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## Evaluation of Abamectin 1.9% EC and diafenthiuron 50% WP influence on cocoon and filament parameters

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### Abstract

The efficacy of insecticides on the cocoon parameters revealed significantly higher values when the silkworms were fed with the leaves harvested abamectin 1.9% EC (@ 0.75ml/l) and diafenthiuron 50% WP (@ 1 g/l) at 15 and 21 DAS. The cocoon weight (2.43, 2.31 and 2.37, 2.27 g/ cocoon at 15 and 21 DAS, respectively), cocoon shell weight (0.56, 0.53 and 0.55, 0.53 g/ cocoon shell at 15 and 21 DAS, respectively) and cocoon shell ratio (23.25, 23.15 and 23.41, 23.66% at 15 and 21 DAS, respectively) were highest respectively in abamectin 1.9% EC and diafenthiuron 50% WP and also longest filament (1312.67, 1233.20 and 1237, 1232.30 m at 15 and 21 DAS, respectively) and highest filament weight (0.47, 0.44 and 0.45, 0.44 g at 15 and 21 DAS, respectively) were recorded in the treatments with foliar spray of abamectin 1.9% EC (@ 0.75ml/l) and diafenthiuron 50% WP (@ 1 g/l) at 15 and 21 DAS.

**Keywords:** Abamectin, WP influence, cocoon and filament parameters, diafenthiuron,

### Introduction

The silkworm, *Bombyx mori* L. is a monophagous insect relying solely on mulberry leaves, which serve as a critical and indispensable source of nutrition for silkworms. The mulberry foliage plays an irreplaceable role in providing vital nutrition for silkworms, ultimately influencing the production of cocoons of remarkable quality (Mahadeva, 2011) [7]. The success and profitability of silkworm rearing is intrinsically linked to the superior quality and abundant yield of mulberry foliage. Multiple factors, such as judicious selection of varieties, meticulous agronomic practices, and the intricate interplay of both biotic and abiotic components collectively influence the overall excellence of mulberry leaves (Krishnaswami *et al.*, 1970) [6]. The luxuriant foliage of mulberry attracts the attention of numerous pests, leading to substantial damage and noteworthy losses in terms of both yield and quality. More than 300 insect and non-insect pests infesting mulberry have been well documented, each inflicting a diverse range of damages (Narasimhanna, 1988) [10]. Notably, the major insect species responsible for affecting the mulberry crop predominantly belong to the orders Hemiptera (28.13%), Thysanoptera (14.44%), Lepidoptera (14.06%), Coleoptera (13.30%), Orthoptera (6.84%), and Isoptera (2.28%).

Among the array of pests that infest mulberry cultivation, thrips and mites stand out as the most formidable adversaries, inflicting widespread damage. Particularly concerning is the prevalence of thrips, as they account for the highest incidence among sap feeders, contributing to 42.55 cent per cent of the infestations, followed by mealy bugs at 20.88 cent per cent. The global impact of thrips on mulberry is substantial, with 35 species recognized as culprits, 21 of which are documented in India. While mites were previously considered minor non-insect pests, causing only a 5-10 cent per cent of damage in India, the distressing scenario exacerbated by the changing climate has created a menacing mites and thrips complex in traditional sericulture regions, wreaking havoc on cocoon production and posing significant challenges to the industry's sustainability. Urgent measures are imperative to combat these formidable pests and safeguard the productivity and viability of mulberry cultivation, preserving the delicate balance between silkworms and their vital nourishment for the future and sustenance of the silk industry.

Use of chemicals is a crucial component of integrated pest management, aimed at keeping both insect and non-insect pests under check in mulberry plantations.

Pesticides, which are synthetic agents designed to disrupt pest physiology in order to protect host plants, play a vital role in sericulture. Regrettably, the resilient silkworm species, *B. mori* L., displays limited resistance to the potent impact of insecticides, leading to a distressing annual decline of more than 30 per cent in silk production attributed to insecticide poisoning (Bing *et al.*, 2010) [3]. Exposing silkworms to insecticide residues can have profound repercussions on their life cycle, affecting essential aspects such as growth, reproduction, cocoon quality, eclosion (hatching) and fecundity. Hence, it is imperative to handle pesticides with care and ensure their responsible use that would ensure safeguarding the health and well-being of the silkworms while effectively managing pests in mulberry plantations. Exploring alternative pest control measures and embracing integrated pest management practices will empower the industry to cultivate mulberry sustainably, safeguarding crop health and ecological balance in the process.

## 2. Material and Methods

The experiment was laid out in a well-established V-1 mulberry garden following Randomized Complete Block Design (RCBD) with 11 treatments and three replications. The leaves were harvested separately from each replication by following individual leaf harvest method. The feeding of treated mulberry leaves was initiated from second feeding after the second moult

**Table 1:** Treatment details

| Treatment       | Description                              |
|-----------------|------------------------------------------|
| T <sub>1</sub>  | Diafenthiuron 50% WP (@ 1 g/l) at 8 DAS  |
| T <sub>2</sub>  | Diafenthiuron 50% WP (@ 1 g/l) at 15 DAS |
| T <sub>3</sub>  | Diafenthiuron 50% WP (@ 1 g/l) at 21 DAS |
| T <sub>4</sub>  | Abamectin 1.9% EC (@ 0.75ml/l) at 8 DAS  |
| T <sub>5</sub>  | Abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS |
| T <sub>6</sub>  | Abamectin 1.9% EC (@ 0.75ml/l) at 21 DAS |
| T <sub>7</sub>  | Diamethoate 30% EC @ 2 ml/l @21DAS       |
| T <sub>8</sub>  | Cyanopyrafen 30% EC @ 0.5ml/l @21DAS     |
| T <sub>9</sub>  | Azadirachtin 1% EC @ 1ml/l @21DAS        |
| T <sub>10</sub> | Control (water spray)                    |
| T <sub>11</sub> | Absolute control(no spray)               |

