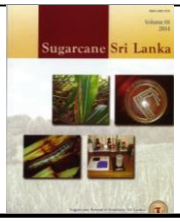
Contents available at: www.sugarres.lk

Sugarcane Sri Lanka

Journal Home Page: https://sugarres.lk/journal



RESEARCH

Effect of physicomorphic leaf characters of sugarcane on the relationship between White Leaf Disease infection under natural environment and behavioural characteristics of *Deltocephalus menoni* (Hemiptera: Cicadellidae); The vector of Sugarcane WLD

K.M.G. Chanchala*[1], V.K.A.S.M. Wanasinghe[1], K.S. Hemachandra[3], L. Nugaliyadde[4], W.R.G. Witharama[2]

[1]*Crop Protection Division, Sugarcane Research Institute, Uda Walawe, 70190, Sri Lanka.*
[2]*Crop Resource and Management Division, Sugarcane Research Institute, Uda Walawe, 70190, Sri Lanka.*
[3]*Faculty of Agriculture, University of Peradeniya, 20400, Sri Lanka.*
[4]*Sri Lanka Organization of Agriculture Professionals, Department of Agriculture, Peradeniya, 20400, Sri Lanka.*

ARTICLE INFO

Article history:

Accepted: 27th March 2026
Published: 30th June 2026
Available online: 30th June 2026

Keywords:
Deltocephalus menoni
Leaf trichome
Stomata
Sugarcane White Leaf Disease
Vector

Citation:
Chanchala, K.M.G., Wanasinghe, V.K.A.S.M., Hemachandra, K.S., Nugaliyadde, L., and Witharama, W.R.G., 2026. Effect of physicomorphic leaf characters of sugarcane on the relationship between White Leaf Disease infection under natural environment and behavioural characteristics of Deltocephalus menoni (Hemiptera: Cicadellidae), the vector of Sugarcane WLD. Sugarcane Sri Lanka, 5(1), pp. 32-42

Available at:

https://doi.org/10.67346/ssj005013242

K.M.G. Chanchala.
https://orcid.org/0000-0002-8433-9372

CC BY

* Corresponding author- g.chanchala@yahoo.com

ABSTRACT

Physicomorphic leaf characters are important component in plant resistant against herbivorous insects. This study was conducted to identify the varied response of *D. menoni*, in relation to plant and leaf physicomorphic characters to understand the relationship between *D. menoni* resistant and plant characteristics. Ten sugarcane varieties were used in study and Pearson correlation coefficient test was performed to detect the associations existing among leaf characters, insect behavioral characteristics and WLD intensity. Significant and positive correlations were observed for nymphal period with trichome density on leaf lamina ($r = 0.47$, $p<0.05$) and on the mid rib ($r = 0.45$, $p<0.05$), showing retarded development of nymphs on varieties with high trichome densities. Trichome length on leaf lamina showed positive and significant correlations with amount of feeding ($r = 0.62$, $p<0.05$), adult conversion rate ($r = 0.54$, $p<0.05$), and adult longevity ($r = 0.66$, $p<0.05$). Trichome length on mid rib also showed similar type of relationship with amount of feeding ($r = 0.55$, $p<0.05$), adult conversion rate ($r = 0.55$, $p<0.05$) and adult longevity ($r = 0.64$, $p<0.05$) illustrating that sugarcane varieties consist with higher trichome lengths increases the behavioural characteristics of the vector on the leaf. However, significantly positive correlations were observed between width of stomata on leaf with amount of feeding ($r=0.45$, $p<0.05$) and aggregation ($r=0.52$, $p<0.05$) of *D. menoni.* Results imply that, *D. menoni* prefer sugarcane variety/ accession associate with higher width of stomata in aggregation and particular varieties enhance the feeding of the *D. menoni* on them.

INTRODUCTION

Developing plants that are either resistant to the phytoplasma or deter vector feeding is the first line of defense in sugarcane White Leaf Disease (WLD) management. Plant breeding is mostly directed towards the developing varieties resistant to disease rather than to the vectors; but, several attempts in breeding for vector resistance have also gain success [1].

Breeding of resistance to insects in sugarcane is comparatively difficult due to its complex genome and the inheritance of polygenic traits [3]. Some of this resistance is based on morphological characters [4]. Both pest and natural enemy populations are influenced negatively or positively by physicomorphic leaf characters [5] such as, leaf area, leaf hair density, length of leaf and leaf thickness. These characters influence on the searching capability of the insect [6], [7].

Trichome of plant is important component to resist against herbivorous insects [8], [9], [10], [11], [12]. They act as physical and chemical deterrents to insect activities [13]. Trichomes interfere with insect colonisation, entrapment, physiological incompatibility and/ or lethality [14]. Trichome density also effects on interaction between insect herbivores and natural enemies. Further it effects on tolerance to abiotic stress.

