Management of Cabbage butterfly, *Pieris brassicae* through Herbal pesticides and its effect on yield

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Abstract: Cabbage is one of the cruciferous vegetable plant grown across the world. A large number of insect pests attack on them but butterfly larvae (*Pieris brassicae*) is one of the most serious one. The current study was conducted at farmer field Malam Jaba Swat. The experiment was Randomized Complete Block Design (RCBD) with three replications and having five treatments along with control. Total three spray were applied at seven days interval. The insecticides combination of botanical extracts and cow urine viz; *Lemongrass (Cymbopogon citratus*) + cow urine @ 10%, Neem leaves extract (*Azadirachta indica*) + cow urine @ 10%, White top weed (*Parthenium hysterophorus)*+ cow urine @10%, Chinaberry (*Melia azedarach*) + cow urine @ 10% were applied against cabbage white butterfly larvae. The results revealed that the lowest mean infestation and mean percent reduction per plant after different treatments was recorded in plot (Chinaberry + cow urine (1.72), (75.40%), followed by *Lemongrass*+ cow urine, Neem leaves extract+ cow urine, White top weed+ cow urine (2.33), (57.10)%, (2.60),(48.65%) and (2.82), (40.61%) respectively). The highest mean infestation (4.18) of cabbage larvae/plant was recorded in control plot. The maximum yield was recorded in plot treated with Chinaberry + cow urine (41.50), trailed by White top weed + cow urine, Lemongrass + cow urine, Neem leaves extract + cow urine (29.73, 27.03 and 23.07 respectively). While the minimum yield kg/plot (18.20) was recorded in control plot. It is concluded from the current experiment that all the combination of different botanical extracts with cow urine showed their efficacy against infestation of cabbage butterfly. But the combination of Chinaberry + cow urine showed better results in percent reduction of cabbage larvae population and the production of cabbage. It is recommended that the combination of Chinaberry + cow urine is superior as compared to other combinations.

Key words. Botanical extracts, Cow urine, Cabbage larvae, yield

Introduction

Cabbage, Brassica oleracea var. capitata Linn. is an important vegetable grown commercially in Europe and in the subcontinent. It is biennial or annual plant with leafy vegetables, particularly Cole crops, constitute a significant portion of the human diet and are rich in phytonutrients such as vitamins (C, A, B1, B6, B9, and E), minerals, fibre and phytochemicals (Dias, 2012). Cabbage is cultivated on more than 2.82 million hectares globally, with a gross output and an average production of 82.8 million tonnes and 29.4 tons per hectare respectively (Shokirov *et al.,* 2021). China is one of the biggest producer of cabbage while in Pakistan it is cultivated in a total area of 5679 hectares, with the production of 101589 tonnes during the 2019 and 2020 (Anonymous, 2021). While in 2019 and 2020 in Khyber Pakhtunkhwa the total area under cultivated was 503 hectares with the production of 4125 tonnes of cabbage in Anonymous, 2021).

The cabbage white butterfly (*Pieris brassicae*) is considered as serious insect pest of cabbage and cauliflower (Shankar *et al.,* 2016) across the globe. A single caterpillar can consume 74 to 80 cm^2 of leaf area (Younas *et al.,* 2005) and the larvae caused 40% production losses in green leafy vegetables every year(Hasan *et al.,* 2006). Feeding causes the plants incapable to form normal cabbage or produce distorted cabbage (Uddin *et al.,* 2007). This pest causes significant damage to all plant stages in cauliflower (Ullah *et al.,* 2016). *P. brassicae* young larvae are gregarious foliar feeders (Hasan & Ansari, 2011). *P. brassicae* larvae can consume cabbage and cauliflower all plant parts, including both vegetative and reproductive parts (Siraj, 1999). A caterpillar can consume up to 74-80 cm^2 of leaf, causing significant damage to its host (Younas, *et al.,* 2004). Severe *P. brassicae* attack can totally destroy the plant leaves and eventually kill it (Hasan & Ansari, 2010).

