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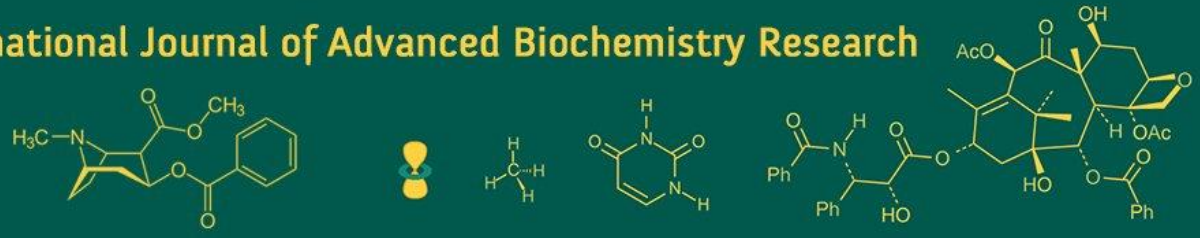

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Biochemical basis of resistance in soybean germplasm against tobacco caterpillar, *Spodoptera litura* (Fabricius)

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Abstract
Chlorophyll content in the studied germplasms ranged from 21.20 to 54.52. Highest chlorophyll content was recorded in NRC 271 (54.52) and Least chlorophyll content was seen in MACS 1756 (21.20). The correlational studies between Chlorophyll (SPAD) and per cent leaf damage revealed that there is significant and positive correlation (r=0.711**).
Phenol is one of the important factors that offer resistance to germplasms against different insects. Phenol content in the studied germplasms ranged from DS 1547 (0.08mg/g) to VLS 89 (0.35 mg/g). The correlational studies between phenol and per cent leaf damage revealed that there was significant and highly negative correlation (r = -0.846**)

Keywords: Phenol, Chlorophyll, biochemical, germplasm

Introduction
One of the major oilseed cash crops in India is the soybean [*Glycine max* (L.) Merrill.], which is a member of the Leguminosae family, subfamily Papilionaceae. It is referred to as the "Miracle bean, Golden bean, and Crop of the planet" since it is a special crop with high nutritional content. It offers 18-19% carbs, 6-7% total minerals, 5-6% crude fiber, 40% protein, 20% oil, and a high content of polyunsaturated fats, particularly Omega 6 and Omega 5 fatty acids. From a nutritional perspective, soybeans are a good source of lecithin and phosphorus, and they contain 20.00% edible oil and 43.2% protein. It also has good levels of vitamin E, potassium, and sulfur. The primary amino acids that the human body needs, such as leucine, methionine, and threonine, are found in soybean protein. It is referred to as "Poor Man's Meat" by vegetarians.
More than 112 plant species from 44 families have been documented to be harmed by *Spodoptera litura* (Fabricius), a polyphagous pest that is found in India and many other nations. Of these, 40 species are known to exist in India. Numerous research workers have identified a variety of crops as its host plants, including maize, lentil, green gram, moth bean, castor, sesame, groundnut, tomato, cauliflower, cabbage, colocasia, agathi, indigo, slender pigweed, brinjal, chilli, banana, lucern, carpet weed, elephant yam, tobacco, grasses, etc.
A nocturnal moth belonging to the Noctuidae family, *Spodoptera litura* is often referred to as the cotton leafworm or tobacco cutworm. A significant polyphagous annoyance throughout Asia, Oceania, and the Indian subcontinent is *S. litura*. *S. litura* is a polyphagous pest that is economically significant in India and, after *Helicoverpa armigera* (Hubner), is regarded as one of the main threats to modern intensive agriculture and shifting cropping patterns globally. South East Asia, China, Korea, Japan, the Philippines, Indonesia, Australia, the Pacific Islands, Hawaii, Fiji, Bangladesh, Sri Lanka, India, and Pakistan are all home to the pest.

Materials and Methods
Collection of experimental data: Observation on different bio-chemical parameters of soybean germplasms were recorded on upper, middle and lower leaves on randomly selected plants from each plot at 45 days after sowing (DAS).

Bio chemical parameter

Five 3rd instar, pre-weighed larvae were released in petri plates and provided pre-weighed leaves of soybean genotypes. After every 24 hrs, we removed the left-over leaves from the petri - plates, oven dry them at 50°C for 15 minutes and weigh. Larval weight and larval mortality was recorded on the daily basis. This process was continued up to pupation. Pupae was placed (genotypes and replication wise separately) in ovi - positional jars, and record the adult eclosion percent the following observation was recorded as per prescribed by Azmi, A. and Sharma, N.A. (2019**).**

Estimated Factors	Using Method
Phenol Content	Folin-Ciocalteau Reagent (FCR)

Phenol estimation

Estimation of total phenols present in plant samples was determined by following Folin - Ciocalteau Reagent (FCR) method given by Ainsworth and Gillespie (2007) [1]. One hundred microliters of standard and sample extract solution were each reacted with 750 µl of Folin-Ciocalteou's reagent for 5 min. After addition of 750 µl of 7.5% Na2CO3, the mixture was allowed to stand in the dark for 30 min, transferred to test tubes and end phase was known by development of blue coloured compound.

