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### Screening of pea germplasm and biophysical basis of resistance to pea leaf miner, *Chromatomyia horticola* (Goureau) under mid-hill conditions of Himachal Pradesh

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**Abstract:** *Chromatomyia horticola* Goureau (pea leaf-miner) is a major and regular pest of pea, which is amenable to control by chemical insecticides. However, there are limitations and hazards associated with insecticidal application. Host plant resistance (HPR) has been viewed as an important component of IPM. Ninety-two pea germplasm were screened against pea leaf miner under field conditions out of which twenty were screened under screen house conditions. The biophysical basis of resistance was also studied. The results revealed that six pea genotypes (DPP 25G, DPPLMR 41, JI 1766 (2), JP 179, LMR 100, S143) exhibited high resistance (Infestation index <0.80); nineteen as resistant and seventeen as moderately resistant to the pest. Various biophysical plant characters like plant height, leaflet area, seed shape and seed colour showed non-significant correlation with leaflet infestation and population of immature stages.

**Key words:** *Chromatomyia horticola*, Host plant resistance, pea leaf miner, screening

#### INTRODUCTION

Field pea (*Pisum sativum* L.) is an important vegetable crop grown in all states of India during *Rabi* season. One of the major constraints affecting the production and aesthetic value of the crop is pea leaf miner. Pea leaf-miner, *Chromatomyia horticola*

Goureau is a major and regular pest of pea [4], having more than 127 known host plants in India [9]. In Himachal Pradesh more than 20 per cent avoidable losses in pea grain yield have been reported beyond 40 per cent infestation [6]. In another study, observation of 40 per cent infestation as economic

threshold level for leaf-miner in pea grown for vegetable purpose was found [8]. This pest is amenable to control by chemical insecticides [2, 3, 7]. However, there are obvious limitations and hazards associated with insecticidal application in vegetables like objectionable pesticide residues, development of resistance to insecticides, and hazards to natural enemies which restrict their use in pest control programme. Host plant resistance (HPR) has been viewed as an important component of Integrated Pest Management (IPM). The studies on HPR in pea for the management of pea leaf miner are very limited. Insect pests are often affected by biophysical characters of the host plants. Hence comprehensive studies were conducted for the screening of pea germplasm for resistance to pea leaf miner in pea.

## MATERIALS AND METHODS

Studies were conducted to evaluate pea germplasm for resistance to *C. horticola* under field and screen-house conditions in the mid hills of Himachal Pradesh. Besides these the biophysical basis of resistance in pea germplasm against *C. horticola* were also determined. The details of experiments are as under:

**a) Field screening:** The trials on screening of pea genotypes for resistance to pea leaf miner were laid out in randomized block design with three replications under field conditions. A total of ninety two pea genotypes was procured from different sources (CSK Himachal Pradesh Krishi Vishvavidyayaya, Palampur; IARI, New Delhi; NBPGR, New Delhi) for the present studies. The recommended package of practices for raising the crop was followed, except for insect-pest management. Observations on total number of leaflets per plant and those infested by pea leaf miner per plant and population of maggots and pupae per plant were recorded twice during March,

coinciding with the peak period of activity of the pest. Data was expressed as mean per cent leaflet infestation and mean population of maggots and pupae per plant and subjected to statistical analysis. The data was further used to work-out the infestation index as per formula [5] :

$$\text{Infestation index} = \log \frac{[1 + \text{Mean no. of larvae and pupae / plant} \times \% \text{ leaflet infestation}]}{100}$$

Based on the infestation index, pea genotypes were grouped in five categories as given hereunder.