The Plant extracts usage has proven environmentally safe and the most effective ways to protect crops from insect pests attack The plant extract degrades more quickly than most chemical insecticides and is, therefore, considered as ecofriendly and less likely to affect untargeted insects unlike chemicals (Hussain *et al*., 2022). Most botanicals degrade quickly either within a few days or in some cases within a few hours (Guleria, S. and Tiku, A.K. 2009). Plants are rich in natural materials that can be used in ecofriendly insect pest management programs and capable of producing wide range of different chemical substances called secondary metabolites and are effective new natural pesticide sources. *Datura aborea* (Linn*.), Nicotiana tobaccum* (Linn.), and *Zanthoxylum alatum* (Roxb.) extracts were found to be repellent and anti-feedant to most of the insect larval stages (Paul and Sohkhlet, 2012). A large number of farmers use plant materials and cow urine to manage insect pests in field crops (Geetanjaly and Tiwari, 2014). Plant extracts are even less toxic to parasitoids' developing larvae in parasitized insects exposed to them. Furthermore, because most of the plant extracts contain a diverse range of active ingredients and thus, inhibiting pest resistance (Pavela, 2011). The present study aimed is to find out the best treatment for management of *P. brassiceae* larval stages by using plant extracts available easily.

Materials and Methods

The current study was carried out in the farmer field at Malam Jaba, Swat between March and July 2022. Cabbage seed variety green light was sown in January, and the nursery was transplanted in the field on March 20th in RCBD with three replications. Each plot size was kept 3 × 2 m and each treatments was replicated three times. Row to row and plant to plant distance was kept 75 cm and 45 cm respectively. Each plot contained four rows with ten plants in each row.

Data collection

The study of insect pest population dynamics began as soon as their infestation was discovered. At weekly intervals, the population density of randomly selected plants was calculated. Data on the selected plants were recorded before spray and after 7 days of spray. The insect population was determined by counting the number of larvae on three randomly selected plants. The collected data was statistically analyzed and the efficacy of the plant extract was determined.

Preparation of botanical extracts:

Chinaberry (*Melia azedarach*)**:**

Fresh leaves of 200g of chinaberry was taken make it grinded and pulverized. After grinding these fresh leaves of chinaberry extracts mixed with 1 liter of cow urine and filter with muslin cloth. Than 100ml of these solution was mixed with 1 liter of water and applied for field application.

Lemongrass *(Cymbopogon citratus*)***:***

About 200g of fresh grasses was taken make it grinded and pulverized. After grinding these grasses extracts mixed with 1 liter of cow urine and filter with muslin cloth. Than 100ml of these solution was mixed with 1 liter of water and applied for field solution.

Neem leaves extract (*Azadirachta indica*)**:**

Grinded 200g of fresh leaves of neem leaves extract was taken and mixed with 1 liter of cow urine. Than these solution was filter with muslin cloth. About 100ml from these solution was mixed with 1 liter of water and applied for field treatment.

White top weed (*Parthenium hysterophorus)***:***

About 200g of fresh leaves of White top weed was crushed and mixed with 1 liter of cow urine. Than these solution was filter with muslin cloth. From making solution 100ml was taken and mixed with 1 liter of water for field treatment.

Treatments details are given as follow:

S.NO	Treatments	Concentration	Recommended dose
1	Lemongrass *(Cymbopogon citratus*) + cow urine	10%	100ml/liter
2	Neem leaves extract (*Azadirachta indica*) + cow urine	10%	100ml/liter
3	White top weed (*Parthenium hysterophorus)* + cow urine	10%	100ml/liter
4	Chinaberry (*Melia azedarach*) + cow urine	10%	100ml/liter
5	Control	----------	----------

Yield kg plot^{-1}

The weight of cabbage collected from each treatment was recorded separately when it was picked from each plot. Total yield was calculated by combining all picking yields from each treatment.

Percent infestation

Three plants were chosen randomly from each experimental plot. From each plant three leaves were collected for examination of pest arrival. Data were recorded at interval of before 24hr and after 7 days after treatment application.

Percent reduction

The following formula was used to calculate the percent reduction.

$$\% \text{ reduction} = \frac{\text{No of insect in control- No of insects in treatment}}{\text{Number of insects in control}} \times 100$$

Statistical Analysis

All of the above parameters were subjected to the analysis of variance and means was separated using LSD test at 5% level of significance, if the data was performing significant.