## 2. Cocoon parameters

### 2.1 Cocoon weight (g)

A total of ten cocoons were selected randomly per replication in all treatments on fifth day after spinning and weighed separately. The average weight of cocoon was computed as

$$\text{Cocoon weight (g)} = \frac{\text{Total weight of cocoons (g)}}{\text{Total number of cocoons weighed}}$$

### 2.2 Floss weight (mg)

The floss of the ten randomly selected cocoons to record average cocoon weight (g/cocoon) was weighed separately replication wise of different treatments and the average floss weight (mg/cocoon) was computed as

$$\text{Floss weight (mg)} = \frac{\text{Total floss weight (mg)}}{\text{Total number of floss weighed}}$$

### 2.3 Pupal weight (g)

The cocoons selected for recording average cocoon weight were cut open and the live pupae were weighed as treatment

and replication wise separately on the same day and the average pupal weight was computed as below:

$$\text{Pupal weight (g)} = \frac{\text{Total weight of pupae (g)}}{\text{Total number of pupae weighed}}$$

### 2.4 Cocoon shell weight (g)

Cut shells of cocoons were used for recording the cocoon shell weight. Cocoon shell weight excluding pupae and exuviae was recorded and the average shell weight was computed separately for each treatment as below:

$$\text{Shell weight (g)} = \frac{\text{Total weight of cocoon shells (g)}}{\text{Number of shells weighed}}$$

### 2.5 Cocoon shell ratio (%)

Cocoon Shell Ratio (CSR) is the proportion of shell weight to cocoon weight expressed in percentage and was calculated as,

$$\text{Cocoon shell ratio (\%)} = \frac{\text{Weight of cocoon shell (g)}}{\text{Weight of cocoon (g)}} \times 100$$

## 3. Reeling parameters

### 3.1 Average filament length (m)

A sample of three cocoons was randomly drawn from each replication and cooked separately in boiling water for two to three minutes to soften the sericin layer. These cooked cocoons were reeled on an eprovette. The length of silk filament was determined using formula,

$$L = R \times 1.125 \text{ m}$$

Where, L = Length of the silk filament (m)

R = Number of revolutions

1.125 m = Circumference of the reel

### 3.2 Non-breakable filament length (NBFL)(m)

It represents the average length of raw silk filament from a cocoon that can be unwound from each cocoon without any breaks. It was calculated by the formula,

$$\text{Non-breakable filament length (m)} = \frac{\text{Total filament length (m)}}{1 + \text{Number of breaks}} \times 100$$

### 3.3 Filament weight (g)

It was obtained by weighing the reeled silk filament of three cocoons from each replication in treatment. Later, average was calculated to obtain average filament weight.

## 3.4 Statistical analysis and interpretation of data

The data collected from the experimental field and silkworm rearing were analyzed statistically by using one-way RCBD and CRD respectively for testing of significance by Fisher's method of analysis of variance as outlined by Sundaraaj *et al.* (1972) [12]. The level of significance used in the F-test was P=0.05. The critical difference (CD) values were computed to compare significance difference between the treatments.

## 4. Results and Discussion

### 4.1 Cocoon parameters

#### 4.1.1 Single cocoon weight (g)

The average weight of ten randomly selected cocoons in each replication was expressed as single cocoon weight (g) that were compared to observe the influence of different molecules on silkworms reared during Jan-Feb, 2023 and

Mar-April, 2023 (Table 1). The maximum single cocoon weight of 2.46 and 2.39 g was recorded with abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS that was on par with diafenthiuron 50% WP (@ 1 g/l) (2.41 and 2.37 g) at 15 DAS, abamectin 1.9% EC @ (0.75ml/l) (2.34 and 2.27g) and diafenthiuron 50% WP (@ 1 g/l) (2.31 and 2.24 g) at 21 DAS and cyenopyrafen 30% EC (@ 0.5ml/l) (2.19 and 2.15 g) during Jan-Feb, 2023 and Mar-April, 2023, respectively. The cocoons obtained from diafenthiuron 50% WP (@ 1 g/l) (1.99 and 1.97 g) at 8 DAS, azadirachtin 10000 ppm (@ 1ml/l) (2.10 and 2.04 g) and diamethoate 30% EC (@ 2 ml/l) (2.14 and 2.17 g) treatments, respectively during Jan-Feb, 2023 and Mar-April, 2023 (Table 2, Plate 1).

When silkworms were fed with monocrotophos, acephate and dichlorvos recorded significant decline in the commercial characters like cocoon weight might be due to residual effect of insecticide treated mulberry leaves. Dimethoate (0.2%) and methyl parathion (0.2%) (Misra *et al.*, 2003) [8] treated mulberry leaves recorded highest cocoon weight upon feeding to the silkworms after a substantial reduction in the residual effect similar to the current observation.

