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# Effect of Emamectin Benzoate 5 SG Against Thrips and Fruit Borer Complex on Grapevine

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**A new insecticide molecule, emamectin benzoate (Proclaim 5 SG) was tested for bio-efficacy against major pests and natural enemies of grapes during 2007 and 2008 seasons. Emamectin benzoate was applied as foliar spray at 8.0 g a.i./ha, 9.5 g a.i./ha, 11.0 g a.i./ha and 22.0 g a.i./ha. Results indicated that emamectin benzoate 5 SG was significantly effective at 11.0 and 22.0 g a.i./ha when sprayed twice at 15 days interval and minimized the incidence of thrips, *Rhipiphorothrips cruentatus* and fruit borers *Helicoverpa armigera* and *Spodoptera litura* on plants and fruits. Among all treatments, emamectin benzoate most effectively reduced pest population and increased fruit yield. The insecticide did not register any adverse effects on coccinellid predators. There were no phytotoxic symptoms observed on the plants due to emamectin benzoate treatment.**

**Key words:** Emamectin benzoate, Bioefficacy, *Scirtothrips dorsalis, Rhipiphorothrips cruentatus, Helicoverpa armigera, Spodoptera litura,* Grape

Grape is a delicious commercial fruit crop in India occupying an area of about 40,000 hectares with an annual production of 11.0 lakh tonnes. In Tamil Nadu, about 4,000 hectares are under grape cultivation with an annual production of about 52,980 tonnes (Anon., 2011) . In recent times, area under grape has increased tremendously due to sizable demand on fruits for table purpose among stakeholders. Insect pests however are the major production constraints in grape cultivation apart from diseases. In grape, 94 species of insect pests have been reported in India (Atwal and Dhaliwal, 2005; Tandon and Verghese, 1994). In Tamil Nadu, table grapes get depreciated value due to the damage caused by thrips, *Scirtothrips dorsalis* (Hood) and *Rhipiphorothrips cruentatus* (Hood), and fruit borers, *Helicoverpa armigera* (Hubner) and *Spodoptera litura* (Fabricius). Thrips attacked new leaves take a whitish or silvery hue, acquire a withered appearance, turn brown, ultimately curl up and drop off from plants. Thrips also damage by rasping surface of flower buds and developing fruits and sucking oozing cell sap. Developing fruits show corky layers or rusty encrustations which downgrade the fruit quality, consumer preference and market value. In addition to irregular defoliation on grape leaves and tender vines, *H. armigera* and *S. litura* also feed on fruit contents and cause reasonable yield loss. Synthetic insecticides provide dramatic effect initially, and hence chemical control methods are still in use among farmers. Earlier, Dimethoate 30 EC 1 ml/l, neem oil 1% 2.5 ml/l, neem oil 5% 0.5 ml/l, *Verticillium lecanii* 5 ml/l, *Beauveria bassiana* 5 g/l during cold and humid climate were in use as per the recommendation of National Research Centre for Grapes, Pune and Tamil Nadu Agricultural University, Coimbatore (source: www. nrcgrapes. nic.in; www.agritech.tnau.ac.in).

In recent times, new insecticide molecules offer advantages over earlier chemistry in terms of greater levels of safety, better performance and reduced environmental impact. Buprofezin 25 SC 1125 ml/ ha was efficient in the reduction of nymph and adult population and branch infestation of *Maconellicoccus hirsutus* (Green) (Muthukrishnan et. al., 2005). Nicotinoid molecules, imidacloprid 17.8% SL 0.3 g, acetamaprid 20% SP 0.3g and thiamethoxam 25%WG 0.3g/l were effective against grape thrips *Scirtothrips dorsalis* (Sunitha and Jagginavar, 2010). In the present investigation, pest management challenges due to above pests were addressed by testing new reduced-risk insecticide, emamectin benzoate 5 SG with an idea to integrating into grape IPM programs. This was coupled with studies to understand the effect of the insecticide on the behavior of arthropod pests and their natural enemies.