The blue coloured samples were subjected to absorbance measurement at 765 nm using a spectrophotometer. Gallic acid was used for construction of a standard curve with a concentration range of 100-500 microgram/ml. using this standard curve, total phenolic content was calculated and expressed as mg/gram of soybean leaf sample.

Statistical analysis

The correlation was worked out between per cent damage and biochemical parameters. The correlation coefficient between dependent (per cent damage) and independent (biochemical parameters) were determined by using the following formula.

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

Where,

r = correlation coefficient

x= Mean of first factor (independent)

y= Mean of second factor (dependent) n= Total no. of observations

After correlating significant and non- significant findings, t-test value n-2 degrees of freedom were calculated with the following formula

$$t = \frac{rxy\sqrt{n-2}}{\sqrt{1-rxy}}$$

t value n-2 d.f.

Where,

r = correlation coefficient

n= Total no. of observations

The calculated t-value obtained was compared with correlation coefficient table at 1 % level of significance.

Results and Discussion

Biochemical factors in different soybean germplasm

Biochemical parameters in plants are very important in offering resistance and susceptibility to plant. Different biochemical parameters that offer resistance to soybean from tobacco caterpillar damage are presented in Table.

Chlorophyll content (SPAD)

Chlorophyll content in the studied germplasms ranged from 21.20 to 54.52. Highest chlorophyll content was recorded in NRC 271 (54.52), followed by VLS 89 (52.46) and NRC 142 (51.95). Least chlorophyll content was seen in MACS 1756 (21.20), DS 1589 (22.45) and AMS 22-16 (23.80).

Phenol content

Phenol is one of the important factors that offer resistance to germplasm against different insects. Phenol content in the studied germplasm ranged from 0.08 to 0.35 mg/g. Among the germplasms studied DS 1547 was the germplasm with least phenol content (0.08mg/g) followed by NRC 267 (0.10 mg/g), NRC 142 (0.14 mg/g). VLS 89 (0.35 mg/g) was the check variety and contained highest amount of phenol content followed by AS 90 (0.34 mg/g) and MACS 1810 (0.32 mg/g).

Table 1: Bio-chemical parameters of resistance in soybean germplasm.

S. N.	Germplasm	Chlorophyll (SPAD)	Phenol content (mg/g)
1	NRC 290	46.95	0.23
2	NRC 295	42.25	0.31
3	JS 25-25	43.415	0.25
4	RVS 23-23	44.45	0.23
5	DS 1480	42.45	0.24
6	DSb 33-09	45.8	0.22
7	ASb 185	37.46	0.29
8	KDS 1198	39.3	0.3
9	NRC 267	49.65	0.1
10	SL 1431	32.25	0.32
11	KBSL 24-1	43.815	0.24
12	NRC 264	45.165	0.21
13	VLS 108	52.805	0.14
14	NRC128(RC)	35.415	0.3
15	JS 95-60(SC)	51.745	0.16
16	RSC 12-11	43.25	0.25
17	RVS 23-22	40.95	0.26
18	MAUS 793	42.5	0.24

19	DS 1455	39.965	0.29
20	NRC 292	41.15	0.25
21	JS 335	38.3	0.28
22	AMS 06	40.5	0.27
23	NRC 142	51.945	0.14
24	SL 1441	48.2	0.33
25	CAUMS 4	44.8	0.23
26	MACS 1859	49.75	0.16
27	JS 20-98	33.28	0.34
28	JS 25-08	46.735	0.22
29	NRC 293	45.615	0.23
30	AMS 2022-1	43.65	0.22
31	AMS 22-14	40.885	0.25
32	RSC 12-05	37.65	0.28
33	MACS 1831	46.885	0.2
34	AUKS 22-10	38.095	0.27
35	Himso 1697	43.8	0.22
36	NRC 291	38.3	0.27
37	NRC128 (RC)	40.945	0.25
38	JS 95-60 (SC)	48.665	0.14
39	DS 1390	51.305	0.33
40	KSS 394	47.855	0.19
41	TS 105	39.455	0.3
42	PusaSipani438	40.3	0.25
43	BAU (M) -6	42.885	0.24
44	NRC 269	39.8	0.27
45	JS 21-17	37.3	0.28
46	NRC 294	47.465	0.21
47	MAUS 817	40.83	0.25
48	VLS 107	44.3	0.25
49	AUKS 22-1	39.3	0.28
50	DLSb 6	45.3	0.2
51	ASb 114	50.515	0.16
52	AS 90	25.465	0.34
53	AMS 22-16	23.805	0.35
54	MAUS 816	47.365	0.17
55	MACS 1756	21.205	0.35
56	RSC 11-95	31.25	0.31
57	KBSL 23-36	39.445	0.26
58	THPS 6	31.595	0.32
59	Lok Soya 03	45.925	0.2
60	KSS 225	29.165	0.3
61	MACS 1810	25.3	0.34
62	ASb 101	47.485	0.18
63	DLSb 5	30.55	0.31
64	DS 1547	48.595	0.08
65	DS 1589	22.45	0.16
66	VLS 89 (C)	52.46	0.35
67	VLS 99 (C)	38.465	0.27
68	MACS 1745	49.65	0.14
69	AMS 22-16	39.505	0.26
70	SKAUS 3	50.5	0.14
71	NRC 271	54.525	0.14
72	VLS 106 (C)	39.385	0.3
	C.D. at 5%	2.665	0.021
	SEm (±)	1.117	0.007

Correlation studies between biochemical factors with per cent leaf damage

Correlation studies were conducted between different factors like chlorophyll content and phenol content with per cent leaf damage due to *Spodoptera litura* in soybean germplasm in field level. The values of correlation coefficients are presented in Table.

