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Screening of Oil Palm Accessions on the Incidence of Rugose Spiralling Whitefly *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) under Natural Conditions

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ABSTRACT: Twelve oil palm accessions were screened to find the level of resistance against invasive rugose spiraling whitefly, *Aleurodicus rugioperculatus* Martin. From the overall seasonal data it was found that among all the tested 12 accessions, EC 869413 was found to be less infested with rugose spiraling whitefly and the accession EC 869395 was found to be heavily infested. All the other tested accessions EC 869399, EC 869412, EC 869408, EC 869409, EC 869397, EC 869407, EC 869414, EC 869404, EC 869406 and EC 869403 were found to have more or less similar infestation. Among the three locations of leaf/frond, the pest population of RSW was found highest at the tip leaflets of frond when compared to base and middle leaflets. Amongst the direction, southern side leaves were recorded with highest population RSW.

Keywords: Oil palm Accessions, Screening, Rugose spiraling whitefly.

INTRODUCTION

Oil palm (*Elaeis guineensis* Jacq.) is the richest source for vegetable oil production with a capacity of 4-6 tons of oil per ha per year. It is the most sustainable crop to feed the hungry mouths of the world as it is recognized universally as the most efficient, effective and highest yielding form of edible oil production. Palm oil contributes 70% of total vegetable oil import and is one of the cheapest oil due to high productivity per hectare (Kalidas *et al.,* 2014). In India, oil palm covers an area of about 0.3 million hectares with production of about 1.2 million tonnes. In India, Andhra Pradesh, Karnataka and Tamil Nadu are major oil palm growing states. Oil palm covers an area of about 0.15 million hectares in Andhra Pradesh and production of about 1.1 million tonnes.

The perennial nature of palms and the mono cropping system as practiced in many areas provide ample scope for the build up of the pest. In India, about 60 insect species were reported to infest oil palm (Dhileepan, 1991; 1992; Kalidas, 2011) of which many were found be responsible for yield loss.

Major pests contribute to the yield loss *viz.*, rhinoceros beetle, *Oryctes rhinoceros* (L.), leaf web worm, *Acria* sp.; psychid, *Mestia plana*; slug caterpillar, *Damaca tenatus*; scales and mealybug were reported as major pests which feed on oil palm and except the leaf web worm, the rest all are found to migrate from the local ecosystem.

Recently, severe incidence and infestation of invasive rugose spiralling whitefly (RSW) *Aleurodicus rugioperculatus* Martin (Hemiptera: Aleyrodidae) was found on oil palm in Andhra Pradesh and Karnataka states in India. The dangerous invasive pest was reported for the first time on coconut (*Cocos nucifera* L.) at Pollachi, Tamil Nadu in India during August 2016 (Sundararaj and Selvaraj 2017).

The coconut and oil palm farmers and traders are worried about the current status of the whitefly complex in south India and its management as it has become major threat to production and productivity of coconut and oil palm.

Host plant can affect the colonizing insect population by influencing the initial arrival, colonization, rate of oviposition, development of insect population, as well as the damage inflicted and crop loss (Van Emden, 1973; Dent, 1991). These parameters are used to measure plant resistance to insect pests. Variation in the susceptibility levels of many plant species has been exploited in the selection of pest-resistant crop cultivars in many plant families (Havlickova, 1993; Agrawal *et al.,* 1991; Ciepala and Sempruch 1999).

The use of host plant resistance in the development of oil palm varieties that can withstand infestation to the rugose spiralling whitefly is however yet to be exploited. Sundararaj and Selevaraj (2017); Chandrika *et al*. (2017) reported that among the various coconut cultivars, dwarf palms are more preferred by RSW when compared to tall varieties. Selvaraj *et al*. (2016) also reported that high incidence of RSW was observed more on hybrid and dwarf varieties *viz*., Chowghat Orange Dwarf, Malayan orange dwarf and Gouthami Ganga.

