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The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 126-132

www.thepharmajournal.com
Received: 02-08-2021
Accepted: 06-10-2021

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Biochemical traits of groundnut genotypes for their reaction to thrips

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Abstract
A field experiment was screened at AICRP on Summer Groundnut, Cotton Improvement Project, MPKV, Rahuri in randomised block design (RBD) under summer condition. The thrips incidence was found to be active throughout the cropping season. These genotypes were further tested for their biochemical traits for their resistance against thrips Based on the per cent leaf damage score by thrips four genotypes *viz.,* Phule Unnati, JL-1224, KDG-160 and KDG-221 were found resistant, whereas, nine genotypes *viz.,* KDG-243, RHRG- 1192, RHRG-16017, RHRG-1189, JL-1240, RHRG-1308, TPG-41, JL-1067 and KDG-244 were recognized as moderately resistant. The genotypes KDG-266 and JL-1229 were found to be moderately susceptible. The pod yield recorded showed non-significant correlation with per cent leaf damage. The biochemical traits of plant such as total phenols (r = -0.919 and -0.937) and total tannin (r = -0.779, -0.810) showed highly significant negative correlation with thrips population and per cent leaf damage. Whereas, total amino acids showed highly significant positive correlation with thrips population and per cent leaf damage (r = 0.675 and 0.792) and total sugars which showed highly significant and positive correlation with thrips population and per cent leaf damage (r = 0.908 and 0.890). Leaf water content showed highly significant negative correlation with thrips population and per cent leaf damage (r = -0.915 and -0.871).

Keywords: Thrips, resistance, groundnut

Introduction

Groundnut (*Arachis hypogea* L.) is a fundamental oilseed and ancillary food crop in the world. Groundnut is a South American native that is cultivated in tropical, subtropical and warm climates around the world. The commercial farming of groundnut, on the other hand, is confined to locations between 40 degrees north and 40 degrees south latitudes. Its seeds are a rich source of edible oil (43-55%) and protein (25-28%) also a valuable source of vitamins *viz.,* K, E and B. Groundnut cake after oil extraction, is a rich protein animal feed and haulm are excellent fodder for ruminant livestocks (Blummel *et al.,* 2005) [3]. Cultivated groundnut also known as peanut.

It is grown in over 100 countries, with India ranking first position in terms of area and second after China in terms of production. China ranks first in groundnut production with 17.39 MT followed by India with production of 6.70 MT, Nigeria 2.89 lakh tonnes, Sudan 2.88 MT and Mynamar 1.60 MT accounting for 37, 14, 6, 2, and 1 per cent of total world production of 46.01 MT during 2018-19. According to all India rabi crop coverage report, Government of India, as on 24th December 2020, groundnut was sown in around 3.37 lakh hectares as compared to last year (3.54 lakh ha). Among the states, Karnataka stood first in area coverage with 128 lakh ha followed by Telangana (0.73 lakh ha), Tamil Nadu (0.48 lakh ha), Odissa (0.44 lakh ha) and Andhra Pradesh (0.35 lakh ha). In terms of production Gujarat is the largest producer contributing 33 per cent of the total production of groundnut followed by Rajastan (21%), Tamil Nadu (14%) and Andhra Pradesh (7%) to total groundnut production in the year 2018-19
(Source: Indiastat, 2020) [22].

The principle biotic factors that impacting groundnut productivity are pests and diseases (Frazer and Gilbert, 1976) [6]. Sucking pests as well as lepidopteran pests damage the groundnut crop. Among sucking pests attacking the groundnut crop, thrips species occur as a complex, mainly starts attacking at the vegetative stage and continuing until the crop is harvested (Vijayalaxmi *et al.*, 2009) [25].

Groundnut thrips are small insects that resides in the flowers and folded terminal leaf buds of groundnut plants. They are tiny approximately 2 mm long, usually hidden and therefore, easily go unnoticed. In the groundnut crop, there are several species of thrips. In different countries, Smith and Barifield (1982) [20] found 19 species that feed on groundnut crops. In India *Scirtothrips dorsalis* Hood, *Frankliniella schultzei* Trybom, *Thrips palmi* Karny, 2 *Megalurothrips usitatus* Bangnall and *Caliothrips indicus* are the important thrips species occurring in groundnut crop, the former three species were mainly dominant in southern states of India, whereas, the later one predominantly occurring in western India (Nandagopal and Vasantha, 1991, Ranga Rao and Winghtman, 1993) [14, 16].