#### 4.1.2 Single floss weight (mg)

The floss weight exhibited significant difference among the treatments during the two seasons, Jan-Feb, 2023 and Mar-April, 2023. The floss weight was notably minimum in the treatment with diafenthiuron 50% WP (@ 1 g/l) (29.72 and 20.78 mg) at 8 DAS that was on par with azadirachtin 10000 ppm (@ 1ml/l) (29.81 and 20.84 mg) treatments. The floss weighed maximum in abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS (35.49 and 24.82 mg) that was on par with diafenthiuron 50% WP (@ 1 g/l) at 15 DAS (34.93 and 24.42 mg), abamectin 1.9% EC (@ 0.75ml/l) (33.96 and 23.75mg) and diafenthiuron 50% WP (@ 1 g/l) (33.95 and 23.74 mg) at 21 DAS, respectively during Jan-Feb, 2023 and Mar-April, 2023 (Table 2, Plate 1).

#### 4.1.3 Single cocoon shell weight (g)

The shell weight of cocoons constructed by the silkworms fed with mulberry leaves harvested from different chemical treated plants during Jan-Feb, 2023 and Mar-April, 2023 showed significant differences among the treatments. A significantly highest cocoon shell weight was recorded with abamectin 1.9% EC (@ 0.75ml/l) (0.60 and 0.53 g) and diafenthiuron 50% WP (@ 1 g/l) (0.59 and 0.52 g) at 15 DAS that were on par with each other and followed by abamectin 1.9% EC (@ 0.75ml/l) (0.55 and 0.51g) and diafenthiuron 50% WP (@ 1 g/l) (0.57 and 0.49 g) at 21 DAS during Jan-Feb, 2023 and Mar-April, 2023, respectively. The lighter weight of cocoon shell was observed when silkworms were fed with diafenthiuron 50% WP (@ 1 g/l) at 8 DAS leaves (0.46 and 0.43 g) on par with azadirachtin 10000ppm EC (@ 1ml/l) (0.47 and 0.43 g) during Jan-Feb, 2023 and Mar-April, 2023, respectively (Table 2, Plate 1).

The cocoon shell weight is a component of total cocoon weight. Hence any variation in cocoon weight results in variation in the shell weight also. Further, varied toxicity level in respective treatments influence the quality of leaf and hence the cocoons spun by the worms feeding on such leaves. These findings are in accordance with the observations reported by Muthuswami *et al.* (2010) [9]. Feeding silkworm with buprofezin 25 SC (@ 1 ml/l) treated

leaves harvested at 20, 30 and 40 DAS resulted in decline in the shell weight. However, feeding of silkworms with insecticide sprayed mulberry harvested after safe waiting period showed a significant improvement with respect to larval weight, cocoon weight and shell weight (Kariappa and Narasimhanna, 1978) [5].

#### 4.1.4 Single pupal weight (g)

The pupal weight exhibited significant difference among different treatments when the silkworms were fed with different chemical treated mulberry leaves. The pupae weighed significantly minimum with diafenthiuron 50% WP (@ 1 g/l) at 8 DAS (1.57 and 1.38 g) on par with azadirachtin 10000 ppm (@ 1ml/l) (1.58 and 1.42 g). The pupal weight recorded maximum in abamectin 1.9% EC (@ 0.75ml/l) (1.86 and 1.75 g) on par with diafenthiuron 50% WP (@ 1 g/l), (1.81 and 1.62 g) at 15 DAS, abamectin 1.9% EC (@ 0.75ml/l), (1.80 and 1.66) and diafenthiuron 50% WP (@ 1 g/l) at 21 DAS (1.75 and 1.61 g) during Jan-Feb, 2023 and Mar-April, 2023, respectively (Table 2 and Figure 1).

Feeding silkworms with dimethoate (0.2%) treated mulberry leaves recorded highest pupal weight (Misra *et al.*, 2003) [8]. The insecticides like demeton, dimethoate showed a significant increase in pupal weight with increase in days after the spray when the larvae were fed with 4<sup>th</sup> instar onwards (Gayathri, 2007) [4].

#### 4.1.5 Cocoon shell ratio (%)

A good cocoon shell ratio reflects good quality cocoons. silkworms exhibited significant difference with respect to cocoon shell ratio that was highest in diamethoate 30 EC@ 2.0 ml/l during Jan-Feb, 2023(25.28) on par with diafenthiuron 50% WP (@ 1 g/l) at 21 DAS (24.81 and 22.51%) and abamectin 1.9% EC (@ 0.75ml/l) (24.51 and 23.99%) and diafenthiuron 50% WP (@ 1 g/l) (24.51 and 22.31%) at 15 DAS and abamectin 1.9% EC (@ 0.75ml/l) at 21 DAS (23.65 and 22.63%). The lowest cocoon shell ratio was recorded in the treatment with diafenthiuron 50% WP (@ 1 g/l) at 8 DAS (21.32 and 20.81%) on par with azadirachtin 10000ppm EC (@ 1ml/l) (22.29 and 21.58%) treatment during Jan-Feb, 2023 and Mar-April, 2023, respectively (Table 2).

The organophosphate insecticides like methyl demeton cause adverse effect on cocoon shell ratio when fourth instar silkworm are fed with the treated leaves (Gayathri, 2007) [4]. The novel insecticide like chlorantraniliprole belonging to ryanoid class found to have residual effect in silkworms even after 15 DAS and resulted in construction of poor-quality cocoons (Sunil Kumar *et al.*, 2017) [13]. However, as evidenced in the studies conducted previously the cocoon parameters viz., cocoon weight, shell weight, pupal weight and cocoon shell ratio recorded higher at 20 DAS compared to 15 DAS even in the present study, which clearly indicates that a significant reduction in the residual toxicity when the safety period was increased, thus leading to improvement in larval and cocoon characters. The shrinkage of silk gland was observed that might be due to the presence of insecticide residues in the treated mulberry leaves fed to silkworms and resulted in flimsy and poor-quality cocoons.

