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SCREENING AND BIOCHEMICAL ANALYSIS OF GROUNDNUT GENOTYPES AGAINST THRIPS, *SCIRTOTHRIPS DORSALIS* HOOD

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ABSTRACT : Of the insect pests attacking groundnut crop, thrips is an important sucking insect pest. Field screening of 30 groundnut genotypes and released varieties against thrips, *Scirtothrips dorsalis* Hood under field condition was taken up at the Zonal Agricultural and Horticultural Research Station, Hiriyur, Chitradurga, Karnataka, India. Among them the six genotypes *viz*., JL-1067, TG-82, PBS 12200, UG-185, ICGV-91115 and GPBD-4 recorded least mean number of thrips (1.96, 2.13, 2.27, 2.43, 2.86 and 2.95/ top trifoliate leaves, respectively) with damage score of 3 recorded 10.2 to 19.20 and 11.20 to 18.40 per cent damage during 2018 and 2019, respectively and were grouped under resistant category. The four entries *viz*., K 1812, TCGS 1694, TG-86 and R 2013-1 with mean number of thrips of 3.12, 3.22, 3.33, 3.42 and/top trifoliate leaves, respectively with damage score of 5 recorded 21.00 to 23.20 and 22.00 to 23.40 per cent damage during 2018 and 2019, respectively and were grouped under moderately resistant category. The 11 entries *viz*., JL 977, TG-83, J 98, K-1809, JCG 4801, R 2001-2, KGL 1322, TCGS 1522, K-9, GKVK-5 and VG 13149 with mean number of thrips of 3.75, 3.78, 3.81, 3.85, 3.88, 3.94, 3.97, 4.09, 4.02, 4.02 and 4.20/ top trifoliate leaves, respectively with damage score of 7 recorded 31.20 to 39.80 and 31.60 to 39.80 per cent damage during 2018 and 2019, respectively and were grouped under moderately susceptible category. Whereas, the remaining nine genotypes *viz*., ICGV 07220, PBS-15044, G2-52, TCGS 1399, PBS 15022, ICVG 15327, J 95, K-6 and susceptible check TMV-2 with thrips population of 3.93, 3.98, 4.04, 4.24, 4.24, 4.32, 4.33, 4.39, and 4.41/top trifoliate leaves, respectively with damage score of 9 recorded 41.20 to 50.20 and 41.40 to 99.20 per cent damage during 2018 and 2019, respectively and were grouped under susceptible category. The correlation between thrips population and phenol content was highly significant and negatively correlated (r= -0.964). Whereas, thrips population and total sugars and amino acid were positively correlated and highly significant (r= 0.951**) and (r= 0.942**), respectively.**

Key words : Biochemical, groundnut, screening, thrips.

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is grown in many countries in the tropical, sub-tropical and warm temperate regions and is one of the most important legume crops in the world. It is mainly cultivated for its high-quality edible oil and digestible protein. About 90% of the global groundnut production comes from Asia and Africa, where it is mostly produced by small holder farmers under rainfed conditions. The number of factors responsible for the low productivity of groundnut includes adverse climatic conditions, poor quality seeds, diseases and insects which significantly affect both the quality and production of groundnut. Among these insect pests are the major limiting factors to reduce pod yield. Thrips are the important sucking pests of the groundnut crop. Several species of thrips have been reported to infest groundnut (Wongkaew, 1993) and they are also known to transmit viral diseases (Mound, 1996). Both nymphs and adults feed on tender leaves and also on flowers by scraping and sucking the sap which leads to the formation of deformed leaves and also causes stunting of the plant. Fundenbrenk *et al* (1998) reported that heavy infestation of thrips at the early stage of the crop could result in losses of biomass and kernel yield. Control of thrips has relied heavily on insecticides and frequent use of insecticides is required in order to obtain effective control. However, frequent use of insecticides is not a suitable strategy against thrips when considering its capacity to develop resistance to

insecticides (Daughtrey *et al*, 1997 and Immaraju *et al*, 1992). The identification of resistant lines and biochemical basis of resistance are important for the development of host plant resistance. The use of resistant varieties / genotypes is a way to lower the cost of crop protection as part of integrated pest management in groundnut (Yambhatnal *et al*, 2011). Thus, the present study was targeted to evaluate groundnut genotypes/ varieties for resistance against thrips and to know biochemical basis of resistance to thrips, *Scirtothrips dorsalis* Hood in these varieties/genotypes.

