Franklinothrips vespiformis

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Species of Franklinothrips (Thysanoptera: Aeolothripidae) are predatory on various other insects. These fast moving, ant-mimicking predatory thrips are widely distributed in the tropics. *F. vespiformis* has gained attention for its potential as a biocontrol agent for a diverse range of greenhouse pests, and it has already been commercially cultured in Europe for certain use.

ant-mimic demography habitat Franklinothrips prey specificity predatory thrips

1. Introduction

The Thysanoptera (thrips) constitute approximately 6500 species that are globally distributed and represent many of the smallest winged insects [1][2]. Several thrips species are globally important, due to their capacity to disperse through the plant trade and vector plant tospoviruses, which cause significant agricultural losses [3]. While most of the thrips are detritivores (mainly fungal feeders) and herbivores (feeders of flowers, fruits, and leaves) [4][5], approximately 300 species have evolved a predatory lifestyle [6].

Predatory thrips are known from several families. Surveys in three districts of northern Thailand revealed 10 species of predatory Phlaeothripidae in five genera, including *Aleurodothrips fasciapennis*, which were present throughout the year and contributed to pest control [7]. In USA, mite-predatory species *Scolothrips sexmaculatus* (Thripidae) and *Leptothrips mali* (Phlaeothripidae) are considered important biological control agents in almonds and apple orchards, respectively [8][9]. However, most of the predatory thrips species are confined within the Aeolothripidae.

Species of *Franklinothrips* (Thysanoptera: Aeolothripidae) are predatory on various other insects. These fast moving, ant-mimicking predatory thrips are widely distributed in the tropics, with 17 species described [1][10][11]. In addition, they are unusual among thrips due to the fact that most of them are habitually parthenogenetic and spin a silken cocoon [12]. Moreover, cocoon spinning is observed among the Aeolothripidae [13]. Among *Franklinothrips*, *F. vespiformis* is the most widespread and was noted considerably earlier as distinctive from most of the other Aeolothrips [14]. *F. vespiformis* has gained attention for its potential as a biocontrol agent for a diverse range of greenhouse pests, and it has already been commercially cultured in Europe for certain use [15][16]. *F. orizabensis*, a similar species, has also been documented as a biocontrol agent for thrips management in avocado plantations in California, USA [17].

2. Distribution

2.1. F. vespiformis

The native range is presumed to be Central America [10], although this species has been recorded subsequently in North and South America, Southeast Asia, Africa, Oceania, and Europe. *F. vespiformis* is distributed in different locations with references, as shown in **Table 1**, and distributed in wild and artificially released populations around the globe, as shown in **Figure 1**.

