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EVALUATION OF COTTON GENOTYPES AGAINST THRIPS, *THRIPS TABACI* (LINDEMANN) FOR HOST PLANT RESISTANCE

Jayasree M.[1*], N.K. Bhute[2], B.V. Deore[3], Y.S. Saindane[3] and R.R. Jadhav[4]

[1]Department of Entomology, MPKV Rahuri, Dist- Ahilyanagar (MS), India-413722
[2]All India Coordinated Cotton Improvement Project, MPKV Rahuri, Dist- Ahilyanagar (MS), India-413722
[3]AINP on Pesticide Residues & Contaminants, Department of Entomology,
MPKV Rahuri, Dist- Ahilyanagar (MS), India-413722
[4]AICRP on Forage crops and Utilization, MPKV Rahuri Dist- Ahilyanagar (MS), India-413722
*Corresponding author E-mail: sreejaya471@gmail.com
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ABSTRACT

An experiment entitled "Evaluation of Cotton genotypes against Thrips, *Thrips tabaci* (Lindemann) for host plant resistance" was conducted at, AICRP on Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahilyanagar (MS) during *Kharif,* 2024. Seven cotton genotypes including resistant check (NDLH-1938) and susceptible check DCH-32 were selected for screening against thrips. Among different cotton genotypes AKH-2013-3, RAH-1076 found superior followed by Ajeet-155 BG-II, Jadoo BG-II. However, NCS-866(Asha) found to be susceptible. Morphological characters were studied for all genotypes to analyse the characters associated with resistance or susceptibility to thrips. It found that leaf thickness, leaf trichome density, gossypol glands are significantly negatively correlated, and the effect of leaf nectar glands cannot be determined as there was no variation in the number of nectar glands across the genotypes. However, it is likely that a single character is not enough for the development of host- plant resistance against insect pests instead a combination of different characters could play a role.

Keywords: Cotton genotypes, Host plant resistance, *Thrips tabaci*, Susceptibility

Introduction

Cotton (*Gossypium hirsutum* L.) (2n=4x=52) is an allotetraploid species belongs to Malvaceae family which is one of the most significant, economically and socially important cash crops in the world. Cotton is cultivated in more than 80 countries in the world. Leading cotton producing countries are India, China, United States, Brazil and Pakistan which make over 75 per cent of total world cotton production (Anon., 2022a). India contributes to 37 per cent of the world's cotton growing area, 22 per cent of world's cotton production and 10.2 per cent of total global exports. India accounts for 26 per cent of global production (Rajput *et al.,* 2023).

The key cause of yield reduction was pest attack (Murugesan *et al*., 2010). The cotton ecosystem of India harbours about 162 species of insects which are known to attack cotton at various stages of growth, of which 15 are key pests. Cotton output and yield are reduced in the early stages by sucking pests such as aphids, thrips, jassids and whiteflies and in the later stages reduced by various kinds of bollworms. For cotton producers, the commercial introduction of transgenic *Bt* cotton to India in 2002 has been beneficial, since it has made it possible to attain them

maximum yields with superior quality. Although control measures have been carried out, significant losses above 12 per cent were estimated (Oerke, 2006). Sarma *et al*. (2021) suggested that yield loss per hectare due to sucking pests is 8.45 quintal. Among the sucking pests thrips, *Thrips tabaci* (Linn) is the most common and key pests in cotton. Important problem limiting the profitable production of cotton seems to be thrips, *Thrips tabaci.* This is one of the most troublesome early seasons sucking pests, it feeds on the plants and spreads viruses such as Tobacco Streak Virus (TSV) which have a direct impact on cotton yield (Rageswari *et al*., 2021).

Host Plant Resistant (HPR) offers a cost effective and ecologically friendly way to reduce sucking pests. Hence one of the finest substitute methods is the use of resistant cultivars (Nawab *et al*., 2014; Salman *et al*., 2011). Herbivorous insect pests behaviour is influenced by specific plant characteristics, which influences their decision to accept or refuse food.

