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# Efficacy of mineral oil against yellow mite, *Polyphagotarsonemus latus* (Banks) (Prostigmata: Tarsonemidae) in jute (*Corchorus olitorius* Linn.)

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**Abstract**
Field experiment was conducted to study the efficacy of agricultural mineral oil against yellow mite *Polyphagotarsonemus latus* infesting jute at two different locations for two successive cropping seasons. A total of seven treatments imposed with mineral oil at various dosages and in combination with neem oil. Results revealed that at Barrackpore, spray application of mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 and 50 DAS was significant over other treatments in reducing the mite infestation and recorded maximum fibre yield in both cropping seasons. At Kendrapara, treatment comprising mineral oil @ 9 ml/litre sparyed at 35 and 50 DAS was significant over other treatments in reducing the mite infestation and recorded maximum fibre yield in both cropping seasons.

**Keywords:** Yellow mite, *Polyphagotarsonemus latus*, mineral oil, neem oil

## Introduction
The yellow mite, *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) is a ubiquitous polyphagous pest infesting more than 100 different plant species including jute. The infestation impact is clearly manifested both on the plant morphology and physiology [1, 2]. Jute, *Corchorus olitorius* L. and *C. capsularis* L. (Malvaceae) is an important bast fibre crop cultivated in India and is confined to Indo-Gangetic plains. The pest infestation commences from early crop growth stage particularly from 25-85 days after sowing (DAS) and persists throughout the crop phenology. Being colonizing the undersurface of young leaves the nymphs as well as adults suck the cell sap, which results in curling of the leaves ventrally in due course of time. The mite infested jute leaves do not attain full size and turn to coppery-brown in color later drop-off prematurely. The mite infestation also causes necrosis of growing points, hampers the internodal length and produces suppressed side branches resulting in significant yield loss coupled with reduction in fibre strength [3, 4]. Since, *tossa* jute (*C. olitorius*) is more vulnerable to *P. latus* infestation in comparison to *white* jute (*C. capsularis*) an estimated yield loss of 42% in magnitude is observed [5]. Traditional tactic for the management of mite is based on chemical control. Though conventional pesticides offer good control but do pose pest resurgence, residual effect, environmental and health hazards. To minimize these conventional pesticides, use of biorational insecticides like azadirachtin and petroleum spray oils (PSO) have paved their way in mite control programmes. Azadirachtin is botanical insecticide obtained from neem tree and possess growth regulating, antifeedant and repellant properties against insects [6]. The petroleum spray oils are by-product of petroleum industry and are sprayed in form of oil-in-water emulsion. When sprayed the waxy coating on the insect is dissolved by the emulsion followed by oil film forming a envelopment over insect body that denies air supply making the insect to die. Owing to their several advantages like being less toxic to beneficial arthropods, posing low mammalian toxicity, lack of resistance development and low residual effect these petroleum spray oils which mainly include highly refined horticultural mineral oil (HMO) and agricultural mineral oils (AMO) have gained peer recognition in pest management [7]. Hence, keeping in view the present investigation was carried on to evaluate the efficacy of mineral oil and plant derived bio pesticide, azadirachtin against yellow mite, *P. latus* in jute.

