Thrips Infestation in Mung bean: Integrated Control with Chemical and Neem-Based Treatments

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ABSTRACT

Aim: To manage thrips of mung bean and observe the impact of different chemical insecticides and neem oil on thrips infested mung bean field.

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Study Design: The experiment was set in randomized complete block design (RCBD) with three replications.

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Place and duration of study: The study was conducted at the research field of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka from March to May, 2022.

Methodology: The mung bean variety, BARI mung 6 was grown in the field and ten treatments viz., Decis 5EC, Ripcord 10EC, Marshal 20EC, Sevin 85SP, Dursban 20EC, Neem oil, Talstar 2WP, Actara 25WG, Confidor 70WG and an untreated control. Insecticides and Neem oil were applied at 7 days interval.

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Results: The lowest population of thrips (1.25 plant^{-1}) was found in Talstar 2WP treated plot which showed maximum percent reduction of thrips. Talstar 2WP also produced the maximum number of flower (16.67 plant^{-1}), number of pod (34.27 plot^{-1}), number of seed plants^{-5} (885.3), seed weight (36.19 g) and gave the highest yield (2.05 kg/plot) of mung bean. Confidor 70WG also showed a better result considering all the above parameters. Neem oil showed poor effectiveness in managing thrips.

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Conclusion: The results of present study indicate that the Talstar 2WP was the most effective insecticide against Thrips infestation on mung bean.

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Keywords: Mung bean, Thrips, Chemical Insecticides, Botanicals, Yield

1. INTRODUCTION

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Mung bean (*Vigna radiate* (L.) Wilczek) belongs to the family Fabaceae, is a good source of protein, carbohydrates, dietary fiber, vitamins, minerals, and large concentrations of bioactive substances [1]. It is one of the most important pulse crops in Bangladesh, ranks 4 th in terms of acreage and production [2]. It is ideally suited for summer, but also can be an excellent fit for crop rotations [3,4]. The global mung bean growing area has increased during the last 20 years at an annual growth rate of 2.5%. Mung bean production in Bangladesh is about 32 thousand metric tons in the area of 96 thousand acres and the average yield is 341kg acre-1 [5]. Mung bean is widely grown, but suffers from several biotic and abiotic stress factors that reduce its production and grain quality [6]. Insect pests are one of the key factors accounting for 42 and 58% of the losses in the mung bean's pre- and post-flowering stages, respectively [7] and limiting the yield [8]. On mung bean, there are over 60 different insect species, and nearly 34 of them are major pests [9]. One of the primary insect pests of mung beans, thrips (Thysanoptera: Thripidae), significantly reduces crop production [10,11]. Severe attacks of *Megalurothrips usitatus* cause yield losses of mung bean from 13% to 64% [12]. Thrips is associated mostly with the damage of tender buds and flowers of mung-bean [13]. During vegetative stage, *M. usitatus* feed inside vegetative buds, rasp the top, unopened trifoliate

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Commented [kb9]: Write complete scientific name with author leaves and suck plant juice oozing out of the plant part. In the initial blooming stage, male and female thrips randomly distributed within the flowers. Both larvae and adults feed on pollen and rasp other flower parts and suck the plant juice oozing out from the injured plant parts which leads to flowers dropping and abnormal pod formation. Losses caused by petal and fruit malformation and scarring are of even greater economic importance [14]. Thrips occur every growing season and cause yield losses through premature dropping of flowers.

So, it is incumbent to control thrips in a safer and effective way for getting higher yield of mung bean. Farmers usually like to get results quickly but environmental safety is also an important considering factor. Neem based pesticides are reported to control young nymphs, inhibit growth and development of older nymphs and reduce egg-laying by adult thrips. Chemical pesticides are used extensively to control the *M. usitatus* population [15,2] but their efficacy is limited since thrips are hidden inside flowers [16]. Moreover, conventional and old generation insecticides provide poor control of insect pests and generally lead to pest resurgence. Therefore, to overcome these problems the use of new generation synthetic insecticides with novel mode of action that are active at very low dosages and manage thrips population, is the ultimate alternative for effective pest management. Hence, the present study was planned to investigate the relative toxicity of neem-based pesticide and newer chemical insecticides in order to find an effective control of thrips infesting mung bean.