As important resistance features in plants, stomatal density and size are also essential for controlling sap-sucking insects. Stomata are naturally occurring apertures that help regulate water and gas exchange, but they can also affect how easily sap-sucking insects can find and reach the phloem. Greater sensitivity may result from simpler access points for insect feeding that are provided by bigger or higher stomatal densities. On the other hand, plants with smaller stomata or a lower stomatal density make it harder for insects to feed and probe, which hinders their capacity to establish. Because fewer stomata made it more difficult for insects to find appropriate feeding locations, Abdelhamid [15] showed that soybean cultivars with lower stomatal densities were less vulnerable to sucking pests like aphids and whiteflies. Accordingly, selecting or breeding crops with optimal stomatal traits can be an effective strategy for integrated pest management. *Deltocephalus menoni* (Hemiptera: Cicadellidae, Deltocephalinae) is the only locally identified vector of Sugarcane White Leaf Disease (WLD) which is one of the major threats to the cane sugar industry in Sri Lanka [16].

Management of WLD vector has been identified as a strategic and integrated approach to prevent rapid spread of this disease in sugarcane plantations. Developing plants that either are resistant or deter vector behavioural characteristics would be a first line of defence to manage the condition.
This study was conducted with the objective of identifying the varied response of *D. menoni*, in relation to plant and leaf physicomorphic characters to understand the relationship between *D. menoni* resistant and plant characteristics.

MATERIALS AND METHODS

This study was conducted at the entomology laboratory of the Sugarcane Research Institute (SRI), Uda Walawe (Average temperature: 30 and Rh: 69). Sugarcane verities: Co 775, SL 83 06, SL 92 5588, SL 96 128, SL 96 328, SL 97 1442, SLT 4921, SLC 2009 01, and the wild accessions SLC 92 95 (*Saccharum spontaneum)* and SLC 92 77 (*Erianthus arundinaceous*) were used for the study level of leaf lamina epicuticle wax of each variety/ accession and performance of *D. menoni* on these varieties/accessions were studied. Available information on WLD incidences in natural environment was considered in selecting the test varieties/accessions for the study.

Determining the variation of physicomorphic leaf characters of sugarcane varieties/ accessions that have variable resistance to WLD

Density of trichome on unit area of sugarcane leaf (cm^2)

Sugarcane plants were prepared and were used in the experiments viz., 30 plants from each variety.

This article is available at: https://doi.org/10.67346/ssj005013242

At four-month stage of plants, third leaf of the plants (30) was detached and the middle portion of the leaf were taken for the study. A thin layer of a white adhesive was applied on to the lower side of the leaf blade (3 cm sections from the middle of the leaf was used) and the bottom was kept touching water to avoid the desiccation and kept until the glue layer gets dried. Then properly dried glue layer was removed from the leaf piece and placed on a clean slide for trichome observations. Trichome density (15 mm^2 area) was observed under Olympus biological microscope: model CX31 under 10X magnifications. Using prepared slides, different types of trichomes present in each sugarcane variety/ accession, number of trichomes and length of the trichome were measured and recorded.

Stomata density per unit area and width of stomata on sugarcane leaf (cm^2)

Similarly to the trichomes, stomata density (15 mm2 area) was observed under Olympus biological microscope: model CX31 under 10X magnifications. Using prepared slides, number of stomata per unit area and width of stomata in each sugarcane variety/ accession were measured and recorded.

Determining level of WLD infection of selected varieties/ accessions by D. menoni under natural environment

D. menoni prevailing land was selected for the trial establishment. Three budded setts from each variety were obtained and 5 m length three rows from each sugarcane accessions were established according to the randomized complete block design (RCBD) with three replicates. Incidence of WLD infection by *D. menoni* was calculated as follows; Number of WLD symptomatic clumps/ Total number of clumps× 100 [17].

Correlations among performance of D. menoni, level of disease infection with physicomorphic leaf characters

Correlations of leaf trichome and stomata densities, trichome length, stomatal width with D. menoni and level of disease infection were studied using data on leaf trichome and stomata (a) behavioural characteristic of *D. menoni* (b), level of WLD infection of selected varieties/ accessions (c).

Data analysis

Analysis of variance was performed using SAS software version 9.0 to test the WLD infection and insect performance on tested varieties/accessions. Square root transformation was done and the transformed data were used in the analysis. Means were separated using Duncan's Multiple Range Test (DMRT) at 0.05 probability level. Pearson correlation coefficient test was performed to detect the associations between level WLD infection and behavioral characteristics of the vector.

RESULTS AND DISCUSSION

Determining the variation of physicomorphic leaf characters of sugarcane varieties/ accessions that have variable resistance to WLD

Four types of morphologically different trichomes were found on leaf blade and mid rib on test sugarcane varieties (Figure 1).