MATERIALS AND METHODS

The experiment was laid out at the Zonal Agricultural and Horticultural Research Station, Hiriyur, Chitradurga District, Karnataka State, to study the response of 30 different groundnut genotypes. The genotypes included recently released varieties in UAS, Dharwad and UAS, Bengaluru against major insect pests and their natural enemies in order to find out the resistant source with three replications as mentioned below. The location of the experimental site is situated in the Central dry zone (Zone-IV) of Karnataka between the 16° 15´ N latitude, 77° 20´ E longitude and at 398.37 m above mean sea level. The genotypes procured from All India Co-ordinated Research Project on Groundnut, Agricultural and Horticultural Research Station, Hiriyur are JL-1067, TG-82, UG-185, PBS-12200, TG-86, JCG 4801, TG-83, TCGS 1522, J 98, TCGS 1694, VG 13149, TCGS 1399, R 2013-1, PBS-15022, KGL 1322, K 1812, JL 977, ICGV 15327, ICGV 07220, R 2001-2, K-1809, PBS-15044, J-95, K-6, K-9, ICGV-91114, GPBD-4, GKVK-5, TMV-2 and G2-52.

Each groundnut genotype was sown in two rows of 3-meter length with a spacing of 30 × 10 cm distance between rows and plants, respectively with the adoption of the standard package of practices except for the plant protection measures against insect pests, diseases and weeds. A row of popular groundnut genotype, TMV-2 was planted around the experiment plot as a susceptible cultivar 10 days prior to sowing of each genotype to favour the build-up of the insect pest population.

Weeding was carried out manually as when required and crop remained natural without being exposed to any kind of pesticides spray (insecticides, fungicides, bactericides and weedicides). Response of different groundnut genotypes against thrips was observed by counting the number from five randomly selected plants which harboured on each entry and also on susceptible cultivar TMV-2 from 15th day after sowing (DAS) with a week interval and counting continued up to 15 days prior to harvest. The data were analyzed using ANOVA technique and subjected to DMRT (Duncan's Multiple Range Test).

Collection of plant samples for biochemical analysis

The samples of tender shoots and leaves of all groundnut genotypes were collected from the field and two grams of leaf sample was taken from each genotype with replication wise and leaf extract (aliquot) was prepared and biochemical constituent's *viz*., sugar, phenols, tannins and proteins were estimated from each of the selected genotypes.

Preparation of oven-dried samples

Tender shoots and leaves of each genotype including susceptible cultivar TMV-2 were collected and dried at 32^{o}C in a hot air oven for 48 hours. Then the samples were powdered using pestle and mortar as well as by using Remi-mixer. The powdered samples were sieved through a 100 mesh screen and stored in sealed plastic containers (0.5 m diameter) at 4°C until analysis.

Preparation of leaf extract in alcohol (aliquot)

The aliquot was prepared by taking two grams of leaf sample and the pieces of leaf tissues were ground thoroughly in a pestle and mortar with a little ethanol and passed through the muslin cloth and the extraction procedure was repeated once again. The filtrates were pooled and filtered through Whatman No. 41 and volume was made to 20 ml with 80 per cent ethanol. The filtrate was clarified by adding 2 ml of saturated lead acetate and 3 ml of disodium hydrogen phosphate and allowed overnight for settling down of the tissues and then filtered through Whatman No. 42 filter paper. The final volume of the clear filtrate was made to 25 ml with 80 per cent ethanol. This constituted the stock solution from which an aliquot was drawn for the estimation of sugar, phenols and protein. The absorbance of each chemical constituent in a sample was measured using a spectrophotometer.

Estimation of sugar

The standard stock solution was freshly prepared by dissolving 100 mg of D-glucose in a small quantity of distilled water and making volume to 100 ml with distilled water which contained 1 mg of glucose per ml. A 10 ml was taken from this and diluted to 100 ml with distilled water which contained 100 micro g of D-glucose per ml to make the working solution. Reducing sugar in the filtrate was estimated by following the procedure as given by Nelson (1944).

The working standard solution was put in different concentrations (ml) like 0, 0.2, 0.4, 0.6, 0.8 and 1 and test samples were put in 0.1 and 0.3 ml. All the test tube

volume was made to 1 ml by adding the distilled water. Then, 1 ml of alkali copper reagent was added and mixed well. These test tubes were kept in a boiling water bath for 20 minutes. After heating, the test tubes were cooled under tap water without shaking. The arseno-molybdate was added to about 1 ml in all the test tubes and mixed immediately and volume was made to 20 ml by distilled water. After the development of blue colour samples were read at 510 nm against the blank reagent at 100 per cent transmittance (% T).

One ml of alcohol-free extract was taken and added to 1 ml of 1N H_2SO_4 to hydrolyze non-reducing sugar and boiled well which upon cooling under running water, 1-2 drops of phenolphthalein indicator was added. Then, 1 ml of 1N NaOH was added drop by drop to neutralize the acid in the hydrolysate till the solution turned pink colour. Then, 1 ml of 1N H_2SO_4 was added till the pink colour disappears. The volume was made to 5 ml by distilled water. From this, 0.3 and 0.5 ml of extract was taken and the Nelson Somogyi's method was followed as was done for estimation of reducing sugar and absorbance was read at 510 nm.