2. MATERIALS AND METHODS

The present research was carried out at the experimental field of Sher-e-Bangla Agricultural University, Dhaka to assess the effects of different insecticidal treatments on mung bean (BARI mung 6) crop growth, thrips infestation, and yield attributes. The experimental site was located at 23.74º N latitude and 90.35º E longitude, with an elevation of 8.2 meters above sea level. The soil in the experimental area belongs to the Tejgaon series, a red-brown terrace soil with clay loam texture, well-drained, and slightly acidic (pH 5.8), ideal for crop growth. The site experiences a subtropical climate characterized by heavy rainfall during the kharif season (April to September) and scanty rainfall in the rabi season (October to March), which provides ample sunshine and favorable conditions for mung bean cultivation. The experiment was laid out using a Randomized Complete Block Design (RCBD) with three replications, and ten treatments were tested, including chemical insecticides and botanical treatment with an untreated control (Table 1).This experimental design allowed for a comprehensive evaluation of the effectiveness of different treatments in controlling pest infestation and promoting crop health, offering insights into the best management practices for improving mung bean yield and reducing pest-related crop losses.

Table 1. The treatments used in the experimental field in controlling mung bean thrips

Treatments (Trade name)	Common name of Insecticides	Dose of insectcides applied @ 7 days interval	Mode of action
T_1= Decis 5EC	Deltamethrin	1.0 ml l^{-1} of water	Contact and stomach
T_2=Ripcord 10EC	Cypermethrin	1.0 ml l^{-1} of water	Contact and stomach
T_3= Marshal 20EC	Carbosulfan	2.0 ml l^{-1} of water	Contact and stomach
T_4 =Sevin 85SP	Carbaryl	2.0 ml l^{-1} of water	Contact and stomach
T_5 =Dursban 20EC	Chlorpyriphos	2.0 ml l^{-1} of water	Contact and stomach
T_6 = Neem oil	Azadirectin	4.0 ml l^{-1} of water + 4 g detergent	Contact and stomach
T_7 = Talstar 2WP	Bifenthrin	0.5 g $l^{-1}$of water	Contact, stomach and systemic
T_8 =Aktara 25WG	Thiamethoxam	0.4 g l^{-1} of water	Systemic and contact

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T_9=Confidor 70WG	Imidaclorpid	0.3 g l^{-1} of water	Contact and stomach
T_{10}=Untreated Control	-	-	-

Each plot measured 3 m × 2 m, with a spacing of 1 m between plots and blocks. Fertilizers were applied as per the recommendations, and the mungbean seeds were sown in furrows at a rate of 45 kg per hectare. Intercultural operations such as thinning, weeding, irrigation, and gap filling were carried out to ensure optimal crop growth. Data were collected on several parameters, including the number of thrips and their reduction percentage, flower infestation, flower shedding, pod count, seed yield, and plant health. Thrips infestation was recorded at 7-day intervals, starting from the first incidence and continuing over four weeks. Flower infestation, shedding, and pod yield were monitored by selecting five random plants in each plot.

The following formulas were used during the experiment for data calculation:

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1. % reduction of thrips = (Number of thrips in control-Number of thrips in treatments / Number of thrips in control) ×100

2. % flower infested by thrips = (Number of infested flower / Total number of flowers) ×100

3. % flower Shedding = (No. of flower shed / No. of total flowers) ×100

4. Reduction (%) of flower shedding over control = (No. of flower shedding in control - No. of flower shedding in treatment / No. of flower shedding in control) ×100

5. Increase (%) of flower = (No. of total flowers in treatments - No. of total flowers in control / No. of flowers in control) ×100

6. % increase of pod = (No. of total pod in treatments - No. of total pod in control / No. of total pod in control) ×100

Statistical analyses were conducted using MSTAT-C software to evaluate the variance and treatment effects, and Duncan's Multiple Range Test (DMRT) was employed to test the significance of differences at the 5% level of probability.