Therefore, the present investigation was conducted to identify the resistant cotton hybrids against thrips under field conditions. Further, morphological characters such as leaf thickness, trichome density, and number of gossypol glands and the yield of different cotton genotypes are studied in order to have a better understanding of the traits of the cotton genotype linked to resistance or susceptibility to thrips.

Materials and Method

Site of the experiment

The field experiment entitled "Evaluation of cotton genotypes against thrips, *Thrips tabaci* (Lindemann) for host plant resistance" was conducted during *Kharif* 2024-25 at the All India Coordinated Cotton Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. The site is situated at 19°48′ N latitude, 74°65′ E longitude, and an elevation of 511m above mean sea level in the scarcity zone of Maharashtra. The soil of the experimental plot was black cotton soil.

Experimental materials

The experimental material consisted of 7 different cotton genotypes AKH-2013-3, RAH-1076, Ajeet-155 BG-II, Jadoo BG II, NCS-866 (Asha), along with one resistant check NDLH-1938 (RC) and susceptible check DCH-32(SC).

Evaluation of cotton genotypes against thrips under field conditions

Field experiment design

The experimental materials were sown in Randomized Block Design (RBD) during June 2024. The plot size was 7.20m×1.80m with three rows. Plant × plant and row × row distance was 90cm and 60cm, respectively. Three replicates each of 7 genotypes, each plot comprised three rows. Standard agronomic practices were performed throughout the growing season.

Estimation of sucking insect pest infestation

The population count of thrips (nymph and adult) was taken at fortnightly interval starting from 45 DAS till 90 DAS. Three plants were randomly selected in one plot and from each plant, three leaves *i.e.,* upper, middle and lower leaves were observed to record the pest population (Ahmad *et al*., 2011).

Estimation of morphological traits against thrips and jassid

Leaf Thickness (mm)

Five randomly selected leaves per plant were taken for measuring thickness of leaf lamina and the averages were calculated and expressed in millimetres (mm). A digital micrometry was used for this purpose.

Trichome density

Leaf samples were collected and cut into one square centimetre size. The leaf samples heated 20 ml of water in small glass vials for 15 minutes at 85^0C. Water was later decanted and 20 ml of 96 per cent ethyl alcohol was added. The samples were boiled at 80^0C for 20 minutes. The alcohol was drained, and fresh alcohol was added till chlorophyll removed completely. The leaf samples then boil at 5^0C by adding 90 per cent concentrated lactic acid until the leaf segments get cleared. The vials then cooled and stored for observation. Finally, the number of trichomes per cm^2 and the trichome length were counted under the compound microscope at 45 x magnification (Khan and Agarwal, 1984).

Gossypol glands (number/cm^2)

The gossypol glands of leaf were estimated from the lower side of the leaves and the number of glands was counted under a stereo binocular microscope from one cm^2 area of each leaf. In leaves, the glands were counted randomly from the opposite ends, one closer to the petiole and the other at the distal end of the leaf as well as from the sides of the leaf at 90 days after planting (Bryson *et al.,* 1983).

Leaf Nectarines

Presence or absence of nectarines in cotton genotypes are recorded.

Stem Hairiness

Genotypes classified as smooth, medium and dense based on plant stem hairiness.

Results and Discussion

Incidence of thrips on different cotton genotypes

According to research works, thrips are found to be active from 45 DAS to 90 DAS which varied across the DAS and genotypes. However, the peak thrips activity was identified 60 DAS and least during 45 DAS. It crossed ETL after 60 days of sowing and remained above ETL till 75 to 80 DAS and it got reduced at later stages of crop growth. Analysis of pooled average of thrips population over the entire observation period depicted that AKH-2013-3 had lowest count of thrips 7.27/3 leaves which was at par with RAH-1076 (10.97/3 leaves) followed by NDLH-1938 (RC) (15.62/3 leaves). Next genotypes in order were Ajeet-155 BG-II (18.86/3 leaves) which was at par with Jadoo BG II (19.37/3 leaves) followed by NCS-866 (Asha) (22.61/3 leaves) remarkably, highest thrip population was recorded in cotton genotypes DCH-32(SC) and (45.65/3 leaves)