Category	Infestation index
Highly Resistant	<0.80
Resistant	0.80-1.00
Moderately Resistant	1.01-1.20
Susceptible	1.21- 1.40
Highly Susceptible	>1.40

- b) Screen-house screening:** Based on results of previous two years studies, selective pea genotypes (n=20) belonging to different categories (representing highly resistant, resistant, moderately resistant, susceptible and highly susceptible group of pea genotypes) were screened against pea leaf miner under screen-house conditions. Pea plants were raised in the pots and were exposed to very high population of leaf miner adults, replicating five times. The leaflet infestation, population of immature stages and leaflet punctures per plant were the criterion followed for screening the germplasm.
- i) Biophysical characteristics:** Morphological plant characters *viz.*, plant height (cm) and leaflet area (cm<sup>2</sup>) as well as seed characteristics of different pea genotypes were recorded. The

observations on plant height were recorded on three randomly selected plants per genotype and mean height per plant was worked out. To study the leaflet area, three leaves, each from upper, middle and lower plant canopy were sampled from each genotype and brought to the laboratory. Total number of leaflets per leaf was counted and leaf area was determined with the help of leaf area meter (ÄT Leaf area meter MK2). Correlation was worked out between these morphological characters and leaflet infestation, population and infestation index. Seed characteristics like seed shape and seed colour after harvest of different pea genotypes were also recorded.

## RESULTS AND DISCUSSION

### a) Field Screening of Pea Genotypes for Pea Leaf miner Resistance

The perusal of data presented in Table 1 revealed no variety to be free from attack of pea leaf miner. The minimum leaflet infestation was recorded in S 143 and LMR 100 (15.44 and 16.73 %, respectively) while mean maggot population was minimum in S 143 and JI 1766 (2) (7.8 and 8.6 maggot and pupa population per plant). Earlier studies on screening of fifty-seven pea germplasms against pea leaf miner carried out in the foot hills of Himachal Pradesh also revealed no line to be recording zero maggots/pupa per plant, and two lines recorded 1-20 maggots/pupa per plant were categorized as resistant [1].

**Table 1**  
**Relative leaflet infestation, population of pea leaf miner and infestation index (leaflet basis) in pea genotypes against *C. horticola***

<i>Genotype</i>	<i>Mean</i>		
	<i>Leaflet infestation (%)*</i>	<i>Population/plant**</i>	<i>Infestation index (leaflet basis)</i>
Accacia	49.01(44.42)	117.3(10.87)	1.77
Arkel	42.19(39.88)	65.5(7.42)	1.25
Azad Pea	34.73(35.99)	52.0(6.99)	1.21
Bonneville	33.08(34.65)	82.3(8.06)	1.21
BP 87	59.20(50.36)	116.7(10.85)	1.85
C 400	45.07(42.14)	133.0(11.57)	1.78
DP 362	57.37(49.22)	92.3(9.65)	1.73
DPP 102	29.47(32.51)	41.3(6.35)	1.12
DPP 102 DY	55.22(47.98)	205.0(14.35)	2.06
DPP 102(T)	45.27(42.09)	37.7(6.16)	1.22
DPP 106	35.93(36.75)	32.8(5.73)	1.11
DPP 107	37.09(36.78)	33.9(5.49)	1.12
DPP 107T Dy	34.80(35.81)	35.3(5.83)	1.07
DPP 107T (WY)	35.75(36.32)	33.3(5.60)	1.11
DPP 110	47.25(43.07)	116.8(10.16)	1.63
DPP 113Dy	38.15(37.95)	51.5(7.02)	1.28