3. RESULTS AND DISCUSSION

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3.1 Incidence of thrips and their infestation on flower of mung bean under different treatments

The average population of thrips at of mungbean under different treatments has been shown in Table 2. The data (Table 2) expressed that the lowest number of thrips (1.25 plant^{-1}) was observed in Talstar 2WP treated plot followed by Confidor 70WG treated plot (1.75 plant-1) having no significant difference between them. Dursban 20EC also showed low number of thrips (1.92 plant^{-1}). However, the highest number of thrips (18.50 plant^{-1}) was found in which control plot which was significantly higher than all other treated plots. Neem oil also showed higher thrips population (5.08 plant^{-1}) than other treatments. Other insecticides have intermediate number of thrips- Decis 5EC (3.33 plant^{-1}), Ripcord 10EC (4.42 plant^{-1}), Marshal 20EC (3.00 plant^{-1}), Sevin 85SP (4.00 plant^{-1}) and Aktara 25WG (2.67 plant^{-1}). Table 2 revealed that Talstar 2WP showed the best performance in reducing of thrips population over control (93.26%) followed by 90.59% and 89.63% by Confidor 70WG and Dursban 20EC, respectively. Neem oil showed poor results (72.55%) in reducing thrips population over control. However, most of the insecticides gave standard level of reduction (80%) of thrips population over control. The results of the study revealed that all the insecticides significantly reduced thrips population infesting mungbean. Table 2 showed that Talstar 2WP was the most effective insecticide against thrips and Confidor 70WG was second effective insecticides, Dursban 20EC was third effective insecticides but Actara 25WG, Marshal 20EC, Decis 5EC, Sevin 85SP were comparatively less effective insecticides than those. Comparatively, Ripcord 10EC and Neem oil extract was poorly effective against thrips infesting mungbean in field condition. The order of effectiveness is Talstar 2WP (93.26%) > Confidor 70WG (90.59%) > Dursban 20EC (89.63%) > Actara25WG (85.54%) >Marshal 20EC (83.74%) > Decis 5EC (81.96%) >Sevin 85SP (78.39%) >Ripcord 10EC (76.05%) > Neem oil (72.55%). The Table 2 showed that Confidor 70WG was more effective than Actara 25WG which supported the findings of Ullah *et al.* [17] and Aslam *et al.* [18]. Poor effectiveness of neem oil against thrips population also agreed with the findings of Bhudev *et al.* [19].

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Flower infestation by thrips was significantly affected by the application of chemical insecticides and neem oil (Table 2). Among the treatments, the lowest flower infestation (0.33 infested flower plant^{-1}) was observed in Talstar 2WP treated plot where lowest infestation (%) and highest number of flowers recorded and was closely followed by Confidor 70WG (0.42 infested flower plant^{-1}). On the other hand, the highest flower infestation (4.25 infested flower plant^{-1}) was recorded from control plot where the highest infestation and lowest number of flowers was recorded and was closely followed by Neem oil (1.25 infested flower plant^{-1}) and Ripcord 10EC (1.25 infested flower plant^{-1}). Other treatments also showed significant variation in flower infestation and they were Decis 5EC (1.00 infested flower plant^{-1}), Marshal 20EC (0.75 infested flower plant^{-1}), Sevin 85SP (1.17 infested flower plant^{-1}), Dursban 20EC (0.58 infested flower plant^{-1}), Aktara 25WG (0.67 infested flower plant^{-1}). The order of effectiveness is Talstar 2WP > Confidor 70WG > Dursban 20EC > Actara 25WG > Marshal 20EC > Decis 5EC >Sevin 85SP > Ripcord 10EC > Neem oil (Table 2).

