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**RESEARCH ARTICLE**

# DAMAGE INFLICTED BY BROWN SLUG, *FILICAULIS ALTE* FERUSSAC, TO SOME VEGETABLE CROPS AT BHADALWAD, SANGHERA AND DASAUNDA SINGH WALA, PUNJAB

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## *Abstract*

Three villages of Punjab viz. Bhadalwad, Sanghera and Dasaunda Singh Wala were surveyed to assess the damage caused by *Filicaulis alte* Ferussac. The slug caused damage to the vegetable saplings and leaves however, no fruit damage was observed in any field of three villages. The study revealed Spinach as the most affected crop in Bhadalwad, Sanghera at 6- leaf stage and Dasaunda Singh Wala at 4- leaf stage with mean percent of damage 29.05, 22.47 and 26.93 respectively in July. In Bhadalwad and Dasaunda Singh Wala, lowest damage was observed in Wanga at 4-leaf stage (12.50%) and at 2-leaf stage (20.71%) respectively whereas in Sanghera field Beans were the least affected crop at 2-leaf stage (15.52%) during the month of June. Also, maximum leaf damage was observed in Spinach during August in all the three fields. The results also suggested that the extent of damage to vegetable crops dependent on availability of shade and shelter to slugs in crop canopy. Hence gastropod control measures should be adopted in July-August.



## Introduction

Vegetable farming plays an important role in crop diversification and is an important source and income. Snails and slugs are important molluscan pests of a wide range of ornamental and vegetable plants in permanently moist regions or in rainy months (Rae et al., 2007). Snails and slugs move by gliding on a muscular foot. The muscles constantly secrete mucus which later dries to form the silvery "slime trail" that signals the presence of either pest (Kaur, 2003).

Slugs are usually most active at night on cloudy or foggy days and cause serious damage as they can build large populations in local areas. They cause irregular holes with smooth edges in leaves and flower and can clip succulent plant parts (Kharbade et al., 2007). The degree of damage inflicted upon any agricultural plantation depends not only on the activity of each individual slug but also on the density of slug population. Slug activity is highly dependent on sufficient soil moisture (Speiser and Hochstrasser, 1998) and air temperature (Kaur and Kaur, 2004).

Mainly three types of damage was noticed i.e. whole seedling consumed, secondly eating leaf margins and irregular holes within it and thirdly tunnels were bored in the fruits of tomato crop. Slugs may feed on plant tissue, causing serious defoliation injury to leafy vegetables and to seedling of many vegetables. Maximum damage was noticed to squash melon and amount of damage was also of appreciable extent to summer squash, cucumber, long melon, cabbage, sarson, spinach, cauliflower and bottle gourd. Comparatively less damage was noticed to turnip, radish, sponge gourd, tomato and brinjal. Two colour forms of *Filicaulis alte* viz.,black, brown with black spots infestated 41% tomato, 33% capsicum, 52% summer squash, 33% beans, 17% brinjal, 61% cabbage, 64% raddish, 60% cauliflower in vegetable fields at Malerkotla, Punjab. 2-leaf seedling stage of tomato, sponge gourd, bottle gourd, long melon, turnip, radish, cabbage and cauliflower was more attacked by slugs as compared to 4 and 6-leaf stage (Kaur, 2011).

**Materials and Methods:**

Vegetable crops at Bhadalwad, Sanghera and Dasaunda Singh Wala villages were sown and observed carefully to study the nature and extent of damage inflicted by slugs to plants. Plants in rows with respect to each type of damage were counted. Following vegetable crops were surveyed for damage inflicted by slugs at experimental fields:

1. Spinach - *Spinacia oleracea*
2. Wanga – *Cucumis melo sub sp melo*
3. Long melon - *Cucumis melo var. utilissiumus*
4. Beans – *Phaseolus vulgaris*
5. Pumpkin – *Cucurbita moschata*
6. Sponge gourd - *Luffa cylindrica*

Three replicates each of 10 $m^2$ for each vegetable crop were taken. Total plants in rows along with damaged ones were counted in each replicate. Plants were observed carefully for slug damage at weekly intervals. Per cent plant damage was calculated by the formula:

$$\text{Per cent damage per replicate} = \frac{\text{Number of damaged plants}}{\text{Total number of plants}} \times 100$$

**Results and Discussion:**

Results of assessment of damage inflicted by slugs to vegetable crops in three fields viz; Bhadalwad, Sanghera and Dasaunda Singh Wala are presented in Table 1, 2, and 3 respectively. Gastropods carved irregular holes within the leaves from April-October as animals were in hibernation from November to February. Slugs attacked the leaves of vegetable crops by nibbling the margins and forming irregular holes on leaf lamina.

