

Comparisons of three chemical treatments to determine efficacy on two species of spiders, *Tegenaria agrestis* and *Latrodectus hesperus*

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Introduction

Pest Management Professionals (PMPs) are requested to control spiders around homes and other buildings. Most spiders are beneficial; however, several species may cause medical problems and many people are not willing to share their residence with this group of organisms (Hedges 2003, 2004). Spiders are not usually tested with various chemicals to determine the efficacy of specific products. Reports from local PMPs suggest that treatment results on spiders have not always been consistent when applications for indoor and outdoor perimeter treatments or interior fogging were made for miscellaneous dooryard pests. The goal of this project was to determine which chemical group and application procedure is most effective in controlling two medically important spiders.

Two species of spiders in the Pacific Northwest and the western United States of medical importance are the hobo spider, *Tegenaria agrestis* (Walckenaer) and the black widow spider, *Latrodectus hesperus* Chamberlin and Ivie (Akre and Myhre 1991, Baird and Akre 1993, Goddard 2003, Gulmahamad 2003, Vetter 2003, Vetter et al. 2003). These tests compared three different classes of chemicals to determine which has the highest efficacy in eliminating these spiders. The groups of chemicals used in these tests include Termidor® SC, a phenyl pyrazole (fipronil); Tempo® SC Ultra, a synthetic pyrethroid (cyfluthrin); and Premise ® 2, a neonicotinoid (imidacloprid) at the highest recommended application rates for perimeter sprays. Three different application techniques were investigated: application to the (1) surface, (2) webbing, and (3) directly to the spider. All application treatments were made in the laboratory.

Methods and Materials

Female black widows and male and female hobo spiders were tested. Adult spiders were collected from the field or purchased from Hatari Invertebrates in Arizona. The majority (75%) of *Latrodectus* spiders were field collected in Arizona, shipped to Spokane, and placed in individual containers for at least one week before testing. The remaining *Latrodectus* spiders were collected in the Spokane area. All *Tegenaria* spiders were field collected under keystone concrete blocks around homes in the Spokane area. Collections were made the last two weeks in July 2004. Spiders were maintained in plastic containers (15 cm x 15 cm x 5 cm) with food (live insects) and water provided every other day. At the initiation of each test, individual spiders were exposed to carbon dioxide for 10 seconds before removal from rearing containers.

The following chemical concentrations were used: 0.06% Termidor® SC, 0.05% Tempo® SC Ultra, and 0.1% Premise® 2. The container surface or webbing was sprayed to the point of run off (3.0 ml) with a 1-liter compressed-air sprayer. Webbing was removed in containers where the substrate was sprayed. Each spider was returned to its containers one hour following the application or when the surface or webbing dried. Direct application to individual spiders was made in a separate container. Each spider was returned to its original container with the webbing removed. Each test was replicated three times. Controls followed the above procedure using applications of water.

Following treatment, spiders were observed at 1, 3, and 6 hrs and daily for 14 days. Mortality was recorded at each observation. In all containers where webbing was removed, surviving spiders reconstructed webbing within the first day.

Results

Percent mortality is shown in Table 1 for exposure to Termidor® SC with each application method for 1-6 hours and 1-5 days. Termidor® SC showed a delayed activity at day 1, after which 100% control was achieved with all applications to *L. hesperus*. For *T. agrestis* females, 33% control was achieved after 3 hours following exposure to the treated webbing and 100% control was achieved on two treated substrates: surface on day 5 and webbing on day 3. After 8 days (Table 7) 66% control was achieved by directly spraying the spider. For the *T. agrestis* males, after 1 hour of exposure, 33% were controlled on two applications: the webbing and direct application to the spider. After 3 hours, 66% was achieved on the webbing and increased to 100% on day 2. On all substrates, 100% were controlled with all applications by day 3.

Table 1. Mortality (%) of *Latrodectus hesperus* females and *Tegenaria agrestis* females and males at 1-6 hours and 1-5 days after exposure to all Termidor® SC treatment applications.

Termidor® SC								
<i>L.hesperus</i> female	1 hr	3 hr	6 hr	day1	day 2	day 3	day 4	day 5
Surface	0	0	0	100	100	100	100	100
Webbing	0	0	0	100	100	100	100	100
Spider	0	0	0	100	100	100	100	100
Avg. % mortality	0	0	0	100	100	100	100	100
<i>T.agrestis</i> female								
Surface	0	0	0	0	33	33	33	100
Webbing	0	33	33	33	33	100	100	100
Spider	0	0	0	33	33	33	33	33
Avg. % mortality	0	11	11	22	33	55	55	78
<i>T. agrestis</i> male								
Surface	0	0	0	33	33	100	100	100
Webbing	33	66	66	66	100	100	100	100
Spider	33	33	100	100	100	100	100	100

Avg. % mortality	22	33	55	66	78	100	100	100
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Tempo® SC Ultra showed a quick knock-down effect (Table 2). After 1 hour, 100% control was achieved with *L. hesperus* with two application methods: surface and direct spraying of the spider. Spraying the webbing achieved 100% control after 24 hours. For *T. agrestis* females, 33% control was achieved after exposure to the treated webbing on day two. On day three, directly spraying the spider achieved 33% control. For *T. agrestis* males, 33% control was achieved three hours after exposure to the treated surface. On day five 100% were controlled on the surface and the webbing applications.