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Table 2. Incidence of thrips and their infestation on flower of mung bean

Treatments	No. of thrips	% Reduction of thrips over control	Number of total flowers	Number of flower infestation by thrips	% Flower infested by thrips
Decis 5EC	3.33 de	81.96 bc	11.17 de	1.00 bc	9.02 bcd
Ripcord 10EC	4.42 bc	76.05 de	11.08 de	1.25 b	11.22 bc
Marshal 20EC	3.00 e	83.74 b	12.58 bcd	0.75bc	6.09 bcd
Sevin 85SP	4.00 cd	78.39 cd	11.67 cd	1.17 b	9.93 bcd
Dursban 20EC	1.92 f	89.63 a	13.42 b	0.58 bc	4.24 cd
Neem oil	5.08 b	72.55 e	9.67 e	1.25 b	12.93 b
Talstar 2WP	1.25 f	93.26 a	16.67 a	0.33 c	2.040 d
Aktara 25WG	2.67 e	85.54 b	13.25 bc	0.67 bc	5.22bcd
Confidor 70WG	1.75 f	90.59 a	15.42 a	0.42 c	2.78 d
Control	18.50 a	-	7.50 f	4.25 a	57.62 a
LSD (0.05)	**0.74**	**3.84**	**1.59**	**0.69**	**8.30**
CV (%)	**9.42**	**2.65**	**7.59**	**4.36**	**9.97**

[In a column, means having different letter(s) are significantly different at 5% level of probability by DMRT]

3.2 Effect of different treatments on flower shedding by thrips on mung bean

Flower shedding by thrips was significantly affected by the application of chemical insecticides and neem oil (Table 3). Among the treatments, the lowest flower shedding (1.00 plant^{-1}) was observed in Talstar 2WP treated plot where lowest shedding rate and highest number of flower (16.67 plant^{-1}) recorded which was followed by Confidor 70WG (1.08 plant^{-1}) and Dursban 20EC (1.08 plant^{-1}). On the other hand, the highest flower shedding (6.8 plant^{-1}) was recorded from untreated control plot where the highest shedding rate and lowest number of flower (7.50 plant^{-1}) recorded and this was closely followed by Neem oil (2.92 plant^{-1}), Ripcord 10EC (2.17 plant^{-1}) and Sevin 85SP (2.17 plant^{-1}). Other treatments also showed significant variation in flower shedding- Marshal 20EC (1.58 plant^{-1}), Decis 5EC (1.92 plant^{-1}) and Aktara 25WG (1.33 plant^{-1}). Table 3 revealed that Talstar 2WP (85.04%) performed the best performance in reducing of flower shedding over control followed by Confidor 70WG (83.77%) and Dursban 20EC (83.37%). Neem oil showed poor performance (56.35%) in reducing flower shedding over control. However, Talstar 2WP, Confidor 70WG, Dursban 20 EC and Actara 25WG (80.36%) resulted standard level of reduction (80%) of thrips population. The results of the study reveal that all the insecticides significantly reduced flower shedding in mungbean. Table 3 showed that Talstar 2WP, was the most effective insecticide against thrips which cause flower shedding and Confidor 70WG was second effective insecticides, Dursban 20EC was third effective insecticides. Other treatments also showed significant variation in reducing of flower shedding. They were- Decis 5EC (72.22%), Ripcord 10EC (68.33%), Marshal 20EC (77.02%), Sevin 85SP (68.53%), Aktara 25WG (80.36%). Comparatively, Neem oil extract comparatively performed poorly against thrips resulting flower shedding of mungbean in field condition. The order of effectiveness is Talstar 2WP > Confidor 70WG > Dursban 20EC > Actara 25WG > Marshal 20EC > Decis 5EC > Sevin 85SP > Ripcord 10EC > Neem oil.

