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Studies on the biology and efficacy of some pesticides in combination with neem oil against chilli fruit borer *(helicoverpa armigera)*, hubner, (lepidoptera: noctudiae)

Dipika Sureshrao Nimbalkar[1], Anand Nagsen Warghat[2], Piyush Sureshrao Barase[3]
[1-3] Department of Agricultural Zoology & Entomology, Raja Balwant Singh College of Agriculture, Bichpuri, Agra, Dr. Bhimrao Ambedkar University, Agra, Uttar Pradesh, India

Abstract
The Studied data of Chilli fruit borer revealed that the Insecticides and neem based insecticide shows, after spraying various treatments in each plot the observation recorded against each replication on weight of healthy fruit and weight of damage fruit data reported in maximum weight of damage fruit were observed in Untreated plot T4, i.e. (1.450 kg) and also the minimum weight of damage fruit were observed in T_1 Malathion (0.04%) i.e. (0.300 gm) respectively were observed in plot. We also compare T_2 (Methyl Dematon 0.02%) and T_3 (Neem Oil 0.03%) then observation are come out. The maximum weight of damage fruit in T_3 (Neem oil 0.03%) is (0.480) and minimum weight of damage fruit in T_2 is (0.480). It is clear that from table that among all treatment T_1 Malathion (0.04%) is the best treatment as same T1>T2>T3>T4 in fig. no. 02 then weight of healthy fruit per plot against each treatments showed that T1 (Malathion 0.04%) is significantly superior over control plot and having maximum weight of healthy fruit is (4.250) in Kilograms and T4 (Untreated water spray) is found minimum is 1.950 in kilograms, hence T1<T2<T3<T4 as mentioned in Fig. No.03. On the basis of fruit weight (Kgs.) per cent losses data showed that maximum per cent of fruit loss in T4 (Untreated water spray) i.e. 47.35% followed by T3 (Neem oil 0.03%) shows less per cent loss of fruit is 14.32% followed by T2 (Methyl dematon 0.02%) is 11.14% and T1 (Malathion 0.04%) is 7.05% means the T1 is found superior, i.e. T1<T2<T3<T4 as mentioned in Fig. no. 04, according to number of fruit damage in each replication against each treatments shows the T1 (Malathion 0.04%) found superior over T4 (Untreated water spray), T1 (Malathion 0.04%) is 218 and T4 (Untreated) is 470 number of fruit were damaged then in comparison of T2 (Methyl dematon 0.02%) & T3 (Neem oil 0.03%) observed that T2<T3 and T3 is 260 followed to T2 is 244 number of fruit damaged, hence T1<T2<T3<T4 (as showed in fig. No. 05) and total number of healthy fruits were observed in treatment in each replication is T1 (Malathion 0.04%) followed by T2<T3 and <T4 respectively, i.e. 2,435 & 2,320 and 1,290 so T1<T2<T3<T4 (is found &mentioned in Fig. No. 06), then on the basis of number of fruit damaged in per cent were revealed that the T1 (Malathion 0.04%) is 8.25% is found most superior than T2 (Methyl dematon 0.02%) is 10.02% < T3 (Neem oil 0.03%) is 11.20% followed by T4 (untreated water spray) is 37.90% respectively and T1<T2<T3<T4 is found after study, (Showed in Fig. No. 07).

Keywords: biology and efficacy, insecticides, neem oil, *Helicoverpa armigera*, chilli

