# Efficacy of RADIANT (Spinetoram) Against Western Flower Thrips in Romaine Lettuce

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## *Abstract*

*RADIANT, a new 2nd generation spinosyn insecticide has recently been introduced to the vegetable industry that has shown excellent activity against western flower thrips in lettuce. Several studies were conducted over 2 growing seasons at the Yuma Ag Center to evaluate the efficacy of RADIANT against thrips in romaine lettuce. Three trials were conducted in spring lettuce under moderate and heavy population pressure, and two fall trials were conducted under low to moderate thrips pressure. In each study, RADIANT performed statistically comparable to or better than Success for control of thrips, but at lower use rates. It appears to provide better residual activity against larvae than Success and the standard compounds presently used, but does not appear to provide any additional adult efficacy. RADIANT will be an excellent addition to our IPM programs, however because it has the same mode-of-action as Success, it will not provide an additional rotational partner for our resistance management programs.*

## Introduction

Western flower thrips (WFT) , *Frankiniella occidentalis*, have become a serious pest in romaine lettuce production. This thrips species is polyphagous and appears to have a wide host range in most vegetable producing areas. They occur on lettuce throughout the growing season and are present in damaging numbers in Oct and Nov and can build up to very serious damaging numbers again in Feb through April. Adults often migrate onto lettuce crops during the winter months as weeds and other host plants dry down or are harvested. WFT are considered a pest because of the cosmetic damage they cause romaine leaves and hearts. Grower tolerance for WFT damage and contamination has recently become very low in romaine lettuce. Consequently, PCAs rely almost exclusively on insecticide applications to prevent WFT damage and have a limited number of effective treatment options. Success, Lannate and pyrethroids are presently the most frequently used products. RADIANT, a new reduced-risk insecticide from Dow AgroSciences has recently been introduced to the vegetable industry that has shown excellent activity against WFT. This macrocyclic lactone compound is considered a 2nd generation sprinosyn, similar to spinosad (Success). However, it reportedly has a broader spectrum than Success and appears to be more active at lower use rates. Registration on leafy vegetables, melons and other important desert crops is pending, but a label is anticipated in the next year or so. The objective of these studies was to evaluate the efficacy of RADIANT against WFT compared with Success, Lannate and other insecticides

## Materials and Methods

**Spring 2005 –Trial I**: The field trial was conducted at the University of Arizona Yuma Agricultural Center. Romaine lettuce 'Fresh heart' was direct seeded 1 Dec into double row beds on 42 inch centers Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Each treatment was replicated four times and arranged in a randomized complete block design. Insecticide treatments and rates used in the trial are found in Tables1 and 2. The foliar applications were made with a $CO_2$ operated boom sprayer operated at 60 psi and 20.5 GPA. A broadcast spray was delivered through 2 TX-18 ConeJet nozzles per bed. An adjuvant, DyneAmic, was applied at 0.125%v/v with all spray applications. Sprays were applied on Feb 9, 15 and 25. No other pesticides were applied.

**Spring 2005 –Trial II**: The field trial was conducted at the University of Arizona Yuma Agricultural Center. Romaine lettuce 'PIC 715'was direct seeded 20 Jan into double row beds on 42 inch centers Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots were two beds wide by 30 ft long and bordered by two untreated beds. Each treatment was replicated four times and arranged in a randomized complete block design. Insecticide treatments and rates used in the trial are found in Tables 3-5. The foliar applications were made with a $CO_2$ operated boom sprayer operated at 60 psi and 20.5 GPA. A broadcast spray was delivered through 2 TX-18 ConeJet nozzles per bed. An adjuvant, DyneAmic, was applied at 0.125%v/v with all spray applications. Sprays were applied on Feb 25, Mar 7 and Mar 17. No other pesticides were applied.

**Fall 2005 –Trial I**: The field trial was conducted at the University of Arizona Yuma Agricultural Center. Romaine lettuce 'Rubicon' was direct seeded 8 Sep into double row beds on 42 inch centers Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Each treatment was replicated four times and arranged in a randomized complete block design. Insecticide treatments and rates used in the trial are found in Tables 6-7. The foliar applications were made with a $CO_2$ operated boom sprayer operated at 60 psi and 20.5 GPA. A broadcast spray was delivered through 2 TX-18 ConeJet nozzles per bed. An adjuvant, DyneAmic, was applied at 0.125%v/v with all spray applications. Sprays were applied on Oct 9, 16 and 22. No other pesticides were applied.

