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# Efficacy of Non conventional Insecticides on the Incidence of Major Insect Pests of Cabbage

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**ABSTRACT: Cabbage, *Brassica oleraceae* L., is an important cole crop vegetable mostly grown in large area of Manipur. However, higher rate of pest infestation likely to occur, which hinder its total production and consumption. Continuous use of synthetic pesticides in agricultural pest management often leads to various negative impacts such as development of resistance by the pest, adverse effect on non-target organisms and hazardous effect on environment. These drawbacks led to an alternative approaches for control of crucifer pests that are cost effective, biodegradable, low toxic effect on non-target organisms and eco-friendly. The resource poor small scale farmers are unaware for control measures of the pests. Therefore, an experiment was undertaken for consecutive two years during the *Rabi* (winter season) of 2019-20 and 2020-21 at demonstration unit, ICAR-Krishi Vigyan Kendra, Churachandpur revealed that the combined application of neem oil 0.15% and Spinosad 45% SC significantly reduced the infestation of mean larval population of *P. xylostella* and *P. brassicae* (2.0 and 4.0/plant), respectively. The results also indicated that the plots treated with neem oil 0.15% and agricultural petroleum spray oil minimized the incidence of *B. brassicae* against the untreated control plot. The mean yield varied from 13.0 to 19.7 t/ha was recorded in treated plots compared with 10.40t/ha in the untreated control. This review brings together all the information of different organic based practices for management of crucifer pests and that are being reported. This will help in establishing the knowledge of limited studies on pest management using different non chemical control methods to more challenging research and conveys the importance of pest management system for taking research forward.**

**Keywords:** Cabbage, efficacy, insect pests management, non-conventional insecticides, yield.

## INTRODUCTION

Cabbage (*Brassica oleracea* Capitata) cruciferous vegetable crop contains higher concentrations of vitamin C, minerals, and dietary fiber. Cabbage is low in saturated fat, cholesterol, high in dietary fiber, vitamin C, vitamin K, foliate, potassium, manganese, vitamin A, thiamin, vitamin B6, calcium, iron and magnesium (Mochiah *et al.,* 2001). However, the crop is attacked by number of fungal, bacterial disease, virus, insects and pests that cause high damage to the production. The crop is prone to infestation by number of insect pests consisting of sucking and defoliating insects at all the stages. It was reported by Hasan and Ansari (2010); Yang *et al.* (2018); Mazhawidza and Mvumi (2017) that some of the major pests of crucifers are *Pieris brassicae* L. (Lepidoptera: Pieridae), *Plutella xylostella* L. (Lepidoptera: Plutellidae), *Brevicoryne brassicae* L. (Hemiptera: Aphididae). Although the crop is attacked by a number of insect pests but diamond back-moth *Plutella xylostella* (Linnaeus) and mustard aphid *L. erysimi* are the most important pests in North India (Lal *et al*., 2002). They damage every part of the plant and ultimate cause high economic loss to the farmers. The time of planting of cabbage, which is a season bound crop, has profound effect on the incidence of cabbage butterfly and diamond back moth (Dey *et al.,* 2017) Increasing international trade and tourism have led to an increase in the introduction of exotic pests that pose considerable economic threat to the agro-ecosystems. Protection of vegetable crops from numerous insect pests primarily depends on the use of synthetic pesticides (Shah, 2019). Therefore, the use of bio-rational insecticides are gaining popularity in integrated pests management (IPM) programme because of their safety to non-targeted organism and non-biomagnification in the food chain. One promising way is to incorporate the use of biological sources such as botanical insecticides in pest management system which has resulted less negative impacts on ecosystem (Couto, 2019; Lengai *et al.*, 2020). Keeping this in view the present investigation was carried out to study the effect of non conventional insecticides on the incidence and management of *P. brassicae, P. xyostella* and *B. brassicae* in cabbage.