The population of mustard painted bugs was observed in 50 germplasms taken under screening to see the performance of germplasms based on the level of infestation of mustard painted bugs. Based on painted bugs population, RC-1, RC-4 and RC-27 were found resistance registering (below 1.5 bugs per plant), RC-3, RC-5, RC-13, RC-14, RC-16, RC-17, RC-19, RC-25, RC-30, RC-32, RC-33, RC-34, RC-42, RC-43, RC-45 and RC-48 were found moderately resistance (between 1.5 to 2.1 bugs per plant), whereas, RC-12 and RC-50 were found highly resistance against this pest (above 2.1 bugs per plant) (Naval and Singh 2023).

Ten different varieties of mustard were screened for resistance/susceptibility against major insect pests of mustard under field conditions results unfolded that variety Giriraj could be an auspicious source of resistant against major insect pests of mustard, however, in specific, PM-26, PM-28 and Giriraj had better control over leaf webber *Crocidolomia binotalis* (Zeller), mustard sawfly *Athalia lugens proxima* (Klug) and aphids *Liphapis erysimi* whereas NRCHB-101, RH-74944 and ACN- 09 were deemed to be susceptible cultivars against major insect pests of mustard (Vinyas *et al*., 2022).

As per the Sneha *et al.* (2022) screening of fifty maize inbreds against maize fall armyworm revealed that, on the basis of leaf damage and kernel damage rating BOX.NO 72173-2-1-1 recorded minimum leaf damage, BOX.NO.1076-5-2-2 recorded minimum kernel damage while, the BOX.NO 426-3 recorded maximum leaf damage (6.6, BOX.NO 1076-5-4-1, 9119-1-2-1 and BOX.NO 426-3 recorded maximum kernel damage

Observations made in Cote d'Ivoire, indicate that differences exist in the susceptibility of palms to the pest, *C. lameensis* (Dimkpa, 2004). The South American palm, *E. oleifera* and the hybrid between *E. Oleifera* and *E. guineensis* were reported to be less susceptible to *C. lameensis* than *E. guineensis* (Philippe, 1977). A high variation in the fecundity of *C. lameensis* has also been observed on different oil palm plantations in Cote d'Ivoire (Mariau and Lecoustre 2000).

The studies of Oliveira *et al.* (2021) on screening oil palm genotypes revealed that genotype has an impact on the infestation by defoliating caterpillars. Oil palms at reproductive age are more prone to higher infestation levels than young trees. Intra-specific genotypes are more vulnerable than inter-specific genotypes to infestations by defoliating caterpillars.

A total of 122 lines of oil palm-Dura female plant, 2 lines of Pisifera male plant, and 4 Tenera commercial varieties (A, B, C and SUP-PSU1) were screened for resistance against *Curvularia* leaf spot and found that 13 Dura lines as highly resistant to CLS (0% disease incidence), whereas one line (129) and the commercial variety B were highly susceptible (100% disease incidence). Three Tenera hybrid lines (138, 187 and 203) showed high resistance to CLS significant difference from susceptible lines. These were the most highly resistant varieties to CLS and should be considered for breeding programmes of oil palm stock among the cases tested (Kittimorakul *et al*., 2019).

Fathul *et al*. (2018) found that plant variety in oil palm DXP gave an effect towards the population male, female and total (male and female) of *Oryctes rhinoceros*. It is probably due to different plant varieties have different chemical compounds inside the palm and different morphology that will attract the *Oryctes rhinoceros* differently.

In an earlier study (Appiah *et al.,* 2007), it was observed that there were slight variations in the ability of oil palm progenies to support the development and growth of the oil palm leaf miner, *C. lameensis.*

While considering the varieties of oil palms, DXP PPNJ 1 and DXP PPNJ 2 gives an effective stance towards the population of the *Oryctes Rhinoceros* male, female and total (male and female) aspects, there was significantly difference ($P < 0.05$) in population of male, female and total (male and female) of *Oryctes rhinoceros* in oil palm and the study found that sampling weeks did not give significant effects ($P > 0.05$) but plant variety gave effect towards the population of *Oryctes rhinoceros* in oil palm (Izaitul Aida *et al*., 2020).