Estimation of amino acids

Total soluble amino acids in the extract are estimated by the following procedure of the Ninhydrin method of Moore and Stein (1958).

0.2 M citrate buffer, pH 5.0: Twenty-one gram citric acid was dissolved in 200 ml of 1.0 N NaOH in 500 ml volumetric flask and volume was made up to 500 ml with distilled water.

Preparation of Ninhydrin Reagent: The solutions of 20 g Ninhydrin dissolved in 500 ml of methyl cellosolve (Ethylene glycol monomethyle ether) and 800 mg of hydrated stannous chloride dissolved in 500 ml of 0.2 N citrate buffer, pH 5.0 were mixed to get ninhydrin reagent.

Diluents solution: equal volumes of distilled water and n-propenol were mixed to get the diluents solutions.

One ml of Ninhydrin reagent was added to 1.0 ml of extract and boiled in a specimen tube over a water bath for 20 min. The specimen tubes were cooled under running water and the volume was made up to 10 ml with diluents solution till it develops a purple colour and absorbance was read at 570 nm. A standard curve was prepared with glycine to calculate the quantity of total soluble amino acids (Moore and Stein, 1958) and expressed as milligram per gram of leaf sample (mg/g).

Estimation of total phenol

100 mg of oven-dried powdered sample was extracted in 100 ml of warm 80 per cent ethanol for 1 hr at room temperature. The extract was centrifuged at 6000 rpm for 15 min. The supernatant was centrifuged to dryness on a water bath and the residue was dissolved in 5 ml water. The alcohol-free extract was used for the estimation of total phenols (Malick and Singh, 1980).

Total phenol was estimated by using the Folin-Ciocalteau reagent method of Bray and Thorpe (1954). Stock catechol solution was prepared by dissolving 50 mg of catechol in distilled water and making the volume to 50 ml with distilled water. This solution contained 1 mg of catechol per ml. Working standard solution was prepared by taking 5 ml of stock standard solution and diluting to 100 ml with distilled water. This working solution contained 1 mg of catechol per ml.

In a series of test tubes, 0, 0.2, 0.4, 0.6, 0.8 and 1 ml of working standard solution was taken and 0.3 and 0.5 ml of aliquot was taken in two different test tubes and volume was made to 1 ml by adding distilled water. Later, 1 ml of 1 N FCR was added to all test tubes. The content was mixed well by shaking. After shaking, 2 ml of 2 per cent sodium carbonate was added. The mixture was shaken well and placed on a hot water bath for one minute. The test tubes were cooled immediately under running water and volume was made to 15 ml with distilled water. Colour absorption was measured at 650 nm in a spectrophotometer.

The data was statistically analyzed by subjecting to the correlation between biochemical parameters and the number of thrips and determined the correlation 'r' using the formula (Lalchand, 1981).

RESULTS AND DISCUSSION

Pooled data of two years (2018 and 2019) on screening of groundnut genotypes against thrips revealed that at 15 days after sowing (DAS) of groundnut genotypes; JL-1067 (1.37/ top trifoliate leaves), TG-82 (1.53), UG-185 (1.83) and PBS 12200 (1.73/ top trifoliate leaves) harboured significantly least number of thrips. However, the population of thrips in the above genotypes was on par with groundnut genotypes, ICGV-91115 (2.27) and GPBD-4 (2.33/ top trifoliate leaves) and these were considered as resistant genotypes (Table 1). But the population of thrips in the above genotypes was significant over the rest of the genotypes and susceptible check, TMV-2 (3.83/top trifoliate leaves). Moderately resistant genotypes included TG-86 (2.70/ top trifoliate leaves), TCGS 1694 (2.57), R2013-1 (2.80) and K1812 (2.43/top trifoliate leaves) (Table 1) as these genotypes were effective in reducing the population of thrips. The population of thrips in the above genotypes were on par with JCG 4801 (3.27/ top trifoliate leaves), TG 83 (3.20),

Table 1 : Performance of selected groundnut genotypes/varieties against thrips, *Scirtothrips dorsalis* under field condition during *kharif* 2018 and 2019.

