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GENETIC RESPONSE OF CITRUS GERMPLASM AGAINST CITRUS LEAF MINER

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ABSTRACT

Fifteen citrus varieties/ cultivars were evaluated to observe the genetic response against citrus leaf miner (*Phyllocnistis citrilla*) for two years at Dept. Plant pathology research area by using Augmented design. *Citrus reticulata* cv. Kinnow, *Citrus sinensis* cv. Jaffa expressed moderately susceptible response towards CLM (17.4 – 18.50%) infestations while seven varieties/ cultivars (*Citrus sinensis* cv. pine apple, *Citrus sinensis* cv. Succari, *Citrus reticulata* cv. mungal singh, *Citrus reticulata* cv. Tangerine, *Citrus reticulata* cv. Malta, *Citrus sinensis* cv. valentia late, *Citrus reticulata* cv. feutral's early) exhibited susceptible response with 20.16 – 29.27 % insect population. *Citrus limonia* cv. china lemon, *Citrus paradise, Citrus sinensis* cv. Musambi, *Citrus limettioides, Citrus sinensis* cv. blood red, *Citrus limonia* cv. mayer lemon showed high inclination ((30.44 – 38.38%) to *Phyllocnistis citrilla.*

Key words: *Phyllocnistis citrilla,* Citrus leafminer, Genetic response.

INTRODUCTION

Citrus is one of the foremost fruit of Pakistan in stipulations of area, yield and export. Although citrus crop is kept in great esteem, yet present status is defenseless by a number of factors, which impede the fruit yield and quality (Atiq, 2008) A number of insects attacked on citrus plants. Among these citrus leaf miner (CLM) *Phyllocnistis citrella* (Stainton) causes a huge loss of quality citrus fruits (Khair, 2004). It was exposed in 1993 in Florida and later on broaden all the citrus growing areas of the world (Bermudez *et al.,* 2004; Hoy and Jessey, 2004) It also exacerbates citrus canker disease by exposing leaf mesophyll cells during its feeding and allowing direct penetration of bacterium. (Chagas *et al.,* 2001, Urbaneja *et al.,* 2003; Chagas *et al.,* 2001and Graham, 2004; Khair, 2004). CLM is found throughout the year but its passion increases during new flushes of the citrus (Barnet *et al.,* 2005). *Phyllocnistis citrella* (Stainton) produces silvery mines on the surface of fruits, leaf and stem and reduces the excellence of fruit and photosynthetic area of the leaf which eventually reduces quantity of the produce (Abdella and Mohamed, 2004; Belasque *et al*., 2005). The larvae of CLM causes smash up by making zigzag shaped mines in the young leaves between the upper and lower epidermal layers, eating the parenchymatic tissue (Raga *et al.,* 2001). The offended epidermis took the shape of twisted silvery galleries (Legaspi *et al.,* 2001). On the older leaves, brownish patches fashioned, which served as foci of infection for citrus canker. The attacked leaves were twisted or folded over but remained on plants for a long time and the damage gradually spread to fresh leaves (Belasque *et al*., 2005). Heavily attacked plants could be observed from a distance and young nurseries are most severely affected. Mining can reduce the plant growth of the young trees and nursery stock (Rogers and Stansly, 2007). CLM can also cause mining of citrus fruit rind but it occurs once in a blue moon (Elzbeth *et al.,* 2008). Impulsive invasion and wide dispersion of *phyllocnists citrilla* in Pakistan creates problem to the formers and researchers. So the present study was conducted to search out the source of resistance among the citrus germplasm because it provides us the best management strategy against citrus leaf miner because different cultivars possessing different rate of tolerance and susceptibility towards CLM (Khair, 2004).

MATERIALS AND METHODS

Fifteen citrus cultivars Blood red (*Citrus sinensis* cv. blood red), Malta (*Citrus reticulata* cv. Malta), China lemon (*Citrus limonia* cv. china lemon), Mayer lemon (*Citrus limonia* cv. mayer lemon), Sweet lemon (Citrus limettioides), Feutral's early (*Citrus reticulata* cv. feutral's early), Jaffa (*Citrus sinensis* cv. Jaffa), Succari (*Citrus sinensis* cv. Succari), Mungal singh (*Citrus reticulata* cv. mungal singh), Grapefruit (*Citrus paradise)*, Tangerine (*Citrus reticulata* cv. Tangerine), Musambi (*Citrussinensis* cv. Succari), Pine apple (*Citrus sinensis* cv. pine apple), Valentia late (*Citrus sinensis* cv. valentia late) and Kinnow (*Citrus reticulata* cv. Kinnow) were collected from Horticulture nursery of University of Agriculture Faisalabad during 2007 for evaluating their resistance or susceptibility towards CLM under natural environmental conditions by using Augmented design. All the recommended agronomic practices were followed to maintain the citrus nursery in good conditions. However, no insecticides