In order to develop a resistant/ tolerant variety in oil palm against invasive rugose spiralling whitefly, it is highly essential to identify the resistant source. Keeping this in view, the present investigation on "Screening of oil palm accessions against invasive whitefly species rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin under natural conditions" was under taken to identify resistant source in oil palm accessions.

MATERIAL AND METHODS

A field experiment was conducted in a randomized block design (RBD) with twelve oil palm accessions. *viz*., EC 869395, EC 869404, EC 869406, EC 869408, EC 869414, EC 869397, EC 869399, EC 869403, EC 869407, EC 869409, EC 869412 and EC 869413 available in germplasm block GP VII at ICAR-IIOPR, Pedavegi during 2021-22. Three unsprayed five years age palms from each accession were selected by simple random technique to record the observations on RSW. The package of practices except plant protection measures was followed.

In each palm of an accession, lowermost four leaves from four directions were selected for data collection.

In each frond six leaflets, two each from base, middle and tip were selected to record the incidence of RSW. Data recorded on number of colonies, adults and nymphs of RSW at fortnight interval starting from February to May.

The data recorded was subjected to transformation. The percentage data on number of colonies, adults and nymphs of RSW obtained from the field experiment were subjected for statistical analysis. The percent incidence and intensity are calculated with the following formula.

Incidence (%). To study the incidence per cent of whitefly complex on palms the data pertaining to the pest incidence was calculated with the following formula:

$$\text{Incidence \%} = \frac{\text{No. of leaves infested with whitefly complex per palm}}{\text{Total no. of leaves per palm}} \times 100$$

Intensity (%). The percentage of intensity was worked out with the following formula:

$$\text{Intensity \%} = \frac{\text{No. of leaflets infested with whitefly complex per leaf}}{\text{Total no. of leaflets per leaf}} \times 100$$

RESULTS AND DISCUSSION

Incidence or Infestation % (RSW)). The incidence of RSW in all the tested oil palm accessions ranged from 87.88 to 97.50 per cent which infers that majority of palms was infested with the invasive whitefly. All the 12 accessions were reported with more than 85 per cent of RSW incidence on all fronds. Among the twelve oil palm accessions, maximum incidence was recorded in EC 869395 as 97.50 per cent and the minimum incidence was recorded in EC 869413 as 87.88 per cent (Table 1).

Intensity % (RSW). The percentage of intensity in twelve oil palm accessions ranged from 42.12 to 77.65 per cent. Among the twelve oil palm accessions the maximum intensity was recorded in EC 869395 as 77.65 per cent and the minimum was recorded in EC 869413 as 42.12 per cent (Table 1).

Seasonal population of rugose spiralling whitefly on oil palm accessions

Spirals of RSW. The oil palm accessions were differed significantly with the number of spirals. The average number of RSW spirals was recorded highest in the accession EC 869395 (2.40) per leaflet. The average number of RSW spirals was recorded lowest in the accession EC 869413, EC 869404 and EC 869406 (0.78, 0.91 and 0.86) per leaflet which are at par with each other (Table 1).

Nymphs of RSW. The nymph population of RSW was found to be non-significant among the accessions. Numerically highest nymph population of RSW was recorded in the accession EC 869395 (3.43) per leaflet) followed by EC 869397 (2.73) per leaflet and the lowest population was recorded in EC 869413 (0.31) followed by EC 869406 (0.34) per leaflet (Table 1).

Adults of RSW. With respect to the RSW adult population, highest population was recorded in the accession EC 869395 (1.67) per leaflet. The adult population in the remaining accessions was found to be at par with each other ranging from 0.07 to 0.48. Numerically, lowest number of RSW adults was recorded in EC 869413 and EC 869406 (0.07 and 0.08) per leaflet respectively (Table 1).