## Materials and methods

The field experiments were conducted in Randomized Block Design (RBD) with three replications at Research Farm of ICAR-Central Research Institute for Jute and Allied Fibres (CRIJAF), Barrackpore, Kolkata (West Bengal) and Jute Research Station (OUAT), Kendrapara, Odisha through All India Network Project on Jute and Allied Fibres (AINPJAF) during 2013-14 and 2014-15 cropping seasons. The seeds of jute (*cv*. JRO 204) were sown in (4 m x 3 m) plots in lines at 30 cm spacing with 10 cm between the plants. All the standard agronomic practices were followed for raising the jute crop. There were seven treatments including control viz., $T_1$- mineral oil @ 3 ml/litre at 35 and 50 DAS, $T_2$- mineral oil @ 6 ml/litre at 35 and 50 DAS, $T_3$- mineral oil @ 9 ml/litre at 35 and 50 DAS, $T_4$-Neem oil @ 3 ml/litre at 35 and 50 DAS, $T_5$- mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 and 50 DAS, $T_6$-Insectcidal soap solution @ 3 ml/litre at 35 and 50 DAS and $T_7$-control (No spray). The yellow mite population (number of mites/cm$^2$ on 2$^{nd}$ unfolded leaf) was recorded at 35 and 50 DAS on ten randomly tagged plants per plot using 1 cm x 1cm white hard paper quadrate under microscope. From each tagged plant mite population was obtained Pre-treatment count a day prior to imposing of treatments and post-treatment count at 4 and 7 days after treatment was recorded. The percent reduction in mite population over control was calculated by modified Abbott's formula [8] followed by Fleming and Retnakaran formula [9].

$$\text{Population reduction (\%)} = 1 - \frac{[\text{Post treatment population in treatment}] \times [\text{Post treatment population in control}]}{[\text{Pre-treatment population in treatment}] \quad [\text{Pre-treatment population in control}]}$$

The percentage population reduction values were duly transformed in to the corresponding angular values and were subjected to analysis of variance. Critical difference (CD) was applied for comparing treatment means [10]. The yield data for each treatment was recorded separately and subjected to statistical analysis to test the significance of mean yield in different treatments. Beside, mean plant height (cm) at 60 DAS on the basis of 20 randomly selected plant/plot and finally dry fibre yield (q/ha) were recorded. Duncan's multiple range test was used to determine significant differences ($P < 0.05$) between treatments (means of numbers for each treatment).

## Results and Discussion

Mineral oil and biopesticide neem oil both individually and combination their off were evaluated against *P. latus* infesting on jute at two locations. Analysis of variance reveals that there was significant effect of pesticide application on reducing *P. latus* population proving that biopesticides application either individually or in combination was effective in causing mortality of *P. latus* as compared to control.

### Barrackpore 2014

The effect of treatments on yellow mite population was significant at different days after treatment (DAT) (Table 1). The post treatment observation at 3 and 7 days after treatment indicated significantly less number of mites in the second unopened leaf for the treatment $T_5$ with 20.63 and 10.00 mites/cm$^2$of leaf respectively. Likewise during 2$^{nd}$ spray at 50 DAS, the effect of treatment was significant with least mite population of 2.56 and 0.13 mites/cm$^2$ leaf respectively at 3 and 7 DAT in treatment $T_5$. The effect of treatment on fibre yield revealed that application of mineral oil @ 3ml/L + neem oil @3ml/L 35 and 50 DAS was the best treatment with highest yield of 24.93q/ha.

### Barrackpore 2015

The effect of treatment on yellow mite population was significant at different days after treatment (DAT) (Table 2). The post treatment observation at 3 and 7 days after 1$^{st}$ spray period revealed treatment $T_5$ to be superior in reducing mite population to 21.8 and 8.60 mites/cm$^2$ of leaf respectively post 3 and 7 DAT. Similarly the 2$^{nd}$ spray at 50 DAS, resulted in significant mite population reduction to 12.00 and 2.40 mites/ cm$^2$ of leaf respectively post 3 and 7 DAT for treatment $T_5$ over control treatment. The effect of treatment on fibre yield indicated that the application of mineral oil @ 3ml/L + neem oil @3ml/L 35 and 50 DAS was the best treatment with highest yield of 23.19q/ha. From the above results it was evident from the data that combination of biopesticides showed a synergistic trend at Barrackpore for both the cropping seasons. The synergistic effect of mineral oil and neem oil were revealed in earlier studies against *T. urticae* infesting cucumber against *Helicoverpa armigera* in pigeon pea and against leafhopper, *Amarsca biguttula biguttula* infesting okra. [11-13]