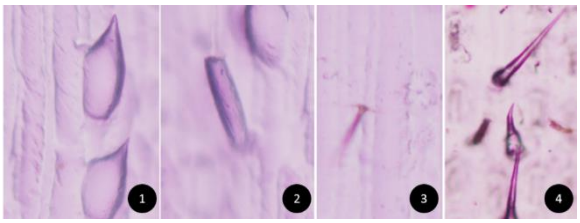


Figure 1: Different types of trichomes recorded on sugarcane leaves of varieties / accessions with variable resistance to WLD (100X4 enlargement)

Type 1 and type 2 trichomes were common on all the test varieties. Type 3 was not observed on two wild relatives and 4 were found only on variety Co 775. Type 1 is prickle-shape, 2 is rod-shaped, 3 is setae shape and 4 is recognised as bicellular micro hair.

Van Dillewijn [18] illustrated three types of trichomes on sugarcane resemble 1, 2, and 4 trichomes and the author had not illustrated type 3 trichome.

This article is available at: https://doi.org/10.67346/ssj005013242

Trichome density (F29, 60= 2.98, p<0.05) and the length (F29, 60= 3.82, p<0.05) of trichome were significantly varied with the sugarcane variety on both leaf blade (F29, 60= 2.90, p<0.05) and the mid rib (F29, 60= 3.61.98, p<0.05). On leaf blade, the highest number of trichomes were recorded on accession SL 92 95 (160.52/15mm^2) and the lowest number of trichomes were recorded on accession SL 92 77 (7.67/15mm2). The highest and the lowest mean length of trichome were recorded on variety SL 96 128 (136.31 µm) and the accession SL 92 77 (24.44 µm) respectively.

In compared to the type 2 and type 3 trichomes, type 1 trichomes number was significantly high in the leaf blade. Length of type one and type two trichomes were not significantly different while type three trichomes had significantly lower length.

silica cells, and trichomes [18]. Artscha wager [19] identified three zones in the upper epidermis viz., 1) a central zone consisting of long cells alternated with groups of short cells, presenting trichomes and silica cells; 2) a stomata zone; and 3) a margin zone consisting of long cells alternated with short cells, also presenting trichomes and silica cells.

Measuring stomata density on unit area and width of stomata on sugarcane leaf

Number of stomata on mid rib, width of the stomata on mid rib, and leaf were significantly varied in sugarcane varieties/ accessions. Number of stomata on leaf in sugarcane varieties/ accessions was not significantly different in sugarcane varieties/ accessions (Figure 3 and Table 2).

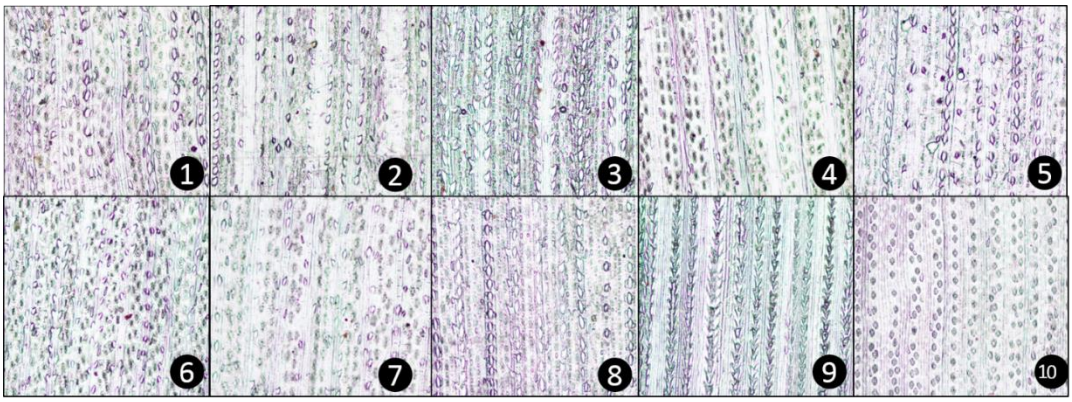


Figure 2: Variation of leaf trichome density on leaf blade of test varieties / accessions with variable resistance to WLD (100X enlargement)

On the mid rib of the leaf, the highest number of trichomes was found on accession SL 92 95 (171.52/15mm^2) and the lowest number of trichomes was found on accession SL 92 77 (2.72/15mm^2). Variety Co 775 had the highest mean length of trichome (128.76 µm) and the accession SL 92 77 had the lowest mean length of trichome (19.13 µm).

Type 1 trichomes were significantly high in number (92.77/15mm^2), in compared to the type 2 (35.33/15mm^2) and type 3 trichomes (2.8/15mm^2). Length of type 1 (106.03 µm) and type 2 (102.4 µm) trichomes were not significantly different while type 3 trichomes (52.68 µm) showed significantly lower length.

In sugarcane, epidermis of leaves presents formations such as bulliform cells, stomata,

Accession SL 92 77 had the highest (344) mean number of stomata and variety Co 775 was having highest mean width of stomata (174.15) on leaf blade (Table 2). Variety Co 775 had the highest mean number of stomata (498.56) and variety SLT 4921 had the highest mean width (144.61) of stomata on mid rib. The lowest mean width of stomata (30.42) on the leaf was recorded on variety SL 8306.