Nymphs + Adults of RSW. The accessions were found to be non-significant with respect to the population of nymphs and adults together. The population of nymphs and adults of RSW together was recorded highest in the accession EC 869395 (5.10) per leaflet followed by EC 869397 (3.29) per leaflet. The population of nymphs and adults of RSW together was recorded lowest in EC 869413 (0.38) per leaflet followed by EC 869406 (0.42) per leaflet (Table 1)

Average seasonal population of rugose spiralling whitefly at three different locations of frond (base, middle and tip leaflets of frond) on oil palm accessions

Spirals of RSW. Amongst the three locations, RSW spirals in the tip leaflets were found to be significantly different among the accessions. The maximum number of spirals of RSW was recorded in the accession EC 869395 (3.03) per leaflet. The minimum number of RSW spirals was recorded in EC 869413, EC 869404 and EC 869399 (0.58, 0.62 and 0.66) per leaflet respectively with no significant difference (Table 1). With respect to location of the leaflets, the average number of spirals per leaflet was high in middle (1.63) and tip (1.51) leaflets which are at par with each other (Table 2).

Nymphs of RSW. Amongst the three locations, nymph population of RSW in the base leaflets was found to be significantly different among the accessions. The maximum number of nymphs was recorded in the accession EC 869395 (3.42) per leaflet. The nymph population in the remaining accessions was ranged from 0.13 to 1.26 (Table 2) in which significant difference was not observed.

Adults of RSW. Among the three locations, the adult population of RSW in the middle and tip leaflets was found to be significantly different among the accessions. The maximum number of adults of RSW was recorded in the accession EC 869395 in both middle and tip leaflets (3.21 and 1.62) per leaflet. The remaining accessions showed no significant difference among the population in the middle leaflets, whereas in tip leaflets, minimum adult population was observed in accession EC 869413 and EC 869399 (0.06 and 0.08) per leaflet (Table 2).

Nymphs + Adults of RSW. The population of nymphs and adults of RSW together was recorded maximum in EC 869395 in both base and tip leaflets (3.65 and 5.06) per leaflet. In the tip leaflets, highest population was also observed in EC 869408 and EC 869397 (4.51 and 3.51) per leaflet which are at par with the accession EC 869395. Minimum population of both adults and nymphs was observed in tip leaflets of EC 869413 and

EC 869399 (0.36 and 0.20) per leaflet which are at par with each other (Table 2).

On perusal of data recorded in three locations of leaf *i.e.*, base, middle and tip leaflets of the frond, maximum number of RSW spirals was recorded in the middle leaflets of frond with a mean value of 1.63 per leaflet followed by tip and base leaflets with 1.51 and 0.99 per leaflet respectively. Maximum nymph population was recorded in the tip leaflets with a mean value of 1.84 per leaflet followed by middle and base leaflets with 1.63 and 0.78 per leaflet respectively. Maximum number of adults was recorded in the tip leaflets with a mean value of 0.62 per leaflet followed by middle and base leaflets with 0.57 and 0.13 per leaflet respectively.

Average population of rugose spiralling whitefly in four directions of leaves (north, south, east and west) on oil palm accessions

Spirals of RSW. Data on the number of RSW spirals in different directions among the accessions showed that there is no significant difference except for the west and south. In the North direction maximum number of spirals was recorded in EC 869395 (2.70) per leaflet and the minimum number of spirals was recorded in EC 869404 (0.69) per leaflet**.** In the South direction maximum number of spirals was recorded in EC 869395 and EC 869407 (2.18 and 2.41) per leaflet respectively and the minimum number of spirals was recorded in EC 869404 (0.75) per leaflet**.** In the East direction maximum number of spirals was recorded in EC 869395 (2.62) per leaflet and the minimum number of spirals was recorded in EC 869408 (0.90) per leaflet**.** In the West direction maximum number of spirals was recorded in EC 869407 (2.22) per leaflet and the minimum number of spirals was recorded in EC 869413 (0.37) per leaflets which are significantly different from the rest of the accessions (Table 3).

Nymphs of RSW. The observations recorded in different directions revealed that the accessions were not differed significantly with respect to nymph population except for north direction which showed a significant difference among the accession. In the North direction maximum number of nymphs was recorded in EC 869395 (4.83) per leaflet and the minimum number of nymphs was recorded in EC 869403, EC 869406, EC 869399, EC 869407, EC 869413 (0.10, 0.32, 0.29, 0.57 and 0.59) per leaflet respectively which are on par with each other. In the South direction maximum number of nymphs was recorded in EC 869395 (3.79) per leaflet and the minimum number of nymphs was recorded in EC 869404 (0.11) per leaflet. In the East direction maximum number of nymphs was recorded in EC 869397 (3.36) per leaflet and the minimum number of nymphs was recorded in EC 869406 (0.27) per leaflet. In the West direction maximum number of nymphs was recorded in EC 869404 (2.68) per leaflet and the minimum number of nymphs was recorded in EC 869399 (0.15) per leaflet (Table 3).