**Fall 2005 –Trial II**: The field trial was conducted at the University of Arizona Yuma Agricultural Center. Romaine lettuce 'PIC 715' was direct seeded 20 Sep into double row beds on 42 inch centers Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Each treatment was replicated four times and arranged in a randomized complete block design. Insecticide treatments and rates used in the trial are found in Tables 8-9. The foliar applications were made with a $CO_2$ operated boom sprayer operated at 60 psi and 20.5 GPA. A broadcast spray was delivered through 2 TX-18 ConeJet nozzles per bed. An adjuvant, DyneAmic, was applied at 0.125%v/v with all spray applications. Sprays were applied on Oct 31, Nov 8 and 17. No other pesticides were applied.

**Spring 2006**: The field trial was conducted at the University of Arizona Yuma Agricultural Center. Romaine lettuce 'PIC 715' was direct seeded 18 Jan into double row beds on 42 inch centers Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots were two beds wide by 33 ft long and bordered by two untreated beds. Each treatment was replicated four times and arranged in a randomized complete block design. Insecticide treatments and rates used in the trial are found in Tables 10-11. The foliar applications were made with a $CO_2$ operated boom sprayer operated at 60 psi and 20.5 GPA. A broadcast spray was delivered through 2 TX-18 ConeJet nozzles per bed. An adjuvant, DyneAmic, was applied at 0.125%v/v with all spray applications. Sprays were applied on Mar 6, 13 , 20 and 31. On the third (Mar 20) and fourth (Mar 31 ) applications, the rate of Lannate was increased to 0.75 lb/ac and Mustang Max was applied at 4 oz/ac instead of Renounce. Also on the fourth application, the Success–only treatment was increased to 9 oz/ac and the rate of RADIANT was increased to 7 oz/ac. No other pesticides were applied.

**Sampling and Statistical Analysis**: Evaluation of WFT control in each study was based on the number of live adults and nymphs per plant sampled from the center 2 rows of each replicate at intervals following each application. Numbers of WFT adults and larvae from 5 plants per replicate were recorded on each sample. Samples were taken by removing plants and beating them vigorously against a screened pan for a predetermined duration. Inside of the pan was a sticky trap to catch the dislodged WFT. Sticky traps were then taken to the laboratory where adult and larvae were counted. WFT adult and larvae numbers were subjected to a two-way analysis of variance using the SAS statistical software. When analysis of variance was significant ($p<0.05$), the mean values were subjected to a protected $LSD_{(p<0.05)}$ F test to distinguish treatment differences.

## Results and Discussion

In each study we conducted, RADIANT performed statistically comparable to or better than Success and at lower use rates. This was most evident in the spring 2005–Trial I where RADIANT applied at rates as low as 2 oz /acre provided the same level of adult and larval WFT control as Success applied at 6 oz (Table 1 and 2). This is particularly important since the RADIANT formulation used in these trials was a 1 lb ai/gal material versus the 2 lb ai/gal Success 2SC formulation. Although the spinosyn class of chemistry is inherently weaker on adult WFT, RADIANT provided adult control comparable to the Lannate +Warrior standard on several post-treatment samples. In the spring 2005–Trial II,

RADIANT was compared to Lannate +Mustang and Beleaf (an aphicide with marginal WFT activity) + Mustang. Adult pressure was much heavier and RADIANT did not provide consistent knockdown of adult WFT (Tables 3-5). In some cases, WFT adult numbers were statistically higher in the RADIANT than in the untreated check. It is not uncommon to measure poor efficacy against adults in late spring trials due to the daily movement of WFT adults from field to field this time of the year, particularly in small plots. The lettuce plants treated with RADIANT may have also been more attractive to migrating adults as very little feeding damage was observed on treated plants, a result of the excellent larval control. The highly significant reduction in larvae numbers was clearly evident following the 3rd application (Table 5).

In the Fall 2005 Trial I, RADIANT provided as good or better control of WFT adult and larvae than Success, which was again applied at a higher rate (Table 6 and 7). In the Fall 2005 Trial II, RADIANT provided larval WFT control comparable to the standard Lannate+Mustang under higher population pressure (Table 8 and 9). In most cases, RADIANT provided statistically similar suppression of adults as well. Measurement of adult efficacy is generally much more accurate in fall trials as adult numbers are lower and not moving a great deal between plots.

RADIANT again showed excellent control of WFT larvae in the final trial (Spring 2006). Efficacy was comparable to its sister compound Success, and statistically superior to Lannate+Renounce in many post-treatment evaluations (Table 10-11). We also included a Success + Renounce treatment and it did not provide significantly better control of WFT larvae than RADIANT. The addition of the pyrethroid to both Success and Lannate did provide statistically better efficacy against WFT adults, however by the end of the trial adult numbers were high in all the treatments, even with the use of higher rates on the last application. Again, the lack of measurable adult control was probably somewhat masked by the daily inter-plot movement of adults.