This article is available at: https://doi.org/10.67346/ssj005013242

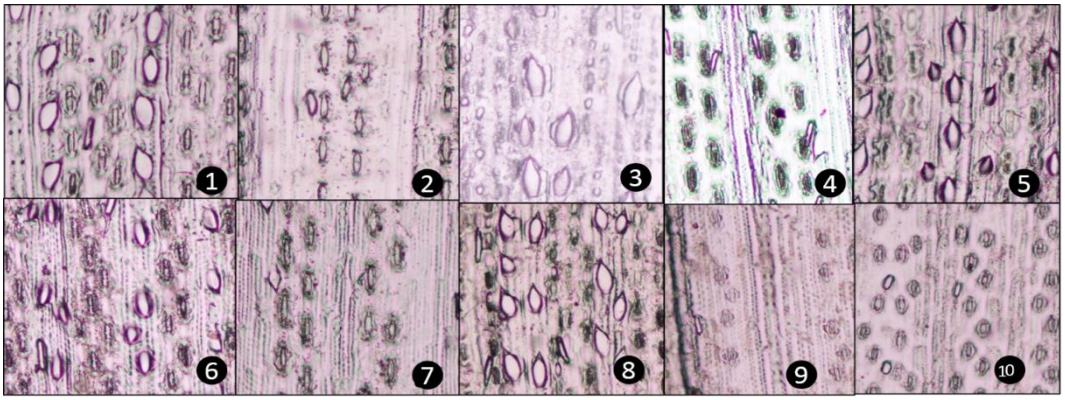


Figure 3: Variation of leaf stomatal density and stomata width on leaf blade of test varieties / accessions with variable resistance to WLD (100X enlargement)

Determining behavioral characteristics of D. menoni on varieties/accessions that have variable resistance to WLD

The mean aggregation of *D. menoni* was significantly varied (F9, 35=18.16, p<0.05) among sugarcane varieties/accessions. The highest aggregation of adults was observed on the variety SL 97 1442 and the lowest aggregation was recorded on SLC 92 95 accession which was not significantly different from several other varieties.

The volume of honeydew production by *D. menoni* is directly proportional to the volume of feeding as shown in the previous studies [2]. Mean honeydew production of D. menoni was significantly higher (F9, 34 =12.6, p<0.05) when it fed on the varieties SL 96 128 (31.59 ± 0.07 mm2) and Co 775 (32.45± 0.07 mm2); hence, these two varieties can be considered as the most preferred sugarcane varieties for feeding of D. menoni. The lowest honey dew production (1.34±1.1mm2) was found when D. menoni fed on SLC 92 77.

The percentage of survival of nymphs of *D. menoni* was significantly varied (F9, 35=17.58, p<0.05) with the sugarcane varieties that they fed on. The highest per centage of survival of nymphs was found when they were on the variety SL96128 (61.71%).

In contrast, lower survival percentages were found when *D. menoni* was on SL 8306 (30.33 ±0.05%) followed by SLC 92 95 (35.34 ± 0.06%) and Co 775 (35.28±0.02%). *D. menoni* was unable to survive on SLC 92 77.

The mean number of eggs laid by *D. menoni* varied significantly with the sugarcane varieties/accessions (F9, 56 =89.54, p<0.05). The highest oviposition (26.56 eggs / 5 days) was found when D. menoni was on the variety SL 8306 and the lowest oviposition (0.08eggs / 5 days) was recorded on SLC 92 77. Contradictorily to the results in feeding, the highest oviposition was recorded on variety SL 8306.

The nymphal period of *D. menoni* significantly varied (F9, 35=31.5, p<0.05) among the varieties/accession. The lowest nymphal periods were recorded on varieties SL 96 128 (15.33 ± 0.03) and SL 96 328 (16 ± 0.06), which were the most favourable varieties for survival of *D. menoni* nymphs.

A longer duration was taken to complete nymphal period when they were on SL 92 5588 (22 ± 0.04), SLC 92 95 (21 ± 0.04) and SL 8306 (21 ± 0.04). Stadium was varied among varieties. *D. menoni* nymphs did not survive on SLC 92 77 and it was also low in SL 96 128 and SL 96 328 while it was high (2±0.001) in SL 92 5588, SL 83 06, and SLT 4921.

