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Thrips (*Megalurothrips usitatus* Bagnall) Infestation in Mung Bean: Integrated Control with Chemical and Neem-based Insecticides

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MAL and MRA planned and designed the research. Author HM conducted the work on the field, collected the data and managed literature searches. Authors MSIK and MEH performed the statistical analysis and wrote & reviewed the manuscript. Authors RA, RSR and MSS involved in wrote and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

This study aimed to manage thrips (*Megalurothrips usitatus* Bagnall) infestation in mung bean fields and evaluate the efficacy of different chemical insecticides and neem oil. The experiment, conducted at Sher-e-Bangla Agricultural University, Bangladesh from March to May 2020, employed a randomized complete block design (RCBD) with ten treatments, including Decis 5EC,

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Ripcord 10EC, Marshal 20EC, Sevin 85SP, Dursban 20EC, Neem oil, Talstar 2WP, Actara 25WG, Confidor 70WG, and an untreated control. Talstar 2WP proved to be the most effective treatment, achieving the lowest thrips population (1.25 plant^{-1}) and the highest percent reduction (93.26 %) in thrips infestation over control treatment. Talstar 2WP also produced the maximum number of flowers (16.67 plant^{-1}), pods (34.27 plot^{-1}), seeds (885.3 plant^{-5}), seed weight (36.19 g), and the highest mung bean yield (2.05 kg/plot) compared to rest other treatments. On the other hand, Confidor 70WG showed 2nd most promising results across all parameters, while neem oil was comparatively less effective. The findings suggest that Talstar 2WP is the most effective insecticide for managing thrips infestation in mung bean, offering improved growth and yield.

Keywords: Mung bean; thrips; chemical insecticides; botanicals; yield.

1. INTRODUCTION

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 (Gan et al. 2017). It is one of the most important pulse crops in Bangladesh, ranks 4th in terms of acreage and production (Yasmin et al. 2019). It is ideally suited for summer, but also can be an excellent fit for crop rotations (Chadha 2010, Kholliev and Dusmanov 2016). 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 covers the area of 96 thousand acres and the average yield is 341kg acre-1 (BBS (Bangladesh Bureau of Statistics) 2015). Mung bean is widely grown but suffers from several biotic and abiotic stress factors that reduce its production and grain quality (Pratap et al. 2021). 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 (Malik 1992) and limiting the yield (Islamov et al. 2021). On mung bean, there are over 60 different insect species, and nearly 34 of them are major pests (Lal and Ahmad 2002). One of the primary insect pests of mung beans, thrips (Thysanoptera: Thripidae), significantly reduces crop production (Hossain et al. 2004, Rahman et al. 2000). Severe attacks of *Megalurothrips usitatus* (Bagnall) cause yield losses of mung bean from 13% to 64% (Farajallah 2013). Thrips is associated mostly with the damage of tender buds and flowers of mung-bean (Lal 2008). During vegetative stage, *M. usitatus* feed inside vegetative buds, rasp the top, unopened trifoliate 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 nymph 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 (Zhang et al. 2007). 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. In addition, neem-based insecticides are environmentally safe and recognized as ecofriendly management practices against insect pest of crop. On the other hand, chemical pesticides are used extensively to control the *M. usitatus* population (Hossain 2015, Yasmin et al. 2019) but their efficacy is limited since thrips are hidden inside flowers (Liu et al. 2018). Moreover, conventional and old generation chemical insecticides provide poor control of insect pests and generally lead to pest resurgence and environmental hazard. Therefore, to overcome the hazardous problems due to old and conventional pesticides at higher dosage, 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 (Yasmin et al. 2019). Hence, the present study was planned to investigate and compare the relative toxicity of neem-based pesticide and newer chemical insecticides against 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 at kharif-1 season in 2020 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 at 7 days interval, 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.

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 mung bean 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 (Mim et al. 2023) were used during the experiment for data calculation:

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.