Grouping of cotton genotypes

All cotton genotypes were analysed for leaf injury grade and divided into four groups. According to the information, AKH-2013-3, RAH-1076, NDLH-1938 (RC) are resistant varieties with grade I and Ajeet-155 BG-II, Jadoo BG-II are categorized into moderately resistant genotypes with grade II. Whereas the genotype NCS-866 (Asha) is susceptible and categorized into grade III, DCH-32 is highly susceptible and categorized into grade IV, which was similar with the findings Phulse and Udikeri (2014) observed the sucking pest incidence in *Bt* and Desi cotton with highest incidence of thrips and leafhoppers was on MRC-7918 BG-II (Bahubali BG II) (17.3 and 5.7/3 leaves respectively) and lowest on DDhC-11. Unknown factors like thickening of cuticles and cell walls, leaf parching and unique plant parts are also important non-preference factors for insects (Harijan *et al*., 2017). Manivannan *et al.* (2017); Murugesan and Kavitha (2010) observed that characters like leaf thickness, phloem thickness, distance from lower epidermis, palisade cell length and trichome length are also important parameters for conferring resistance against leafhoppers. Farooq *et al*. (2018) screened fifteen genotypes of cotton against thrips and found that FH-142 proved to be the least attractive cultivar with population of 0.67 thrips/leaf and the maximum population of thrips was recorded on FH-451 followed by FH-455 and they also observed that on cumulative basis the highest peak of thrips population was recorded on FH-455.

Morphological characters of different cotton genotypes in relation to thrips

The leaf thickness of different cotton genotypes measured varied between 0.49 to 0.26 mm. The leaf thickness was recorded more in AKH-2013-3 (0.49 mm) which was par with Jadoo BG II (0.45 mm), and NDLH-1938 (RC) (0.38 mm) followed by RAH-1076 (0.32 mm) and the genotypes NCS-866 (Asha) (0.31 mm) and the leaf thickness is very less in the genotype DCH-32 (SC) with 0.27 mm Gulzar and Sanpal (2005) found similar observations where leaf thickness shows a negative role against thrips and jassid incidence. Ashfaq *et al.* (2010) reported that thick leaf lamina conferred resistance against leafhoppers.

During the research work, the highest number of trichomes were found in the leaves of cotton genotype AKH-2013-3 with 140.3/cm^2 area which was followed by RAH-1076 (114.6/cm^2 area). Next genotypes in order were NDLH-1938 (RC) (110/cm^2 area), Ajeet-155 BG-II (96.5/cm^2 area), Jadoo BG II (94.5/cm^2 area), NCS-866 (Asha) (88.5/cm^2 area). Whereas the least number of trichomes were registered in DCH-32(SC) (50.7/cm^2 area). These conclusions are supported by studies by Deb *et al.* (2015), who stated that plant characters, such as trichomes are which enable cotton crops resistance to sucking pests. Additionally, Aslam *et al.* (2004) noted that trichome density and leaf hair length were significant morphological traits that contributed to cotton's resistance to leafhopper infestation. Manivannan *et al.* (2021) claimed that between entries, the trichome density varied greatly, ranging from 70 trichomes/mm^2 (DCH-32) to 320.6 trichomes/mm^2 (AKH-1301).The trichome length recordings also show significant negative correlation Sajjad *et al.* (2004) gave the relationship of the insect with hair density and leaf hair length. Murugesan and Kavitha, 2010 exhibited hair length and hair density shows significant negative association with leafhopper damage and oviposition.

The highest number of gossypol glands were recorded in AKH-2013-3 (108.67/cm^2) which was on par with RAH-1076 (105.31/cm^2), Ajeet-155 BG-II (98.63/cm^2), followed by NDLH-1938 (RC) (94.00/cm^2), Jadoo BG II (93.09/cm^2), NCS-866 (Asha) (90.00/cm^2) which were on par with each other and the least number of gossypol glands were seen in DCH-32 (SC) (83.45/cm^2). These observations align

with the results reported by Arif *et al.* (2006), Irfan *et al.* (2008), Khalil *et al.* (2017), Rizwan *et al.* (2021) and Saleem *et al.* (2018), who also found that leaf gossypol glands serve as an important source of resistance against major sucking pests such as thrips, jassid and whiteflies.