### Kendrapara 2014

The treatment $T_3$ (mineral oil @9ml/L at 35 and 50 DAS) was statistically significant over all other treatments in reducing the mite population 3.6 and 0.6 mites/sq.cm at 3 DAT and 7 DAT after spraying over control 17.00 mites/cm$^2$ (Table 3). During 2$^{nd}$ spraying all the treatments were significantly different over control but maximum mite population was reduced in $T_3$ (2.2 mites/cm$^2$) over control (10.50 mites/sq.cm) at 3 DAT and similar trend was observed at 7 DAT. The highest fibre yield was observed in $T_3$ (29.19 q/ha) being at par with $T_2$ (27.64 q/ha) $T_5$ (26.60 q/ha), $T_1$ (25.87 q/ha) and $T_4$ (24.49 q/ha).

### Kendrapara 2015

Spraying of mineral oil @9ml/L at 35 and 50 DAS ($T_3$) resulted in highest reduction of yellow mite population *i.e* 4.8 mite/cm$^2$ over all other treatments as well as from control (19.7 mite/cm$^2$) at 3 DAT (Table 4). Likewise, 7 DAT a similar trend in reduction in mite population *i.e* 1.9 mite/cm$^2$ was recorded in $T_3$ which statistically happened to be significant over all other treatments and control (21.9 mite/cm$^2$). During second spraying all the treatments are significantly differed over the control *per se* reduction in mite population from control, $T_7$ (14.3 mite/cm$^2$) to minimum mite population in $T_3$ (3.6 mite/cm$^2$) at 3 DAT as well as same trend was reflected in reducing mite population in $T_3$ (1.3 mite/cm$^2$) over control (11.4 mite/cm$^2$) at 7 DAT. Spray application of mineral oil @9 ml/L at 35 and 50 DAS) also recorded the highest fibre yield (25.53 q/ha).

The present findings also confirm the findings reported elsewhere globally. Multiple spray application of mineral oil @1 percent recorded consistent suppression of white apple leafhopper, *Typhlocyba pomari*; red mite, *T. urticae;* nymphs

of grape wine leafhopper and sesame leafhopper *Orosius albicinctus* [7, 14-17]. It is evident that mineral oil (petroleum oils) action mechanism is mechanical and not chemical in nature. By forming a thin residual film on the leaf surface the insect infestation is reduced by adherence of insects to leaf surface their by preventing oviposition and feeding [18]. Form the present study and reports documented elsewhere mineral oils in combination with biopesticides pose synergistic effect cause less phytotoxicity, do not pose threat to parasitoids and predators, beneficial insects and pollinators and thus can be recommended in IPM programmes [13, 19]. Though mineral oils do not pose residual action but has the ability of preventing the transmission of virus and fungi. Efficacy of agricultural mineral oil is also governed by the ambient temperature prevailing, since the loss of mineral oils is manifested to a maximum extent in tropical and sub-tropical climate conditions rather than in temperate regions hence multiple sprays are taken up for long lasting action [20].

**Table 1:** Bio-efficacy of different treatments against yellow mite population and fibre yield in jute at Barrackpore during 2014