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Table 3. Effect of different treatments on flower shedding by thrips on mung bean

Treatments	Number of total flower	Number of flower shedding	% Flower shedding	% Reduction of flower shedding over control
Decis 5EC	11.67 de	1.92bc	16.48 c	72.22 bc
Ripcord 10EC	11.08 de	2.17 bc	19.69 c	68.33 c
Marshal 20EC	12.58 bcd	1.58 cde	12.47 de	77.02 abc
Sevin 85SP	11.17 cd	2.17cd	19.29 cd	68.53 c
Dursban 20EC	13.42 b	1.08 e	8.10e	83.37 ab
Neem oil	9.67 e	2.92 b	30.02 b	56.35 d
Talstar 2WP	16.67 a	1.00 e	6.02e	85.04 a
Aktara 25WG	13.25 bc	1.33 de	10.08 de	80.36 ab
Confidor 70WG	15.42 a	1.08 e	6.99 e	83.77 a
Control	7.50 f	6.83 a	91.22 a	-
LSD (0.05)	**1.59**	**0.83**	**6.45**	**11.35**
CV (%)	**7.59**	**21.86**	**17.07**	**8.74**

[In a column, means having different letter(s) are significantly different at 5% level of probability by DMRT]

3.3 Effect of chemical insecticides and neem oil on increase of flower and pod of mung bean

The average number of flower of mungbean under different treatments has been shown in Table 4. Table 4 revealed that the highest number of flower (16.67 plant^{-1}) was observed in Talstar 2WP treated plot followed by Confidor 70WG treated plot (15.42 plant^{-1}) having no significant difference between them. Dursban 20EC (13.42 plant^{-1}) and Aktara 25WG (13.25 plant^{-1}) also showed higher number of flower. However, the lowest number of flower (7.50 plant^{-1}) was found in untreated control plot which was significantly lower compared to all other treated plots. Neem oil also showed comparatively lower number of flower (9.67 plant^{-1}) than other treatments. Other insecticides gave the intermediate number of flowers against thrips infestation [Decis 5EC (11.67 plant^{-1}), Ripcord 10EC (11.08 plant^{-1}), Marshal 20EC (12.58 plant^{-1}) and Sevin 85SP (11.17 plant^{-1})]. Table 4 revealed that Talstar 2WPshowed the best performance in increasing of no. of flower over control (123.5%) followed by 108.5% and79.68% by Confidor 70WG and Dursban 20EC, respectively. Neem oil showed poor results (30.82%) in increasing total flower over control. However, most of the insecticides did not give standard level of increasing flower (80%). The results of the study reveal that all the insecticides significantly increase flower in mungbean. Table 4 showed that Talstar 2WP was the most effective insecticide in increasing flower percentage and Confidor 70WG was second effective insecticides, Dursban 20EC was the third effective insecticides. Other treatments also showed significant variation in increasing the flower number and they were- Decis 5EC (57.15%), Ripcord 10EC (49.66%), Marshal 20EC (68.10%), Sevin 85SP (49.86%), Aktara 25WG (77.55%). Comparatively, Neem oil extract was poor in effectiveness in infestingflower shedding of mungbean under field condition. The order of effectiveness is Talstar 2WP > Confidor 70WG >Dursban 20EC > Actara 25WG >Marshal 20EC > Decis 5EC >Sevin 85SP >Ripcord 10EC >Neem oil. The average number of pod of mungbean under different treatments has been shown in Table 4. The data highest number of pod (34.27 plant^{-1}) was observed in Talstar 2WP treated plot followed by Confidor 70WG treated plot (29.73 plant^{-1}) having significant difference between them. Dursban 20EC (29.13 plant^{-1}), Actara 25WG (28.73 plant^{-1}) and Marshal 20EC (28.27 plant^{-1}) also showed higher number of pod (Table 4). However, the lowest number of pod (18.73 plant^{-1}) was found in untreated control plot which was significantly lower than all other treated plots. Neem oil also showed lower no. of pod (22.87 plant^{-1}) than other treatments. Other insecticides gave intermediate number of pods [Decis 5EC (27.33 plant^{-1}), Ripcord 10EC (23.60 plant^{-1}) and Sevin 85SP (25.33 plant^{-1})].

