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RESISTANCE OF APPLE CULTIVARS TO TWO-SPOTTED SPIDER MITE, *TETRANYCHUS URTICAE* KOCH (*ACARINA, TETRANYCHIDAE*) PART I. BIONOMY OF TWO-SPOTTED SPIDER MITE ON SELECTED CULTIVARS OF APPLE TREES

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Abstract: Apple cultivars investigated as new hosts for two-spotted spider mite, *Tetranychus urticae* Koch appeared to provide good environment for its development and reproduction. The best conditions for two-spotted spider mite development were on leaves of cultivars Novamac and Freedom with a net reproduction (R_o) 22.6 and 20.3 respectively, while the worst on cultivars Pioner and Primula with R_o 8.9 and 10.2, respectively.

Key words: *Tetranychus urticae* (Koch), bionomy, apple cultivars

INTRODUCTION

Two-spotted spider mites (*Tetranychidae*) occurring in orchards attack the most frequently apple trees and plums, seldom pear trees, sweet cherries and sour cherries, and only can occasionally be found on peaches. For many years the following spider mite species have been recognized as pests of orchard trees; European red mite (*Panonychus ulmi* Koch) (Ruszkowski 1933; Chapmann et al. 1952; Putman 1958; Niemczyk and Wiąckowski 1965; Goonewardene et al. 1976; Paiva and Janick 1980), *Bryobia rubrioculus* Scheuten (Ruszkowski 1933; Kremer 1956; Strunkova 1954; Boczek 1999) and hawthorn spider mite (*Tetranychus viennensis* Zacher) in Europe and Asia (Müller 1957; Gotoh 1986; Skorupska and Boczek 1984).

Over last decade two-spotted spider mite (*Tetranychus urticae* Koch) became in orchards a new noxious species of significant importance. Previously it was mainly known as pest of medical plants and some cultivated black currants. Its mass occurrence in orchards, mainly apple orchards, resulted in almost complete endangered of European red mite (*P. ulmi*) in these particular ecosystems.

Few published papers refer only to population density of this species on different apple cultivars (Skorupska 1993; Warabieda 2000). Based on population density of two-spotted spider mite on leaves of investigated apple cultivars the authors established degree of susceptibility of investigated apple cultivars to infestation of two-spotted spider mite.

In spite of polyphagous nature of two-spotted spider mite and its numerous host plants, a bionomy of this species has been identified only on several plant species. However, population parameters were calculated for two-spotted spider mite only for red clover (*Trifolium pratense*) (Carey and Bradley 1982), cotton (*Gossypium herbaceum*), (Saito 1979), black currant (*Ribes nigrum*), (Czajkowska and Kropczyńska 1996), strawberry (*Fragaria vesca*), (Laing 1969) and bean (*Phaseolus vulgaris*) (Watson 1964).

The aim of carried out studies was to characterize some important parameters of two-spotted spider mite bionomy on selected apple cultivars, to calculate population parameters for this species and to compare results from laboratory experiments with field trails data.

MATERIAL AND METHODS

Investigations on two-spotted spider mites development, life length and fecundity were conducted on five selected apple cultivars Primula (Polish cv.), Pionier (Russian cv.), Lodel, Novamac (Canadian cvs.) and Freedom (American cv.). Spider mites taken into investigations originated from a laboratory rearing performed on leaves referring to particular cultivar. The investigations on life length and fecundity were carried out throughout entire life cycle while these on development from egg until adult form. Tests on development were performed on 1-day old eggs (at different initiate number). All investigations were carried out at room temperature on leaf disks of the studied apple cultivars that were placed in Petri dishes on wet cotton. Each experiment was checked every day and conducted in three replications.

Population parameters were calculated according with method of Andrewartha and Birch (1954) and collected data was submitted to an analysis of variance and a Student's t-test.

RESULTS

All five investigated apple cultivars appeared to be good hosts to two-spotted spider mite. The duration of males' life was the same on all tested apple cultivars but females' life length differed upon an apple cultivars. The females lived the longest on cvs. Novamac and Freedom (45.8 and 45.2 days, respectively) and the shortest on cv. Primula (35.2 days).

Most adult forms lived over 2 weeks and after that period their mortality started to increase (Fig. 1).

Time from mating until first egg laying differed and was mostly depended upon the apple cultivar. The longest time was recorded on cvs. Primula and Pionier (5.1 and 4.9 days, respectively), while the shortest on cvs. Freedom and Novamac (4.2 and 4.3 days, respectively).

