Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(5): 1964-1967

Received: 03-07-2018
Accepted: 04-08-2018

**KD Bisane**
Fruit Research Station, ICAR-AICRP on Fruits (Banana, Papaya and Sapota), Navsari Agricultural University, Gandevi, Gujarat, India

**NM Patil**
Banana Research Station, Mahatma Phule Krishi Vidyapeeth, Jalgaon, Maharashtra, India

**B Padmanaban**
ICAR-National Research Centre for Banana, Tiruchirappalli, Tamil Nadu, India

**SP Saxena**
Fruit Research Station, ICAR-AICRP on Fruits (Banana, Papaya and Sapota), Navsari Agricultural University, Gandevi, Gujarat, India

**Prakash Patil**
Project Coordinator (Fruits), ICAR-All India Coordinated Research Project on Fruits, ICAR-IIHR, Bengaluru, Karnataka, India

**Correspondence**
**KD Bisane**
Fruit Research Station, ICAR-AICRP on Fruits (Banana, Papaya and Sapota), Navsari Agricultural University, Gandevi, Gujarat, India

# Technique for management of banana red rust thrips, *Chaetanophothrips signipennis* (Bagnall)

**KD Bisane, NM Patil, B Padmanaban, SP Saxena and Prakash Patil**

**Abstract**
Red rust thrips, *Chaetanophothrips signipennis* (Bagnall) (Thripidae: Thysanoptera), is a major concern affecting the commercial value of fruits in the banana-growing belt of Gujarat and Maharashtra, as well as Tamil Nadu, India. In this context, a multi-location trial was attempted at F.R.S., Gandevi, B.R.S., Jalgaon and ICAR-NRCB, Tiruchirappalli under the ICAR-AICRP (Fruits) program. Results observed over three years of the efficacy of bio-rational pesticides for rust thrips management indicated that bud injection of imidacloprid (0.3 ml/500 ml water) @ 1 ml/bud minimized fruit infestation by rust thrips up to 9.08% at Gandevi, Gujarat and 13.81% at Jalgaon, Maharashtra over the conventional spraying and bunch sleeving method. Significantly comparable data was observed with bud injection of azadirachtin (1%) (5 ml/l water) @ 2 ml/bud over conventional spray at both the locations. At Tiruchirappalli, Tamil Nadu, on the other hand, a higher number of blemish-free fruits was produced by bud injection with imidacloprid @ 1 ml/bud and bunch sleeving at the shooting stage. The virtues of effective technology furnished a higher number of unblemished fruits and original peel superficial appearance remains impassive under the bud injection method with imidacloprid and azadicacthin as well as a better BC ratio offered due to very low dose of pesticide. Also, the imidacloprid residue was not detected in the fruit at harvest.

**Keywords:** Red rust thrips, *Chaetanophothrips signipennis* (Bagnall), Banana

## 1. Introduction
India is the leading banana-producing country in the world. Banana is one of the cheapest staple foods for millions in the world and has a vital role in supplying the nutritional requirements in the human diet. With the current scenario of increased banana productivity, ensuring quality of the fruit is a major worry among producers. Their biggest challenge is to be able to offer high market price with low plant protection expenditure.
Given this requirement, the attack by different insect pests, mites and nematodes limits the quantitative and qualitative aspect of banana and plantains. About 19 insect pests were found to cause damage in banana in India, resulting in economic loss [7]. Among them, red rust thrips, *Chaetanophothrips signipennis* (Bagnall) (Thysanoptera: Thripidae), affect the cosmetic value of the fruits, which results in low sale price at the wholesale and retail market. There is no loss in productivity of banana due to rust thrips infestation, but the fruit quality deteriorates, leading to lower market rate grades.
The primary host for rust thrips is banana, anthurium and dracaena although they are also known to infest immature fruits of orange, mandarin, tomatoes and green peas [6]. Similarly, feeding has been recorded on citrus and tomato and a number of species of weeds [11]. This pest has a diverse distribution in Asia, particularly in India, Indonesia, Java, Philippines and Sri Lanka. In the Western Hemisphere, it has been reported in Brazil, Costa Rica, French West Indies, Honduras, Mexico, Panama, Puerto Rico and Trinidad and Tobago. In the USA, it is present in Hawaii and Florida. In Oceania, banana thrips have been recorded in New South Wales and Queensland (Australia), and Fiji and Papua New Guinea [10]. In Florida, these thrips feed on foliage on a wide range of foliage plants, whereas it is a banana pest in Central America where it caused 'banana rust' [4]. Banana rust thrips are similar in appearance to two other introduced *Chaetanaphothrips* species, the anthurium thrips, *C. orchidii* (Moulton) and *C. leeuweni* (Karny), which also share the same hosts, including banana, and anthurium [5]. Banana rust thrips differentiated from the other two species by clear differences in body features (specifically, the presence in females of body hairs and glands that are visible only with a microscope) [9].

