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RESEARCH ARTICLE

Biophysical and Morphological Basis of Resistance against Linseed (*Linum usitatissimum* L.) Bud fly (*Dasyneura lini* Barnes)

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Abstract

A field experiment was conducted at the research cum instructional farm, College of Agriculture, Nagpur, Dr. PDKV, Maharashtra during *rabi* 2021-22 with the objective to find the biophysical and morphological basis of resistance against linseed bud fly (*Dasyneura lini* Barnes). A set of 36 germplasm was sown in RBD in paired rows of 2 m and a spacing of 45 cm x 10 cm. The results indicated that resistant germplasm against bud fly IC498428 and Jawahar-17 had relatively higher sepal thickness (21.18 and 19.64 μ) as well as lower average infestation recorded (8.19 and 9.75%) while susceptible germplasm IC413173 (49.12%), IC498783 (42.70%), IC498924 (42.48%) and EC011748 (45.00%) exhibited minimum sepal thickness (6.90, 9.28, 9.32 and 8.33 μ, respectively). The character association studies showed a highly significant negative correlation (r = -0.852**) between the thickness of sepals and the percentage of bud fly infestation. The correlation between plant height and bud infestation was negative (-0.042) and non-significant.

Keywords: Bud fly, Linseed, Sepal thickness, Susceptible, Resistance.

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Introduction

Linseed (*Linum usitatissimum L.*) belongs to family Linaceae, which is grown worldwide for its multifunctional properties like food, fiber, and fuel as a *rabi* season crop. Due to its high adaptability, linseed is India's fourth major oil seed crop and third major fiber crop. It plays a vital role in industries as its linen, which is costlier than cotton fiber, is used as a raw material for making clothes, paper cigarette filter, packaging material and other eco-friendly products. Linseed fibre, obtained from the stem of plant, is more tensile than cotton.

Due to its strength, non-elasticity, repeatability and recyclable nature, it is very attractive to be used as rope and thread, which is the major interest for its cultivation (Jhala and Hall 2010). After oil extraction, the cake is used for cattle as a protein stock and fine manure (Sankari, 2000; Kurt and Bozkurt, 2006). Different names know it at different locations like Arasi, Alsi, Jawas, Tisi and Chana. Linseed oil makes several daily use products, such as paint, varnishes, water-resistant fabric and linoleum (Dash *et al*., 2017). Linseed is the best herbal source of PUFA- Poly unsaturated fatty acids such as linoleic and linolenic (ω-3) acid, which are essential for humans since they can't be synthesized in the body. Besides the highly desirable ω-6/ ω-3 fatty acid ratio of 0.3:1, linseed is also a rich source of secoisolariciresinol diglucoside (SDG) and a major bioactive lignan, which provides protection against certain types of cancers and hormonal disorders.

Linseed contains 33 to 42% seed oil and 18 to 23% protein. India contributes to 4.41 and 3.66% of area and production, respectively (Statistics of Directorate of Oilseed Development, Ministry of Agriculture and Farmers Welfare, Govt. of India, 2020). According to Srivastava (2009), linseed is grown mostly under rainfed (63%), *utera* (25%) and irrigated (17%) and input-starved conditions in major linseed-producing states, such as Madhya Pradesh, Chhattisgarh, Maharashtra, Jharkhand, Uttar Pradesh, and Odisha. In India, the net sown area of linseed crop is 1.83 lakh ha. production is 1.11 lakh tonnes during 2021-22 (FAOSTAT, 2022) with a 2.5% growth rate and an average 604 kg/ha yield. in India. Linseed is still considered an oilseed crop with unexplored potential for commercial production concerning industrial, nutritional and nutraceutical utility.

