoseiulus persimilis* and *Neoseiulus californicus* for control of spider mites on strawberries in Turkey, and (2) Predator removal with respect to established populations of *Typhlodromalus aripo* and *Amblydromalus (Typhlodromalus) manihoti*, which are supposed to control green mites on cassava in Africa. These examples show that microhabitat specialization of the predators in the field reduces negative effects of intraguild predation among predator species and promotes their synergistic effect on pest suppression.

Comparative repellent effects of different acaricide residues to predatory and spider mites. Is there a need for including behavior into standardized testing methods?

Francisco J. Sáenz-de-Cabezón Irigaray, Frank G. Zalom 95-98

Abstract: Pesticides can increase the risk of pest outbreaks by promoting dispersal. Different formulations of active ingredients (Kanemite®, Zeal®, Oberon®, Acramite® and Fujimite®) were tested for irritancy effects on three species of predatory mites: *Phytoseiulus persimilis* Athias-Henriot, *Galendromus occidentalis* (Nesbitt) and *Neoseiulus fallacis* (Garman) (Acari, Phytoseiidae) and two species of spider mites *Tetranychus urticae* Koch and *T. pacificus* McGregor (Acari, Tetranychidae). Measured by a choice experiment of treated and untreated disk leaves offered to adult female mites, all species responded to the pesticide residues tested except for Zeal. Responses among species differed for several of the pesticides tested. Dispersal in species with high population rates of increase, like spider mites, can result in pest outbreaks in unstable environments such as agricultural production systems. The inclusion of behavior into standardized testing would increase the predictability of pesticide effects.

Spatial refuge use by herbivorous mites poses major challenges for biological control

Peter Schausberger 99-100

Abstract: Plant morphological traits such as size, architecture, leaf shape, surface waxes, thorns, domatia or trichomes are known to strongly influence herbivorous insects and mites and their natural enemies, predators and parasitoids. Plant morphological traits may have direct and/or indirect (i.e., mediated by third organisms), positive or negative effects on plant-inhabiting arthropods at the individual, population and community levels. Here, I focus on plant-inhabiting mites and show how plant micro-habitat morphology may affect herbivore-predator interactions. In particular, I emphasize the challenge posed to biological control when herbivorous mites use plant morphological structures as spatial refuges from competitors and predators (Jeffries & Lawton, 1984; Hawkins *et al.*, 1993). The first example (Koller *et al.*, 2007) deals with the interaction between tomato plants, the spider mite *Tetranychus evansi* (Tetranychidae) and the predatory mite *Neoseiulus californicus* (Phytoseiidae). Tomato plants may directly defend themselves against herbivores via chemistry and surface glandular trichomes (Kennedy, 2003). However, some herbivores such as *T. evansi* overcome the plant defense mechanisms and specialize on tomato, possibly to benefit from enemy-free space. Our study suggests that tomato provides *T. evansi* a two-pronged protection from their natural enemy, *N. californicus*, because tomato exerts direct and indirect, prey-mediated, negative effects on the predators. Along the same line, the second example (Lawson-Balagbo *et al.*, 2007a; Negloh *et al.*, 2009) suggests that the tiny coconut mite *Aceria guerreronis* (Eriophyidae) uses the tight space between the perianth and the surface of coconut fruits as a refuge from competitors and predators. Natural enemies of the coconut mite such as the predatory mites *Neoseiulus paspalivorus*, *N. baraki* (Phytoseiidae) and *Proctolaelaps bickleyi* (Ascidae), which are commonly present on coconut trees and perform well with *A. guerreronis* as prey (Lawson Balagbo *et al.*, 2007b, Negloh *et al.*, 2008), have difficulties to access the space beneath the perianth due to their large size. Body size constraints lead to asynchronous colonization of the chambers beneath the perianth by the tiny herbivore and their larger predators, allow *A. guerreronis* a head-start in population build-up and interfere with its natural control. I argue that spatial refuge use by *T. evansi* and *A. guerreronis* is a key issue for their currently insufficient natural and biological control.