Duration of egg laying by two-spotted spider mites throughout their life also differed and was for the most part dependent upon the apple cultivar. The data showed

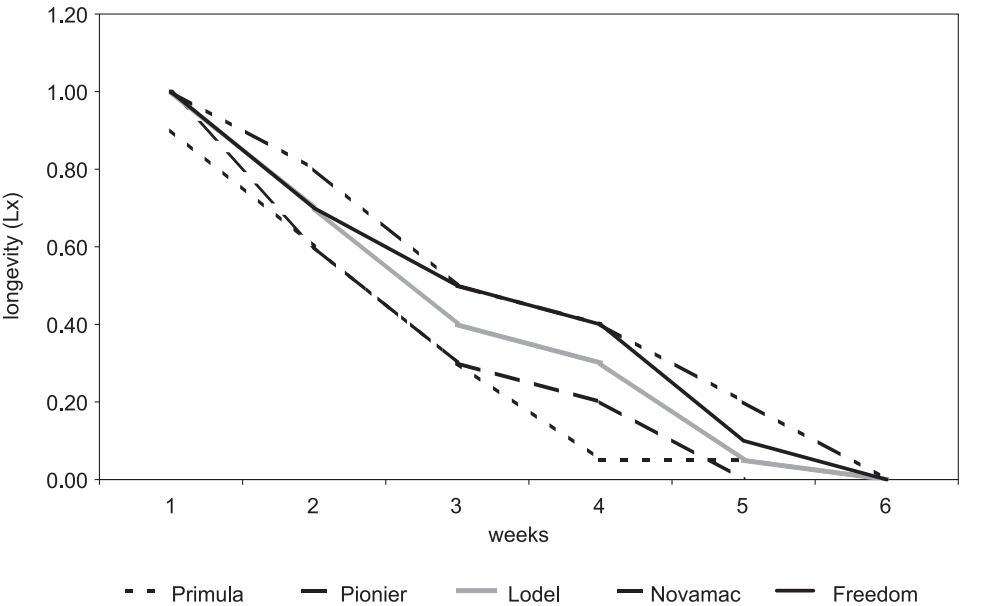

Fig. 1. Longevity (Lx) of two-spotted spider mite on five apple cultivars (Primula, Pionier, Lodel, Novamac and Freedom)

that on cvs. Novamac and Freedom the duration of laying of eggs was similar and an average amounted to 19.3 and 18 days, respectively. However on cv. Pionier, two-spotted spider mite ceased laying eggs by one week earlier than on remaining cultivars.

Fecundity of two-spotted spider mite on examined apple trees differed significantly. Females laid more eggs on cvs. Novamac and Freedom (61.1 and 51.2 eggs, respectively) and much less on cvs. Primula and Pionier (28.7 and 31.5 eggs, respectively). The highest fecundity was recorded during second week of females life (Fig. 2).

Average times of female and male development were diverse and males developed faster than females. In all, the shortest male development was recorded on cv. Primula (16.9 days) while on cv. Freedom 17.0 day. The longest development time was observed on cvs. Novamac and Lodel (17.6 days).

Females developed the shortest on cv. Pionier (22.6 days) and the longest on cv. Primula (23.3 days).

Mortality percent registered throughout development of two-spotted spider mite was in a range from 41.8% on cv. Lodel till 21.5% on cv. Novamac (Tab. 1).

Cultivar Novamac appeared to be the best host plant to two-spotted spider mite development. On leaves of this apple cultivar spider mites multiplied their population 22.7 times during 27.4 days. The worst cultivars for spider mite development were Pionier and Primula. Two-spotted spider mite increased its population 8.9 times during 26.4 days on cv. Pionier and 10.2 times during 26.5 days on cv. Primula.

The lowest intrinsic rate of increase (r_m) was recorded for cvs. Primula and Pionier (0.0842 and 0.0788, respectively) while the highest for cv. Novamac (0.1138).

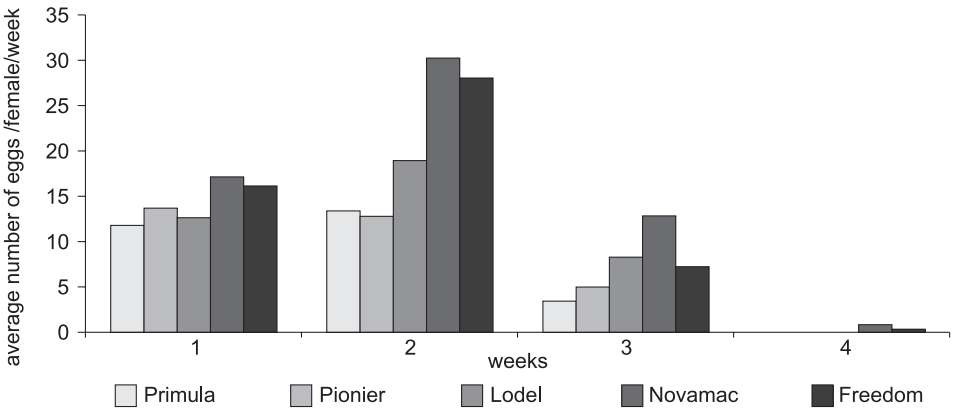

Fig 2. Age specific fecundity (mx) of two-spotted spider mite on five apple cultivars (Primula, Pionier, Lodel, Novamac and Freedom)

Table 1. Development and reproduction of two-spotted spider mite, *Tetranychus urticae* on 5 apple cultivars