In summary, application of RADIANT to romaine lettuce showed significant activity against WFT comparable to Success, but at lower use rates. This is important as many consider that Success is presently used in produce production at low rates. It appears to provide better residual activity against larvae than the standard compounds presently used, but does not appear to provide any additional adult efficacy. We plan to further evaluate RADIANT in combination with pyrethroids and other active ingredients to determine if adult activity can be significantly enhanced. RADIANT also has excellent residual activity against our lepidopterous larvae complex in lettuce (JCP, unpublished data), and will be an excellent addition to our IPM programs. Because of its enhanced residual activity at low use rates against WFT and Lep larvae, it will likely replace Success uses in produce crops. Unfortunately, because it has the same mode-of-action as Success, it will not provide an additional rotational partner for our resistance management programs.

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Table 1. Adult WFT numbers on spring romaine lettuce, 2005 – Trial I

| | | Mean WFT adults / Plant | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate** | **9-Feb** | **14-Feb** | **17-Feb** | **21-Feb** | **25-Feb** | **28-Feb** | **4-Mar** |
| RADIANT | 7 oz | 3.0a | 2.7 bc | 3.6 b | 2.5 bc | 5.1 a | 8.3 b | 13.7 b |
| RADIANT | 5 oz | 3.5a | 3.7 bc | 3.5 b | 2.7 bc | 6.0 a | 7.6 bc | 16.7 b |
| RADIANT | 3 oz | 4.5a | 2.9 bc | 3.1 b | 2.3 bc | 7.0 a | 8.8 b | 16.5 b |
| RADIANT | 2 oz | 2.5a | 3.8 bc | 3.5 b | 3.5 bc | 5.9 a | 9.3 ab | 19.2 b |
| Success 2SC | 6 oz | 3.1a | 4.3 b | 3.3 b | 3.7 b | 4.3 a | 7.3 bc | 17.1 b |
| Lannate+Warrior | 0.8 lb+ 3.8 oz | 3.1a | 1.9 c | 0.8 c | 1.7 c | 4.3 a | 3.6 c | 13.3 b |
| Untreated | -- | 3.0a | 7.3 a | 7.1 a | 6.3 a | 6.8 a | 13.9 a | 29.7 a |

Means followed by the same letter are not significantly different, SAS ANOVA, protected $LSD_{(p>0.05)}$

Table 2. Larvae WFT numbers on spring romaine lettuce, 2005 – Trial I

| | | Mean WFT larvae/ Plant | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate** | **9-Feb** | **14-Feb** | **17-Feb** | **21-Feb** | **25-Feb** | **28-Feb** | **4-Mar** |
| RADIANT | 7 oz | 10.2a | 8.5 bc | 6.7 bc | 2.0 b | 1.5 b | 2.0 b | 0.5 b |
| RADIANT | 5 oz | 11.2a | 5.8 c | 7.1 bc | 3.7 b | 1.3 b | 1.7 b | 0.2 b |
| RADIANT | 3 oz | 13.0a | 8.0 bc | 12.6 b | 2.3 b | 2.5 b | 1.7 b | 0.3 b |
| RADIANT | 2 oz | 12.3a | 10.8 bc | 11.5 bc | 3.7 b | 2.7 b | 2.9 b | 0.4 b |
| Success 2SC | 6 oz | 12.8a | 11.9 b | 11.9 bc | 3.5 b | 2.5 b | 2.0 b | 0.7 b |
| Lannate+Warrior | 0.8 lb+ 3.8 oz | 13.0a | 7.9 bc | 5.2 c | 4.1 b | 2.9 b | 1.6 b | 0.9 b |
| Untreated | -- | 13.2a | 18.9 a | 25.9 a | 20.8 a | 23.1 a | 13.7 b | 4.8 a |

Means followed by the same letter are not significantly different, SAS ANOVA, protected $LSD_{(p>0.05)}$

Table 3. Adult and Larvae WFT numbers following the first application on spring romaine lettuce, 2005 – Trial II.