Considering the number of nectar glands in the cotton leaves, there was no discernible variation across the different genotypes. Our study on nectar glands revealed no significant differences in the number of nectar glands among the evaluated genotypes, making it difficult to assess their influence on pest populations. However, Siddiqui *et al.* (2021) reported that genotypes possessing nectar glands showed lower populations of thrips when compared to variants with less nectar glands. Stem hairiness prevents sucking pests like thrips and from moving around and feeding, thereby developing a physical barrier. It inhibits the effectiveness for nutrition and egg laying.

Yield of cotton genotypes

The yield of different cotton genotypes varied from 5.48 to 14.52q/ha. The lowest yield was recorded in DCH-32(SC) with 5.48q/ha. The genotypes NCS-866 (Asha) (8.56 q/ha), NDLH-1938 (RC) (9.15 q/ha), RAH-1076 (10.46 q/ha), AKH-2013-3(11.28 q/ha) were par with each other. The highest yield was recorded in the BG-II genotypes Ajeet-155 BG-II (13.55 q/ha), Jadoo BG II (14.52 q/ha) were at par with each other. The *Bt* cotton genotypes have recorded highest cotton yield compared to non-*Bt* cotton genotypes as they are resistant to major insect pests of cotton such as bollworms and moderately resistant to sucking pests but the cotton genotypes AKH-2013-3, RAH-1076 has recorded less yield compare to *Bt* genotypes as they are only resistant to sucking pests but not to the bollworms.

Correlation between incidence of sucking pests (thrips) and morphological components

Leaf thickness had significant and negative correlation with the thrips population (r= -0.714). Trichome density also had significant and negative correlation with the thrips (r= -0.964). Whereas the number of gossypol glands/cm^2 also showed significant and negative correlation with both the pests (thrips= -0.863).

Conclusion

Cotton genotypes, AKH-2013-3, RAH-1076 can be suggested as resistant while Ajeet-155 BG-II, Jadoo BG-II are moderately resistant. The susceptible variety is NCS-866(Asha) with DCH-32 being the highly susceptible check against the sucking pests, thrips. Morphological characters such as Leaf thickness, Stem hairiness, Trichome density and Number of gossypol glands are negatively correlated with thrips incidence. However, it is likely that a single character is not enough for the development of host-plant resistance against insect pests instead a combination of different morphological characters could play a role.

Table 1 : Incidence of thrips on different cotton genotypes

Sr. No.	Genotypes	Number of thrips /3 leaves				
		45 DAS	60 DAS	75 DAS	90 DAS	Mean
1	AKH-2013-3	3.40 (1.84)	10.25 (3.20)	9.20 (3.03)	6.52 (2.55)	7.27 (2.70)
2	RAH-1076	3.45 (1.86)	15.00 (3.87)	11.11 (3.33)	4.32 (2.08)	10.97 (3.31)
3	Ajeet-155 BG-II	4.78 (2.19)	38.10 (6.17)	27.40 (5.23)	5.18 (2.28)	18.86 (4.34)
4	Jadoo BG II	4.50 (2.12)	35.90 (5.99)	23.80 (4.88)	13.30 (3.65)	19.37 (4.40)
5	NCS-866 (Asha)	4.20 (2.05)	38.00 (6.16)	30.10 (5.49)	18.15 (4.26)	22.61 (4.75)
6	NDLH-1938 (RC)	3.30 (1.82)	28.70 (5.36)	18.90 (4.35)	11.60 (3.41)	15.62 (3.95)
7	DCH-32(SC)	19.00 (4.36)	65.10 (8.07)	58.60 (7.66)	39.90 (6.32)	45.65 (6.76)
	SE(m) ±	0.09	0.11	0.07	0.01	0.02
	CD at 5 %	0.26	0.25	0.23	0.04	0.09
	CV %	2.36	0.57	0.49	0.20	0.22