Table 2. Mortality (%) of *Latrodectus hesperus* females and *Tegenaria agrestis* females and males at 1-6 hours and 1-5 days after exposure to all Tempo® SC Ultra treatment applications.

Tempo® SC Ultra								
<i>L.hesperus</i> female	1 hr	3 hr	6 hr	day 1	day 2	day 3	day 4	day 5
Surface	100	100	100	100	100	100	100	100
Webbing	33	33	33	100	100	100	100	100
Spider	100	100	100	100	100	100	100	100
Avg. % mortality	78	78	78	100	100	100	100	100
<i>T.agrestis</i> female								
Surface	0	0	0	0	0	0	0	0
Webbing	0	0	0	0	33	33	33	33
Spider	0	0	0	0	0	33	33	33
Avg. % mortality	0	0	0	0	11	22	22	22
<i>T. agrestis</i> male								
Surface	0	33	33	66	66	66	66	100
Webbing	0	0	33	66	66	66	66	100
Spider	0	0	66	66	66	66	66	66
Avg. % mortality	0	11	44	66	66	66	66	89

Premise® 2 had 33% control with *L. hesperus* after 24 hours by directly spraying the spider (Table 3). For *T. agrestis* females on day 3, 33% were controlled after exposure to the treated surface. Exposure to application to the webbing achieved 33% control on day 14 (Table 7). For *T. agrestis* males, direct chemical application to the spider showed a quick knock-down after 1 hour but the spider revived after 24 hours and remained alive for the 14 days of observation. On day 2 and on day 3, 33% control was achieved on the surface application and webbing application respectively.

Table 3. Mortality (%) of *Latrodectus hesperus* females and *Tegenaria agrestis* females and males at 1-6 hours and 1-5 days after exposure to all Premise® 2 treatment applications.

Premise® 2								
<i>L.hesperus</i> female	1 hr	3 hr	6 hr	day 1	day 2	day 3	day 4	day 5

Surface	0	0	0	0	0	0	0	0
Webbing	0	0	0	0	0	0	0	0
Spider	0	0	0	33	33	33	33	33
Avg. % mortality	0	0	0	11	11	11	11	11
<i>T. agrestis</i> female	0	0	0	0	0	33	33	33
Surface	0	0	0	0	0	0	0	0
Webbing	0	0	0	0	0	0	0	0
Spider	0	0	0	0	0	11	11	11
Avg. % mortality								
<i>T. agrestis</i> male								
Surface	0	0	0	0	33	33	33	33
Webbing	0	0	0	0	0	33	33	33
Spider	33	33	33	0	0	0	0	0
Avg. % mortality	11	11	11	0	11	22	22	22

All spiders in the control group survived through the 14 days of observation after exposure to all application methods using water, with the exception of one *T. agrestis* male which died after exposure to the surface application on day 3 (Table 7).

Discussion / Summary

The three application methods showed similar results. For the three chemicals, results showed application to the substrate achieved 63% control, application to the webbing achieved 67% and directly spraying the spider resulted in 55% control (Table 4).

Table 4. Summary of percent mortality by comparison of application methods per chemical treatment for all spider groups tested.

	Termidor® SC	Tempo® SC Ultra	Premise® 2	Total
Surface	100	66	22	63
Webbing	100	78	22	67
Spider	89	66	11	55

When all the spider groups were considered, Termidor® SC achieved 96% mortality, while Tempo® SC Ultra achieved 70% mortality (Table 5). Premise® 2 controlled only 18% after 14 days.

Table 5. Summary of percent mortality of the spider groups tested per chemical treatment for all application methods.

	Termidor® SC	Tempo® SC Ultra	Premise® 2
<i>L. hesperus</i> female	100	100	11
<i>T. agrestis</i> female	87	22	22
<i>T. agrestis</i> male	100	89	22
Total	96	70	18

Both Termidor® SC and Tempo® SC Ultra controlled 100% of black widow spiders after day 1 (Table 6). Termidor® SC had delayed activity on day 1, while Tempo® SC Ultra controlled 78% 1 hour after exposure. Premise® 2 controlled 11% of black widows on day 1.

Table 6. Summary of percent mortality for *Latrodectus hesperus* females, *Tegenaria agrestis* females and males following exposure to Termidor® SC, Tempo® Ultra and Premise® 2 at 1-6 hours and 1-5 days.