Neoseiulus californicus and *Beauveria bassiana*: a proficuous coexistence?

Sauro Simoni, Silvia Guidi, Franca Tarchi 101

Abstract only

Demographic testing reveals complex effects of pesticides on biological control of Pacific spider mite (*Tetranychus pacificus*) by the western predatory mite (*Galendromus occidentalis*) on grape plants

Menelaos C. Stavrinides, Nicholas J. Mills 102

Abstract only

Classical biological control of the red palm mite (*Raoiella indica*): area of origin and preliminary surveys

Bryony Taylor 103-105

Abstract: Red palm mite (RPM) has recently become a serious pest of palms and other ornamentals in the Caribbean and eastern USA. A classical biological control project has been set up to examine the potential of using specialised natural enemies. The first stages of the project have focussed on the assessment of host plant relations as a basis to understand likely area of origin and on the design of preliminary surveys for natural enemies. The centre of diversity for the majority of the host plant families points towards the floristic province known as Malesia, which encompasses the Malay peninsula, Indonesia, New Guinea and The Philippines. Based on this, preliminary surveys for the RPM and natural enemies have been set up in Indonesia, Malaysia and Papua New Guinea. Surveys for natural enemies have also been set up in India where the commonly reported hosts *Cocos nucifera* and *Areca catechu* have been naturalised for over 1000 years.

Phytoseiid mites associated with forest trees in two “Natura 2000” locations: S.

Adriano woods (Sicily) and Fraktò virgin forest (Greece)

Haralabos Tsolakis, Salvatore Ragusa 106

Abstract only

Oviposition behavior of *Phytoseiulus persimilis* facing the risk of intraguild predation

Andreas Walzer, Peter Schausberger 107-112

Abstract: Natural selection should favor females that are able to avoid oviposition where predation risk on offspring is high. In natural and biological control systems ovipositing females are often confronted with several predators that represent differing threats posed to the offspring. The threat-sensitive predator avoidance hypothesis predicts that such females should be able to assess the degree of predation risk and perform graded anti-predation behavior such as selective spatial oviposition. We tested this hypothesis within a guild of spider mite predators consisting of adult *Neoseiulus californicus* and *Amblyseius andersoni* females as intraguild (IG) predators of *Phytoseiulus persimilis* immatures as IG prey. First, we determined the predation risk for *P. persimilis* larvae confronted with *A. andersoni* or *N. californicus* females. Second, prey patch and oviposition site selection of naïve and experienced *P. persimilis* females (reared in absence or presence of the IG predators) were evaluated when having the choice between a prey patch with only spider mites and a prey patch with spider mites and eggs of either *N. californicus* or *A. andersoni*. *Amblyseius andersoni* females were more aggressive against *P. persimilis* larvae than *N. californicus*. Consequently, prey patches containing eggs of *A. andersoni* or *N. californicus* were considered high risk and low risk prey patches for *P. persimilis*. Irrespective of low or high risk, *P. persimilis* females preferred predator free prey patches and avoided oviposition in prey patches with IG predator eggs. However, experienced *P. persimilis* females showed a graded IG oviposition avoidance behavior. Their oviposition preference for predator free prey patches was more pronounced in the high risk situation than in the low risk situation. We discuss the potential implications of these findings for biological control.