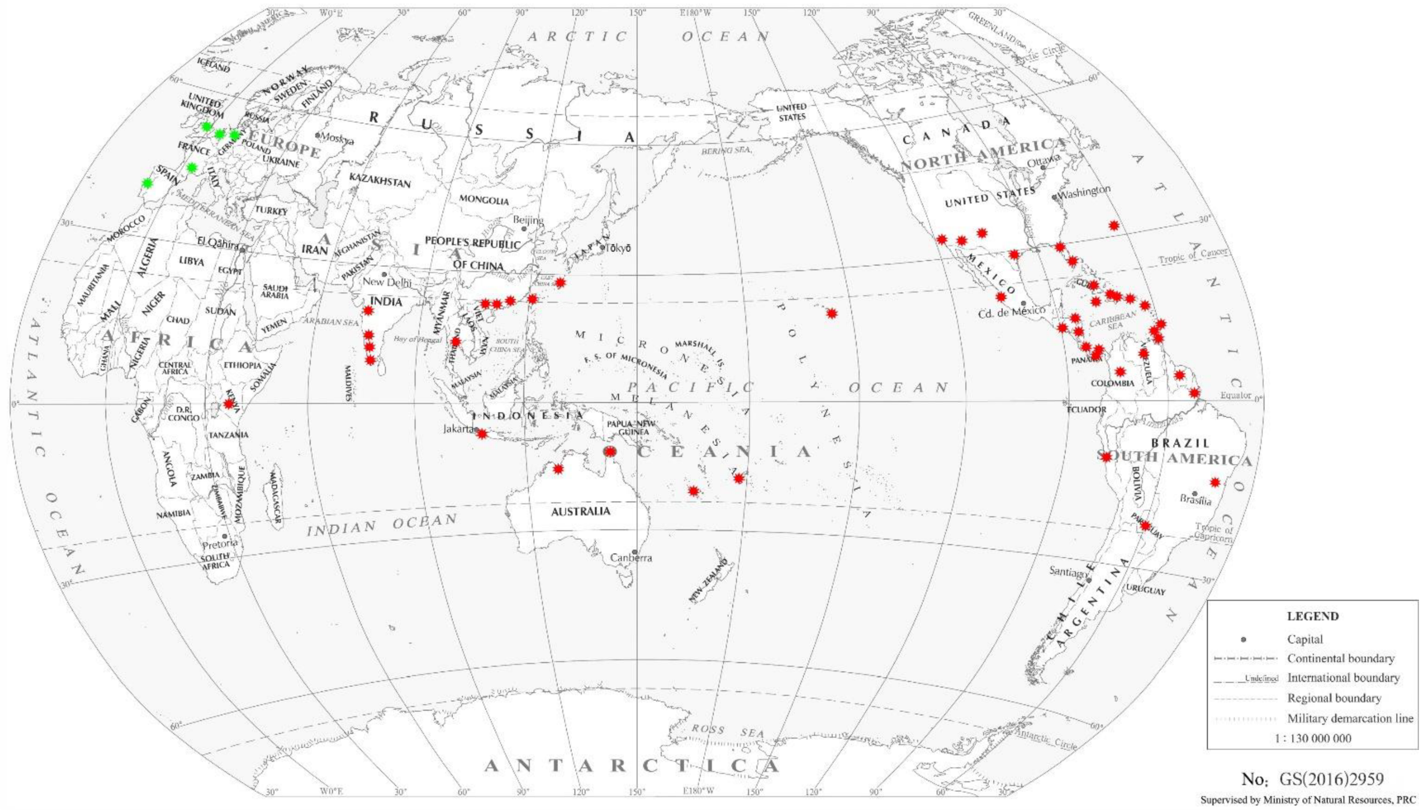

Figure 1. Known global distribution of *Franklinothrips vespiformis*. Red spots indicate locations with wild populations; green spots indicate artificial releases.

Table 1. The distribution of *Franklinothrips vespiformis*.

Region	Country (Location)	Reference(s)
North America	USA (Colorado)	[18]
	USA (Arizona, California, Florida, Texas)	[10][19][20][21]
	Mexico	[22][23][24][25]

Region	Country (Location)	Reference(s)
Caribbean	Jamaica, Dominican Republic, Barbados	[24][25]
	Puerto Rico	[25]
	Trinidad and Tobago	[26][27]
	St. Vincent Island, West Indies	[24][25]
Central America	Costa Rica, El Salvador, Nicaragua	[14][22][24]
	Honduras	[28]
	Panama	[14]
South America	Brazil	[29][30][31]
	Paraguay	[24]
	Peru (Miraflores)	[14]
	Surinam	[12][25]
Asia	China (Taiwan)	[32]
	China (Guangdong Yunnan, Guangxi)	[11]
	India (Karnataka, Maharashtra, Kerala, Tamil Nadu)	[33][34]
	Indonesia (Java)	[35]

Region	Country (Location)	Reference(s)
	Japan (Okinawa)	[36][37]
	Thailand	[7][25]
Oceania	Australia (Queensland)	[10]
	New Caledonia	[10]
	Hawaii	[24]
Europe	France	[38][39][40]
	Germany	[41]
	Portugal	[24]
	UK	[15][16][42]

Compared with the pantropical *F. vespiformis*, the reported distribution of 16 other *Franklinothrips* spp. are relatively more localized. The current known distribution includes *F. atlas* Hood and *F. megalops* Trybom (mainly in Africa), *F. basseti* Mound and Marullo as well as *F. variegatus* Girault (Australia), *F. brunneicornis* Mound and Reynaud (New Caledonia), and *F. fulgidus* Hood and *F. lineatus* Hood (Brazil) [1]. Five additional species are noted from Asia, i.e., *F. rarosae* Reyes (Philippines), *F. strasseni* Mound and Reynaud (Nepal), *F. suzukii* Okajima (Taiwan), *F. tani* Mirab-Balou, Shi and Chen (China), and *F. uttarakhandiensis* Vijay Veer (India) [1]. Moreover, three additional species are recorded from Central America, i.e., *F. tenuicornis* Hood (Panama), as well as *F. orizabensis* Johansen and *F. caballeroi* Johansen (Mexico and Costa Rica). Furthermore, in USA, *F. orizabensis*, which closely resembles *F. vespiformis*, has been reported from Arizona, California, Colorado, Florida, and Texas [17][43].

3. Morphological Characteristics

F. vespiformis experiences partial metamorphosis, developing through egg, larva, pupa, and adult stages (**Figure 2**). The following is based on the authors' observations, which is supplemented with published findings [36][44][45].