**Damage to Vegetable Crops**

1. Spinach (*Spinacia oleracea*): In Bhadalwad field, the sowing of spinach crop was done in the first week of June. The young leaves were totally consumed by slugs and their margins were eaten and irregular holes within them as vegetable matured. 12.09 per cent damage was noticed to seedling stage on 10 June which was increased to 28.26 per cent at 4-leaf stage on 4 July. The maximum mean per cent damage to seedling was 29.05 per cent to 6-leaf stage on 12 July. The damage decreased to 22.35 per cent on 20 July at multiple leaf stage. About 26.20 per cent leaf damage was noticed on 28 July which was increased to 55.58 per cent on 21 August. This might be done to favorable edaphic conditions and more surface active slug population. In Sanghera field, mean per cent damage was observed to 12.96 per cent on 12 June which was increased to 22.47 per cent at 6-leaf stage on 14 July and again decreased to 16.66 per cent at multiple leaf stage. About 29.13 per cent leaf damage was observed on 30 July which was increased to 51.51 per cent on 23 August. In Dasaunda Singh Wala field, maximum mean per cent damage was observed to 26.93 per cent on 9 July at 4-leaf stage which was decreased to 22.44 and 13.83 per cent at 6- leaf stage and multiple leaf stage respectively. Mean per cent leaf damage was observed to 29.42 per cent on 2 August which was increased to 47.23 per cent on 26 August. Earlier studies revealed that slug consumed up to 60 per cent spinach crop (Godan, 1983). Kaur and Kaur (2003) also reported that Black/brown slug with mid-dorsal streak cause damage to sponge gourd (53%), spinach (48%), cauliflower (20%).
2. Wanga (*Cucumis melo sub sp melo*): In Bhadalwad field, observed mean per cent damage to seedling was very less in second week of June i.e. 9.64 which was increased further. Maximum damage was observed to 14.60 per cent at 6-leaf stage on 12 July. 15.15 per cent leaf damage was observed on 28 July which was increased to 26.84 per cent on 21 August. In Sanghera field, damage was noticed from 12 June to 23 August. Damage to seedling was maximum on 20 June at 2-leaf stage i.e. 19.57 per cent which was decreased further to 18.30 and 12.83 per cent at 6-leaf stage and multiple leaf stage respectively. Leaf damage was observed to 21.68 per cent on 30 July which was increased to 50.66 per cent on 23 August. In Dasaunda Singh Wala field, maximum damage was observed on 23 June i.e. 20.71 per cent at 2-leaf stage which was further decreased to 13.62 per cent at 6-leaf stage. Only 9.77 per cent damage was observed at multiple leaf stage. Leaf damage was also observed from 2 August to 26 August. Damage to leaves was maximum on 26 August i.e. 48.31 per cent.
3. Long melon (*Cucumis melo var. utilissiumus*): In Bhadalwad field, little mean per cent damage was observed on 10 June i.e. 13.02 per cent. This damage was further increased to 22.08 per cent at 6-leaf stage. At 2-leaf stage only 16.87 per cent damage was observed on 18 June. 17.98 per cent damage was observed on 20 July at multiple leaf stage. Damage to leaves was observed from 28 July to 21 August and it was maximum on 21 August i.e. 39.24 per cent. In Sanghera field, damage was observed from 12 June to 23

August. Maximum damage to seedling was observed to 22.38 at 2-leaf stage on 20 June. This damage further decreased to 14.57 and 11.41 per cent at 6- leaf stage and multiple leaf stage respectively. 28.55 per cent leaf damage was observed on 30 July which was further increased to 50.72 per cent on 23 August. In Dasunda Singh Wala field maximum damage to seedling was noticed to 22.19 per cent at 2-leaf stage on 23 June. This damage further decreased to 20.25, 16.02 and 11.46 at 4-leaf, 6-leaf and multiple leaf stage. Maximum damage to leaves was observed on 26 August i.e. 46.80 per cent. Studies repored that maximum damage was noticed to squash melon and amount of damage was also of appreciable extent to summer squash, cucumber, long melon, cabbage, sarson, spinach, cauliflower and bottle gourd (Kaur and Kaur, 2003).

