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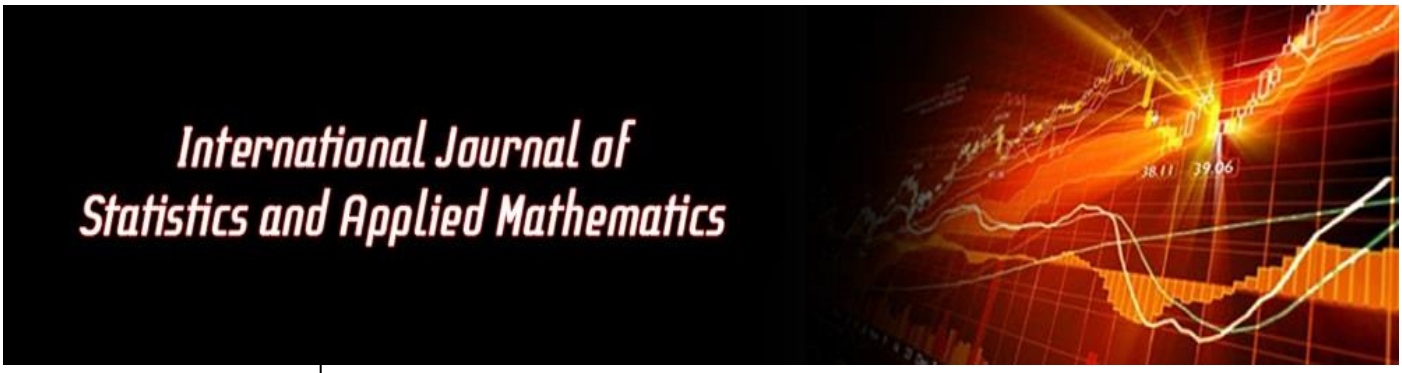

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Comparison of biorational module with farmers practice against vector of viral and phytoplasma diseases of brinjal, *Solanum melongena* L.

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Abstract
In order to evaluate the effectiveness of the Bio-rational module (BRM)against mosaic, little leaf disease and whiteflies during Kharif 2020, the resulting module was tested in two different locations: the Agricultural Research Station (ARS) farm, Virinjipuram and the farmers' field in the K. V. Kuppam block of Vellore district. The findings showed that the BIDM was better in reducing the occurrence of mosaics in both studied areas, recording 5.16 and 6.12% and having the lowest incidence of small leaves. When compared to farmers' practices at every stage of the process, the bio-intensive module adopted plots likewise had the lowest whitefly population. At ARS, Virinjipuram and in farmers' fields, the whitefly population at 30 days after transplanting (DAT) was 4.45 and 3.77 Nos per plant. A significantly greater fruit output was recorded at the ARS farm (34.02 t/ha) and in farmers' fields (30.36 t/ha) upon adoption of the bio-intensive module. This was accompanied by higher benefit-cost ratios of 5.84 and 5.18, respectively. In contrast, the ARS farm reported the lowest fruit output of 31.71 t/ha with a BC ratio of 5.57, while the farmers' field recorded the lowest fruit yield of 25.68 t/ha with a CB ratio of 1:4.43.

Keywords: Bio-rational module, efficiency, farmers practice, brinjal, mosaic disease, vector population

Introduction
In the tropics and subtropics, brinjal, also known as egg plant (*Solanum melongena* L.), is a significant solanaceous crop. With the exception of higher elevations, it is one of the most widely cultivated, well-liked, and important vegetable crops in India. Despite having a perennial nature, it is commercially farmed as an annual crop. In terms of fruit color, size, and shape, it is a highly favored crop. Iron, phosphorus, calcium, and vitamins A, B, and C are all abundant in it. Vegetables are attacked by a number of biotic and abiotic stresses, and in many regions of the world, diseases linked to viruses and phytoplasmas are one of their main obstacles, resulting in large losses in production yield and quality.

Pathogens like mycoplasma, Gemini virus and clostero virus are also transmitted by insects *viz*., Jassids, *Hishimonas phycitis* (Distant) and whitefly, *B. tabaci* (Duffus, 1996 and Srinivasan, 2009) [1, 5]. The brinjal little leaf disease was first described by Thomas and Krishnaswami, (1939) [6] in India with 100% yield loss in epidemics Rao and Kumar, (2017) [3]. Several approaches were suggested for the management of virus and phytoplasma diseases and their insect vectors. Cultural management strategies such as rouging of infected plants, adjustment of date in sowing, use of clean propagating material, rotation with non-host crops, and removal of weeds coupled with vector control are effective methods for the containment of diseases. The dependency of the virus and phytoplasmas on a living host for their survival makes it impossible their management with a single management tool. Therefore, combining cultural, physical, biological, resistance, and chemical applications may make an integrated approach the most practical and long-term choice.

However, careless chemical use results in a variety of issues, including resistance development, food, soil, and groundwater contamination, as well as harmful effects on non-target and other organisms.

Reducing pesticide use while preserving the crop quality that producers and consumers desire is one of the most difficult tasks in creating and executing an Integrated Disease Management (IDM) module.

In light of this, the biorational module that was created was tested in farmers' fields for both its effectiveness and financial effects.