S. No.	Treatments	No of thrips / top trifoliate leaves						
		15 DAS	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Pooled Mean
1	JL-1067	1.37 (1.36)^{a}	1.57 (1.43)^{a}	1.83 (1.52)^{a}	2.37 (1.69)^{a}	2.47 (1.72)^{a}	2.13 (1.62)^{a}	1.96(1.57)^{a}
2	TG-82	1.53 (1.42)^{a}	1.77 (1.50)^{a}	2.00 (1.57)^{a}	2.63 (1.77)^{a}	2.63 (1.76)^{a}	2.23 (1.65)^{a}	2.13(1.61)^{a}
3	UG-185	1.83 (1.52)^{a}	2.00 (1.57)^{a}	2.30 (1.66)^{a}	2.90 (1.84)^{a}	2.97 (1.86)^{a}	2.57 (1.75)^{a}	2.43(1.70)^{a}
4	PBS-12200	1.73 (1.49)^{a}	1.90 (1.54)^{a}	2.13 (1.62)^{a}	2.73 (1.80)^{a}	2.77 (1.81)^{a}	2.33 (1.68)^{a}	2.27(1.66)^{a}
5	TG-86	2.70 (1.79)^{b}	3.00 (1.87)^{b}	3.20 (1.92)^{b}	3.73 (2.06)^{b}	3.87 (2.09)^{b}	3.50 (2.00)^{b}	3.33(1.96)^{b}
6	JCG 4801	3.27 (1.94)^{bc}	3.57 (2.02)^{bc}	3.63 (2.03)^{bc}	4.33 (2.20)^{bc}	4.47 (2.23)^{bc}	4.00 (2.12)^{bc}	3.88(2.09)^{bc}
7	TG-83	3.20 (1.92)^{bc}	3.50 (2.00)^{bc}	3.53 (2.01)^{bc}	4.27 (2.18)^{bc}	4.33 (2.20)^{bc}	3.87 (2.09)^{bc}	3.78(2.07)^{bc}
8	TCGS-1522	3.47 (1.99)^{bc}	3.77 (2.06)^{bc}	3.83 (2.08)^{bc}	4.57 (2.25)^{bc}	4.67 (2.27)^{bc}	4.23 (2.18)^{bc}	4.09(2.14)^{bc}
9	J 98	3.20 (1.92)^{bc}	3.50 (2.00)^{bc}	3.57 (2.02)^{bc}	4.27 (2.18)^{bc}	4.37 (2.20)^{bc}	3.93 (2.10)^{bc}	3.81(2.08)^{bc}
10	TCGS 1694	2.57 (1.75)^{b}	2.83 (1.83)^{b}	3.10 (1.90)^{b}	3.63 (2.03)^{b}	3.80 (2.07)^{b}	3.37 (1.96)^{b}	3.22(1.93)^{b}
11	VG 13149	3.53 (2.01)^{c}	3.80 (2.07)^{bc}	4.03 (2.13)^{c}	4.67 (2.27)^{c}	4.80 (2.30)^{c}	4.37 (2.21)^{c}	4.20(2.17)^{c}
12	TCGS 1399	3.60 (2.02)^{c}	3.83 (2.08)^{c}	4.03 (2.13)^{c}	4.73 (2.29)^{c}	4.87 (2.32)^{c}	4.37 (2.21)^{c}	4.24(2.18)^{c}
13	R 2013-1	2.80 (1.82)^{b}	3.10 (1.90)^{b}	3.23 (1.93)^{b}	3.87 (2.09)^{b}	3.97 (2.11)^{b}	3.57 (2.01)^{b}	3.42(1.98)^{b}
14	PBS-15022	3.60 (2.02)^{c}	3.83 (2.08)^{c}	4.03 (2.13)^{c}	4.73 (2.29)^{c}	4.87 (2.32)^{c}	4.37 (2.21)^{c}	4.24(2.18)^{c}
15	KGL 1322	3.37 (1.97)^{bc}	3.63 (2.03)^{bc}	3.70 (2.05)^{bc}	4.43 (2.22)^{bc}	4.57 (2.25)^{bc}	4.10 (2.14)^{bc}	3.97(2.12)^{bc}