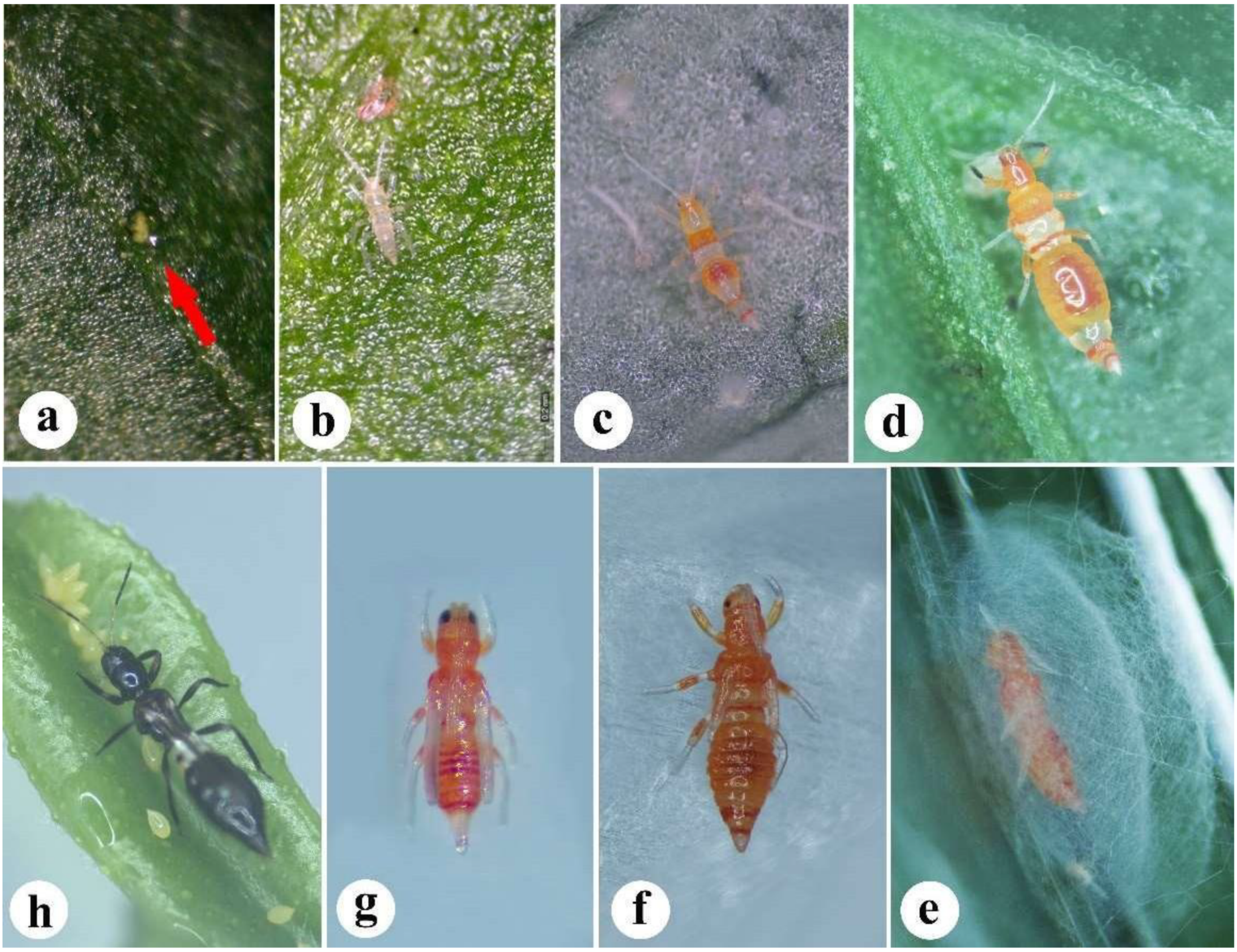

Figure 2. Different stages of *Franklinothrips vespiformis*. (**a**) Egg; (**b**–**d**) Larva: (**b**) Newly emerged larva; (**c**) first instar larva; (**d**) second instar larva; (**e**–**g**) pupal stages: (**e**) pupa into cocoon; (**f**) Pupal stage 1; (**g**) pupal stage 2; (**h**) adult.

3.1. Eggs

Eggs are produced singly inside the leaf tissue, and they can be distinguished by yellow-green projections. Eggs are kidney-shaped and transparent white, with dimensions of 0.4 ± 0.01 mm by 0.1 ± 0.003 mm (**Figure 2**a).

3.2. Larva

Two instars are included in the larval period. The newly emergent first instars are pale white, with the third antennal segment about 3.5 to 4.5 times as long as wide (**Figure 2**b). After feeding for 1 or 2 days, the mesothorax and abdomen segments III–VII develop a red coloration (**Figure 2**c). The second instars have a distinctive hump-back. In addition, the head and prothorax develop a red coloration as the mesothorax. The second instar in the third antennal segment is about 7.0 to 8.0 times as long as wide, and the fore tibia and tarsus are dark (**Figure 2**d). Both of the instars possess seven segmented antennae with three distal segments, which are closely fused. The red hypodermal pigments are only present on the femora.