Introduction
Chilli (*Capsicum annuum* L.) is one of the important commercial spices crop grown in India. It belongs to the family Solanaceae and originated from South and Central America where it was domesticated around 7000 BC. The genus *Capsicum* includes 30 species. Chilli being a crop of tropical and subtropical region. It requires a warm humid climate Portuguese trades introduced it to India, Indonesia and other part of Asia around 450-500 year ago (Berke and Shieh, 2000) and since then. It has gained importance as an important spice and vegetable crop. The attractive colour is because of presence of a pigment known as capsanthin and the pungency due to an alkaloid capsaicin. Chilli is used as a paste, powder or chilli sauce in whole farol. There are Indian pickles, especially with tender mango in which chilli powder is added lavishly to form a thick paste with biting sensation at the end of curing. India is the only country rich in many varieties of chilli with different quality factor. Chilli is also known to have a medicinal value, as it prevents heart attack by dieting the blood vessels of late the export value of capsaicin further led to increase in production of chilli in India. Capsicum has been cultivated over centuries, producing both pungent and sweet fruits. *Capsicum annuum* L. is characterized by a wide variety of fruit size, shape and with different capsaicinoid content. The major countries producing chili in the world are Egypt Ghana, Nigeria, Tunisia, Mexico, USA, Argentina, Indonesia, Korea Pakistan, India, Sri Lanka, Turkey, Bulgaria, Hungary, Italy, Romania, Spain, and Yugoslavia. In India, chilli is grown on an area of 9.08 lakh ha with an annual production of 10.70 lakh tones of chilli from an area of 1.74 lakh ha (Singhal, 2003). A number of limiting factors have been attributed for low productivity in chilli. Among 51 of them ravages caused by insect pests are significant. The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage (Anon., 1987). *Helicoverpa armigera* a polyphagous pest, known to attack crop in most severe of Katagihallimath (1963) reported complete destruction of the fruit contents by *H. armigera* larvae in chilli, which infested up to 92 per cent of the plants and caused 77 percent fruit damage Of late, it has become a pest of concern on chilli in North-Western Karnataka, causing about 30 per cent damage to the crop (Shivaramu and Kulkarni, 2001) Pesticides interventions in reproductive phase. Pesticides interventions in reproductive phase of the crop targeting fruit borers control result in

accumulation of residues there are easily detectable in transit or before consumption. Any non-chemical strategy or reduced insecticides for managing fruit borer could be a welcome approach.

Scope and Limitations

There is large scope for developing eco – friendly, safe and effective pest management approaches because the indiscriminate use of chemical insecticide disturbed the natural balance of pest, leading to resurgences of pest and population in crop ecosystem from the angle botanicals have become more attractive and are considered to provide on eco-friendly alternative (Dodia 2008). At present there is growing market all over the world for organically produced fruits, vegetable, spices, and grain etc. and farmer are getting higher rate for such product. Further benefits of these inputs are to improve the soil microorganism, to enhance the soil carbon content of soil and to improve the soil fertility and micro-fauna.

Materials and Methods

The Experiments was carried out under field conditions at the ICAR Research field, Raja Balwant Singh College, Bichpuri, Dr. Bhimrao Ambedkar University, and Agra (U.P.). The study on the biology and efficacy of mentioned chemicals with combination of neem oil against *Helicoverpa armigera* shown in Randomized Block Design. There were four replications with 3x 2.5 m meter plot size. The plant spacing between row to row and plants to plant were maintained 60 cm and 40 cm, respectively. The present investigations were carried out with a view to find out the biology and efficacy of some eco-friendly materials like botanicals, & some insecticides against the pest of chilli.

Details of Layout

- Design of layout: - R.B.D
- Replication: - 4
- Treatment: - 4
- Total no of plant: - 220
- Plot size: - 3 x 2.5 M
- Length of experimental field: - 10 M
- Width of experimental field: - 14 M
- Width of main irrigation channel: - 1 M
- Width of sub irrigation channel: - 50 cm
- Total plot area: - 14 x 10 m = 140 sq. Treatments taken for study showed in Fig.No.01
- Width of bund: - 50 cm
- Row to row spacing: - 60 cm
- Plant to plant spacing: - 40 cm

Treatments
T_1 = Malathion (0.04%)
T_2 = Methyl Dematon (0.002%)
T_3 = Neem Oil (0.03%)
T_4 = Untreated (Water Spray)

1. Inter-cultural operation carried in field

1.1 Preparation of field

After the harvest at previous crop, a pre sowing irrigation was not required because sufficient amount of water is received from rainfall. The field was well ploughed by tractor and stubble of previous crop, grasses. Stones were removed from the field by manual labour. The field was levelled and demarcated as per layout plan attached here. The layout of the experimental field was done 2/12/2016.

1.2 Preparatory tillage

During summer, the soil thoroughly prepared by ploughing followed by two harrowing. The field was cleaned by picking stubbles of previous crop. Before sowing of seeds on raised beds, one harrowing was given and the experimental plots were laid out as per the statistical design

1.3 Sowing of seed on raised beds

The seed of brinjal chandur (local) variety was sown on 02.10.2015 to raise the seedlings in nursery. Regular watering and weeding were undertaken up to transplanting seeding to the main field.