16	K 1812	2.43 (1.71)^{b}	2.77 (1.80)^{b}	2.93 (1.85)^{b}	3.60 (2.02)^{b}	3.73 (2.06)^{b}	3.27 (1.94)^{b}	3.12(1.90)^{b}
17	JL 977	3.17 (1.91)^{bc}	3.40 (1.97)^{bc}	3.53 (2.01)^{bc}	4.27 (2.18)^{bc}	4.27 (2.18)^{bc}	3.87 (2.09)^{bc}	3.75(2.06)^{bc}
18	ICGV 15327	3.70 (2.05)^{c}	3.93 (2.10)^{c}	4.10 (2.14)^{c}	4.77 (2.29)^{c}	4.97 (2.34)^{c}	4.47 (2.23)^{c}	4.32(2.20)^{c}
19	ICGV 07220	3.37 (1.97)^{bc}	3.60 (2.02)^{bc}	3.63 (2.03)^{bc}	4.43 (2.22)^{bc}	4.57 (2.25)^{bc}	4.10 (2.14)^{bc}	3.93(2.11)^{bc}
20	R 2001-2	3.27 (1.94)^{bc}	3.57 (2.02)^{bc}	3.63 (2.03)^{bc}	4.40 (2.21)^{bc}	4.53 (2.24)^{bc}	4.07 (2.14)^{bc}	3.94(2.11)^{bc}
21	K-1809	3.27 (1.94)^{bc}	3.50 (2.00)^{bc}	3.57 (2.02)^{bc}	4.33 (2.20)^{bc}	4.43 (2.22)^{bc}	4.00 (2.12)^{bc}	3.85(20.9)^{bc}
22	PBS-15044	3.37 (1.97)^{bc}	3.63 (2.03)^{bc}	3.70 (2.05)^{bc}	4.43 (2.22)^{bc}	4.57 (2.25)^{bc}	4.13 (2.15)^{bc}	3.98(2.12)^{bc}
23	J-95	3.70 (2.05)^{c}	3.93 (2.10)^{c}	4.10 (2.14)^{c}	4.83 (2.31)^{c}	4.97 (2.34)^{c}	4.47 (2.23)^{c}	4.33(2.20)^{c}
24	K-6	3.83 (2.08)^{c}	4.00 (2.12)^{c}	4.13 (2.15)^{c}	4.87 (2.31)^{c}	5.03 (2.35)^{c}	4.50 (2.24)^{c}	4.39(2.21)^{c}
25	K-9	3.43 (1.98)^{bc}	3.70 (2.05)^{bc}	3.70 (2.05)^{bc}	4.47 (2.23)^{bc}	4.60 (2.26)^{bc}	4.13 (2.15)^{bc}	4.02(2.13)^{bc}
26	ICGV-91115	2.27 (1.66)^{ab}	2.50 (1.73)^{ab}	2.70 (1.79)^{ab}	3.30 (1.95)^{ab}	3.37 (1.97)^{ab}	3.03 (1.88)^{ab}	2.86(1.83)^{ab}
27	GPBD-4	2.33 (1.68)^{ab}	2.57 (1.75)^{ab}	2.77 (1.81)^{ab}	3.43 (1.98)^{ab}	3.50 (2.00)^{ab}	3.10 (1.90)^{ab}	2.95(1.86)^{ab}
28	GKVK-5	3.43 (1.98)^{bc}	3.77 (2.06)^{bc}	3.77 (2.06)^{bc}	4.50 (2.24)^{bc}	4.60 (2.26)^{bc}	4.17 (2.16)^{bc}	4.02(2.13)^{bc}
29	G2-52	3.43(1.98)^{bc}	3.73 (2.06)^{bc}	3.77 (2.06)^{bc}	4.53 (2.24)^{bc}	4.60 (2.26)^{bc}	4.17 (2.16)^{bc}	4.04(2.13)^{bc}
30	TMV-2	3.83(2.08)^{c}	4.03 (2.13)^{c}	4.13 (2.15)^{c}	4.90 (2.32)^{c}	5.03 (2.35)^{c}	4.50 (2.24)^{c}	4.41(2.22)^{c}
	S.Em.±	0.04	0.04	0.03	0.04	0.04	0.04	0.04
	C.D. (P = 0.05)	0.17	0.17	0.16	0.16	0.18	0.16	0.17