**Table 1**: **Per cent vegetable damaged inflicted by the brown slug, *F. alte* to whole seedlings/saplings and leaf throughout crop period at Bhadalwad village**

| Dates/Year 2013 | Spinach | Wanga | Long melon | Beans | Pumpkin | Sponge gourd |
|---|---|---|---|---|---|---|
| **Damage to whole seedlings/saplings** | | | | | | |
| **10-Jun** | 12.09 ± 1.24 | 9.64 ± 1.44 | 13.02 ± 2.48 | 13.11 ± 0.58 | 9.98 ± 1.82 | 12.42 ± 1.26 |
| **18-Jun** | 17.19 ± 0.92* | 12.23 ± 1.17* | 16.87 ± 1.75* | 12.56 ± 2.00* | 10.74 ± 1.45* | 18.88 ± 1.11* |
| **26-Jun** | 17.47 ± 1.26** | 11.06 ± 1.31** | 18.05 ± 2.33** | 19.33 ± 1.27** | 8.42 ± 1.84** | 18.15 ± 2.77** |
| **04-Jul** | 28.26 ± 0.68** | 12.50 ± 1.36** | 20.91 ± 4.34*** | 17.02 ± 1.66*** | 13.17 ± 1.75** | 18.09 ± 3.27*** |
| **12-Jul** | 29.05 ± 2.98*** | 14.60 ± 3.13*** | 22.08 ± 2.03*** | 15.54 ± 1.77*** | 17.77 ± 2.22*** | 15.58 ± 2.23*** |
| **20-Jul** | 22.35 ± 1.32 MLS | 10.09 ± 1.91 MLS | 17.98 ± 1.22 MLS | 11.74 ± 1.82 MLS | 9.87 ± 2.76 MLS | 9.67 ± 1.17 MLS |
| **Damage to leaves** | | | | | | |
| **28-Jul** | 26.20 ± 2.95 | 15.51 ± 2.22 | 19.65 ± 3.90 | 20.70 ± 2.83 | 24.35 ± 2.16 | 24.96 ± 1.17 |
| **05-Aug** | 42.98 ± 3.83 | 21.20 ± 3.69 | 27.86 ± 1.10 | 28.05 ± 3.59 | 31.68 ± 2.11 | 30.58 ± 1.54 |
| **13-Aug** | 48.24 ± 3.17 | 23.44 ± 2.65 | 34.31 ± 1.42 | 32.45 ± 3.92 | 34.06 ± 1.65 | 34.76 ± 1.59 |
| **21-Aug** | 55.58 ± 4.58 | 26.84 ± 2.55 | 39.24 ± 1.23 | 36.46 ± 1.77 | 41.38 ± 1.46 | 41.76 ± 2.97 |

Values are Means±SE

Damage to * 2-leaf stage, ** 4-leaf stage, *** 6-leaf stage, MLS- Multiple leaf stage

**Table 2: Per cent vegetable damaged inflicted by the brown slug, *F. alte* to whole seedlings/saplings and leaf throughout crop period at Sanghera village**

| Dates/Year 2013 | Spinach | Wanga | Long melon | Beans | Pumpkin | Sponge gourd |
|---|---|---|---|---|---|---|
| **Damage to whole seedlings/saplings** | | | | | | |
| **12-Jun** | 12.96 ± 1.96 | 12.71 ± 2.48 | 17.44 ± 0.82 | 12.35 ± 1.28 | 17.57 ± 4.77 | 15.30 ± 1.99 |
| **20-Jun** | 17.64 ± 1.67* | 19.57 ± 2.72* | 22.38 ± 3.26* | 15.52 ± 0.26* | 16.27 ± 2.88* | 22.08 ± 1.30* |
| **28-Jun** | 19.02 ± 0.71** | 19.40 ± 3.13** | 18.77 ± 2.41** | 14.91 ± 3.15** | 14.75 ± 9.07** | 16.93 ± 1.54** |
| **06-Jul** | 19.40 ± 1.66** | 18.48 ± 4.08*** | 15.26 ± 2.43*** | 15.07 ± 3.73*** | 17.02 ± 2.22** | 17.80 ± 3.06*** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **14-Jul** | 22.47 ± 1.30*** | 18.30 ± 1.47*** | 14.57 ± 3.08*** | 12.90 ± 3.64*** | 11.18 ± 3.50*** | 15.06 ± 2.40*** |
| **22-Jul** | 16.66 ± 5.16 MLS | 12.83 ± 9.88 MLS | 11.41 ± 3.60 MLS | 8.28 ± 2.27 MLS | 8.88 ±0.55 MLS | 10.75 ± 2.56 MLS |
| **Damage to leaves** | | | | | | |
| **30-Jul** | 29.13 ± 2.94 | 21.68 ± 6.15 | 28.55 ± 1.70 | 18.01 ± 1.01 | 20.55 ± 2.43 | 27.02 ± 2.70 |
| **07-Aug** | 37.20 ± 1.52 | 34.14 ± 6.49 | 36.67 ± 1.19 | 27.74 ± 0.90 | 32.22 ±1.11 | 29.76 ± 1.93 |
| **15-Aug** | 45.19 ± 2.44 | 41.69 ± 6.02 | 39.71 ± 2.58 | 33.19 ± 2.03 | 38.33 ± 2.55 | 35.51 ± 1.10 |
| **23-Aug** | 51.51 ± 2.23 | 50.66 ± 4.68 | 50.72 ± 0.72 | 38.93 ± 1.64 | 44.44 ± 2.78 | 40.01 ± 1.53 |

