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BIOPHYSICAL BASIS OF RESISTANCE IN LINSEED AGAINST BUD FLY *DASINEURA LINI* (BARNES)

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ABSTRACT

Field experiment was conducted during rabi season of 2022-23 at COA, Nagpur, to study the biophysical basis of resistance in linseed against bud fly. Significantly lower bud fly infestation was recorded in germplasm IC0498517 (8.07 per cent). Whereas, significantly higher bud fly infestation was recorded in germplasm Neelum (51.09 per cent). On the basis of bud fly infestation, germplasm was categorized into different categories as 19 resistant, 17 moderately resistant, 5 moderately susceptible and 1 susceptible (Neelum). The correlation studies showed that there was a significant negative correlation (r = -0.336*) between thickness of sepals and bud fly infestation. However, bud fly infestation was significant negative correlation (r = -0.356*) with seed yield. The days required to complete fifty per cent flowering showed non-significant positive correlation ($r = 0.233^{NS}$) with bud fly infestation. While, total number of buds was significant positive correlation (r = 0.569*) with bud fly infestation.

Keywords **:** Screening, *Linum usitatissimum* L., sepal thickness, correlation, susceptible, host plant resistance, germplasm line, bud fly, flowering and oil seeds.

Introduction

Linseed (*Linum usitatissimum* L.) is an important oilseed crop belongs to the genus Linum of the family Linaceae. Linseed is an important industrial and fibre producing crop. Linseed is a best source of omega-3 fatty acid and it is essential as it cannot be synthesized by the body, must be supplemented directly from foods. About 20 species of insect pests infest linseed in different stages of plant growth. Among these the linseed bud fly *Dasineura lini* (Barnes) (Diptera: Cecidomyiidae) is the most important limiting factor causing up to 88 per cent grain yield losses and it is a key pest of linseed. The intensity of infestation was initially one to two larvae per bud in last week of January. Maximum numbers of larvae (16-25 larvae/bud) were recorded during last week of February and middle of March (Malik *et al*., 2000). The adult of this gall-midge is a small orange fly. The female lays eggs in tender green buds, either singly or in clusters of 3-5. Just after emergence, the larvae are transparent, with a yellow patch on the abdomen. The full-grown maggots drop to the ground, prepare a cocoon and pupate in the soil. Damage is the result of feeding by maggots on buds and flowers. Consequently, no pod-formation takes place. The infested buds become hollow and unproductive. At present, in the world where organic produce is much preferred in the market, there is great scope for using resistant variety and IPM strategies for the eco-friendly management of insect pest. Many plants have their physical characters, sepal size, seed coat size, which reduce insect pest infestation. It is a well-documented fact that increased dependence on agrochemicals including fertilizers has led to several ill effects on the environment and human health. Hence, identification of resistant variety against linseed bud fly is necessary as it reduces the overuse of pesticides, helps in

controlling environmental pollution (soil, water, air, etc.), also due to low production cost of linseed as pesticides cost will be reduced. This information will help in developing a resistant variety against linseed bud fly, *Dasineura lini* (Barnes) attacking at bud stage of the crop and the present study was therefore undertaken.