Figures in the parenthesis are transferred values $\sqrt{x+0.5}$, Means followed by same letter in the column do not differ significantly by DMRT (P=0.05).

TCGS 1522 (3.47), J 98 (3.20), KGL 1322 (3.37), JL 977 (3.17), R-2001-2 (3.27), K-1809 (3.27), K-9 (3.43) and GKVK-5 (3.43) per trifoliate leaves (Table 1) and were considered as moderately susceptible (Table 1). A similar trend in the population of thrips was observed from 30 to 90 DAS. The population of thrips was significantly more in G2-52 (3.43/ top trifoliate leaves), ICGV-07220 (3.37), PBS-15044 (3.37), VG 13149 (3.53), TCGS 1399 (3.60), PBS 15022 (3.60), ICVG 15327 (3.70), J 95 (3.70), K-6 (3.83/top trifoliate leaves) and susceptible check TMV-2 (3.83/top trifoliate leaves) for the pooled data 2018 and 2019 *Kharif* and categorized as susceptible (Table 1). A similar population trend was observed on 30, 45, 60, 75 and 90 DAS also.

The results of pooled mean of six observations over two years revealed that among them six genotypes *viz*., JL-1067, TG-82, PBS 12200, UG-185, ICGV-91115 and GPBD-4 recorded least mean number of thrips (1.96, 2.13, 2.27, 2.43, 2.86 and 2.95/top trifoliate leaves, respectively) and were grouped under resistant category. The four entries *viz*., K 1812, TCGS 1694, TG-86 and R 2013-1 with mean number of thrips of 3.12, 3.22, 3.33, 3.42 and/top trifoliate leaves, respectively and were grouped under moderately resistant category. The 11 entries *viz*., JL 977, TG-83, J 98, K-1809, JCG 4801, R 2001-2, KGL 1322, TCGS 1522, K-9, GKVK-5 and VG 13149 with mean number of thrips of 3.75, 3.78, 3.81, 3.85, 3.88, 3.94, 3.97, 4.09, 4.02, 4.02 and 4.20/ top trifoliate leaves, respectively and were grouped under moderately susceptible category. Whereas, the remaining nine genotypes *viz*., ICGV 07220, PBS-15044, G2-52, TCGS 1399, PBS 15022, ICVG 15327, J 95, K-6, and susceptible check TMV-2 with thrips population of 3.93, 3.98, 4.04, 4.24, 4.24, 4.32, 4.33, 4.39 and 4.41/top trifoliate leaves, respectively and were grouped under susceptible category (Table 1).

The six entries *viz*., JL-1067, TG-82, UG-185, PBS-12200, ICGV-91115 and GPBD-4 with damage score of 3 recorded 10.2 to 19.20 and 11.20 to 18.40 per cent damage during 2018 and 2019, respectively and were grouped under resistant category. The four entries *viz*., TG-86, TCGS 1694, K 1812 and R 2013-1 with damage score of 5 recorded 21.00 to 23..20 and 22.00 to 23.40 per cent damage during 2018 and 2019, respectively and were grouped under moderately resistant category. The 11 entries *viz*., JCG 4801, TG-83, TCGS 1522, J 98, KGL 1322, JL 977, R 2001-2, K-1809, K-9, GKVK-5 and VG 13149 with damage score of 7 recorded 31.20 to 39.80 and 31.60 to 39.80 per cent damage during 2018 and 2019, respectively and were grouped under moderately susceptible category. The remaining 9 entries *viz*., TCGS 1399, PBS-15022, ICGV 15327, ICGV 07220, PBS-15044, J-95, K-6, G2-52 and TMV-2 with damage score of 9 recorded 41.20 to 50.20 and 41.40 to 99.20 per cent damage during 2018 and 2019, respectively and were grouped under susceptible category (Table 2).

The highest total phenol content was recorded in lowest thrips infested genotypes JL-1067 (0.56 mg/g), TG-82 (0.54 mg), UG-185 (0.50 mg) and PBS 12200 (0.52 mg/g) followed by ICGV-91115 (0.40 mg), GPBD-4 (0.40 mg), K1812 (0.38 mg), TCGS 1694 (0.36 mg), TG-86 (0.35 mg) and R 2013-1 (0.32mg/g) for pooled data of 2018 and 2019. Highest thrips infested genotypes JCG 4801, TG 83, TCGS 1522, J 98, VG 13149, TCGS 1399, PBS 15022, KGL 1322, JL 977, ICGV 15327, ICGV 07220, R 2001-2, K-1809, PBS 15044, J 95, K-6, K-9, GKVK-5 and G2-52 contained lowest phenol content of 0.23, 0.23, 0.21, 0.23, 0.21, 0.20, 0.21, 0.22, 0.23, 0.20, 0.22, 0.22, 0.23, 0.22, 0.20, 0.20, 0.22, 0.21 and 0.21 mg/g, respectively which is almost equal to quantity of phenol recorded in susceptible check (control) TMV-2 (0.20 mg/g). The correlation between thrips population and phenol content was negatively correlated and highly significant (r= -0.964**) (Table 3).

