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EFFECT OF POLLEN FROM DIFFERENT PLANT SPECIES ON DEVELOPMENT OF *Typhlodromus pyri* (Sheuten) (Acari: Phytoseiidae)

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ABSTRACT

Typhlodromus pyri (Sheuten) (Acari: Phytoseiidae) is a phytoseiid mite with a high potential in controlling the false Chilean mite (*Brevipalpus chilensis* Baker; Acari: Tenuipalpidae). The purpose of this study was to determine the effect of different plant species pollen as a complementary food in the development of *T. pyri* when its prey is in low levels of availability. Mites were individually placed on black plastic boxes with pollen and maintained at a temperature of 26 ± 2 °C, 70 ± 5% relative humidity (RH), and a photoperiod of 16:8 h (L:D). Postembryonic development of *T. pyri* was studied in 11 pollen species, as well as in a mixed diet of *Hirschfeldia incana* (L.) and *B. chilensis*. Results show that *H. incana* was the only pollen in which there was no mortality ($P > 0.05$) along with the control (*Oxalis pes-caprae* L.). Mean duration from egg to adult with *H. incana* was 8.70 ± 1.66 d, protonymph 3.27 ± 0.21 d, and deutonymph 2.90 ± 1.45 d ($P > 0.05$). The mix feeding of *T. pyri* did not show any significant differences neither in the mean time from egg to adult, nor in mortality by feeding only with *B. chilensis*. Survival curves of *T. pyri* fed only with *H. incana* pollen, combined with *B. chilensis*, and only with *B. chilensis* are higher in the first 14 d of life. The sex ratio was not significantly affected by being fed only with *H. incana* pollen, *B. chilensis*, or by a combination of both.

Key words: phytoseiid mite, complementary food, *Hirschfeldia incana*, *Brevipalpus chilensis*, survival curve.

INTRODUCTION

Typhlodromus pyri (Scheuten) (Acari: Phytoseiidae) is a predatory mite adapted to a great diversity of agroecosystems and their surrounding vegetation (Prischmann *et al.*, 2002; Hardman *et al.*, 2006). Male and female development of this predator has been detected in Chile on *Brevipalpus chilensis* Baker (Acari: Tenuipalpidae) in vineyard (*Vitis vinifera* L.), reason why it could adapt to climatic conditions of other productive zones of the country (Ragusa and Vargas, 2002). This species are used worldwide due to its effectiveness on *Tetranychus urticae* Koch and *Panonychus ulmi* (Koch) populations in countries where they show some resistance to acaricides (Marshall and Lester, 2001; Hardman *et al.,* 2005). Resistant strains of this phytoseiid have been commonly used in vineyards and apple orchards (*Malus domestica* Borkh.), under integrated pest management by exercising control even when the application of non-selective products is required (Hardman *et al.*, 2000; Bonafos *et al.*, 2007). It is a type III or generalist predator feeding on various species of tetranychidae, tarsonemidae, pollen, fungi, and other mites (McMurtry and Croft, 1997; Luh and Croft, 2001). These characteristics have the potential to control in other agricultural phytophagous mites such as tenuipalpidae.

The *Brevipalpus* genus has increased its economic importance worldwide possibly due to the limited participation of natural enemies and the techniques employed to avoid them (Gerson, 2008).

Laboratory studies point out that *T. pyri* has high regulation of the population level of *B. chilensis* with high consumption rate of immature and egg stages (Vargas *et al.*, 2005). Even though generalist predators are limited by the fact that they are more effective with low density phytophagous mite populations, this can be overcome by enhancing the population density (Prischmann *et al.*, 2006).