Material and Methods

The field trial was conducted under field condition in Randomized Block Design (RBD) with three replications to screen forty-two germplasm (IC0356352, IC0525920, IC305141, IC0199753, IC0499165, EC0009827, IC0096672, IC0199749, IC0096551, IC0525919, IC0499146, IC0498992, IC0058417-A, IC0096540, IC0053273, IC0054981, IC0413173, EC0520246, IC0526162, IC0499061, IC0526089, IC0345391, IC0096530, IC0096638, IC0564592, IC0526058, IC0591124, IC0526063, IC0526138, IC0118855, IC0498486, IC0498538, IC0498660, IC0342799, IC0342801, IC0342805, IC0498517, IC0498420, IC0498449, IC0498768, Neela and Neelum of linseed against bud fly in year (2022-23) during Rabi Season at Research Field of All India Co-ordinate Research Project on Linseed, College of Agriculture, Nagpur, MH (India). A single germplasm line was sown in a row of 3 m length in the third week of December with spacing of 30 between rows. Infester row of Neelum as susceptible check and Neela as a resistant check were grown after every ten rows of test entries. The recommended agronomic practices without any plant protection measures were followed. The bud fly infestation was recorded at dough stage on five plants per entry by counting total number of floral buds as well as infested buds, which was converted into % bud infestation. Bud fly infestation and biophysical parameters such as plant height, no. of buds per plant, days to 50 % flowering, sepal thickness and seed yield were recorded as per the standard method of AICRP on linseed (Anonymous, 2015a). Also, the correlation between bud fly infestation (%) and plant height (cm), no. of buds per plant, days to 50 % flowering (days), sepal thickness (µm) and seed yield (gm) were worked out by using OPSTAT software and ICAR WASP version 2.0 software.

Results and Discussion

Significantly lower bud fly infestation was recorded in IC0498517 followed by IC0342801, IC0096672, IC0499061, IC0498768, IC0499146, Neela, IC0053273, IC0499165, IC0096551, IC0525919, IC0342805, IC0498420, IC0096638, IC0498992, IC0199749, IC0498660, IC0342799, IC0526063 which were at par with each other followed by remaining test germplasm. On the basis of bud fly infestation per cent, all the germplasm was categorized into different categories. Among all the 42 germplasm there were 19 resistant, 17 moderately resistant, 5 moderately susceptible and 1 susceptible germplasm (Neelum) observed during experiment. (Anonymous, 2015b). The above findings are in close confirmation with present investigation given by Malik *et al*., (2000), Shrivastava *et al*., (2003), Daharia (2011), Malik and Srivastava (2012), Biradar *et al*., (2016), Biradar *et al*., (2021) with similar methodology using different germplasm / genotypes to find resistant germplasm lines against linseed bud fly for using in breeding programme.

Table 1: Bud fly infestation and quantitative biophysical parameters in different germplasm

Germplasm	Bud fly infestation (%)	Sepal thickness (µm)	Seed yield (gm)	50% flowering (days)	Total number of buds	Plant height (cm)	B.I.I.
IC0356352	18.38	25.13	2.00	45	56.80	37.97	MR
IC0525920	15.64	21.81	2.15	51	61.07	37.47	MR
IC305141	20.08	21.92	2.51	52	72.87	46.00	MR
IC0199753	19.52	14.40	2.26	52	76.07	41.57	MR
IC0499165	9.17	15.57	2.83	49	70.07	45.53	R
EC0009827	16.23	17.58	2.72	50	64.33	48.97	MR
IC0096672	8.82	19.09	2.32	51	64.40	49.23	R
IC0199749	9.69	17.96	2.09	52	62.53	49.07	R
IC0096551	9.33	20.76	1.81	51	61.13	46.83	R
IC0525919	9.35	15.93	2.11	49	63.53	36.40	R
IC0499146	9.01	21.67	3.21	47	57.87	41.10	R
IC0498992	9.59	15.65	2.74	53	65.20	47.67	R
IC0058417-A	15.89	18.86	3.11	49	82.07	44.53	MR
IC0096540	34.78	18.52	1.29	57	58.24	40.80	MS
IC0053273	9.15	22.08	2.61	51	66.87	44.20	R