Thrips are polyphagous in nature and may be found in virtually all of Asia's groundnut- growing countries, causing significant crop damage. Distinct kinds of thrips attack different parts of the groundnut plant at different times during different crop stages of the growth period, resulting in considerable yield loss.

Material and Methods

A field experiment was conducted at AICRP on Summer Groundnut, Cotton Improvement Project, MPKV, Rahuri in randomised block design (RBD) under summer condition. The sowing was carried out by dibbling at the spacing of 30 cm and 10 cm between the rows and plant respectively. All other cultural practices were undertaken to maintain healthy crop except plant protection measures for pests.

Experiment Detail

The experiment was conducted at AICRP on Summer Groundnut, Cotton Improvement Project, MPKV, Rahuri in randomised block design (RBD) under summer condition. The fifteen groundnut genotypes were screened for their reaction against thrips. The influence of biochemical characters of plants on thrips population and damage were studied at 45 DAS in this experiment.

Several biochemical characteristics play a major role in plant resistance against thrips, entries belonging to different categories *viz*., resistant, moderately resistant, moderately susceptible, susceptible, highly susceptible, were categorised.

Methods

Screening of Groundnut Varieties against Thrips

The experiment was conducted during summer 2020-2021, at AICRP on Summer Groundnut, Cotton Improvement Project, MPKV, Rahuri in randomised block design (RBD) to find out the resistant sources for thrips. A total of 15 treatments of groundnut genotypes (Table 3.1) were collected from All India Co-ordinated research project on summer groundnut, MPKV, Rahuri. The reaction of genotypes was assessed by visual observation of thrips population on terminal leaf bud and per cent leaf damage on each treatment.

Thrips population per terminal leaf bud and per cent leaf damage: The thrips population count was recorded from terminal leaf bud of ten randomly selected plants in each treatment and the visual observations were made on per cent leaf damage due to thrips during the peak infestation. The categorization of groundnut genotypes was made based on rating scale of damage. The thrip population was correlated with per cent leaf damage.

$$\text{Damage \%} = \frac{\text{Number of damaged leaflets}}{\text{Total number of leaflets}} \times 100$$

Pod yield

The groundnut crop was harvested after attaining physiological maturity.

The dried pod weight was recorded from each treatment separately. Further, the plot wise yield was calculated on kilogram per hectare basis for statistical analysis.

Table 1: List of Genotypes Screened against Thrips under Field Condition

Sr. No	Genotypes
1	JL-1129
2	RHRG-16017
3	KDG-244
4	RHRG-1308
5	JL-1224
6	KDG-266
7	RHRG-1189
8	KDG-160
9	Phule unnati
10	JL-1067
11	KDG-221
12	JL-1240
13	RHRG-1192
14	KDG-243
15	TPG-41

Table 2: Rating Scale for Thrips Damage in Groundnut

Damage scale	Per cent damage	Category
1	0-10	Resistant
2	11-30	Moderately resistant
3	31-50	Moderately susceptible
4	51-70	Susceptible
5	71-100	Highly susceptible

Biochemical Traits

Tender shoot and leaves of 15 groundnut genotypes were collected, which includes resistant, moderately resistant and susceptible groups, and dried at 32˚C in a hot air oven for 48 hr. The samples were powdered using mixer for 3 min. The powdered samples were sieved through a mesh screen and stored in sealed plastic containers at 4˚C, for further analysis.

Estimation of total phenols by using spectrophotometer

100 mg of oven dried powdered samples were extracted in 10 ml of warm 80 per cent ethanol for 1 hour at room temperature. The extracts were centrifuged for 15 min at 6000 rpm. The supernatant of the samples was evaporated to dryness on a water bath and residue was dissolved in 5 ml of water. Total phenols were calculated by using alcohol-free extracts (Malik and Singh, 1980) [12].