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

Treatments (Trade name)	Common name of Insecticides	Dosage	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
T_9: Confidor 70WG	Imidaclorpid	0.3 g l^{-1} of water	Contact and stomach
T_{10}: Untreated Control	-	-	-

3. RESULTS AND DISCUSSION

3.1 Incidence of Thrips and their Infestation on Flower of Mung Bean under Different Treatments

The efficacy of various insecticides and neem oil in controlling thrips population on mungbean is summarized in Table 2. The lowest thrips count (1.25 plant^{-1}) was observed in Talstar 2WP-treated plots, followed closely by Confidor 70WG (1.75 plant^{-1}), with no significant difference between them. Dursban 20EC also showed low thrips populations (1.92 plant^{-1}), while the highest infestation (18.50 plant^{-1}) was recorded in the control plot. Neem oil exhibited higher thrips numbers (5.08 plant^{-1}) compared to other treatments. The effectiveness in reducing thrips over control was highest in Talstar 2WP (93.26%), followed by Confidor 70WG (90.59%) and Dursban 20EC (89.63%), whereas neem oil showed lower efficacy (72.55%). Flower infestation by thrips was also significantly influenced by treatments. The lowest flower infestation (0.33 infested flowers plant^{-1}) occurred in Talstar 2WP-treated plots, followed by Confidor 70WG (0.42 infested flowers plant^{-1}), whereas the highest infestation was observed in the control plot (4.25 infested flowers plant^{-1}). Neem oil and Ripcord 10EC showed comparatively poor performance. Overall, Talstar 2WP proved most effective, followed by Confidor 70WG and Dursban 20EC, while neem oil and Ripcord 10EC were the least effective.

The results demonstrate the superior efficacy of Talstar 2WP in managing thrips infestation on mungbean, significantly reducing the population by 93.26% over the untreated control, which aligns with findings from Ullah et al. (2000) and Aslam et al. (2004). Confidor 70WG and Dursban 20EC also showed high efficacy, reducing thrips populations by 90.59% and 89.63%, respectively. These insecticides effectively minimized flower infestation, with Talstar 2WP and Confidor 70WG recording the lowest numbers of infested flowers per plant. Conversely, neem oil exhibited limited efficacy, reducing thrips by only 72.55%, a finding consistent with Bhudev et al. (2005), who reported the lower efficiency of botanical treatments compared to synthetic insecticides. The significant reduction in thrips population by Talstar 2WP and Confidor 70WG may be attributed to their contact and systemic modes of action, providing prolonged protection. Dursban 20EC's performance highlights its role in integrated pest management (IPM) strategies for mungbean cultivation. However, the comparatively lower efficacy of neem oil underscores the need for further refinement or combination with other control measures to enhance its effectiveness. Overall, the results emphasize the importance of selecting potent insecticides like Talstar 2WP and Confidor 70WG for sustainable thrips management in mungbean fields, ensuring improved crop yield and quality.

3.2 Effect of Different Treatments on Flower Shedding by Thrips on Mung Bean

Flower shedding in mungbean caused by thrips was significantly influenced by the application of chemical insecticides and neem oil (Table 3). The lowest flower shedding (1.00 plant^{-1}) was observed in Talstar 2WP-treated plots, which also recorded the highest number of flowers (16.67 plant^{-1}), followed by Confidor 70WG and Dursban 20EC (both 1.08 plant^{-1}). Conversely, the untreated control plot exhibited the highest flower shedding (6.8 plant^{-1}) and the lowest number of flowers (7.50 plant^{-1}), closely followed by Neem oil (2.92 plant^{-1}), Ripcord 10EC (2.17 plant^{-1}), and Sevin 85SP (2.17 plant^{-1}). Talstar 2WP demonstrated the highest reduction in flower shedding (85.04%) over control, followed by Confidor 70WG (83.77%) and Dursban 20EC (83.37%). Neem oil exhibited comparatively lower efficacy (56.35%). The insecticides Talstar 2WP, Confidor 70WG, Dursban 20EC, and Aktara 25WG achieved a standard reduction rate (>80%), while other treatments like Decis 5EC (72.22%), Marshal 20EC (77.02%), and Sevin 85SP (68.53%) also significantly reduced shedding. Neem oil was comparatively less effective in reducing flower shedding. The effectiveness order was Talstar 2WP > Confidor 70WG > Dursban 20EC > Aktara 25WG > Marshal 20EC > Decis 5EC > Sevin 85SP > Ripcord 10EC > Neem oil.

The study revealed that Talstar 2WP was the most effective treatment in reducing flower shedding caused by thrips in mungbean, achieving an 85.04% reduction compared to the control. Confidor 70WG and Dursban 20EC followed closely with reductions of 83.77% and 83.37%, respectively. These treatments also corresponded to higher flower production, indicating their efficacy in mitigating thrips damage. Conversely, Neem oil and Ripcord 10EC exhibited comparatively lower effectiveness, reducing flower shedding by 56.35% and 68.33%, respectively. The findings highlight the superior performance of Talstar 2WP, making it a promising option for integrated pest management in mungbean cultivation. Our results are close to the findings of Mim et al. (2023) who stated that the lowest percentage of flower shedding (8.41%) was recorded during the experiment using Stargate 48SC insecticide.

