



# Evaluation of Resistance of Linseed Genotypes against Bud Fly, *Dasyneura lini* Barnes (Diptera: Cecidomyiidae): Implications for Sustainable Crop Improvement

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Experiments were carried out at the Research Farm of Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India during Rabi 2021-22, 2022-23 and 2023-24 to evaluate the resistance of linseed genotypes against bud fly, *Dasyneura lini* (Barnes) for sustainable crop improvement. A total of 77 genotypes screened out for resistance against bud fly, *Dasyneura lini*, and were

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categorized and replicated thrice in RBD. Out of 77 genotypes, 40 genotypes were resistant, 34 genotypes were moderately resistant and 03 genotypes moderately susceptible to bud fly infestation. The observed resistant genotypes are BRLS 128, BRLS 111-2, BRLS 129, BRLS 125, BRLS 126-2, BRLS 102, BRLS 127-2, BRLS 108-1, BRLS 111-1, BRLS 126-4, BRLS 126-1, BRLS 108-3, BRLS 106-1, BRLS 120-2, BRLS 127-1, BRLS 105-1, BRLS 130-1, BRLS 112-2, BRLS 108-1, BRLS 110-7, BRLS 103, BRLS 106-2, BRLS 126-5, BRLS 110-4, BRLS 107-1, BRLS 111-3, LCK 8682, NDL 2015-03, BRLS 102-1, BRLS 116, SLS 64, BRLS 112-3, BRLS 119, BRLS 107, BRLS 120-4, BRLS 120, BRLS 109-5, BRLS 124-2, Sabour Yellow and BRLS 121. The resistant genotypes observed against bud flies may be used as donor parents in the multiple resistance breeding programme of linseed.

**Keywords:** Evaluation; screening; genotypes; linseed; bud fly; *dasyneura lini*; resistant.

## 1. INTRODUCTION

Linseed *Linum usitatissimum* L. (Family: Linaceae) is one of the oldest oilseed crops also known as flax cultivated in around 47 countries for seeds, oil, and fiber. This crop occupies an area of 35.40 lakh hectares, yielding 33.67 lakh tonnes with an average productivity of 951 kg per hectare in the world [1]. Whereas, in India, it is solely cultivated as a *rabi* crop which is grown over the acreage of 2.50 lakh hectares on marginal and sub-marginal irrigated, rainfed, and *utera* situations and contributes to the production of 1.00 lakh tonnes with the productivity of 412 kg per hectare during the year 2019-20 [2]. It is the richest source of vegetarian omega-3 fatty acids and a good source of protein, dietary fiber, lignin, flax fibre, and essential micro-nutrients. This crop suffers from many diseases and insect pests at various phases of its growth which reduce the crop yield and quality. Amongst insect pests, bud fly, *Dasyneura lini* (Barnes) becomes the most important [3] and destructive pest of linseed resulting loss in seed yield ranging from 40.0 to 80.0% [4]. Screening of genotypes against bud flies has been a way to identify the best genotypes for further development of resistant/tolerant varieties of linseed to the insect. Therefore, the present investigation aimed to screen several genotypes under field conditions to identify suitable genotypes against linseed bud flies for sustainable crop improvement.

## 2. MATERIALS AND METHODS

Experiments were carried out at the Research Farm of Bihar Agricultural College, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India located at 25°15' North Latitude, 86°57' South Longitude and altitude of 46 meters above the MSL during the *Rabi* season of 2021-22, 2022-23 and 2023-24.

A total of 77 genotypes of linseed crop from ICAR-All India Coordinated Research Project on Linseed, Bihar Agricultural University, Sabour were used for resistance screening against *Dasyneura lini* Barnes. The seeds of different genotypes were sown three weeks delayed from the normal date of sowing in the two-row length of 3 m with a row-to-row spacing of 30 cm replicated thrice in Randomized Block Design. There were varieties Neela (resistant check) and Neelum (susceptible check) also sown after a set of test rows. All recommended agronomic practices were followed for the raising of the crops. No substances were sprayed in the plots till harvesting of the crop. The bud fly infestation was recorded at the dough stage from five randomly selected plants per genotype by counting the total number of floral buds as well as infested buds and the percent bud infestation was calculated as per the following formulae as given by Malik [5].

$$\text{Bud fly infestation (\%)} = \frac{\text{Infested buds}}{\text{Total number of buds}} \times 100$$

All the tested genotypes were categorized into different categories of resistant based on average bud fly infestation by following the formula suggested by Malik [6].