In India, red rust thrips, *C. signipennis*, is becoming a significant pest in many banana growing belts of the country, especially Gujarat, Maharashtra and Tamil Nadu, mainly because they limit the marketability of the produce although quality in terms of taste and nutrition remains unaffected. Red rust thrips cause infestation on a few plant species only and banana plants are the only sources of infestation in a plantation.

As part of its life cycle, the females lay eggs in plant tissues and newly hatched yellow nymphs feed for a few days. The mature nymphs migrate off the host into the soil and undergo pupation. The entire biology is completed in approximately 28 days [6].

Red thrips hide inside the flower bud. Therefore, conventional spraying by using insecticides during the fruiting stage would be uneconomical and also harmful to natural enemies. Further, non-judicious use of a pesticide may lead to residue problems and such contaminated food situations can pose a health risk to humans and other forms of the life. Also, no technology is yet available that can be used to manage red rust thrips, except some conventional spraying methods with insecticides and microbial agents. But such methods are too late to keep the cosmetic value of the fruits as such until maturity. With this consideration, the bud injection technique was evaluated over other bio-rational pesticides for managing banana red rust thrips, *C. signipennis*, at different locations.

## 2. Materials and Methods

### 2.1 Experimental details: Treatments and design of layout

The farm trials were laid out with nine treatments designed in RBD and replicated three times to test the bud injection technique for management of rust thrips, *C. signipennis*, as against the conventional method of spraying and bunch sleeving. The trial was framed and tested at Tirukkattupalli, Thanjavur District conducted by ICAR-NRCB, Tiruchirappalli, during 2009–10 and 2010–11, and later with modifications such as lowering the dose of bud injection. The multi-location experiment was initiated at the research farm of F. R. S., Gandevi and B. R. S., Jalgaon for three consecutive years [2011–12, 2012–13 and 2013–14] under the ICAR-AICRP (Fruits) program.

The bud injection technique, which uses imidacloprid 17.8 SL (0.3 ml/500 ml water) @ 1 ml/bud and Azadirachtin (1%) (5 ml/l water) @ 2 ml/bud, was compared with bunch sleeving at shooting stage (100 gauge thickness, 6% ventilation) and conventional spraying of different botanicals such as azadirachtin (1%) @ 5ml/l, neem seed kernels extract (5%), neem oil (1%) @ 2 ml/l, pongamia oil (1%) and chlorpyriphos 20 EC (0.05%) @ 2.5 ml/l as standard check and control. In the earlier trial at Tiruchirappalli, the dose of imidacloprid 17.8 SL solution was slightly different [0.1 ml/500 ml water and bud injection @ 1 ml/bud]. For this investigation program, Grand Naine from Gujarat and Maharashtra was chosen as the commercial variety of banana for cultivation at Gandevi and Jalgaon, whereas at Tiruchirappalli (Tamil Nadu), the Poovan variety was tested due to severe thrips damage.

