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STATUS OF MITE PEST FAUNA PREVAILING IN BRINJAL AGRO-ECOSYSTEM

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Findings of the field studies on qualitative and quantitative composition of phytophagous mites infesting brinjal, conducted during, 1997 to 2001, in Varanasi region of Uttar Pradesh revealed that brinjal was infested with six mite pest species, viz. *Tetranychus urticae, T. macfarlanei, T. ludeni, Brevipalpus phoenicis, Polyphagotarsonemus latus* and *Aceria lycopersici.* Out of these mite species, *T. urticae* appeared as major pest during post-rainy season, as minor pest in rainy season and as mild pest in autumn. *A. lycopersici* appeared in the form of mild to severe pest during spring and as extremely severe pest during summer season. *T. urticae* remained almost absent in presence of heavy incidence of *A. lycopersici* in spring and summer seasons on brinjal. The findings indicated that displacement of *T. urticae* from brinjal by heavy occurrence of *A. lycopersici* on the same host plant indicated the changing scenario of mite pest spectrum on brinjal in the present studies. As such, *T. urticae* remained the major mite pest during post-rainy and autumn and *A. lycopersici* emerged as severe pest during spring and summer season in brinjal agro-ecosystem in the agro-climatic conditions of Varanasi region.

Key words : Brinjal, mite pest spectrum, status, interspecies competition.

INTRODUCTION

In India egg plants (aurbergin) is known as brinjal. Brinjal (*Solanum melongena* L.) is one of the most important solanaceous vegetable grown in India almost all the year round. With the introduction of high yielding crop varieties and repeated and indiscriminate use of broad spectrum insecticides over the years, mite pest fauna, which were earlier considered as minor and pest of negligible importance, now are emerging as one of the major biotic stresses in vegetables in general and brinjal agro-ecosystem in particular. As such, plant injuries caused by mite pest species are responsible for loss in yield ranging from 10 to 30 percent in brinjal. However, mite pest spectrum and their status normally varies from place to place, crop to crop and season to season (ChannaBasavanna. 1971; Singh & Singh, 1996; Prasad, 2006; Prasad *et al.,* 2007). Almost nothing has been done so far to explore the information pertaining to the changing status of mite pests infesting brinjal in Varanasi region of Uttar Pradesh. Keeping all these objectives in mind, the present studies were taken up.

MATERIALS AND METHODS

Periodical field survey and surveillance work was conducted at fortnightly intervals in different places in and around Varanasi areas as well as vegetable Research Farm, B.H.U., Varanasi during 1997 to 2001 in order to visualize the incidence, seasonal variations and pest status of phytophagous mites prevailing in the brinjal agro-ecosystem. Plant parts (*i.e.* leaves, vegetative and floral buds etc.) infested with mite pests were

plucked, collected and placed in the individual polyethylene bags area and date wise and brought to the laboratory for determining qualitative and quantitative composition of mite pest species, season wise of brinjal. A magnifying lens of 10x was used in the fields during the survey work for on spot possible visualization of mite pest species.

The mites (except eriophyid mite) collected with the help of a soft and fine camel hair brush were preserved in 70 per cent ethyl alcohol and a few drops of glycerol. The mites were mounted in Hoyer's medium and identified for their documentation. The eriophyid mite were, however, mounted directly in the mounting medium. The infested leaves were cut into pieces of 1.0 cm^2 for examining them under the stereoscopic microscope for the isolation, identification, quantification and documentation of the prevailing mite pests species. On the basis of number of the respective mite pest(s) species harbored by per unit area (here, one square centimeter) of leaf, the mite pests(s) were categorized as traces (negligible), minor, major (mild), severe and extremely severe pest (Table I). Data of quantitative composition of the respective mite species recorded and obtained from all the surveyed locations were pooled together species, season and years wise for their final documentation. Ultimately, the data of five years were again pooled together season wise and year wise. Ultimately the data of five years were again pooled together season wise in respect of individual mite species for final documentations of the findings, thus, obtained.

Besides the field survey, an experiment was also conducted during three consecutive years, 1999 to 2001 in the Acarological laboratory of the Department of Entomology & Agril. Zoology, Institute of Agril. Sciences, BHU, Varanasi to study interspecies competition between *Tetranychus urticae* Koch and *Aceria lycopersici* Wolff. observed during the surveyed periods for the laboratory studies. Ten brinjal plants, 2 each of 5 varieties, viz Pusa Purple Round, Pusa Purple Long, Mukta Keshi, Pusa Purple Cluster and Pant Samrat were raised in the earthen pots in the glass house during spring summer during 1999, 2000 and 2001 in the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. These plants were grown in the protected and unprotected conditions without any pesticidal treatment to have mite free plants of brinjal. As precautionary measures, the plants were provided with foliar sprays with clean water twice in a week up to dripple point. In the another set of raising the same five brinjal varieties, they were grown in the vegetable research farm in the open fields with all the recommended agronomical packages, without any plant protection measures for allowing the plants for natural mite pest infestation, during the spring summer season during the three consecutive years, 1999, 2000 and 2001. These plants were found to be heavily infested with *A. lycopersici.*