## 3. RESULTS AND DISCUSSION

Mean data of two years on bud fly infestation in 77 genotypes of linseed scoring recorded under natural conditions are presented in Tables 2 and 3. The bud fly infestation varied irrespective of the genotypes. The bud fly infestation in the linseed crop started at the bud emergence and reached till the buds got open. The observed infestation was varied from 0.00 to 34.00% at the dough stage. A total of 40 genotypes viz., BRLS 128, BRLS 111-2, BRLS 129, BRLS 125, BRLS 126-2, BRLS 102, BRLS 127-2, BRLS 108-1,

BRLS 111-1, BRLS 126-4, BRLS 126-1, BRLS 108-3, BRLS 106-1, BRLS 120-2, BRLS 127-1, BRLS 105-1, BRLS 130-1, BRLS 112-2, BRLS 10-8-1, BRLS 110-7, BRLS 103, BRLS 106-2, BRLS 126-5, BRLS 110-4, BRLS 107-1, BRLS 111-3, LCK 8682, NDL 2015-03, BRLS 102-1, BRLS 116, SLS 64, BRLS 112-3, BRLS 119, BRLS 107, BRLS 120-4, BRLS 120, BRLS 109-5, BRLS 124-2, Sabour Yellow and BRLS 121 were registered under resistant category and the bud fly infestation range varied from 0.00 to 10.00%. There was no incidence of bud fly observed in genotype BRLS 128. A total of 34 genotypes were found under moderately resistant category in which the bud fly infestation range varied from >10.00 to 25.00%, the genotypes are RL 1556, NDL 2014-8, RLC 159, BRLS 109-1, NDL 2014-1, RLC 143, LMS 2015-11, BRLS 124-3, BRLS 124-1, OL-09-2015, BAU 14-11, LCK-1611, OL 98-15-2, BRLS 110-2, LMS 2015-31, BRLS 105, RLC 151, Sagar Local, RLC 168, RLC 156, BRLS 116-1, Sakoor, DLV-1, RLC 163, RLC 148, BRLS 109-2, LCK 1529, RLC 153, BRLS 130-5, BRLS 110-3, RLC 162, BRLS 130-3, BRLS 110-1 and T 99. A total of 03

genotypes viz., L 103, RLC 158 and LMS 2015-27 were registered as moderately susceptible in respect of bud fly infestation. The highest infestation of bud fly was registered at 34.00% in genotype LMS 2015-27, however, these entries were recorded under the category of susceptible. None of the genotypes was registered under the category of highly susceptible against bud fly infestation.

**Table 1. Categorical division**

% infestation	Category
Up to 10%	R –Resistant
>10 to 25%	MR – Moderately Resistant
>25 to 50%	MS – Moderatly Susceptible
>50 to 75%	S – Susceptible
>75%	HS – Highly Susceptible

All the screened genotypes for resistance against bud fly, *Dasyneura lini* were categorized and are presented in Table 3. Out of 77 genotypes, 40 genotypes are resistant, 34 genotypes are moderately resistant and 03 genotypes moderately susceptible to bud fly infestation.