The first spray of the conventional pesticide *viz.*, azadirachtin (1%); neem seed kernels extract (5%); neem oil (1%); pongamia oil (1%) and chlorpyriphos 20 EC was applied in banana at the time of shooting and the second spray after opening of all hands. Bud injection with Azadirachtin (1%) and imidacloprid 17.8 SL was given during the time of flower emergence when the flower was in an upright position at an angle of $30^0$, leaving one-fourth length of the bud from the top. Bunch sleeving was done at shooting stage by using polythene of 100 gauge thickness containing 6% ventilation in the form of holes.

### 2.2 Observations

The total number of fruits and infested fruits were counted to record percent fruit infestation due to rust thrips. Similarly, bunch weight and yield of unblemished fruits were recorded. The annual yield of healthy fruits was recorded during each year and the economics was calculated on pooled yield during the concluding year. All the necessary recommended crop protection practices for other pests were followed during the banana cropping season. Due to apprehensions about the presence of residual imidacloprid 17.8 SL in the fruit at the time of harvest, the fruit sample was tested at the Food Quality Testing Laboratory, NAU, Navsari (Gujarat) and ICAR-National Research Centre for Grapes, Pune (Maharashtra).

### 2.3 Statistical Analysis

The data on fruit infestation values were duly transformed into the corresponding arc sing values and subjected to analysis of variance.

## 3. Results and Discussion

Adult banana rust thrips reproduce sexually and congregate on fruits, mainly where the fruits touch each other. Both the adult and the nymph of thrips feed by puncturing the plant's surface cells and sucking the sap, causing reddish brown oval stains or red spots on the finger, which can extend over the entire length of the fruit. Sometimes, during severe infestation, peel cracking is also observed. Infestation on fruit bunches was seen to occur across the phases of crop growth, but damage symptoms appeared only when the bunches emerged at crop maturity. When the fruits are infested with rust thrips, the market value is reduced although the quality of fruits is not affected and the fruits remain edible. It is also seen that commercial cultivars such as Poovan (Mysore–AAB), Monthan (Bluggoe–ABB), Saba (ABB–Bluggoe), Ney Poovan (Pome–AB) and Rasthali (Silk–AAB) are more susceptible to rust thrips [7].

Peak damage symptoms due to red rust thrips appeared from August onwards, displaying 14% to 30% symptoms from August to November during 2009–11 [1] and 22% to 35% symptoms between August and October at the fruiting stage during 2013–14 at Jalgaon [1]. At Gandevi, however, fruit damage due to red rust flower thrips commenced in June and remained till October, during the fruiting stage, with higher fruit damage being reported during September (11.32%–13.39%) [3]. In the Tamil Nadu ecosystem, on the other hand, peak damage was mainly seen during the months of June and July when bunch emergence commenced [7].

These preceding findings on seasonal occurrence of red thrips showed that the pests start feeding on young fingers soon after the flower petals dry with a typical water-soaked appearance on mature fruits at an early phase. Rusty-red patches appear on infested fruits and later there is apparent cracking of skin or sometimes splitting of the fruit under heavy injury. Fruit scratch is usually seen on the side of the fingers that are touching or are close together. But in the case of severe infestation, the whole fruit may be blemished and cover more of the fruit's surface.

### 3.1 Tiruchirappalli

Among the bio-rational pesticides that were used against red rust thrips, the fingers were found free from blemishes in the bud injection technique that uses imidacloprid as well as bunch sleeving at the shooting stagein Poovan banana during 2009–10 and 2010–11 (Table 1). There was no fruit infestation by rust thrips seen in the treatment involving Neem Seed Kernel Extract (NSKE) 0.2% spray during 2009–10 in the first year trial, but 19.16% fruit damage was observed during 2010-11. Besides these results, damage due to rust thrips was observed in all other treatments. However, in two years of pooled results, the standard check involving chlorpyriphos 0.05% spray with 11.96% fruit damage was also seen to produce better results over NSKE (19.16%) and bud injection of azadirachtin (29.08%). Pongamia oil spray, on the other hand, was not found effective at all. The control bunches recorded the maximum rust thrips incidence.