*contd. table 1*

<i>Genotype</i>	<i>Mean</i>		
	<i>Leaflet infestation (%)*</i>	<i>Population/plant**</i>	<i>Infestation index (leaflet basis)</i>
DPP 113T Ry	37.65(37.83)	45.3(6.80)	1.26
DPP 120	35.11(38.26)	63.5(7.61)	1.35
DPP 127	45.34(42.18)	59.9(7.67)	1.44
DPP 127 ( R)	36.44(36.77)	40.3(6.30)	1.19
DPP 127W	35.74(36.30)	32.5(5.62)	1.05
DPP 13T	43.84(41.15)	53.2(6.94)	1.30
DPP 137	34.47(35.11)	24.2(4.96)	0.97
DPP 19	51.90(46.07)	38.3(6.24)	1.32
DPP 25G	24.08(28.64)	13.0(3.64)	0.59
DPP 26G	35.48(36.00)	34.8(5.63)	1.07
DPP 4	44.10(41.74)	68.0(7.93)	1.49
DPP 62	36.86(37.11)	36.7(5.94)	1.13
DPP 80	30.37(33.14)	26.4(5.10)	0.92
DPP LMR 41	24.29(29.04)	16.9(4.14)	0.69
EC 381853	32.90(34.46)	24.3(4.92)	0.93
EC 381854	32.46(34.33)	24.2(4.90)	0.92
EC 381855	29.54(32.28)	24.2(4.87)	0.88
EC 381856	42.36(40.27)	42.7(6.41)	1.27
EC 381857	36.55(36.83)	49.7(7.09)	1.27
EC 381858	46.63(43.01)	80.0(8.82)	1.57
EC 381860	29.18(32.05)	20.0(4.47)	0.80
EC 381861	29.09(32.17)	21.1(4.49)	0.81
EC 381862	34.44(35.66)	23.0(4.71)	0.93
EC 381864	41.65(40.12)	45.9(6.67)	1.29
EC 381865	32.13(33.95)	22.1(4.68)	0.88
FC 2	29.76(32.99)	42.3(6.58)	1.13
Im 25	39.62(38.77)	60.7(7.46)	1.38
JI 1210	43.53(40.84)	36.5(6.06)	1.22
JI 1412	42.04(40.20)	64.7(7.85)	1.43
JI 1542	54.92(47.83)	65.6(7.97)	1.54
JI 1559	44.64(41.90)	48.3(7.02)	1.35
JI 1569	36.71(37.22)	38.4(6.00)	1.18
JI 1766 (1)	40.84(39.33)	119.4(9.56)	1.42
JI 1766 (2)	29.88(33.01)	8.6(2.92)	0.53
JI 2431	49.47(44.67)	121.0(11.02)	1.78
JI 2433	38.41(38.04)	24.3(4.91)	1.00
JI 2436	28.39(31.96)	29.5(5.22)	0.94
JI 2437	38.95(38.44)	49.4(6.95)	1.29
JI 2439	41.45(40.05)	33.7(5.88)	1.17

contd. table 1

Genotype	Mean		
	Leaflet infestation (%)*	Population/plant**	Infestation index (leaflet basis)
JP 141	29.71(33.01)	33.3(5.79)	1.04
JP 15	33.30(35.19)	62.7(7.95)	1.34
JP 179	21.56(26.49)	13.7(3.70)	0.56
JP 825	52.75(46.57)	58.0(7.67)	1.50
JP 885	44.48(41.81)	100.0(10.05)	1.66
Kinnauri	29.63(32.52)	28.9(5.23)	0.93
KS 156	47.27(43.41)	75.3(8.72)	1.56
KS 215	51.36(45.77)	91.0(9.58)	1.68
KS 221	33.91(34.92)	54.5(7.16)	1.29
KS 268	31.15(33.77)	32.7(5.79)	1.05
Lincoln	37.61(37.59)	45.8(6.41)	1.19
LMR 100	16.73(23.44)	13.9(3.74)	0.51
LMR 20	22.65(28.33)	23.3(4.93)	0.80
LMR 4	32.02(34.22)	24.5(4.93)	0.92
Mater Ageta	42.42(40.47)	22.8(4.80)	1.01
Mithi Phali	33.64(35.35)	27.5(5.22)	0.99
NDVP 10	46.91(43.17)	113.8(10.02)	1.63
NDVP 12	45.53(42.39)	73.4(7.74)	1.42
NDVP 250	51.67(45.94)	28.0(5.36)	1.19
NDVP 8	45.39(42.24)	40.3(6.31)	1.28
NDVP 9	51.20(45.67)	75.3(8.74)	1.60
Palam Priya	35.44(35.79)	27.0(5.11)	0.97
Pb 87	53.54(46.98)	48.0(6.90)	1.42
PHPMR 1	46.26(42.83)	65.3(8.14)	1.49
PMR 4	36.11(36.43)	139.8(10.56)	1.54
S 143	15.44(22.74)	7.8(2.93)	0.32
Sel 82	35.97(36.54)	26.7(5.12)	1.01
Sugar Giant	34.60(35.53)	25.7(5.03)	0.97
T-10	40.12(38.87)	43.0(6.48)	1.25
UU 11	50.83(45.54)	46.3(6.83)	1.39
UU 12	38.04(37.82)	24.1(4.87)	0.98
VP 5	43.98(41.52)	61.0(7.86)	1.44
VP 8005	38.30(38.21)	70.3(8.45)	1.45
VP 87	38.18(38.00)	31.2(5.58)	1.11
VP 8902	39.99(38.92)	44.2(6.63)	1.27
VP 9003	31.03(33.34)	47.3(6.72)	1.20
VRP 7	40.97(39.78)	98.7(9.97)	1.62
VRP 8	41.64(40.16)	75.0(8.70)	1.51

