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Field Screening of Groundnut Genotypes Against Leaf Miner, *Aproaerema Modicella* Deventer

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ABSTRACT

A field screening experiment was conducted on 25 groundnut genotypes including one check Kadiri 6 variety at the Agricultural Research Station, Kadiri during *kharif* and *rabi* 2017-18. Among them, nine genotypes showed resistant reaction against groundnut leaf miner *Aproaerema modicella*. These genotypes K-1451, VG-9521, ICGV-94379, K-1736, VRI(GN-6) , K-1661, TGLPS-03, K-1706 and K-1809 were categorised as resistant types, out of which, K-1809 showed maximum resistance recorded with minimum cumulative foliage damage per cent of 10. Among the screened genotpyes 15 were moderately resistant and the susceptible check, Kadiri-6 showed moderately susceptible reaction with maximum foliage damagre per cent (42.91%). Among the biochemical constituents of the leaves characterised for the genotypes screened, phenol content showed a significant positive correlation (r= 0.904) and total sugars were negatively correlated (r= -0.936) with foliage damage whereas, morphological characters like leaf thickness and trichome density showed significant possitive correlattion (r= 0.921 & 0.941) with the foliage damage due to the infestation of leaf miner.

Groundnut is a native crop of Brazil and was introduced into India in the sixteenth century. The most important groundnut growing countries are India, China, Nigeria, Sudan and USA. In Andhra Pradesh the crop is grown in an area of 23.12 lakh hectares with an annual production of 21.7 lakh tons and productivity of 564 kg ha^{-1}. (Ministry of Agriculture and Farmers Welfare, Government of India, 2014-15). It is cultivated as *kharif* and *rabi* crop in India in an area of 4.76 M ha with a production of 6.77 M t and productivity of 1552 kg ha^{-1}. (Economic survey, 2015-16).

The groundnut leaf miner, *Aproaerema modicella* Deventer, belongs to the family Gelechiidae, and the order Lepidoptera. It is an oligophagous insect pest and feeds only on leguminous host plants and is a serious pest of groundnut in both rainy and post rainy seasons in India. The leaf miner is considered as the most important insect pest of groundnut in India and particularly in rainfed Rayalaseema districts of Andhra Pradesh (Ayyar, 1963; Nair, 1975; Reddy, 1988). In Andhra Pradesh, the incidence of leaf miner, *A. modicella* Deventer is severe during *kharif* season in many of the mandals of Chittoor, Kadapa and Ananthapur districts

MATERIAL AND METHODS

The experiment was conducted during *kharif* & *rabi* 2017-18, at Agricultural research station, Kadiri, to find out the resistant sources of leafminer. A total of 25 entries (T-64, K-1809, TMV-04, K-1451, GG-03, K-1725, S-206, K-1799, VRI (GN-6), K-1735, TGLPS-03, K-1802, VG-9521, K-1736, ICGV-94379, K-1742, TMV-03, K-1661, CHANDRA, K-1936, K-1687, K-1641, K-1706, VRI-03 and K6) were collected from All India Co-ordinated Research Project (AICRP) on groundnut Kadiri. Each entry was sown in two rows of 3m length with a spacing of 30 cm between rows and 10 cm between plants. The crop was raised as per the recommended package of practices except for the plant protection measures against pests. The reaction of genotypes/varieties was assessed by visual grading of damage and absolute insect count on each entry.

Visual observations were made on per cent foliage damage due to leaf miner (0-100%) during the peak infestation period by following the standard scale (1-10) (Annual Progress Report 1986). The observation on per cent leaflet damage was made by counting total number of leaflets and damaged leaflets from 10 randomlyselected plants of each entry and expressed as per cent leaflet damage. Leaflet damage score was given by using the standard scale (1-100) given by Kandakoor *et al.,* (2013) (Table 1). The larval population was recorded from top five leaves of randomly selected plants that were used for studying per cent leaflet damage and foliage damage by *A. modicella*

Categorization of genotypes/varieties was made based on foliage damage and severity index was calculated by following the methodology of Ghule *et al.* (1988) (Table 2). After the crop attained maturity, the pods were harvested separately from each screening plot, dried properly and pod weight was recorded. The reaction of groundnut genotypes/ varieties against leaf miner was assessed mainly by visual recording of per cent foliage damage. Per cent leaflet damage was also recorded for calculating severity indices.