### 5. Reeling parameters

**5.1 Non-breakable filament length (NBFL) (m):** NBFL is the measure of longest silk filament that could be reeled

without any break. Longest non-breakable filament was reeled from the cocoons of the treatment, abamectin 1.9% EC (@ 0.75ml/l) recorded (1323.40 and 1161.90 m) which were on par with diafenthiuron 50% WP (@ 1 g/l) at 15 DAS (1337.63 and 1018.27 m), abamectin 1.9% EC (@ 0.75ml/l), (1259.97 and 1093.93 m) and diafenthiuron 50% WP (@ 1 g/l) (1280.80 and 1093.57 m) at 21 DAS. The shortest break in the filament was observed in azadirachtin 10000ppm EC (@ 1ml/l) (1064.70 and 894.30 m) on par with diafenthiuron 50% WP (@ 1 g/l) at 8 DAS (1064.50 and 930.83 m) treatment during Jan-Feb, 2023 and Mar-April, 2023, respectively (Table 3).

**5.2 Cocoon filament length (m):** Significant differences were observed in the length of cocoon filament among different treatments during Jan-Feb, 2023 and Mar-April, 2023. The longest filament was reeled from the cocoons constructed by silkworms fed with leaves of the plants treated with abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS (1412.67 and 1212.67 m) which was on par with diafenthiuron 50% WP (@ 1 g/l) (1337.63 and 1137.63 m) at 15 DAS, abamectin 1.9% EC (@ 0.75ml/l) (1333.20 and 1133.20 m) and diafenthiuron 50% WP (@ 1 g/l) (1332.03 and 1093.57 m) at 21 DAS. The filament length was observed to be shortest with azadirachtin 10000 ppm (@ 1ml/l) (1095.60 and 969.60 m) on par with diafenthiuron 50% WP (@ 1 g/l) at 8 DAS (1210.93 and 1010.93 m) treatment during Jan-Feb, 2023 and Mar-April, 2023, respectively (Table 3).

### 5.3 Filament weight (g)

The silkworms fed with pesticides sprayed mulberry leaves during Jan-Feb, 2023 and Mar-April, 2023 showed significant difference in filament weight (Table 1). Among the chemicals, abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS leaves recorded significantly maximum weight of the filament (0.49 and 0.45 g) that was on par with diafenthiuron 50% WP (@ 1 g/l) at 15 DAS (0.47 and 0.44 g), abamectin 1.9% EC (@ 0.75ml/l) (0.46 and 0.42 g) and diafenthiuron 50% WP (@ 1 g/l) (0.47 and 0.44g) at 21 DAS. The shortest break in the filament was observed in azadirachtin 10000 ppm (@ 1ml/l) (0.41 and 0.38 g) on par with diafenthiuron 50% WP (@ 1 g/l) at 8 DAS (0.42 and 0.39 g) during Jan-Feb, 2023 and Mar-April, 2023, respectively (Table 1). The reduced filament weight in azadirachtin 10000 ppm (@ 1ml/l) might be due to residual effect of insecticides, resulting in thin shelled cocoons which gave reduced filament length leading to decrease in filament weight.

The residual effect of insecticides resulted in construction of poor quality cocoons, especially thin shelled ones and thus the silk production and hence there was a marked reduction in the silk filament length upon feeding the pesticide sprayed mulberry leaves to the silkworms (Roxelle *et al.*, 2013 and Sunil Kumar *et al.*, 2017) <sup>[11, 13]</sup>. However, with the filament length exhibited a significant increase with reduced levels of toxicity that necessitates the careful harvesting of the leaves after the specified safety period as evidenced in the present study.