Emamectin benzoate was discovered in 1984 as a broad spectrum lepidoptericide. Patil and Rajanikanth (2004) reported mode of action and efficacy. This product is a mixture of emamectin benzoate $B_1a$ and emamectin benzoate $B_1b$ that are extracted from actinomycete microorganism, a Japanese strain of *Streptomyces avermitilis* and act

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as agonists for GABA-gate chloride channels. It is both a stomach and contact insecticide. It is a broad spectrum pesticide and is highly toxic to many arthropods, including spider mites, agromizid leaf miners, ants, cockroaches, and selected lepidopteran pest species. Therefore, emamectin benzoate was evaluated against grapevine pests under TNAU-Syngenta biological testing programme.

## Materials and Methods

Two field experiments were conducted in farmers' holdings at Jadhigoundanpatti, Dindigul District of Tamil Nadu from December 2007 to March 2008 and from April 2008 to July 2008 under irrigated conditions. The experiments were laid out on eight years old black seeded grape (cv. Panner) in a randomized block design with seven treatments and four replications. The plot size was 15 ´ 6 m which contained 10 vines. The treatments used in the experiments were emamectin benzoate 5 SG 8.0, 9.5, 11.0, 22.0 and 44.0 g a.i. /ha, monocrotophos 36 WSC 360 g a.i./ha and untreated control. The treatments were imposed when the pests appeared at critical growth stages like new flush, flowering and berry developing stages, and repeated at 15 days interval using a high volume sprayer with a spray volume of 500 l/ha to a level of runoff. Teepol at 0.5 ml/l of spray fluid was used as a wetting agent in all the treatments except untreated control.

Larval population and per cent fruit damage of *H. armigera* and *S. litura,* per cent fruit damage by thrips, *R. cruentatus* and population of grubs and adults of *Cryptolaemus montrouzeiri* (Mulsant) predators were observed on five randomized selected vines on pretreatment and 3, 7 and 14 days after first and second spray. Fruit yield was also taken and represented as yield/ha. All these data were transformed with square root and arcsine transformations wherever appropriate before analysis and original values are given in Tables. These data were analyzed using RBD analysis of variance (ANOVA). Means were separated and ranked by using Duncan's Multiple Range Test (Gomez and Gomez, 1984). The observations on phytotoxicity symptoms (leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty) were recorded on $7^{th}$ day after each spray by using visual scoring system.

## Results and Discussion

***Effect of emamectin benzoate 5 SG against H. armigera larval population***

In the first year field experiment, fruit borer, *H. armigera* larval population varied from 5.0 to 6.0/ vine before imposing treatments. The observations recorded on 3, 7 and 14 days after treatment (DAT) are given in Fig. 1. Mean data of all days of observations revealed that *H. armigera* larval population ranged from 1.4 to 6.6 larvae/vine.

**Table 1. Effect of emamectin benzoate 5 SG against *H. armigera* and *S. litura* larval population and fruit damage on grapevine – I & II Season**

| Treatment and doses (a.i. /ha) | *Helicoverpa armigera* | | | | *Spodoptera litura* | | | | Fruit damage by *H. armigera* and *S. litura* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean population per vine | | Per cent reduction over control | | Mean population per vine | | Per cent reduction over control | | Mean per cent fruit damage | | Per cent reduction over control | |
| | ISeason | IISeason | ISeason | IISeason | ISeason | IISeason | ISeason | IISeason | ISeason | IISeason | I Season | IISeason |
| Emamectin benzoate 5 SG 8 g | 4.3 D | 3.8 C | 34.6 | 41.5 | 3.0 C | 2.8 C | 58.3 | 60.0 | 17.0 C | 18.5 C | 58.0 | 68.0 |
| Emamectin benzoate 5 SG 9.5 g | 3.8 C | 3.5 C | 42.2 | 46.1 | 2.7 B | 2.4 B | 62.5 | 65.7 | 13.2 B | 15.4 B | 67.0 | 63.0 |
| Emamectin benzoate 5 SG 11 g | 1.6 A | 1.4 A | 75.7 | 78.4 | 1.0 A | 1.2 A | 86.0 | 83.0 | 5.9 A | 7.4 A | 85.5 | 82.2 |
| Emamectin benzoate 5 SG 22 g | 1.4 A | 1.3 A | 79.0 | 80.0 | 0.7 A | 0.8 A | 90.3 | 89.0 | 5.0 A | 5.4 A | 87.8 | 87.0 |
| Monocrotophos 36 WSC 360 g | 2.3 B | 2.5 B | 65.0 | 61.5 | 2.8 B | 2.8 C | 61.0 | 60.0 | 13.3 B | 13.9 B | 67.3 | 66.5 |
| Untreated | 6.6 E | 6.5 D | - | - | 7.2 D | 7.0 D | - | - | 40.7 D | 41.6 D | - | - |
| CD at 0.05% | 0.65 | 0.60 | - | - | 0.33 | 0.53 | - | - | 4.01 | 3.52 | - | - |
| SEd | 0.31 | 0.29 | - | - | 0.16 | 0.26 | - | - | 1.94 | 1.71 | - | - |