Values are Means±SE

Damage to * 2-leaf stage, ** 4-leaf stage, *** 6-leaf stage, MLS- Multiple leaf stage

**Table 3**: **Per cent vegetable damaged inflicted by the brown slug, *F. alte* to whole seedlings/saplings and leaf throughout crop period at Dasaunda Singh Wala village**

| **Dates/Year 2013** | **Spinach** | **Wanga** | **Long melon** | **Beans** | **Pumpkin** | **Sponge gourd** |
|---|---|---|---|---|---|---|
| **Damage to whole seedlings/saplings** | | | | | | |
| **15-Jun** | 18.69 ± 0.66 | 16.38 ± 2.29 | 19.56 ± 1.25 | 14.60 ± 1.31 | 19.02 ± 3.46 | 16.78 ± 2.38 |
| **23-Jun** | 25.41 ± 3.20* | 20.71 ± 1.83* | 22.19 ± 2.13* | 22.17 ± 2.43* | 23.41 ± 0.94* | 19.31 ± 1.60* |
| **01-Jul** | 23.61 ± 3.09** | 19.27 ± 1.08** | 20.25 ± 2.98** | 19.37 ± 1.99** | 15.87 ± 2.08** | 21.61 ± 3.72** |
| **09-Jul** | 26.93 ± 1.94** | 17.63 ± 2.37*** | 17.51 ± 1.37*** | 15.41 ± 2.30*** | 15.80 ± 0.42** | 18.09 ± 2.18*** |
| **17-Jul** | 22.44 ± 1.22*** | 13.62 ± 2.72*** | 16.02 ± 1.78*** | 20.63 ± 5.96*** | 11.86 ± 3.17*** | 18.07 ± 2.05*** |
| **25-Jul** | 13.83 ± 2.07 MLS | 9.77 ± 1.05 MLS | 11.46 ± 2.16 MLS | 9.36 ± 1.20 MLS | 9.69 ± 0.30 MLS | 9.67 ± 3.29 MLS |
| **Damage to leaves** | | | | | | |
| **2-Aug** | 29.42 ± 2.94 | 33.64 ± 1.76 | 30.89 ± 3.00 | 21.45 ± 1.06 | 22.42 ±2.43 | 25.10 ± 1.71 |
| **10-Aug** | 35.35 ± 2.95 | 38.53 ± 2.17 | 35.74 ± 3.21 | 27.47 ± 1.30 | 28.78 ± 4.77 | 28.06 ± 1.87 |
| **18-Aug** | 39.33 ± 1.29 | 41.66 ± 1.74 | 38.85 ± 1.70 | 32.15 ± 1.77 | 32.12 ± 2.12 | 31.27 ± 0.42 |
| **26-Aug** | 47.23 ± 3.15 | 48.31 ± 3.10 | 46.80 ± 0.68 | 34.87 ± 0.80 | 38.78 ± 1.21 | 40.71 ± 0.86 |

Values are Means±SE

Damage to * 2-leaf stage, ** 4-leaf stage, *** 6-leaf stage, MLS- Multiple leaf stage