Adults of RSW. Significant difference among the accessions was not observed for adult population from all the four directions. In the North direction maximum number of adults was recorded in EC 869397 (1.28) per leaflet and the minimum number of adults was recorded in EC 869406 (0.01) per leaflet. In the South direction maximum number of adults was recorded in EC 869395(1.82) per leaflet and the minimum number of adults was recorded in EC 869404 (0.12) per leaflet. In the East direction maximum number of adults was recorded in EC 869397 (1.00) per leaflet and the minimum number of adults was recorded in EC 869406 (0.02) per leaflet. In the West direction maximum number of adults was recorded in EC 869409 (1.08) per leaflet and the minimum number of adults was recorded in EC 869413 (0.01) per leaflet (Table 3).

The data collected on the incidence of RSW from leaves in four directions *i.e.*, North, South, East and West, has revealed that maximum number of RSW spirals was recorded in the South direction with a mean value of 1.57 per leaflet followed by East, North and West directions with mean values of 1.52, 1.30 and 1.11 per leaflet respectively. With respect to RSW nymphs, maximum nymph population was recorded in the East direction with a mean value of 1.54 per leaflet followed by South, North and West directions with mean values of 1.44, 1.43 and 1.29 per leaflet respectively. In case of RSW adults, maximum number was recorded in South direction with a mean value of 0.79 per leaflet followed by West, North and East direction with mean values of 0.41, 0.32 and 0.25 per leaflet respectively. Statistically, there is significant difference among the four directions with respect to spirals and adult population of RSW, with highest pest population recorded in south direction (Table 3).

The overall results on the infestation of rugose spiralling whitefly on oil palm accessions revealed that the accession EC 869413 was found to be less infested with rugose spiralling whitefly whereas the accession EC 869395 was found to be heavily infested. All the remaining accessions showed more or less similar infestation with respect to whitefly infestation. Majority of the pest population of RSW was observed at the tip leaflets of the frond. The antixenosis/ antibiosis factors of the oil palm accessions might be the reason for resistance, hence recorded low pest intensity and incidence in EC 869413. The nutritional composition of tip leaflets would be high when compared to base and middle leaflets due to fresh growth in the tip leaflets. This might be a reason for the high pest infestation at the tip leaflets.

Further studies on accession EC 869413 are required in depth to find out the factors associated (Biophysical and biochemical) for low pest incidence in order to promote the accession EC 869413 for breeding programme in the development of new varieties.

The results of the present investigation are in agreement with the findings of other researchers in other crops for various crop pests. Sundararaj and Selevaraj (2017); Chandrika *et al*. (2017) reported that among the various coconut cultivars, dwarf palms are more preferred by RSW when compared to tall varieties. Selvaraj *et al*. (2016) also reported that high incidence of RSW was observed more on hybrid and dwarf varieties *viz*., Chowghat Orange Dwarf, Malayan orange dwarf and Gouthami Ganga. Srinivisan *et al*. (2016) reported that the dwarf coconut palms such as Chowghat Orange

Dwarf, Malayan yellow dwarf, Malayan green dwarf and Dwarf × Tall hybrids (COD × WCT) recorded high Infestation Grade Index (IGI) as compared to that of West Coast Tall and Arasampatti Tall in Tamil Nadu. The South American palm, *E. oleifera* and the hybrid between *E. oleifera* and *E. guineensis* were reported to be less susceptible to *C. lameensis* than *E. guineensis* (Philippe, 1977). A high variation in the fecundity of *C. lameensis* has also been observed on different oil palm plantations in Cote d'Ivoire (Mariau and Lecoustre 2000).