were used in order to develop maximum insect population pressure. Natural inoculum was selected for infection from the fruit plant nursery of the Horticulture Department. Population infestation was recorded by using Lukshman scale (1998). SAS/STAT statistical software was used to perform all the statistical analysis (SAS Institute, 1990). Fisher's protected least significant difference (LSD) was used to separate the means (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Citrus leaf miner was active throughout the year and multiplied on young growth. CLM infected young citrus flush including leaves and young stems. Colonization data for citrus CLM on fifteen the varieties of citrus during 2006-07 were presented in Table 1. The CLM population started increasing during first week of September and became maximum in third week of October; the minimum population was observed in the first week of January. Maximum CLM populations was found on *C. limonia* cv. China lemon, *C. paradise, C. sinensis* cv. musambi*, C. limettioides, C. sinensis* cv. blood red *and C. limonia* cv. mayer lemon, showing infestation severities of 30.44, 31.21, 31.54, 31.77, 33.73 and 34.27, respectively (Table2). The CLM population occurred on *C. reticulata* cv. kinnow *and C. sinensis* cv. Jaffa, with severities 17.40 and 18.50, respectively. Out of fifteen varieties, 7 were at or above economic threshold levels for CLM populations i.e one or two larvae. CLM were found on all citrus varieties in varying degrees. *C. reticulata* cv. kinnow and *C. sinensis* cv. jaffa had the lowest populations whereas *C. paradise, C. limonia* cv. China lemon, *C. paradise, C. sinensis* cv. musambi, *C. limettioides, C. sinensis* cv. blood red and *C. limonia* cv. mayer lemon developed high CLM populations. CLM populations were higher during 2006-07 than 2007-08.

Different citrus varieties expressed varying response toward CLM population. Varieties such as *C. limonia* cv. China lemon, *C. paradise, C. sinensis* cv. musambi*, C. limettioides, C. sinensis* cv. blood red and *C. limonia* cv. mayer lemon were most susceptible to CLM attack in both years, whereas the least susceptibility was observed on *C. reticulata* cv. kinnow and *C. sinensis* cv. Jaffa.

There was a significant interaction of year x varieties with development of CLM. Varieties responded differently in preference CLM. The most suitable varieties for maximum development of CLM populations were moderately susceptible to highly susceptible varieties to CLM (Table.1&Table 2). *C. sinensis* cv. jaffa that was moderately susceptible during first year became susceptible during second year. Similarly, *C. reticulata* cv. feutral's early, which was susceptible during 2006-07, became highly susceptible during 2007-08. Peak populations were observed from February to April and August to October during both years. Maximum CLM counts were observed on the variety *C limonia* cv. *mayer lemon*. Overall *C. reticulata* cv. kinnow was the most resistant variety tested. and *C. sinensis* cv. blood red, *C. limonia* cv. mayer lemon, *C. limettioides, C. paradise* and *C. limonia* cv. China lemon were the most susceptible varieties.

Maximum population infestation was observed during the 2nd week of September and third week of April, whereas the minimum population infestation occurred during the third week of January. Population infestation increased from February to April and then decreased and it again increased from the first week of July to the last week of October during both the years. The significant interaction of years x varieties showed that CLM populations varied among citrus varieties during both years. The level of CLM infestation was highest during 2007-08, with a mean population incidence of 38.38, as compared to the highest population incidence of 34.27 in 2006-07.

CLM is the most destructive insect of citrus which reduce the quality and quantity of the citrus fruit (Urbaneja *et al.,* 2003). In the present experiment DMR test showed variable degree of susceptibility among citrus cultivars. Genetic resistance probably is the only durable and long lasting solution to the CLM (Munoz *et al.,* 2008). A possible solution to the insect problem, therefore, is the transfer of resistant genes to most of citrus varieties, which obviously will require long time period (Reference). The short-term solution should be screening of available germplasm (Shevankar *et al.,* 2000) for relative susceptibility, as in this study and to identify low rating variations for breeding manipulation.

Among the citrus varieties tested against CLM, *C. paradise* exhibited high susceptibility while *C. reticulata* cv. kinnow and *C. sinensis* cv. jaffa showed moderately susceptible response towards CLM. Similar results were reported by El-Dessouki (2001) and Xiao *et al.,* (2007). Citrus varieties vary in leaf thickness which is an important criteria for CLM attack (Fahim, 2001 and Khair, 2004). *Citrus limonia* cv. mayer lemon has low value of leaf thickness as compared to other varieties tested which should be the main reason of high infestation rate of CLM. The higher degree of susceptibility among citrus cultivars may be induced due to certain anatomical modifications that can increase or decrease interaction between citrus cultivars and CLM (Hare 1992, Gassmann and Hare 2005, Muller and Riederer 2005, Mathews *et al.,* 2007) or it may be due to certain type of metabolic changes (Smith and Boyko 2007). Certain types of chemical compounds in citrus cultivars may act as repellent or attractant for CLM which induce differential resistance or susceptibility in citrus cultivars for CLM attack. (Isman 2000, Rocchini *et al.,* 2000, and Ode 2006). To elucidate this, further

research on morpho-anatomical and physiological features are necessary.

