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Avocado Thrips Subproject 1: Laboratory Studies on Biology, Field Phenology, and Foreign Exploration

Mark S. Hoddle Department of Entomology, UC Riverside

Cooperating Personnel: Lindsay Robinson, Karsten Drescher, Jennifer Jones, Nicole Fernandes, and Stephen Vega

Benefit to the Industry

An improved understanding of the biology, phenology, and global distribution of avocado thrips and different species of natural enemies that attack this pest will greatly enhance our ability to manage this pest with natural enemies and pesticides, and will assist with the development of novel monitoring techniques to aid with control decisions.

Objectives

This Subproject has three objectives: (1) Determine the temperature requirements for development of immature avocado thrips in the laboratory and correlate with observed phenology in the field. (2) Determine the temperature requirements for development of immature *Franklinothrips* sp. (a predator of avocado thrips) in the laboratory and correlate with observed phenology in the field. (3) Determine the geographic distribution of avocado thrips and catalogue natural enemy species associated with this pest in Latin America.

Summary

Avocado thrips was first discovered in June 1996 damaging fruit and foliage in Saticoy and Oxnard, Ventura County, California. By July 1997, infestations of avocado thrips were north of the initial discovery area in San Luis Obispo County and south in San Diego County.

Feeding damage by adult and larval *S. perseae* to young leaves causes distortion resulting in brown scarring along the midrib and veins on the leaf underside result as leaves mature. Thrips larvae and adults also feed on developing fruit. Feeding can scar

the entire fruit surface, while localized feeding produces discrete brown scars that elongate as fruit matures. Heavily infested orchards in Ventura County experienced 50-80% crop damage in 1997 and much of the fruit was either unmarketable or downgraded in packinghouses.

Avocados are an economically important crop in California and the harvest in 1996-1997 was worth $259 million (US) (California Avocado Commission, 1997). Economic losses are incurred when fruit is disfigured by thrips feeding as it is either culled or down graded in packinghouses after harvest.

The research presented here provides information on the developmental and reproductive biology of S. *perseae* and geographic distribution of avocado thrips in Mexico. These data are necessary for several reasons. First, they will assist with *S. perseae* production and colony management on which natural enemies from Central America will be reared. Second, knowledge of the pest's lifecycle will assist with timings of natural enemy releases or application of selective pesticides in orchards. Third, the effect of temperature on *S. perseae* development and survivorship will assist our understanding of the constrained coastal distribution of this pest in California, and will guide foreign exploration efforts for this pest and its natural enemies in Central America.

1) Developmental and Reproductive Biology of *Scirtothrips perseae* in the Laboratory and Field Phenology.

The developmental and reproductive biology *of Scirtothrips perseae* was determined in the laboratory at three constant temperatures, 20°C, 25°C, and 30°C. All experiments were conducted with young avocado leaves that were caged with *S. perseae* within Munger cells (Munger 1942). At each temperature the mean number of days in each lifestage, longevity and daily fecundity of mated and unmated female thrips was determined.

At the lowest experimental temperature (20°C), *S. perseae* exhibited greatest survivorship, and mated females produced significantly more progeny of which a greater number were female when compared to 25°C and 30°C (Table 1).

Table 1. Mean duration in days (± SE) of each lifestage of *S. perseae*, first instar to adult survivorship, the proportion of offspring reared to adulthood that were female, and lifetime fecundity of mated females.

	Temperature		
Lifestage	**20°C**	**25°C**	**30°C**
Eggs	14.32±0.14	10.97±0.07	8.87±0.10
1st Instars	3.76±0.12	1.23±0.03	1.64±0.05
2nd Instars	3.31±0.10	3.88±0.10	2.18±0.11
Propupae	1.39±0.10	1.41±0.06	1.37±0.09
Pupae	3.85±0.08	2.60±0.11	2.53±0.16
Unmated Adults	14.07±0.63	9.79±0.63	3.44±0.38
Mated Adults	13.50±2.24	8.44±0.64	
1st Instar to Adult Survivorship	41%	37%	15%
Proportion of Females	0.69	0.62	0.58
Lifetime Fecundity	30.85±6.00	19.81±1.52	

Jack-knifed estimates of net reproduction (R_o), generation time (T_c), and intrinsic rate of increase (r_m), were significantly greater at 20°C than corresponding values at 25per °C. Population doubling time (Td) was significantly lower at 20°C indicating S. *perseae* populations can double 33% faster at this temperature in comparison to 25°C (Table 2).