Data are mean values of three replications
Figures were transformed by square root transformation for population data, arc sine transformation for per cent data and the original values are given Means within columns lacking common bold upper case superscript are significantly different ($p<0.05$)

Emamectin benzoate 22 and 11 g a.i. /ha contributed significant reduction of larval population to 1.4 and 1.6/vine to an extent of 79.0 and 75.7 per cent respectively. Monocrotophos registered lower larval population of 2.3/vine and contributed 65.0 per cent reduction respectively (Table 1).

The observation of *H. armigera* larval population before imposing treatments (6.0 to 6.6/vine) and observation on 3, 7 and 14 DAT during second season are shown in Fig. 1. Mean data revealed that *H. armigera* larval population ranged from 1.3 to 6.5 larvae/vine. Emamectin benzoate 22 and 11 g a.i. /ha contributed significant reduction of larval population to 1.3 and 1.4/vine to an extent of 80.0 and 78.4 per cent respectively. Monocrotophos registered lower larval population of 2.5/vine and contributed 61.5 per cent reduction respectively (Table 1). The present findings can be correlated with the findings of Bheemanna *et al.* (2005) who found that emamectin benzoate @ 8.5g a.i/ha effectively protected okra crop from fruit borer, *E. vittella* and obtained higher fruit yield.

***Effect of emamectin benzoate 5 SG against S. litura larval population***

*S. litura* larval population varied from 4.0 to 5.3/ vine before imposing treatments in first season (Fig 2). Mean of post treatment observations on 3, 7 and 14 DAT indicated that *S. litura* larval population ranged from 0.7 to 7.2/vine. Emamectin benzoate 22 and 11 g a.i. /ha were equally effective and

**Table 2. Effect of emamectin benzoate 5 SG on grape fruit damage by thrips *R. cruentatus* and *C. montrouzeiri* population and fruit yield – I & II Season**

| Treatments and doses (a.i. /ha) | *Rhipiphorothrips cruentatus* | | | | *Cryptolaemus montrouzeiri* | | Fruit yield kg/ ha | |
|---|---|---|---|---|---|---|---|---|
| | Mean per cent fruit damage | | Per cent reduction over control | | Mean grubs and adult population /vine | | | |
| | ISeason | IISeason | ISeason | IISeason | ISeason | IISeason | ISeason | IISeason |
| Emamectin benzoate 5 SG 8 g | 18.4C | 15.3BC | 59.0 | 61.9 | 2.0B | 3.4B | 9450C | 10250C |
| Emamectin benzoate 5 SG 9.5 g | 15.5B | 13.6B | 65.5 | 66.1 | 2.2B | 3.2B | 10101B | 10300C |
| Emamectin benzoate 5 SG 11 g | 9.0A | 7.2A | 80.0 | 82.0 | 2.0B | 2.9B | 12000A | 12200A |
| Emamectin benzoate 5 SG 22 g | 8.1A | 5.6A | 82.0 | 86.0 | 1.9B | 2.6B | 12250A | 12550A |
| Monocrotophos 36 WSC 360 g | 16.5B | 16.8C | 63.2 | 58.2 | 0.8C | 1.8C | 10150 B | 11000B |
| Untreated | 44.8D | 40.2D | - | - | 2.8A | 4.5A | 8550D | 8620D |
| CD at 0.05% | 4.01 | 2.87 | - | - | 0.33 | 0.34 | 63.8 | 65.8 |
| SEd | 1.94 | 1.39 | - | - | 0.16 | 0.16 | 28.6 | 30.6 |

Data are mean values of three replications
Figures were transformed by square root transformation for population data, arc sine transformation for per cent data and the original values are given Means within columns lacking common bold upper case superscript are significantly different ($p<0.05$)

superior in reducing the larval population to 0.7 and 1.0/vine and resulted in 90.3 and 86.0 per cent reduction respectively over control. Monocrotophos, however contributed a lower population of 2.8/vine with per cent reduction of 61.0 (Table 1) . Lower doses of emamectin benzoate 9.5 and 8.0 g a.i/ha doses resulted in lower population of 2.7 and 3.0 larvae/vine with 62.5 and 58.3 per cent reduction respectively.