Generalist phytoseiidae have apreference for feeding on phytophagous mites, however pollen represents the only food source in many crops during spring and summer

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(Duso *et al.*, 2004). Vargas *et al.* (2005), determined that *T. pyri* does not feed on adult stage of *B. chilensis*, the most predominant stage at the beginning of the spring, which is why the presence of complementary food in the orchard would be a relevant factor in promoting phytoseiidae survival. *T. pyri* has high mobility and search capacity which would allow it to find complementary food when they are low levels of availability of its prey (Slone and Croft, 2001). At the same time, dispersion of generalist predators is helped by macropredator movement in the orchard (Chuleui and Croft, 2001).

Agricultural systems have usually been managed under the monoculture concept, where the simplified ecosystems are making difficult the balance in the natural enemy/prey relationship. The presence of generalist predators that benefits the diversity of natural ecosystems, as well as other agricultural systems in which the habitat has been manipulated to promote diversity, is among the reasons of contributing to complementary food, such as pollen (Nichols and Altieri, 2004). Tsolakis *et al.* (1997) studied the frequency of different predators on general vegetation, thus demonstrating that it has a great influence as *T. pyri* reservoirs. The differences in morphological structures between plant species that keep the pollen can be an influence into the capacity for beneficial mites to persist and establish themselves. Trichomes and a domatium as a refuge in *V. vinifera*, promote the maintenance of *T. pyri* in the agroecosystems (Duso and Vettorazzo, 1999; Roda *et al.*, 2003; Loughner *et al.*, 2008). At the same time, leaf morphology provides a microclimate allowing water conservation, a favorable condition for the development of eggs and phytoseiid immature stages which are highly dependent on temperature and relative humidity (Gerson *et al.*, 2003). Overmeer (1981) evaluated the reproductive and biological parameters of *T. pyri* with pollen from seven plant species under laboratory conditions, detecting differences among them, where *Vicia faba* L. gave a similar result when fed with phytophagous mites.

Other studies determined that *Typhlodromus exhilaratus* Ragusa fed with *Rosmarinus officinalis* L. or *Oxalis* sp. pollen have a positive influence on the duration of juvenile stages and on the oviposture rate when compare to be fed with *Panonychus citri* (McGregor) or *Tetranychus urticae* (Koch) (Ragusa, 1981). Some mites such as *Amblyseius hibisci* (Chant), have shown a decrease in their predation rate in the presence of pollen (McMurtry and Scriven, 1966), fact also observed in *T. pyri* fed with *Typha latifolia* L. pollen (Qingcai and Walde, 1997). *Amblyseius victoriensis* (Womersley) and *Typhlodromus doreenae* Schicha, fed with *Typha orientalis* Presl. pollen efficiently increased their number of mobile stages and eggs (James, 1993; James and Whitney, 1993). Previous studies evaluating the effect of pollen of different species conducted by the Instituto de Investigaciones Agropecuarias INIA, La Cruz (unpublished data), found that *Oxalis pes-caprae* L. was the one with the best laboratory results in relation to postembryonic development and reproductive parameters in *T. pyri*. *Oxalis pes-caprae* is frequently found in ecosystems of the temperate climate of Chili; however since it is species that blooms in winter, its potential use is limited to habitat management in deciduous crops. This illustrates the necessity to know which species have a positive effect on the development of *T. pyri* in order to promote them when *B. chilensis* is not available. The purpose of this research was to study the effect of feeding with pollen from different plant species, developed in an agricultural ecosystem, as an alternative food source for *T. pyri*.

MATERIALS AND METHODS

Postembryonic parameters of the *T. pyri* predatory mite fed with different types of pollen from dominant plant species in a diverse agroecosystem were evaluated.