\* Figures in parentheses are the angular transformed values

\*\* Figures in parentheses are the square root transformed values

**Rating of pea genotypes:** Based on the infestation index, DPP 25G, DPPLMR 41, JI 1766 (2), JP 179, LMR 100, S143 were rated as highly resistant to pea leaf miner (Infestation index <0.80) (Table 2). Nineteen genotypes were rated as resistant, seventeen as moderately resistant, twenty-three as susceptible and twenty-seven as highly susceptible.

**Table 2**  
**Categorization of pea genotypes for resistance to pea leaf miner**

Category	Infestation index	Genotype(s)
Highly Resistant	<0.80	DPP 25G, DPPLMR 41, JI 1766 (2), JP 179, LMR 100, S143
Resistant	0.80-1.00	DPP 80, DPP 137, EC 381853, EC 381854, EC 381855, EC 381860, EC 381861, EC 381862, EC 381865, EC 381860, JI 2433, JI 2436, Kinnauri, LMR 4, LMR 20, Mithi Phalli, Palam Priya, Sugar Giant, UU 12,
Moderately Resistant	1.01-1.20	DPP 26G, DPP 127W, DPP 107 TDy, DPP 127(R), DPP 127W, DPP 62, FC 2, JI 1569, JI 2439, JP 141, KS 268, Lincoln, Matar Ageta, NDVP 250, Sel 82, VP 87, VP 9003
Susceptible	1.21- 1.40	Arkel, Azad Pea, Bonneville, DPP 13T, DPP 120, DPP 102(T), DPP 113Dy, DPP 113TRy, DPP 120, DPP 19, EC 381856, EC 381857, EC 381864, Im 25, JI 1210, JI 1559, JI 2437, JP 15, KS 221, NDVP 8, T 10, UU 11, VP 8902
Highly Susceptible	>1.40	Accacia, BP 87, C 400, DP 362, DPP 102Dy, DPP 110, DPP 127, DPP 4, EC 381858, JI 1412, JI 1542, JI 2431, JI 1766(1), JP 825, JP 885, KS 156, KS 215, NDVP 9, NDVP 10, NDVP 12, Pb 87, PHPMR1, PMR 4, VP 5, VP 8005, VRP 7, VRP 8

### b) Screenhouse screening

Observations on the leaflet infestation in the selected pea genotypes under screenhouse conditions revealed that the highest infestation was in DPP 120 (47.61%) being at par to Lincoln, Arkel, Azad Pea and Bonneville (Table 3). Lowest infestation was found in JI 1766(2) being at par to DPPLMR 41, LMR 100 and Sel 82. Population of leaf miner was maximum (24.8/plant) in Lincoln which was at par to LMR 4, Sugar Giant, Matar Ageta and DPP 120. However, leaflet punctures per plant were maximum in DPP 120 (74.75/plant) being at par to LMR 4, DPP 25G, Arkel, Mithi Phali, Sugar Giant, Kinnauri, JI 2436 and EC 381855. The infestation index varied from 0.35 to 1.08 being minimum in JI 1766(2) and maximum in Lincoln.

### c) Biophysical basis of Resistance

Observations recorded on morphological plant characters revealed a considerable variation in pea genotypes. The plants were observed to be dwarf to tall type with mean height varying between 32.0 and 155.3 cm (Table 4) in different pea genotypes. The leaflets of pea genotypes were of small to large in size ranging from 0.81 to 7.55 cm<sup>2</sup> in area. The correlation studies revealed a non-significant negative correlation between leaflet infestation with leaflet area and plant height. However, mean maggots and pupae per plant and infestation index showed a non-significant positive correlation with these morphological characters. Similarly seed characters were not found to affect leaflet infestation by the miner.