Materials and Methods

Two field experiments were conducted simultaneously at different locations one at Agricultural Research Station, Virinjipuram, Vellore District, Tamil Nadu and second at farmers' holding field at K.V. Kuppam block of Vellore district to assess the performance of Bio-rational module (BRM) module against the mosaic, little leaf disease and whitefly, *Bemisia tabaci* Gennadius during Kharif 2020 with two components of management viz., Bio-rational module (BRM) and Farmers' practice (Table 1). Brinjal (Variety: VRM 2) seedlings (25 days old) were transplanted in an area of 20 cents with a spacing of 60x45 cm (R x P) under each management modules. The recommended agronomic package of practices was followed to raise a good crop. The need based spray and insecticides were sprayed with the help of a knapsack sprayer using 500 L of spray per hectare. Observations on the disease incidence of mosaic and little leaf were taken using the given formula in each module. Similarly, three leaves-one at the top, middle, and bottom of each plant were used to count the whitefly population at 30, 60, and 90 days after transplanting (DAT). The results were recorded and reported as the population per plant. The following formula was used to calculate the disease incidence. The resulting fruit yield per plot has been converted to fruit yield per hectare, and the cost-benefit ratio for various management modules has also been calculated. AGRES, Gomez, and Gomez (1984) [2] were used to statistically assess the population, mosaic disease incidence, and fruit yield data collected in various treatments.

Table 1: Bio-rational module Vs farmers practice'

Bio-rational module	Farmers' practice
1. Seed treatment with *Trichoderma viride* @ 4 g /kg or *Bacillus subtilis* @ 10 g / kg 2. Nursery application of neem cake @ 1.0 kg sq.m^{-1} 3. Growing of maize as border crop in main field 4. Roguing out early diseased plants 5. Installation of yellow sticky traps @ 12 /ha 6. Foliar spray of neem oil formulation @ 3 ml/ litre 7. Single application of spiromesifen 240 SC @ 1.0 ml and thiacloprid 240 SC @ 1.0 ml per litre of water	1. Two applications of imidacloprid 17.8 SL @ 5ml per litre of water at 30 & 45 DAT. 2. Single application of acephate 75 SP @ 1.5 g per litre of water at 60 DAT

$$\text{Mosaic and little leaf disease (\%)} = \frac{\text{Number of affected plant in a plot}}{\text{Total number of plants in a plot}} \text{ X } 100$$

Results and Discussion

The results revealed that there was a remarkable decrease in the disease incidence and whitefly population. Observations on disease incidence and vector population were recorded at regular intervals at ARS farm and also in farmers' holding and are presented in Tables 2 and 3.

At ARS farm, among the three treatments, the bio-rational module was found superior in minimising the mosaic (5.16%) and little leaf diseases (2.59%) and whitefly population (0.89 No./plant) with increased fruit yield (34.02 t/ha) and higher Cost : Benefit (1:5.84). The untreated check recorded the highest incidence of mosaic (18.50%) and little leaf (8.24%) and whitefly population coupled with lowest fruit yield (27.58 t/ha) and C:B (1:4.07).

Likewise, in farmers' holding also, the results revealed that an adoption of bio-intensive management module was found superior in minimising the mosaic (6.12%) and little leaf diseases (3.06%) and whitefly population (1.62 Nos/plant) with increased fruit yield (30.36 t/ha) and higher C:B (1:5.18). The untreated check recorded the highest incidence of mosaic (12.54%) and little leaf (7.31%) diseases and whitefly population (6.32 Nos/plant) coupled with lowest fruit yield (25.68 t/ha) and Cost: Benefit (1:4.43).

The present finding on the use of integrated pest management package over conventional methods was also studied by Sandeep *et al.*, (2017) [4]. They found that seedling root treatment for 3 hours with imidacloprid (1 ml/l) + Soil application of *Trichoderma* + installation of pheromone traps @ 35 /ha + Mechanical removal of infected shoots and fruits + spraying of NSKE 4 % recorded the lowest shoot and fruit infestation and wilt incidence. In case of Chillies, IDM was found effective to check the powdery mildew, anthracnose and die back diseases and increase fruit yields. Yadav *et al.*, (2017) [7] also reported that the per cent disease incidence of powdery mildew, anthracnose on leaves, fruit infection and plant mortality in chillies were recorded 3.6, 17.7, 23.0 and 5.6 in IDM fields and 7.8, 33.6, 37.7 and 17.1 in without IDM fields.

Conclusion

Thus the findings clearly indicated that with an adoption of bio-intensive IDM module *viz.*, Seed treatment with *Trichoderma viride* @ 4 g /kg or *Bacillus subtilis* @ 10 g / kg Nursery application of neem cake @ 1.0 kg sq.m^{-1}, growing of maize as border crop, roguing out of early diseased plants, Installation of yellow sticky traps @ 12 /ha, Foliar spraying of neem oil formulation @ 3 ml/ litre or NSKE 5 % and need based applications of spiromesifen 240 SC @ 1.0 ml and thiacloprid 240 SC @ 1.0 ml per litre of water reduced the mosaic and little leaf diseases and also whitefly population besides increasing the fruit yield and cost benefit ratio.

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