Results

It was observed and clear from table. 1 that before treatment application the infestation of cabbage larvae was nonsignificant in all the treatments. In the present investigation, after first spray application the lowest mean cabbage larvae infestation was recorded in plot treated with Chinaberry + cow urine (1.53), followed by Neem leaves extract + cow urine, Lemongrass + cow urine, White top weed + cow urine (2.18, 2.36 and 3.11 respectively), while highest mean infestation per plant (3.90) was observed in control plot. Similarly, after second treatment the lowest mean infestation was recorded in plot treated with Chinaberry + cow urine (1.10), followed by Lemongrass + cow urine, Neem leaves extract + cow urine, White top weed + cow urine (1.73, 2.30 and 2.89 respectively), while highest mean infestation (4.33) of cabbage larvae was observed in control plot. However, after third treatment the minimum mean infestation of cabbage larvae was noted in plot treated with Chinaberry + cow urine (0.40), followed by Lemongrass + cow urine, White top weed + cow urine, Neem leaves extract + cow urine (1.27, 1.45 and 2.04 respectively), while maximum mean infestation of cabbage larvae (4.61) was observed in control plot. The results showed that the overall lowest mean infestation after all the treatments was recorded in plot treated with Chinaberry + cow urine (1.72), followed by Lemongrass + cow urine, Neem leaves extract + cow urine, White top weed + cow urine (2.33, 2.60 and 2.82 respectively). The highest mean infestation (4.18) of cabbage larvae was recorded in control plot.

The results revealed that after first treatment as shown in the table.2 the highest mean percent mortality was recorded in plot treated with Chinaberry + cow urine (60.53), followed by Neem leaves extract + cow urine, Lemongrass + cow urine (43.79 and 39.06 respectively), while lowest mean percent mortality was recorded in plot treated with White top weed + cow urine (20.22). Similarly, after second treatment the highest mean percent mortality was observed in plot treated

with Chinaberry + cow urine (74.51), followed by Lemongrass + cow urine, Neem leaves extract + cow urine (60.05 and 46.81 respectively), while lowest mean percent mortality was recorded in plot treated with White top weed + cow urine (33.28). However, after third treatment the highest mean percent mortality was observed in plot treated with Chinaberry + cow urine (91.17), followed by Lemongrass + cow urine, White top weed + cow urine (72.17 and 68.33 respectively), while lowest mean percent mortality (55.36) was recorded in plot treated with Neem leaves extract + cow urine. The results showed that overall maximum mean percent mortality was recorded in plot treated Chinaberry + cow urine (75.40), trailed by Lemongrass + cow urine, Neem leaves extract + cow urine (57.10 and 48.65 respectively), while lowest mean percent mortality (40.61) was observed by plot treated with white top weed + cow urine.

The results showed in table. 3 that maximum yield kg/plot was recorded in plot treated with Chinaberry + cow urine (41.50), trailed by white top weed + cow urine, Lemongrass + cow urine, Neem leaves extract + cow urine (29.73, 27.03 and 23.07 respectively). While the minimum yield kg/plot (18.20) was recorded in control plot.

Discussion

The experiment was conducted at famer field Malam Jaba Swat during 2021-22. To study the effect of different combination of botanical extracts with cow urine against cabbage white butterfly larvae. Among tested plant extracts with combination of cow urine was recorded effectively.

Before the tested insecticides all the experimental plot the population of insect pests are non-significant (Hussain *et al.*, 2022). The current observation revealed that cow urine was effective in different plant extracts combination. Geetanjaly and Tiwari (2014 also reported that cow urine formulation are ecofriendly management against cabbage butter fly.

All the insecticides have antifeedant property of each of the botanical extracts and maximum mean percent mortality was recorded in plot treated Chinaberry + cow urine (75.40%), trailed by Lemongrass + cow urine, Neem leaves extract + cow urine (57.10%) and (48.65%) respectively), while lowest mean percent mortality (40.61%) was observed by plot treated with white top weed + cow urine against all the three applications. These findings are similar to the finding of Vattikonda and Sangam (2016), who also described the better antifeedant activity of azadirachtin (*Azadirachta indica*) against *P. demoleus*. Nathan (2006) described that majority of limnoid compounds present in the leaves of *Azadiracta indica* observed more antifeedant activity. Bakavathiappan *et al.*, (2012) perceived the antifeedant activity was directly related to the concentration of the extract. The botanical extract of *P. hysterophorus* also revealed their potential against insect pests. This agreement also similar to the agreement of (Khan *et al.,* 2015).