An aliquot sample of 0.1 ml was diluted to 3 ml with water and 0.5 ml of Folin- Ciocalteu reagent (FCR) was added and mixed. Exactly after 3 min, 2 ml of 20 per cent sodium carbonate solution was added and kept in boiling water bath for one minute, After cooling under running tap water, the absorbance was read at 650 nm, against the reagent blank in a spectrophotometer. A standard graph was constructed with catechol as a standard. The total phenol content was expressed as mg g-1 d.wt.

Estimation of total tannins

Analytic method for a quantitative determination of tannin was performed according to (Amadi *et al*. 2004. and Ejikeme *et al*. 2014) [2, 5]. By dissolving 50g of sodium tungstate in 37 ml of distilled water, Folin-Denis reagent was made, to the reagent prepared above, 10 g of phosphomolybdic acid and 25 ml of ortho-phospheric acid were added. Reflux of the mixture was carried out for two hour, cooled, and diluted to 500 ml with distilled water. One gram of leaf sample in a conical flask was added to 100 ml of distilled water. This was boiled gently for 1hr on an electric water bath and filtered using whatman no 1 filter paper in a 100 ml volumetric flask. Addition of 5 ml of Folin-Denis reagent and 10 ml of saturated sodium carbonate solution into a 50 ml distilled water and 10 ml of diluted extract was carried out after being pipetted into a100 ml conical flask for colour development. The solution was allowed to stand for 30 minutes in a water bath at a temperature of 25˚C after thorough agitation. The absorbance of the sample was read at 700 nm, against the reagent blank in a spectrophotometer.

A standard graph was constructed with tannic acid. The total tannin was expressed as mg g-1 d.wt.

Estimation of total amino acids

One ml of ninhydrin reagent was added to 1 ml of extract and boiled in a tube over water bath for 20 minutes. The tubes were cooled under running tap water and the volume was made up to 10 ml with diluents solution till it developed a purple colour and absorbance was read at 570 nm. A standard graph was prepared with glycine to calculate the quantity of total soluble amino acids (Moore and Stein., 1954) [13].

Estimation of total sugars by anthrone method

Principle: carbohydrates are 1st hydrolysed into simple sugars using dilute hydrochloric acid. The glucose is dehydrated to hydroxymethyl furfural in hot acidic medium.

This compound forms with anthrone a green coloured product with an absorption maximum at 630 nm.

Weigh 100mg of the sample into a boiling tube. Hydrolyse by keeping it in a boiling water bath for three hours with 5 ml of 2.5N HCL and cool to room temperature. Neutralised it with solid sodium carbonate solution until it the effervescence ceases. Then diluted to 100 ml and centrifuged, the supernatant was collected and aliquot sample of 0.5 ml was taken for analysis. Prepared the standards by taking 0, 0.2, 0.4, 0.6, 0.8 and 1 ml of working standards, whereas, „0" served as blank. Made the volume up to 1 ml in all the tubes including the sample tubes by adding distilled water and 4 ml of anthrone reagent was added and heated for eight minutes in a boiling water bath. After cooling under running tap water, the absorbance was read at 630 nm, against the reagent blank in a spectrophotometer. A standard graph was constructed with standard glucose. The total carbohydrate was expressed as mg g-1 d.wt (Thimmaiah., 2009) [24].

Estimation of leaf water content

The Fresh leaves of each leaf sample were weighed and recorded as fresh weight (Wf) and then dried at 80˚C for 72 hrs and recorded as dry weight of leaflet (Wd). Leaf water content was measured by calculating the difference between fresh dry weight and dry weight.

Leaf water content = Fresh weight of leaves - Dry weight of leaves

Statistical Analysis

The data on average thrips population was translated into square root transformation (√ and then subjected to statistical analysis as suggested by Panse and Sukhatme (1985) [15]. The average per cent damage and leaf water content was translated into arcsine transformation. The relationship between thrips population and per cent damage was analyzed by correlation analysis „r" to find out the influence of biochemical traits of groundnut genotypes against thrips, simple correlation coefficients were carried out (Lalchand 1981) [11].

Results and Discussion

Results on the investigations carried out during present studies on various biochemical traits of groundnut genotypes for their reaction to thrips and varietal reaction to thrips damage on leaves on different groundnut genotypes are explained in this chapter.