1.4 Transplanting

After the receipt adequate rains, on harrow was given before transplanting land was levelled and marking was done at 60x45 cm by bullock drawn marker. The seedling of chilli variety (Desi kranti) transplanted on 4/12/2016 with two seedlings each ridge and furrow method.

1.5 Gap filling and Thinning

Gap filling was done 10 days after transplanting of crop and thinning operation was performed 20 days after transplanting of the crop, keeping one healthy seedling per hill. Each plot had a density of 20 plants per plot.

1.6 Inter-cultural operation

Hoeing and weeding operation were carried out periodically to conserve soil moisture and to eradicate the weed. Total two crisscross hoeing and three weeding were undertaking during the crop season.

Preparation of spray solution

The required concentrations of spray solution were prepared by using following formula:

$$\text{Amount of insecticide require} = \frac{\text{Concentration required x Amount of water required}}{\text{Formulation}}$$

Application of spray solution

The required quantity of insecticides was being thoroughly mixed with water as per the concentration of spray at times of spraying and then the solution was used for spraying. From that the total quantity of water required to cover 1 ha area was determined and then the actual quantity of insecticide to be mixed on gram active ingredient basis was calculated. The spraying was done during morning hours with the help of knapsack sprayer. The suspension was thoroughly mixed before spraying and stirred frequently during the time of spray due care was taken for even distribution of spray solution, thoroughly coverage of entire plant and avoiding drifting of spray solution. Spraying and containers were washed thoroughly with fresh water after each application to avoid contamination.

Number of Spray Application with dates

First Spray: 15 FEB 2017

Second Spray: 05 MAR 2017

Third Spray: 25 MAR 2017

Method of observation

a. Vegetative Phase: Percent fruit infestation per plot was worked out.

b. Reproductive Phase: Also, percent fruit infestation by following observation from the selecting five plants. Observations were recorded on 7th, 10th and 15th day after spraying (D.A.S.). Form randomly five plants, following observations were recorded.

1. Total weight of damage fruits (kg) from each plot.
2. Total weight of healthy fruits (kg) from each plot.
3. Number of Healthy fruit from each plot.
4. Number of damage fruit from each plot.

Percent fruit infestation

The percent of infested fruit due to fruit borer on number as well as weight basis was be worked out by using the following formulae.

$$percent\ fruit\ damage(number\ basis) = \frac{Number\ of\ damage\ fruits}{Total\ number\ of\ fruits\ \ plucked} x\ 100$$

$$percent\ fruit\ damage(weight\ basis) = \frac{Number\ of\ damage\ fruits}{Total\ number\ of\ fruits\ \ plucked} x\ 100$$

Results and Dicussion

The Effects of the some insecticides were found in the observations with comparison of botanicals against chilli fruit borer (*Helicoverpa armigera)* as mentioned, the maximum weight of damage fruit were observed in Untreated plot T_4 i.e. (1.450 kg) and also the minimum weight of damage fruit were observed in T_1 Malathion (0.04%) i.e. (0.300 gm) respectively were observed in plot. We also compare T2 (Methyl Dematon 0.02%) and T3 (Neem Oil 0.03%) then observation are come out. The maximum weight of damage fruit in T3 (Neem oil 0.03%) is (0.480) and minimum weight of damage fruit in T2 is (0.480).

It is clear that from table that among all treatment T_1 Malathion (0.04%) is the best treatment as shown in Fig. No. 02 then It is clear from table that maximum weight of healthy fruit (4.250) obtained from the T_1 (Malathion 0.04%) and the minimum weight (1.950) obtained from the T_4 (Untreated Water Spray) of healthy fruit was obtained the treated plot. The maximum weight (4.250) of healthy fruit remained in (Malathion 0.04%) T_1. We also compare T_2 (Methyl Dematon 0.02%) and T_3 (Neem Oil 0.03%) then observation are come out. The approximately weight of healthy fruit n T_2 (Methyl Dematon 0.02%) (3.590) is larger than T_3 (Neem oil 0.03%) is (3.350).

