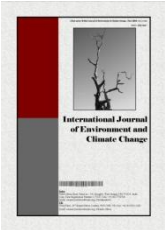

International Journal of Environment and Climate Change

12(9): 73-82, 2022; Article no.IJECC.85978
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Studies on Pest Complex of Broad Leaf Mustard, *Brassica juncea* var. *rugosa* Roxb. Tsen and Lee in the Valley of Manipur

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2022/v12i930740

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/85978

Original Research Article

Received 29 January 2022
Accepted 09 April 2022
Published 14 April 2022

ABSTRACT

A experiment was conducted at Entomological Research Farm, Department of Entomology, College of Agriculture, Central Agricultural University, Imphal. Total eleven insect pest species were found to infest the crop *viz.* Large cabbage white butterfly, *Pieris brassicae*; Asian cabbage white butterfly, *Pieris canidia*; mustard aphid, *Lipaphis erysymi* and striped flea beetle, *Phyllotreta striolata* were observed frequently while, Cabbage aphid, *Brevicoryne brassicae*; green peach aphid, *Myzus persicae*; crucifer flea beetle, *Phyllotreta cruciferae*; mustard sawfly, *Athalia lugens proxima*; cabbage semilooper, *Trichoplusia ni*; fungus beetle, *Monolepta signata* and tobacco grasshopper, *Atractomorpha crenulata* were observed rarely.

Keywords: Pest complex; broad leaf mustard; sucking pests; defoliators.

1. INTRODUCTION

Broad leaf mustard, *Brassica juncea* var. *rugosa* Roxb. Tsen and Lee. This Broad leaf mustard crop is not the same as the commercial mustard species grown for oil extraction. It is one of the most important vegetable crops found in Manipur and other Northeastern States of India. The broad leaf mustard is a rabi season crop, but in the few decades, as demand has increased, it

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has being grown round the year. Estimating crop damage due to insect pests is important because it provides updated information about the amount of damage inflicted to crops by different insect pests, helps in assigning priorities based on the relative importance of insect pests, helps in assigning priorities based on the relative importance of insect pests, determines the allocation to research and extension in plant protection and evaluating crop varieties for their susceptibility/ resistance to insect pests.

2. MATERIALS AND METHODS

An experiment was conducted during *Rabi*, 2019-20 in the Experimental field of Department of Entomology, Entomological Research Farm, College of Agriculture, Central Agricultural University, Imphal to identify the seasonal incidence of pest complex of broad leaf mustard, *Brassica juncea* var. *rugosa* in Manipur. The soil type was clayey. The trial site was located in the Manipur valley at 24o 81`N latitude and 93o 89`E longitude.

The local cultivar of broad leaf mustard 'Lamtachabi' seeds @ 4kg/ha were sown in nursery bed prepared with fine sandy loam soil mixed with compost. Line sowing was followed with a spacing of 10 cm between line to line. Proper watering was done at regular intervals till the seedlings attain transplanting stage. Three sowing dates were maintained followed by transplanting dates i.e., nurseries were sown on 1st November, 2019; 1st December, 2019; and 1st January of 2020.The recommended cultural practices for cultivation of broad leaf mustard were adopted. The experiment was laid out in randomized block design. The field was ploughed four times for fine tilth. Recommended FYM was added at the time of ploughing and for properly mixed in the soil. Beds were made to a size of 4m x 5m. The recommended dose of NPK was applied at the rate of 80: 40: 40 g per plot. Thirty days old seedlings were transplanted from nursery to main field with a plant to plant spacing of 45cm X 45cm. Irrigation was done at the time of transplantation and throughout the cropping period as and when needed.

2.1 Sucking Pests

The number of aphids and hoppers were counted visually from three randomly selected leaves of a plant (i.e., 1 leaf each from the top, middle and lower portion). Five plants were randomly selected from each plot to take the observation. However, for painted bug population, the average number of bug per plant was from the five randomly selected plants.

2.2 Defoliators

The population of beetles, grasshoppers, caterpillars, etc. were counted visually from the randomly selected five plants of each plot. Different cabbage butterfly species were counted separately. After counting the population, average population per plant were worked out.

2.3 Statistical Analysis

The data were analyzed by using the Microsoft Excel (2019 version). The data obtained on insect pests of broad leaf mustard from experimental field; per cent data were transformed into angular transformation and number data into square root transformation for subjected to statistical analysis (Analysis of Variance).

