USE OF TRADITIONAL KNOWLEDGE IN MANAGEMENT OF OKRA MOSAIC VIRUS IN MULLAITHIVU DISTRICT OF SRI LANKA

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ABSTRACT

Okra mosaic virus disease (OkMV) is a major biotic constraint on Okra (Abelmoschus esculentus) cultivation in Sri Lanka. Diseased plants show characteristic symptoms of mosaic, yellowing on leaves, small and yellowish green fruits. Yield loss due to this virus is quite high, up to 80-94 percent is reported under heavy infection. Effective and efficient control of pest can be achieved by the use of chemicals, but it is hazardous for the environment due to their toxicity. Hence, there is a need to search for environmentally friendly and cost-effective alternative approaches to control OkMV. Plant metabolites and plant-based pesticides appear to be one of the better alternatives as they known to have minimal environmental impact and danger in contrast to the synthetic pesticides. Therefore, the present study was conducted for the management of Okra mosaic virus through the vector control (Hopper) by using medicinal plants based traditional knowledge. Farmer's field in Mullaithivu was selected for the study. There were 5 treatments, i.e. Chemical (Thiamethoxam) and three different medicinal plant extracts such as extracts of neem (Azadiracta indica) seeds, garlic (Allium sativum) bulbs and Ginger (Zingiber officinale) rhizome extracts were used in the experiment to study the impact of these treatments on growth and yield parameters of Okra (variety Haritha). According to the results, the highest rate of incidence of Okra mosaic virus was found in the plots with no plant extract management. Though all the plant extract produced better performance than control, where control treatment doesn't apply any chemical or plant extract., Neem seeds extract treated plants had minimal rate of incidence of this virus as well as recorded maximum plant height, fruit length, fruits diameter and yield. Based on the study findings, Neem seeds extract could be used to control Okra mosaic virus instead of chemical (Thiamethoxam) while minimizing the health hazards and the environmental pollution.

Key words: *Okra, Plant extract, Mosaic virus, Vector. Environment friendly*

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INTRODUCTION

Okra (Abelmoschus esculentus L.) is a vegetable crop belongs to the Malvaceae family and its very popular in the Indo-Pak subcontinent. In India, it ranks number one in its consumption, but its original home is Ethiopia and Sudan, and North-eastern African countries. Medicinal plants are the nature's gift to human being to have disease-free healthy life. It plays a vital role to preserve our health. In recent times, the use of herbal products has increased tremendously in the western world as well as developed countries. Medicinal plants are believed to be safer and proved elixir in the treatment of various ailments. Okra is an important medicinal plant of tropical and subtropical countries. Its medicinal usage has been reported in the traditional systems of medicine such as Ayurveda and Siddha (Jayaweera, 1982).

Okra (Abelmoschus Esculantus) is one of the most popular vegetables grown in the Wet, Intermediate and Dry zone of Sri Lanka. Okra is cultivated about 7066 ha producing an average yield of 5.3 Mt/ha. Therefore, the total annual Okra production in Sri Lanka is 37,330 Mt with a per capita availability of 2.0 kg/ha. Young Okra pods are consumed fresh or cooked. Fiber of the Okra stem is used in the paper industry. Okra is a good source of vitamins A, B, C as well as protein, carbohydrates, fats, minerals, iron and iodine. Consumption of 100 g of fresh Okra pod provides 20%, 15%, and 50% of the daily requirement of calcium, iron and ascorbic acid, respectively (Fajinmi, 2012).

The crop is susceptible to various diseases caused by insects, fungi, nematodes and viruses. However, its cultivation is seriously threatened by the attack of the Okra Mosaic Virus (OkMV) by affecting different parts of the plant (Amit Kumar, 2017). The virus is not seed transmitted, but it is mainly transmitted by hoppers. OkMV is a tymovirus infecting members of the family Malvaceae. Yield reductions of 20 to 50% have been reported in Okra due to OkMV. This loss may increase to 90% depending on severity of the disease. Okra mosaic virus symptoms are characterized by a homogenous interwoven network of yellow mosaic pattern enclosing islands of green tissue in leaf blades. In extreme cases, infected leaves become yellowish or creamy colour (Deepal and Wasala, 2014). If plants are infected within 20 days after germination, growth is retarded, and few leaves and pods are formed.

Yield loss may be up to 95%. The extent of damage declines with delay in infection (Fajinmi, 2012).

