Reproduction of Four Thrips Species (Thysanoptera: Thripidae) on Uncultivated Hosts[1]

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Understanding the population dynamics of a crop pest is of fundamental importance to the management of crop infestations. Thrips, in particular *Frankliniella* spp. (Thysanoptera: Thripidae), cause extensive economic damage to crops throughout the world by feeding and oviposition. Many researchers have studied the dynamics of *Frankliniella* spp. in numerous crops (e.g., Ramachandran et al. 2001, Agric. Forest Entomol. 3: 129-137; Reitz et al. 2003, J. Econ. Entomol. 96: 1201-1214; Stavisky et al. 2002, J. Econ. Entomol. 95: 1216-1221). These studies are clearly valuable, but the importance of immigration to the pest status of thrips makes studies of population dynamics outside of crops vitally important. Many researchers have identified the location of adult thrips outside crops (e.g., Chamberlin et al. 1993, J. Econ. Entomol. 86: 40-45; Chellemi et al. 1994, Environ. Entomol. 23: 335-342; Groves et al. 2002, Plant Dis. 86: 573-582; McPherson et al. 2003, J. Entomol. Sci. 38: 660-668). However, a clear distinction must be made between those plant species in which only adults are found and those plant species in which both adults and larvae are found. There have been numerous papers that have reported the associations of larval thrips with plant hosts, though few have identified these larvae to species (Johnson et al. 1995, Plant Dis. 79: 572-576; Toapanta et al. 1996, Environ. Entomol. 25: 793-800; Groves et al. 2002; Kahn et al. 2005, J. Econ. Entomol. 98: 1810-1815) and, therefore, did not clarify which *Frankliniella* species are using a particular plant species as a reproductive host. This paper reports a year-long survey of uncultivated plants in northern Florida, identifying plant species used as reproductive hosts by 4 common pest thrips species [*Frankliniella occidentalis* (Pergande), *F. bispinosa* (Morgan), *F. tritici* (Fitch), and *F. fusca* (Hinds)]. Three of these species (*F. fusca*, *F. bispinosa*, and *F. occidentalis*) are vectors of *Tomato spotted wilt virus* (TSWV). The thrips larvae are the only stage capable of viral acquisition, and identification of the reproductive plant

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hosts is important in identifying the sources of viruliferous adults invading crop fields (Avila et al. 2006, Florida Entomol. 89: 204-207, Whitfield et al. 2005, Annu. Rev. Phytopathol. 2005. 43: 459-489).

The survey was conducted at the North Florida Research and Extension Center, University of Florida, Quincy, Gadsden Co. Four field margin sites, 6 fallow field sites, and 3 woodland sites were sampled every 3-4 wks from 20 October 2003 until 01 October 2004 (with the exception of December and January).

Lagerstroemia indica L. did not occur in any of the sample sites, but it is a common ornamental plant in the landscape of northern Florida, particularly in urban areas. Trees of this species on the research station were sampled when it became apparent that little reproduction was occurring in our sites from June onwards and that *L. indica* was being used by *F. bispinosa* and *F. tritici.*

On each sample date, a 50-m transect was randomly placed at each site, and all plants species that fell either partly or wholly within 1 m either side of the transect line were sampled for thrips. Plants were sampled by a beating method in which a branch with flowers (if present) was beaten 1-4 times onto a white board to dislodge any adults or larval thrips, which were collected. Adults were identified to species, and each larva was allowed to develop on a segment of green bean and, upon eclosion, identified to species. Plant species in which adults and larvae were found were classified as reproductive hosts whereas those in which only adults were found were classified as feeding hosts. The flowering period of most plant species on which adults or larvae were collected was recorded throughout the year.

Frankliniella occidentalis were found on 7 plant species (Fig. 1), and 2 of these plant species had *F. occidentalis* larvae on them and were classed as reproductive hosts. These 2 reproductive hosts were only used by *F. occidentalis* when they were flowering. *Frankliniella occidentalis* was only present on feeding and reproductive hosts during the spring (April and May, Julian days 165-235) (Fig. 1).

Frankliniella bispinosa was found on 13 plant hosts; 2 were recorded as reproductive hosts (Fig. 2). These 2 reproductive hosts were used during the spring and summer (May to August, Julian days 205-325) while they were flowering.