3. RESULTS AND DISCUSSION

3.1 Asian White Cabbage Butterfly, *Pieris canidia* (L.)

During the study period, two species of cabbage butterfly i.e., *Pieris canidia* and *Pieris brassicae* were observed. In the 1st November transplanted crop, cabbage butterfly population range from 0.10 larvae/plant to 2.24 larvae/plant and the highest population was recorded at 56 days after transplanting (DAT). The incidence of *P. canidia* was higher in 1st December transplanted crop. The population range from 0.26 larvae/ plant to 3.24 larvae/plant and peak population was observed at 49 DAT. In late transplanted crop i.e., at 1st January, the population range from 0.16 larvae/plant to 2.68 larvae/plant. The maximum population of 2.68 larvae per plant was observed at42 DAT.

Overall mean population of the pest in the three transplanting dates shown that a significantly higher incidence was observed at 1st December transplanted crop and it was followed by 1st January transplanted crop and 1st November transplanted crop in descending order. In all the transplanting dates, the incidence of the pest was low in the early crop stage and it increases gradually and reaches its maximum during maximum leaf development stage. *Pieris canidia*, an important insect pest of cabbage, Brassica

oleracea var. capitata Linn., a related vegetable crop with broad leaf mustard in Manipur was reported by Singh et al. [1]. However, little or no information is available on the incidence of *P. canidia* in broad leaf mustard at Manipur.

3.2 Large Cabbage White Butterfly, *Pieris brassicae* (L.)

Another species of cabbage butterfly observed along with *Pieris canidia* was large cabbage white butterfly, *Pieris brassicae*. The large cabbage butterfly population range from 0.08 larvae/plant to 0.30 larvae/plant in the 1st November transplanted crop and the highest population was recorded at 35 DAT. In 1st January transplanted crop, the population range from 0.14 larvae/plant to 0.46 larvae/plant and peak population was observed at 42 DAT. However, in 1st December transplanted crop, the population range from 0.18 larvae/plant to 0.44 larvae/plant. The maximum population of 0.44 larvae/plant was observed at 28 DAT.

Overall mean population of the pest in the three transplanting dates shown that the average incidence observed at both 1st December transplanted crop and 1st January transplanted crop was almost same with 0.31 and 0.32 larvae/plant followed by 1st November transplanted crop with 0.18 larvae/plant. In all the transplanting dates, the incidence of the pest was low in the early crop stage and it increases gradually and reaches its maximum during maximum leaf production stage of the crop.

Devjani and Singh [2] also reported *P. brassicae*, an important pest of related vegetable crop of broad leaf mustard i.e., Cauliflower, Brassica oleracea var. botrytis in Manipur. Sharmila et al. [3] also reported that the infestation of the pest began from last week of November and extended up to last week of April at Manipur in cauliflower crop. Present finding is in conformity with the finding of Sharmila et al. [3] however, in different related crops.

3.3 Mustard Aphid, *Lipaphis erysimi* (Kalt.)

Among all the aphid species *viz.*, *Myzus percicae, Brevicoryne brassicae* and *Lipaphis erysimi* which infest the broad leaf mustard, the population of *L. erysimi* recorded the maximum and the population of remaining two species were negligibly low during the cropping season. Hence, only the population of *L. erysimi* was recorded. In all the transplanting dates, the population of *L. erysimi* was low in the early crop stage, however, it gradually increases as the crop advances its growth stages and even remain high up to early reproductive stage of the crop. In 1st January transplanted crop maximum population of mustard aphid, 44.24 aphids/leaf was recorded at 49 DAT. However, in 1st December transplanted crop, the maximum aphid population of 52.04 aphids/leaf was recorded at 56 DAT and in 1st January transplanted crop at 49 DAT with 64.60 aphids/leaf. Even at 70 DAT, the aphid population was as high as 25.20, 26.96 and 29.46 aphids/leaf in 1st November, 1st December and 1st January transplanted crops, respectively.

The highest average population of aphid was recorded in the 1st January transplanted crop with 42.72 aphids/leaf followed by 1st December transplanted crop with 34.77 aphids/leaf and 1st November transplanted crop with 29.37 aphids/leaf in descending order. *L. erysimi* an important insect pests of mustard Brassica campestris was reported by Mandal Sunil Kumar, Barun [4] and Singh et al. [5]. A decline in the population of the aphid in leaves in the later stage of crop may be due to their shifting towards prefer site of infestation i.e., the terminal shoot and also increase in the number of natural enemies population. The high infestation of the pest in the terminal shoot of *B. campestris* was also reported by Singh et al. [5].