* Figures in the parenthesis indicate $\sqrt{x+0.5}$ transformed values

Table 2 : Morphological parameters in different cotton genotypes

Sr. No	Genotypes	Leaf Thickness (mm)	Trichome Density/cm^2	Gossypol glands/cm^2	Nectar Glands	Stem Hairiness
1	AKH-2013-3	0.49	140.3	108.67	1	Dense
2	RAH-1076	0.32	114.6	105.31	2	Dense
3	Ajeet-155 BG-II	0.38	96.5	98.63	1	Medium
4	Jadoo BG II	0.45	94.5	93.09	2	Medium
5	NCS-866 (Asha)	0.31	88.5	90.00	1	Medium
6	NDLH-1938 (RC)	0.38	110.0	94.00	2	Medium
7	DCH-32(SC)	0.27	50.7	83.45	1	Smooth
	SE(m) ±	0.01	1.68	0.24	-	-
	CD at 5 %	0.04	5.00	0.71	-	-
	CV %	7.05	3.08	0.43	-	-

Table 3 : Yield of different cotton genotypes

Sr. No	Genotypes	Yield (q/ha)
1	AKH-2013-3	11.28
2	RAH-1076	10.46
3	Ajeet-155 BG-II	13.55
4	Jadoo BG II	14.52
5	NCS-866 (Asha)	8.56
6	NDLH-1938 (RC)	9.15
7	DCH-32(SC)	5.48
	SE(m)	0.60
	CD at 5 %	1.79
	CV %	9.01

Table 4 : Correlation between incidence of thrips and morphological compounds

Morphological characters	Degree of correlation
	Thrips
Leaf thickness	-0.714*
Trichome density	-0.964**
Gossypol glands	-0.863**

* - level of significance at 1 %, ** - level of significance at 5 %

Fig. 1: Thrips on leaf

Fig. 2 : Symptoms of plant effected by thrips

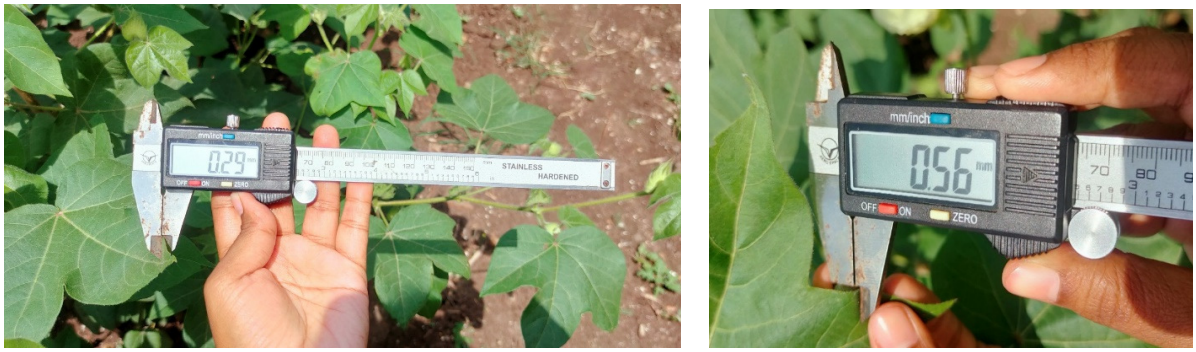
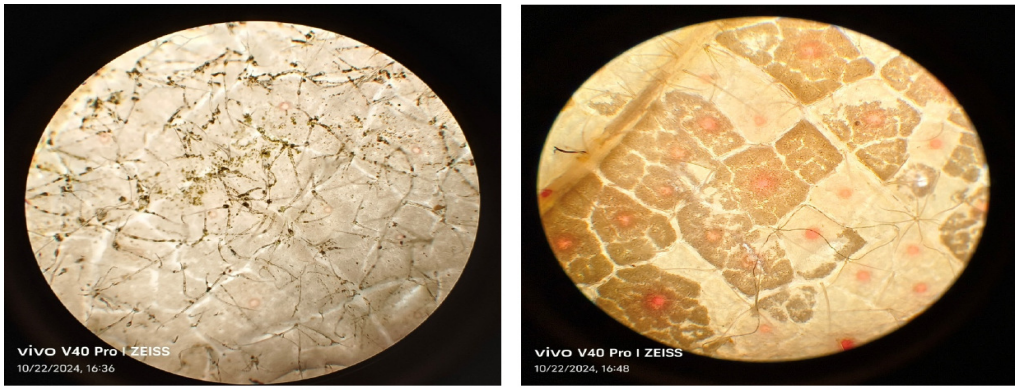