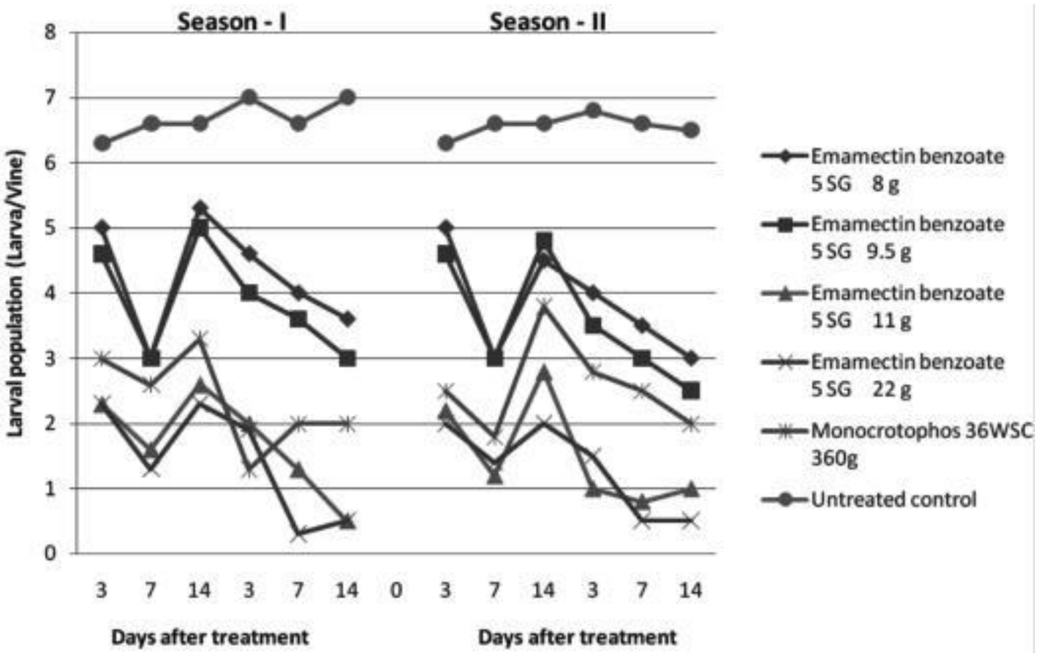


**Fig. 1. Effect of emamectin benzoate 5 SG against larval populaton of *Helicoverpa armigera***

In second season, *S. litura* larval population ranged from 6.0 to 7.3/vine before imposing treatments (Fig 2). Mean observations of 3, 7 and 14 DAT indicated that *S. litura* larval population varied from 0.8 to 7.0/vine. Emamectin benzoate 22 and 11 g a.i. /ha were equally effective and superior in reducing the larval population to 0.8 and 1.2/vine and resulted in 89.0 and 83.0 per cent reduction respectively over control. Monocrotophos, however contributed a lower population of 2.8/vine with per cent reduction of 60.0 (Table 1). Lower doses of emamectin benzoate 9.5 and 8.0 g a.i/ha doses resulted in lower population of 2.4 and 2.8 larvae/ vine with 65.7 and 60.0 per cent reduction respectively. The results are in corroboration with the findings of Kuttalam *et al.* (2008) who reported that emamectin benzoate 5 SG at 15g a.i/ha was found to be superior in reducing leaf and fruit damage at the end of sprayings.