IC0054981	16.56	21.82	2.69	56	83.33	43.80	MR
IC0413173	15.24	24.92	3.07	56	87.80	38.33	MR
EC0520246	16.26	25.22	1.75	52	71.67	50.10	MR
IC0526162	21.25	25.77	1.42	52	72.80	46.30	MR
IC0499061	8.82	22.95	1.77	56	75.93	47.87	R
IC0526089	14.92	26.09	2.19	52	84.93	32.53	MR
IC0345391	16.93	19.79	1.84	53	85.93	34.20	MR
IC0096530	14.30	19.74	2.49	53	69.53	50.30	MR
IC0096638	9.51	24.58	2.82	51	73.60	45.93	R
IC0564592	17.21	14.11	2.43	57	81.93	46.23	MR
IC0526058	19.10	18.09	2.10	52	78.67	51.40	MR
IC0591124	17.94	22.85	2.41	52	54.07	55.97	MR
IC0526063	9.76	19.51	1.24	57	64.33	45.23	R
IC0526138	13.51	13.13	1.47	52	64.47	47.80	MR
IC0118855	27.03	9.52	1.60	47	77.93	55.53	MS
IC0498486	28.06	18.52	1.71	49	63.47	49.83	MS
IC0498538	29.51	16.18	1.32	58	71.80	36.37	MS
IC0498660	9.70	17.30	2.27	52	79.13	42.37	R
IC0342799	9.72	14.71	2.25	47	67.27	43.43	R
IC0342801	8.64	20.10	2.27	53	68.87	38.40	R
IC0342805	9.43	16.19	2.01	59	69.80	43.90	R
IC0498517	8.07	14.83	2.25	53	70.33	47.80	R
IC0498420	9.49	15.65	2.32	58	80.93	43.03	R
IC0498449	27.22	14.75	1.86	59	78.20	41.53	MS
IC0498768	8.88	15.11	1.83	60	65.80	39.43	R
Neela (RC)	9.13	18.82	2.88	65	59.13	40.13	R
Neelum (SC)	51.09	6.23	2.09	62.7	149.93	40.13	S

Table 2: Correlation of biophysical parameters of linseed germplasm with bud fly infestation

Sr. No.	Correlation coefficient (r)				
	Plant height (cm)	**Total number of buds per plant**	**Days to 50% flowering (days)**	**Sepal thickness (µm)**	**Seed yield / ten plants (gm)**
Bud fly infestation (%)	-0.052^{NS}	0.569*	0.233^{NS}	-0.336*	-0.356*

* : Correlation is significant at 5% level.
NS : Non Significant

Out of forty-two germplasm lines, IC0526089 germplasm i.e. (26.09 µm) had thickest sepal as compared to moderately resistant, moderately susceptible and susceptible germplasm. The results revealed that sepal thickness had significant negative correlation with bud infestation (%) (r = -0.336*) (Table 2) (Fig. 1). The above finding is in close confirmation with present investigations done by Painter (1951) who reported that thickness of plant parts was an important component for plant resistance. David and Easwara Moorthy (1988) suggested that many morphological characters contribute to the resistance of plants to insect pests. These include trichomes, surface waxes, hardness of plant tissues, thickening of cell walls. Gupta *et al*., (2015) studied on histological basis of resistance in linseed against bud fly and observed that there was highly significant negative correlation between thickness of sepal and percent bud infestation. But this result is in contradiction with results of Malik *et al*., (1995) reported that sepal thickness provided significant positive impact (r = 0.8698 and 0.8664) on bud infestation which was maximum 0.39 and 0.40 mm in case of variety Neelum and minimum (0.28 and 0.29 mm) in variety Neela. The bud fly infestation (%) had significant negative and correlation with seed yield (r = -0.356*) (Table 2). The above finding is in close confirmation with Malik (2005), who reported that the linseed seed yield was reduced to the tune of 26.4 kg/ha with every per cent increase in bud infestation. Highly significant negative correlation was noticed between bud fly infestation and seed yield. The genotype Neelum beared highest number of buds i.e. (149.93) and the genotype IC0591124 beared the lowest number of buds i.e. (54.07). It had had significant positive correlation with bud infestation (%) (r = 0.569*) (Table 2). The present finding is in contradiction with investigation done by Malik *et al*.

(1995) revealed that number of buds per plant did not show their significance in bud fly resistance.