3.3. Pupa

Pupae are found underneath the leaves, inside a white silk cocoon constructed by the larva (2e). The pupa are red in color with three stages, pre-pupal stage, pupal stage 1 (**Figure 2**f) and pupal stage 2 (**Figure 2**g). Wing buds are well developed, but shorter in pre-pupal stage (show non-obvious movement, prepared for cocoon construction). The pupal skin of the appendages is segmented only in pre-pupa. The antennal sheaths do not reach the metathorax (pupa 1), but reach the abdomen (pupa 2). In addition, posterior wing buds reach abdominal segment III (pupa 1), while both the anterior and posterior wing buds reach abdominal segment V (pupa 2). The legs and hind tibiotarsus are shorter than pterothorax (pupa 1), and the legs and hind tibiotarsus are longer than pterothorax (pupa 2).

3.4. Adult Female

Female *F. vespiformis* (myrmici) are common and have a body length of 2.5–3.0 mm (**Figure 3**a). Females are fully winged and their forewing is slender with a rounded apex. The body is black with white bands on the second and third segments, and an anteriorly narrowed abdomen. The abdomen is broadest at segment five or six. The body, legs, and antennae are brown. However, antennal segments I–III and abdominal segments II and III are yellow. Moreover, the anterior margins are brown and the femora is often yellowish at distal end. Legs brown with femora yellowish at distal end. Fore-wing brown with three paler areas in the base, middle and sub-apex.