Table 1. Damage score of per cent damage and related category to calculate severity index

Leaf let damage (%)	Score (A)	Foliage damage (%)	Score (B)	Severity index
01-Oct	1	01-Oct	1	
Oct-20	2	Oct-20	2	
20-30	3	20-30	3	
30-40	4	30-40	4	$\frac{A \times B}{100}$
40-50	5	40-50	5	
50-60	6	50-60	6	
60-70	7	60-70	7	
70-80	8	70-80	8	
80-90	9	80-90	9	
90-100	10	90-100	10	

Severity index is the index showing the severity of infestation interms of severity of burning/ drying symptoms . Severity index was calculated by using the formula :

$$SI = \frac{A \times B}{100}$$

Where,

A = mean leaflet damage score

B = mean foliage damage score

$$\text{Mean leaflet damage score} = \frac{\text{No. of mined leaflets}}{\text{Total no. of leaflets}} \times 100$$

$$\text{Mean foliage damage score} = \frac{\text{No. of defoliated leaves}}{\text{Total no of leaves}} \times 100$$

Categorization of genotypes/varieties was done based on severity index (Table 3) by following the methodology of Ghule *et al*. (1988).

Table 2. Per cent of damage and selected category of level of resistance

S. No	Foliage damage (%)	Category
1	0	Immune
2	Jan-20	Resistant
3	21-40	Moderately resistant
4	41-60	Moderately susceptible
5	61-100	Highly susceptible

Biophysical analysis

Morphological parameters of leaf

Morphological characters like leaf shape, colour, thickness, trichome density and biochemical contents with regard to total phenols and total sugars in the leaves of screened genotypes were characterized at 45 DAS.

Fresh uniformly developed leaves were collected at 40-50 days after germination from randomly selected plants and subsequently leaf thickness, leaf laminar hairs were measured in accordance with Jackai and Oghiakhe (1989). The groundnut leaves were cut into bits of 9 mm^2 (3x3 mm) with the help of stainless steel blade and hairs present on the laminar portion of these leaves were

Table 3. Cumulative performance of the selected groundnut genotypes/varieties against leaf miner, *Aproaerema modicella* under field conditions (*kharif* & *rabi*, 2017-18) at ARS Kadiri.

S. No	Genotypes	Leaflet damage (%)	Score (A)	Foliage Damage (%)	score (B)	Severity Index (A X B) / 100	Genotype reaction	Yield (kg. plot^{-1})	Yield (kg. ha^{-1})
1	T-64	24.66	3	21.87	3	0.09	MR	3.85	2566.70
2	K-1809	12.69	2	10.00	1	0.02	R	4.65	3100.00
3	TMV-04	31.51	4	25.72	3	0.12	MR	3.50	2330.30
4	K-1451	16.52	2	12.54	2	0.04	R	4.18	2783.30
5	GG-3	30.88	4	24.95	3	0.12	MR	3.57	2380.00
6	K-1725	31.87	4	26.26	3	0.12	MR	3.47	2310.00
7	S-206	23.17	3	20.46	3	0.09	MR	4.13	2753.30
8	K-1799	31.12	4	25.45	3	0.12	MR	4.02	2680.00
9	VRI (GN-6)	15.02	2	10.86	2	0.04	R	4.34	2893.30
10	K-1735	24.73	3	21.92	3	0.09	MR	3.82	2546.70
11	TGLPS-3	14.08	2	10.28	2	0.04	R	4.41	2940.00
12	K-1802	23.24	3	21.96	3	0.09	MR	3.94	2626.70
13	K-1736	15.19	2	10.89	2	0.04	R	4.32	2880.00
14	VG-9521	15.55	2	11.81	2	0.04	R	4.22	2810.00
15	ICGV-94379	15.47	2	11.20	2	0.04	R	4.30	2863.30
16	K-1742	29.60	3	24.98	3	0.19	MR	3.61	2403.30
17	TMV-03	25.74	3	22.96	3	0.09	MR	3.68	2450.00
18	K-1661	14.12	2	10.52	2	0.04	R	4.38	2920.00
19	Chandra	24.00	3	21.69	3	0.09	MR	3.90	2600.00
20	K-1936	27.24	3	23.31	3	0.09	MR	3.65	2430.00
21	K-1687	25.62	3	22.03	3	0.09	MR	3.77	2510.00
22	K-1641	24.32	3	21.83	3	0.09	MR	3.87	2580.00
23	K-1706	13.37	2	10.00	1	0.02	R	4.50	3000.00
24	VRI-03	32.81	4	28.72	3	0.12	MR	3.40	2263.30
25	K6(Check)	45.90	5	42.91	5	0.25	S	3.26	2174.70
Mean		23.45	-	19.81	-	-		3.94	
F-Test		sig	-	sig	-	-		sig	
SEm±		0.145	-	0.182	-	-		0.1	
CD (P=0.05)		0.425	-	0.534	-	-		0.3	
CV (%)		0.871	-	1.298	-	-		3.68	