All the treatment are significantly superior over control plot T_1 (Malathion 0.04%) as shown in Fig. No. 03 then it is clear from table the maximum percent of fruit loss on the basis of fruit weight is obtained in T4 untreated water spray (74.35%). We also compare T2 (Methyl Dematon 0.02%) and T_3 (Neem Oil 0.03%) then observation are come out. The maximum percent of fruit loss in T3 (Neem oil 0.03%) is (14.32%) and minimum percent of fruit loss in T_2 is (11.14%) as compared to T3. (Fig. No. 04) the as per studied data from Fig. No. 05, total number of fruit damage is maximum on the basis of number of fruit damage is Maximum in T4 (untreated water spray) and minimum in T1 (Malathion 0.04%).We also compare T2 (Methyl Dematon 0.02%) and T3 (Neem Oil 0.03%) then observation are come out. The maximum Total number of fruit damage in T3 (Neem oil 0.03%) is (260) and minimum total number of fruit damage in T2 is (244). It is clear from Fig. No. 06 the maximum total number of healthy fruit is T1 Malathion (2640) comparatively the minimum total number of healthy fruit in T4 untreated water spray. We also compare the T_2 (Methyl Dematon 0.02%) and T3 (Neem Oil 0.03%). Then the approximately maximum total number of healthy fruit in T2 (Methyl Dematon 0.02%) is (2435) as compared to T3 (Neem Oil 0.03%) i.e. (2320). Malathion 0.04% is superior to the other treatments. The final observation showed that the It is clear from Fig. No. 07 the minimum number of fruit loss in percent T1 Malathion 0.04% (8.25%) and the maximum number of fruit loss in percent in T4 Untreated water spray. In treatment T2 (Methyl Dematon 0.02%) the percent in loss on the basis of number of fruit damage is (10.02%). The approximately maximum T2 than T3 (Neem Oil 0.03%) i.e. (11.20%).

Observations

Per cent fruit infestation

The per cent of infested fruit due to fruit borer on number as well as weight basis was be worked out by using the following formulae.

$$per\ cent\ fruit\ damage(number\ basis) = \frac{Number\ of\ damage\ fruits}{Total\ number\ of\ fruits\ \ plucked} x\ 100$$

$$per\ cent\ fruit\ damage(weight\ basis) = \frac{Number\ of\ damage\ fruits}{Total\ number\ of\ fruits\ \ plucked} x\ 100$$

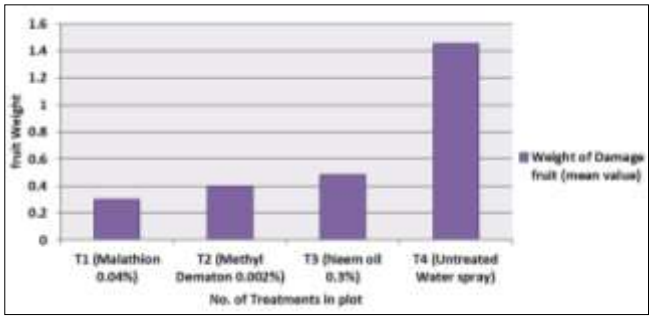

Fig 2: Weight of damaged fruit per plot in different treatment (in kg)

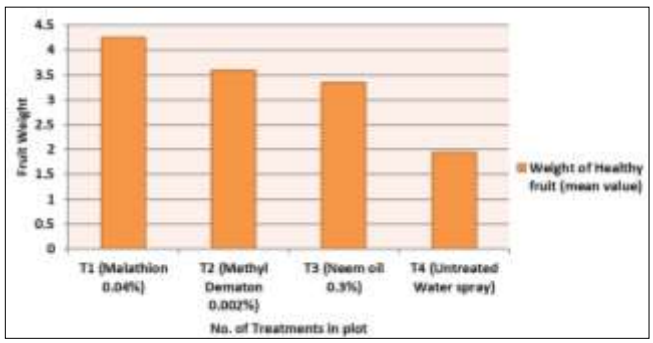

Fig 3: Weight of Healthy fruit per plot in different treatment (in kg)

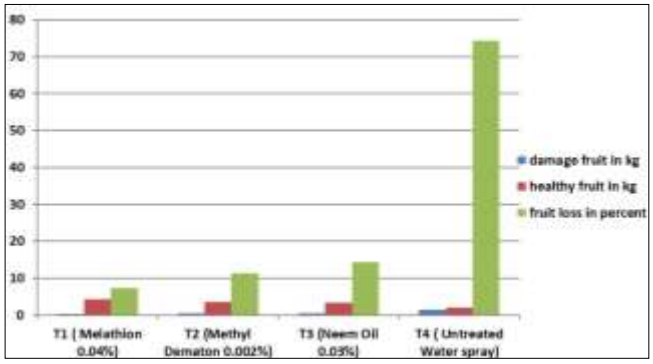

Fig 4: Fruit loss in percent each treatment on the basis of fruit weight (in kg)