Screening of Groundnut Genotypes against Thrips

A total of fifteen groundnut genotypes were screened against thrips in summer. The absolute thrips population counts were also recorded per terminal leaf bud at every 15 days interval upto 90 days after sowing from each treatment. The visual observations were recorded on the per cent leaf damage due to thrips, at peak infestation using 1 to 5 scale.

Performance of Genotypes against Thrips during Summer 2021 Thrips population.

The groundnut genotypes expressed differential reactions against thrips throughout its growing stage, during summer 2020-21, the incidence of thrips was recorded on different groundnut genotypes and presented in (Table 3).

The thrips incidence was found to be active throughout the cropping season. Periodical observations on thrips population revealed that, activity of thrips was more during vegetative stage of the crop *viz.*, 30 DAS and 45 DAS, respectively and after wards the incidence of thrips population gets decreased. The cumulative data on thrips incidence indicated that the population of thrips per terminal leaf bud on genotypes varied from 1.95 (Phule unnati) to 6.18 (KDG-266) per terminal leaf bud and the lowest thrips number was observed on Phule unnati (1.95) followed by KDG-160 (1.96), KDG-221 (2.47), JL-1224 (3.02), RHRG-1192 (3.10) and KDG-243 (3.45). The present study results are in similar with Harish *et al.* (2014) [9] who reported the thrips population occurred at maximum proportions at early stages of the crop growth.

Per cent leaf damage (%)

The data on per cent leaf damage by thrips in different genotypes of groundnut were differed significantly during summer, 2020 - 21 (Table 3). The per cent leaf damage recorded at peak stage of infestation at 30 DAS and 45 DAS, showed that the damage percentage of leaf was maximum at 45 days after sowing of groundnut. The cumulative data on per cent leaf damage during summer 2020-21 was recorded based on rating scale 1 to 5, four genotypes *viz.*, Phule unnati (8.43%), JL-1224 (9.35%), KDG-160 (9.42%) and KDG-221 (9.66%) were grouped under resistant category as they recorded the leaf damage per cent ranging from 8.43 to 9.66, while, 9 genotypes *viz.*, KDG-243 (16.20%), RHRG-1192 (19.74%), RHRG-16017 (20.42%), JL-1240 (21.23%), RHRG-1189 (21.29%), RHRG-1308 (22.38%), TPG-41 (22.69%), JL-1067 (24.81%) and KDG-244 (27.90%) were grouped under moderately resistant category as they recorded the leaf damage per cent range of KDG-243 (16.20%) to

KDG-244 (27.90%) and moderately susceptible genotypes category had KDG-266 (31.92%) and JL-1129 (32.35%) per cent leaf damage (Table 3). The less damage was observed on Phule unnati (8.43%) and was at par with KDG-160, JL-1224 and KDG-221.

The relationship between thrips population and per cent leaf damage was significant and positive at one per cent level with the „r" value of 0.923.

The present findings are in similar with Ekvised *et al.* (2006) [6] who screened eight groundnut genotypes, in that IC 10 showed the minimum thrips number and plant damage. The present findings with respect to per cent leaf damage are comparable with Subhash (2010) [23] who screened 56 different genotypes of groundnut and it revealed that no genotype reacted as immune, however 13 genotypes reacted as resistant, 25 genotypes recorded as moderately resistant, 11 genotypes reacted as moderately susceptible and seven genotypes as a susceptible and none of genotypes were highly susceptible with respect to per cent leaf damage in case of damage.

Table 3: Performance of groundnut genotypes against thrips under field condition

Sr. No	Genotypes	Mean Thrips population/ terminal leaf bud	Mean Per cent Leaf Damage	Damage score	Pod yield (kg/ha)
1	JL-1129	6.04 (2.59)*	32.35 (34.65)**	3	4133.33
2	RHRG-16017	5.19 (2.43) *	20.42 (26.11) **	2	3381.00
3	KDG-244	5.62 (2.51) *	27.90 (31.88) **	2	3146.67
4	RHRG-1308	4.06 (2.22) *	22.38 (28.23) **	2	3022.00
5	JL-1224	3.02 (1.98) *	9.35 (17.79) **	1	2927.67
6	KDG-266	6.18 (2.63) *	31.92 (34.38) **	3	3213.00
7	RHRG-1189	5.17 (2.42) *	21.29 (27.46) **	2	3209.00
8	KDG-160	1.96 (1.70) *	9.42 (17.74) **	1	3431.00
9	Phule unnati	1.95 (1.70) *	8.43 (17.86) **	1	3573.00
10	JL-1067	5.57 (2.51) *	24.18 (29.43) **	2	3164.33
11	KDG-221	2.47 (1.83) *	9.66 (18.08) **	1	3707.00
12	JL-1240	5.12 (2.41) *	21.23 (27.41) **	2	3609.00
13	RHRG-1192	3.10 (1.98) *	19.74 (26.36) **	2	3088.67
14	KDG-243	3.45 (2.09) *	16.20 (23.71) **	2	3565.67
15	TPG-41	4.53 (2.30) *	22.69 (28.41) **	2	3102.00
	SE(m) ±	0.176	0.593		229.768
	CD @ 5%	0.510	1.718		665.61