Experimental orchard

The study was carried out with organic management in a common vineyard orchard located in the Casablanca Valley (33º20' S; 71º20' W), Valparaíso Region, Chile. Flowers or inflorescences in the pre-anthesis stage of *V. vinifera* cvs. Chardonnay and Merlot, along with other different associated plant species, were randomly collected between October 2004 and December 2005. Twelve dominant species were detected in the orchard. Four of those where of the Asteraceae family (*Anthemis cotula* L., *Conyza bonariensis* (L.) Cronquist, *Lactuca serriola* L., and *Taraxacum officinale* (Weber) ex F.H. Wigg., two Brassicacea (*Raphanus sativus* L. and *Hirschfeldia incana* (L.) Lagr.-Foss., and a single plant of the followings Chenopodiaceae (*Chenopodium album* L.), Oxalidaceae (*O. pes-caprae*), Papaveraceae (*Eschscholzia californica* Cham.), Poaceae (*Poa annua* L.), Rosaceae (*Rosa* sp.), and Umbelifera (*Conium maculatum* L.). Recollected weeds belonging to the Asteraceae family gave a very little amount of pollen, except for *A. cotula*, reason why they were not considered in this assay.

Pollen extraction

Pollen was extracted in the INIA La Cruz predator breeding laboratory. Stamens were separated and put on trays to decrease pollen grain moisture content. The drying process took place at a temperature of 26 ± 2 ºC and RH of 60 ± 5% for approximately 5 d. Once dry, thecae were separated with tweezers under a stereomicroscope, sieved, collected in acrylic boxes, and maintained in the same above-mentioned environmental conditions for approximately 3 d for final drying. The acrylic boxes with pollen were put on a silica gel base to avoid excessive humidity and prevent fungus development. They were then stored at 5 ºC, because they do not lose their viability under this conditions, and it is possible to store them for several months in accordance with James and Whitney (1993).

Postembryonic development of *T. pyri*

Postembryonic development of *T. pyri* was evaluated with pollen of nine dominant plant species in the orchard and *V. vinifera* cvs. Chardonnay and Merlot. Each treatment was defined as a type of pollen obtained from a determined plant species. The control was fed with *O. pes-caprae* pollen. Small, 4-cm-diameter black plastic dishes were employed for each treatment (Swirski *et al.,* 1970), a *T. pyri* egg, no more than 20 h old, from the laboratory mite breeding was placed on each dish. Each egg corresponded to one replicate for a total of 20 replicates per treatment which were randomly placed on plastic trays. Pollen from a specific plant species, 7 x 10^{-4} g, was added on a daily basis to each plastic box, old grains were eliminated to avoid fungus development and provide fresh food. Based on similar results with the control, subsequent studies were carried out with *H. incana* pollen in a mixed diet of eggs and immature mobile stages of *B. chilensis*. In accordance with the results obtained by Vargas *et al.* (2005), each mite was daily provided with 15 eggs and 19 immature stages. Along with supplementing the pollen in this daily treatment, predatory mites were eliminated and new individuals added.

They were maintained at a temperature of 26 ± 2 ºC and 70 ± 5% HR, in accordance with the methodology used by Gerson *et al.* (2003), as well as a 16:8 h (L:D) photoperiod. Observations were carried out with a stereomicroscope 40X (Zeiss Stemi, Göttingen, Germany) every 24 h until dead of the individuals, recording the molting time-lapse period.

Survival and longevity

H. incana pollen was selected to evaluate survival and longevity, due to the similarity of the control (*O. pes-caprae*) results, which was evaluated by itself and with a mixed diet of eggs and immature mobile stages of *B. chilensis*. Methodology was the same as the one applied to determine postembryonic development.

Determination of sex ratio

This parameter was evaluated in *H. incana* pollen, as well as in a mixed diet combining *B. chilensis* eggs and mobile stages. Four 7-cm-diameter black plastic dishes were employed for each treatment as described by Swirski *et al.* (1970). Twenty-five *T. pyri* eggs, no more than 20 h old, from females previously fed with *H. incana* pollen or with a mixed diet of *H. incana* and *B. chilensis* pollen were placed in each box. On a daily basis, mites born in each treatment were fed a quantity of pollen, 2 x 10^{-2} g, and old pollen grains were eliminated. In the mixed diet treatment, predatory mites were eliminated along with the pollen, whereas eggs and immature mobile stages of *B. chilensis* were added. Once they died, the adults were maintained in 75% alcohol to determine the percentage of males and females. Individuals collected were mounted with Hoyer solution and identified with a contrast microscope (Model 473014, Zeiss, West Germany).