3.3 Effect of Chemical Insecticides and Neem Oil on Increase of Flower and Pod of Mung Bean

The average number of flowers and pods of mungbean under different treatments is presented in Table 4. Talstar 2WP demonstrated the highest number of flowers (16.67 plant^{-1}), followed closely by Confidor 70WG (15.42 plant^{-1}), with both treatments showing no significant difference. Dursban 20EC (13.42 plant^{-1}) and Aktara 25WG (13.25 plant^{-1}) also performed well. In contrast, the untreated control plot recorded the lowest number of flowers (7.50 plant^{-1}), significantly lower than all treated plots. Neem oil showed comparatively lower flower numbers (9.67 plant^{-1}). Talstar 2WP achieved the highest percentage increase in flowers over control (123.5%), followed by Confidor 70WG (108.5%) and Dursban 20EC (79.68%), while Neem oil showed a modest increase (30.82%). Similarly, Talstar 2WP produced the highest number of pods (34.27 plant^{-1}), followed by Confidor 70WG (29.73 plant^{-1}) and Dursban 20EC (29.13 plant^{-1}). The untreated control plot recorded the lowest pod number (18.73 plant^{-1}). Neem oil also displayed lower pod numbers (22.87 plant^{-1}). Talstar 2WP showed the best performance in increasing pod numbers over control (83.78%), with Confidor 70WG (59.30%) and Dursban 20EC (55.89%) ranking second and third, respectively. These results align with Shah et al. (2007), who reported significant variation in pods per plant and seed yield across different insecticides. The order of effectiveness for both flowers and pods was Talstar 2WP > Confidor 70WG > Dursban 20EC > Aktara 25WG > Marshal 20EC > Decis 5EC > Sevin 85SP > Ripcord 10EC > Neem oil.

Talstar 2WP demonstrated the highest efficacy in enhancing both flower and pod production in mungbean, with a 123.5% increase in flowers and an 83.78% increase in pods over the untreated control. Confidor 70WG and Dursban 20EC also performed well, showing significant improvements in both parameters. In contrast, Neem oil exhibited comparatively lower efficacy in increasing both flowers and pods. These findings align with Shah et al. (2007), emphasizing the effectiveness of synthetic insecticides over botanical alternatives in managing thrips and boosting mungbean yield.

3.4 Effect of Chemical Insecticides and Neem Oil on Yield of Mungbean

3.4.1 Number of pods plant^{-5}

The number of pods per five plants was significantly affected by the application of different chemical insecticides and neem extract. Talstar 2WP produced the highest number of pods (171.3 plant^{-5}), resulting in the maximum reduction of thrips (Table 5), followed by Confidor 70WG (148.7 pods), Dursban 20EC (145.7 pods), and Actara 25WG (143.7 pods). The untreated control plot recorded the lowest number of pods (93.67 plant^{-5}). In terms of yield,

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]

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

Treatments	Number of total flowers	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]

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]

Talstar 2WP-treated plots achieved the highest seed yield (2.05 kg $plot^{-1}$), while the untreated control yielded the lowest (1.06 kg $plot^{-1}$). Other treatments produced intermediate pod numbers, including Decis 5EC (136.7), Ripcord 10EC (118.0), Marshal 20EC (141.3), and Sevin 85SP (128.7). Neem oil extract (114.3 pods) showed comparatively poor performance in reducing thrips infestation in mungbean under field conditions. Our results are close to the findings of Mim et al. (2023) who stated that the the highest number of pod (34.28 $plant^{-1}$) was recorded during the experiment using Stargate 48SC insecticide in the integrated management package.

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

Significant variation was observed in the number of seeds per pod across different treatments against thrips infestation in mungbean. Talstar 2WP @ 0.5 g L^{-1} produced the highest number of seeds (885.3 $plant^{-5}$), closely followed by Confidor 70WG @ 0.3 g L^{-1} (881.7 $plant^{-5}$). In contrast, the untreated control plot recorded the lowest seed count (401.7 $plant^{-5}$), followed by Neem oil @ 4 ml L^{-1} (638.3 $plant^{-5}$) (Table 5). Intermediate seed numbers were observed in other treatments, including 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).