"*" Figures in the parentheses are √ transformed value,
"**" Figures in parentheses are in arcsine transformed values

Table 4: Categorization of Genotypes based on their Performance against Thrips under Field Condition (Summer 2021)

Damage score	Genotypes	Damage (%)	Category
1	Phule Unnati, KDG-160, JL-1224, KDG-221	8.43% - 9.66%	Resistant
2	KDG-243, KDG-244, RHRG-1192, JL- 1240, RHRG-1189, RHRG-1308, TPG-41,JL-1067, RHRG-16017	16.2% - 27.90%	Moderately resistant
3	JL-1129, KDG-266	31.92% & 32.35%	Moderately susceptible
4	Nil	-	Susceptible
5	Nil	-	Highly susceptible

Pod yield (kg ha-1)

The pod yield varied in different genotypes and mean pod yield ranged from 2928kg/ha (JL-1224) to 3707 kg/ha (KDG-221) in resistant varieties and in moderately resistant varieties the pod yield varied from 3022 kg/ha (RHRG-1308) to 3609 kg/ha (JL-1240). While, 3213 kg/ha (KDG-266) and 4133 kg/ha (JL-1129) in moderately susceptible varieties (Table 3). The highest yield was recorded on JL-1129(4133 kg/ha) and was at par with Phule unnati, KDG- 243, JL-1240 and KDG-221. The pod yield showed non-significant and positive correlation with thrips population and per cent leaf damage.

The present experimental trial results are in parallel with Rao (2000) [17] who recorded that moderately high yields were recorded in some of the susceptible genotypes which are supposed to have more tolerance ability to the leaf miner due to the inherent genetic potential, and hence more yields were realized.

Studies Biochemical Basis of Resistance in Groundnut against Thrips: To study the role of biochemical components of groundnut genotypes on thrips population and leaf damage, the following components were analysed, relationships were calculated and the results are presented in (Table 5).

Total phenols (mg g-1)

Total phenols in different groundnut genotypes varied from 0.18 mg/g (JL-1129) to 0.87 mg/g (Phule unnati). The genotype Phule unnati (0.87mg/g) showed significantly high total phenol which was resistant to thrips damage, while it was low in JL-1129 (0.18 mg/g) which was susceptible to thrips damage. The highest phenol content was observed in Phule unnati (0.87 mg/g) and was at par with KDG-160 (0.83 mg/g), JL-1224 (0.76 mg/g), KDG-221 (0.64 mg/g), KDG-243 (0.62 mg/g) and TPG-41 (0.60 mg/g). The correlation relationship between thrips population and total phenol was highly significant and negative (r = -0.919). The correlation between per cent leaf damage and total phenol was significant and negative (r = - 0.937).

The present investigation results are in correspondence with Chandrayadu *et al.* (2016) [4] who screened 39 groundnut genotypes and revealed that phenols showed significant and negative relationship with number of thrips and jassids and their damage. Linear regression analysis revealed that more phenols contributed for thrips and jassids resistance in groundnut.

The present finding results are in correspondence with Sonawane *et al.* (2019) [21] who reported that phenol content showed significant and negative correlation with thrips population (r = -0.830).

The present finding results are in accordance with Gadad *et al.* (2014) [8] who observed that phenol content of plants are significant and negatively correlated with phenol content (r= -0.850).