A. Healthy cocoons  
(Abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS)



B. Flimsy cocoons  
(Diafenthiuron 50% WP (@ 1 g/l) at 8 DAS)



C. Flimsy cocoons  
(Diafenthiuron 50% WP (@ 1 g/l) at 8 DAS)



D. Muted cocoons  
(Azadirachtin 1% EC @ 1ml/l)

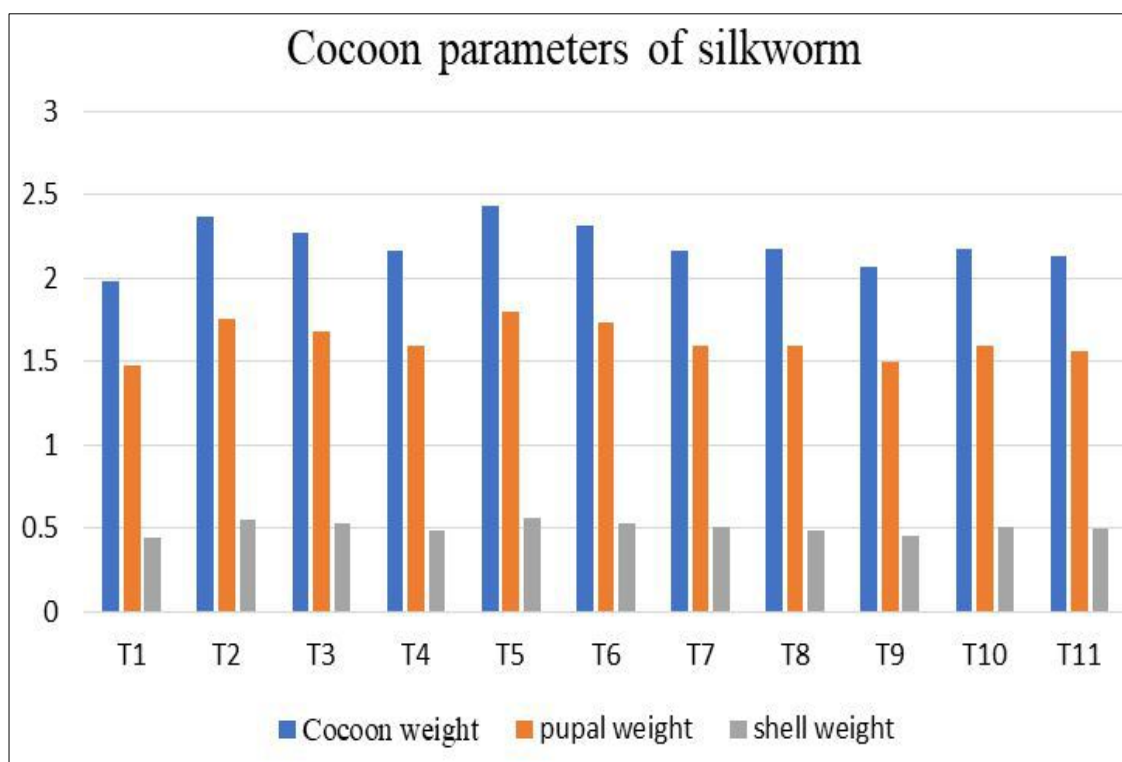
**Plate 1:** Deformed cocoon produced by silkworm feed with different chemicals sprayed mulberry leaves

**Table 2:** Cocoon parameters of silkworm, *B. mori* L. as influenced by feeding mulberry leaves sprayed with selected chemicals at different days after spray