**Table 2. Screening of linseed genotypes against bud fly, *Dasyneura lini* (Barnes) at Sabour**

Entry	Bud flies infestation at dough stage (%)				Reaction
	2021-22	2022-23	2023-24	Average	
BRLS 128	-	0.00	0.00	0.00	R
BRLS 111-2	-	0.29	0.00	0.15	R
BRLS 129	-	0.66	0.00	0.33	R
BRLS 125	-	0.00	1.82	0.91	R
BRLS 126-2	-	0.71	1.22	0.97	R
BRLS 102	-	0.00	2.04	1.02	R
BRLS 127-2	-	1.28	0.89	1.09	R
BRLS 108-1	-	2.79	0.00	1.40	R
BRLS 111-1	-	2.00	1.12	1.56	R
BRLS 126-4	-	0.71	2.56	1.64	R
BRLS 126-1	-	1.79	2.04	1.92	R
BRLS 108-3	-	1.29	2.98	2.14	R
BRLS 106-1	-	1.01	3.44	2.23	R
BRLS 120-2	-	3.84	0.98	2.41	R
BRLS 127-1	-	2.39	3.06	2.73	R
BRLS 105-1	-	4.04	2.12	3.08	R
BRLS 130-1	-	3.45	2.98	3.22	R
BRLS 112-2	-	4.58	2.34	3.46	R
BRLS 10-8-1	6.72	2.56	3.04	4.11	R
BRLS 110-7	-	2.33	6.80	4.57	R
BRLS 103	-	3.48	6.02	4.75	R
BRLS 106-2	-	4.42	5.10	4.76	R
BRLS 126-5	-	5.21	4.34	4.78	R
BRLS 110-4	-	3.29	6.79	5.04	R
BRLS 107-1	-	5.25	4.96	5.11	R
BRLS 111-3	-	6.72	4.44	5.58	R

Entry	Bud flies infestation at dough stage (%)				Reaction
	2021-22	2022-23	2023-24	Average	
LCK 8682	8.77	3.91	456	5.75	R
NDL 2015-03	8.51	5.42	4.88	6.27	R
BRLS 102-1	-	7.57	5.45	6.51	R
BRLS 116	-	8.40	4.63	6.52	R
SLS 64	11.72	6.30	5.22	7.75	R
BRLS 112-3	-	9.15	6.42	7.79	R
BRLS 119	-	6.78	9.05	7.92	R
BRLS 107	9.47	6.89	8.78	8.38	R
BRLS 120-4	-	11.27	5.80	8.54	R
BRLS 120	-	10.58	7.43	9.01	R
BRLS 109-5	-	8.69	9.68	9.19	R
BRLS 124-2	-	11.90	6.76	9.33	R
Sabour Yellow	11.11	9.41	9.04	9.85	R
BRLS 121	-	7.47	12.52	10.00	R
RL 1556	16.07	9.20	8.12	11.13	MR
NDL 2014-8	14.56	10.27	8.62	11.15	MR
RLC 159	11.54	12.67	10.08	11.43	MR
BRLS 109-1	-	14.40	8.53	11.47	MR
NDL 2014-1	18.18	8.78	9.34	12.10	MR
RLC 143	9.49	15.51	12.21	12.40	MR
LMS 2015-11	20.63	7.19	9.99	12.60	MR
BRLS 124-3	-	13.66	12.24	12.95	MR
BRLS 124-1	-	15.96	10.23	13.10	MR
OL-09-2015	20.11	7.16	12.76	13.34	MR
BAU 14-11	16.67	10.13	13.37	13.39	MR
LCK-1611	22.32	3.94	14.66	13.64	MR
OL 98-15-2	25.00	5.79	10.22	13.67	MR
BRLS 110-2	-	15.20	13.07	14.14	MR
LMS 2015-31	14.63	12.09	17.54	14.75	MR
BRLS 105	-	16.72	12.88	14.80	MR
RLC 151	17.65	13.04	14.22	14.97	MR
Sagar Local	16.98	16.57	12.34	15.30	MR
RLC 168	23.02	7.04	17.32	15.79	MR
RLC 156	20.81	15.29	12.23	16.11	MR
BRLS 116-1	-	15.76	16.78	16.27	MR
Sakoor	18.48	17.32	13.66	16.49	MR
DLV-1	31.82	10.57	8.98	17.12	MR
RLC 163	17.86	18.18	15.60	17.21	MR
RLC 148	18.37	17.58	16.23	17.39	MR
BRLS 109-2	-	20.89	16.32	18.61	MR
LCK 1529	16.10	22.14	17.73	18.66	MR
RLC 153	30.90	13.34	11.83	18.69	MR
BRLS 130-5	-	18.38	20.04	19.21	MR
BRLS 110-3	-	22.16	16.64	19.40	MR
RLC 162	13.99	21.44	24.88	20.10	MR
BRLS 130-3	-	23.46	16.78	20.12	MR
BRLS 110-1	-	20.45	23.44	21.95	MR
T 99	15.73	35.81	23.09	24.88	MR
L 103	23.58	28.74	29.76	27.36	MS
RLC 158	18.30	34.92	29.36	27.53	MS
LMS 2015-27	18.11	51.80	32.09	34.00	MS
Neela	5.71	4.17	5.12	5.00	R
Neelum	40.43	45.11	32.78	39.44	MS