Fig. 3: Leaf lamina thickness measurement by Digital Micrometry

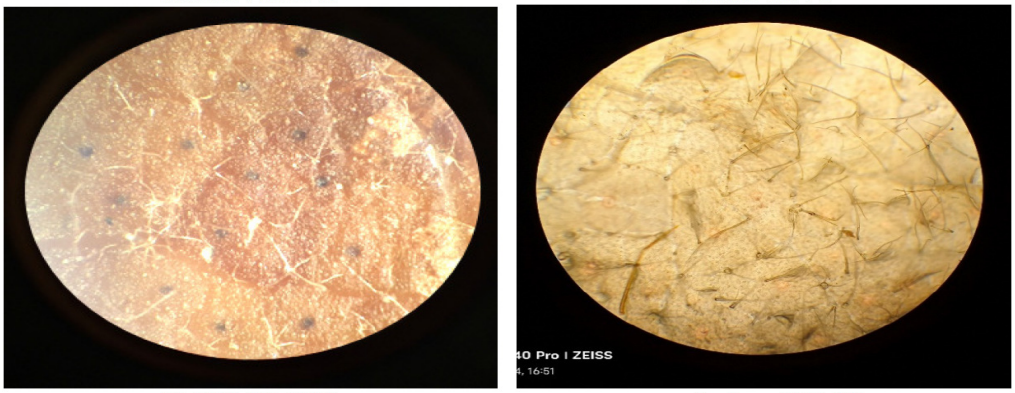
AKH 2013-3 **RAH-1076**

Jadoo BG II **DCH-32(SC)**

Fig. 4 : Stem hairiness of different cotton genotypes

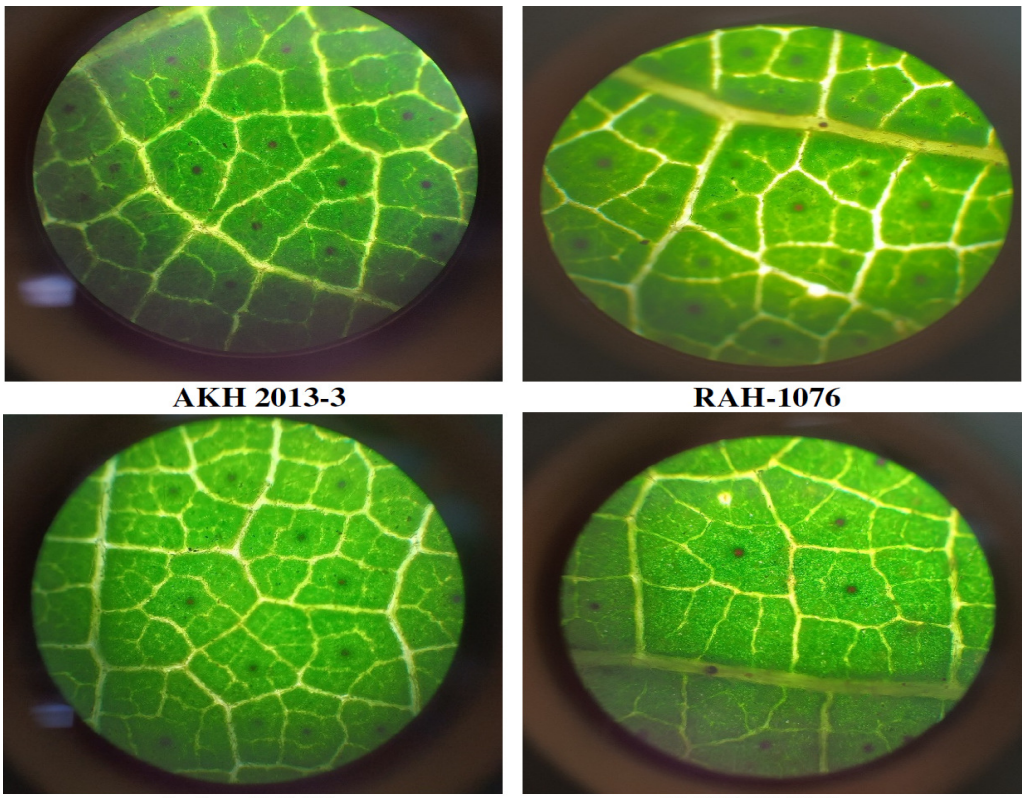


AKH 2013-3 **RAH-1076**