## MATERIAL AND METHODS

The field study was carried out at demonstration unit, ICAR-KVK Churachandpur, Pearsonmun, Manipur, India during *Rabi* season (winter) of 2019-20 and 2020-21 with a view to assess the influence of non-conventional insecticides on the incidence of major insect pests of cabbage in Manipur. The farm is situated at 24.0 N and 24.3 N latitude and 93.15 E and 94.0 E longitudes with an average altitude of 1000 m above mean sea level while the soil is clay loam with soil pH of 5.7. Seven different treatments consisted of $T_1$ = Neem oil 0.15%, $T_2$ = Spinosad 45% SC, $T_3$ = Agricultural petroleum spray oil, $T_4$ = Neem oil 0.15% + Spinosad 45% SC, $T_5$ = Neem oil 0.15% + Agricultural petroleum spray oil, $T_6$ = Agricultural petroleum spray oil + Spinosad 45% SC and $T_7$ = Untreated control. The cabbage var. Golden acre was transplanted in 4 m × 4 m plot with 50 cm × 50 cm spacing during first week of November. Each treatment replicated 3 times in randomized block design. The spraying was started 20 days after transplanting during late afternoon hours and repeated at an interval of 15 days till profitable yield was obtained. Observations were recorded on the population of sucking and foliage damage caused due to cabbage aphids, diamond back moth and cabbage butterfly (top, middle and bottom/plant) at 3, 10 and 15 days after treatment from randomly selected 5 plants in each plot starting from second week after transplanting till the day before harvest. The yield of cabbage was recorded from each plot during harvest. The data of pests' population and yield recorded of two years were statistically analyzed and B:C ratio was calculated.

## RESULT AND DISCUSSION

The data obtained from the field trial in two consecutive years (2019-20 and 2020-21) on the average pests population, percentage of avoidable yield loss and yield increased over control (t/ha) are presented in Table 1 and 2. During the experimental period all the treatment schedules were significantly superior over control throughout the entire period of study. A great deal of variation on the incidence of cabbage aphid *Brevicoryne brassicae* Linnaeus, cabbage butterfly, *Pieris brassicae* Linneaus and the diamond back moth *Plutella xylostella* was observed in the cabbage crop with different treatments.

**Effect on the population of cabbage aphid:** The results based on three sprays mean data on field evaluation of six non-conventional insecticides and one untreated control against cabbage aphid revealed that neem oil 0.15% + agricultural petroleum spray oil proved to be the most effective with mean aphid population of 5.0/plant as compared to 6.2 to 14.4/plant in other treatments whereas 34.5/plant in untreated check (Table 1). Patil and Patel (2013) have found neem oil @ 0.5% in little higher concentration effective against *Aphis gossypi* in isabgol crop under field conditions. The similar result was obtained from the field study by Michael and Raja (2012) found that the repellent activity significantly greater in leaf disc treated with *Melia azedarach* Linn at higher concentration. The second most effective treatments of Agricultural spray oil (Servo Agro Spray) and Agricultural spray oil (Servo Agro Spray) + Spinosad 45% SC with their corresponding mean population of 6.2 and 6.4/plant, respectively. The application of Spinosad 45% SC for aphid population (14.4/plant) did not show satisfactory control. The present findings are partially in accordance with the report of Bhat *et al*. (2011); Pissinati and Vintura (2015); El-Wakeil and Saleh (2007).

**Effect on the population of Diamond back moth:** Overall, all the insecticides significantly reduced the population of *Plutella xylostella* L. larvae for the entire cropping period as compared to the untreated plot. Among the insecticides, neem oil 0.15% in combination with Spinosad 45% SC was the most effective in reducing the population below ETL and recorded the mean population of 2.0/plant which is considered at par with the application of Spinosad 45% SC (2.2/plant). The results were supported from the study by Ranjbari *et al*. (2012) that maximum mortality rate for 1st, 2nd, 3rd and 4th instars larvae in 600, 700, 800 and 900 ppm of Spinosad was achieved 100, 95, 98.3 and 93.3% after 72 hours, respectively therefore Spinosad could be an important agent in control of larval instars of *Plutella xylostella*. Spinosad (2750 µl/5000 ml) was the effective concentrations for controlling *Plutella xylostella* L. with mortality rate of more than 50%, 60% and 80%, respectively (Ismail *et al.*, 2012).