Similarly, *P. hysterophorus* extract can dissolved in different solvent showed different efficacy against insect pests. These report are similar to the report of Rizvi *et al.,* (2012) and Koubala *et al.,* (2013). Some botanical extracts have active ingredients in different extraction solvents may have different dissolving nature and may revealed the synergistic effect with a particular solvent against a specific pest (Oyedokun *et al.,* 2011).

The present experiment with the botanical extract of chinaberry *Melia azedarach* L. most effective to reduce the population of cabbage *P. brassicae*. These results are similar to the results of

Przybyszewski, (1993), Khan and Siddiqui (1994), Grisakova *et al.,* (2006), Sharma & Gupta, (2009), and Hussain *et al*., 2022).

The neem leaf extract at 10% gave significant mortality of *P. brassicae* as well as feeding disturbances to the caterpillars and reducing the growth and development of insect larvae.

The aqueous extracts of *M. azedarach* and *A. indica* as antifeeding activity and growth inhibitors for the larvae of *Plutella xylostella* L. was also reported Charleston *et al.,* (2005).

Similarly, Grisakova *et al.* (2006) studied the effects of Neem EC (1% azadirachtin) on the cabbage butterfly which is major pest of cruciferous plants and found the neem extract also induced high mortality by causing lethal failure. His findings match to the finding of our experiment and revealed that Neem had toxic effect against Cabbage butterfly.

Our results are in line with the study conducted by Amin *et al.* (2014), who found neem oil and neem seed extract was non-significant with each other. The results showed that after 7 days of neem spray application, the infestation of cabbage butterfly was effected in all the treatments. Our finding is similar to the findings of Ali *et al*., (2016), who used neem extract against sucking insect pests and recorded it was best control among all his treatments. Various botanical extract effected yield of cabbage with deferent treatments application, as reported by Hussain *et al*., 2022.

Conclusion and recommendation

All the combination of botanical extracts gave a significant results to reduce the infestation of cabbage white butterfly larvae. Among various combination of botanical extracts, Chinaberry + cow urine reflect superior infestation reduction and production as compared to other combinations. It is therefore recommended that the combination of Chinaberry + cow urine as significantly minimize the infestation of cabbage butterfly.

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Conflicts of Interest: The authors declare no conflict of interest.

Table 1. Mean infestation of cabbage butterfly larvae per plant at different day interval during 2021-22

Treatments	Means infestation plant				
	BSA	**1st (trt)**	**2nd (trt)**	**3rd (trt)**	**Means**
Lemongrass + cow urine	3.93[a]	2.36[c]	1.73[d]	1.27[c]	2.33[d]
Neem extract+ cow urine	3.87[a]	2.18[c]	2.30[c]	2.04[b]	2.60[c]
White top weed+ cow urine	3.83[a]	3.11[b]	2.89[b]	1.45[c]	2.82[b]
Chinaberry+ cow urine	3.83[a]	1.53[d]	1.10[e]	0.40[d]	1.72[e]
Control	3.87[a]	3.90[a]	4.33[a]	4.61[a]	4.18[a]
C.V	7.27	7.56	5.91	8.68	3.08
SE	0.22	0.16	0.11	0.17	0.08

Same letter showed that the treatments are nonsignificant with LSD (0.05)

Table 2. Mean percent reduction of cabbage butterfly larvae per plant at different day interval during 2021-22

Treatments	Means percent reduction			
	Mortality 1st (trt)	Mortality 2nd (trt)	Mortality 3rd (trt)	Means
Lemongrass + cow urine	39.06[b]	60.05[b]	72.17[b]	57.10[b]
Neem extract + cow urine	43.79[b]	46.81[c]	55.36[d]	48.65[c]
White top weed + cow urine	20.22[c]	33.28[d]	68.33[c]	40.61[d]
Chinaberry + cow urine	60.53[a]	74.51[a]	91.17[a]	75.40[a]
C.V	9.86	6.69	8.60	2.38
SE	3.29	2.93	5.03	1.09

Same letter showed that the treatments are nonsignificant with LSD (0.05)

Table 3. Mean yield kg/plot at different treatments during 2021-22

Treatments	Yield kg/plot
Lemongrass+ cow urine	27.03[c]
Neem extract+ cow urine	23.07[d]
White top weed+ cow urine	29.73[b]
Chinaberry+ cow urine	41.50[a]
Control	18.20[e]
CV	3.38
SE	0.77

Different letter showed that the treatments are significant with LSD (0.05)

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