A – Mean leaflet damage score; B – Mean Foliage damage score; *Significant at 5% level; Plot size 5m X 3m

Table 4. Cumulative categorization of groundnut genotypes/varieties based on the field screening against leafminer, *Aproaerema modicella* during *kharif* and *rabi,* 2017-18 under field screening

S. No.	Screened genotypes/Entries	Foliage damage (%)	Category	Total No.
1	-	0	Immune	0
2	K-1451, VG-9521, ICGV-94379, K-1736, K-1661, TGLPS-03, VRI (GN-6), K-1706, K-1809	Jan-20	Resistant	9
3	VRI-03, K-1725, TMV-04, K-1799, GG-3, K-1742, K-1936, TMV-03, K-1687, K-1735, T-64, K-1641, Chandra, K-1802,S-206	21-40	Moderately resistant	15
4	K6	41-60	Moderately susceptible	1
5	-	61-100	Highly susceptible	0
			Total	25

counted under a binocular microscope (10x, 100x magnification). Similarly, leaf thickness was also measured under a compound microscope using stage and ocular micrometer. The above observations of leaf characters were compared with the susceptible check, *i.e.* K6

Biochemical analysis

Fresh tender shoot and the leaves were collected from groundnut genotypes, which included resistant, moderately resistant and susceptible group, and were dried at 32^0C in a hot air oven for 48 hr. The samples were powdered using blender for 3 min. The powdered samples were sieved through a 100 mesh screen and stored in sealed plastic containers (0.05 m diameter) at 4^0C for assessment of total sugars and total phenols.

Total sugars

Total sugars were hydrolysed in 1.0 ml of 1.0 N H_2SO_4 to 0.5ml of aliquot and heated over boiling water bath for 30 min. After cooling under running water, one to two drops of phenolphthalein indicator was added. Later 1.0 N NaOH was added by drop to neutralize the acid in the contents till it developed pink colour. Further, 1.0 N H_2SO_4 was added to make it colourless, finally the volume was made up to 10 ml with distilled water and absorbance was read at 510 nm using spectrophotometer (Nelson,1944).

Total phenol content

100 mg of oven dried powdered sample was extracted in 10 ml of warm 80% ethanol for 1 hour at room temperature. The aqueous extract was centrifuged at 6000 rpm for 15 min. After centrifugation supernatant was evaporated to dryness on a water bath and the residue was dissolved in 5 ml water. Alcohol free extract was used for estimation of total phenols (Malick and Singh, 1980; Abdul *et al.,* 2012). An aliquot sample of 0.1ml was diluted to 3ml with water and 0.5ml of Folin-ciocalteau reagent (FCR) was added and mixed well. Exactly after 3min, 2 ml of 20% sodium carbonate solution was added and kept on 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. Finally a standard graph was constructed with Catechol as a standard. The total phenol content was expressed as mg. g^{-1} of dry weight sample.

Statstical Analysis

After the crop-attained maturity, the pods were harvested separately from each screening plot, dried properly and pod weight was recorded. Further, the plot wise yield was calculated for statistical interpretations.

RESULTS AND DISCUSSION

Field screening of 25 groundnut varieties against leaf miner revealed that nine genotypes K-1451, VG-9521, ICGV-94379, K-1736, VRI(GN-6) , K-1661, TGLPS-03, K-1706 and K-1809 were resistant with cumulative mean per cent foliage damage between 10 to 12.54. whereas, the 15 genotypes were showed moderately resistant reaction *viz*., VRI-03, K-1725, TMV-04, K-1799, GG-3, K-1742, K-1936, K-1687, TMV-03, K-1735, T-64, K-1641, Chandra, K-1802 and S-206 recorded with 20.46 to 28.72 per cent foliage damage and the susceptible check K6 was the genotype only showed moderately susceptible reaction with a foliage damage of 42.91 and pod yield of 3.26 kg per plot was obtained. Among the 25 genotypes screened during the season *kharif* & *rabi* 2017-18, the genotype K- 1809 recorded with lower per cent foliage damage of 10 and the maximum pod yield of 4.65 kg per plot was obtained. The present results were in similar lines with the findings of Ghule *et al*. (1988) reported eighteen entries were moderately resistant (21 to 40%). The yields recorded in different groundnut genotypes are in similar trend with Harish (2008) who reported the yields recorded in resistant genotypes were most probably due to differences in infestation of leaf miner.