### 3.2 Gandevi

The three-year mean data on bio-efficacy of the bio-rational pesticides (Table 2) used for rust thrips management at Gandevi indicated that the bud injection technique with imidacloprid (0.3 ml/500 ml water) @ 1 ml/bud exhibited the lowest thrips infestation on the fruit (9.08%), which was on-par with bud injection of azadirachtin (5ml/l) @ 2 ml/bud (17.64%) and standard check with chlorpyriphos 0.05% (22.06%). Higher thrips infestation was observed in bunch sleeving (58.99%) and control (64.69%). However, during the individual year trials of 2011-12, 2012-13 and 2013-14, bud injection of imidacloprid was significantly superior in producing less blemished fruits over bud injection of azadirachtin and conventional spraying of chlorpyriphos. Also, fluctuating thrips infestation was observed during all the three years of experimentation. Spraying of herbal products was not found effective in reducing fruit damage over bud injection technique. The trend of treatment bio-efficacy dominance in reducing blemished fruits was almost the same during all three consecutive years of the investigation period.

The bunch yield weight of unblemished fruits was highest (73.55 t/ha) in bud injection with imidacloprid and was comparable with bud injection of azadirachtin (68.06 t/ha). Next to this bud injection technique, standard check chlorpyriphos 0.05% application was also found better over other the remaining treatments and recorded 63.26 t/ha yield. The cost of plant protection was less due to very low dose of insecticide in bud injection of imidacloprid (0.3 ml/ 500 ml water) @ 1 ml/bud and azadirachtin (5ml/l) @ 2 ml/bud, which exhibited the higher BCR ratio of 3.06 and 2.49, respectively over other conventional spraying method (Table 2).

### 3.3 Jalgaon

Among the bio-rational pesticides that were used against rust thrips at Jalgaon, results revealed that bud injection of imidacloprid (0.3 ml/500 ml water) @ 1 ml/bud showed the lowest number of blemished fruits (13.81%), followed by bud injection of azadirachtin (5ml/l) @ 2 ml/bud (15.43% blemished fruits) (Table 3). The standard check chlorpyriphos 0.05% application recorded fruit damage up to 16.12% and was found at par with bud injection of azadirachtin. However, in contrast to Tiruchirappalli and Gandevi, spraying of pongamia oil (1%) on the bunches also resulted in a comparatively higher number of unblemished fruits (16.32%), which is on-par with the bud injection of azadirachrin and chlorpyriphos. Highest thrips infestation was recorded in bunch sleeving (28.42%) and the control (41.88%). A similar superiority trend of treatment in reducing the number of blemished fruits was reported during all three consecutive years of investigation.

The average yield of healthy fruits remained higher (84.31 t/ha.) in the treatments with bud injection of imidacloprid, chlorpyriphos spraying (83.22 t/ha) and bud injection of azadirachtin (82.90 t/ha). The B:C ratio was highest in the bud injection technique with imidacloprid (2.62) and azadirachtin (2.55) due to low doses of pesticides.

Bud injection with imidacloprid (0.3 ml/500 ml water) @ 1 ml solution/bud and azadirachtin (5ml/l water) @ 2 ml/bud during the emergence of banana flowers was effective in reducing the damage caused by rust thrips and in improving the cosmetic value of martetable fruits over conventional spraying during the fruiting stage at all three locations despite the agro-ecological differences. This method also proved to be economical because of the low quantity of imidacloprid and azadirachtin that were required in the bud injection technology, which reduced expenditure considerably as compared to conventional spraying. Further, there is no problem of insecticide residue during the harvesting of fruits as revealed by the pesticide residue tests conducted on the harvested fruits. The reason behind this may be the longer period of about 90-100 days required between flower emergence and fruit maturity, which reduces the risk of pesticide in the fruit at harvest and health hazards. However, under the Tamil Nadu condition, bunch sleeving at the shooting stage was also seen to be an effective technique for preventing rust thrips incidence. That this is a contrast result in comparison with the other two locations may be due to the change in agro-ecological situation and varietal variability. Also, the fact that crop rotation is not regularly followed in these locations may be a reason for inadequate protection. Recently, in another investigation, two sprays of *Lecanicillium lecanii* and *Beauveria bassiana* (2 x $10^8$ cfu/g) @ 3 g/l was found superior in minimizing banana fruit infestation with rust thrips up to 11% as compared to herbal insecticide spraying at Jalgaon location [8].