Neem oil 0.15% and agricultural petroleum spray oil were fairly effective as they decreased the pest population (6.5/plant) and (8.0/plant), respectively. However, better result was observed when applied in combination of both (5.3/plant) as compared with the untreated plot (12.60/plant) revealed in Table 1. Botanical pesticide Neemix had a significant result in reduction of *P. xylostella* population up to 86% as compared to control plot (Sapkota *et al.*, 2022). This finding is consistent with Ngosong *et al.* (2021), who revealed that neem seed extract effectively controlled *P. xylostella* and was one of the eco-friendly, cost effective and safe bio-pesticide that enhanced livelihood of resource poor farmers in Ghana. Sharma *et al*. (2014) have documented neem oil @ 2.5-3.0% to be effective against larvae of this insect and supports our findings. The findings of Hill and Foster (2000) also confirm the present investigation.

**Effect on the population of cabbage butterfly:** The number of *Pieris brassicae* larvae sharply decreased in all the treatments except the untreated control plot after application of insecticides (Table 1). The combination of neem oil 0.15% and Spinosad 45% SC was found to be the most effective in suppressing the pest recording the minimum mean population of 4.0 larvae/plant as compared to 5.4 larvae/plant to 22.8 larvae/plant in the rest of the insecticidal treatment and 32.3 larvae/plant in the untreated check which is closely followed by Spinosad 45% SC (5.4 larvae/plant). Satpathy *et al.* (2007) confirm our findings and reported that Spinosad is a broad spectrum insecticide used against a range of

agricultural insect pests like *Helicoverpa armigera, Pieris rapae, Plutella xylostella* and *Trichopulsia nia*. However, no significant difference was observed between plots treated with neem oil 0.15% and agricultural petroleum spray oil recording the mean larval population of 18.4/plant and 22.8/plant respectively. Neem seed kernel-based water dispersible powder at 0.1 % was effective in suppressing the cruciferous insects, namely the cabbage butterfly (*Pieris brassicae nepalensis* Doubleday), the soybean hairy caterpillar (*Spilarctia casigneta Kollar*), the tobacco caterpillar (*Spodoptera litura* Fab.) and the diamondback moth (*Plutella xylostella* L.) on cabbage and increasing its yield (Neupane, 1999). Our results matched with the findings of Singh *et al.* (1987) who observed the repellent effect of neem (*Azadirachta indica*) against 2nd and 3rd instar larvae of *Pieris brassicae* on cabbages.

In this study, efficacy test was carried out to evaluate the insecticidal activities against of *P. xylostella, P. brassicae* and *B. brassicae* under field condition. The results of experiments in this study revealed that all the insecticidal treatments were significantly effective in reducing the pests population compared to untreated control. However, among the treatments minimum mean population of *P. xylostella* and *P. brassicae* were recorded in neem oil 0.15% + Spinosad 45% SC treated plots closely followed by Spinosad 45% SC alone in both the pests. As spinosyns are produced by fermentation of an actinomycete, Spinosad has been classified as a biopesticide (Copping and Menn 2000), although, it has clearly insecticidal characteristics that differ from the majority of entomopathogen-based biopesticides (Cisneros *et al*., 2002; Salgado, 1998). It should be possible to use Spinosad to control diamondback moth larvae that are resistant to other insecticides. The treatment with neem oil 0.15% + agricultural petroleum spray oil proved to be inferior to other treatments in case of *B. brassicae* (Table 1). After 24 hr of treatment, mixture of agricultural petroleum spray oil + *Azadirachtin* at 1% and 2% each were found to inflict highest mite mortality (100%) followed by agricultural petroleum spray oil at 2% (90% mortality) which was, however, at par with agrospray at 1% affording 86.6% mortality (Deka *et al.,* 2011). Petroleum oil alone or combined with a microbial agent as emulsifier have a synergistic and less harmful effect for the environment and are recommended for use in IPM programmes (Khyami and Ateyyat 2002). The neem leaf extract at 10% gave significant mortality of *P. brassicae* as well as feeding disturbances to the caterpillars and reducing the growth and development of insect larvae (Hussain *et al.,* 2022).