| **Application # 1** | | **Mean WFT / Plant** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1-Mar** | | **4-Mar** | | **7-Mar** | |
| **Treatment** | **Rate/ac** | **Adult** | **Larvae** | **Adult** | **Larvae** | **Adult** | **Larvae** |
| Mustang+Lannate | 4 oz + 0.8 lb | 6.3 b | 6.1 bc | 13.1 b | 5.1 b | 19.1 cd | 4.3 ab |
| Mustang+Beleaf | 4 oz+2.3 oz | 28.5 a | 8.1 b | 27.5 a | 8.9 a | 28.3 ab | 7.8 a |
| RADIANT | 5 oz | 13.9 b | 2.7 c | 16.7 b | 1.3 c | 23.1 bc | 1.2 b |
| Untreated | -- | 23.9 a | 17.5 a | 19.7 b | 8.8 a | 18.2 d | 5.4 a |

Table 4. Adult and Larvae WFT numbers following the second application on spring romaine lettuce, 2005 – Trial II.

| **Application # 2** | | **Mean WFT / Plant** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **11-Mar** | | **14-Mar** | | **17-Mar** | |
| **Treatment** | **Rate/ac** | **Adult** | **Larvae** | **Adult** | **Larvae** | **Adult** | **Larvae** |
| Mustang+Lannate | 4 oz + 0.8 lb | 49.4 b | 6.0 b | 90.7 b | 33.2 b | 66.6 a | 59.3 b |
| Mustang+Beleaf | 4 oz+2.3 oz | 36.4 b | 16.8 b | 80.7 b | 70.4 b | 84.0 a | 72.0 b |
| RADIANT | 5 oz | 94.8 a | 2.3 b | 109.9 a | 10.6 b | 81.3 a | 24.7 b |
| Untreated | | 53.0 b | 83.6 a | 82.2 b | 170.7 a | 70.0 a | 204.0 a |

Table 5. Adult and Larvae WFT numbers following the second application on spring romaine lettuce, 2005 – Trial II.

| **Application # 3** | | **Mean WFT / Plant** | | | | | |
|---|---|---|---|---|---|---|---|
| | | **21-Mar** | | **24-Mar** | | **28-Mar** | |
| **Treatment** | **Rate/ac** | **Adult** | **Larvae** | **Adult** | **Larvae** | **Adult** | **Larvae** |
| Mustang+Lannate | 4 oz + 0.8 lb | 42.6 b | 30.7 b | 60.0 a | 100.0 a | 104.0 a | 60.0 c |
| Mustang+Beleaf | 4 oz+2.3 oz | 42.0 b | 75.3 b | 62.3 a | 94.7 a | 138.0 a | 98.7 b |
| RADIANT | 5 oz | 90.7 a | 25.3 b | 78.7 a | 18.0 b | 119.3 a | 4.7 d |
| Untreated | | 64.7 b | 255.3 a | 79.3 a | 165.3 a | 142.7 a | 210.7 a |

Means followed by the same letter are not significantly different, SAS ANOVA, protected $LSD_{(p>0.05)}$

Table 6. Adult WFT numbers on fall romaine lettuce, 2005 – Trial I.

| | | Mean WFT adults / plant | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate/ac** | **7-Oct** | **11-Oct** | **15-Oct** | **19-Oct** | **22-Oct** | **27-Oct** | **3-Nov** | **8- Nov** |
| Success | 6 oz | 0.8 a | 1.8 ab | 5.3 a | 1.8 b | 3.3 c | 5.2 ab | 4.1 ab | 6.3 a |
| XDE 175 | 5 oz | 0.9 a | 1.0 b | 5.3 a | 1.9 b | 2.8 b | 3.4 b | 3.8 b | 4.5 a |
| UTC | . | 0.7 a | 3.8 a | 4.9 a | 4.2 a | 5.3 a | 5.8 a | 5.7 a | 7.0 a |

Table 7. Larvae WFT numbers on fall romaine lettuce, 2005 – Trial I.

| | | Mean WFT larvae / plant | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate/ac** | **7-Oct** | **11-Oct** | **15-Oct** | **19-Oct** | **22-Oct** | **27-Oct** | **3- Nov** | **8-Nov** |
| Success | 6 oz | 0.9 a | 2.9 a | 1.1 b | 0.2 b | 1.0 b | 0.4 b | 0.9 b | 2.7 b |
| XDE 175 | 5 oz | 1.0a | 2.7 a | 1.0 b | 0.2 b | 0.3 b | 0.1 b | 0.3 b | 1.0 b |
| UTC | . | 1.0 a | 8.4 a | 3.4 a | 1.6 a | 2.4 a | 3.2 a | 6.6 a | 7.0 a |

Means followed by the same letter are not significantly different, SAS ANOVA, protected $LSD_{(p>0.05)}$