Total tannins (mg g-1)

The experimental study on total tannin content resulted that tannin content in different genotypes varied from 0.0026 mg/g (KDG-160) to 0.0051 mg/g (Phule unnati) from leaf sample in resistant genotypes. The tannin content in moderately resistant genotypes varied from 0.0013 mg/g (KDG-244) to 0.0040 mg/g (KDG-243), while in moderately susceptible genotypes varied from 0.0013 mg/g (JL-1129) to 0.0022 mg/g (KDG-266). The correlation relationship between tannin content with both thrips population and per cent leaf damage was negative and significant respectively(r = - 0.779, -0.810).

The results reported by Kandakoor *et al.* (2014) [10] are in similar with the present experimentation, that tannins showed significant and negative relationship with number (r = - 0.864) and damage (r = -0.784) of thrips and linear regression analysis revealed that high amount of contributed for thrips resistant in groundnut.

The experimental trial results of the present investigation are in accordance with Vijayalaksmi *et al.* (2013) [25] who noticed the significant and negative correlation with the thrips population.

Total free amino acids (mg g-1)

Total free amino acids in different groundnut genotypes varied from 3.02 mg/g (KDG-243) to 5.32 mg/g (JL-1129) and mentioned in table 5. The correlation relationship between amino acids with both thrips population and per cent leaf damage was positive and significant with „r" value 0.675 and 0.792. The highest quantity of amino acids were recorded in moderately susceptible genotype which has recorded 5.32 mg/g (JL-1129). The lowest quantity of amino acids was observed in resistant variety KDG-243 (3.02 mg/g) and was at par with JL- 1224 (3.06 mg/g), RHRG-1308 (3.09 mg/g), KDG-221 (3.09 mg/g), Phule unnati (3.17 mg/g) and KDG-160 (3.21 mg/g).

The findings of present experimental trial results are in correspondence with Kandakoor *et al.* (2014) [10] who reported that amino acids showed positive relationship with number of thrips and the per cent leaf damage with correlation value (r = 0.337).

Similar results are reported by Agbahoungba *et al.* (2018) [1] who reported that high concentration of amino acid in plants are contributed to the increase of thrips damage (r = 2.10).

Total sugars (mg g-1)

The present experimental result revealed that the total sugar content in different screened genotypes ranged from 1.42 mg/g (Phule unnati) to 5.63 mg/g (JL-1129), the highest sugar content was recorded in susceptible genotypes, while least sugar content was recorded in resistant genotypes which had less thrips damage and was at par with all genotypes. The correlation relationship between thrips population and total sugar content of genotypes was positive and significant (r = 0.908). The correlation relationship between per cent leaf damage and total sugar content of genotypes also has positive and significant relation (r = 0.890).

The present analysis results are in correspondence with Sonawane *et al.* (2019) [21]

Who reported that total sugars of groundnut leaves showed positive and significant relationship with thrips population (r = 0.520).

The present analysis results are in correspondence with Chandrayadu *et al.* (2016) [4] who reported that total sugars (r= 0.313, 0.38) showed positive relationship with number of thrips and jassids and their damage per cent.

Leaf water content (%)

The leaf water content in different screened genotypes varied from 37.97% to 66.63 per cent mentioned in table 5. The lowest leaf water content was recorded in JL-1229 and highest leaf water content in KDG-160. The highest leaf water content was observed in resistant variety KDG-160 (66.63%) and was at par with JL-1224 (59%), RHRG-1192 (60.79%), Phule unnati (61.20%), and KDG-221 (64.87%). The correlation between leaf water content and with both thrips population and per cent leaf damage was negative and significant (r = -0.915 and - 0.871).

The present experimental study results are in comparable with Sonawane *et al.* (2019) [21] who reported that leaf water content showed significant and negative relationship with thrips population.

The present experimental study results are in parallel with Gadad *et al.* (2014) [8] who indicated that leaf water content showed negatively correlation with the thrips population.