4 Beans (*Phaseolus vulgaris*): In Bhadalwad, field mean per cent damage to seedling was observed to 13.11 per cent on 10 June and was further increased to 19.33 per cent on 26 June at 4-leaf stage. Minimum damage was observed on 18 June at 2-leaf stage i.e. 12.56 per cent. Leaf damage was increased from 20.70 to 36.46 per cent from 28 July to 21 August. In Sanghera field, maximum damage was observed on 20 June i.e. 15.52 per cent at 2-leaf stage which further decreased to 12.90 and 8.28 per cent at 6-leaf stage and multiple leaf stage respectively. 18.01 per cent leaf damage was observed on 30 July which was further increased to 38.93 per cent on 23 August. In Dasaunda Singh Wala field, at 2-leaf stage the maximum damage was observed i.e. 22.17 per cent on 23 June. This damage was further decreased to 15.41 per cent on 9 July and again increased to 20.63 per cent on 17 July. Maximum leaf damage was observed to 34.87 per cent on 26 August. According to Barker (2002), seedling with first true leaves was the most susceptible stage of bean plants to gastropod damage. Slugs also cause damage to beans, cabbage, cauliflower, tomato, strawberry, grape, banana (Flint, 2007; John and Louis, 2007).

5 Pumpkin *(Cucurbita moschata*): In Bhadalwad field, maximum mean per cent damage was observed on 12 July i.e. 17.77 per cent at 6-leaf stage and minimum damage was observed on 20 July i.e. 9.87 per cent at multiple stage. Maximum leaf damage was observed to 41.38 per cent on 21 August and minimum leaf damage observed to 24.35 per cent on 28 July. In Sanghera filed, 17.57 per cent damage was noticed to seedling stage on second week of June which was further decreased to 8.88 per cent at multiple leaf stage on 22 July. About 20.55 per cent leaf damage was noticed on last week of July which was further increased to 44.44 per cent on 23 August. In Dasaunda Singh Wala field, maximum damage to seedling was observed at 2-leaf stage on 23 June i.e. 23.41 per cent which was decreased to 11.86 and 9.69 per cent at 6-leaf stage and multiple leaf stage respectively. Maximum leaf damage was observed to 38.78 per cent on last week of August and minimum damage was observed in first week of August. The slug *A. alter L.* has been reported on root crops, leaf vegetables, carrots, potatoes, lettuce, cabbage, cauliflower, pumpkin from Malaysia (Abdullah, 1992).

6 Sponge gourd (*Luffa cylindrical*): In Bhadalwad field, maximum mean per cent damage was observed to sponge gourd on 18 June i.e. 18.88 per cent at 2-leaf stage which was further decreased to 15.58 per cent in second week of July at 6-leaf stage. At multiple leaf stage only 9.67 per cent damage was observed. Leaf damage was observed from 24.96 per cent (minimum) to 41.76 per cent (maximum) on 28 July and 21 August. In Sanghera field, maximum mean per cent damage was observed to 22.08 per cent on 20 June at 2-leaf stage which was decreased to 15.06 and 10.75 per cent on 14 July and 22 July at 6-leaf stage and multiple leaf stage respectively. Maximum leaf damage was observed in last week of August i.e. 40.01 per cent and minimum leaf damage was noticed to 27.02 in last week of July. In Dasaunda Singh Wala field, 21.61 per cent damage was noticed to seedling stage in first week of July at 4-leaf stage which was further decreased to 18.07 and 9.67 at 6-leaf stage and multiple leaf stage on 17 July and 25 July respectively. 25.10 per cent leaf damage was observed in first week of August and maximum leaf damage was observed to 40.71 per cent in last week of August. Kaur (2002) reported that the slugs ate bark stem of brinjal, tomato, sponge gourd and lobia. The maximum damage to whole seedling by slugs was 13.5% in brinjal (*Solanum melongena*) during last week of February, 63.4% in cucumber (*Cucumis sativus*), 62.8% in long melon (*Cucumis melo* var. utilissiumus), 30.2% in sponge gourd (*Luffa cylindrica*), 35.5% in turnip (*Brassica campestris* var. rapa), 30.9% in radish (*Raphnus sativus*) during September, 43.1% in spinach (*Spinacia oleracea*), 50.8% in cabbage (*Brassica oleracea* var. botrytis) during October, 47.7% in sarson (*Brassica rapa* L. var Trilocularis) during first week of November (Kaur and Mehta, 2010).

## Conclusion:

The study thus revealed that the incidence of slug damage increased with increased activity of slugs in the field which in turn depend on the presence of soil moisture content in crop ecosystem. In general, young seedling stage of crop was more vulnerable to slug attack but sometimes even the older plants were also attacked. More damage was observed in July-August in vegetable. So, slug control measures must be adopted during these months.

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