Table 2: Correlation between tobacco caterpillar damage and bio-chemical parameters.

Traits	r value
Chlorophyll (SPAD)	**0.711****
Phenol	**-0.846****

Note: ** Correlation coefficients significance at 1 % (r = 0.574) -ve sign: Negatively correlated No sign: positively correlated

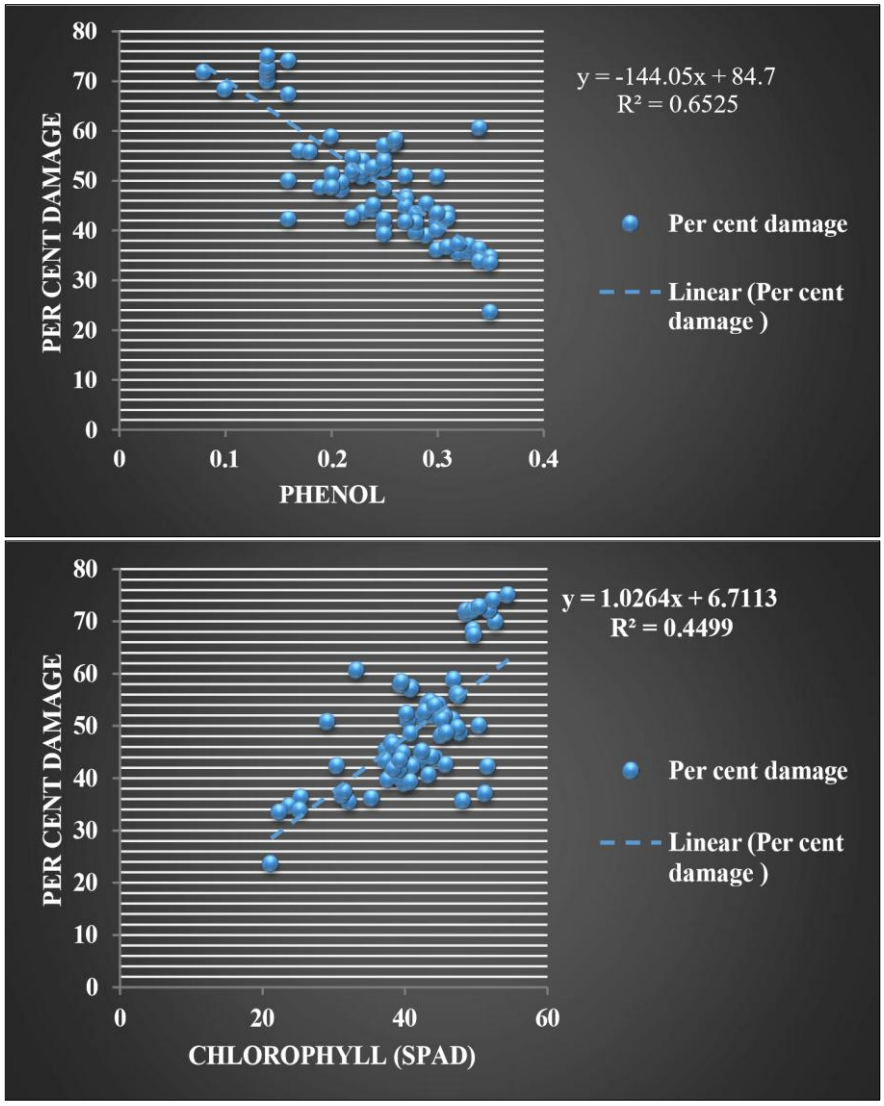

Fig 1: Correlation between tobacco caterpillar damage and bio-chemical parameters (Chlorophyll, Phenol)

Conclusion

Chlorophyll content in the studied germplasms ranged from 21.20 to 54.52. Highest chlorophyll content was recorded in NRC 271 (54.52) and Least chlorophyll content was seen in MACS 1756 (21.20). The correlational studies between Chlorophyll (SPAD) and per cent leaf damage revealed that there is significant and positive correlation (r=0.711**).

Phenol is one of the important factors that offer resistance to germplasms against different insects. Phenol content in the studied germplasms ranged from DS 1547 (0.08mg/g) to VLS 89 (0.35 mg/g). The correlational studies between phenol and per cent leaf damage revealed that there was significant and highly negative correlation (r = -0.846**)

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