R – Resistant, MR – Moderately Resistant, MS – Moderately Susceptible, S – Susceptible

**Table 3. Categorization of linseed genotypes for resistance against bud fly, *Dasyneura lini* (Barnes)**

Category	Scale (% infested buds)	No. of genotypes	Genotypes
Resistant (R)	Up to 10%	40	BRLS 128, BRLS 111-2, BRLS 129, BRLS 125, BRLS 126-2, BRLS 102, BRLS 127-2, BRLS 108-1, BRLS 111-1, BRLS 126-4, BRLS 126-1, BRLS 108-3, BRLS 106-1, BRLS 120-2, BRLS 127-1, BRLS 105-1, BRLS 130-1, BRLS 112-2, BRLS 10-8-1, BRLS 110-7, BRLS 103, BRLS 106-2, BRLS 126-5, BRLS 110-4, BRLS 107-1, BRLS 111-3, LCK 8682, NDL 2015-03, BRLS 102-1, BRLS 116, SLS 64, BRLS 112-3, BRLS 119, BRLS 107, BRLS 120-4, BRLS 120, BRLS 109-5, BRLS 124-2, Sabour Yellow, BRLS 121
Moderately Resistant (MR)	>10 to 25%	34	RL 1556, NDL 2014-8, RLC 159, BRLS 109-1, NDL 2014-1, RLC 143, LMS 2015-11, BRLS 124-3, BRLS 124-1, OL-09-2015, BAU 14-11, LCK-1611, OL 98-15-2, BRLS 110-2, LMS 2015-31, BRLS 105, RLC 151, Sagar Local, RLC 168, RLC 156, BRLS 116-1, Sakoor, DLV-1, RLC 163, RLC 148, BRLS 109-2, LCK 1529, RLC 153, BRLS 130-5, BRLS 110-3, RLC 162, BRLS 130-3, BRLS 110-1, T 99
Moderately Susceptible (MS)	>25 to 50%	03	L 103, RLC 158, LMS 2015-27
Susceptible (S)	>50 to 75%	-	-
Highly Susceptible (HS)	>75%	-	-

The results of the present workers confirmed with the findings of Nayak et al. [7 and 8], where they screened different genotypes of linseed and found 04 genotypes viz., RL-27010, RLC-123, RLC-129, and LSJ-103 were resistant against the bud fly infestation, while, there were 34 germplasm of linseed screened against bud fly at Berhampore, West Bengal and reported that bud fly infestation ranged from 6.8 – 36.1%. Entries Ireland (TFlax), NDL-2011-23 and RLC-148 were found resistant with bud fly infestation up to 10%, whereas entries BAU-833-11, EC-399086, LMS-2010-2-15, LMS-2010-1-27, LMS-2012-112, LW-9828, NDL-2211-20, RLC-133, RLC-138, RLC-143, RLC-145, Silwani, BAUP-101, BAUP-102, LSL-93, NL-287, NDL-2002, RLC-151 and SHA-1 were moderately resistant to bud fly with >10 – 25% damage [9]. Similarly, there were 100 germplasm of linseed screened under natural conditions at Mauranipur, Uttar Pradesh against bud fly infestation, the germplasm, RL-49-4-5, RLC-33-4, and RL-15-1 were registered under the resistant category and 20 genotypes namely, R-31, R-76, R-966, R 1141/41, R-1156, Raisen local, RCC-7, RH-41 K-4, RL-8-4, RL-9-2, RL-15-1, RL-34-1, RL45-1, RLC-2, RLC-5, RLC29,

RLC-29 (K), T397, RLC-33-5, and RLC-47 were categorized as moderately resistant [10]. The bud fly infestation over the environments, a reference set comprising 195 accessions including 46 resistant, 94 moderately resistant and 55 moderately susceptible/susceptible germplasm was developed [11].

#### 4. CONCLUSION

On the basis of present investigation, it may be concluded that, a total of 40 genotypes were observed resistant against linseed bud fly, *Dasynerura lini*, however, the resistant genotypes may be used as donor parents in the multiple resistance breeding programme of linseed. None of the genotypes registered under the highly susceptible category.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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