**Effect on cabbage yield**: The yield of cabbage was found maximum in neem oil 0.15% + Spinosad 45% SC treated plot (19.7 t/ha) followed by at par recorded yield of 18.0 t/ha and 17.8 t/ha from Agricultural petroleum spray oil + Spinosad 45% SC and Spinosad 45% SC, respectively as compared to 13.0 to 15.1 t/ha in the rest of the treatments and 10.4 t/ha in the untreated control. However, the highest B:C ratio was recorded from Spinosad 45% SC (2.7) closely followed by neem oil 0.15% + Spinosad 45% SC (2.62) against the untreated plot (1.74), respectively. The cabbage yields recorded in all the insecticidal treatments were significantly higher than that of untreated control. The above finding show a close resemblance with the research carried out by Stanikzi and Thakur (2016) who reported the highest yield with treatments of Spinosad 45% SC (187.60 q/ha) followed by Indoxacarb 14.5% SC (178.25 q/ha).

The avoidable loss due to *P. xylostella, P. brassicae* and *B. brassicae* infestation varied from nil in neem oil 0.15% + Spinosad 45% SC sprayed plots to 47.0 % in untreated check. Among the insecticidal treatments maximum avoidable yield loss (34.1%) was observed in agricultural petroleum spray oil treated plot (Table 2). Similarly, the highest marketable yield in terms of increased production over control was recorded from combined application of neem oil 0.15% + Spinosad 45% SC (88.7%) and agricultural petroleum spray oil + Spinosad 45% SC (70.2%).

**Table 1: Relative effect of non-conventional insecticides on the population of pests and yield of cabbage during *rabi* 2019-20 and 2020-21.**

| Treatments | [1]Mean population of insect/plant | | | [2]Yield (t/ha) | B:C Ratio |
|---|---|---|---|---|---|
| | *B. brassicae* | *P. xylostella* | *P. brassicae* | | |
| $T_1$ = Neem oil 0.15% | 8.5(3.00) | 6.5(3.22) | 18.4(4.33) | 15.1 | 2.0 |
| $T_2$ = Spinosad 45% SC | 14.4(3.82) | 2.2(1.50) | 5.4(2.26) | 17.8 | 2.7 |
| $T_3$ = Agricultural petroleum spray oil | 6.2(2.58) | 8.0(3.46) | 22.8(4.79) | 13.0 | 2.00 |
| T4 = Neem oil 0.15% + Spinosad 45% SC | 7.8(2.81) | 2.0(1.44) | 4.0(2.08) | 19.7 | 2.6 |
| $T_5$ = Neem oil 0.15% + Agricultural petroleum spray | 5.0(2.30) | 5.3(3.03) | 15.8(4.02) | 15.5 | 2.1 |
| $T_6$ = Agricultural petroleum spray oil + Spinosad 45% SC | 6.4(2.62) | 3.2(1.89) | 7.6(2.80) | 18.0 | 2.2 |
| $T_7$ = Control | 34.5(5.88) | 12.6(3.17) | 32.3(5.73) | 10.5 | 1.7 |
| SEm (±) | 0.28 | 0.26 | 0.19 | 2.08 | - |
| CD (0.05) | 0.69 | 0.65 | 0.48 | 3.71 | - |

Figures in parentheses are $\sqrt{X+0.5}$ transformed values; [1]Mean larval/aphid population of three time intervals under observation based on three application data; [2]Mean cabbage yield (t/ha) based on three replication.