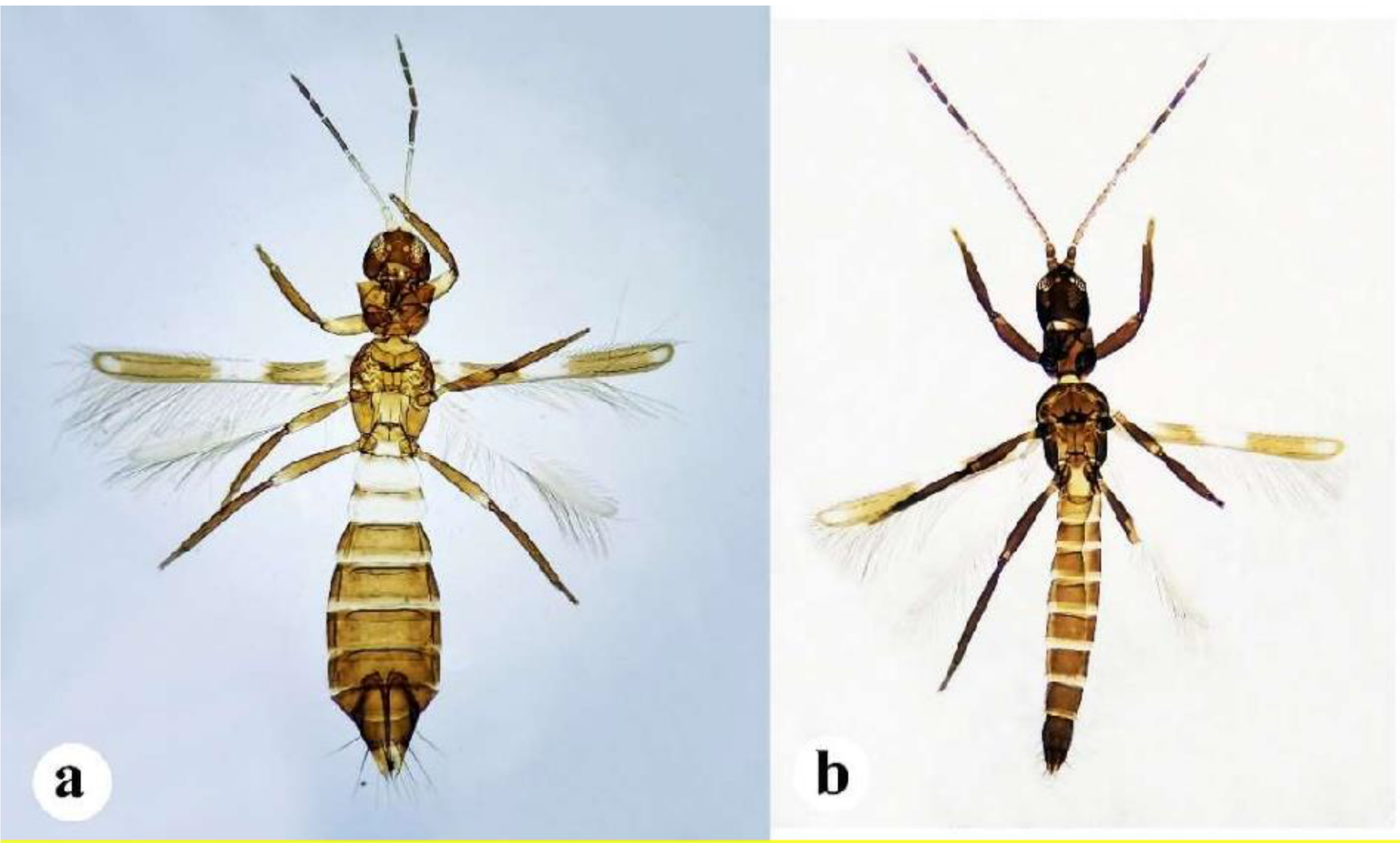

Figure 3. Sexual dimorphism in adult *Franklinothrips vespiformis.* (**a**) Female; (**b**) Male.

3.5. Adult Male

Male *F. vespiformis* are rare, similar to female in colour with a smaller and less ant-like appearance (**Figure 3**b). Males have a longer and darker antennae, a less constricted waist, and commonly paler wings. The second and third antennal segment is approximately as long as the head, with a long sensory metanotum formed of irregular scallops. The head is broader than long, the eyes are prolonged ventrally, and the posterior ocelli are larger than the anterior. The prothorax is narrower towards the base, and the metanotum has no sculpture medially, with long and slender legs. Abdominal sternite II with two pairs of discal setae; sternites III–VIII with two pairs of posteromarginal setae and one pair of discal setae in a line.

4. Life History

4.1. Developmental Parameters

F. vespiformis is active at temperatures over 18 °C and develop from egg to adult within roughly 3 weeks at 27 °C. Moreover, it survives up to 60 days as an adult (**Table 2**), with no reported diapause. Previous studies of mass storage suggest a differential cold tolerance among the different life stages. In general, the viability of the eggs declines when stored below 7.0 °C, although storing eggs at 12.5 °C for 4–5 weeks was possible [15][16]. The potential to store eggs may assist the mass rearing and dissemination of *F. vespiformis* as a biological control agent.

Table 2. Developmental parameters (days) of *Franklinothrips vespiformis* reared at different temperatures.

Development Parameter	Temperature (°C)			Reference(s)
	21 °C	25 °C	27 °C	
Life Stage (Days (±SE))				[15][16]
Eggs	16.06 ± 0.8	10.39 ± 0.1	9.7 ± 0.0	
Larva 1	4.04 ± 0.12	2.03 ± 0.0	1.9 ± 0.0	
Larva 2	3.9 ± 0.1	2.1 ± 0.0	1.1 ± 0.0	
Prepupal and Pupal	12.5 ± 0.1	7.4 ± 0.1	5.3 ± 0.0	

Development Parameter	Temperature (°C)			Reference(s)
	21 °C	25 °C	27 °C	
Unmated Males	24.3 ± 1.6	16.4 ± 1.3	9.0 ± 0.7	
Mated Males	15.6 ± 1.9	12.8 ± 1.6	8.0 ± 0.6	
Reproductive parameter (±SE)				
Unmated Females				
Pre-oviposition period (days)	1.6 ± 0.2	0.9 ± 0.2	2.4 ± 1.0	
Mean total progeny	67.9 ± 21.4	71.2 ± 12.9	8.5 ± 3.8	
Mean daily progeny	2.3 ± 0.2	4.1 ± 0.3	1.0 ± 0.1	
Mean lifetime oviposition rate	154 ± 22.4	314 ± 44.1	105 ± 17.9	
Mean daily oviposition rate	7.1 ± 0.4	18.1 ± 13.6	12.9 ± 1.3	
Mated Females				
Pre-oviposition period (days)	1.5 ± 0.2	0.9 ± 0.1	0.8 ± 0.2	
Mean total progeny	35.2 ± 6.6	44.4 ± 11.8	8.4 ± 2.8	
Mean daily progeny	1.8 ± 0.1	3.1 ± 0.2	0.9 ± 0.2	
Mean lifetime oviposition rate	128 ± 25.5	220 ± 47.9	101 ± 14.7	