Talstar 2WP (83.78%) showed the best performance in increasing of number of pod plant^{-1} over control followed by Confidor 70WG (59.30%) and Dursban 20EC (55.89%). Neem oil showed poor performance (22.57%) in increasing pod over untreated control plot. However, only Talstar 2WP gave standard level of increasing pod (80%) compared to untreated control. The results of the study revealed that all the insecticides significantly increase pod in mungbean. Talstar 2WP was the most effective insecticide in increasing the rate of pod formation and Confidor 70WG was second effective insecticides, Dursban 20EC was third effective insecticides. Other treatments also showed significant variation in increasing pod number and they were- Decis 5EC (46.68%), Ripcord 10EC (26.62%), Marshal 20EC (50.96%), Sevin 85SP (35.71%), Aktara 25WG (54.08%). Comparatively, Neem oil extract was less effective in mungbean in field condition. The order of effectiveness is Talstar 2WP > Confidor 70WG > Dursban 20EC > Actara25WG > Marshal 20EC > Decis 5EC > Sevin 85SP > Ripcord 10EC > Neem oil. These results agree with the report of Jahangir Shah *et al*. [20] who reported that pods plant^{-1} and seed yield kg ha^{-1} varied significantly among different insecticides.

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Table 4: Effect of chemical insecticides and neem oil on increase of flower and pod of mung bean

Treatments	Number of total flowers/plant	% Increase of flower number over control	Number of pod/plant	% increase of pod number over control
Decis 5EC	11.67 de	57.15 cd	27.33 bc	46.68 bc
Ripcord 10EC	11.08 de	49.66 de	23.60 de	26.62 d

Marshal 20EC	12.58 bcd	68.10 bcd	28.27 b	50.96 b
Sevin 85 SP	11.17 cd	49.86 de	25.33 cd	35.71 cd
Dursban 20 EC	13.42 b	79.68 b	29.13 b	55.89 b
Neem oil	9.67 e	30.82 e	22.87 e	22.57 d
Talstar 2 WP	16.67 a	123.5 a	34.27 a	83.78 a
Aktara 25WG	13.25 bc	77.55 bc	28.73 b	54.08 b
Confidor 70 WG	15.42 a	108.5 a	29.73 b	59.30 b
Control	7.50 f	-	18.73 f	-
LSD (0.05)	**1.59**	**21.62**	**2.42**	**13.49**
CV (%)	**7.59**	**17.43**	**5.27**	**16.11**

[In a column, means having different letter(s) are significantly different at 5% level of probability by DMRT]

3.4 Effect of chemical insecticides and neem oil on yield of mungbean

3.4.1 Number of pods plant^{-5}

Number of pods plant^{-5} was significantly influenced by the effect of various chemical insecticides and neem extract where, treatment Talstar 2WP produced the maximum number of pods plant^{-5} (171.3) which resulted maximum reduction of thrips (Table 5). It was followed by Confidor 70WG (148.7 pod), Dursban 20EC (145.7 pod) and Actara 25WG (143.7 pod). Among the other treatments, the minimum number of pods plant^{-5} (93.67 pod) was recorded in untreated control plot (Table 5). Among all the insecticides used in this study, Talstar 2WP treated plots had significantly the highest yield of (2.05 kg plot^{-1}) while the lowest seed yield (1.06 kg ha^{-1}) was obtained from the untreated control plots. Other treatments gave intermediate level of pod and they were- Decis 5 EC (136.7), Ripcord 10EC (118.0), Marshal 20EC (141.3) and Sevin 85SP (128.7). Comparatively, Neem oil extract (114.3) performed poorly in reducing in thrips infesting mungbean under field condition.