3.4 Striped Flea Beetle, *Phyllotreta striolata* (F.)

The incidence of flea beetle gradually increases as the crop stage advances in all the three transplanting dates. Among all the observations, maximum population of 6.34 flea beetles/plant was recorded at 70 DAT in 1st January transplanted crop. In the other two transplanting dates also, the maximum population was recorded at 70 DAT with 5.62 beetle/plant in 1st December transplantation and 4.98 beetles/plant in 1st November transplantation.

Comparing the average population of flea beetle of three transplanting dates, it was observed that the highest population of 3.29 beetle/plant was observed in the 1st January transplanted crop and it was followed by the 1st December transplanted crop with 2.82 flea beetle/plant. The least average population of 2.44 beetles/plant among the three transplanted crops was recorded in the 1st November transplanted crop.

Table 1. List of pest complex observed on broad leaf mustard

Sl. No	Common Name	Scientific Name	1st November transplantation	1st December transplantation	1st January transplantation	Status
1	Asian white cabbage butterfly	*Pieris canidia* (L.)	+	+	+	Frequently observed
2	Large cabbage white butterfly	*Pieris brassicae* (L.)	+	+	+	Frequently observed
3	Mustard aphid	*Lipaphis erysymi* (Kalt.)	+	+	+	Frequently observed
4	Cabbage aphid	*Brevicoryne brassicae* (L.)	+	+	+	Rarely observed
5	Green peach aphid	*Myzus persicae* (Sulzer).	+	+	+	Rarely observed
6	Striped flea beetle	*Phyllotreta striolata* (F.).	+	+	+	Frequently observed
7	Crucifer flea beetle	*Phyllotreta cruciferae* (Goeze)	+	+	+	Rarely observed
8	Cabbage semilooper	*Trichoplusia ni* (Hub.)	+	+	+	Rarely observed
9	Mustard sawfly	*Athalia lugens proxima* (Klug)	+	+	+	Rarely observed
10	Fungus beetle	*Monolepta signata* (Oliver)	+	+	+	Rarely observed
11	Tobacco grasshopper	*Atractomorpha crenulata* (F.)	+	+	+	Rarely observed

Table 2. Effect of planting dates on the incidence of asian white cabbage butterfly, *Pieris canidia* during *Rabi*, 2019-20 inbroad leaf mustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of larvae/plant										
	7DAT	14DAT	21DAT	28DAT	35DAT	42DAT	49DAT	56DAT	63DAT	70DAT	Mean
1st November transplantation	0.10 (0.77)	0.28 (0.88)	0.78 (1.13)	1.16 (1.27)	1.30 (1.32)	2.12 (1.62)	2.18 (1.64)	2.24 (1.65)	1.50 (1.39)	0.96 (1.19)	1.26 (1.28)
1st December transplantation	0.26 (0.87)	0.44 (0.97)	1.38 (1.37)	1.64 (1.46)	2.02 (1.59)	2.36 (1.69)	3.24 (1.92)	2.92 (1.83)	2.22 (1.65)	1.78 (1.50)	1.83 (1.48)
1st January transplantation	0.16 (0.80)	0.36 (0.92)	0.88 (1.17)	1.36 (1.36)	1.58 (1.44)	2.68 (1.76)	2.44 (1.71)	2.62 (1.73)	1.80 (1.47)	1.26 (1.28)	1.51 (1.39)
S.Ed	0.02	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.01
CD	0.04	0.02	0.02	0.04	0.04	0.06	0.06	0.06	0.06	0.06	0.02

Table 3. Effect of planting dates on the incidence of large cabbage white butterfly, *Pieris brassicae* during *Rabi*, 2019-20 inbroad leaf mustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of larvae/plant										
	7DAT	14DAT	21DAT	28DAT	35DAT	42DAT	49DAT	56DAT	63DAT	70DAT	Mean
1st November transplantation	0.08 (0.76)	0.14 (0.80)	0.22 (0.85)	0.26 (0.87)	0.30 (0.89)	0.28 (0.88)	0.20 (0.84)	0.12 (0.79)	0.10 (0.77)	0.10 (0.77)	0.18 (0.82)
1st December transplantation	0.18 (0.82)	0.24 (0.86)	0.36 (0.93)	0.44 (0.97)	0.40 (0.95)	0.24 (0.86)	0.32 (0.91)	0.36 (0.93)	0.30 (0.89)	0.24 (0.85)	0.31 (0.90)
1st January transplantation	0.14 (0.80)	0.20 (0.84)	0.28 (0.88)	0.34 (0.92)	0.36 (0.93)	0.46 (0.98)	0.44 (0.97)	0.42 (0.96)	0.34 (0.92)	0.20 (0.83)	0.32 (0.90)
S.Ed	0.01	0.02	0.02	0.024	0.02	0.01	0.016	0.01	0.022	0.018	0.005
CD	0.03	0.04	0.04	0.051	0.04	0.03	0.034	0.02	0.46	0.037	0.011