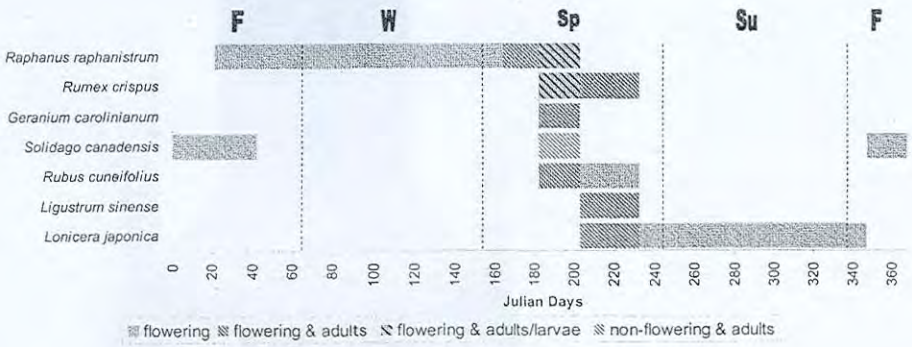

Fig. 1. Plant host use by *F. occidentalis* over one year. Julian days begin on October 20, 2003 and end October 1, 2004. F = fall, W = winter, Sp = spring, Su = summer. Plant flowering periods are shown plus whether they were feeding (adults only) or reproductive hosts (adults and larvae).

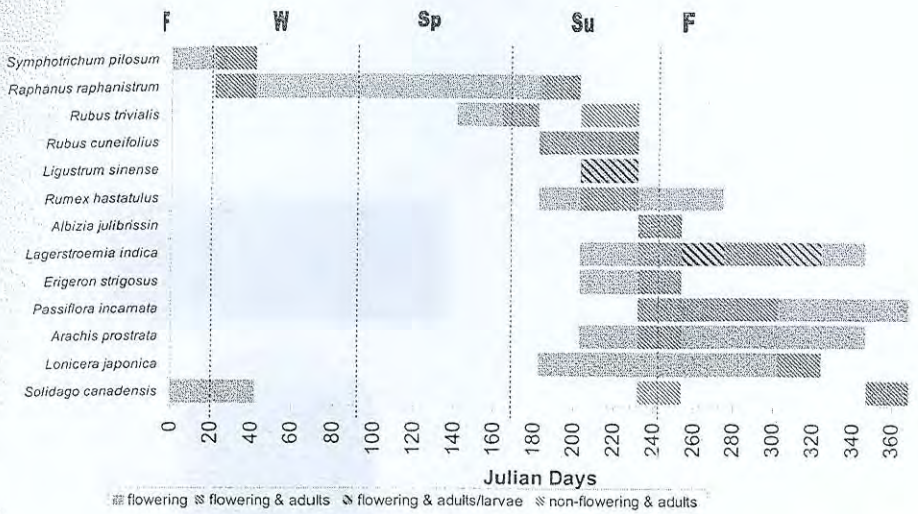

Fig. 2. Plant host use by *F. bispinosa* over one year. Julian days begin on October 20, 2003 and end October 1, 2004. F = fall, W = winter, Sp = spring, Su = summer. Plant flowering periods are shown plus whether they were feeding (adults only) or reproductive hosts (adults and larvae).

Frankliniella fusca was found predominantly during the spring (April to May, Julian days 165-235) (Fig. 3). Twenty plant species were identified as hosts, 12 of which were reproductive hosts. Of these 12 reproductive hosts, 3 were not flowering when *F. fusca* larvae were collected. All reproductive hosts were used during the spring (April and May, Julian days 165-235).

Frankliniella tritici were collected from 48 plant species over the course of the year; 18 were identified as reproductive hosts (Fig. 4). Of these 18 reproductive hosts, 14 were used when flowering, 3 were used during both flowering and nonflowering periods, and 1 was used only during a nonflowering period. The majority of these reproductive hosts (10) were used during the spring (April and May, Julian days 165-235).

Most of the reproductive hosts for these 4 *Frankliniella* species were found in the spring, which is also the period when thrips populations are increasing (Chellemi et al. 1994; Toapanta et al. 1996; Reitz et al. 2003). This increase in thrips numbers plus their vagility and polyphagous lifestyle (Mound 1997. pp. 197-215. *In* T. Lewis (ed.), Thrips as Crop Pests. Wallingford, CAB International) creates the ideal conditions for crop invasion.