Statistical analysis

Data were processed by analysis of variance (ANOVA). When statistical differences were detected due to the treatment effect, media separation was carried out by the Tukey multiple comparison range test with the SAS (SAS Institute, 2001) computer program.

RESULTS AND DISCUSSION

Postembryonic development

The lowest mean duration of the *T. pyri* larval stage was obtained with *P. annua* and the highest with *H. incana* ($P < 0.05$) with all species in a short or transition period (Table 1). Schausberger and Croft (1999) established that *T. pyri* is classified as a non-feeding larva fed although it could be done occasionally. It was observed in this study that the time prolongation of the larval stage in relation to the rest of the treatments was possibly due to have been fed on *H. incana* and *V. vinifera* cvs. Chardonnay and Merlot when they were provided. Regardless of the type of pollen made available, it was observed that all larvae were able to molt and reach the protonymph stage in all treatments.

The highest and lowest time in the protonymph stage was obtained with *H. incana* and *E. californica*, respectively. *T. pyri* only reached the deutonymph stage when fed with *O. pes-caprae*, *H. incana*, and *R. sativus* showing that if the pollen has no nutritional value, it dies shortly after the first molting (Table 1).

Broufas and Koveos (2000) determined that cherry (*Prunus avium* L.), apricot (*Prunus armeniaca* L.), and walnut (*Juglans regia* L.) pollen have a high nutritional value for *Euseius finlandicus* Oudemans because the mortality rate of immature stages was lower and mean longevity was higher. Papadopoulos and Papadoulis (2008) were also able to satisfactorily develop *Typhlodromus foenilis* Oudemans on apple pollen (*Malus pumila* Mill.), pear (*Pyrus comunis* L.), cherry, plum (*Prunus domestica* L.), walnut, almond (*Prunus*

Table 1. Effect of feeding pollen from 11 plant species on the development (d) and survival rate of *Typhlodromus pyri*.

Scientific name	n	Larva	Protonymph	Deutonymph	Egg to adult	Survival rate
		Mean ± SEM				%
Oxalis pes-caprae	20	1.00 ± 0.00ab	3.30 ± 0.98ab	2.65 ± 0.81a	7.21 ± 1.10a	100
Hirschfeldia incana	20	1.40 ± 0.50a	3.70 ± 1.17b	2.90 ± 1.45a	8.70 ± 1.66a	70
Raphanus sativus	20	1.05 ± 0.23ab	3.32 ± 2.59ab	2.63 ± 3.39a	7.32 ± 5.33a	40
Eschscholzia californica	20	1.03 ± 0.18a	0.53 ± 0.57c	---	---	---
Chenopodium album	20	1.03 ± 0.18a	1.47 ± 0.68cd	---	---	---
Conium maculatum	20	1.03 ± 0.18a	3.42 ± 0.97ab	---	---	---
Rosa sp.	20	1.03 ± 0.18a	2.45 ± 1.86ae	---	---	---
Anthemis cotula	20	1.07 ± 0.25a	1.47 ± 0.86cd	---	---	---
Vitis vinifera var. Chardonay	20	1.23 ± 0.43a	1.67 ± 0.55de	---	---	---
Vitis vinifera var. Merlot	20	1.23 ± 0.50a	1.37 ± 0.56cd	---	---	---
Poa annua	20	0.70 ± 0.84b	0.70 ± 1.12cd	---	---	---
ANOVA						
F-value		5.27	24.54	38.29	1.27	
Significance		< 0.0001	< 0.0001	< 0.0001	< 0.2877	

Distinct letters indicate significant differences (Tukey, P < 0.05); SEM: standard error; n: number of replicates.

amygdalus L.), and apricot, where the last two species had the highest nutritional value. However, in this study *V. vinifera* cvs. Chardonnay and Merlot pollen would not have any nutritional value for *T. pyri* since it would not be used as a complementary food even when there was no other food available, demonstrated by a high mortality after reaching the protonymph stage.