Table 4. Effect of planting dates on the incidence of mustard aphid, *Lipaphis erysimi* during *Rabi*, 2019-20 in broad leafmustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of aphids/leaf										
	7DAT	14DAT	21DAT	28DAT	35DAT	42DAT	49DAT	56DAT	63DAT	70DAT	Mean
1st November transplantation	7.92 (2.90)	16.86 (4.15)	19.40 (4.45)	24.90 (5.03)	30.36 (5.53)	43.80 (6.63)	44.24 (6.69)	42.96 (6.58)	38.04 (6.18)	25.20 (5.05)	29.37 (5.32)
1st December transplantation	11.94 (3.52)	20.04 (4.51)	26.64 (5.17)	31.00 (5.58)	38.84 (6.26)	48.98 (6.98)	51.00 (7.14)	52.04 (7.21)	40.30 (6.37)	26.96 (5.23)	34.77 (5.80)
1st January transplantation	13.56 (3.69)	23.84 (4.86)	39.32 (6.28)	39.86 (6.32)	53.82 (7.35)	61.82 (7.87)	64.60 (8.03)	57.70 (7.62)	43.18 (6.61)	29.46 (5.45)	42.72 (6.41)
S.Ed	0.06	0.09	0.08	0.08	0.07	0.08	0.09	0.06	0.08	0.06	0.04
C.D	**0.13**	**0.18**	**0.17**	**0.17**	**0.14**	**0.17**	**0.20**	**0.13**	**0.17**	**0.13**	**0.08**

Table 5. Effect of planting dates on the incidence of striped flea beetle, *Phyllotreta striolata* during *Rabi*, 2019-20 in broadleaf mustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of striped flea beetle/plant										
	7DAT	14DAT	21DAT	28DAT	35DAT	42DAT	49DAT	56DAT	63DAT	70DAT	Mean
1st November transplantation	0.84 (1.15)	1.02 (1.23)	1.32 (1.34)	1.66 (1.45)	1.84 (1.51)	1.92 (1.53)	3.06 (1.87)	3.56 (2.01)	4.24 (2.17)	4.98 (2.34)	2.44 (1.66)
1st December transplantation	1.08 (1.25)	1.24 (1.31)	1.48 (1.40)	2.06 (1.59)	2.16 (1.61)	2.32 (1.66)	3.48 (1.99)	4.06 (2.12)	4.66 (2.27)	5.62 (2.46)	2.82 (1.76)
1st January transplantation	1.32 (1.33)	1.50 (1.40)	1.80 (1.50)	2.52 (1.71)	2.70 (1.77)	2.78 (1.79)	4.12 (2.13)	4.62 (2.25)	5.18 (2.37)	6.34 (2.61)	3.29 (1.89)
S.Ed	0.03	0.02	0.02	0.04	0.03	0.05	0.03	0.03	0.02	0.03	0.003
C.D	**0.06**	**0.05**	**0.05**	**0.08**	**0.07**	**0.10**	**0.07**	**0.07**	**0.05**	**0.07**	**0.007**

Table 6. Effect of planting dates on the incidence of cabbage semilooper, *Trichoplusia ni* during *Rabi*, 2019-20 in broadleaf mustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of larvae/plant					
	21DAT	28DAT	35DAT	42DAT	49DAT	Mean
1st November transplantation	0.00(0.71)	0.00(0.71)	0.08(0.76)	0.12(0.78)	0.14(0.79)	0.07(0.75)
1st December transplantation	0.10(0.77)	0.16(0.81)	0.24(0.85)	0.28(0.87)	0.24(0.85)	0.20(0.83)
1st January transplantation	0.22(0.84)	0.24(0.85)	0.32(0.90)	0.38(0.93)	0.36(0.91)	0.30(0.89)
S.Ed	**0.008**	**0.01**	**0.02**	**0.02**	**0.02**	**0.003**
CD	**0.01**	**0.02**	**0.04**	**0.04**	**0.04**	**0.006**