Two spring reproductive hosts are of particular interest due to their high abundance in our sites (unpubl. data) and their widespread distribution throughout the U.S. *Oenothera laciniata* Hill was used as a reproductive host by *F. tritici* and *F. fusca* and is found in most states east of the Rocky Mountains and in California, whereas *Lolium perenne* L. subsp. *multiflorum* (Lam.) Husn. was used as a reproductive host by *F. tritici* and is found in all states (USDA, NRCS 2004, The PLANTS Database, Version 3.5, http://plants.usda.gov). These 2 hosts may not only be important to thrips popu-

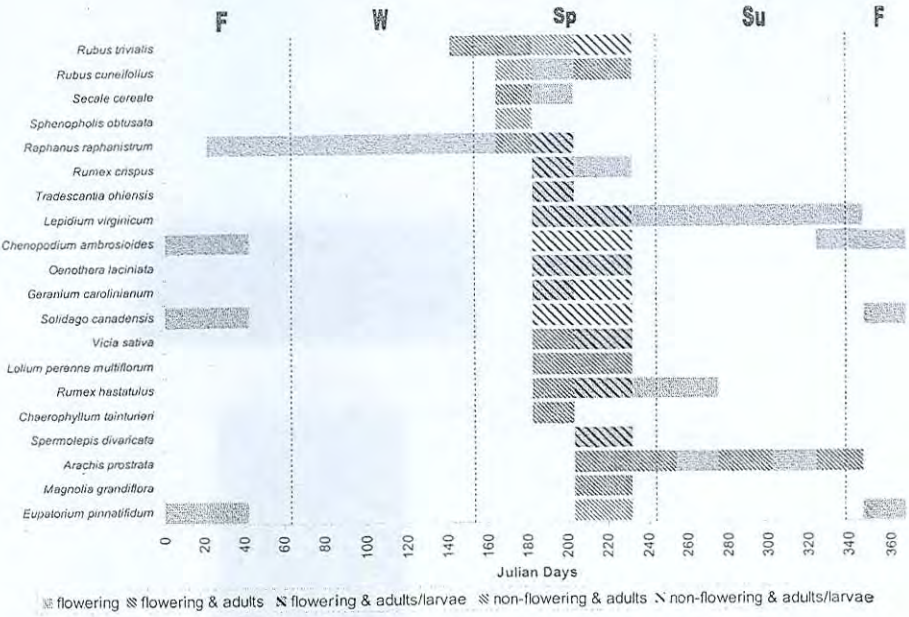

Fig. 3. Plant host use by *F. fusca* over one year. Julian days begin on October 20, 2003 and end October 1, 2004. F = fall, W = winter, Sp = spring, Su = summer. Plant flowering periods are shown plus whether they were feeding (adults only) or reproductive hosts (adults and larvae).

lation dynamics in northern Florida, but may also be important in other regions of the U.S. Both are confirmed TSWV hosts (Chatzivassiliou et al. 2001, Plant Dis. 85: 40-46; Parrella et al. 2003, J. Plant Path. 85: 227-264) and could be sources of TSWV infection. Other plant hosts with high abundances in our sites included *Rubus cuneifolius* Pursh. (reproductive host for *F. tritici*), *Rumex hastatulus* Baldw. (reproductive host for *F. fusca*), and *Rubus trivialis* Michx. (reproductive host for both *F. tritici* and *F. fusca*). The intrinsic rate of increase of *F. tritici* and *F. fusca* on these 5 plant hosts should be measured to determine which plant hosts are the most important source for thrips population dynamics.

Other hosts identified during the spring period with widespread national distributions include *Erigeron strigosus* Muhl., *Raphanus raphanistrum* L., *Lonicera japonica* Thunb., *Geranium carolinianum* L., *Rumex crispus* L., *Lepidium virginicum* L., and *Vicia sativa* L. (USDA, NRCS 2004, The PLANTS Database, Version 3.5, http://plants.usda.gov). The first 5 are confirmed TSWV hosts, whereas there are confirmed TSWV hosts in the same genera of the latter 2 species (Parrella et al. 2003).

While *Frankliniella* thrips generally preferred hosts when they were flowering, we could not identify reproductive hosts based on patterns of endemicity or plant family. The factors that distinguish reproductive and feeding hosts are unclear. Larvae may be nutritionally limited; the quality of a food source (such as pollen) or the presence of defensive compounds may determine which plants species are viable as a reproductive host. Equally, the structure of the flower of reproductive hosts may enable