Okra mosaic disease is one of the most devastating disease causes in Sri Lanka. The weather condition in Sri Lanka is more congenial to the vector hopper survival throughout of the region i.e. the warm and humid condition. Chemical pesticides usage for the control of insect vectors of plant viruses is very hazardous to the environment as well as the humans directly associated with insecticides application or consumption of treated produce. Keeping in view the experiment management of viral disease is to prevent the crop losses and quality deterioration through different ways, which includes use of chemical insecticide and plant extracts. The antiviral properties of the plant extracts in controlling viral diseases have been well discussed in several other earlier reports. Many plant extracts have several inhibitors and ribosome-inactivating proteins that directly interfere with virus multiplication and protein synthesis (Venkatesan, 2010). Therefore, the present study was designed to investigate the effect of medicinal plant extracts on the Okra mosaic virus control.

METHODOLOGY

The experiment was conduct at a farmer field in Mullaitivu in the Low country Dry zone. Randomized Complete Block Design was used with 5 treatments and 3 replicates, as given below. The rate of application of plant extracts and frequency are explained under extracts preparation and spraying.

Treatment 1- control (No plants extracts, or chemicals applied)

Treatment 2- Neem seeds extract

Treatment 3- Garlic bulbs extract

Treatment 4- Ginger Rhizome extract

Treatment 5- Chemical (Thiamethoxam)

Land preparation

The soil was swapped by rake to remove the weeds, stones and other unwanted elements. The application of the land was harrowed two times to obtain fine tilt conditions of soil. The field was laid out with blocking perpendicular to the slope of the land. Three blocks were made, and each block was further divided into five plots with the plot size of 3.6m X 3m for each treatment.

Field planting

Okra seed were directly sown in the field. Planting holes space at 90 x 60 cm. 3-4 seeds per holes at depth of 1-2 cm were laid. Two weeks after

sowing, thin out 2 plants /hill were done. Thereafter, the vacancies were filled after 1 week.

Extracts Preparation and Spraying

Plant samples were grinded in water at 100 g L-1 (10% concentration) in blender and filter through double layered cheese cloths.

Extracts were used immediately for spraying.

First spray was done after 15 days of sowing. The plant extracts and chemical were sprayed 5 times at 15 days interval. All exposed surface of the plants including leaves, buds, twigs, branches and fruits was sprayed.

Fertilizer application

Basal fertilizer was applying before planting. Top dressing was applied 4 weeks after planting as given below (Table 1).

Table 1. Fertilizer application

Fertilizers		Rate
Basal	Urea	150Kg/ha
	TSP	200Kg/ha
	MOP	75Kg/ha
TD	Urea	150Kg/ha
	MOP	75Kg/ha

Other agronomic practices

Basin irrigation method was used for irrigating the plants. At early stage of planting, the field was irrigated at two days interval then four days interval. Hand weeding was done whenever weeds emerged.

Data was recorded on individual plant basis. Plant height was determined at twice a week intervals. The number of infected plants were counted in each plot. Numbers of fruits, numbers of green pods, green pods weight and pods weight were taken from 5 randomly selected plants in each plot. Randomly selected five pods per plot were used to measure the length and diameter. Data were analyzed for ANOVA with the help of a computer package program of SAS.

