The Pharma Innovation Journal 2022; SP-11(4): 963-965

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(4): 963-965

www.thepharmajournal.com
Received: 04-02-2022
Accepted: 06-03-2022

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Seasonal incidence of linseed bud fly, *Dasyneura lini* (Barnes) on different varieties in relation to weather parameters

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Abstract
Sowing of nine varieties (LCK 1933, SLS 122, LSL 93, LMC 2017-R-8, JLS 95, T 397, RLC 171, RLC 175, RLC 176) was done on 11th November, 2020 during *Rabi* season for investigate the seasonal incidence of linseed bud fly, *Dasyneura lini* (Barnes) on different varieties of linseed. Bud fly infestation started from 1st SMW and continued up to 9th SMW. On the basis of peak infestation period, the maximum bud fly infestation was recorded on JLS 95 (39.88%) while minimum bud fly infestation was found in LCK 1933 (30.88%) variety of linseed. The bud fly infestation percentage was ranged from 3.15% to 34.79%. The findings demonstrated that maximum and average temperature had significantly positively correlated with the bud fly infestation percentage. Minimum temperature, morning relative humidity, evening relative humidity, average relative humidity, rainfall and sunshine hours had little bearing on the bud fly infestation.

Keywords: Linseed varieties, weather parameters, bud fly infestation, percentage of bud fly

Introduction
Linseed is also known as Flaxseed. Flaxseed is one of the world's oldest crop, having been grown since the dawn of civilization. *Linum usitatissimum* is the Latin word for flaxseed, which means "very useful." Flax was initially introduced to the United States by colonists, who used it to make clothing fiber (Laux, 2011) [1]. Commercially, every part of the flaxseed plant is used, either directly or after processing. The stem produces high-quality fibers that are strong and long-lasting. Flax was primarily utilized in the manufacture of cloths (linen) and papers until the 1990s, while flaxseed oil and its sub-products are used in the formulation of animal feed (Singh *et al*., 2011) [2].

Linseed is a major crop grown as '*Utera*' during the *Rabi* season (Agashe *et al*., 2018) [3]. In Chhattisgarh, linseed is one of the important oilseed crop, which shares about 19.05 per cent area and 16.21 per cent production of the country. The important linseed growing districts of Chhattisgarh are Rajnandgaon, Durg, Bilaspur, Kabirdham, Raipur, Dhamtari, Sarguja, Kanker and Raigarh (Chhattisgarh Sandarbh, 2007) [4]. The total area under linseed cultivation is around 19.90 thousand tonnes with a total productivity of 344 kg/ha (Anonymous, 2017c) [5].

At different stages of its development, linseed crops are attacked by numbers of insect pests and, among them, bud fly is one of the most limiting factors in the production of linseeds, causing enormous avoidable yield losses, particularly in central India and northern India, and damaged by up to 50-80 percent, followed by semilooper (*Plusia orichalsia* Fabr.), linseed thrips (*Caliothrips indicus* Barnall) and linseed caterpillar (*Spodoptera exigua* Hub.) (Mukherji *et al*., 1999, and Malik *et al*., 2000) [7]. The linseed bud fly, *Dasyneura lini* (Cecidomyiidae: Diptera), is the most damaging main pest of the flower bud, inflicting 88 percent of grain damage (Mukherji *et al*., 1999; Malik *et al*., 2000; Khalkho *et al*., 2018) [7, 8].

The major threat to linseed production is Bud fly. Female eggs lie on the overlapping sepals of immature flower buds in cluster and cause damage to feed within the ovary of flower buds, resulting in cloves like deformed buds and affecting the yield directly. The infested buds become hollow, and the healthy buds can be easily distinguished. The bud fly stays active in late maturing varieties until the green buds are available. The maggot descends to the ground, builds a soft silken cocoon and pupates inside the ground (Daharia, 2011) [9].

The use of pesticide as an oil seed crop can pose many problems, such as pesticide residue, mortality of non-target insects, secondary epidemic of pests and environmental contamination,

disruption of the equilibrium of pests in nature and even the abandonment of cultural power. The problem of pesticide use in oilseeds, oil and oil cakes is therefore more troubling than in other crops (Daharia, 2011) [9].

The production of resistant bud fly cultivars and other insect pests should be the highest priority among the various components of the IPM programme. Cultivars that are immune or tolerant are better for natural predators and consequently the entire environment. The first step in the production of resistant cultivars is to determine the source of resistance to insect pests by germplasm screening. Any linseed crop varieties have been reported to have moderate to high resistance against linseed bud fly (Singh *et al*., 1990) [10].

Material and Method

Study of seasonal incidence of linseed bud fly under plain region of Chhattisgarh were carried out Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, a constituent college of Indira Gandhi Krishi Vishwavidyalaya, Raipur during *Rabi* season 2020-21. Sowing of 9 linseed varieties ((LCK 1933, SLS 122, LSL 93, LMC 2017-R-8, JLS 95, T 397, RLC 171, RLC 175, RLC 176) was done on 11th November 2020-21 during Rabi season to determine their potential against bud fly infestation of linseed under field condition. The weekly meteorological data record from the meteorological observatory of the Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur. 10 plants were randomly selected in each plot of three replication and tagged as to record observation, which row to row distance of 30cm maintained in RBD.