In an earlier study (Appiah *et al.,* 2007), it was observed that there were slight variations in the ability of oil palm progenies to support the development and growth of the oil palm leaf miner, *C. lameensis*. Sujatha *et al*. (2010) reported that lowest mite damage index in Laccadive Ordinary and the highest in Laccadive Micro. Among the 17 coconut hybrids screened, ECT × GB (Godavari Ganga) recorded the lowest mite damage, whereas LM × GB recorded the highest damage among various cross combinations.

The findings in the present investigation are in conformity with the observations of Muthiah and Rajarathinam (2002) who found that Chowghat Orange Dwarf, Siam, British Solomon Island (BSI), Ayiramkachi, Philippines Ordinary and Spicata were found to be moderately tolerant and the cultivars Seychelles and St. Vincent were found to be highly susceptible to mite attack in coconut. Fathul *et al.* (2018) found that plant variety in oil palm DXP gave an effect towards the population male, female and total (male and female) of *Oryctes rhinoceros*. It is probably due to different plant varieties have different chemical compounds inside the palm and different morphology that will attract the *Oryctes rhinoceros* differently.

The genotype HOVTSB-I 2021-19 (0.00%) was one of unique and promising genotype resistant to earwig, wireworm & subterranean ants. Moreover, it exhibited relatively good yield, can be used as resistant source in groundnut breeding programs against pod borers (Magar *et al.*, 2023).

The results in the present investigation is also in agreement with the findings of Izaitul Aida *et al*. (2020) who stated that sampling weeks did not give significant effects ($P > 0.05$) but plant variety gave effect towards the population of *Oryctes rhinoceros* in oil palm. Significant differences do not exist in the susceptibility levels of the five oil palm progenies investigated. Although evidence of resistance of oil palm progenies to the oil palm leaf miner, *C. lameensis*, is lacking, such varietal resistance may exist since not all palm species are successfully host plants for the pest (Hartley, 1988). The observed slight variations on the various progenies may be an indication of differential degree of antixenosis for feeding or antibiosis for development or tolerance or a combination of these and call for advance investigation on the molecular genetics of the plant. The differences in the parameters investigated offer the potential to establish susceptibility level, which can be developed further and incorporated into integrated pest management strategy for sustainable management of the pest (Dimkpa *et al*., 2010).

Intra-specific genotypes are more vulnerable than inter-specific genotypes to infestations by defoliating caterpillars. This study contributes to the bioecological knowledge on defoliating caterpillars on oil palm and therefore provides important information to strengthen integrated pest management practices (Oliveira *et al*., 2021). Bagde *et al.* (2016) reported that among the 26 coconut genotypes screened for their reaction to the coconut eriophyid mite, minimum infestation was observed in the genotypes Jamica, BSI, Lono, Guwam and Orange dwarf which are useful for the coconut growers in minimizing loss caused by eriophyid mite and the data regarding the tolerance level helpful in breeding programs of coconut cultivars for development of resistant varieties to mite infestation.

Table 1: Average Seasonal population of Rugose spiralling whitefly on oil palm accessions.

Accession no.	Rugose spiralling whitefly				Incidence (%)	Intensity (%)
	Spirals	Nymphs	Adult	Nymphs+ Adult		
AC 869395	2.40^{a}	3.43	1.67^{a}	5.10	97.50	77.65
AC 869404	0.91^{d}	1.22	0.36^{b}	1.59	91.02	66.17
AC 869406	0.86^{d}	0.34	0.08^{b}	0.42	90.55	62.16
AC 869408	1.06^{bcd}	1.27	0.77^{b}	2.04	88.56	56.01
AC 869414	1.61^{abcd}	1.73	0.29^{b}	2.02	93.84	61.23
AC 869397	1.79^{abc}	2.73	0.56^{b}	3.29	88.56	58.29
AC 869399	1.04^{cd}	0.69	0.19^{b}	0.88	90.28	42.71
AC 869403	1.42^{bcd}	0.92	0.16^{b}	1.08	92.59	72.84
AC 869407	1.91^{ab}	1.85	0.26^{b}	2.12	90.94	59.76
AC 869409	1.56^{abcd}	1.64	0.48^{b}	2.12	90.23	57.36
AC 869412	1.21^{bcd}	0.98	0.43^{b}	1.41	89.63	44.68
AC 869413	0.78^{d}	0.31	0.07^{b}	0.38	87.88	42.12
SE(m)±	0.26	0.82	0.21	1.91	-	-
S.D. (p=0.05)	0.88	S	0.77	NS	-	-

Values with same letters in the superscript are non-significantly different; NS- Non significant.