**Table 1:** Percentage of bunches infested with banana rust thrips, *C. signipennis*, at Tirukkattupalli, Thanjavur District (ICAR-NRCB, Tiruchirappalli)

| Tr. No.* | Per cent infestation of fruit/bunch # | | |
|---|---|---|---|
| | 2009–10 | 2010–11 | Pooled |
| $T_1$ | 0.0 (2.87) a | 0.0 (2.87) a | 0.0 (2.87) a |
| $T_2$ | 39.58 (38.95) e | 35.42 (36.51) d | 37.48 (37.75) f |
| $T_3$ | 0.0 (2.87) a | 19.16 (25.94) c | 19.16 (25.94) c |
| $T_4$ | 20.41 (26.80) c | 21.25 (27.42) c | 29.08 (28.62) d |
| $T_5$ | 29.08 (32.60) d | 30.17 (33.28) d | 29.63 (32.97) e |
| $T_6$ | 60.41 (51.04) f | 63.54 (52.87) e | 61.98 (51.94) g |
| $T_7$ | 0.0 (2.87) a | 0.0 (2.87) a | 0.0 (2.87) a |
| $T_8$ | 10.40 (18.32) b | 13.53 (21.40) b | 11.96 (20.18) b |
| $T_9$ | 72.12 (58.18) g | 71.08 (57.53) f | 71.60 (57.81) h |
| CD at 5% | 5.60 | 4.45 | 3.43 |
| CV% | 7.73 | 5.75 | 6.74 |
| # Figures in parentheses are $\sqrt{\text{arc sin}}$ transformed values. | | | |

**Table 2:** Percentage of bunches infested with banana rust thrips, *C. signipennis,* at Gandevi

| Tr. No.* | Per cent infestation of fruit/bunch # | | | | Pooled yield (t/ha) | BC ratio |
|---|---|---|---|---|---|---|
| | 2011-12 | 2012-13 | 2013-14 | Pooled | | |
| $T_1$ | 79.12 (62.83) $^{e}$ | 61.67 (51.81) $^{e}$ | 36.18 (36.97) $^{e}$ | 58.99 (50.54) $^{d}$ | 47.83 | 0.13 |
| $T_2$ | 23.77 (29.14) $^{bc}$ | 38.53 (38.36) $^{d}$ | 25.02 (29.98) $^{d}$ | 29.11 (32.49) $^{bc}$ | 57.26 | 1.34 |
| $T_3$ | 23.53 (29.01) $^{bc}$ | 28.31 (32.14) $^{c}$ | 24.27 (29.44) $^{cd}$ | 25.37 (30.20) $^{bc}$ | 60.18 | 1.58 |
| $T_4$ | 18.76 (25.62) $^{b}$ | 20.23 (26.69) $^{b}$ | 13.93 (21.88) $^{b}$ | 17.64 (24.73) $^{ab}$ | 68.06 | 2.49 |
| $T_5$ | 25.75 (30.49) $^{c}$ | 39.88 (39.16) $^{d}$ | 26.71 (31.09) $^{d}$ | 30.78 (33.58) $^{bc}$ | 55.55 | 1.13 |
| $T_6$ | 27.87 (31.80) $^{c}$ | 45.00 (42.13) $^{d}$ | 29.71 (33.01) $^{d}$ | 34.19 (35.65) $^{c}$ | 53.49 | 0.94 |
| $T_7$ | 8.90 (17.22) $^{a}$ | 10.83 (19.19) $^{a}$ | 7.51 (15.85) $^{a}$ | 9.08 (17.42) $^{a}$ | 73.55 | 3.06 |
| $T_8$ | 18.82 (25.54) $^{b}$ | 28.11 (32.00) $^{c}$ | 19.26 (26.00) $^{c}$ | 22.06 (27.85) $^{abc}$ | 63.26 | 1.94 |
| $T_9$ | 71.41 (57.72) $^{d}$ | 79.68 (63.29) $^{f}$ | 42.98 (40.94) $^{f}$ | 64.69 (53.98) $^{d}$ | 43.72 | -- |
| CD at 5% | 3.94 | 4.08 | 3.67 | 9.35 | -- | -- |
| CV% | 6.63 | 6.16 | 7.19 | 6.62 | -- | -- |
| # Figures in parentheses are √arc sin transformed values. | | | | | | |