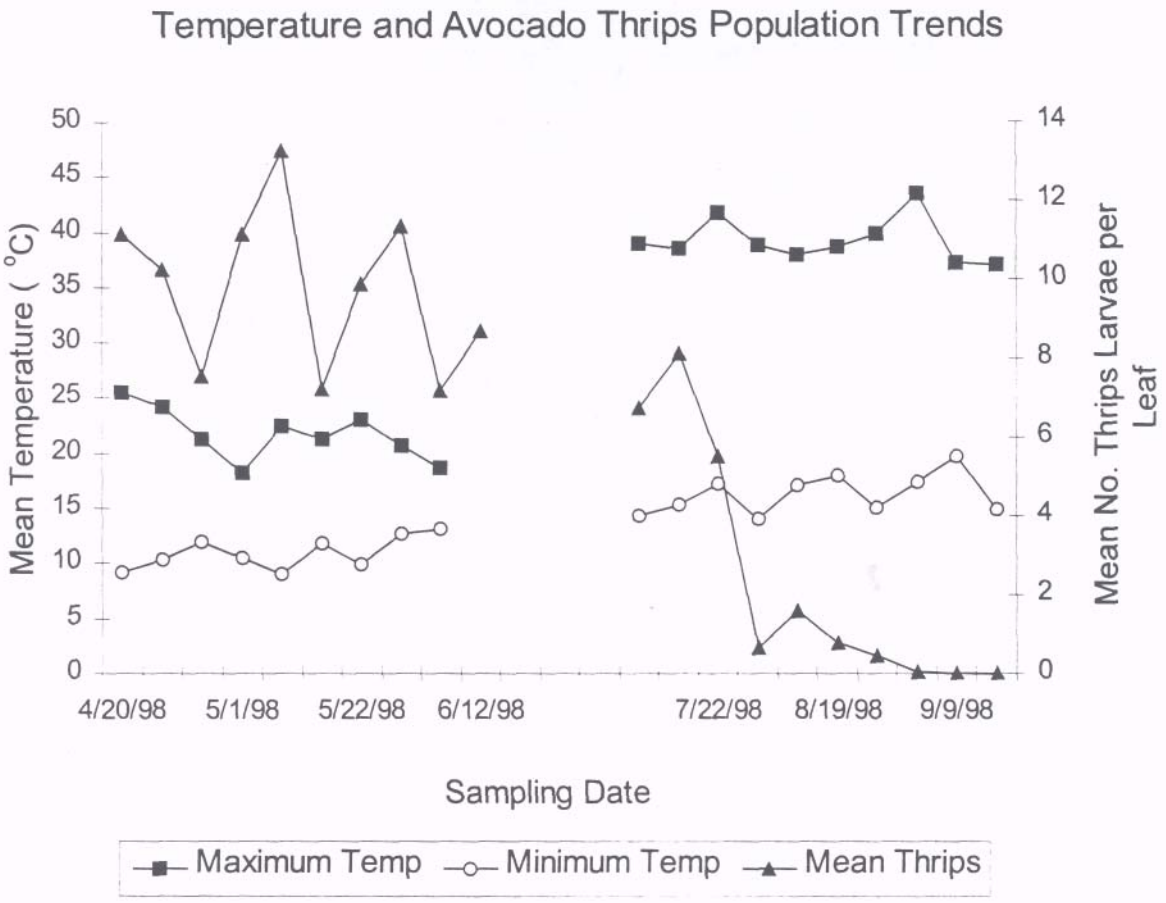
Table 2. Mean demographic growth parameters (±SE) for *S. perseae*. Means followed by different letters across temperatures are significantly different at the 0.05 level.

Temperature	R_o	T_c	r_m	T_d
20°C	15.10±0.06[a]	28.35±0.02[a]	0.10±0.0002[a]	6.88±0.02[a]
25°C	5.27±0.04[b]	24.12±0.02[b]	0.07±0.003[b]	10.34±0.04[b]

Unmated females produce only male offspring confirming arrhenotoky in S. perseae. Laboratory findings corroborate field observations where S. perseae builds to economically injurious levels in California avocado orchards over the winter and spring months before declining in summer. This thrips appears to be intolerant of moderately high temperatures and this may explain why S. perseae has not colonized inland valley orchards which on average have higher temperatures than coastal avocado orchards.

Monitoring of avocado thrips numbers on young flush has clearly shown that populations of this pest decline over summer as temperatures increase even though there is abundant young foliage for feeding and oviposition (Fig. 1). Avocado thrips is the only known pest species of Scirtothrips that outbreaks in cold weather.

Fig. 1. Phenology of avocado thrips on top-worked trees in Fallbrook CA. This graph clearly shows the relationship between avocado thrips population declines and increasing summer temperatures.



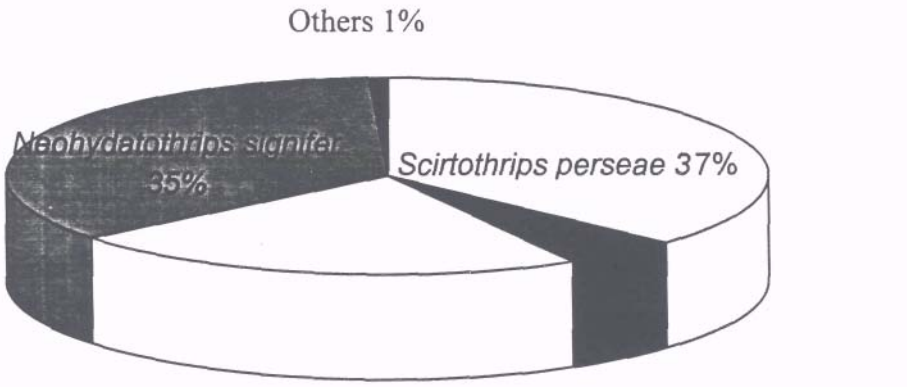
2) Foreign Exploration for Avocado Thrips and Thrips Natural Enemies in Central America.