Hour/day	Spider	Termidor® SC	Tempo® SC Ultra	Premise® 2
1 hr	<i>L.hesperus</i> female	0	78	0
	<i>T. agrestis</i> female	0	0	0
	<i>T. agrestis</i> male	22	0	11
3 hrs	<i>L.hesperus</i> female	0	78	0
	<i>T. agrestis</i> female	11	0	0
	<i>T. agrestis</i> male	33	11	11
6 hrs	<i>L.hesperus</i> female	0	78	0
	<i>T. agrestis</i> female	11	0	0
	<i>T. agrestis</i> male	56	44	11
1 day	<i>L.hesperus</i> female	100	100	11
	<i>T. agrestis</i> female	22	0	0
	<i>T. agrestis</i> male	67	67	0
2 days	<i>L.hesperus</i> female	100	100	33
	<i>T. agrestis</i> female	33	11	0
	<i>T. agrestis</i> male	78	67	11
3 days	<i>L.hesperus</i> female	100	100	11
	<i>T. agrestis</i> female	56	22	11
	<i>T. agrestis</i> male	100	67	22
4 days	<i>L.hesperus</i> female	100	100	11
	<i>T. agrestis</i> female	56	22	11
	<i>T. agrestis</i> male	100	67	22
5 days	<i>L.hesperus</i> female	100	100	11
	<i>T. agrestis</i> female	78	22	11
	<i>T. agrestis</i> male	100	78	22

There was a difference in the control between genders of *T. agrestis*. Termidor® SC controlled 11% of the *T. agrestis* females after 3 hours but mortality increased to 78% after 5 days. Tempo® SC Ultra controlled 11% of the females after 2 days and increased to 22% on day 3. Premise® 2 controlled 11% of the females after 3 days and increased to 22% on day 14. For the *T. agrestis* males, Termidor® SC controlled 22% after the first hour of exposure and increased to 100% control on day 3. Tempo® SC Ultra controlled 11% of the males after 3 hours and on day 5 increased to 78%. Premise® 2 controlled 11% of the males after 1 hour but the spider revived after a 1 day period and remained alive. After 3 days Premise® 2 controlled 22% of the males.

Research on chemical sensitivity to spiders is difficult because large numbers of spiders are not readily available for bioassay. These tests were limited to three replications per chemical per application method. Of the three classes of chemicals used in perimeter treatments, these three spider groups were most sensitive to phenyl pyrazole and the synthetic pyrethroid. The spiders were least sensitive to imidacloprid. Termidor is not currently labeled for spider control; however, in perimeter treatments for other insects such as carpenter ants, spiders are secondarily exposed.

Black widows were more sensitive than hobo spiders and hobo males were more sensitive than hobo females. This work was limited to only two species of spiders which belong to two families: Theridiidae and Agelenidae. Other spider groups may show different sensitivities to these chemicals.

Table 7. Mortality (%) of spiders following exposure to all chemical treatments per application method after 1-6 hours and 1-14 days.

Termidor® SC																	
Surface	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> female	0	0	0	0	33	33	33	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> male	0	0	0	33	33	100	100	100	100	100	100	100	100	100	100	100	100
Webbing	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> female	0	33	33	33	33	100	100	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> male	33	66	66	66	100	100	100	100	100	100	100	100	100	100	100	100	100
Spider	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> female	0	0	0	33	33	33	33	33	33	33	66	66	66	66	66	66	66
<i>T. agrestis</i> male	33	33	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Tempo® SC Ultra																	
Surface	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> male	0	33	33	66	66	66	66	100	100	100	100	100	100	100	100	100	100

Webbing	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	33	33	33	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> female	0	0	0	0	33	33	33	33	33	33	33	33	33	33	33	33	33
<i>T. agrestis</i> male	0	0	33	66	66	66	66	100	100	100	100	100	100	100	100	100	100
Spider	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
<i>T. agrestis</i> female	0	0	0	0	0	33	33	33	33	33	33	33	33	33	33	33	33
<i>T. agrestis</i> male	0	0	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Premise® 2																	
Surface	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> female	0	0	0	0	0	33	33	33	33	33	33	33	33	33	33	33	33
<i>T. agrestis</i> male	0	0	0	0	33	33	33	33	33	33	33	33	33	33	33	33	33
Webbing	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
<i>T. agrestis</i> male	0	0	0	0	0	33	33	33	33	33	33	33	33	33	33	33	33
Spider	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	33	33	33	33	33	33	33	33	33	33	33	33	33	33
<i>T. agrestis</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> male	33	33	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Control																	
Surface	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> male	0	0	0	0	0	33	33	33	33	33	33	33	33	33	33	33	33
Webbing	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> male	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spider	1hr	3hr	6hr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>L.hesperus</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>T. agrestis</i> male	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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