Sazo *et al*. (2006) demonstrated that *Neoseiulus californicus* (McGregor) fed with *E. californica* could have a survival rate similar when fed with T. *urticae*. However, it was observed in this study that when *T. pyri* was fed with *E. californica*, individuals avoid approaching this pollen and if they came in contact with it, they energetically eliminated it from their bodies. That is because this type of pollen could contain toxic elements for some phytoseiid mite species.

When the *T. pyri* deutonymph is fed with *O. pes-caprae*, its deutonymph stage has the same mean duration as with H. *incana* and *R. sativus* (P > 0.05) (Table 1).

T. pyri reached the adult stage when it was provided with *O. pes-caprae*, *H. incana,* or *R. sativus* and did not differ in mean duration from egg to adult. Only with *O. pes-caprae* pollen it was possible to determine that all individuals reached the adult stage. It had a survival rate of 70% with *H. incana* pollen and 40% with *R. sativus* pollen (Table 1). This makes *R. sativus* less attractive than the other species evaluated belonging to the same botanical family.

Carotenoids pollen posess the indispensable nutrients for the female phytoseiid predators entering diapause (Overmeer and Van Zon, 1983). In consecuence, if there is enough pollen, they would not respond exclusively to the availability of the existing prey. Dicke (1988) and Fitzgerald and Solomon (1991) determined that there would be no carotenoid effect for *T. pyri* entering diapause. Females do not need them, or if they did, they would be able to extract enough from the pollen and use it as a complementary food in presence of short day length conditions (Dicke, 1988; Fitzgerald and Solomon, 1991). Entering diapause would be conditioned by the photoperiod, which is why the presence of pollen would only be important at the beginning of the season when the *B. chilensis* population is essentially female.

Analysis of the intestinal content of *T. pyri* by electrophoresis revealed that the main nutrition components are pollen in spring, eriophyidae and thrips larvae in summer, mites in summer until autumn (Engel and Ohnesorge, 1994). Qingcai and Walde (1997) reaffirm this by pointing out that the presence of pollen would be of great importance when prey density is low. An increase in *T. pyri* numeric response early in the summer, would allow better control of *B. chilensis* during the season.

Table 2 shows that *T. pyri* postembryonic parameters with a *H. incana* diet and a mixed diet with *B. chilensis*. Furthermore, results are compared with those from studies published by the Instituto de Investigaciones Agropecuarias INIA La Cruz in which this mite is fed with both eggs and mobile stages of *B. chilensis*.

T. pyri in the larval stage shows the highest time when provided with *H. incana* pollen (1.40 d) and show

Table 2. Effect of feeding *Hirschfeldia incana* and *Brevipalpus chilensis* pollen on the development (d) and survival rate of *Typhlodromus pyri.*

Scientific name	n	Larva	Protonymph	Deutonymph	Egg to adult	Survival rate
		Mean ± SEM				%
H. incana	20	1.40 ± 0.50a	3.70 ± 1.17a	2.90 ± 1.45a	8.70 ± 1.66a	70
H. incana/B. chilensis	15	1.00 ± 0.00b	1.90 ± 1.02bc	2.16 ± 1.18a	6.13 ± 1.87b	100
B. chilensis (motiles)	15	1.27 ± 0.46ab	1.20 ± 0.41b	2.40 ± 1.24a	7.87 ± 1.19a	100
B. chilensis (eggs)	15	1.13 ± 0.35ab	2.13 ± 0.74c	2.27 ± 1.03a	8.53 ± 1.13a	100
ANOVA						
F-value		4.03	23.89	1.33	11.31	
Significance		< 0.0108	< 0.0001	< 0.2729	< 0.0001	

Distinct letters indicate significant differences according to Tukey Test (P < 0.05); SEM: standard error; n: number of replicates.

no difference from when it is fed only with eggs or mobile stages of *B. chilensis*. On the other hand, a mixed diet has the lowest value and does not differ from data obtained only with the phytophagous mite (P > 0.05). The protonymph stage maintains the tendency of longest duration with an exclusive pollen diet, and is significantly different from the rest. There were no differences among treatments with mixed diet and only *B. chilensis*. No differences were observed at the deutonymph stage (P > 0.05) (Table 2).