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3.4.2 Number of seed (in the pod) plant^{-5}

A significant variation was found in the number of seed (in the pod) plant^{-5} due to the effect of different chemical insecticides and neem oil applied against thrips infesting mung bean. Among the treatment, Talstar 2WP @ 0.5 g l^{-1} produced the maximum number of seeds (in pod) plant^{-5} (885.3) which was closely followed by Confidor 70WG @ 0.3 g l^{-1}of water (881.7). Similarly, the minimum number of seeds (in the pod) plant^{-5} (401.7) was recorded in pods of untreated control plot which was followed by treatment T6, Neem oil @ 4 ml l^{-1}of water (638.3) (Table 5).Other treatments gave intermediate level of seed (in pods) plant^{-5} and they were- Decis 5EC (774.7), Ripcord 10EC (703.0), Marshal 20EC (826.7), Sevin 85SP (718.3), Dursban 20EC (866.0) and Actara 25WG (826.7).

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3.4.3 Seed weight (g)

The maximum seed weight (36.19 g) plant^{-5} was recorded in Talstar 2WP treated plot which was followed by Confidor 70WG (33.30). The maximum number of thrips infesting in untreated control plot resulted minimum seed weight (16.57 g). Neem oil provided poor results (25.98 g) in respect of weight of seed. Other treatments resulted intermediate number of seed weight and they were- Decis 5EC (29.67 g), Ripcord 10EC (26.21 g), Marshal 20EC (31.50 g), Sevin 85SP (26.25 g), Dursban 20EC (31.65 g) and Actara 25WG (31.54 g) (Table 5).

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3.4.4 Yield plot^{-1} (Kg)

The yield per plot of mungbean was affected by the application of different insecticidal treatments. The highest yield per plot was obtained by the application of Talstar 2WP (2.05

kg) followed by Confidor 70WG (1.96 kg). The lowest yield per plot was obtained in untreated control plot (1.06 kg) followed by Neem oil (1.27 kg). Other treatments gave intermediate levels of yield and they were Decis 5EC (1.68 kg), Ripcord 10EC (1.52 kg), Marshal 20EC (1.83 kg), Sevin 85SP (1.55 kg), Dursban 20EC (1.94 kg) and Actara 25WG (1.91 kg) (Table 5).

Table 5. Effect of chemical insecticides and neem oil on yield characteristics of mungbean

Treatments	Number of pod plant^{-5}	Number of seed (in pods) plant^{-5}	Seed weight (g) plant^{-5}	Yield plot^{-1} (Kg)
Decis 5EC	136.7 bc	774.7 c	29.67 d	1.68
Ripcord 10EC	118.0 de	703.0 d	26.21 e	1.52
Marshal 20EC	141.3 bc	826.7 b	31.50 c	1.83
Sevin 85SP	128.7 cd	718.3 d	26.25 e	1.55
Dursban 20EC	145.7 b	866.0 a	31.65 c	1.94
Neem oil	114.3 e	638.3 e	25.98 e	1.27
Talstar 2WP	171.3 a	885.3 a	36.19 a	2.05
Aktara 25WG	143.7 b	826.7 b	31.54 c	1.91
Confidor 70 WG	148.7 b	881.7 a	33.30 b	1.96
Control	93.67 f	401.7 f	16.57 f	1.06
LSD (0.05)	**12.85**	**21.57**	**0.92**	**-**
CV (%)	**5.58**	**1.68**	**1.85**	**-**

[In a column, means having different letter(s) are significantly different at 5% level of probability by DMRT]

3.5 Relationship among number of thrips population with flower infestation, shedding, increse and number of pod of mungbean

The rate of flower infestation was significantly affected by thrips. The Figure 1 illustrated a proportional relationship between number of thrips and flower infestation percentage. There was a positive relationship between number of thrips and flower infestation rate. The result showed that the flower infestation rate increase with the increase of thrips population but pesticide using reduce the thrips population and flower infestation.