Development Parameter	Temperature (°C)			Reference(s)
	21 °C	25 °C	27 °C	
Mean daily oviposition rate	6.5 ± 0.5	15.9 ± 1.1	12.8 ± 1.1	
Population growth parameters (±SE)				
Net reproductive rate (R_0)	18.5 ± 0.18	33.3 ± 0.28	4.5 ± 0.07	
Generation time (T_c)	49.1 ± 0.12	27.9 ± 0.05	24.2 ± 0.06	
Intrinsic rate of increase (r_m) [36]	0.06 ± 0.0002	0.13 ± 0.0003	0.06 ± 0.0007 [14][20] [46][47][48]	
Finite rate of increase (λ)	1.06 ± 0.0002 [46]	1.14 ± 0.0004	1.07 ± 0.0007	
Survival time in days (T_d)	11.12 ± 0.03 [49][50]	5.16 ± 0.01	11.05 ± 0.12	

were not -mediated tracycline m, which indicates possibly

4.3. Ovipositing Behavior

Arakaki and Okajima [36] as well as Arakaki, Miyoshi, and Noda [46] studied the reproductive behavior of *F. vespiformis*. Viable eggs are produced via parthenogenesis with eggs laid singly into the stem, leaf vein or other soft plant tissue using their serrated ovipositor. Females can oviposit three eggs within an hour, producing 150 to 200 eggs in their lifetime. Moreover, females deposit a drop of yellowish protective secretion on the exposed tip of the eggs, which makes them difficult to locate.

4.4. Cocoon Spinning

Several species among *Franklinothrips* and *Aeolothrips* construct silken cocoons underneath the leaves or in the soil or leaf litter, for example, *Aeolothrips kuwanaii, A. fasciatus, A. melaleucus, Orothrips kelloggi, Ankothrips yuccae,* and *A. gracilis* [10][12][51]. Reyne [12] indicated that the cocoon production of *F. vespiformis* takes a full and larvae were observed sharply twisting and turning their abdomens, with the final cocoon as white and oval-shaped, measuring roughly 2.7 mm × 1.3 mm in size [12][36].

4.5. Ant-Mimicking Behavior

While some degree of myrmecomorphy is associated with most of the *Franklinothrips*, the extent of ant-like features and behavior is highly pronounced in adult female *F. vespiformis* [14]. A highly constricted first abdominal segment produces an ant-like waist [36]. Similar to ants, individuals can run quickly and palpate their antennae on the ground. These distinguishing characteristics have been proposed in order to help adults escape predation [52][53].

References

1. ThripsWiki. Providing information on the World’s thrips (version Nov 2018). In Species 2000 & ITIS Catalogue of Life, 2019 Annual Checklist; Roskov, Y., Ower, G., Orrell, T., Nicolson, D., Bailly, N., Kirk, P.M., Bourgoin, T., DeWalt, R.E., Decock, W., Nieukerken, E., et al., Eds.; Naturalis: Leiden, The Netherlands, 2019; Available online: www.catalogueof-life.org/annual-checklist/2019 (accessed on 23 November 2021).
2. Parker, B.; Skinner, M.; Ewis, T. (Eds.) Thrips Biology and Management; NATO ASI Series. Life Science; Springer: Boston, MA, USA, 1995; Volume 276.
3. Riley, D.G.; Joseph, S.V.; Srinivasan, R.; Diffie, S. Thrips vectors of tospoviruses. J. Integr. Pest Manag. 2011, 2, I1–I10.
4. Morse, J.G.; Hoddle, M.S. Invasion biology of thrips. Annu. Rev. Entomol. 2006, 51, 67–89.
5. Reynaud, P. Thrips (Thysanoptera). Chapter 13.1. BioRisk 2010, 4, 767.
6. zur Strassen, R. Binomial data of some predacious thrips. In Thrips Biology and Management; Parker, B., Skinner, M., Ewis, T., Eds.; Springer: Boston, MA, USA, 1995; pp. 325–328.
7. Saengyot, S. Predatory thrips species composition, their prey and host plant association in Northern Thailand. Agric. Nat. Resour. 2016, 50, 380–387.
8. Parrella, M.; Rowe, D.; Horsburgh, R. Biology of Leptothrips mali, a common predator in Virginia apple orchards. Ann. Entomol. Soc. Am. 1982, 75, 130–135.
9. Haviland, D.R.; Rill, S.M.; Gordon, C.A. Field biology of Scolothrips sexmaculatus (Thysanoptera: Thripidae) as a predator of Tetranychus pacificus (Acari: Tetranychidae) in California almonds. J. Econ. Entomol. 2021, 114, 1111–1116.
10. Mound, L.A.; Reynaud, P. Franklinothrips; a pantropical Thysanoptera genus of ant-mimicking obligate predators (Aeolothripidae). Zootaxa 2005, 864, 1–16.
11. Mirab-Balou, M.; Shi, M.; Chen, X.-X. A new species of Franklinothrips Back (Thysanoptera: Aeolothripidae) from Yunnan, China. Zootaxa 2011, 2926, 61–64.
12. Reyne, A. A Cocoonspinning Thrips. Tijdschr. Voor Entomol. 1920, 63, 40–45.
13. Pereyra, V.; Cavalleri, A. The genus Heterothrips (Thysanoptera) in Brazil, with an identification key and seven new species. Zootaxa 2012, 3237, 1–23.