**Table 3**  
Screening of different pea genotypes against *C. horticola* under laboratory (screenhouse) conditions

<i>Genotypes</i>	<i>Leaflet infestation (%)</i>	<i>Population (maggots and pupae) per plant</i>	<i>Leaflet punctures/plant</i>	<i>Infestation index</i>
Arkel	44.19	17.5	64.50	0.94
Azad Pea	47.35	13.0	20.75	0.85
Bonneville	42.79	13.0	22.00	0.82
DPP 120	47.61	19.3	74.75	1.01
DPP 25G	21.71	16.5	51.00	0.66
DPP 80	21.23	14.3	31.75	0.60
DPPLMR 41	17.65	15.3	32.75	0.57
EC 381855	23.27	13.3	44.75	0.61
EC 381862	22.98	17.0	39.50	0.69
JI 1766(2)	12.08	10.3	6.00	0.35
JI 2436	27.65	16.5	64.50	0.75
Kinnauri	21.84	16.0	44.50	0.65
Lincoln	44.43	24.8	36.75	1.08
LMR 100	14.70	15.5	34.75	0.52
LMR 4	33.33	23.0	71.25	0.94
Matar Ageta	28.07	20.0	15.25	0.82
Mithi Phalli	21.62	11.5	52.75	0.54
Palam Priya	20.89	15.5	32.25	0.63
Sel 82	15.21	12.0	13.25	0.45
Sugar Giant	23.75	19.5	44.00	0.75
CD (P=0.05)	6.55	6.12	34.36	

**Table 4**  
Morphological characters of different pea genotypes in relation to *C. horticola* infestation

<i>Pea genotype</i>	<i>Plant height (cm)</i>	<i>Leaflet area (cm<sup>2</sup>)</i>	<i>Seed shape</i>	<i>Seed colour</i>
Azad Pea	67.0	3.86	Wrinkled	Greenish cream
Bonneville	123.3	3.17	Round	Green
DPP 102	140.3	2.46	Wrinkled	Greenish cream
DPP 102 (T)	119.0	1.89	Wrinkled	Cream
DPP 110	141.7	2.63	Wrinkled	Creamish green
DPP 113 DY	141.3	6.25	Round	Cream
DPP 120	120.0	2.26	Round	Creamish green
DPP 127	118.7	3.06	Round	Cream
DPP 13T	133.3	3.27	Round	Cream

contd. table 4

<i>Pea genotype</i>	<i>Plant height (cm)</i>	<i>Leaflet area (cm<sup>2</sup>)</i>	<i>Seed shape</i>	<i>Seed colour</i>
DPP 19	61.3	1.28	Wrinkled	Cream
DPP 25G	32.0	0.82	Wrinkled	Cream
DPP 26G	131.7	3.67	Wrinkled	Greenish cream
DPP 4	70.7	2.65	Wrinkled	Green
DPP 62	65.7	1.38	Wrinkled	Creamish green
DPP 80	60.3	1.83	Wrinkled	Creamish green
DPP LMR 41	64.0	2.43	Wrinkled	Creamish green
EC 381853	74.7	1.91	Wrinkled	Cream
EC 381854	133.7	1.40	Round	Greenish cream
EC 381855	121.7	1.80	Round	Creamish green
EC 381856	54.3	1.84	Round	Greenish cream
EC 381857	72.3	1.93	Dimpled	Creamish green
EC 381858	76.7	2.97	Wrinkled	Green
EC 381860 yellow	63.0	3.72	Round	Greenish/Whitish
EC 381861	47.7	1.24	Dimpled	Light green
EC 381862	48.7	2.19	Wrinkled/Dimpled	Creamish green
EC 381864	48.0	1.81	Dimpled	Greenish cream
EC 381865	94.3	2.87	Dimpled/Round	Creamish green
IM 25	60.7	2.16	Wrinkled	Creamish green
JI 1210	92.3	4.77	Wrinkled	Greenish cream
JI 1412	110.3	2.28	Wrinkled	Light green
JI 1542	68.0	1.46	Wrinkled	Greenish cream
JI 1766 (1)	87.7	1.96	Wrinkled	Creamish green
JI 1766 (2)	57.7	1.30	Wrinkled	Cream
JI 2433	80.7	2.30	Wrinkled	Creamish green
JI 2436	78.7	1.93	Wrinkled	Mustard brown
JI 2437	59.3	2.80	Wrinkled	Greenish cream
JP 15	78.3	0.83	Round	Cream
Kinnauri	148.7	3.25	Round	Dull cream
KS 221	70.3	3.27	Wrinkled	Cream
Lincoln	66.7	1.59	Wrinkled	Cream
LMR 100	92.7	2.15	Round	Mustard green
LMR 4	101.7	1.88	Dimpled	Parrot green
Mithi Phali	90.3	1.99	Round	Green
NDVP 10	70.0	1.94	Wrinkled	Green
NDVP 12	70.0	2.00	Wrinkled	Light green