Table 7. Effect of planting dates on the incidence of mustard sawfly, *Athalia lugens proxima* during *Rabi*, 2019-20 in broadleaf mustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of larvae/plant					
	28DAT	35DAT	42DAT	49DAT	56DAT	Mean
1st November transplantation	0.10(0.77)	0.14(0.79)	0.20(0.82)	0.08(0.76)	0.06(0.74)	0.12(0.79)
1st December transplantation	0.18(0.81)	0.30(0.87)	0.36(0.90)	0.16(0.80)	0.12(0.78)	0.22(0.83)
1st January transplantation	0.12(0.78)	0.14(0.79)	0.24(0.84)	0.14(0.79)	0.08(0.76)	0.14(0.80)
S.Ed	**0.02**	**0.02**	**0.03**	**0.02**	**0.01**	**0.004**
CD	**0.04**	**0.04**	**0.05**	**0.04**	**0.02**	0.007

Table 8. Effect of planting dates on the incidence of fungus beetle, *Monolepta signata* during *Rabi*, 2019-20 in broad leafmustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of beetle/plant								
	21DAT	28DAT	35DAT	42DAT	49DAT	56DAT	63DAT	70DAT	Mean
1st November Transplantation	0.02(0.72)	0.04(0.73)	0.08(0.76)	0.10(0.77)	0.16(0.81)	0.20(0.84)	0.16(0.81)	0.14(0.80)	0.11(0.78)
1st December Transplantation	0.00(0.71)	0.02(0.72)	0.04(0.73)	0.06(0.74)	0.08(0.76)	0.10(0.77)	0.08(0.76)	0.08(0.76)	0.06(0.74)
1st January Transplantation	0.06(0.74)	0.08(0.76)	0.12(0.78)	0.16(0.81)	0.22(0.84)	0.28(0.88)	0.20(0.83)	0.24(0.85)	0.17(0.81)
S.Ed	0.006	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.002
C.D	**0.013**	**0.03**	**0.03**	**0.03**	**0.04**	**0.03**	**0.03**	**0.03**	**0.005**

Table 9. Effect of planting dates on the incidence of tobacco grasshopper, *Atractomorpha crenulata* during *Rabi*, 2019-20in broad leaf mustard, *Brassica juncea* var. *rugosa* (Lamtachabi) agro-ecosystem

Treatment	Number of grasshopper/plant										
	7DAT	14DAT	21DAT	28DAT	35DAT	42DAT	49DAT	56DAT	63DAT	70DAT	Mean
1st November transplantation	0.00 (0.71)	0.02 (0.72)	0.04 (0.73)	0.06 (0.75)	0.04 (0.73)	0.06 (0.75)	0.10 (0.77)	0.08 (0.76)	0.04 (0.73)	0.00 (0.71)	0.04 (0.74)
1st December transplantation	0.02 (0.72)	0.04 (0.73)	0.06 (0.75)	0.08 (0.76)	0.12 (0.78)	0.14 (0.79)	0.10 (0.77)	0.12 (0.78)	0.10 (0.77)	0.08 (0.76)	0.09 (0.76)
1st January transplantation	0.02 (0.72)	0.08 (0.76)	0.04 (0.73)	0.10 (0.77)	0.12 (0.78)	0.08 (0.76)	0.06 (0.75)	0.16 (0.81)	0.12 (0.78)	0.10 (0.77)	0.09 (0.76)
S.Ed	0.003	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.002
C.D	**0.007**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.005**

Patel et al. [6] reported *P. cruciferae* at Uttarakhand. However, in conformity with the present finding, Anooj et al. [7] reported striped flea beetle, *P. striolata* as an important emerging pest of cruciferous vegetables including mustard at Delhi and its neighbouring states.

3.5 Cabbage Semilooper, *Trichoplusia ni* (Hub.)

During the cropping season, the population of cabbage semilooper was very low. In three different transplanting dates, the population of cabbage semilooper ranged from 0.00 larvae/plant to 0.38 larvae/plant. The highest population of 0.38 larvae/plant was observed at 42 DAT in 1st January transplanted crop. In the later stage of the crop the population of the pest was almost nil.