DCH-32(SC) **Jadoo BG II**

Fig. 5: Trichome density of different cotton genotypes



AKH 2013-3 **RAH-1076**

Jadoo BG II **DCH-32(SC)**

Fig. 6 : Gossypol glands of different cotton genotypes

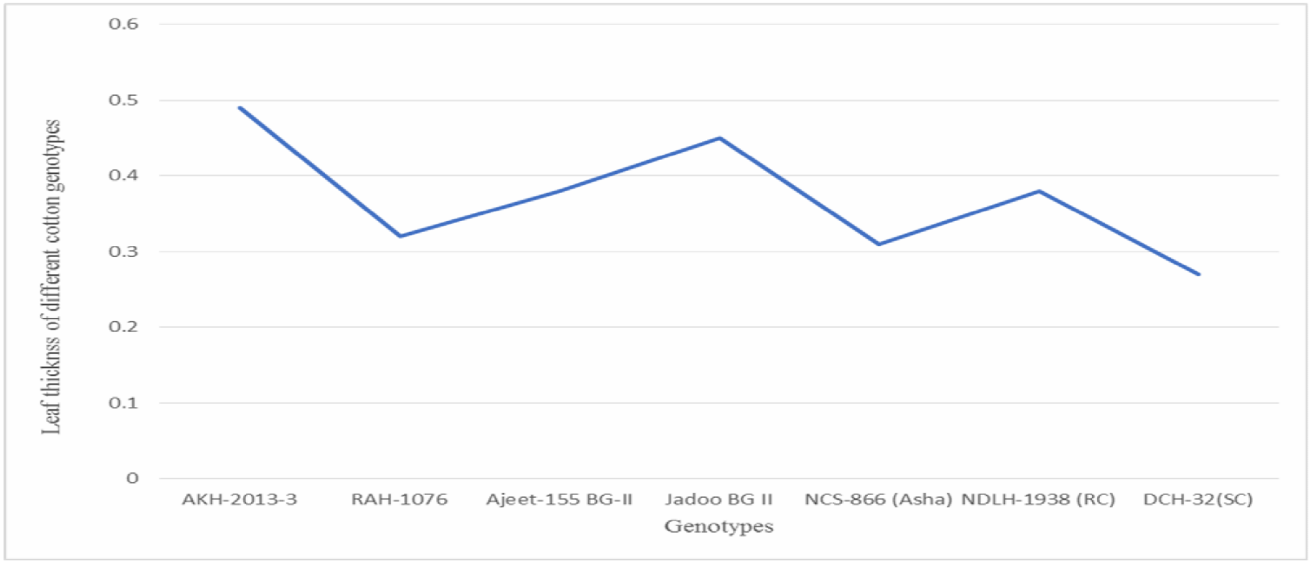


Fig. 7: Leaf thickness (mm) of different cotton genotypes