Various biotic and abiotic factors are responsible for adverse effects of crop yield and bud fly is a major destructive pest of linseed, which has been reported to cause economic loss ranging from 37 to 80% (Malik, 2006). Among the factors that influence changes in population densities of bud fly are seasonal effects of weather, ongoing changes in climatic conditions and mechanisms through which they act upon its population density (Karuppaiah and Sujayanad, 2012). Bud fly (*Dasyneura lini* Barnes) is a dipteran fly belonging to the Cecidomyidae family and is a slow-flying insect. Therefore, to stabilize the yield and reduce the bud fly infestation on the basis of host plant resistant potentiality of genotypes, this research work evaluating for resistant genotypes of linseed under field conditions was taken up to identify the probable resistance host plant to bud fly, which could possibly help in improving yield and eventually the farmers' income.

Material and Methods

A field experiment was conducted at a research farm, College of Agriculture, Nagpur (Dr. PDKV, Akola). A set of 36 germplasm (Including two checks) were sown in randomized block design in paired row of 2 m row length and spacing was maintained at 45 x 10 cm in last week of November 2021 during *rabi* season for screening against linseed bud fly. Agronomic practices were maintained as per crop recommendation (Braidek, 1975) and no plant protection measures were given. After every 10 entries, Neelum (Susceptible check) and Neela (Resistant check) were sown. Bud fly incidence was recorded at the dough stage of crop.

Table 1: Classification of bud fly infestation range

Sl. No.	*Bud infestation (%)*	*Category*
1.	0–10	Highly resistant
2.	10.1–25	Moderate resistant
3.	25.1–40	Moderate susceptible
4.	40.1 60	Susceptible
5.	>60	Highly susceptible

Three plants were selected per entry for observation, followed by counting their total number of flower buds and infested buds. Bud fly Infestation Index (BII) was calculated as the percentage of infected buds among total number of buds and statistical methods such as, descriptive statistics, Pearson's Correlation coefficient, phenotypic path analysis etc. were used to establish relationships among characters. The germplasm was taken from the National Gene Bank of ICAR- National Bureau of Plant Genetic Resources, New Delhi

Table 2: Influence of sepal thickness on bud fly infestation

Sl. No.	*Accession number*	*Sepal thickness (μ m)*			*Mean (μ m)*	*Average bud fly infestation (%)*
		R1	*R2*	*R3*		
1	IC598324	18.61	15.88	19.12	17.87	15.69
2	EC115148	16.56	14.24	16.14	15.65	18.37
3	IC564606	17.49	17.39	18.6	17.83	18.01
4	IC525982	15.88	20.89	20.1	18.96	17.00
5	IC597268	10.18	9.62	12.55	10.78	29.15
6	IC498428	22.29	19.39	21.86	21.18	8.19
7	IC585268	13.07	16.11	18.6	15.93	19.39
8	IC629184	14.09	13.59	20.12	15.93	17.23
9	EC041535	9.21	10.88	10.98	10.36	30.40
10	IC096652	8.08	7.68	7.11	7.62	38.98
11	IC526030	15.9	21.75	18.93	18.86	25.75
12	IC525936	10.44	8.57	10.82	9.94	28.99
13	IC585341	10.26	9.6	10.09	9.98	29.57
14	IC096500	10.39	11.69	9.97	10.68	28.16
15	IC499135	21.64	21.04	22.26	21.65	17.76
16	IC525950	19.06	19.14	16.18	18.13	25.54
17	IC498924	8.15	9.13	10.67	9.32	42.48
18	EC541203	15.42	13.75	14.66	14.61	25.12
19	EC022872	10.1	8.98	9.31	9.46	30.70
20	IC621685	18.44	16.4	23.69	19.51	25.64
21	IC499139	17.38	12.7	20.25	16.78	25.00
22	IC526153	16.49	22.51	15.46	18.15	19.53
23	IC498738	14.29	15.21	16.43	15.31	26.32
24	IC498783	9.22	8.78	9.83	9.28	42.70
25	IC096558	11.18	10.21	9.59	10.33	20.77
26	IC498596	15.57	15.87	16.56	16.00	22.12
27	IC413173	6.58	5.38	8.75	6.90	49.12
28	EC541211	10.62	9.53	10.44	10.20	30.58
29	IC510949	21.81	16.43	15.38	17.87	16.44
30	Jawahar-17	22.12	19.23	17.58	19.64	9.75
31	IC498975	13.41	13.67	13.56	13.55	20.93
32	IC498991	12.24	12.39	11.93	12.19	19.91
33	EC011748	7.42	8.44	9.14	8.33	45.00
34	IC526028	12.75	12.66	15.81	13.74	22.64
35	Neelum	9.46	11.3	10.54	10.43	36.75
36	Neela	25.15	22.62	17.51	21.76	5.61