Conclusion

Among the forty-two linseed germplasm evaluated, clear variability was observed in their response to bud fly infestation. Based on percent infestation, the germplasm were categorized into four groups: 19 resistant, 17 moderately resistant, 5 moderately susceptible and 1 susceptible entry. Germplasm IC0498517 recorded the lowest bud fly infestation (8.07%), indicating a high level of resistance, whereas the susceptible check Neelum exhibited the highest infestation (51.09%), confirming its susceptibility.The findings of the study clearly indicate that biophysical traits, particularly sepal thickness, play a significant role in imparting resistance against linseed bud fly. The resistant germplasm identified in this investigation can serve as valuable donor sources in resistance breeding programmes. Their utilization will aid in developing improved linseed varieties with inherent resistance, thereby promoting eco-friendly and sustainable pest management strategies, reducing dependence on chemical insecticides, and ultimately enhancing linseed productivity.

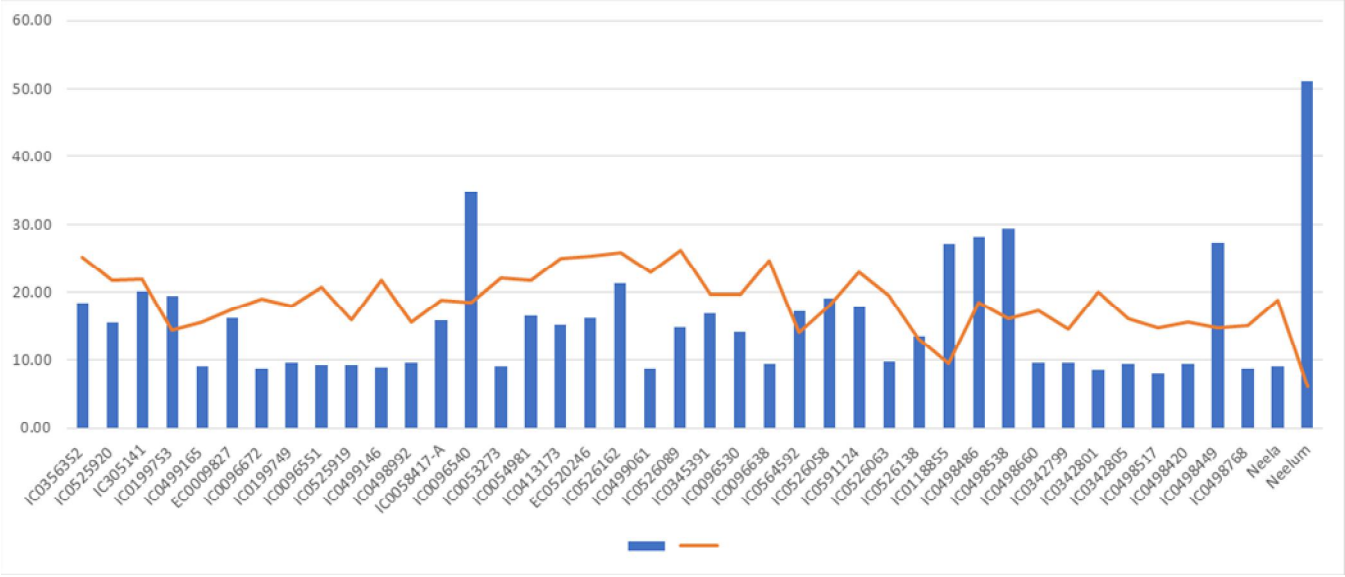

Fig. 1 : Relationship between bud fly infestation (%) and sepal thickness of different linseed germplasm

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Author Contribution Statement

Priyanka Chaple and Vidyasagar Biradar constructed and conducted trial and raw data collection. Janhavi Dose and Nishant Zatale analyzed the data. Kiran Budhvat and Madhuri Laute wrote manuscript. All authors read and approved the manuscript.

Conflicts of Interest / Competing Interests

Authors have no conflict for interest.

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