RESULT AND DISCUSSION

Growth parameters

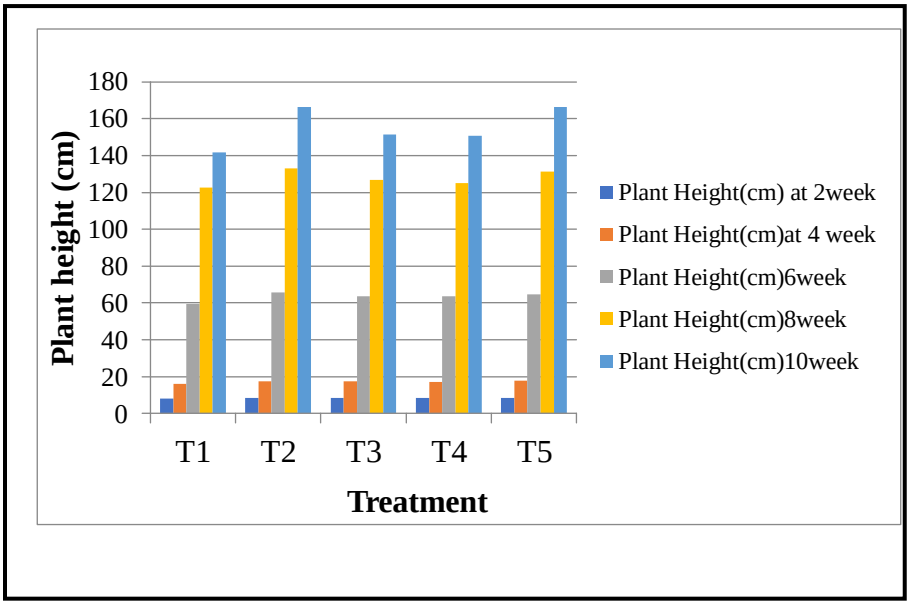
- Plant height (cm) in 2 weeks interval

There was a significant influence of plant extracts against Okra mosaic virus for plant height at different growth stage. It was revealed that virus infestation reduced plant height irrespective of growth stages. 2 weeks after sowing plants of different treatments showed statistically similar performance. But at the later stages such as 4th week, 6th week, 8th week and 10th week after sowing there was significant difference among the plants of different treatments. The tallest plants were observed in T5 (Chemical (Thiamethoxam)) treatments followed by T2 (Neem seeds extract). T3 (Garlic bulbs extract) and T4 (Ginger Rhizome extract) treatment similar height, smallest plants were found in T1 (control) treatment. It was found that plants under the control treatment differed from other treatments for plant height at all stages of growth (Figure 1).

Plants under controlled treatment were found to be stunted due to the influence of virus. While in other cases where Okra plants were treated with plant extracts, better growth was exhibited. Among the plant extracts, neem seed extract could be considered as the best treatment against OkMV for plant height, as neem seed extract treated plant were found to be tallest (8.3, 17.4, 65.6, 133.1 and 166.2 cm at 2nd week, 4th week, 6th week, 8th week and 10th week after sowing respectively) in all stages. Infected plants under control treatment gave average height of 8.2 cm, 16.2 cm, 59.6 cm, 122.6 cm and 141.7 cm at 2nd week, 4th week, 6th week, 8th week and 10th week after sowing respectively (Figure 1).

On the other hand, plant extracts treatments ensured better height than control and was able to reduce the severity of the virus. This was supposed to be due to the reduction of virus incidence by the application of plant extracts and the presence of antiviral activity in the plant extract as observed by Bhyan and Alam (2007).

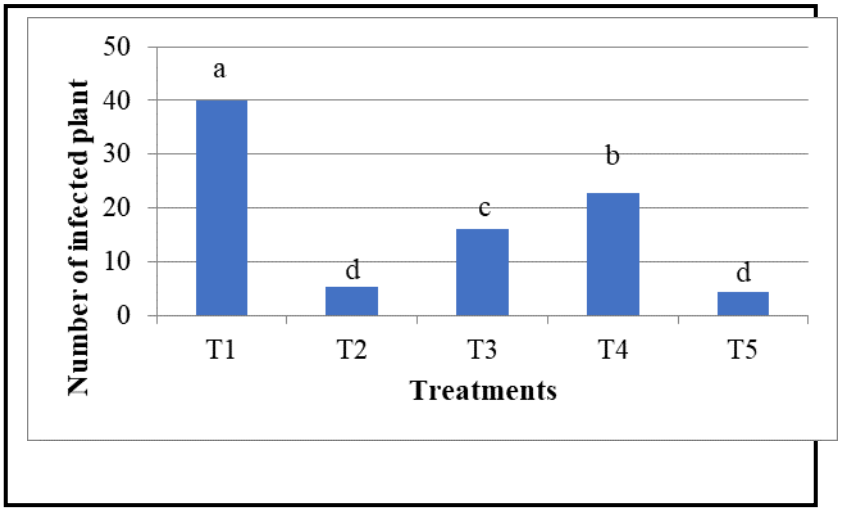
Figure 1. *Effect of different treatments on plant hight (cm) in 2 weeks interval*



- **Number of infected plants/ plot**

The numbers of infected plants/plot were significantly different from each treatment. According to the data most infected plant were shown in T1 (Control) treatment. Lowest infected plants/plot were shown in T5 (Chemical (Thiamethoxam)) treatment and then T2 (Neem seeds extract) treatment. T3 (Garlic bulbs extract) treatment, T4 (Ginger Rhizome extract) treatment and T1 (Control) treatment are significantly different (Figure 2). It can also be concluded that plant extracts can be used as good pesticide to keep the rate of infestation under control. Lower rate of plant infestation may be due to the effect of phytopesticides on the vectors of the virus or directly on OkMV. It was recorded that some plant extract like neem have a number of properties useful for insect management (Schmutterer, 1990).