Table 2: Average seasonal population of Rugose spiralling whitefly at three different locations of leaf (Base, Middle and Tip leaflets) on oil palm accessions.

Accession No.	Spirals			Nymphs			Adults			Nymphs + Adults		
	Base	Middle	Tip	Base	Middle	Tip	Base	Middle	Tip	Base	Middle	Tip
AC 869395	1.72	2.45	3.03^{a}	3.42^{a}	3.43	3.44	0.24	3.21^{a}	1.62^{a}	3.65^{a}	6.64	5.06
AC 869404	0.96	1.15	0.62^{e}	0.90^{b}	1.70	1.08	0.28	0.60^{b}	0.18^{bc}	1.17^{b}	2.3	1.26
AC 869406	0.55	0.96	1.06^{de}	0.13^{b}	0.17	0.71	0.06	0.03^{b}	0.12^{bc}	0.18^{b}	0.2	0.83
AC 869408	0.60	1.29	1.27^{cde}	0.19^{b}	0.81	2.81	0.09	0.53^{b}	1.70^{a}	0.28^{b}	1.34	4.51
AC 869414	1.08	1.76	2.09^{abc}	0.55^{b}	1.91	2.76	0.18	0.38^{b}	0.38^{bc}	0.74^{b}	2.29	3.14
AC 869397	1.45	2.00	1.93^{bcd}	1.26^{b}	3.29	2.62	0.18	0.55	0.89^{ab}	1.44^{b}	3.84	3.51
AC 869399	1.20	1.25	0.66^{e}	0.22^{b}	0.57	0.13	0.11	0.39^{b}	0.08^{c}	0.33^{b}	0.96	0.21
AC 869403	1.27	1.53	1.47^{bcde}	0.81^{b}	0.84	1.10	0.26	0.07^{b}	0.14^{bc}	1.07^{b}	0.91	1.24
AC 869407	0.98	2.38	2.37^{ab}	0.41^{b}	2.46	2.70	0.07	0.25^{b}	0.47^{bc}	0.48^{b}	2.71	3.17
AC 869409	0.63	2.15	1.87^{bcd}	0.33^{b}	1.90	2.54	0.03	0.36^{b}	1.02^{ab}	0.36^{b}	2.26	3.56
AC 869412	0.80	1.64	1.17^{cde}	0.16^{b}	0.82	1.94	0.06	0.41^{b}	0.81^{abc}	0.22^{b}	1.23	2.75
AC 869413	0.74	1.02	0.58^{e}	1.06^{b}	0.72	0.28	0.04	0.10^{b}	0.06^{c}	1.11^{b}	0.82	0.34
SE (m)±	0.18	0.61	0.32	0.93	3.41	2.31	0.03	0.86	0.30	1.21	6.71	2.97
S.D. (p=0.05)	NS	NS	0.96	1.63	NS	NS	NS	1.57	0.93	1.86	NS	NS
Mean	**0.99^{b}**	**1.63^{a}**	**1.51^{a}**	**0.78^{b}**	**1.63^{a}**	**1.84^{a}**	**0.13^{b}**	**0.57^{a}**	**0.62^{a}**	**0.92^{b}**	**2.21^{a}**	**2.47^{a}**
SE (m)±	0.126			0.53			0.25			1.32		
S.D.(p= 0.05)	0.30			0.61			0.42			0.97		

Values with same letters in the superscript are non-significantly different; NS- Non significant

Table 3.Average population of Rugosse spiralling whitefly at four directions of leaves (North, South, East and West) on oil palm accessions