14. Goldarazena, A.; Gattesco, F.; Atencio, R.; Korytowski, C. An updated checklist of the Thysanoptera of Panama with comments on host associations. Check List 2012, 8, 1232–1247.
15. Larentzaki, E.; Powell, G.; Copland, M.J. Effect of cold storage on survival, reproduction and development of adults and eggs of Franklinothrips vespiformis (Crawford). Biol. Control 2007, 43, 265–270.
16. Larentzaki, E.; Powell, G.; Copland, M.J. Effect of temperature on development, overwintering and establishment potential of Franklinothrips vespiformis in the UK. Entomol. Exp. Appl. 2007, 124, 143–151.
17. Hoddle, M.S.; Oevering, P.; Phillips, P.A.; Faber, B.A. Evaluation of augmentative releases of Franklinothrips orizabensis for control of Scirtothrips perseae in California avocado orchards. Biol. Control 2004, 30, 456–465.
18. Mahaffey, L.A.; Cranshaw, W.S. Thrips species associated with onion in Colorado. Southwest. Entomol. 2010, 35, 45–50.
19. Stannard, L.J., Jr. Peanut-winged thrips (Thysanoptera: Thripidae). Ann. Entomol. Soc. Am. 1952, 45, 327–330.
20. Stannard, L.J. Phylogenetic studies of Franklinothrips (Thysanoptera: Aeolothripidae). J. Wash. Acad. Sci. 1952, 42, 14–23.
21. Hoddle, M.S.; Mound, L.A.; Paris, D.L. Thrips of California; CBIT Publishing: Brisbane, QLD, Australia, 2012; Available online: https://keys.lucidcentral.org/keys/v3/thrips_of_california/Thrips_of_California.html (accessed on 23 November 2021).
22. Crawford, D. Some Thysanoptera of Mexico and the south. I. Pomona Coll. J. Entomol. 1909, 1, 109–119.
23. Cambero-Campos, J.; Johansen-Naime, R.; García-Martínez, O.; Cerna-Chávez, E.; Robles-Bermúdez, A.; Retana-Salazar, A. Species of thrips (Thysanoptera) in avocado orchards in Nayarit, Mexico. Fla. Entomol. 2011, 94, 982–986.
24. CABI. Invasive Species Datasheet, Franklinothrips vespiformis (Vespiform Thrips). 2021. Available online: https://www.cabi.org/isc/datasheet/24485 (accessed on 23 November 2021).
25. Greathead, D.J.; Greathead, A.H. Biological control of insect pests by insect parasitoids and predators: The BIOCAT database. Biocontrol 1992, 13, 61N–68N.
26. Callan, E.M. Natural enemies of the cacao thrips. Bull. Entomol. Res. 1943, 34, 313–321.
27. Williams, C. Plant diseases and pests: Notes on some Trinidad thrips of economic importance. Trinidad Tobago Bull. 1918, 3, 143–146.

28. Watson, J.; Hubbell, T. On a collection of Thysanoptera from Honduras. Fla. Entomol. 1924, 7, 60–62.
29. Moulton, D. The Thysanoptera of South America. Revta Entomol. 1932, 2, 464–465.
30. de França, S.M.; de Melo Júnior, L.C.; Neto, A.V.G.; Silva, P.R.R.; Lima, É.F.B.; Melo, J.W.S. Natural enemies associated with Phaseolus lunatus L. (Fabaceae) in Northeast Brazil. Fla. Entomol. 2018, 101, 688–691.
31. Lima, E.F.B.; Souza-Filho, M.F. Leucothrips furcatus (Thysanoptera Thripidae): A new pest of Sechium edule (Cucurbitaceae) in Brazil. Bull. Insectol. 2018, 71, 189–191.
32. Wang, C.-L. Two new records and two new species of thrips (Thysanoptera, Terebrantia) of Taiwan. Chin. J. Entomol. 1993, 13, 251–257.
33. Tyagi, K.; Kumar, V. Thrips (Insecta: Thysanoptera) of India-an updated checklist. Halteres 2016, 7, 64–98.
34. Mahendran, P.; Radhakrishnan, B. Franklinothrips vespiformis Crawford (Thysanoptera: Aeolothripidae), a potential predator of the tea thrips, Scirtothrips bispinosus Bagnall in south Indian tea plantations. Entomon 2019, 44, 49–55.
35. Sartiami, D.; Mound, L.A. Identification of the terebrantian thrips (Insecta, Thysanoptera) associated with cultivated plants in Java, Indonesia. ZooKeys 2013, 306, 1–21.
36. Arakaki, N.; Okajima, S. Notes on the biology and morphology of a predatory thrips, Franklinothrips vespiformis (Crawford) (Thysanoptera: Aeolothripidae): First record from Japan. Entomol. Sci. 1998, 1, 359–363.
37. Pijnakker, J.; Overgaag, D.; Guilbaud, M.; Vangansbeke, D.; Duarte, M.; Wäckers, F. Biological control of the Japanese flower thrips Thrips setosus Moulton (Thysanoptera: Thripidae) in greenhouse ornamentals. IOBC-WPRS Bull. 2019, 147, 107–112.
38. Pizzol, J.; Nammour, D.; Hervouet, P.; Poncet, C.; Desneux, N.; Maignet, P. Population dynamics of thrips and development of an integrated pest management program using the predator Franklinothrips vespiformis. In Proceedings of the XXVIII International Horticultural Congress on Science and Horticulture for People (IHC2010), Lisbon, Portugal, 22–27 August 2010; pp. 219–226.
39. Pizzol, J.; Nammour, D.; Ziegler, J.-P.; Voisin, S.; Maignet, P.; Olivier, N.; Paris, B. Efficiency of Neoseiulus cucumeris and Franklinothrips vespiformis for controlling thrips in rose greenhouses. In Proceedings of the International Symposium on High Technology for Greenhouse System Management: Greensys 2007, Naples, Italy, 4–6 October 2007; Volume 801, pp. 1493–1498.
40. Loomans, A.; Vierbergen, G. Franklinothrips: Perspectives for greenhouse pest control. IOBC WPRS Bull. 1999, 22, 157–160.