Determining the geographic distribution of avocado thrips is essential if natural enemies climatically pre-adapted to California are to be located and successfully established for biological control of this pest. Because *S. perseae* exhibits monophagy (i.e., feeds on only one host plant) or highly restricted oligophagy (i.e., only feeds on two-three host plants) in California, we suspect that the natural range of this pest is closely correlated with the centers of origin of the host plant. Three distinguishable ecological races or subspecies of avocado *(Persea americana* Miller) are recognized these being (1) Mexican *(P. americana* var. *drymifolia),* (2) Guatemalan *(P. americana* var. *guatemalensis)* and (3) West Indian *(P. americana* var. *americana)* types. All three areas will be searched for avocado thrips and natural enemy surveys will be conducted.

Fig. 2. Distribution of avocado thrips in Latin America.

Other species of phytophagous thrips have been found feeding on avocados in Mexico. One species, *Neohydatothrips signifer* Priesner, is found almost as common as S. *perseae. Neohydatothips signifer* is not in California and could be a potential new avocado pest in this state (Fig. 3).

Fig. 3. Phytophagous Thrips Collected on Avocados in Mexico



n= 575 slide mounted specimens

The most common natural enemies found in association with *S. perseae* in Mexico have been predatory thrips (Fig. 4). The most abundant of these predators has been *Leptothrips mcconnelli* (70% of collected predators), *Franklinothrips vespiformis* (20%), and *Aeolothrips* spp. (5%). One genus of parasitoid, *Ceranisus* spp. (Hymenoptera: Eulophidae) and whirly gig mites (Acari: Anystidae) have been recovered.

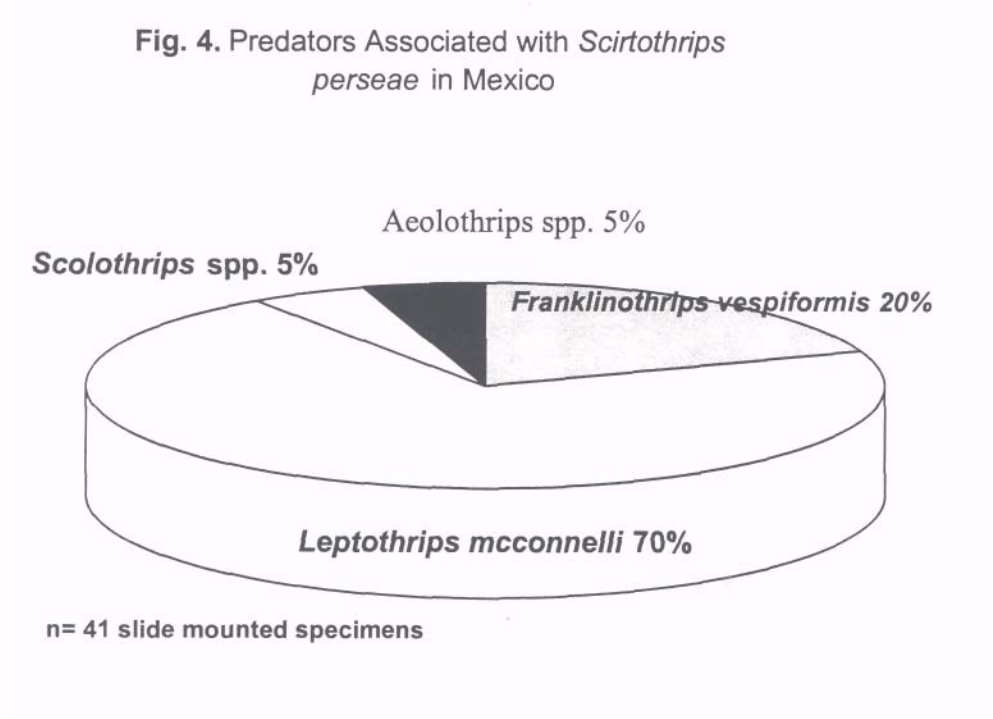


Fig. 4. Predators Associated with *Scirtothrips perseae* in Mexico

Background Reading

Hoddle, M.S. 1997. The avocado thrips: a new pest for California avocado growers. Subtropical Fruit News 5:1-3.

Hoddle, M.S. & J.G. Morse. 1998. Avocado thrips update. Citrograph 83: 3-7.

Hoddle, M.S. & J.G. Morse. 1998. Avocado thrips: a serious new pest of avocados in California. California Avocado Society Yearbook 81: 81-90.

Hoddle, M.S. 1999. Avocado thrips web-page - www.biocontrol.ucr.edu

Hoddle, M.S. 1999. Developmental and reproductive biology of *Scirtothrips perseae* Nakahara: a new pest of avocado in California. *Entomologia Experimentalis et Applicata.* (In Press).