**Table 2: Avoidable loss of cabbage due to *B. brassicae, P. xylostella and P. brassicae* and increase yield of different insecticidal treatments over control during *rabi* 2019-20 and 2020-21.**

| Treatments | Cabbage yield (t/ha) | Avoidable loss (%) | Increase yield over control | |
|---|---|---|---|---|
| | | | (t/ha) | Percentage |
| Neem oil 0.15% | 15.1 | 23.4 | 4.6 | 44.4 |
| Spinosad 45% SC | 17.8 | 9.8 | 7.3 | 70.2 |
| Agricultural petroleum spray oil | 13.0 | 34.1 | 2.5 | 24.3 |
| Neem oil 0.15% + Spinosad 45% SC | 19.7 | 0.0 | 9.3 | 88.7 |
| Neem oil 0.15% + Agricultural petroleum spray oil | 15.5 | 21.5 | 5.0 | 48.2 |
| Agricultural petroleum spray oil + Spinosad 45% SC | 18.0 | 8.7 | 7.6 | 72.4 |
| Control | 10.5 | 47.0 | - | - |

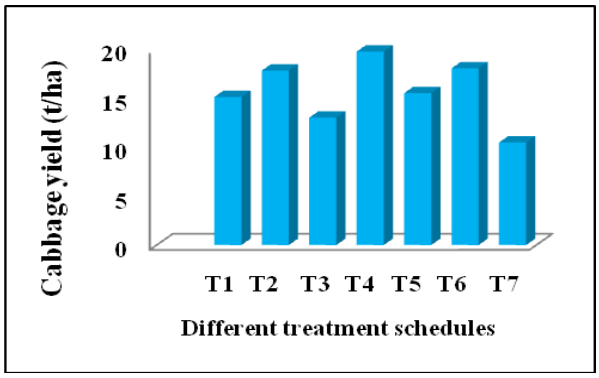


**Fig. 1.** Cabbage yield (t/ha) in different treatment schedules.

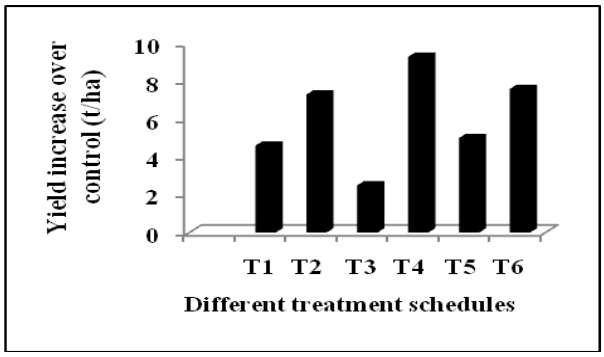


**Fig. 2.** Cabbage yield increase over control (t/ha) in different treatment schedules.

## CONCLUSIONS

The study advocates that in cabbage crop grown organically *B. brassicae* can be managed by using neem oil 0.15% + agricultural petroleum spray oil whereas neem oil 0.15% + Spinosad 45% SC for *P. xylostella* and *P. brassicae*, respectively. Management programs that emphasize biological and cultural controls can integrate Spinosad and other insecticides like neem oil and Agricultural petroleum spray oil sparingly, thereby prolonging their usefulness so that the use of chemical pesticides can be minimized.

## FURURE SCOPE

The excessive use of chemical pesticides in vegetable crops is a common management practice of pests and diseases. Vegetable crop like cabbage consume in the form of salad and half boiled. Keeping in view of health hazards and chemical pesticides exposure the scope of organic farming and its importance are very high. Health awareness is another reason for the scope of chemical free products. The majority of India's population depends on agriculture and other related activities. Organic products are also in great demand, people today are aware of the quality foods that also have potential income. Hence, chemical free insecticides approaches to controlling pests and diseases are prophylactic rather than reactive.

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