This article is available at: https://doi.org/10.67346/ssj005013242

Table 1: Mean trichome number and trichome length on sugarcane varieties; both leaf blade and the mid rib of sugarcane leaves

Variety	Number of trichomes/15 mm²			Length of trichomes (µm)		
	Type 1	Type 2	Type 3	Type 1	Type 2	Type 3
Leaf Blade						
Co 775	033.89±07.21	044.00±21.71	13.2±3.06	140.19±50.62	144.67±42.14	113.98±21.75
SL 83 06	067.56±15.06	067.56±19.32	0.22±0.22	094.96±09.44	060.47±27.75	012.64±12.64
SL 92 5588	108.11±29.74	076.33±65.04	0.56±0.40	113.55±07.51	065.93±31.02	016.05±08.04
SL 96 128	037.56±15.97	017.78±05.14	4.11±0.40	147.48±22.93	138.50±20.62	122.96±04.89
SL 96 328	115.22±12.55	011.78±01.60	5.67±1.58	140.96±33.18	125.51±28.17	100.42±34.22
SL 97 1442	121.67±52.04	056.44±28.22	5.11±4.62	093.41±02.30	104.20±13.82	051.84±36.31
SLT 4921	027.78±08.11	021.00±01.71	1.11±0.80	135.9±47.45	130.54±32.94	062.39±49.42
SLC 2009 01	143.78±14.17	025.22±08.85	2.00±2.00	150.62±30.95	131.86±28.35	023.87±23.87
SLC 92 59	379.33±86.12	102.22±10.22	0±0.00	060.59±24.43	022.88±22.88	0±0.00
SLC 92 77	0±0.00	023.00±06.16	0±0.00	0±0.00	073.31±04.52	0±0.00
Mid Rib						
Co 775	035.78±05.01	044.67±30.44	5.67±1.58	148.53±92.83	139.76±99.17	097.98±57.47
SL 83 06	052.78±14.21	045.11±28.79	3.89±3.89	094.14±08.00	087.94±10.97	019.16±19.16
SL 92 5588	107.78±36.98	055.78±31.05	0.67±0.67	107.03±02.09	114.44±12.51	028.39±28.39
SL 96 128	040.44±15.23	010.44±03.95	3.33±0.51	133.06±21.38	124.35±22.53	110.42±13.28
SL 96 328	113.67±23.92	015.00±02.59	5.00±1.92	142.61±31.59	120.49±22.88	101.16±29.91
SL 97 1442	073.00±31.36	034.56±14.78	3.00±2.83	104.69±11.69	105.54±18.82	046.62±29.32
SLT 4921	017.56±05.31	015.22±01.85	2.56±1.54	128.26±35.57	128.02±25.63	043.41±29.64
SLC 2009 01	083.00±08.74	013.11±05.08	3.89±2.08	144.41±38.46	120.15±45.89	079.68±19.73
SLC 92 95	403.22±20.27	111.33±17.69	0±0.00	057.56±26.87	025.91±20.08	0±0.00
SLC 92 77	0±0.00	008.11±01.63	0±0.00	0±0.00	057.40±8.34	0±0.00

This article is available at: https://doi.org/10.67346/ssj005013242

Table 2: Mean stomata number and width on both leaf blade and the mid rib of sugarcane varieties/ accessions

Variety	Stomata density (#/mm²)		Width of Stomata (µm)	
	Leaf	Mid-rib	Leaf	Mid-rib
Co 775	271.89±37.69	498.56±281.27	174.15±50.99	121.22±48.18
SL 8306	287.76±21.21	233.11±18.90	030.42±16.71	100.57±08.96
SL 92 5588	243.56±34.61	177.89±02.98	076.77±12.88	081.02±10.69
SL 96 128	262.67±21.98	179.56±31.95	161.78±21.84	142.86±13.40
SL 96 328	312.44±72.01	256.44±54.01	130.59±14.98	111.26±26.18
SL 97 1442	281.00±35.85	208.22±27.67	087.22±12.29	086.76±10.68
SLT 4921	284.56±20.53	189.33±26.94	142.63±41.07	144.61±67.64
SLC 2009 01	258.33±35.62	241.33±70.73	097.65±19.92	114.71±13.97
SLC 92 55	253.67±02.72	253.67±02.72	075.90±00.91	075.90±00.91
SLC 92 77	344.00±09.71	252.44±16.15	085.24±07.01	033.40±06.80

Mean adult longevity was significantly varied with the varieties/accessions (F9, 35=24.86, p<0.05). Adult longevity was significantly high when *D. menoni* was on SLT 4921, Co 775, SL 96 328, and SLC 2009 01 (average of 40.99 ± 0.49d). The lowest adult longevity was found when they were on SLC 92 95 (10.66 ± 0.03d) and the variety SL 92 5588 (11.7 ± 0.04d). *D. menoni* survived only for two days on SLC 92 77 and equal survival period (2 days) recorded for D. menoni adults which subjected to starvation.