Table 3: Categorization of 36 germplasm based on pest infestation

Sl. No.	*Infestation range (%)*	*Category*	*No. of accessions*	*Germplasm*
1	0–10	Highly resistant	3	Jawahar-17, IC498428 and Neela (Check)
2	10.1–25	Moderate resistant	14	IC598324, EC115148, IC564606, IC525982, IC585268, IC629184, IC499135, IC526153, IC096558, IC498596, IC510949, IC498975, IC498991, IC526028.
3	25.1–40	Moderate susceptible	15	IC597268, EC041535, IC096652, IC526030, IC525936, IC585341, IC096500, IC525950, EC541203, EC022872, IC621685, IC499139, IC498738, EC541211 and Neelum (Check).
4	40.1–60	Susceptible	4	IC498924, IC498783, IC413173 and EC011748.
5	>60	Highly susceptible	0	Nil

for the experimental trial. The germplasm was categorized into five groups (Malik, 2005) as depicted in Table 1.

Biophysical and Morphological Basis of Resistance

The response shown by plants against insect pests can be attributed to morphological or biophysical traits. Selected entries of linseed were investigated on the basis of biophysical and morphological parameters like plant height and sepal thickness under field conditions. During the maturity stage, plant height was measured in centimeters, from the soil surface (base of the plant) to apical portion of the plant using a standard scale to determine if height plays a role in resistance.

Sepal thickness were studied under laboratory conditions and correlated with bud infestation. Thirty-six germplasm lines were selected, including Neelum susceptible and Neela resistant checks. Three pre-mature buds per line were taken from three different plants for the purpose of measuring sepal thickness. Selected buds were peeled out and cut the cross sections of sepals with the help of sharp knife were measured using a trinocular microscope in micrometers (µm) given in Table 2.