contd. table 4



Pea genotype	Plant height (cm)	Leaflet area (cm <sup>2</sup> )	Seed shape	Seed colour
NDVP 250	62.3	7.55	Wrinkled	Cream
Palam Priya	59.3	1.43	Wrinkled	Whitish green
Pb 87	50.3	0.81	Wrinkled	Creamish green
PHPMR 1	74.3	1.43	Round	Cream
PMR4	85.0	5.63	Wrinkled	Cream
Sel 82	53.7	2.09	Wrinkled	Dark brown
Sugar Giant	155.3	4.54	Wrinkled	Creamish
T 10	105.7	1.59	Wrinkled Depressed	Creamish green
UU 11	69.7	2.86	Round	Creamish green
UU 12	82.3	1.89	Wrinkled	Greenish cream
VP 8902	135.7	2.87	Wrinkled	Cream

  

Correlation coefficient	Plant height (cm)	Leaflet area (cm <sup>2</sup> )
Leaflet infestation	-0.0748	-0.0902
Population	0.1515	0.1235
Infestation index	0.0795	0.1162



Plate 1: Damage by Pea Leaf-Miner in pea

## RERERENCES

- Bhatia, R. Gupta, D and Pathania, N.K. (1995). Screening of pea germplasm against the leaf miner, *Chromatomyia atricornis* Meigen in the foot hills of Himachal Pradesh (India). *Journal of Entomological Research* 19(1): 57-59.
- Dash, A. N. (1990). Evaluation of some insecticides for their efficacy against pea leaf-miner, *Phytomyza atricornis* Meign. *Indian J. Pl. Prot.* 18(2): 295-297.
- Khajuria, D. R. and Sharma, J. P. (1995). Efficacy of insecticides in controlling pea leaf-miner (*Chromatomyia horticola*) on seed crop of pea (*Pisum sativum*). *Indian J. agric. Sci.* 65(5): 381-384.
- Manzoor, U., Haseeb, M. and Sharma, D.K. (2014). Surveillance of insect pest complex of pea, *Pisum sativum* L. in agro-climatic conditions of Aligarh, Uttar Pradesh. *Trends in Biosciences* 7(11): 1131.
- Mehta, P. K., Sharma, T. N. and Chandel, R. S. (1998). Resistance in pea genotypes to leaf-miner, *Chromatomyia horticola* (Goureau). *Indian J. agric. Sci.* 68(5): 271-273.
- Mehta, P. K., Sood, P. and Chandel, Y. S. (1994). Extent of losses caused by pea leaf-miner, *Chromatomyia horticola* in mid-hills of Himachal Pradesh. *Indian J. Pl. Prot.* 22(1): 1-4.
- Mehta, P. K., Vaidya, D. N. and Kashyap, N. P. (1995). Efficacy and economics of some insecticides against leaf-miner, *Chromatomyia horticola* Goureau on pea. *J. Insect Sci.* 8(1): 81-82.
- Sharma, J. K. and Kashyap, N. P. (1998). Yield loss assessment caused by leaf-miner, *Chromatomyia horticola* on vegetable pea (*Pisum sativum*). *Him J. agric. Res.* 24 (1&2): 79-84.
- Singh, P. and Mavi, G. S. (1982). A critical review on the distribution and host plant index of the leaf-miner, *Phytomyza horticola* Goureau. *Bull. Pure appl. Sci.* 1: 83-85.