| Treatments | Yellow mite (no. /cm$^2$ leaf area) | | | | | | Fibre yield (q/ha) |
|---|---|---|---|---|---|---|---|
| | 35 DAS (Pre count) | 3 DAT | 7 DAT | 50 DAS (Pre count) | 3 DAT | 7 DAT | |
| $T_1$ | 61.06 | 44.96 | 37.70 | 17.20 | 7.96 | 2.03 | 21.77 |
| $T_2$ | 85.40 | 50.33 | 26.43 | 29.06 | 9.06 | 1.33 | 21.04 |
| $T_3$ | 79.13 | 45.96 | 30.63 | 20.66 | 11.36 | 1.30 | 23.55 |
| $T_4$ | 51.33 | 31.36 | 33.10 | 25.33 | 12.10 | 1.60 | 23.47 |
| $T_5$ | 42.43 | 20.63 | 10.00 | 18.90 | 2.56 | 0.13 | 24.93 |
| $T_6$ | 59.83 | 30.53 | 21.26 | 26.90 | 5.90 | 1.36 | 21.88 |
| $T_7$ | 54.66 | 77.66 | 151.03 | 37.33 | 39.56 | 30.66 | 19.51 |
| SEm± | 9.01 | 7.54 | 5.55 | 3.24 | 1.52 | 1.59 | 0.58 |
| CD(P=0.05) | 4.36 | 3.98 | 3.42 | 2.59 | 1.78 | 1.83 | 1.09 |

$T_1$- Mineral oil @ 3 ml/litre at 35 and 50 DAS, $T_2$- Mineral oil @ 6 ml/litre at 35 and 50 DAS, $T_3$- Mineral oil @ 9 ml/litre at 35 and 50 DAS,$T_4$-Neem oil @ 3 ml/litre at 35 and 50 DAS, $T_5$- Mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 and 50 DAS, $T_6$-Insectcidal soap solution @ 3 ml/litre at 35 and 50 DAS, $T_7$-control (No spray).

**Table 2:** Bio-efficacy of different treatments against yellow mite population and fibre yield in jute at Kendrapara during 2014

| Treatments | Yellow mite (no. /cm$^2$ leaf area) | | | | | | Fibre yield (q/ha) |
|---|---|---|---|---|---|---|---|
| | 35 DAS (Pre count) | 3 DAT | 7 DAT | 50 DAS (Pre count) | 3 DAT | 7 DAT | |
| $T_1$ | 11.20 | 7.30 | 5.00 | 8.80 | 5.10 | 4.00 | 25.75 |
| $T_2$ | 10.80 | 5.00 | 1.40 | 7.20 | 2.50 | 0.80 | 28.05 |
| $T_3$ | 13.10 | 3.60 | 0.60 | 6.70 | 1.90 | 0.00 | 28.41 |
| $T_4$ | 11.60 | 6.90 | 4.80 | 8.90 | 5.20 | 3.80 | 24.83 |
| $T_5$ | 11.10 | 5.40 | 1.90 | 7.70 | 3.20 | 1.40 | 27.01 |
| $T_6$ | 10.50 | 4.70 | 6.20 | 10.80 | 5.40 | 5.90 | 22.55 |
| $T_7$ | 12.50 | 14.00 | 15.70 | 18.20 | 10.10 | 9.60 | 20.27 |
| SEm± | 0.94 | 0.52 | 0.39 | 0.62 | 0.33 | 0.25 | 1.47 |
| CD(P=0.05) | 2.90 | 1.58 | 1.21 | 1.90 | 1.03 | 0.76 | 4.51 |

$T_1$- Mineral oil @ 3 ml/litre at 35 and 50 DAS, $T_2$- Mineral oil @ 6 ml/litre at 35 and 50 DAS, $T_3$- Mineral oil @ 9 ml/litre at 35 and 50 DAS,$T_4$-Neem oil @ 3 ml/litre at 35 and 50 DAS, $T_5$- Mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 and 50 DAS, $T_6$-Insectcidal soap solution @ 3 ml/litre at 35 and 50 DAS, $T_7$-control (No spray).