When *T. pyri* was fed with a mixed diet, it showed a lower duration from egg to adult (6.13 d) and was different from the rest of the treatments (P < 0.05). Mean duration from egg to adult of *T. pyri* fed with mobile stages of *B. chilensis* were 7.6 and 8.8 d on an egg diet, with no observation of mortality (Vargas *et al*., 2005) (Table 2). Duso and Camporese (1991) obtained a mean duration from egg to adult of 7.1 d with *Mesembryanthemum criniflorum* L. f. pollen and 6.6 d with *P. ulmi*. The mean time in this study from egg to adult using exclusively *H. incana* pollen was greater (P > 0.05) than the one obtained by Vargas *et al*. (2005). Overmeer (1981) determined that when *T. pyri* was fed with *T. urticae*, the mean duration was 9 to 12.5 d and 9 to 12 d with *V. faba*. On the other hand, feeding this mite with *H. incana* combined with *B. chilensis*, the mean duration was similar to that obtained by Vargas *et al*. (2005) (Table 2).

Survival and longevity

The behavior of the three kind of feeding, shows a 100% survival rate during the first 7 d of life. As for *T. pyri* fed exclusively with *H. incana*, a decrease in survival rate starts on day 7 as compared to when it is fed with a mixed diet or only with *B. chilensis* with a decrease reaching days 21 and 29, respectively (Figure 1). Survival rate gradually decreases with *H. incana* in comparation with the other two diets, which showed an abrupt drop between day 21 and 35. The 50% mortality for *T. pyri* fed with *H. incana* and with the mixed diet is reached at about the age of 49 d, whereas this occurs before (33 d) when it is fed only with *B. chilensis* (Figure 1). In studies carried out with another generalist species, *Iphiseius degenerans* (Berlese), it was determined that feeding with castor pollen progressively decreased mortality from day 20 and the 50% mortality rate was reached around day 45 (Van Rijn and Tanigoshi, 1999). This shows that the presence of *H. incana* pollen in *V. vinifera* orchards is an alternative of supplementary food for *T. pyri* which would allow it to survive at the beginning of the season when activated overwintering *B. chilensis* females move to the shoots to oviposit and initiate the birth of juveniles. Adisson *et al*. (2000) observed that *T. pyri* has a higher correlation with population growth at the beginning of the spring and pollen supply than with the presence of prey.

Longevity or average age of *T. pyri* fed only with *H. incana* is 58 and 56 d with a mixed diet including *B. chilensis* (Figure 1). This contrasts with the results obtained when it is fed only with *B. chilensis,* averaging 29.6 d (Vargas *et al*., 2005). It is not possible to generalize that exclusive pollen diets produce greater longevity than feeding with mites. Camporese and Duso (1995) determined that *T. talbii* fed with *Tydeus caudatus* has a similar duration as *T. pyri* fed with *H. incana*. It was observed in this study that high longevity decreases activity. Therefore, a decrease in the feeding rate occurs as a undesirable characteristic since it could lead to lower depredation. Qingcai and Walde (1997) determined that the presence of *T. latifolia* pollen significantly reduces the depredation rate of *T. pyri* on *P. ulmi*. Nevertheless, the presence of pollen as an alternative food does not change the functional response of the consumption curve of *P. ulmi* over time. There was a permanent consumption of