Significantly the lowest total sugars content was observed in genotypes which were infested with lowest number of thrips; JL-1067 (2.89 mg/g), TG-82 (3.01 mg/g), UG-185 (3.44 mg/g) and PBS 12200 (3.20 mg/g), ICGV-91115 (3.98 mg/g), GPBD-4 (4.08 mg/g), K1812 (4.20 mg/g), TCGS 1694 (4.29 mg/g), TG-86 (4.37 mg/g) and R2013-1 (4.59 mg/g) for the pooled data 2018 and 2019. Highest total sugars were recorded in remaining genotypes and released varieties, which were infested with more number of thrips; JCG 4801(6.41 mg/g), TG 83 (6.22 mg/g), TCGS 1522 (6.80 mg/g), J 98 (6.31 mg/g), VG 13149 (6.82 mg/g), TCGS 1399 (6.89 mg/g), PBS 15022 (6.83 mg/g), KGL 1322 (6.53 mg/g), JL 977 (6.21 mg/g), ICGV 15327 (6.89 mg/g), ICGV 07220 (6.49 mg/g), R 2001-2 (6.42 mg/g), K-1809 (6.33 mg/g), PBS 15044 (6.61 mg/g), J 95 (6.99 mg/g), K-6 (7.19 mg/g), K-9 (6.63 mg/g), GKVK-5 (6.73 mg/g) and G2-52 (6.69 mg/g) which were almost equal to quantity present in susceptible check, TMV-2 (7.39 mg/g). The correlation between thrips population and total sugars was positive and highly significant (r = 0.951**) (Table 3).

The lowest amino acid content was recorded in genotypes infested with least number of thrips; JL-1067 (3.72 mg/g), TG-82 (3.79 mg/g), UG-185 (3.86 mg/g), PBS 12200 (3.82 mg/g), ICGV-91115 (3.89 mg/g), GPBD-4 (3.92 mg/g), K1812 (4.22 mg/g), TCGS 1694 (4.26 mg/g), TG-86 (4.29 mg/g) and R2013-1 (4.40 mg/g). Higher amount of amino acid content was recorded in remaining

Table 2 : Categorization of groundnut genotypes and varieties against thrips, *Scirtothrips dorsalis* in groundnut during 2018 and 2019.

S. No.	Genotypes	Damage (%)		Range of damage (%)		Damage score	Resistance category
		2018	2019	2018	2019		
	- Nil -	-	-	-	-	1	Highly resistant
1	JL-1067	10.20	11.20	10.20-19.20	11.20-18.40	3	Resistant
2	TG-82	13.00	12.60				
3	UG-185	16.40	15.60				
4	PBS-12200	14.20	14.20				
5	ICGV-91115	18.20	18.40				
6	GPBD-4	19.20	17.60				
7	TG-86	21.80	23.20	21.00-23.20	22.00-23.40	5	Moderately resistant
8	TCGS 1694	21.80	23.40				
9	K 1812	23.20	23.20				
10	R 2013-1	21.00	22.00				
11	JCG 4801	31.20	32.80	31.20-39.80	31.60-39.80	7	Moderately Susceptible
12	TG-83	32.20	32.20				
13	TCGS 1522	34.20	34.40				
14	J 98	31.20	31.60				
15	KGL 1322	39.00	37.20				
16	JL 977	31.80	38.60				
17	R 2001-2	39.80	32.80				
18	K-1809	39.40	39.80				
19	K-9	35.40	38.80				
20	GKVK-5	39.80	34.40				
21	VG 13149	38.40	39.20				
22	TCGS 1399	41.60	41.40	41.20-50.20	41.40-49.20	9	Susceptible
23	PBS-15022	41.20	43.20				
24	ICGV 15327	44.80	44.80				
25	ICGV 07220	41.40	41.80				
26	PBS-15044	41.20	41.60				
27	J-95	48.40	48.40				
28	K-6	50.20	49.20				
29	G2-52	45.80	44.80				
30	TMV-2	49.60	49.20				

genotypes infested with higher number of thrips; JCG 4801(4.99 mg/g), TG 83 (4.82 mg/g), TCGS 1522 (5.33 mg/g), J 98 (4.90 mg/g), VG 13149 (5.40 mg/g), TCGS 1399 (5.44 mg/g), PBS 15022 (5.43 mg/g), KGL 1322 (5.19 mg/g), JL 977 (4.82 mg/g), ICGV 15327 (5.49 mg/g), ICGV 07220 (5.12 mg/g), R 2001-2 (5.10 mg/g), K-1809 (4.92 mg/g), PBS 15044 (5.21 mg/g), J 95 (5.52 mg/g), K-6 (5.54 mg/g), K-9 (5.22 mg/g), GKVK-5 (5.31 mg/g) and G2-52 (5.29 mg/g), which was on par with quantity documented in susceptible check, TMV-2 (5.59 mg/g). The correlation between thrips population and content of amino acid was positive and highly significant (r= 0.942**) (Table 3).

Phenols are extremely abundant plant allele-chemicals often associated with feeding deterrence or growth inhibition of herbivores. Present findings are in line with Naik (2005), Gadad *et al* (2014), Subash *et al* 2014 and Sonawane *et al* (2019) who observed that phenols showed a significant and negative relationship with the number of thrips in groundnut and strongly support the present findings. Varadhrajan and Veeravel (1996)

Table 3 : Effect of biochemical constituents of groundnut genotypes on thrips population *Scirtothrips dorsalis* during *kharif* 2018 and 2019 (Pooled Mean).