Figure 2. Number of infected plants/ plot observed under different treatments

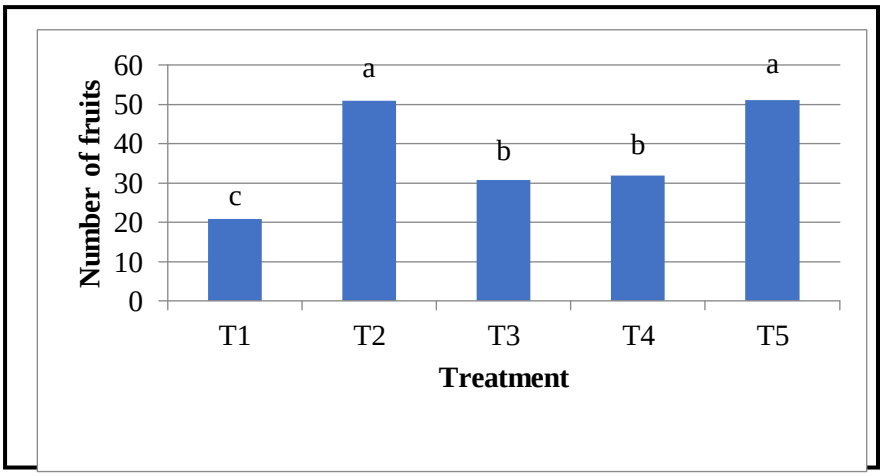


Yield parameters

- **Number of fruits/ plant**

The highest number of fruit/ plants was found in T5 (Chemical (Thiamethoxam)) treatment and the lowest number of fruits was observed in T1 (Control) treatment (Figure 3). T2 (Neem seeds extract) and T5 treatments are not significantly different but they are significantly different from other treatments. T3 (Garlic bulbs extract) and T4 (Ginger Rhizome extract) treatments are not significantly different. The maximum number of fruits per plant was observed in healthy plants (Ibrahim Khaskheli, 2017).

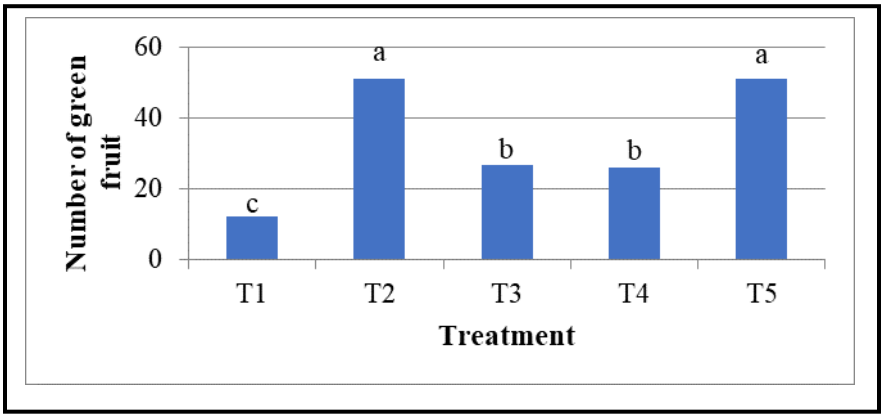
Figure 3. *Effect of different treatments on number of fruits/ plant*



- **Number of green fruits/ plant**

Best performance is shown in T2 (Neem seeds extract) treatment and T5 (Chemical (Thiamethoxam)). Poor performances are shown in T1 (Control) treatments (Figure 4). T3 (Garlic bulbs extract) and T4 (Ginger Rhizome extract) treatments are not significantly different. But T2 and T5 treatments are significantly different from rest of the treatments. Infected plants remain stunted and bear very few deformed fruits. The fruits are also yellow, small, and reduced in size, having irregular yellow areas. It causes great loss by affecting quality and yield of fruits (Ibrahim Khaskheli, 2017),