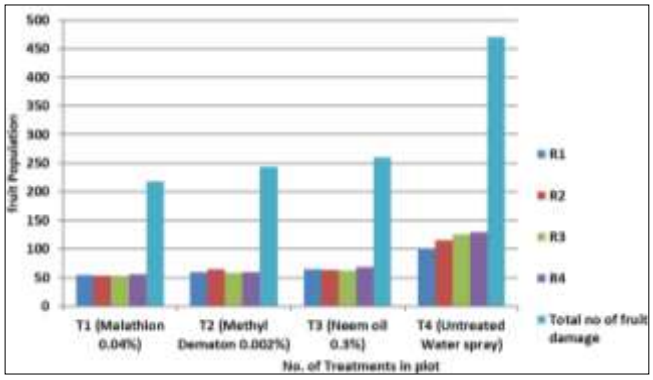

Fig 5: No. of fruit damage in each replication against each treatment

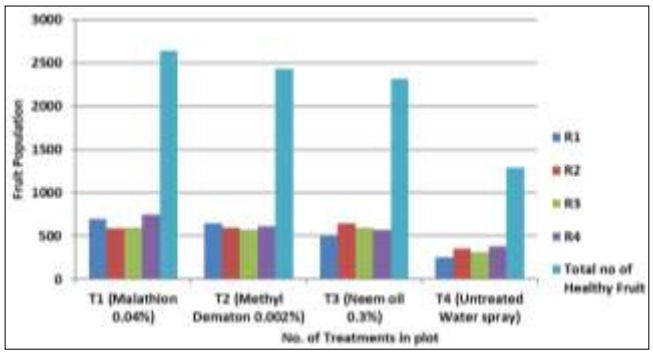

Fig 6: Total No of Healthy fruit in each replication against each treatment

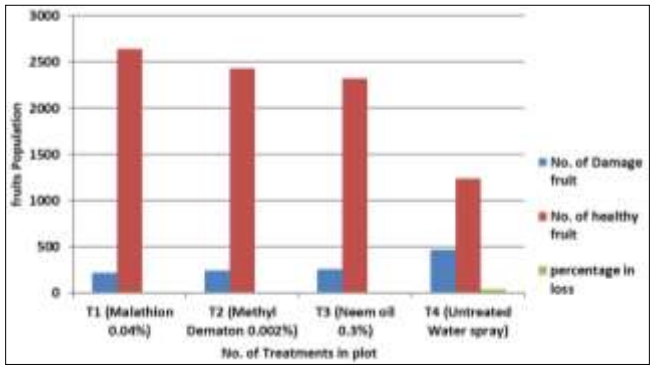

Fig 7: Percentage in loss for each treatment on the basis of No. of fruits

Conclusion

The Effects of the some insecticides and botanicals were found in the observations with comparison of botanicals against chilli fruit borer (*Helicoverpa armigera)* as mentioned and found inadequately superior in no. of treatments each are the maximum weight of damage fruit were observed in Untreated plot T4 i.e. (1.450 kg) and also the minimum weight of damage fruit were observed in T1 Malathion (0.04%) i.e. (0.300 gm) respectively were observed in plot (as per Figure No. 02), the maximum weight of healthy fruit (4.250) obtained from the T_1 (Malathion 0.04%), The maximum weight (4.250) of healthy fruit remained in (Malathion 0.04%) T_1. All the treatments were significantly superior over control plot T_1 (Malathion 0.04%) (Showed in Fig. No. 03). The maximum percent of fruit loss in T3 (Neem oil 0.03%) is (14.32%) and minimum percent of fruit loss in T2 is (11.14%) as compared to T3 (Mentioned in Fig. No. 04). The maximum Total number of fruit damage in T3 (Neem oil 0.03%) is (260) and minimum total number of fruit damage in T2 is (244) (From data of Fig. No. 05). The maximum total number of healthy fruit is T1 Malathion (2640) then the approximately maximum total number of healthy fruit in T2 (Methyl Dematon 0.02%) is (2435) as compared to T3 (Neem Oil 0.03%) i.e. (2320). Malathion 0.04% is superior to the other treatments (as per Fig. No. 06). The minimum number of fruit loss in percent T1 Malathion 0.04% (8.25%) and the maximum number of fruit loss in percent in T4 Untreated water spray (data from Fig. No. 07).

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