| Treatments         | Period of treatment     |                     |                     |                          |                     |                     |                        |                      |                      |                        |                      |                     |                     |                     |                     |
|--------------------|-------------------------|---------------------|---------------------|--------------------------|---------------------|---------------------|------------------------|----------------------|----------------------|------------------------|----------------------|---------------------|---------------------|---------------------|---------------------|
|                    | Single Cocoon weight(g) |                     |                     | Single Floss weight (mg) |                     |                     | Single Pupal weight(g) |                      |                      | Single Shell weight(g) |                      |                     | CSR (%)             |                     |                     |
|                    | Jan-Feb, 2023           | Mar-Apr, 2023       | Average             | Jan-Feb, 2023            | Mar-Apr, 2023       | Average             | Jan-Feb, 2023          | Mar-Apr, 2023        | Average              | Jan-Feb, 2023          | Mar-Apr, 2023        | Average             | Jan-Feb, 2023       | Mar-Apr, 2023       | Average             |
| T <sub>1</sub>     | 1.99 <sup>d</sup>       | 1.97 <sup>c</sup>   | 1.98 <sup>d</sup>   | 29.72 <sup>b</sup>       | 20.78 <sup>b</sup>  | 25.25 <sup>b</sup>  | 1.57 <sup>c</sup>      | 1.38 <sup>d</sup>    | 1.47 <sup>d</sup>    | 0.46 <sup>e</sup>      | 0.43 <sup>bc</sup>   | 0.44 <sup>d</sup>   | 21.32 <sup>ab</sup> | 20.81 <sup>c</sup>  | 21.07 <sup>c</sup>  |
| T <sub>2</sub>     | 2.41 <sup>ab</sup>      | 2.37 <sup>ab</sup>  | 2.37 <sup>ab</sup>  | 34.93 <sup>a</sup>       | 24.42 <sup>a</sup>  | 29.68 <sup>a</sup>  | 1.81 <sup>ab</sup>     | 1.69 <sup>ab</sup>   | 1.75 <sup>ab</sup>   | 0.59 <sup>ab</sup>     | 0.52 <sup>ab</sup>   | 0.553 <sup>a</sup>  | 24.51 <sup>ab</sup> | 22.31 <sup>ab</sup> | 23.41 <sup>a</sup>  |
| T <sub>3</sub>     | 2.31 <sup>abc</sup>     | 2.24 <sup>abc</sup> | 2.27 <sup>abc</sup> | 33.95 <sup>ab</sup>      | 23.74 <sup>ab</sup> | 28.87 <sup>ab</sup> | 1.75 <sup>abc</sup>    | 1.61 <sup>abcd</sup> | 1.68 <sup>abcd</sup> | 0.57 <sup>a</sup>      | 0.49 <sup>abc</sup>  | 0.53 <sup>ab</sup>  | 24.81 <sup>ab</sup> | 22.51 <sup>ab</sup> | 23.66 <sup>a</sup>  |
| T <sub>4</sub>     | 2.25 <sup>abcd</sup>    | 2.08 <sup>bc</sup>  | 2.16 <sup>bcd</sup> | 32.79 <sup>ab</sup>      | 22.93 <sup>ab</sup> | 27.86 <sup>ab</sup> | 1.69 <sup>bc</sup>     | 1.49 <sup>bcd</sup>  | 1.59 <sup>bcd</sup>  | 0.47 <sup>de</sup>     | 0.49 <sup>abc</sup>  | 0.48 <sup>bcd</sup> | 21.05 <sup>b</sup>  | 22.89 <sup>bc</sup> | 21.97 <sup>ab</sup> |
| T <sub>5</sub>     | 2.46 <sup>a</sup>       | 2.39 <sup>a</sup>   | 2.43 <sup>a</sup>   | 35.49 <sup>a</sup>       | 24.82 <sup>a</sup>  | 30.16 <sup>a</sup>  | 1.86 <sup>a</sup>      | 1.75 <sup>a</sup>    | 1.80 <sup>a</sup>    | 0.60 <sup>a</sup>      | 0.53 <sup>a</sup>    | 0.56 <sup>a</sup>   | 24.49 <sup>ab</sup> | 23.99 <sup>a</sup>  | 23.25 <sup>a</sup>  |
| T <sub>6</sub>     | 2.34 <sup>abc</sup>     | 2.27 <sup>abc</sup> | 2.31 <sup>abc</sup> | 33.96 <sup>ab</sup>      | 23.75 <sup>ab</sup> | 28.85 <sup>ab</sup> | 1.80 <sup>abc</sup>    | 1.66 <sup>abc</sup>  | 1.73 <sup>abc</sup>  | 0.55 <sup>ab</sup>     | 0.51 <sup>ab</sup>   | 0.53 <sup>ab</sup>  | 23.65 <sup>ab</sup> | 22.63 <sup>ab</sup> | 23.15 <sup>a</sup>  |
| T <sub>7</sub>     | 2.14 <sup>bcd</sup>     | 2.17 <sup>abc</sup> | 2.16 <sup>bcd</sup> | 30.27 <sup>b</sup>       | 21.16 <sup>b</sup>  | 25.72 <sup>b</sup>  | 1.64 <sup>c</sup>      | 1.56 <sup>abcd</sup> | 1.59 <sup>bcd</sup>  | 0.54 <sup>abc</sup>    | 0.48 <sup>abc</sup>  | 0.51 <sup>abc</sup> | 25.28 <sup>a</sup>  | 22.07 <sup>b</sup>  | 23.67 <sup>a</sup>  |
| T <sub>8</sub>     | 2.19 <sup>abcd</sup>    | 2.15 <sup>abc</sup> | 2.17 <sup>bcd</sup> | 31.393 <sup>ab</sup>     | 21.95 <sup>ab</sup> | 26.67 <sup>ab</sup> | 1.65 <sup>c</sup>      | 1.53 <sup>abcd</sup> | 1.59 <sup>bcd</sup>  | 0.49 <sup>cde</sup>    | 0.49 <sup>abc</sup>  | 0.48 <sup>bcd</sup> | 22.20 <sup>ab</sup> | 22.90 <sup>ab</sup> | 22.55 <sup>ab</sup> |
| T <sub>9</sub>     | 2.10 <sup>cd</sup>      | 2.04 <sup>c</sup>   | 2.07 <sup>cd</sup>  | 29.81 <sup>b</sup>       | 20.84 <sup>b</sup>  | 25.33 <sup>b</sup>  | 1.58 <sup>c</sup>      | 1.42 <sup>cd</sup>   | 1.50 <sup>cd</sup>   | 0.47 <sup>de</sup>     | 0.43 <sup>c</sup>    | 0.45 <sup>cd</sup>  | 22.63 <sup>ab</sup> | 21.587 <sup>c</sup> | 22.11 <sup>c</sup>  |
| T <sub>10</sub>    | 2.22 <sup>abcd</sup>    | 2.12 <sup>abc</sup> | 2.17 <sup>bcd</sup> | 32.33 <sup>ab</sup>      | 22.61 <sup>ab</sup> | 27.47 <sup>ab</sup> | 1.65 <sup>c</sup>      | 1.57 <sup>abcd</sup> | 1.59 <sup>bcd</sup>  | 0.52 <sup>abcd</sup>   | 0.493 <sup>abc</sup> | 0.51 <sup>abc</sup> | 23.29 <sup>ab</sup> | 23.22 <sup>a</sup>  | 23.26 <sup>a</sup>  |
| T <sub>11</sub>    | 2.16 <sup>bcd</sup>     | 2.10 <sup>bc</sup>  | 2.13 <sup>bcd</sup> | 30.40 <sup>b</sup>       | 21.26 <sup>b</sup>  | 25.83 <sup>b</sup>  | 1.64 <sup>c</sup>      | 1.48 <sup>bcd</sup>  | 1.56 <sup>cd</sup>   | 0.50 <sup>bcd</sup>    | 0.48 <sup>abc</sup>  | 0.49 <sup>bcd</sup> | 23.33 <sup>ab</sup> | 22.88 <sup>a</sup>  | 23.10 <sup>a</sup>  |
| F-Test             | *                       | *                   | *                   | *                        | *                   | *                   | *                      | *                    | *                    | *                      | *                    | *                   | *                   | *                   | *                   |
| S.E.M ±            | 0.088                   | 0.077               | 0.073               | 1.321                    | 1.321               | 1.122               | 0.083                  | 0.074                | 0.072                | 0.015                  | 0.012                | 0.009               | 1.228               | 1.147               | 1.051               |
| CD <sub>0.05</sub> | 0.259                   | 0.226               | 0.216               | 3.899                    | 3.990               | 3.313               | 1.641 <sup>ab</sup>    | 0.219                | 0.213                | 0.044                  | 0.037                | 0.025               | 0.361               | 1.310               | 0.320               |
| CV                 | 6.787                   | 6.121               | 5.762               | 7.088                    | 7.09                | 7.089               | 8.326                  | 8.257                | 7.621                | 5.012                  | 4.394                | 2.951               | 9.119               | 8.893               | 7.964               |

T<sub>1</sub>= Diafenthion 50% WP (@ 1 g/l) at 8 DAS, T<sub>2</sub>= Diafenthion 50% WP (@ 1 g/l) at 15 DAS, T<sub>3</sub>=Diafenthion 50% WP (@ 1 g/l) at 21 DAS, T<sub>4</sub>= Abamectin 1.9% EC(@ 0.75ml/l) at 8 DAS, T<sub>5</sub>=Abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS, T<sub>6</sub>= Abamectin 1.9% EC (@ 0.75ml/l) at 21 DAS, T<sub>7</sub>=Diamethoate 30% EC @ 2 ml/l, T<sub>8</sub>=Cyanopyrafen 30% EC @ 0.5ml/l, T<sub>9</sub>=Azadirachtin 1% EC @ 1ml/l, T<sub>10</sub>= Control (water spray) T<sub>11</sub>= Absolute control.