Among the 25 genotypes, studied for morphological visual leaf characters like leaf shape and leaf colour did not have profound influence on the foliage damage by *A. modicella*.

Leaf colour

Among the twenty five genotypes studied for leaf colour, twelve genotypes recorded with normal green colour, and other eight genotypes recorded with dark green in colour and the rest five genotypes were shown light green colour. The resistant variety K-1809 showed dark green coloured leaves exhibited high degree of resistance to *A. modicella*. A few of the varieties like VRI-03 and TMV-03 with dark green leaves showed moderate resistant response to leaf miner. The susceptible check Kadiri-6 noticed normal green colour but exhibited more foliage damage among the genotypes screened. The results are more or less similar with the findings of Lava Kumar Reddy (2000) who reported that out of the 55 ICRISAT cultures screened, the lowest incidence was observed in cultures having dark green thick leaves *viz*., ICGV-86031 (20%), ICGV-87495 (25%), ICGV-87237 (30%), ICGV-86011 (30%), ICGV-87206 (30%) and ICGV-87165 (30%) respectively.

Leaf shape

Among the twenty five groundnut genotypes studied for leaf shapes, four types of leaf shapes such as ovate, oblong, lanceolate and oblong lanceolate were recorded. Out of them fifteen genotypes were observed with leaf shape of oblong, three of them ovate in shape, two of them with lanceolate shape and the remaining five genotypes were noticed with oblong lanceolate. The resistant genotype K-1809 observed with ovate leaf shape, whereas, the genotype Kadiri-6 with oblong shape was noticed.

Leaf thickness & Trichome density

Among the 25 genotypes characterised for morphological parameters like leaf thickness and trichome density varied from 20.33 to 31.51 mm and 24.53 to 35.02 No. per 3 mm^2. The resistant genotypes like K-1809 and other genotypes with resistance reaction showed leaf thickness and trichome density ranged from 31.51 to 27.76 mm and 32.09 to 35.02 No. per 3 mm^2 compared to lower leaf thickness (20.33 mm) and trichome density (24.53 No. per 3 mm^2) recorded in susceptible genotype Kadiri-6. Leaf thickness and trichome density recorded in various genotypes were shown significant positive correlation (r= 0.920 & r= 0.940) with foliage damage due to the infestation of leaf miner. The findings draws support from the report of (Mothilal, 2012) who reported that biophysical characteristics like leaf thickness and trichome density are said to be responsible for resistance against leaf miner in groundnut. Thus it was clear that presence of more leaf thick ness and more trichome density imparts resistance to the damage by leaf miner.

Phenols and total sugars

Of the 25 genotypes screened, total sugars and phenol contents of the leaves analysed varied from 2.04 to 5.68 mg.g-1 to 0.37 to 0.84 mg.g-1. The lower sugar content and the higher phenol contents were recorded among the resistant genotypes like K-1809 were 2.04 and 5.68 $mg.g^{-1}$ respectively. The moderately resistant genotypes recorded slight lower content of phenol and high amount of total sugars than resistant genotypes. The susceptible check Kadiri-6 was recorded higher sugar content and lower phenol content of 5.68 mg.g-1 and 0.37 mg.g-1 respectively. The presence of higher phenol content implied resistance among the genotypes screened. Thus, results revealed that phenols showed significant negative correlation (r= -0.904) but the total sugars showed significant positive correlation (r= 0.936) on the foliage damage by leaf miner. The results are in accordance with the findings of Kandakoor *et al*. (2013) who conducted biochemical analysis with regard to thrips revealed that phenols and tannins showed significant negative correlation (r=-0.641, -0.784). The results are in line with findings of Chandrayudu *et. al* (2016) reported that presence of high sugar content and lower phenol content in the leaves of groundnut genotypes positively correlated with damage of thrips and jassids.

CONCLUSION

The 25 groundnut genotypes screened, among them nine genotypes categorised under resistant category, 15 genotypes exhibited moderate resistent response and only the genotype Kadiri 6 showed moderately susceptible reaction. As more than 70 % of the groundnut growing area comes under rainfed cultivation in India, resource poor farmers are neither adopt nor affordable to take any plant protection measures. The poor farmers not afforded to incure more expenditure on the insecticides against *A. modicella* that had been employed for pest control. This problem can be overcome by using hybrids developed with wide variety of genetic base.

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