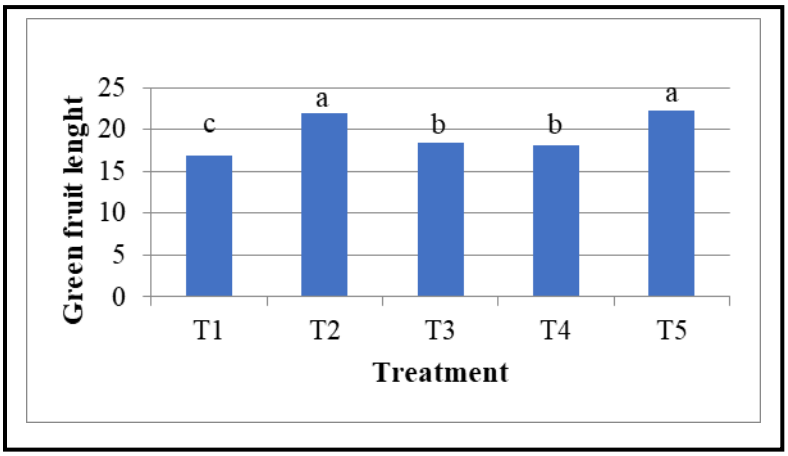
Figure 4. *Effect of different treatments on number of green fruits/ plant*



- **Green fruit length**

Average length of fruit among the treatments ranged from 16.8 -22.2 cm. According to the Figure 5, highest fruit length can be obtained in T5 (Chemical (Thiamethoxam)) and T2 (Neem seeds extract) treatment. Lowest value can be obtained in T1 treatment. T3 (Garlic bulbs extract) and T4 (Ginger Rhizome extract) treatments are not significantly different. T2 and T5 treatments are also not significantly different. T1 (Control) treatment is significantly different from all other treatment. Fruits of OkMV infested plants of the control plot appeared to be smallest (5.1 cm), lightest (7.5 g) than that of plant extract treated plants agrees with the findings of Bhyan et al, (2007).

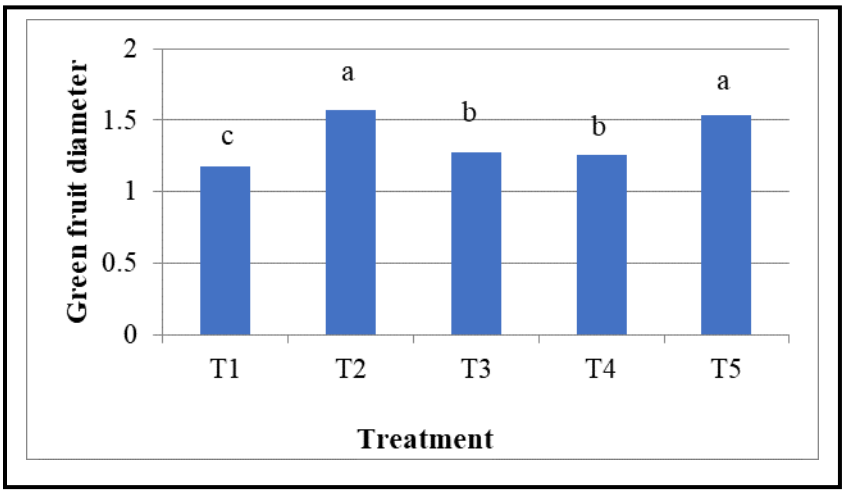
Figure 5. *Effect of different treatments on Green fruits length (cm)*



- **Green fruit Diameter**

There is no significant difference between T2 (Neem seeds extract) treatment and T5 (Chemical (Thiamethoxam)) treatments. And T3 (Garlic bulbs extract) and T4 (Ginger Rhizome extract) treatments were not shown significant difference among them but they were significant difference from T1 (control) and T2 (Neem seeds extract) treatment and T5 (Chemical (Thiamethoxam)) treatments. T1 (control) is significantly different from all other treatments. The highest diameter was shown in T2 (Neem seeds extract) treatment and lowest in control treatment (Figure 6).

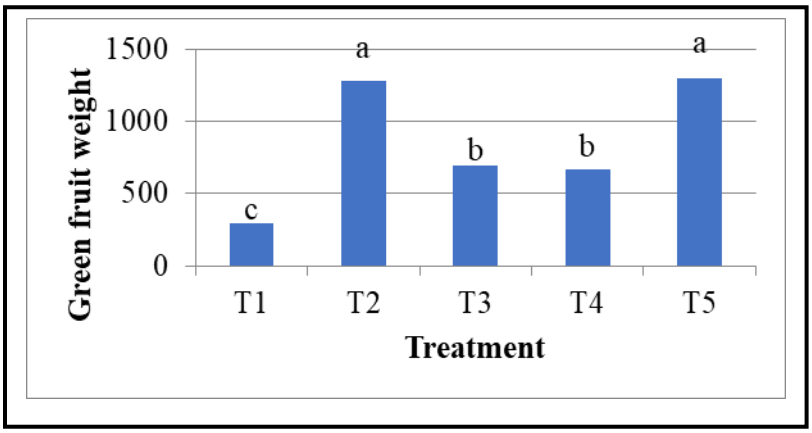
Figure 6. *Effect of different treatments on Green fruit Diameter (cm)*