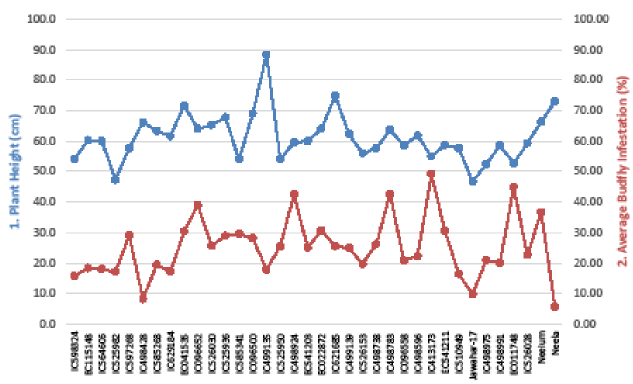

Figure 1: Plant height against average bud fly infestation of 36 germplasms

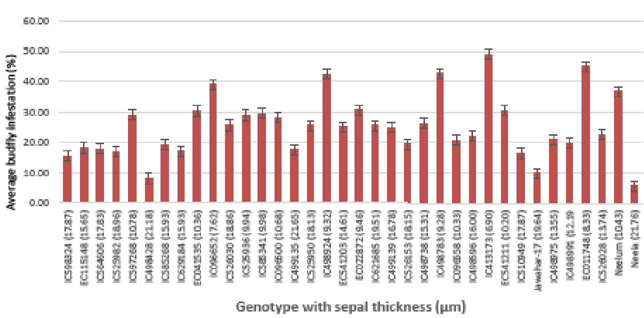

Figure 2: Average bud fly infestation on the basis of sepal thickness

Result and Discussions

The bud fly gradually increased in population from the bud initiation stage to dough stage of crop, but maximum bud fly population was seen from second fortnight of February to first week of March. Thirty-six linseed germplasm were screened against bud fly infestation under natural conditions. The bud fly infestation ranged between 8.19% (IC498428) and 49.12% (IC413173). The germplasm had different degrees of susceptibility to bud fly attack and was classified accordingly (Malik, 2005) Table 1. Out of 36 germplasms, only two germplasm were recorded for minimum average infestation of bud fly that came under resistant category (0.00–10.00%), while 14 germplasm came under moderately resistant category (10.01–25%) against bud fly infestation. Fifteen germplasm were grouped under the moderately susceptible category, having 25.01 to 40% infestation. Four linseed germplasm lines had 40.01 to 60.00% bud fly infestation and were categorized under the susceptible category. There was no germplasm found within the highly susceptible category (>60% infestation) during the investigation period depicted in Table 3.

In the experiment, recorded plant height ranged between 47.27 cm in IC525982 and 88.33 cm in IC499135 and the mean of plant height was recorded at 61.22 cm. The correlation between plant height and bud fly infestation was negative (-0.042) and non-significant (Figure 1). The result was contradictory to studies by Ekka (2017) and Gupta (2011), where the plant height showed a positive non-significant correlation with bud fly infestation (0.233 and 0.028, respectively).

Sepal thickness is a very important factor associated with histological resistance in linseed against linseed bud fly. The present investigation showed the bud fly intensity with the flower bud sepal thickness relationship. On the basis of experiments, germplasm with maximum sepal thickness was IC498428 and Jawahar-17 (21.18 and 19.64 µ, respectively), which showed strong resistance against bud fly infestation (8.19 and 9.755, respectively). Among 36 germplasms, IC413173 had minimum sepal thickness (6.90 µ), and the highest bud fly infestation (49.12%). The thickness of sepal in another germplasm ranged between 6.90 and 23.43 µ. The relationship of the sepal thickness with bud infestation indicates that resistant germplasm, Neela, IC498428 and Jawahar-17 had maximum sepal thickness 23.43, 21.18 and 19.64 µ, respectively and minimum bud infestation 5.61, 8.19 and 9.75%, respectively. Among 36 linseed germplasm only four germplasm IC413173, EC011748, IC498783 and IC498924 suffered maximum infestation i.e., 49.12, 45.00, 42.70, and 42.48%, respectively, which had sepal thickness 6.90, 8.33, 9.28 and 9.32 µ (Figure 2). Statistical correlation between sepal thickness and bud fly was found to be negatively correlated (-0.852**) phenotypic path coefficient of -0.3898 and r value of -0.797**. From the negatively significant value of correlation coefficient between sepal thickness and bud fly infestation, it is clear that when sepal thickness increases, the infestation of bud fly decreases. Similar findings were reported by Ekka (2017) and Gupta (2015). Pal and Malik (2020), who studied the impact of sepal thickness on bud fly infestation, reported negative non-significant correlation (r= -0.7224) between the characters. Our findings reflect significantly negatively correlation (-0.852**) between sepal thickness and bud fly infestation. Among the biophysical parameters, sepal thickness played an important role in bud fly infestation. Genotypes with less thickness of sepal are favorable for bud fly infestation and vice versa.

Conclusion

Among the 36 germplasm IC498428 (8.19% infestation) and Jawahar-17 (9.75% infestation) were found resistant to bud fly. The correlation studies showed that there was negative significant correlation between sepal thickness and bud fly infestation (-0.852**). Hence, genotypes with thick sepals exhibit more resistance against bud fly infestation. Furthermore, tall genotypes showed higher resistance as plant height was negatively correlated with bud fly infestation (-0.042).