Determining Level of WLD infection of selected varieties/ accessions by D. menoni under natural environment

Under the moderate pressure of *D. menoni* and WLD inoculum in the surrounding area, the WLD infection was significantly higher in varieties/accessions SL 97 1442, SL 96 128, and CO 775 while WLD infection was not observed in variety SLC 92 77

Correlations among behavioural characteristics of D. menoni, disease intensity and leaf trichomes and stomata

Correlations of trichomes with behavioural characteristics of D. menoni

Significantly positive correlations were observed between trichome density and length with insect behavioural characteristics. Significant and positive correlations were observed for nymphal period with trichome density on leaf lamina (r = 0.47, p<0.05) and on the mid rib (r = 0.45, p<0.05), showing retarded development of nymphs on varieties with high trichome densities. Trichome length on leaf lamina showed positive and significant correlations with amount of feeding (r = 0.62, p<0.05), adult conversion rate (r = 0.54, p<0.05), and adult longevity (r = 0.66, p<0.05). Trichome length on mid rib also showed similar type of relationship with amount of feeding (r = 0.55, p<0.05), adult conversion rate (r = 0.55, p<0.05) and adult longevity (r = 0.64, p<0.05) illustrating that sugarcane varieties consist with higher trichome lengths increases the behavioural characteristics of the vector on the leaf.

The morphology and density of leaf trichomes vary considerably among plant species, among

populations, and within individual plants. The structure of trichomes can range from unicellular to multi-cellular, and the trichomes can be straight, spiral, hooked, branched, or un-branched [9], [20]. Some trichomes have glands (glandular trichomes) that release secondary metabolites (e.g., terpenes and alkaloids) which can be poisonous, repellent, or can trap insects and other organisms [21]. In some species, individual plants produce both glandular and non-glandular leaf trichomes [22], [23]. Also, leaf trichomes contribute for complex environment by exudating secondary metabolites and proteins that have antibiotic or antixenotic effects [24]. The findings of present study are not in agreement with the response of more of the other insects to trichome density and length; in many cases higher trichome densities cause to reduce performance of insect on particular plants.

There are few reports that trichome densities enhance the performance of pest populations i.e., whiteflies prefer plants with non-glandular trichomes over glabrous plants and preferentially oviposit near trichome bases which provide shelter for the sessile nymphs, and deter natural enemies [25].
Contradictory to the results, higher leaf trichome densities and lengths have proven to be one of the most effective resistant characters in many plants, for example, Lit and Bernado [26] recorded that egg plant varieties with high resistance to the cotton leaf hopper *Amrasca bigutulla* associated with higher leaf trichome densities, lengths, number of branches and higher midrib trichome densities. Jagathesan [27] reported that leaf hairs have been implicated as important factors for insect resistance in sugarcane and Glabrous mutants in which leaf hairs or trichomes are greatly reduced or absent have been identified in sugarcane as susceptible for herbivore insects. Kumarasinghe and Jepson [28] recorded that preference of oviposition of *Pyrilla perpusilla* affected by the spine density although there was no significant effect on feeding of the Pyrilla. Kumarasinghe [29] noted that, during the insect life cycle, advanced stages of development are not affected by the spine density. Agrawal [30] reported that sugarcane clones with low number of spines on their leaves show a considerably reduced susceptibility to the whitefly.

Dutta [31], recorded the significant negative correlation between the trichome density with fecundity and hatching of certain tea clones to red spider mite (*Oligonychus coffeae*) in tea. Gradients in susceptibility and resistance mechanisms of Buddleia *L. taxa* to the two-spotted spider mite (*Tetranychus urticae* Koch) have been identified and the resistance was positively correlated with increased pubescence [31]. Many other agricultural crops also found to be associated with higher trichome densities in pest resistance viz., wheat, cotton, potato, vegetable crops and many other plant spp [10], [25], [33], [22], [34].

Ricci and Capelletti [35] explained the scenario as, number of insect pests found to be high on the cultivars with the lowest leaf hair density as the high densities and lengthier trichomes may create hindrance in searching. Some studies show that the trichome densities do not have any effect on pests as reported by Steinite and Ievinsh [36], non-glandular trichomes on strawberry has no effect on the resistance for spider mite.

War [37] showed that, induction of trichomes in response to insect damage in many plants such as Gray willow, Virginia pepper weed, wild radish, Grey alder, and black mustard. This increase in trichome density in response to damage can only be observed in leaves developing during or subsequent to insect attack. Furthermore, it was also observed that change in relative proportion of glandular and non-glandular trichomes is also induced by the herbivore.

Correlations of stomata density and width with behavioural characteristics of D. menoni

Stomata density on both leaf and mid-rib was not correlated to the insect behavioural characteristics and level of WLD in the natural environment. However, significantly positive correlations were observed between width of stomata on leaf with amount of feeding ($r=0.45$, $p<0.05$) and aggregation ($r=0.52$, $p<0.05$) of *D. menoni*. Results imply that, *D. menoni* prefer sugarcane variety/ accession

associate with higher width of stomata in aggregation and particular varieties enhance the feeding of the D. menoni on them.

There are some research findings are in conformity with our results. Nair [38] confirmed that stomata size of *Pieris taxa* (Ericaceae), is positively correlated with damage occurs due to feeding of lace bug (*Stephanitis takeyai*). The same study further reported that, *S. takeyai* feed by inserting their stylet in to leaf through stomata. Sadof and Neel [39] reported that, thin cuticle and high densities of stomata enhanced leaf penetration, as sucking insects have been known to either penetrate leaf directly through the cuticle or stomates.