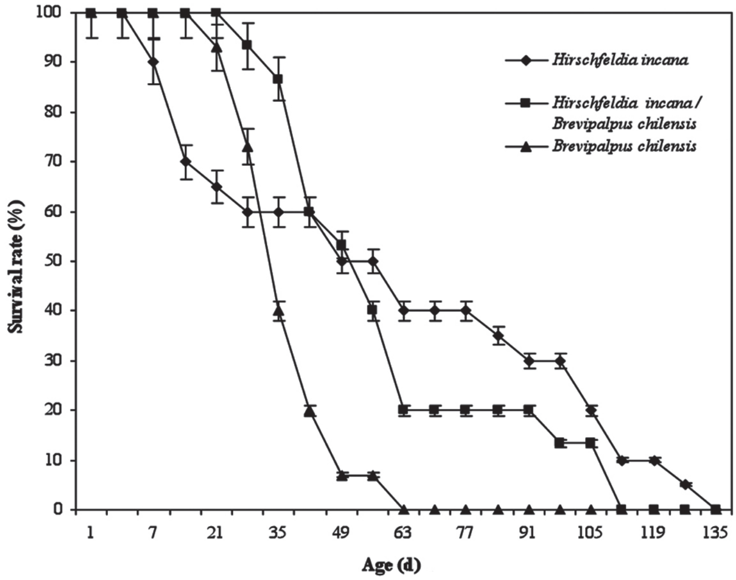

Figure 1. Survival rate of *Typhlodromus pyri* in length of time fed on a exclusive diet of *Hirschfeldia incana* and *Brevipalpus chilensis*, and with a mix diet of both.

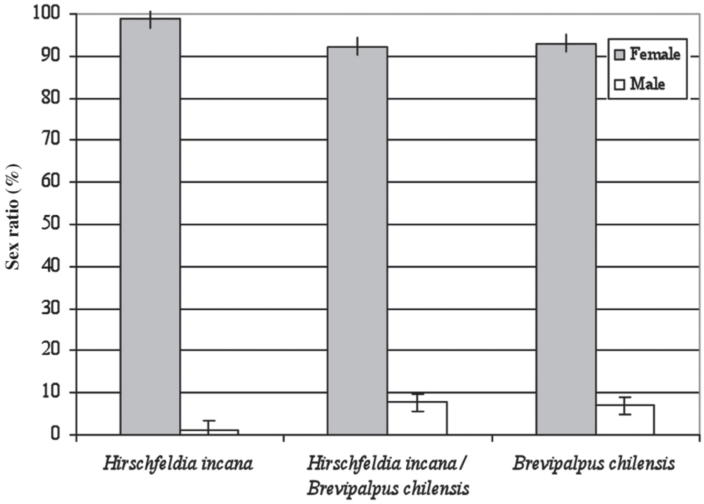

Figure 2. Percentage of *Typhlodromus pyri* males and females fed on a exclusive diet of *Hirschfeldia incana* and *Brevipalpus chilensis*, and with a mix diet of both.

mites despite the pollen availability in mixed feeding with *H. incana* and *B. chilensis*.

Determination of sex ratio

There are 98.9% females and 1.1% males when *T. pyri* is fed only with *H. incana*. When *B. chilensis* is added, 92.23% are females and if it is only fed *B. chilensis* (unpublished data), 93% are females (Figure 2). The high ratio of females early in spring is a frequent reproductive behavior in predatory species that do not require a large number of mating events to produce total egg production (Bounfour and McMurtry, 1987). Ferragut *et al.* (1987) determined that temperature is another factor in the sexual expression of these predators; increasing temperature between 18 and 32 ºC in *Euseius stipulatus* (Athias-Henriot) decreased the female ratio while the opposite occurred in *T. phialatus*. Studies carried out with *Typhlodromus athiasae* Porath and Swirski and *T. negevi* (Swirski and Amitai), established that there is a direct relation between the increase in the number of available prey and female production in a progeny (Momen and El-Borolossy, 1999).