Rate of flower shedding percentage was significantly affected by thrips. Figure 1 showed a proportional relationship between number of thrips and rate of flower shedding. There was a positive relationship between number of thrips and rate of flower shedding. The result showed that the flower shedding percentage increase with the increase of thrips population but pesticide reduce the thrips population and flower shedding.

The rate of flower increasing was significantly affected by thrips. Figure 1 showed a negative relationship between number of thrips and the rate of increase of flower. The result showed that the rate of flower increasing enhance with the decrease of thrips population but pesticide use reduced the thrips population.

The rate of pod increasing was significantly affected by thrips. Figure 1 showed a negative linear relationship between number of pod and number of thrips. The result showed that the pod number increased with the decreased in thrips population but using pesticide reduces the thrips population.

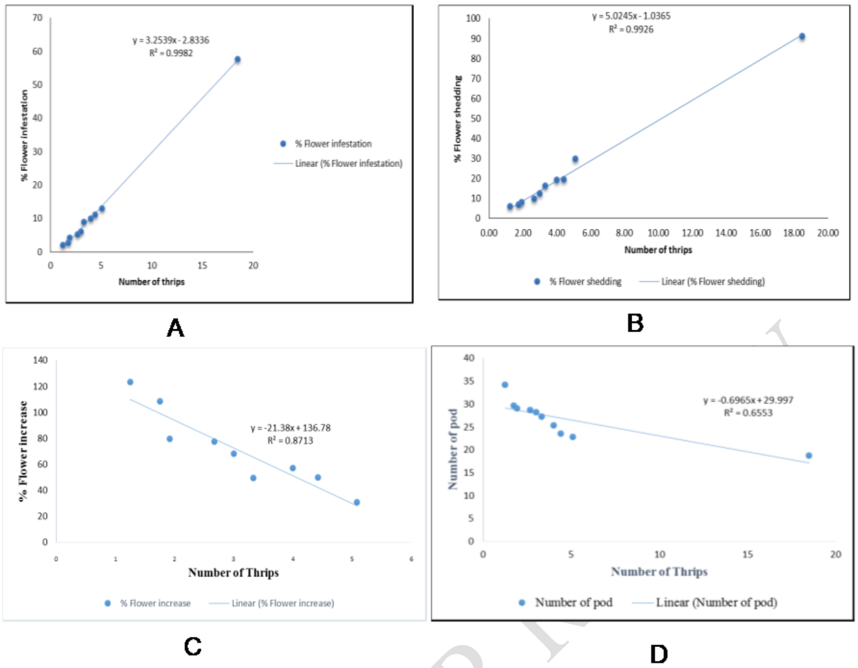

Figure 1. Relationship among of thrips population with (A) percentage of flower infestation, (B) % shedding of flower, (C) increase of flower and (D) pod number

4. CONCLUSION

The study demonstrated that all tested chemical insecticides and neem oil significantly reduced the population of thrips infesting mung bean. Among them, Talstar 2WP (0.5 g l^{-1}) was the most effective, reducing thrips by 93.26% and resulting in the lowest number of infested flowers and flower shedding. Confidor 70WG exhibited a comparable effect with 90.59% reduction, while neem oil showed moderate efficacy, reducing the population by 72.55%. Furthermore, Talstar 2WP also led to the highest growth and yield outcomes, including the greatest number of flowers, pods, and seeds, as well as the highest seed weight and yield. In contrast, the untreated control plot recorded the highest thrips population and the lowest yield and growth characteristics. Overall, Talstar 2WP emerged as the superior treatment in managing thrips on mungbean and boosting crop yield, with Confidor 70WG showing similar results, while neem oil was less effective.

Acknowledgments

Competing Interests

AUTHORS' CONTRIBUTIONS

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