Table 5: Influence of biochemical traits of groundnut genotypes on thrips population and leaf damage

Sr. No	Genotypes	Thrips population/ Terminal leaf bud	Per cent leaf damage (%)	Total phenols (mg g-1)	Total tannins (mg g-1)	Total free amino acids (mg g-1)	Total sugars (mg g-1)	Leaf water content (%)
1	JL-1129	6.04 (2.59)*	32.35 (34.65) **	0.18	0.0013	5.32	5.63	37.97 (38.01) **
2	RHRG-16017	5.19 (2.43) *	20.42 (26.11) **	0.37	0.0024	3.53	4.43	53.70 (47.10) **
3	KDG-244	5.62 (2.51) *	27.90 (31.88) **	0.32	0.0013	4.75	5.31	45.70 (42.49) **
4	RHRG-1308	4.06 (2.22) *	22.38 (28.23) **	0.44	0.0033	3.09	3.49	57.70 (49.41) **
5	JL-1224	3.02 (1.98) *	9.35 (17.79) **	0.76	0.0043	3.06	2.65	59.00 (50.16) **
6	KDG-266	6.18 (2.63) *	31.92 (34.38) **	0.23	0.0022	4.49	4.30	47.77 (43.70) **
7	RHRG-1189	5.17 (2.42) *	21.29 (27.46) **	0.44	0.0025	4.01	4.64	50.13 (45.05) **
8	KDG-160	1.96 (1.70) *	9.42 (17.74) **	0.83	0.0026	3.21	2.34	66.63 (54.70) **
9	Phule unnati	1.95 (1.70) *	8.43 (17.86) **	0.87	0.0051	3.17	1.42	61.20 (51.20) **
10	JL-1067	5.57 (2.51) *	24.18 (29.43) **	0.34	0.0023	3.33	4.14	49.73 (54.70) **
11	KDG-221	2.47 (1.83) *	9.66 (18.08) **	0.64	0.0045	3.09	1.93	64.87 (49.06) **
12	JL-1240	5.12 (2.41) *	21.23 (27.41) **	0.52	0.0033	4.13	3.49	50.63 (44.83) **
13	RHRG-1192	3.10 (1.98) *	19.74 (26.36) **	0.52	0.0032	4.36	3.23	60.79 (53.64) **

14	KDG-243	3.45 (2.09) *	16.20 (23.71) **	0.62	0.0040	3.02	3.53	58.47 (45.34)**
15	TPG-41	4.53 (2.30) *	22.69 (28.41)**	0.60	0.0030	4.15	3.66	57.10 (49.06)**
	SE(m) ±	0.176	0.593	0.114	0.0001	0.0824	0.102	2.764
	CD @ 5%	0.510	1.718	0.332	0.0003	0.238	0.295	8.007

"* " Figures in the parentheses are √ transformed value, "**" Figures in parentheses are in arcsine transformed values

Table 6: Correlation Thrips Population and Per cent Leaf Damage with Biochemical Constituents of Groundnut Genotypes during Summer 2021

Biochemical constituents Th		**rips („r" Value)**
Thrips population/term bud		**inal leaf Per cent damage (%)**
Total phenol (mg g-1)	-0.919**	-0.937**
Total tannin (mg g-1)	-0.779**	-0.810**
Total sugars (mg g-1)	0.908**	0.890**
Amino acids (mg g-1)	0.675**	0.792**
Leaf water content (%)	-0.915**	-0.871**

*Significant at 5% = 0.514 **Significant at 1% = 0.641

Conclusions

Out of fifteen groundnut genotypes tested for their reaction against thrips, four genotypes were resistant. Nine genotypes were moderately resistant, while, two genotypes were moderately susceptible. The resistant genotypes can be utilized in the breeding programme for developing new varieties with resistance.

From the present investigation, it can be concluded that, resistance with high phenol content, high total tannins, low total sugars, low total amino acids and high leaf water content minimize the pest attack. Thus, the selected genotypes containing the above selected characters can be considered for developing resistant varieties against thrips.

The studies on biochemical traits of groundnut for their reaction to thrips concluded that use of genotypes with resistance to thrips is one of the most comforting alternatives control measures since it is environmentally and economically safe and can be easily used in integrated pest management with other control measures.

The details obtained from the present studies provides guidelines for further selection of promising lines and helps to formulate appropriate breeding strategies for breeders. Also, these obtained resistant sources can be used as donors in the breeding programs. In integrated pest management (IPM) strategies host plant resistance offers a primary control strategies for thirps management.

Acknowledgement

The help received from the dean (PG) and department of entomology during the course of Masters Degree program, Mahatma Phule Krishi Vidyapeeth, Rahuri is gratefully acknowledged

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