Average highest population of the pest was recorded at late transplanted crop (1st January transplanted crop) with 0.30 larvae/plant and it was followed by 1st December transplanted crop (0.20 larvae / plant) and 1st November transplanted crop (0.07 larvae / plant) in descending order.

Trichoplusia ni as a pest of mustard was also reported by Moir and Szito [8]. According to Coapio et al. [9] *T. ni* is a polyphagous pest and feed more than 150 plant species from 36 families and prefer cabbage than other crops, they recorded. Cameron et al. [10] reported broccoli as preferred host of *T. ni* among the host plant they recorded. Low population observed in the present study may be due to broad leaf mustard as a non-preferred host available during the cropping season.

3.6 Mustard Sawfly, *Athalia lugens proxima* (Klug.)

In all the planting dates, the populations of sawfly were very low after 56 DAT, hence population of sawfly are shown only up to 56 DAT. The population gradually increases as the crop stage advances and peak population was recorded at 42 DAT in all the planting dates. In 1st November transplanted crop the maximum population was 0.20 larvae/plant. In 1st December transplanted crop it was 0.36 larvae/plant and in the 1st January transplanted crop it was 0.24 larvae/plant. The lowest population was recorded at 56 DAT in all the different dates of transplanting.

Among the average population of sawfly in three transplanted crops, maximum infestation of 0.22 larvae/plant was observed in 1st December transplanted crop. 1st November transplanted crop showed the least infestation with 0.12 larvae/plant.

Kalasariya and Parmar [11] also reported mustard sawfly *A. lugens proxima* as a pest of mustard at Gujarat, India.

3.7 Fungus Beetle, *Monolepta signata* (Oliver)

The population of fungus beetle, during *Rabi*, 2019-20 ranged from 0.02 beetles/plant to 0.20 beetles/plant in 1st November transplanted crop. The peak incidence was recorded at 56 DAT and afterward it declines slowly. In 1st December transplanted crop, Incidence of the pest was first observed at 28 DAT with beetles/pant and population increases gradually and reach its peak at 56 DAT with 0.10 beetles/plant. Similar with 1st November transplanted crop, fungus beetle was recorded from 21 DAT with 0.06 beetle/plant and reach its peak at 56 DAT with 0.28 beetles/plant.

The highest average population of 0.17 beetles/plant was observed at the 1st January transplanted crop among the three different transplantations and it was followed by 1st November transplanted crop with 0.11 beetles/plant and with 0.06 beetles/plant in 1st December transplanted crop in descending order.

Sarma et al. [12] also reported fungus beetle *M. signata* as an important pest of cabbage, a closely related vegetable crop of broad leaf mustard in Assam a neighbouring state of Manipur. However, Das, R. [13] reported, *M. signata* as a pest of mustard in Cachar district of Assam.

3.8 Tobacco Grasshopper, *Atractomorpha crenulata* (F.)

A small population of grasshopper was also recorded infesting broad leaf mustard during *Rabi*, 2019-20. In the 1st November transplanted crop, grasshopper population was recorded from 14 DAT (0.02 grasshopper/plant) and maximum population of 0.10 grasshopper/plant was observed at 49 DAT. However, grasshopper population of 0.02 grasshopper/plant was

recorded from 7 DAT in 1st December transplanted crop and highest population of 0.14 grasshopper/plant at 42 DAT. Similar with 1st December transplanted crop, in 1st January transplanted crop the population of grasshopper was recorded from 7 DAT, however, the peak population with 0.16 grasshopper/plant was recorded at 56 DAT. Even upto 70 DAT, the populations of grasshopper were recorded as 0.08 and 0.10 grasshopper/plant in 1st December and 1st January transplanted crop, respectively. However, no grasshopper population was recorded at 70 DAT in 1st November transplanted crop.

1st December and 1st January transplanted crop showed similar average population of grasshopper with 0.09 grasshopper/plant and 1st November transplanted crop recorded 0.04 grasshopper/plant as average population. Bustami et al. [14] also reported green grasshopper as important pest of *Brassica juncea* at Indonesia.

4. CONCLUSION

There were 11 pests found associated broad leaf mustard, *Brassica juncea* var *rugosa*. Pest infestation was less in early transplanted crop i.e. 1st November transplanted crop. In all the planting dates, the pest found to be associated with crop from early to late stage, however higher populations were recorded at maximum leaf development stages. Maximum incidence was observed in the 1st December transplanted crop. As very little or no work has been done on the pest complex of broad leaf mustard, there is a scope to research more on this topic in different regions of Manipur.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/85978