Accession No.	Sprials				Nymphs				Adults				Nymphs + Adults			
	South	East	North	West	South	East	North	West	South	East	North	West	South	East	North	West
EC 869395	2.18^{ab}	2.62	2.70	2.10^{ab}	3.79	3.05	4.83^{a}	2.03	1.82	0.23	0.08	0.11	5.61^{ab}	3.29	4.92	2.140
EC 869404	0.75^{e}	0.93	0.69	1.27^{bcd}	0.11	1.16	0.96^{bc}	2.68	0.12	0.34	0.37	0.58	0.23^{c}	1.51	1.33	3.26
EC 869406	1.15^{cde}	1.02	0.84	0.40^{de}	0.45	0.27	0.32^{c}	0.41	0.08	0.02	0.01	0.19	0.53^{c}	0.30	0.32	0.61
EC 869408	1.04^{de}	0.90	1.12	1.15^{cde}	1.53	0.58	1.61^{bc}	1.36	1.00	0.26	0.76	1.07	2.52^{bc}	0.85	2.37	2.43
EC 869414	1.94^{abc}	1.66	1.65	1.18^{cde}	1.00	1.61	2.51^{abc}	1.79	0.32	0.51	0.31	0.02	1.32^{c}	2.12	2.83	1.82
EC 869397	1.51^{bcde}	1.77	2.57	1.32^{bc}	2.94	3.36	3.07^{ab}	1.52	3.52	1.00	1.28	0.89	6.47^{a}	4.36	4.35	2.41
EC 869399	1.33^{bcde}	0.94	1.11	0.76^{cde}	0.39	0.40	0.29^{c}	0.15	0.52	0.08	0.12	0.02	0.91^{c}	0.48	0.41	0.18
EC 869403	1.88^{abcd}	1.55	1.35	0.91^{cde}	0.84	2.00	0.10^{c}	0.73	0.12	0.09	0.08	0.33	0.97^{c}	2.10	0.18	1.07
EC 869407	2.41^{a}	1.86	1.15	2.22^{a}	2.68	1.87	0.57^{c}	2.29	0.50	0.19	0.02	0.33	3.18^{abc}	2.07	0.60	2.62
EC 869409	1.84^{abcd}	2.43	0.91	1.04^{cde}	1.12	2.19	1.23^{bc}	2.01	0.33	0.07	0.41	1.08	1.46^{c}	2.26	1.65	3.09
EC 869412	1.80^{abcd}	1.58	0.80	0.64^{cde}	1.46	1.09	1.09^{bc}	0.25	0.91	0.14	0.37	0.29	2.37^{bc}	1.23	1.47	0.54
EC 869413	1.03^{de}	1.02	0.69	0.37^{e}	0.99	0.88	0.59^{c}	0.29	0.19	0.08	0.01	0.01	1.18^{c}	0.96	0.61	0.30
SE (m)±	0.25	0.78	0.76	0.27	2.24	3.62	2.13	2.60	1.35	0.16	0.28	0.25	4.77	5.01	3.70	3.94
C.D. (p=0.05)	0.85	NS	NS	0.89	NS	NS	2.47	NS	NS	NS	NS	NS	3.70	NS	NS	NS
Mean	**1.57^{a}**	**1.52^{a}**	**1.30^{ab}**	**1.11^{b}**	**1.44**	**1.54**	**1.43**	**1.29**	**0.79^{a}**	**0.25^{b}**	**0.32^{b}**	**0.41^{b}**	**2.23**	**1.79**	**1.75**	**1.71**
SE (m)±	0.146				0.531				0.20				0.94			
C.D. (p= 0.05)	0.318				NS				0.371				NS			

Values with same letters in the superscript are non significantly different; NS- Non significant

CONCLUSIONS

From the above investigation, it was concluded that selection of oil palm accession EC 869413 in crop improvement programme enables the breeder to develop a promising variety against RSW as it recorded with low pest incidence.

FUTURE SCOPE

1. As the present study in oil palm is the first of its kind, it serves as base for future research
2. The accession identified as resistant source can be utilized in future breeding programme to develop a resistant variety against invasive whitefly species.

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