\*Significant at 0.05; DAS: Days After Spray of the chemical, Numbers superscript with same alphabets are statistically on par

**Fig 1:** Cocoon parameters of silkworm

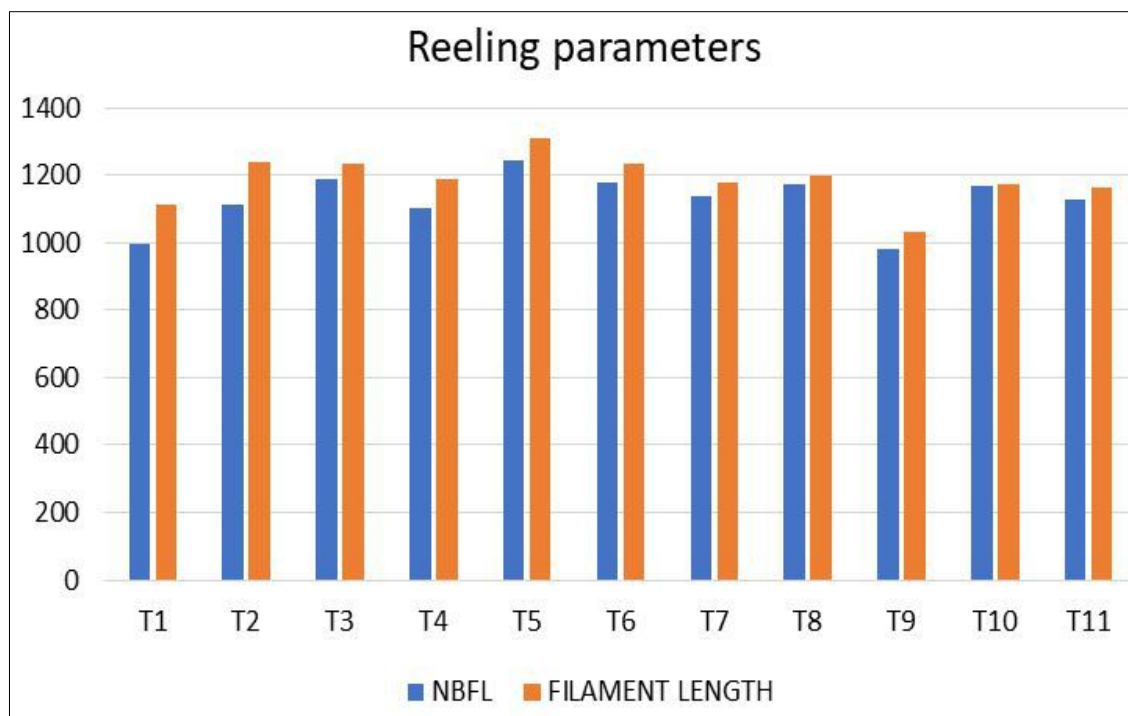


Fig 2: Reeling parameters

**Table 3:** Reeling parameters of silkworm, *B. mori* L. as influenced by feeding mulberry leaves sprayed with selected chemicals at different days after spray