CONCLUSIONS

The feeding, survival, and longevity of *D. menoni* increases with higher trichome lengths providing higher opportunities for the vector to transmit the disease. *D. menoni* prefer sugarcane variety/ accession associate with higher width of stomata in aggregation and particular varieties enhance the feeding of the *D. menoni* on them.

REFERENCES

[1] Martin-Tanguy, J. (1997) Conjugated polyamines and reproductive development biochemical, molecular and physiological approaches. *Physiologia Plantarum* 100: 675–688. [CrossRef]

[2] Heinrichs, E. A.; Medrano, F. G. Rapusas, H. R. (1985) Genetic variation for insect resistant in rice. Los Banos, Laguna, IRRI, 118-28. [CrossRef]

[3] White, W. H., Kimbeng, C. A., Gravois, K. A., & Zhou, M. M. (2010). Breeding resistant sugarcane for managing the stem borer *Diatraea saccharalis*: progress and prospects for Louisiana. [CrossRef]

[4] Dicke, M. (1998). *Direct and indirect effects of plants on beneficial organisms.* In: Ruberson, J.R. (ed.) Handbook of Pest Management. [CrossRef]

[5] Krips, O.E. P.W. Kleijn, P.E.L. Willems, G.J.Z. Gols and M. Dicke. (1999). Leaf hairs influence searching efficiency and predation rate of the predatory mite *Phytoseiulus persimilis* (Phytoseiidae: Acarina). *Experimental and Applied Acarology* 23(2):119-131. [CrossRef]

[6] Croft, B. A., Pratt, P. D., Koskela, G. and Kaufman. D. (1999). Predation, reproduction, and impact of *phytoseiid* mites (Acari:Phytoseiidae) on cyclamen mite, *Phytonemus pallidus* (Acari:Tarsonemidae) on strawberry. *Journal of Economic Entomology* (91): 1307-1314. [CrossRef]

[7] Cédola, C.V., Sánchez, N.E. and Liljesthröm, G.G. (2001). Effect of tomato leaf hairiness on functional and numerical response of *Neoseiulus californicus* (Acari:Phytoseiidae). *Experimental and Applied Acarology* (25):819–831. [CrossRef]

[8] Levin, D.A., (1973) The role of trichomes in plant defence. *The Quarterly Review of Biology* 48:3–15. [CrossRef]

[9] Southwood, S.R., (1986). Plant surfaces and insects – an overview. In: Juniper B, Southwood SR (eds) Insects and the plant surface. Arnold, London, 1–22. [CrossRef]

[10] A° gren J, Schemske, D.W. (1993) The cost of defence against herbivores: an experimental study of trichome production in *Brassica rapa*. *The American Naturalist* 141:338–350. [CrossRef]

[11] Karban, R., Baldwin, I.T., (1997). Induced responses to herbivory. The University of Chicago Press, Chicago, IL. [CrossRef]

[12] Traw BM, Dawson TE. (2002). Reduced performance of two specialist herbivores (Lepidoptera: Pieridae, Coleoptera: Chrysomelidae) on new leaves of damaged black mustard plants. *Environmental Entomology* 31:714–722. [CrossRef]

[13] Esau, K., 1977 *Anatomy of Seed Plants*, Ed. 2. John Wiley & Sons, New York. [CrossRef]

[14] Duffey, S.S. (1986) Plant glandular trichomes: their partial role in defence

against insects. In: Juniper B, Southwood SR (eds) Insects and the plant surface, Arnold, London, 151–172. [CrossRef]

[15] Abdelhamid, N. M. R., Khalil Bagy, N. M. M., & Hashem, H. F. (2023). Impact of leaf trichomes and stomatal density on the response of three soybean varieties to sucking pest infestation. *Piercing and Sucking Insects Department, Plant Protection Research Institute, Agriculture Research Center, Giza, Egypt.* [CrossRef]

[16] Seneviratne, J.A.U.T. (2008). An investigation of the secondary transmission of sugarcane white leaf disease in Sri Lanka, PhD Thesis, University of Peradeniya, Sri Lanka.

[17] Chanchala, K.M.G., Wanasinghe, V.K.A.S.M., Hemachandra, K.S., Nugaliyadde, L. and Witharama, W.R.G. (2020) Effect of the Epicuticular Wax Level of Leaf Lamina on the Behaviour of Leaf Hopper *Deltocephalus menoni* (Hemiptera: Cicadellidae); A Vector of Sugarcane White Leaf Disease. Tropical Agricultural Research, 31(1): 73-85. [CrossRef]

[18] Van dillewijn, C. 1952. Botany of sugarcane. Waltham: The *Chronica Botanica,*. 371. [CrossRef]

[19] Astscha Wagerhein, S.A. (1925) Anatomy of the vegetative organs of sugarcane. *Journal of Agriculture* 30: 197-221