3.4.3 Seed weight (g)

The highest seed weight (36.19 g $plant^{-5}$) was recorded in Talstar 2WP treated plots, followed by Confidor 70WG (33.30 g). The untreated control plot, with the highest thrips infestation, showed the lowest seed weight (16.57 g). Neem oil yielded poor results (25.98 g). Intermediate seed weights were observed in 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). Our results are close to the findings of Mim et al. (2023) who recorded 1000 seed weight (34.10 g) and yield (1642.19 kg ha-1) of mung bean using the integrated management package including Stargate 48SC treatment.

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).

3.5 Relationship among Number of Thrips Population with Flower Infestation, Shedding, Increase and Number of Pod of Mung Bean

The rate of flower infestation was significantly affected by thrips. The Fig. 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. Fig. 1 showed a proportional relationship between number of thrips and rate of flower shedding.

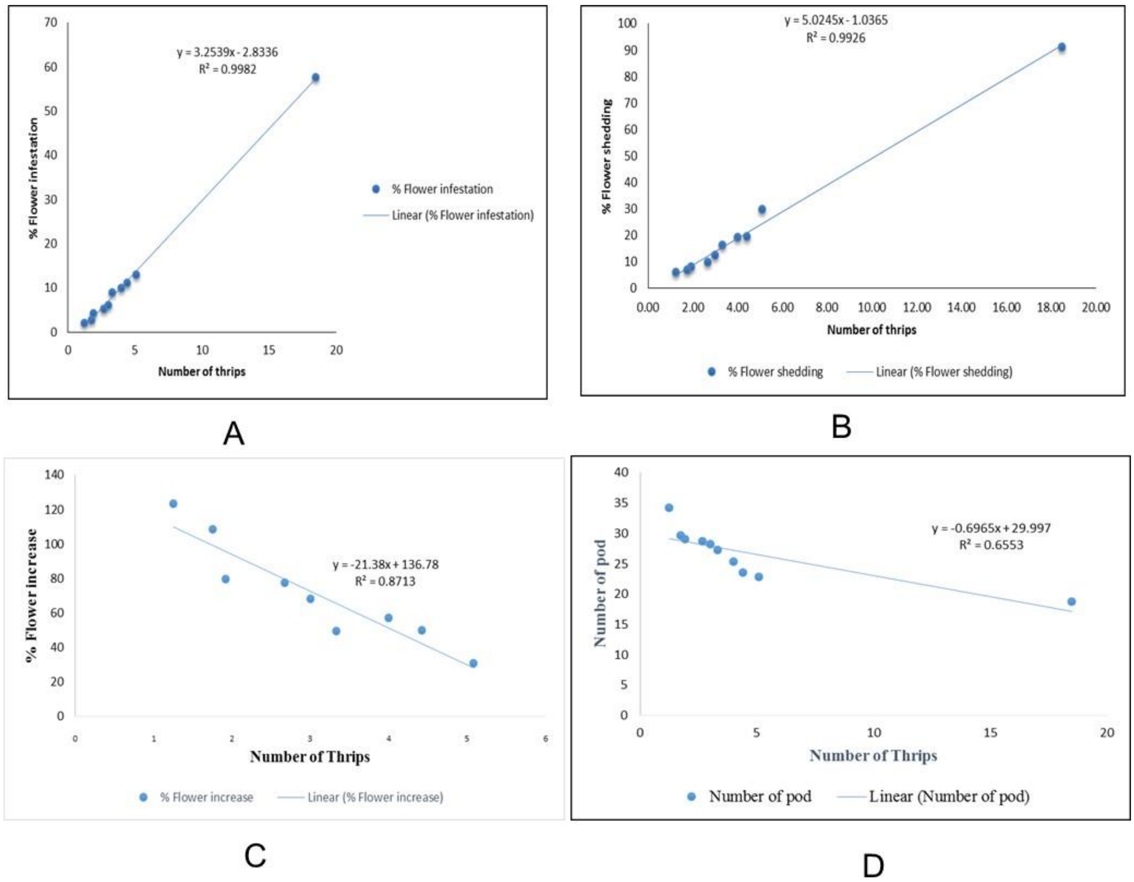

Fig. 1. Relationship among of thrips population with (A) percentage of flower infestation, (B) % shedding of flower, (C) increase of flower and (D) pod number

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]

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. Fig. 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. Fig. 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.

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.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that generative AI technologies such as Large Language Models (ChatGPT, Quillbot etc.) have been used during editing, grammar checking and paraphrasing of the manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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