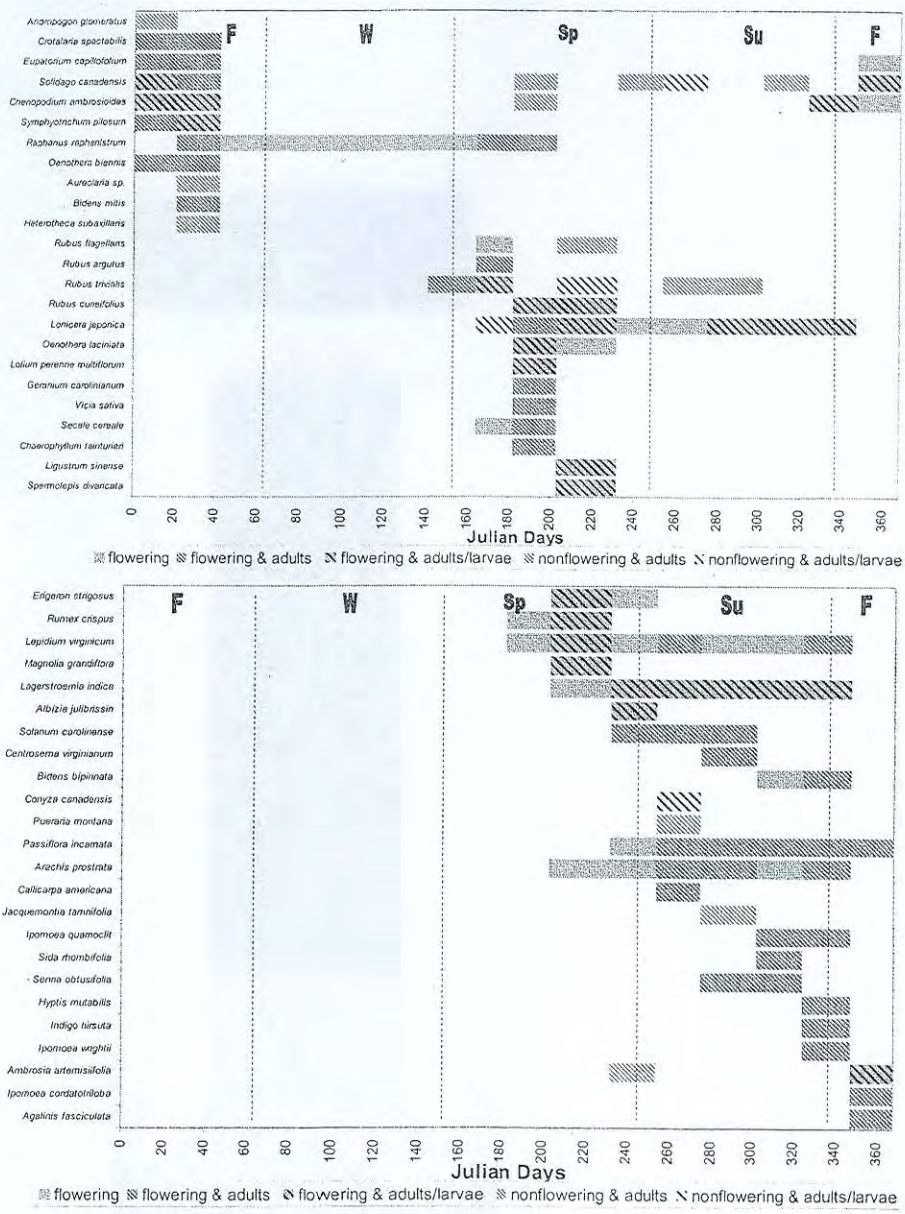

Fig. 4. Plant host use by *F. tritici* over one year. Julian days begin on October 20, 2003 and end October 1, 2004. F = fall, W = winter, Sp = spring, Su = summer. Plant flowering periods are shown plus whether they were feeding (adults only) or reproductive hosts (adults and larvae).

thrips larvae to better avoid predation. However, these reproductive hosts did not fall into the same plant families, and flower structures varied markedly from the large, relatively open flowers of *Magnolia grandiflora* L. and *R. trivialis* to the small inflorescences of *Solidago canadensis* L.

These 4 thrips species may have similar requirements in reproductive hosts as there was some overlap in host use among the 4 thrips species. Of the 23 reproductive hosts identified, 8 were used simultaneously as a reproductive host for 2 thrips species. An additional 10 reproductive hosts for either *F. tritici* or *F. fusca* were used as feeding hosts by either *F. occidentalis* or *F. bispinosa*. As *F. occidentalis* and *F. bispinosa* adults were rare in the landscape, we may not have collected larvae from these plant hosts even though they may be reproductive hosts for these thrips species. Thus, there may be a greater overlap in host use than shown here.

This survey identified 23 reproductive hosts of at least 1 of these 4 *Frankliniella* species. The reproductive hosts identified for *F. occidentalis*, *F. bispinosa*, and *F. tritici*, are all new recordings, while 9 of the 12 reproductive hosts for *F. fusca* are also new. The results of our study provide a step in identifying those plant hosts that are of greatest importance to *Frankliniella* population dynamics.

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