#### *Effect of emamectin benzoate 5 SG against fruit damage caused by H. armigera and S. litura larval population*

In first season experiment, larvae of *H. armigera* and *S. litura* caused irregular biting and feeding on fruits and pulps. This damage was completely

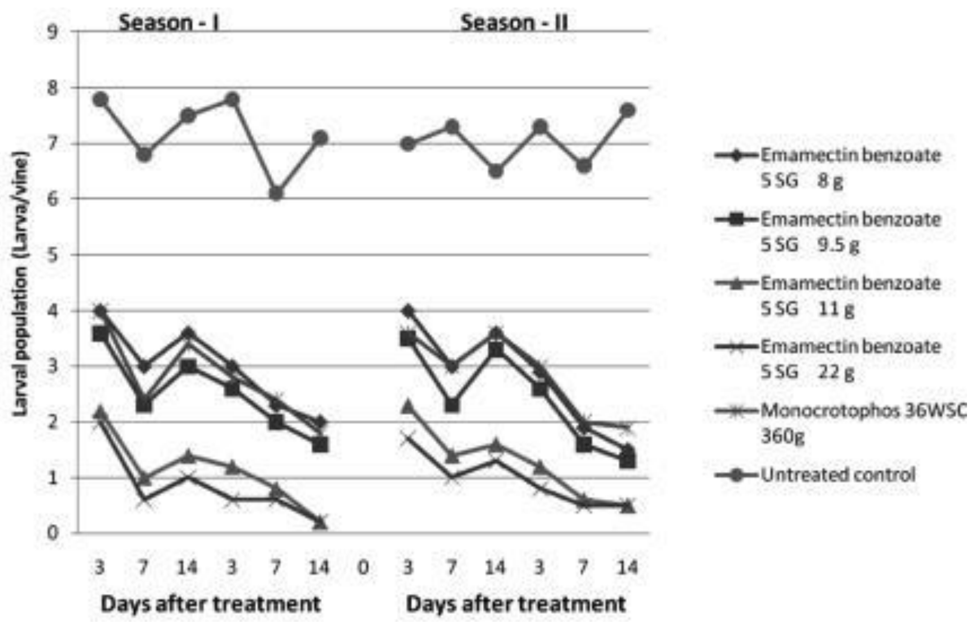


**Fig. 2. Effect of emamectin benozoate 5 SG against larval populaton of *Spodoptera litura***

different from thrips damage (rusty corky encrustations on the skin of fruits). Fruit damage due to larvae ranged from 31.0 to 36.6 per cent before imposing treatments (Fig. 3) . Mean data of post treatment observations on 3, 7 and 14 days indicated that fruit damage due to *H. armigera* and *S. litura* ranged from 5.0 to 40.7 per cent/vine. Emamectin benzoate 22 and 11 g a.i. /ha were equally effective and superior in reducing the fruit damage to 5.0 and 5.9 per cent/vine and resulted in 87.8 and 85.5 per cent reduction respectively over control. Lower doses of emamectin benzoate 9.5 g a.i/ha dose resulted in

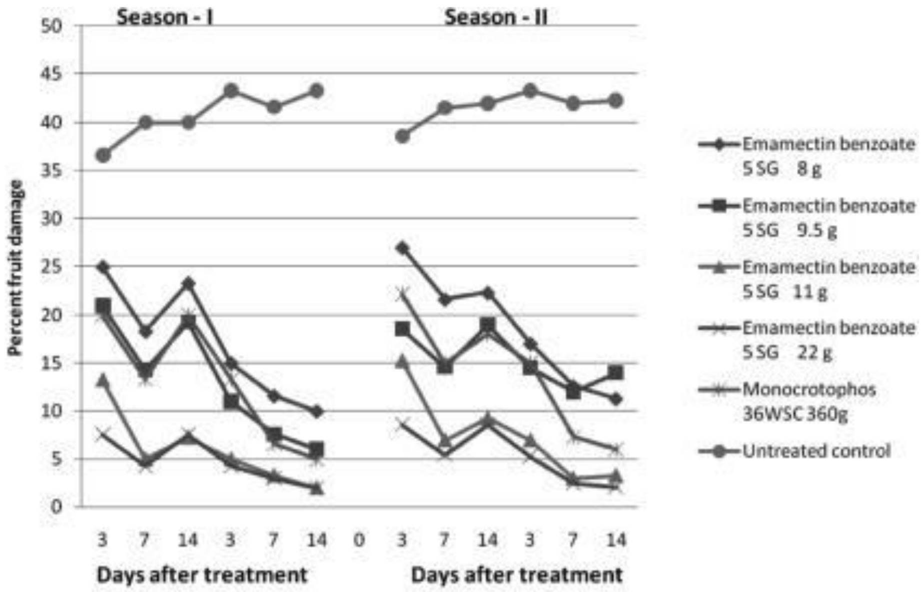


**Fig. 3. Effect of emamectin benozoate 5 SG on grape fruit damage by *Helicoverpa armigera* and *Spodoptera litura***

lower fruit damage of 13.2 per cent/vine with 67.0 per cent reduction respectively. Monocrotophos, however contributed a lower fruit damage of 13.3 per cent/vine with per cent reduction of 67.3 (Table 1).