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References

Biradar SA, K Ajith Kumar, B Rajanna, AS Savitha, GV Shubha, I Shankergoud, BM Chittapur, and PK Singh (2016) Prospects and challenges in linseed (*Linum usitatissimum* L.) production. A review. *J. Oilseeds Res.* **33(1)**: 1-13.

Biradar VK, AY Thakare and PP Deshpande (2017) Determination of economic threshold level of linseed bud fly (*Dasyneura lini* Barnes). *J Ecol Environ.* **35(2)**: 774-777.

Braidek, JG (1975) Agronomic considerations in flax production. In: Harapiak, J.T. (Ed.). Oil Seed and Pulse Crops in Western Canada: A Symposium. Western Co-operative Fertilizers, Calgary, Alberta, pp. 279–285.

Dash1 J, BS Naik and UB Mohapatra (2017) Research article; Linseed: a valuable crop plant. *Int. J. Adv. Res.* (IJAR). **5(3)**: 1428-1442.

Deole S, AK Gupta and D Dash (2015) Neem-based formulations used against bud fly, *Dasyneura lini* Barnes in Linseed (*Linum usitatissimum*) crop. *Int. J. Sci. Res. Publ.* **5(2)**: 1-4.

Ekka RK, S Mandal, RS Meena and S Padamshali (2018) Some physical basis of host plant resistance in linseed (*Linum usitatissimum* L.), against bud fly, *Dasyneura lini* (Barnes). *J. Pharmacogn. Phytochem.* pp: 2010-2015.

Ekka RK (2017) Studies on seasonal incidence and screening of various germplasm of linseed against linseed bud fly Dasyneura lini Branes. M.Sc. (Ag.) thesis, Banaras Hindu University, Varanasi, 43p.

FAO. 2021. World Food and Agriculture - Statistical Yearbook 2021. Rome.https://doi.org/10.4060/cb4477en.

Farrukh A, AB Lanjar, BH Chang, FH Magsi, K Asghar, A Rajput, AD Keerio and LB Qureshi (2017) Insect biodiversity in different varieties of linseed. *Eur. J. Acad. Res.* **4**: 8306-8335.

Gupta Avinash Kumar (2011) Basis of Resistance in Linseed (Linum usitatissimum Linn) Against Linseed Bud Fly (Dasyneura lini Barnes). Thesis submitted to Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India. pp 69-89.

Gupta MP (2004) Field screening of linseed (*Linum usitatissimum*) Linn. Genotype of bud fly (*Dasyneura lini* Barnes). *J. Oilseeds Res.* **21(1)**: 108-111.

Jhala AJ and MH Linda (2010) Flax (*Linum usitatissimum* L.): Current uses and future applications. Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, T6G 2P5, AB, Canada. *Aust. J. Basic Appl. Sci.* **4(9)**: 4304-4312.

Kaur V, S Kumar, R Yadav, DP Wankhede, J Arvind, J Radhamani, JC Rana and A Kumar (2018) Analysis of genetic diversity in Indian and exotic linseed germplasm and identification of trait specific superior accessions. *J. Environ. Biol.* **39**: 702-709.

Kaur V, SK Yadav, Sheela, D Singh, V Kumar, J Arvind and A Kumar (2022) Screening of linseed germplasm collection conserved in Indian National Gene Bank for drought tolerance and identification of trait specific promising accessions. *Int. Conf. on AAFS Aug. 22 - 24th, 2022.* pp: 146.

Kaur V, R Yadav and DP Wankhede (2017) Linseed genetic resources for climate change intervention and future breeding. *J. Appl. Nat. Sci.* **9**: 1112-1118.

Karuppaiah, V and GK Sujayanad (2012) Impact of climate change on population dynamics of insect pests. World. *J. Agric. Sci.* **8(3)**: 240-246.

Kumar P, P Kumar and HB Sharma (2021) Management of linseed bud fly (*Dasineura lini* Barnes) effect and proper use of insecticides. *Int. J. Res. Eng. Appl. Manag.* (IJREAM). **7(4)**:

2454-9150.