[20] Werker, E., (2000). Trichome diversity and development. *Advances in Botanical Research* 31:1–35. [CrossRef]

[21] Duffey, S.S. (1986) Plant glandular trichomes: their partial role in defence against insects. In: Juniper B, Southwood SR (eds) Insects and the plant surface, Arnold, London, 151–172. [CrossRef]

[22] Hare, J.D., Elle, E., (2002). Variable impact of diverse insect herbivores on dimorphic *Datura wrightii*. *Ecology* 83:2711–2720. [CrossRef]

[23] Rautio, P. Markkola, A. Martel, J. Tuomi, J. Harma, E. Kuikka, K. Siitonen, A. Riesco, I.L., Roitto,M (2002). Developmental plasticity in birch leaves: defoliation causes shift from glandular to nonglandular trichomes *OIKOS* 98: 437–446. [CrossRef]

[24] Wagner, G.J., Wang, E. and Shepherd, R.W. (2004). New approaches for studying and exploiting an old protuberance, the plant trichome. *Annals of Botany* 93: 3– 11. [CrossRef]

[25] Krips, O.E. P.W. Kleijn, P.E.L. Willems, G.J.Z. Gols and M. Dicke. (1999). Leaf hairs influence searching efficiency and predation rate of the predatory mite *Phytoseiulus persimilis* (Phytoseiidae: Acarina). *Experimental and Applied Acarology* 23(2):119-131. [CrossRef]

[26] Lit, M.C., and Bernado, E.N., (1990) .Mechanisam of resistance of Eggplant (*Solanum melongena)* to the Cotton leaf Hopper, *Amrasca biguttula* II Morphological and Biochemical factors associated with Resistance. *Philliphine Journal of crop science* 15 (2): 79-84. [CrossRef]

[27] Jagathesan, D., (1977) Induction and isolation of mutants in sugar- cane. Mutat. Breed. News l9: 5–6. [CrossRef]

[28] Kumarasinghe, N.C. and Jepson,P.C. (2003).Antixenotic effect of sugarcane leaves on feeding and oviposition by *Pyrilla perpusilla* Walker. *Sugar technology 5* (1&2): 11 – 19. [CrossRef]

[29] Kumarasinghe , N. C., Wratten, S. D. & Jepson, P. C. (2001). Morphological basis for resistance in sugarcane to *Pyrilla perpusilla* Walker (Homoptera: Lophopidae) International *Journal of Pest Management* 47(2):127-134. [CrossRef]

[30] Agarwal, R.A. (1959). Morphological characteristics of sugarcane and insect resistance. *Entomologia experimentalis et applicata* 12: 767-776. [CrossRef]

[31] Dutta, M. (2015). Morphological resistance of certain tea clones to red spider mite (*Oligonychus coffeae)* in tea. Journal of Entomology and Zoology Studies, 3(4), 454–457. [CrossRef]

[32] Gillman, J. H., Dirr, M. A., & Braman, S. K. (1999). Gradients in susceptibility and resistance mechanisms of Buddleia L. taxa to the two-spotted spider mite (*Tetranychus urticae* Koch). *Journal of the American Society for Horticultural Science*, *124*(2), 114-121. [CrossRef]

[33] Valverde, P.L., Fornoni, J., Nunez-Farfan, J., (2001). Defensive role of leaf trichomes in resistance to Van dillewijn, C. 1952. Botany of sugarcane. Waltham: The *Chronica Botanica,*. 371. [CrossRef]

[34] Handley, R., Ekbom, B., & Ågren, J. (2005). Variation in trichome density and

resistance against a specialist insect herbivore in natural populations of Arabidopsis thaliana. *Ecological Entomology*, *30*(3), 284-292. [CrossRef]

[35] Ricci, C. & Capelletti, G. (1998) Relationship between some morphological structures and locomotion of *Clithostethus orcuatus* Rossi (Coleoptera; Coccinellidae), a whitefly predator. *Frustula Entomologica* 11: 195–202.

[36] Steinite, I., & Ievinsh, G. (2003). Possible role of trichomes in resistance of strawberry cultivars against spider mite. *Acta Universitatis Latviensis*, *662*(1), 59-65. [CrossRef]

[37] War, A.R., Paulraj,M.G. Ahmad,T. Buhroo,A.A Hussain, B, Ignacimuthu, S.,and Sharma, H.C. (2012). Mechanisms of Plant Defense against Insect *Herbivores Plant Signaling & Behavior* 7:10, 1306-1320. [CrossRef]

[38] Nair, S., Bramank, and Knauft DA. (2012) Resistance Mechanisms in Pieris Taxa (Ericaceae) to *Stephani tistakeyai* (Hemiptera: Tingidae) *Environtal Entomology* 41(5): 1153-1162. [CrossRef]

[39] Sadof, C.S., Neel, J.J., (1993). Use of host plant resources by the Euonymus scale, *Unapis euonymi* (Homoptera: diapsiddae). *Annals of entomological society of America* 86:614-620