Fruit damage caused by *H. armigera* and *S. litura* ranged from 36.3 to 38.6 per cent before imposing treatments during second season (Fig 3). Mean observations of 3, 7 and 14 DAT indicated that fruit damage due to *H. armigera* and *S. litura* ranged from 5.4 to 41.6 per cent/vine. Emamectin benzoate 22 and 11 g a.i. /ha were equally effective and superior in reducing the fruit damage to 5.4 and 7.4 per cent/ vine and resulted in 87.0 and 82.2 per cent reduction respectively over control. Lower doses of emamectin benzoate 9.5 g a.i/ha dose resulted in lower fruit damage of 15.4 per cent/vine with 63.0 per cent reduction respectively. Monocrotophos, however contributed a lower fruit damage of 13.9 per cent/vine with per cent reduction of 66.5 (Table 1). These results are in confirmation with the findings of Ishaaya and Ohsawa, (2002) who reported that emamectin benzoate primarily controlled the lepidopteran pests in foliage and fruity vegetables.

***Effect of emamectin benzoate 5 SG against fruit damage caused by thrips Rhipiphorothrips cruentatus***

In first season, thrips caused fruit damage by forming rusty and corky encrustations on the skin of fruits. Fruit damage due to thrips ranged from 31.3 to 35.0 per cent before imposing treatments (Fig. 4). Mean data of 3, 7 and 14 DAT revealed that fruit damage by thrips varied from 8.1 to 44.8 per cent due to treatments. Significant effect due to emamectin benzoate 22 and 11 g a.i. /ha (8.1 and 9.0%) was achieved with per cent reduction of 82.0 and 80.0 respectively followed by emamectin benzoate 9.5 g a.i./ha (15.5% fruit damage with 65.5% reduction over control). Monocrotophos, however, registered 16.5 per cent damage respectively to an extent of 63.2 per cent reduction against untreated (Table 2).

Fruit damage due to thrips ranged from 38.0 to 41.5 per cent before imposing treatments during second season (Fig. 4). Mean data of 3, 7 and 14 DAT revealed that fruit damage by thrips varied from 5.6 to 40.2 per cent due to treatments. Significant effect due to emamectin benzoate 22 and 11 g a.i. / ha (5.6 and 7.2%) was achieved with per cent reduction of 86.0 and 82.0 respectively followed by emamectin benzoate 9.5 g a.i./ha (13.6% fruit damage with 66.1% reduction over control) and emamectin benzoate 8 g a.i./ha (15.3% fruit damage with 61.9% reduction over control). Monocrotophos, however, registered 16.5 per cent damage respectively to an extent of 63.2 per cent reduction against untreated (Table 3).