Predator cues induce behavioral shifts in alternative prey: consequences for prey life history traits and its host plant

Andreas Walzer, Peter Schausberger 113-117

Abstract: The ability to kill much prey per time unit is an important selection criterion for potential new biological control agents. Efficient predators are expected to reduce the population densities of herbivorous pests by killing and consuming them, which keeps the host plants green. These predator–prey and predator–plant interactions are termed direct and indirect density-mediated interactions. Another set of interactions among predator, prey and plants are called direct and indirect trait-mediated interactions: predators induce shifts in prey behavior and life history, which in turn influence the host plant of the prey. Although theory predicts that trait-mediated interactions can similarly trigger top-down trophic cascades on the basal resource as density-mediated interactions do, trait-mediated effects of biological control agents on herbivorous pests and crops have been largely ignored. Here, we report about direct and indirect

trait-mediated interactions among a generalist predator (*Neoseiulus californicus*), an alternative prey (the western flower thrips *Frankliniella occidentalis*) and its host plant. We show that the presence of predator eggs alters thrips behavior and negatively affects thrips survival and development. Moreover, the mere presence of predator eggs reduces leaf damage caused by thrips. The latter result indicates a positive trophic cascade.

Novel application of pollen to augment the predator *Amblyseius swirskii* on greenhouse sweet pepper

Phyllis Weintraub, Sophia Kleitman, Rafi Mori, Samuel Gan-Mor, Liana Ganot, Eric Palevsky 119-124

Abstract: It has been demonstrated for a number of predators and parasitoids, that the addition of pollen and/or nectar as a supplementary diet improves the efficacy of pest control. Until now these studies have always been small trials and have involved manual application of pollen. We have developed a hand-held prototype electrostatic pollen applicator with a viscosity enhancer (EPAVE) that is composed of a feeder, blower, charging system and fine droplets generator for the application of pollen to greenhouse plants. The study system for this work consisted of the generalist predator *Amblyseius swirskii* and the pests *Frankliniella occidentalis* and *Tetranychus urticae* on sweet pepper. In potted plant trials we demonstrated that *A. swirskii* can establish and thrive on seedling pepper plants when the only source of food is corn pollen; the effect of corn pollen allowed predators to produce significantly more eggs, nymphs and adults than *A. swirskii* released in bran only. In the field trials there were clear trends between treatments; more predators and fewer pests were found in the pollen treatments. These trials clearly show that our patented EPAVE delivers pollen to greenhouse peppers in such a way that *A. swirskii* can establish and control pests. Future work will be directed to optimizing the quantity of pollen delivered and application timing.

Effect of host plant on the functional response of *Orius albidipennis* (Hemiptera:

Anthocoridae) to *Tetranychus urticae* (Acari: Tetranychidae)

Abbas Ali Zamani, Shabnam Vafaei, Reza Vafaei, Shila Goldasteh, Katayoon Kheradmand 125-129

Abstract The effect of host plants on the functional response of *Orius albidipennis* (Hemiptera: Anthocoridae) to six different densities (2, 4, 8, 16, 32, 64 and 128 mites per leaf) of *Tetranychus urticae* (Acari: Tetranychidae) on three varieties of soybean (Gorgan, DPX and Williams) was investigated in Petri dishes in an incubator at 25±1°C, 65±5% HR and 16L:8D h. All dishes were checked for predation activity after 24 hours. The handling times and attack coefficients of the type II response were estimated using Holling's disc equation (Holling, 1959) and Roger's random attack equations. The highest theoretical maximum predation rate was estimated on DPX variety (about 80). Handling time (T_h) for the bug ranged from 0.005±0.002 to 0.012±0.003 days, recorded for the varieties DPX and Williams, respectively. Using Holling type II model, the R^2 values were 0.80, 0.88 and 0.78 for Gorgan, DPX and Williams, respectively. The type III functional response model generally fit the data better than type II, based on the R^2 values obtained in our investigations.

***Aceria carvi* – potential threat for caraway production in Europe?**

Rostislav Zemek, Erja Huusela-Veistola 131-134

Abstract: The cropping area of caraway in Europe has increased substantially during the past few years. *Aceria carvi* Nal. is one of the major pests of this crop occurs in most countries where caraway is grown. Since there is no effective way of controlling this mite pest, the expansion of caraway area together with changes in climate can bring about serious problems. Therefore, the need to fill in gaps in our knowledge of this serious pest is all the more urgent.