Green fruits weight/plant

The green fruits weight is an important yield components of Okra to achieve highest yield. Average green fruits weight/ plant among the treatments ranged from 295.1g to 1302.2g. Variety Haritha produced pods less than 30 g of average weight (Gunawardana et al., 2011). According to Figure 7 green fruit weight of control treatment (T1) is significantly different from other treatments. One of the reasons was that all the plants in the control treatment were infected with the virus. T3 (Garlic bulbs extract) and T4 (Ginger Rhizome extract) treatments are not significantly different. T2 and T5 treatments are also not significantly different. However, the highest green fruit weight/plant was obtained in T5 and T2 treatments. It was thus clear that virus caused a severe effect on fruit formation, which was minimized by the application of phytopecticides (Bhyan et al, 2007).

***Figure** 7. Effect of different treatments on Green fruits weight (g)*



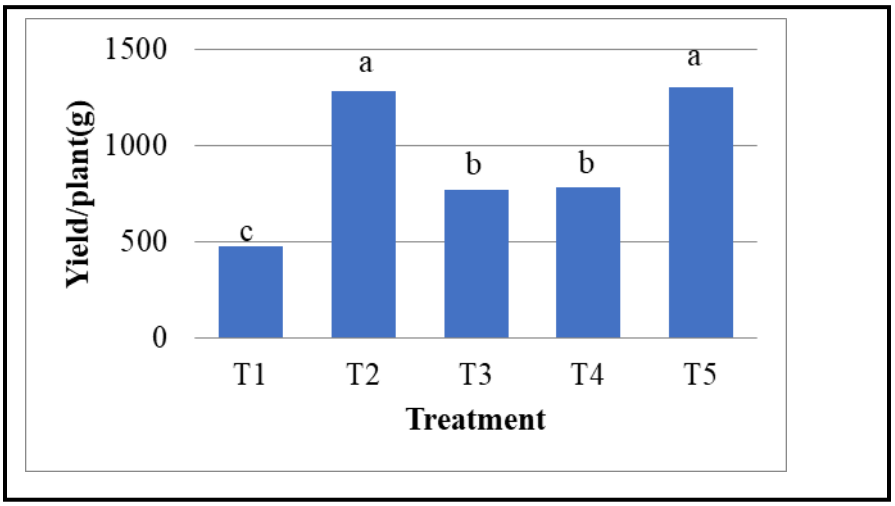
Yield/plant

It was observed that there was a significant difference among the treatments in both healthy and infested group of plants for yield (Figure 8). Neem seeds extract treated plants performed better than plants of the control treatment. In healthy plants, fruit yield ranged from 1302.2g /plant and in OkMV infested plant it was 478.8g/plant. In both groups, highest yield was observed in Neem seeds extract and Chemical (Thiamethoxam) treated plots and lowest in control plants. The difference between the yield of healthy and infested plants indicated that there was a negative influence of OkMV on yield. Vanlommel et al.

(1996) revealed that OkMV infestation causes a yield loss of 26%.

However, in cowpea a complete loss of yield has also been observed (Kareem and Taiwo, 2007). Many plant extracts have several inhibitors and ribosome-inactivating proteins that directly interfere with virus multiplication and protein synthesis (Venkatesan, 2010).

Figure 8. *Effect of different treatments on Yield/plant (g)*



CONCLUSION

In this experiment the spray of Chemical (Thiamethoxam) and Neem seeds extracts gave very impressive results in controlling Okra mosaic virus. Among all treatments tested with plant extracts Neem seeds extract was the best, easiest and environment friendly method to control the OkMV disease incidence. In addition to that, it helped to suppress the vector population, when applied after 15 days interval starting from two weeks after germination.

There is an urgent need to promote traditional knowledge on pest and disease control to safeguard the environment and to ensure food security. However, due to the unavailability of chemical pesticides and high cost, neem seeds extracts can be suggested to farmers as an eco-friendly management of Okra mosaic virus.

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