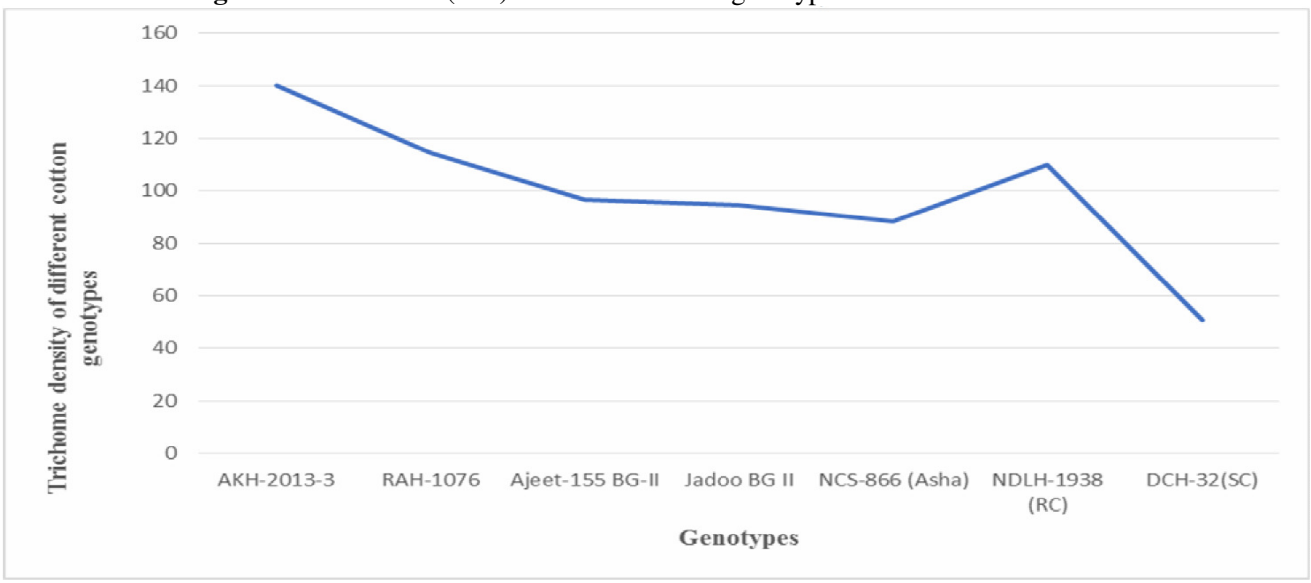


Fig. 8 : Trichome density of different cotton genotype

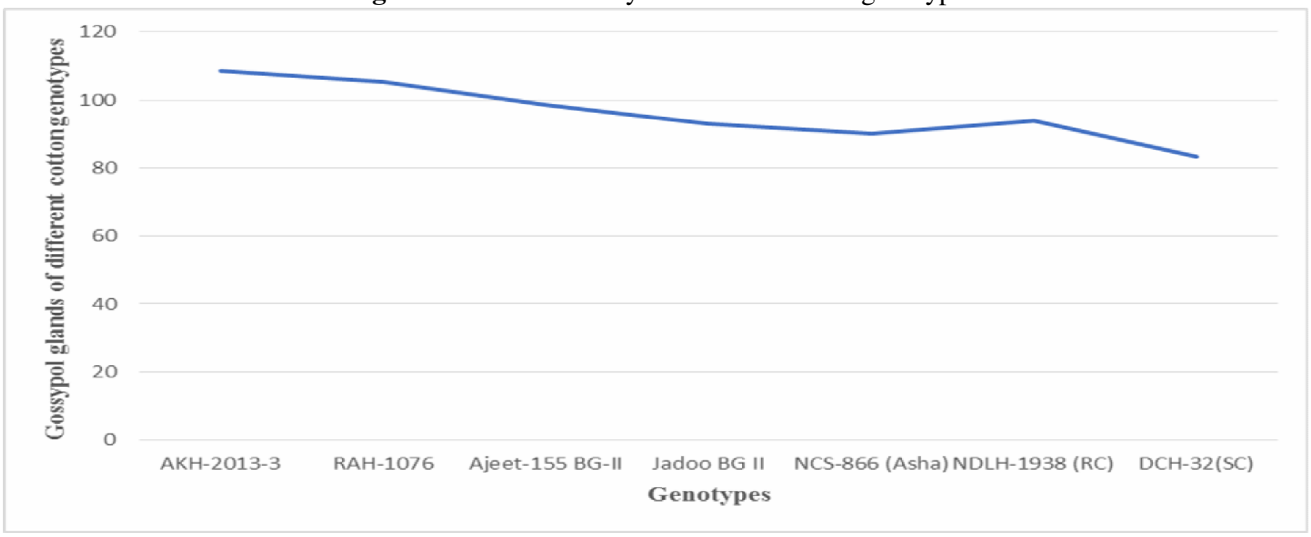


Fig. 9 : Gossypol glands of different cotton genotype

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