Table 8. Adult WFT numbers on fall romaine lettuce, 2005 – Trial II.

| | | Mean WFT adults / plant | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate** | **27-Oct** | **3-Nov** | **7-Nov** | **11-Jan** | **16-Nov** | **23-Nov** |
| Lannate+Mustang | 0.5 lb+ 4 oz | 9.7a | 2.6 c | 3.8 b | 2.2 c | 3.8 c | 1.5 b |
| Success | 6 oz | 9.9a | 5.1 a | 4.3 b | 4.8 b | 7.0 b | 4.3 b |
| XDE 175 | 5 oz | 9.9a | 3.9 b | 5.5 ab | 3.4 bc | 4.2 bc | 3.1 b |
| UTC | . | 7.0a | 6.2 a | 7.0 a | 10.7 a | 11.3 a | 9.3 a |

Table 9. Larvae WFT numbers on fall romaine lettuce, 2005 – Trial II.

| | | Mean WFT larvae / plant | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate** | **27-Oct** | **3-Nov** | **7-Nov** | **11-Jan** | **16-Nov** | **23-Nov** |
| Lannate+Mustang | 0.5 lb+ 4 oz | 82.4a | 26.4 bc | 16.1 bc | 4.1 c | 0.7 c | 0.9 b |
| Success | 6 oz | 75.7a | 25.3 bc | 12.8 c | 3.6 c | 2.8 b | 1.7 b |
| XDE 175 | 5 oz | 71.7a | 14.0 c | 10.5 c | 1.9 c | 0.8 c | 1.5 b |
| UTC | . | 88.0a | 46.3 a | 37.9 a | 18.1 a | 11.2 a | 10.0 a |

Means followed by the same letter are not significantly different, ANOVA, protected $LSD_{(p>0.05)}$

Table 10. Adult WFT numbers on spring romaine lettuce, 2006.

| | | Mean WFT adults / plant | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate** | **3-Mar** | **9-Mar** | **13-Mar** | **17-Mar** | **20-Mar** | **24-Mar** | **29-Mar** | **6-Apr** | **10-Apr** | **13-Apr** |
| Lannate+Renounce | 0.5 lb+3.5 oz | 12.8a | 2.0c | 6.2c | 5.1b | 8.5a | 12.7c | 60.0a | 28.5bc | 43.5a | 133.8a |
| Success+Renounce | 5 oz + 3.5 oz | 12.0a | 2.0c | 8.2b | 6.0b | 12.0a | 15.5c | 51.9a | 21.0c | 61.8a | 105.6a |
| Success | 6 oz | 12.1a | 3.3bc | 7.3bc | 10.0a | 14.8a | 23.4b | 63.0a | 33.3ab | 56.1a | 79.2b |
| RADIANT | 5 oz | 11.8a | 3.8b | 5.7c | 12.3a | 14.2a | 25.2b | 56.7a | 29.7b | 46.8a | 75.0b |
| UTC | - | 12.0a | 9.1a | 14.6a | 11.8a | 10.2a | 31.6a | 40.9a | 39.9a | 63.0a | 75.6b |

Table 11. Larvae WFT numbers on spring romaine lettuce, 2006.

| | | Mean WFT larvae / plant | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate** | **3-Mar** | **9-Mar** | **13-Mar** | **17-Mar** | **20-Mar** | **24-Mar** | **29-Mar** | **6-Apr** | **10-Apr** | **13-Apr** |
| Lannate+Renounce | 0.5 lb+3.5 oz | 1.6a | 4.2c | 16.0c | 18.5b | 15.8b | 11.1b | 25.2b | 24.0b | 97.2a | 70.5b |
| Success+Renounce | 5 oz + 3.5 oz | 3.1a | 9.6b | 22.5b | 24.0b | 16.4b | 8.7b | 33.6b | 17.7bc | 37.5bc | 44.4bc |
| Success | 6 oz | 2.4a | 7.4bc | 12.1c | 6.6c | 8.7bc | 5.9bc | 43.8b | 13.5c | 41.4b | 35.1cd |
| RADIANT | 5 oz | 2.2a | 4.3c | 5.9d | 3.6c | 2.8c | 1.4c | 15.3b | 8.7c | 15.3c | 21.6d |
| UTC | - | 2.6a | 16.8a | 35.7a | 60.7a | 63.5a | 77.3a | 92.7a | 53.1a | 52.2b | 166.6a |

Means followed by the same letter are not significantly different, SAS ANOVA, protected $LSD_{(p>0.05)}$