41. Zegula, T.; Sengonca, C.; Blaeser, P. Entwicklung, reproduktion und Prädationsleistung von zwei Raubthrips-arten Aeolothrips intermedius Bagnall und Franklinothrips vespiformis Crawford (Thysanoptera: Aeolothripidae) mit ernährung zweier natürlicher beutearten. Gesunde Pflanz. 2003, 55, 169–174.
42. Cox, P.; Matthews, L.; Jacobson, R.; Cannon, R.; MacLeod, A.; Walters, K. Potential for the use of biological agents for the control of Thrips palmi (Thysanoptera: Thripidae) outbreaks. Biocontrol Sci. Technol. 2006, 16, 871–891.
43. Hoddle, M.S. Predation behaviors of Franklinothrips orizabensis (Thysanoptera: Aeolothripidae) towards Scirtothrips perseae and Heliothrips haemorrhoidalis (Thysanoptera: Thripidae). Biol. Control 2003, 27, 323–328.
44. Tyagi, K.; Mound, L.; Kumar, V. Sexual dimorphism among Thysanoptera Terebrantia, with a new species from Malaysia and remarkable species from India in Aeolothripidae and Thripidae. Insect Syst. Evol. 2008, 39, 155–170.
45. Kumar, B. Thrips. In Polyphagous Pests of Crops; Omkar, Ed.; Springer: Singapore, 2021; pp. 373–407.
46. Arakaki, N.; Miyoshi, T.; Noda, H. Wolbachia-mediated parthenogenesis in the predatory thrips Franklinothrips vespiformis (Thysanoptera: Insecta). Proc. R. Soc. London Ser. B Biol. Sci. 2001, 268, 1011–1016.
47. Kumm, S.; Moritz, G. First detection of Wolbachia in arrhenotokous populations of thrips species (Thysanoptera: Thripidae and Phlaeothripidae) and its role in reproduction. Environ. Entomol. 2008, 37, 1422–1428.
48. Nguyen, D.T.; Spooner-Hart, R.N.; Riegler, M. Loss of Wolbachia but not Cardinium in the invasive range of the Australian thrips species, Pezothrips kellyanus. Biol. Invasions 2016, 18, 197–214.
49. O’Neill, K. Identification of the Newly Introduced Phlaeothripid Haplothrips? Clarisetis Priesner (Thysanoptera). Ann. Ent Soc. Am. 1960, 53, 507–510.
50. Pal, S.; Wahengbam, J.; Raut, A.; Banu, A.N. Eco-biology and management of onion thrips (Thysanoptera: Thripidae). J. Entomol. Res. 2019, 43, 371–382.
51. Putman, W.L. Notes on the predaceous thrips Haplothrips subtilissimus hal. and Aeolothrips melaleucus Hal. Can. Entomol. 1942, 74, 37–43.
52. Johansen, R.M. Algunos aspectos sobre la conducta mimetic de Franklinothrips vespiformis (Crawford (Insecta: Thysanoptera)). An. Instit. Biol. Univ. Nac. Mex. 1977, 47, 45–52.
53. Johansen, R.M. Nuevos estudios acerca del mimetismo en el genero Franklinothrips Back (Insect: Thysanoptera) en Mexico. An. Inst. Biol. Univ. Nac. Mex. 1983, 53, 133–156.