Kumar V, D Singh, B Jat and V Kaur (2022) Linseed: Essential Field Practices and Cultivation Techniques. *Agricolation Article* ID: AG25. **2(4)**: 1-5.

Kunal G, TN Anil, RB Goswami, P Nirala and SS Acharya (2019) Insect herbivores and their natural enemies in linseed and their population dynamics. *Indian J. Entomol*. **81(3)**: 458-462.

Malik YP (2005) Estimation of economic threshold level for bud fly (*Dasyneura lini* Barnes) in linseed (*Linum usitatissimum* L.). *J. Oilseeds Res*. **22(1)**: 100-102.

Minz PK, R Prasad and D Prasad (2009) Varietal screening of linseed against bud fly (*Dasyneura lini)* and capsule borer (*Helicoverpa armigera)* and their impact of seed yield Uttar Pradesh. *J. Zool*. pp: 291-294.

Patel RK and BS Thakur (2000) Insect pest complex and seasonal incidence in linseed with particular reference to bud fly (*Dasyneura lini* Barnes). *J. Plant Prot. Environ*. **2(2)**: 102-107.

Prasad R and D Prasad (2012) Seed yield loss in linseed due to bud fly (*Dasyneura lini* Barnes) under Ranchi conditions. *J. Eco-friendly Agric*. **7(1)**: 43-44.

Pal RK and R Singh (2010) Screening of linseed germplasm against bud fly *Dasyneura lini* Barnes. *Int. J. Plant Prot*. **3(2)**: 410-411.

Pradhan V, GP Painkra, KL Painkra and PK Bhagat (2018) Seasonal incidence of major insect pests in linseed. *J. Plant Dev. Sci*. **10(10)**: 579-581.

Pal R and YP Malik (2018) Screening of linseed germplasm against bud fly (*Dasyneura lini* Barnes) under field conditions. *Int. J. Pure Appl. Biosci*. **6(3)**: 196-201.

Pal R and YP Malik (2020) Histological basis of resistance in linseed against bud fly (*Dasyneura lini* Barnes) in Central Uttar Pradesh. *Int. Jour. Agric. Inv*. **5(1)**: 25-30.

Reddy MP, BR Reddy and JJ Maheshwari (2013) Screening of linseed genotypes for resistance against bud fly, *Alternaria* and Powdery mildew, genetic parameters for yield components in linseed (*Linum usitatissimum* L.). *Int. J. Curr. Microbiol. Appl. Sci*. ***2*(9)**: 267-276.

Rabindra P, A Kandulna and D Prasad (2005) Efficacy and economics of insect pest management in linseed grown under farmers and improved agronomical practices. *J. Plant Prot. Environ*. **2(2)**: 49-54.

Rabindra Prasad and Devendra Prasad (2012) Association between intensity of bud fly (*Dasyneura lini* Barnes) incidence and linseed seed yield. *Eco-friendly Agric. J.* **7(1)**: 49-50.

Sankari HS (2000) Linseed (*Linum usitatissimum* L.) cultivars and breeding lines as stem biomass producers. *J. Agron. Crop Sci*. **184(4)**: 225-231.

Singh PK and Ramanand (2000) Screening of linseed germplasm against bud fly infestation. *J. Crop Improv*. **27(2)**: 240-242.

Singh P, Sumit and DK Yadav (2015) Inheritance of resistance to bud fly infestation in linseed (*Linum usitatissimum* L.). *Indian J. Genet*. **75(3)**: 386-388.

Tripathi R, S Ali and R Kumar (2002) Screening of linseed germplasm against bud fly, (*Dasyneura lini* Barnes). *Dept. Ento.* **9(1)**: 85-86.

Tripathi R, S Ali and R Kumar (2003) Determination of economic threshold level of bud fly (*Dasyneura lini* Barnes) of linseed. *Shashpa* **10(2)**: 139 –141.