Apple cultivars	Longevity in days		Preoviposi-tional period	Duration of eggs laying in days	Mean number of eggs per female	Duration of development in days		Mortality %
	Males	Females				Male	Female	
Primula	28.4 a	35.2 a	5.1 c	14.7 a	28.7 a	16.9 a	23.3 a	28.8 b
Pionier	29.7 ab	38.3 b	4.9 bc	14.7 a	31.5 b	17.3 a	22.6 a	34.3 c
Lodel	29.4 ab	42.4 c	4.5a b	15.3 a	39.9 c	17.6 a	24.0 a	41.8 d
Novamac	31.5 c	45.8 d	4.3 a	19.3 b	61.1 e	17.6 a	22.8 a	21.5 a
Freedom	30.7 bc	45.2 d	4.2 a	18.0 c	51.2 d	17.0 a	23.0 a	22.0 a

The same letters within columns indicate no differences between cultivars

The lowest values of l parameter describing finite rate of increase were for cvs. Primula and Pionier (1.0879 and 1.0821, respectively) and the highest for cv. Novamac (1.1205) (Tab. 2).

Table 2. Population parameters of two-spotted spider mite, *Tetranychus urticae*

Apple cultivars	R_o	T	r_m	λ
Primula	10.25 a	26.50 a	0.0842 a	1.0879 a
Pionier	8.91 a	26.37 a	0.0788 a	1.0821 a
Lodel	12.24 ab	27.20 a	0.0884 ab	1.0924 ab
Novamac	22.67 c	27.39 a	0.1138 c	1.1205 c
Freedom	20.31 bc	27.89 a	0.1085 bc	1.1146 bc

Explanation – see table 1

CONCLUSIONS

Results from investigations on some bionomy elements of two-spotted spider mite on apple cultivars among which two cultivars were considered as susceptible

and three having some kind of resistance, indicate that apple cultivar played an important role in spider mite development.

Skorupska (1993) and Warabieda (2000) showed in their studies that there were differences in a degree of infestation of apple cultivars by *T. urticae*. Skorupska (1993) noted that two-spotted spider mite infested the least cv. Golden Delicious, moderately cvs. Spartan and James Grieve and the most cvs. McIntosh and Cortland. Warabieda (2000) demonstrated that cvs. Piros, Jester and Katja were attacked the least while cvs. Lobo, Close and Jerseymac the severest. Cultivar Lodel was infested at high degree. Cultivars Witos and Novamac were attacked at similar moderate level.

Presented data on two-spotted spider mites biology on five apple cultivars indicate that cultivar Novamac was the best host apple tree proved by the highest female fecundity and the lowest mortality throughout its development cycle. Two-spotted spider mite increased its population 22.7 times during one generation on cv. Novamac while on cvs. Pionier and Primula only 8.9 and 10.2 times, respectively. Meanwhile, on cv. Lodel this species increased its population 12.2 times.

The presented results indicate that apple tree is an interioras host for two-spotted spider mite than strawberry, black currant, red clover or cotton (Laing 1961; Czajkowska and Kropczyńka 1996; Saito 1979; Carey and Bradley 1982).

Results collected from laboratory studies differed from field trials data. Warabieda (2000) registered the highest population of two-spotted spider mite on cv. Lodel and a medium on cv. Novamac. Various sizes of leaves and growth dynamic might be the reasons of these differences as cv. Lodel has leaves smaller as compared to cv. Novamac. Leaf area of cv. Novamac was larger for colonization of two-spotted spider mite population what resulted in less population density despite considerably higher net reproduction on this cultivar than on others.

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POLISH SUMMARY

ODPORNOŚĆ ODMIAN JABŁONI NA PRZĘDZIORKA CHMIELOWCA,*TETRANYCHUS URTICAE* KOCH (*ACARINA, TETRANYCHIDAE)*

CZĘŚĆ I. BIONOMIA PRZĘDZIORKA CHMIELOWCA (*TETRANYCHUS URTICAE* KOCH) NA WYBRANYCH ODMIANACH JABŁONI

Pięć badanych odmian jabłoni (Primula, Pionier, Lodel, Novamac i Freedom) okazały się dobrymi roślinami żywicielskimi dla przędziorka chmielowca (*Tetranychus urticae* Koch). Długość życia samców była zbliżona na badanych odmianach jabłoni, natomiast długość życia samic była zróżnicowana, najdłużej żyły na odmianach Novamac i Freedom, a najkrócej na odmianie Primula.

Płodność samic przędziorka chmielowca (*T. urticae*), różniła się istotnie na badanych odmianami jabłoni. Najwięcej jaj złożyły samice na odmianach Novamac i Freedom, a najmniej na Primula i Pionier.

Najkrótszy czas rozwoju samców zaobserwowano na odmianach Primula i Freedom, a najdłuższy na Novamac i Lodel, natomiast samice najkrócej rozwijały się na odmianie Pionier, a najdłużej na Primula.

Procent śmiertelności w czasie rozwoju wynosił od 41,8% na odmianie Lodel do 21,5% na odmianie Novamac. Z badanych odmian jabłoni, najlepsze warunki życia przędziorek chmielowiec znalazł na liściach Novamac, gdzie w ciągu 27,4 dnia pomnożył swoją populację 22,7 razy, a najgorsze na odmianach Pionier (26,4 dnia – 8,9 razy) i Primula (26,5 dnia – 10,2 razy).