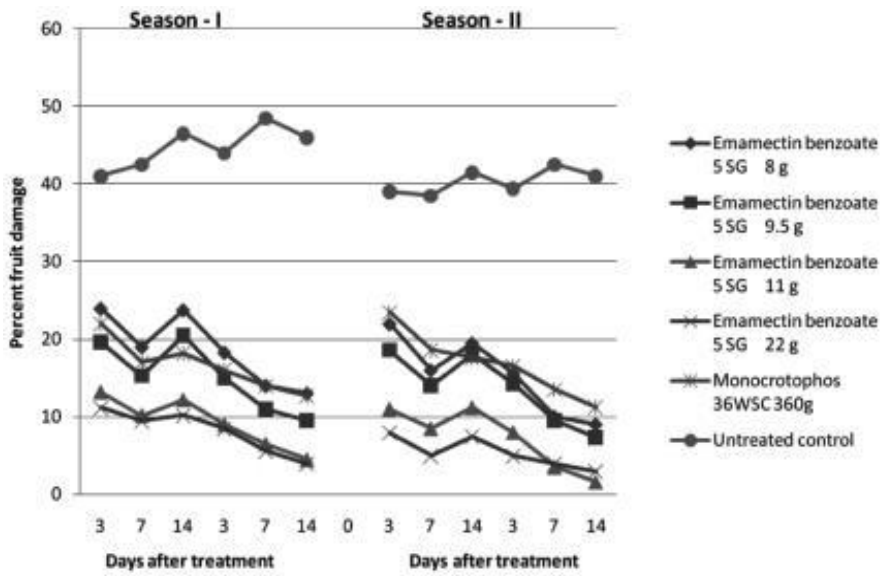


**Fig. 3. Effect of emamectin benozoate 5 SG on grape fruit damage by thrips *Rhipiphorothrips cruentatus***

***Effect of emamectin benzoate 5 SG on Cryptolaemus montrouzeiri population on grapevine and fruit yield***

Coccinellids, *C. montrouzeiri* population ranged from 2.6 to 3.3/vine before imposing the treatments during the first season. Mean data after two rounds of application of treatments (0.8 to 2.8 /vine) revealed that emamectin benzoate 5 SG at any dose was not lethal to the coccinellid predators for first season. Fruit yield ranged from 8550 to 12250 kg/ha. There was significant effect due to treatments on the yield. Highest yield was recorded in emamectin benzoate 22 g a.i. /ha followed by emamectin benzoate 11 g a.i. /ha (12000 kg/ha), monocrotophos (10150 kg/ ha), emamectin benzoate 9.5 g a.i/ha (10101 kg/ha) and emamectin benzoate 8 g a.i/ha (9450 kg/ha). The yield was however, 8550 kg/ha in the untreated control for first season experiment (Table 3).

In second season, *C. montrouzeiri* population ranged from 3.9 to 4.6/vine before imposing the treatments. Mean data after two rounds of application of treatments (1.8 to 4.5 /vine) revealed that emamectin benzoate 5 SG at any dose was not lethal to the coccinellid predators (Table 3). Fruit yield ranged from 8620 to 12550 kg/ha. There was significant effect due to treatments on the yield. Highest yield was recorded in emamectin benzoate 22 g a.i. /ha followed by emamectin benzoate 11 g a.i. /ha (12200 kg/ha), monocrotophos (11000 kg/ ha), emamectin benzoate 9.5 g a.i/ha (10300 kg/ha) and emamectin benzoate 8 g a.i/ha (10250 kg/ha). The yield was however, 8620 kg/ha in the untreated control.

The present findings also in confirmation with those of Udikeri *et al.* (2004) who observed that activity of insect predators like *Chrysoperla* and coccinellids in emamectin benzoate @ 11g a.i/ha treated plots was at par with untreated check. This indicated that emamectin benzoate is non-toxic to *C. montrouzeiri* predator in grape ecosystem.

***Phytotoxic effect of emamectin benzoate 5 SG on grapevine plants***

Emamectin benzoate 5 SG doses (8, 8.9. 11, 22 and 44 g a.i/ha) did not result any phytotoxic symptoms like leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty at any day after treatment on vine, leaves, flowers, berries and fruit bunches in two season experiments.

These results are in corroboration with the findings of Kuttalam *et al.* (2008) who reported that emamectin benzoate 5 SG at 15g a.i/ha was superior in reducing leaf and fruit damage at the end of sprayings. Similarly, Ishaaya and Ohsawa, (2002) also reported that emamectin benzoate primarily controlled the lepidopteran pests in foliage and fruity vegetables. The present findings can also be correlated with the findings of Bheemanna *et al.* (2005) who found that emamectin benzoate @ 8.5g a.i/ha effectively protected okra from fruit borer, *E. vittella* and obtained higher fruit yield. With regard to effect on predators, Udikeri *et al.* (2004) observed that activity of *Chrysoperla* and other coccinellids in emamectin benzoate @ 11g a.i/ha treated plots were at par with untreated check, which corroborates that emamectin benzoate 5 SG is also non-toxic to *C. montrouzeiri* predator in grape ecosystem.

It is concluded that two rounds of emamectin benzoate 5 SG 22 and 11 g a.i. /ha at 15 days interval were superior in minimizing the larval population of *H. armigera* and *S. litura* and bunch and fruit damage by fruit borers and thrips. As both the doses were statistically on par in their efficacy, the lower dose of emamectin benzoate 11 g a.i/ha may be suggested for the management of *H. armigera, S. litura, S. dorsalis* and *R. cruentatus.* These doses did not register any adverse effects on *C. montrouzeiri* population. There were no phytotoxic symptoms observed on the plants due to any emamectin benzoate treatments.

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