**Table 3:** Bio-efficacy of different treatments against yellow mite population and fibre yield in jute at Barrackpore during 2015

| Treatments | Yellow mite (no. /cm$^2$ leaf area) | | | | | | Fibre yield (q/ha) |
|---|---|---|---|---|---|---|---|
| | 35 DAS (Pre count) | 3 DAT | 7 DAT | 50 DAS (Pre count) | 3 DAT | 7 DAT | |
| $T_1$ | 43.03 | 28.5 | 19.6 | 31.4 | 21.7 | 12.5 | 18.52 |
| $T_2$ | 45.00 | 26.6 | 19.8 | 36.4 | 22.9 | 10.0 | 20.36 |
| $T_3$ | 48.23 | 27.9 | 18.1 | 29.2 | 17.3 | 10.0 | 21.81 |
| $T_4$ | 55.90 | 31.7 | 20.7 | 39.4 | 22.5 | 12.1 | 18.71 |
| $T_5$ | 61.03 | 21.8 | 8.6 | 34.9 | 12.0 | 2.4 | 23.19 |
| $T_6$ | 51.26 | 30.5 | 22.4 | 28.4 | 17.5 | 10.2 | 18.09 |
| $T_7$ | 65.00 | 86.0 | 0.6 | 38.4 | 42.9 | 39.4 | 14.49 |
| CD(P=0.05) | 16.36 | 9.42 | 5.75 | 9.41 | 8.67 | 7.21 | 2.68 |

$T_1$- Mineral oil @ 3 ml/litre at 35 and 50 DAS, $T_2$- Mineral oil @ 6 ml/litre at 35 and 50 DAS, $T_3$- Mineral oil @ 9 ml/litre at 35 and 50 DAS,$T_4$-Neem oil @ 3 ml/litre at 35 and 50 DAS, $T_5$- Mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 and 50 DAS, $T_6$-Insectcidal soap solution @ 3 ml/litre at 35 and 50 DAS, $T_7$-control (No spray).

**Table 4:** Bio-efficacy of different treatments against yellow mite population and fibre yield in jute at Kendrapara during 2015

| Treatments | Yellow mite (no. /cm$^2$ leaf area) | | | | | | Fibre yield (q/ha) |
|---|---|---|---|---|---|---|---|
| | 35 DAS (Pre count) | 3 DAT | 7 DAT | 50 DAS (Pre count) | 3 DAT | 7 DAT | |
| $T_1$ | 13.5 | 7.6 | 5.3 | 11.4 | 5.1 | 3.8 | 25.87 |
| $T_2$ | 12.9 | 5.3 | 2.1 | 8.5 | 2.5 | 1.0 | 27.64 |
| $T_3$ | 15.2 | 4.2 | 1.1 | 7.0 | 2.2 | 0.5 | 29.19 |
| $T_4$ | 13.7 | 7.2 | 5.5 | 11.8 | 5.2 | 4.0 | 24.49 |
| $T_5$ | 13.8 | 5.7 | 2.5 | 8.1 | 3.4 | 2.1 | 26.60 |
| $T_6$ | 12.0 | 4.9 | 7.1 | 13.6 | 5.4 | 5.6 | 22.50 |
| $T_7$ | 13.9 | 15.3 | 17.0 | 21.0 | 11.1 | 10.5 | 19.66 |
| CD(P=0.05) | 2.70 | 1.34 | 1.41 | 2.30 | 0.99 | 0.79 | 4.54 |

$T_1$- Mineral oil @ 3 ml/litre at 35 and 50 DAS, $T_2$- Mineral oil @ 6 ml/litre at 35 and 50 DAS, $T_3$- Mineral oil @ 9 ml/litre at 35 and 50 DAS,$T_4$-Neem oil @ 3 ml/litre at 35 and 50 DAS, $T_5$- Mineral oil @ 3 ml/litre + neem oil @ 3 ml/litre at 35 and 50 DAS, $T_6$-Insectcidal soap solution @ 3 ml/litre at 35 and 50 DAS, $T_7$-control (No spray).

## Conclusion

Agricultural mineral oil being safe in causing less phytotoxicity, causing no harm to biocontrol agents *viz.*, predators and parasitoids, beneficial insects and pollinators can be recommended as component of IPM for effective management of insect pests. Spray of mineral oil in combination with biopesticides can also be recommended for management of insect pests due to synergistic mode of action.

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