A high presence of female at the beginning of the season could initially benefit the predatory mite population growth rate and thus have a high number of individuals when the pest occurs. Therefore, reproductive parameters should be studied as a complement in order to determine aspects such as oviposture rate and egg viability.

Species of the Brassicaceae family, *R. sativus* and *H. incana*, would show greater potential for use in orchard habitat management, and the latest species is the one which could have a better response as a complementary or supplementary food. Biodiversity is undoubtedly a powerful tool for integrated pest management, but is not consistently beneficial if there is no ecological engineering process associated with it (Gurr *et al.*, 2004). Therefore, species compatible with crop health must be considered, those that should be shown early in autumn so that pollen is available in the spring and can be combined with late blooming species.

CONCLUSIONS

The best food source for *T. pyri* was *H. incana* pollen which provided the highest survival percentage comparing to the others diets including only pollen. This result suggests that the presence of *H. incana*, which blooms when spring begins because *B. chilensis* is not yet available as food source, needs to be promoted.

Regarding the duration of the cycle and survival rate, a diet with *H. incana* pollen has an effect on *T. pyri* which is similar to that obtained with mixed feeding or exclusively with *B. chilensis*.

Survival curves of this predatory mite fed with *H. incana* in a mixed diet and with *B. chilensis* showed that the number of death of the individual was constant over time.

It is possible to reduce development time from egg to adult when *T. pyri* is fed with mites as well as with *H. incana* pollen. On the other hand, this pollen could benefit *T. pyri* development in the absence of tenuipalpidae mites.

Feeding exclusively with *H. incana* or *B. chilensis* pollen or with a mixed diet, does not significaly affect the *T. pyri* sex ratio, maintaining a high proportion of females.

Pollen of the Asteraceae family does not contribute as a complementary food for *T. pyri* due to the scarcity of pollen in its anthers. Similarly, *S. californica* is not a food alternative due it could contain toxic elements for predatory mites.

RESUMEN

Efecto del polen de diferentes especies vegetales sobre el desarrollo de *Typhlodromus pyri* (Sheuten) (Acari: Phytoseiidae). *Typhlodromus pyri* (Sheuten) (Acari: Phytoseiidae) es un ácaro que presenta un alto potencial de uso para el control de la falsa arañita roja de la vid (*Brevipalpus chilensis* Baker; Acari: Tenuipalpidae). El objetivo de este estudio fue determinar el efecto del polen de diferentes especies vegetales como alimento complementario para *T. pyri* cuando escasea su presa. Los parámetros post-embrionarios de *T. pyri* se estudiaron en 11 especies de polen, en una dieta mixta de polen de *Hirschfeldia incana* (L.) y *B. chilensis*. Los ácaros se colocaron individualmente sobre cajas plásticas negras con polen a una temperatura de 26 ± 2 ºC y 70 ± 5% de humedad relativa y un fotoperíodo de 16:8 h (L:O). Los resultados muestran que el polen de *H. incana* fue el único en que no hubo mortalidad (P > 0,05) al igual que en el polen testigo (*Oxalis pes-caprae* L.). Con polen de *H. incana* la duración promedio de huevo a adulto fue de 8,70 ± 1,66 d, protoninfa 3,70 ± 1,17 d y deutoninfa 2,90 ± 1,45 d (P > 0,05). Con la dieta mixta no hubo diferencias significativas en el tiempo medio de duración de huevo a adulto, ni en la mortalidad con respecto a la alimentación sólo con *B. chilensis*. Las curvas de supervivencia de *T. pyri* alimentado sólo con polen *H. incana*, en combinación con *B. chilensis* y sólo con *B. chilensis*, son altas en los primeros 14 d de vida. La proporción de sexos no es afectada significativamente por la alimentación sólo con polen de *H. incana*, sólo de *B. chilensis*, o combinados.

Palabras clave: ácaros fitoseidos, alimento complementario, *Hirschfeldia incana*, *Brevipalpus chilensis*, curva supervivencia.

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