Table 1. Screening and grading of 15 citrus varieties/ cultivars against citrus leaf miner in 2006-07

Varieties/ Cultivars	Population incidence (Mean)	Response
Citrus reticulata cv. kinnow	17.40 [i]	MS
Citrus sinensis cv. jaffa	18.50 [i]	MS
Citrus sinensis cv. pine apple	20.16 [h]	S
Citrus sinensis cv. succari	20.88 [gh]	S
Citrus reticulata cv. mungal singh	21.75 [g]	S
Citrus reticulata cv. tangerine	23.47 [f]	S
Citrus reticulata cv. malta	26.33 [e]	S
Citrus sinensis cv. valentia late	27.99 [d]	S
Citrus reticulata cv. feutral's early	29.27 [cd]	S
Citrus limonia cv. china lemon	30.44 [bc]	HS
Citrus paradise	31.21 [b]	HS
Citrus sinensis cv. musambi	31.54 [b]	HS
Citrus limettioides	31.77 [b]	HS
Citrus sinensis cv. blood red	33.73 [a]	HS
Citrus limonia cv. mayer lemon	34.27 [a]	HS

LSD = 1.39

Table 2. Screening and grading of 15 citrus varieties/ cultivars against citrus leaf miner in 2007-08

Varieties/ Cultivars	Population incidence (Mean)	Population incidence (Mean)
Citrus reticulata cv. kinnow	18.93 [i]	MS
Citrus sinensis cv. jaffa	20.86 [h]	S
Citrus sinensis cv. pine apple	22.10 [h]	S
Citrus sinensis cv. succari	22.17 [h]	S
Citrus reticulata cv. mungal singh	24.21 [g]	S
Citrus reticulata cv. tangerine	25.70 [f]	S
Citrus reticulata cv. malta	27.08 [f]	S
Citrus sinensis cv. valentia late	28.86 [e]	S
Citrus reticulata cv. feutral's early	31.65 [d]	HS
Citrus limettioides	32.57 [d]	HS
Citrus paradise	34.35 [c]	HS
Citrus sinensis cv. musambi	35.69 [bc]	HS
Citrus limonia cv. china lemon	36.54 [b]	HS
Citrus sinensis cv. blood red	36.64 [b]	HS
Citrus limonia cv. mayer lemon	38.38 [a]	HS

LSD = 1.47

*Mean values in a column sharing similar letters do not differ significantly as determined by LSD test $P \leq 0.05$.

MS = Moderately susceptible S = Susceptible

HS = Highly susceptible

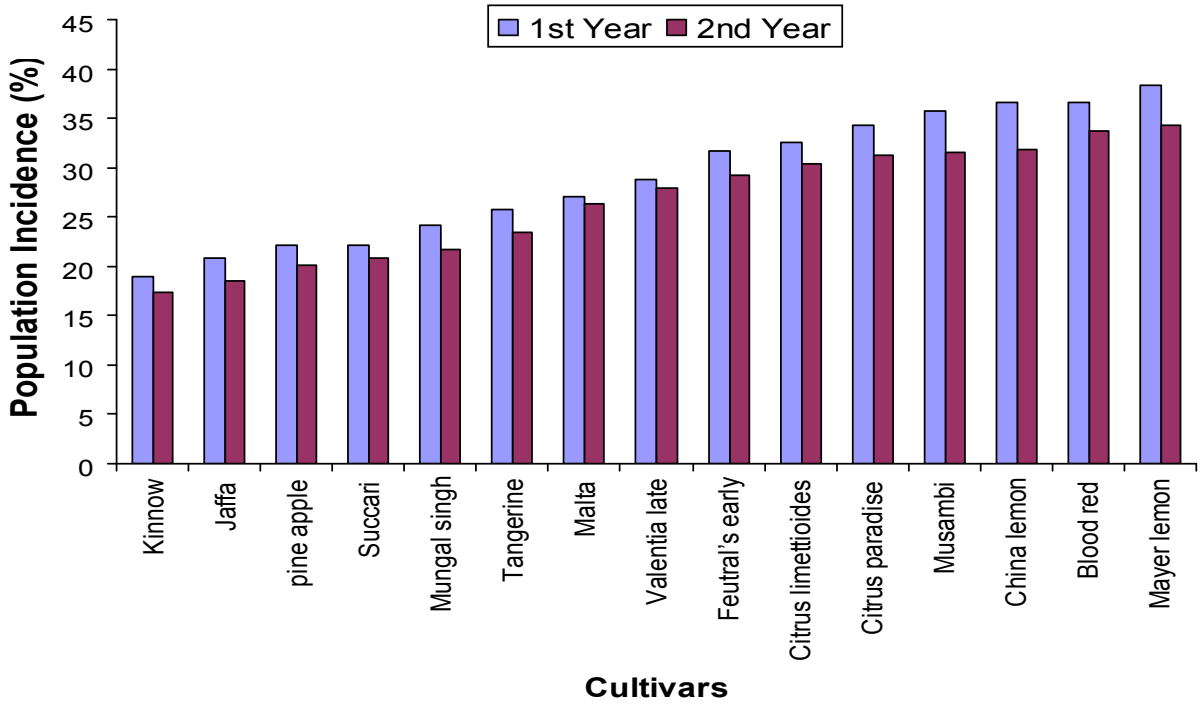

Fig. Comparison of genetic response of citrus cultivars against citrus leafminer(CLM)

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