| Treatments         | Period of treatment    |                        |                       |                        |                        |                        |                     |                    |                    |
|--------------------|------------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|---------------------|--------------------|--------------------|
|                    | NBFL (m)               |                        |                       | Filament length (m)    |                        |                        | Filament weight (g) |                    |                    |
|                    | Jan-Feb, 2023          | Mar-Apr, 2023          | Average               | Jan-Feb, 2023          | Mar-Apr, 2023          | Average                | Jan-Feb, 2023       | Mar-Apr, 2023      | Average            |
| T <sub>1</sub>     | 1064.50 <sup>d</sup>   | 930.83 <sup>cd</sup>   | 997.67 <sup>c</sup>   | 1210.93 <sup>d</sup>   | 1010.93 <sup>cd</sup>  | 1110.93 <sup>cd</sup>  | 0.42 <sup>b</sup>   | 0.39 <sup>b</sup>  | 0.40 <sup>b</sup>  |
| T <sub>2</sub>     | 1208.60 <sup>bc</sup>  | 1018.27 <sup>ab</sup>  | 1113.43 <sup>b</sup>  | 1337.63 <sup>ab</sup>  | 1137.63 <sup>ab</sup>  | 1237.63 <sup>ab</sup>  | 0.47 <sup>ab</sup>  | 0.44 <sup>ab</sup> | 0.45 <sup>ab</sup> |
| T <sub>3</sub>     | 1280.80 <sup>ab</sup>  | 1093.57 <sup>abc</sup> | 1187.18 <sup>ab</sup> | 1332.03 <sup>ab</sup>  | 1132.03 <sup>ab</sup>  | 1232.03 <sup>ab</sup>  | 0.44 <sup>ab</sup>  | 0.42 <sup>ab</sup> | 0.44 <sup>ab</sup> |
| T <sub>4</sub>     | 1264.80 <sup>abc</sup> | 943.07 <sup>bcd</sup>  | 1103.93 <sup>b</sup>  | 1322.83 <sup>b</sup>   | 1054.23 <sup>bcd</sup> | 1188.53 <sup>bc</sup>  | 0.45 <sup>ab</sup>  | 0.39 <sup>ab</sup> | 0.42 <sup>ab</sup> |
| T <sub>5</sub>     | 1323.40 <sup>a</sup>   | 1161.90 <sup>a</sup>   | 1242.65 <sup>a</sup>  | 1412.67 <sup>a</sup>   | 1212.67 <sup>a</sup>   | 1312.67 <sup>a</sup>   | 0.49 <sup>a</sup>   | 0.45 <sup>a</sup>  | 0.47 <sup>a</sup>  |
| T <sub>6</sub>     | 1259.97 <sup>abc</sup> | 1093.93 <sup>abc</sup> | 1176.95 <sup>ab</sup> | 1333.20 <sup>ab</sup>  | 1133.20 <sup>ab</sup>  | 1233.20 <sup>ab</sup>  | 0.46 <sup>ab</sup>  | 0.42 <sup>ab</sup> | 0.44 <sup>ab</sup> |
| T <sub>7</sub>     | 1187.53 <sup>c</sup>   | 1091.73 <sup>abc</sup> | 1139.63 <sup>b</sup>  | 1234.33 <sup>cd</sup>  | 1122.83 <sup>b</sup>   | 1178.58 <sup>bc</sup>  | 0.43 <sup>ab</sup>  | 0.43 <sup>ab</sup> | 0.43 <sup>ab</sup> |
| T <sub>8</sub>     | 1257.93 <sup>abc</sup> | 1086.13 <sup>abc</sup> | 1172.03 <sup>ab</sup> | 1289.13 <sup>bcd</sup> | 1111.43 <sup>b</sup>   | 1200.28 <sup>abc</sup> | 0.44 <sup>ab</sup>  | 0.42 <sup>ab</sup> | 0.43 <sup>ab</sup> |
| T <sub>9</sub>     | 1064.70 <sup>d</sup>   | 894.30 <sup>d</sup>    | 979.50 <sup>c</sup>   | 1095.60 <sup>e</sup>   | 969.60 <sup>cd</sup>   | 1032.60 <sup>d</sup>   | 0.41 <sup>b</sup>   | 0.38 <sup>b</sup>  | 0.39 <sup>b</sup>  |
| T <sub>10</sub>    | 1259.73 <sup>abc</sup> | 1076.80 <sup>bcd</sup> | 1168.23 <sup>ab</sup> | 1274.33 <sup>bc</sup>  | 1089.13 <sup>bc</sup>  | 1175.56 <sup>abc</sup> | 0.44 <sup>ab</sup>  | 0.41 <sup>ab</sup> | 0.43 <sup>ab</sup> |
| T <sub>11</sub>    | 1204.47 <sup>bc</sup>  | 1052.73 <sup>bcd</sup> | 1128.60 <sup>b</sup>  | 1254.23 <sup>bcd</sup> | 1076.50 <sup>bc</sup>  | 1165.37 <sup>bc</sup>  | 0.45 <sup>ab</sup>  | 0.41 <sup>ab</sup> | 0.43 <sup>ab</sup> |
| -test              | *                      | *                      | *                     | *                      | *                      | *                      | *                   | *                  | *                  |
| S.E.M ±            | 28.171                 | 28.872                 | 22.434                | 29.761                 | 30.491                 | 29.218                 | 0.021               | 0.014              | 0.013              |
| CD <sub>0.05</sub> | 83.142                 | 85.221                 | 66.223                | 87.86                  | 90.010                 | 86.245                 | 0.044               | 0.021              | 0.039              |
| CV                 | 4.372                  | 5.120                  | 3.444                 | 4.351                  | 5.312                  | 4.252                  | 5.851               | 5.890              | 5.352              |

NBFL: Non-Breakable Filament Length

T<sub>1</sub>= Diafenthiuron 50% WP (@ 1 g/l) at 8 DAS, T<sub>2</sub>= Diafenthiuron 50% WP (@ 1 g/l) at 15 DAS, T<sub>3</sub>=Diafenthiuron 50% WP (@ 1 g/l) at 21 DAS, T<sub>4</sub>= Abamectin 1.9% EC (@ 0.75ml/l) at 8 DAS, T<sub>5</sub>=Abamectin 1.9% EC (@ 0.75ml/l) at 15 DAS, T<sub>6</sub>= Abamectin 1.9% EC (@ 0.75ml/l) at 21 DAS, T<sub>7</sub>=Diamethoate 30% EC @ 2 ml/l, T<sub>8</sub>=Cyanopyrafen 30% EC @ 0.5ml/l, T<sub>9</sub>=Azadirachtin 1% EC @ 1ml/l, T<sub>10</sub>= Control (water spray) T<sub>11</sub>= Absolute control.

\*Significant at 0.05; DAS: Days After Spray of the chemical; Numbers superscript with same alphabets are statistically on par

## 6. Conclusion

The abamectin 1.9% EC (@ 0.75ml/l) and diafenthiuron 50% WP (@ 1 g/l) at 15 DAS and 21 DAS harvested leaf were showing good results compared to other chemicals in all cocoon and filament parameters so these chemicals are safely use to control both mites and thrips in mulberry plantation.

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