Method of observation

For bud fly infestation – Number of bud fly infected buds and total no. of buds were recorded from 10 plants in each plot and bud fly infestation percentage was calculated by using given following formula-

$$\text{Percent bud fly infestation} = \frac{\text{(Number of infested buds)}}{\text{(Total number of bud)}} \times 100$$

Statistical analysis

The data were subjected to the analysis of variance using simple Randomized block design program. The simple correlation was worked out between bud fly infestation percentage and weather parameters.

Result and Discussion

Bud fly infestation: The first appearance of bud fly infestation was recorded on 1st SMW, 4th week of December with maximum bud fly infestation was in 39.88% in JLS 95. The result revealed that the bud fly infestation on variety LCK 1933, SLS 122. LSL 93 (ZC), LMC 2017-R-8, JLS 95 (ZC), T 397 (NC), RLC 171, RLC 175 and RLC 176 were found to be positively correlated with maximum and minimum temperature, rainfall and sunshine hours and negatively correlated with relative humidity.

Table 1: Bud fly infestation (%)* by linseed bud fly *Dasyneura lini* during *Rabi*, 2020-2021

SMW	Varieties								
	LCK 1933	SLS 122	LSL 93 (ZC)	LMS 2017-R-8	JLS 95 (ZC)	T 397 (NC)	RLC 171	RLC 175	RLC 176
1	2.44	3.12	3.04	3.65	3.52	3.46	3.35	3.28	2.45
2	6.58	7.84	14.25	9.56	10.67	12.44	15.66	15.44	9.65
3	10.36	11.45	12.56	13.49	14.22	18.34	14.46	14.56	14.56
4	13.54	15.55	18.86	17.58	17.55	24.46	20.34	18.77	19.87
5	16.54	20.23	17.34	16.24	21.34	25.55	19.86	26.45	20.48
6	20.64	24.74	23.45	22.14	22.44	27.68	26.45	29.68	22.34
7	26.54	29.34	30.12	34.88	31.14	28.54	28.56	33.45	25.24
8	27.65	35.67	29.45	35.25	36.54	30.22	30.34	38.76	27.45
9	30.88	39.45	33.79	35.78	39.88	33.45	32.56	36.78	30.58
Max.	30.88	39.45	33.79	35.78	39.88	33.45	32.56	36.78	30.58
Min.	2.44	3.12	3.04	3.65	3.52	3.46	3.35	3.28	2.45
Average	12.93	15.62	15.24	15.71	16.44	17.01	15.97	18.10	14.39
*Bud fly infestation (%) per ten plants									

Table 2: Correlation between bud fly infestations of different varieties of linseed with climatic factors

Varieties	Temperature (ºC)			Relative Humidity (%)			Rainfall (mm)	Sunshine (Hours)
	Max.	Min.	Average	Morning	Evening	Average		
LCK 1933	0.630*	0.379	0.584*	-0.451	-0.004	-0.504	0.378	0.163
SLS 122	0.639*	0.419	0.614*	-0.456	0.016	-0.530	0.418	0.141
LSL 93(ZC)	0.670*	0.413	0.627*	0.431	0.015	-0.435	0.313	0.125
LMS 2017-R-8	0.631*	0.429	0.617*	-0.398	0.010	-0.516	0.384	0.150
JLS 95 (ZC)	0.667*	0.434	0.639*	-0.427	0.024	-0.514	0.420	0.112
T 397 (NC)	0.628	0.233	0.488^{NS}	-0.389	-0.044	-0.430	0.335	0.113
RLC 171	0.657*	0.362	0.588*	-0.425	0.026	-0.429	0.334	0.093
RLC 175	0.613*	0.376	0.574	-0.480	0.093	-0.471	0.437	0.047
RLC 176	0.647*	0.294	0.537	-0.399	-0.043	-0.470	0.358	0.127
*Significant at 5% level of significance								

Conclusion

Based on the result of the present investigation it can conclude that linseed varieties are prone to insect attack. During 2020-21, with sowing towards the second week of November, bud fly infestation caused by *Dasyneura lini* on different varieties of linseed. Bud fly infestation percentage was noticed from 1st SMW to 9th SMW. The range of bud fly infestation was significantly higher during February. The

correlation coefficient run between bud fly infestation percentage and the climatic parameters such as temperature, relative humidity, sunshine hours and rainfall. The findings demonstrated that some climatic conditions had positively correlated with bud fly infestation. Maximum temperature had positive significant impact on bud fly infestation. Whereas, other climatic condition like minimum temperature, relative humidity, rainfall, and sunshine hours had little bearing on the bud fly infestation.

The bud fly infestation percentage was recorded for the different varieties, which reveals that the first appearance of bud fly infestation was recorded on 1st SMW to 9th SMW, i.e. from fourth week of December to fourth week of February. The highest bud fly infestation percentage was recorded in the variety JLS 95 and the least bud fly infestation was recorded in the variety LCK 1933.

Acknowledgement

I am thankful to the dean, all the professors and colleagues for their help during this study. This study is a part of M.Sc. thesis of the first author.

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