**Table 3:** Percentage of bunches infested with banana rust thrips, *C. signipennis,* at Jalgaon

| Tr. No.* | Per cent infestation of fruit/bunch # | | | | Pooled yield (t/ha) | BC Ratio |
|---|---|---|---|---|---|---|
| | 2011-12 | 2012-13 | 2013-14 | Pooled | | |
| $T_1$ | 24.16 (29.43) $^{f}$ | 29.22 (32.73) $^{h}$ | 31.87 (34.36) $^{g}$ | 28.42 (32.17) $^{e}$ | 81.05 | 2.20 |
| $T_2$ | 16.69 (24.12) $^{e}$ | 18.68 (25.62) $^{f}$ | 20.25 (26.75) $^{de}$ | 18.54 (25.50) $^{d}$ | 81.66 | 2.45 |
| $T_3$ | 16.66 (24.10) $^{e}$ | 20.18 (26.71) $^{g}$ | 22.98 (28.68) $^{f}$ | 19.94 (26.50) $^{d}$ | 82.89 | 2.48 |
| $T_4$ | 12.70 (20.90) $^{b}$ | 15.66 (23.32) $^{b}$ | 17.94 (25.05) $^{b}$ | 15.43 (23.09) $^{ab}$ | 82.90 | 2.55 |
| $T_5$ | 15.38 (23.08) $^{d}$ | 17.67 (24.85) $^{de}$ | 19.35 (26.11) $^{cd}$ | 17.47 (24.68) $^{d}$ | 82.52 | 2.51 |
| $T_6$ | 14.17 (22.11) $^{c}$ | 16.70 (24.12) $^{c}$ | 18.21 (25.28) $^{b}$ | 16.36 (23.84) $^{bc}$ | 83.29 | 2.54 |
| $T_7$ | 10.61 (19.00) $^{a}$ | 14.38 (22.27) $^{a}$ | 16.44 (23.91) $^{a}$ | 13.81 (21.73) $^{a}$ | 84.31 | 2.62 |
| $T_8$ | 12.66 (20.88) $^{b}$ | 16.98 (24.32) $^{cd}$ | 18.71 (25.62) $^{bc}$ | 16.12 (23.61) $^{bc}$ | 83.22 | 2.54 |
| $T_9$ | 41.33 (40.02) $^{g}$ | 39.87 (39.15) $^{i}$ | 41.88 (40.34) $^{h}$ | 41.03 (39.84) $^{f}$ | 79.40 | 2.11 |
| CD at 5% | 0.57 | 0.67 | 0.78 | 1.49 | -- | -- |
| CV% | 4.22 | 2.69 | 3.07 | 3.33 | -- | -- |
| # Figures in parentheses are √arc sin transformed values. | | | | | | |

## 4. Conclusion

Considering all these facts and results, the bud injection technique is safer and efficient in reducing the percentage of blemished fruits affected by rust thrips. The bud injection technology is expected to help reduce the cost of insecticides up to 60-75% over conventional spraying and in turn fetch higher income on quality marketable fruit.

## 5. Acknowledgement

This work has been carried out with financial support from the Indian Council of Agricultural Research (ICAR) and the collaborative organization of SAU's and ICAR Institutes under ICAR-All India Coordinated Research Project (AICRP) on Fruits. The authors wish to acknowledge the support offered by ICAR and the collaborative organizations in providing the required research facilities.

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