S. No.	Genotypes and varieties	No. of thrips/top trifoliate leaves	Phenols (mg/g)	Total sugars (mg/g)	Aminoacids (mg/g)
1	JL-1067	1.96	0.56	2.89	3.72
2	TG-82	2.13	0.54	3.01	3.79
3	UG-185	2.43	0.50	3.44	3.86
4	PBS- 12200	2.27	0.52	3.20	3.82
5	TG-86	3.33	0.35	4.37	4.29
6	JCG 4801	3.88	0.23	6.41	4.99
7	TG-83	3.78	0.23	6.22	4.82
8	TCGS 1522	4.09	0.21	6.80	5.33
9	J 98	3.81	0.23	6.31	4.90
10	TCGS 1694	3.22	0.36	4.29	4.26
11	VG 13149	4.20	0.21	6.82	5.40
12	TCGS 1399	4.24	0.20	6.89	5.44
13	R 2013-1	3.42	0.32	4.59	4.40
14	PBS-15022	4.24	0.21	6.83	5.43
15	KGL 1322	3.97	0.22	6.53	5.19
16	K 1812	3.12	0.38	4.20	4.22
17	JL 977	3.75	0.23	6.21	4.82
18	ICGV 15327	4.32	0.20	6.89	5.49
19	ICGV 07220	3.93	0.22	6.49	5.12
20	R 2001-2	3.94	0.22	6.42	5.10
21	K-1809	3.85	0.23	6.33	4.92
22	PBS-15044	3.98	0.22	6.61	5.21
23	J-95	4.33	0.20	6.99	5.52
24	K-6	4.39	0.20	7.19	5.54
25	K-9	4.02	0.22	6.63	5.22
26	ICGV-91115	2.86	0.40	3.98	3.89
27	GPBD-4	2.95	0.40	4.08	3.92
28	GKVK-5	4.02	0.21	6.73	5.31
29	G2-52	4.04	0.21	6.69	5.29
30	TMV-2	4.41	0.20	7.39	5.59
Correlation for thrips population and biochemical constituents			-0.964	0.951	0.942
			**	**	**

** Significant at 1% level.

also observed that the genotypes with higher phenol content recorded a lower thrips population. Somashekhar *et al* (2003) observed that thrips resistant groundnut entry 136 had a higher quantity of phenols than the susceptible entries. Further, similar results were observed with other crops by Sujatha *et al* (1987) revealed that the total phenolic content had a negative correlation with the brown planthopper (BPH) on rice cultivars, against thrips in cotton (Balakrishnan, 2006) and cowpea (Alabi *et al*, 2011). Rohini *et al* (2011) reported that the presence of a high quantity of phenols conferred resistance against thrips. Vijayalakshmi (2013) showed negative and significant relation with thrips population and phenol content in the onion leaves.

Augustine *et al* (2018) reported that there was a

negative and significant correlation between percent damage due to pulse beetle and phenol content of the seeds in cowpea. Natikar and Balikai (2018) reported that the total phenol content in the shoot borer tolerant genotypes of potato was found higher compared to susceptible genotypes. Gurunath and Balikai (2018) reported that total phenols correlated significantly and negatively with foliage drying due to aphids in safflower. Anaji and Balikai (2006) reported that total phenols were negatively and non-significantly correlated with the shoot bug incidence in *rabi* sorghum. The above reports support the present results.

The present findings are in accordance with Somashekhar *et al* (2003), Subash *et al* (2014) and Sonawane *et al* (2019), who reported that total sugar showed a positive relationship with thrips population in groundnut and also similar results were obtained with other crops by Sachan and Sachan (1991) and Nanda *et al* (2000). Subash *et al* (2014) reported that the amount of amino acids showed a positive relationship with number of thrips in groundnut. Balikai and Lingappa (2002) also reported that total sugars in healthy leaves were positively and significantly correlated with aphid incidence in *rabi* sorghum.

Gurunath and Balikai (2018) reported that total amino acids correlated significantly and positively with aphid population and foliage drying due to aphids in safflower supports the present results.

In the present investigation, 30 groundnut genotypes were screened in the field experiment. Among them, only six were found encouraging with the least number of thrips. Phenol acts as a defensive source against insect attack because oxidation of phenols produces toxic quinones which covalently bind to leaf protein digestion in herbivores (Bhonwong *et al*, 2009). This suggests that groundnut varieties with a high concentration of phenols play a major role against thrips damage. Reducing, non-reducing and total sugar contribute greatly to the susceptibility of the host to insect pest. Susceptibility was associated with higher sugar content in leaf and other plant parts because sugar acts as a feeding stimulant for insects.

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