Keeping in view the seriousness of the red spider mite (*T. urticae)* and the eriophyid mite (*A. lycopersici)* emerging, on brinjal, feeding preference of the spider mite (*T. urticae)* on healthy brinjal leaves (raised in glass house conditions) as well as on heavily infested brinjal leaves with *A. lycopersici* (>18 ± 2 mites/cm^2) was studied. The studies on host feeding preference of *T. urticae* was made through free choice method at 32 ± 1^0. Circular leaf discs (3.0 cm dia) of all the five brinjal varieties were arranged at equidistant intervals inside the petridish (10cm dia) laid inside the white enamel trays (30 cm x 30cm). A large number of the mites (*T. urticae*) were collected in the glass vials from the heavily infested okra fields plants for releasing them on the desired leaves of brinjal in the laboratory conditions for the purpose of testing the preferablility of mite-

free brinjal leaves under the two conditions for feeding by *T. urticae.* Two hundred female mites *(T. urticae) were collected,* arranged and allowed for pre-starving for about 1.0 hour were released in the centre-most portion of the each set-up of leaf bit of brinjal plants (var. Mukta Keshi) bearing petriplate. This process of release of the mites (*T. urticae)* was made for each of the two separate set of the white enamel tray one each containing healthy brinjal leaf discs and the leaf discs heavily infested with *A. lycopersic.* As such, 4 replications were maintained for each of the two sets. The observations in respect of number of mites found, after migration and dispersal, on different leaf discs were recorded after 2, 4 and 6 hours of realizing mites. Mean of all the observations were calculated for data interpretation and documentation.

RESULTS AND DISCUSSION

Findings pertaining to seasonal pest status of mite fauna are presented in Table 1 and that of interspecies competition between *Tetranychus urticae* Koch and *Aceria lycopersic* Wolff. are presented in Table II.

Seasonal occurrence and status of mite pests in brinjal : The results (Table I) reveal that almost half a dozen of phytophagous mite species were found to occur on brinjal crop in the field in Varanasi region of Uttar Pradesh, India. Among them three mite species, *Tetranychus urticae* Koch, *Tetranychus macforlanei* Baker and Pritchard, *Tetranychus ludeni* Zacher belong to the family, Tetranychidae and rest three mite species, one of each *e.g. Breyipalpus phoenicis* Geij., *Polyphagotarsonemus latus* Banks and *Aceria lycopersici* Wolff, fall under the Tenuipalpidae, Tarsonemidae as well as Eriophydae, respectively.

The findings (Table I) indicate that all the three tetranychid mites *viz. T. urticae, T. macfarlanei* and *T. ludeni* remained as either traceable/negligible form or even absent during spring-summer, on brinjal. After wards their population began to be slightly increased even during rainy season. Later on, *T. urticae* attained the status as severe and mild pest during post-rainy and autumn seasons respectively. *T. macfarlane* and *T. ludeni* appeared in the form of traces (negligible) population even during post-rainy and autumn seasons. *B. phoenicis* and *P. latus* appeared in the forms of negligible to minor status as pest during spring, summer, rainy, post-rainy seasons and became absent during winter season, respectively. On brinjal *A. lycopersici* emerged as pest in the form of mild to severe in spring, severe to extremely severe pest during summer season. Its population came down in terms of pest of negligible or traceable forms during rainy season and ultimately, it became absent during post rainy, autumn and winter seasons where *T. urticae* appeared as minor, severe, mild and negligible pest during the respective seasons in the Varanasi region of Uttar Pradesh in the present studies (Table I). The survey of literatures revealed that almost complete lack of information is available so far about the seasonal occurrence of all these mite species on brinjal. However Singh & Putatunda (1974) and Arbabi *et al.* (1994) reported the occurrence of *A. lycopersici* on brinjal as a very minor and negligible pest on brinjal in Varanasi Region. Grewal (1992) and Singh & Singh (1996) reported that brinjal harboured *T. urticae,* as major pest and *T. macforlanei, T. ludeni, B. phoenicis, B. californicus P. latus and A. lycopersici* as minor pest species in Punjab and Varanasi regions of the country, respectively. They also revealed that the dominant mite pest, *T. urticae* (*T. cinnabarinus*) attained its 1st peak during hot summer months (May-June). Prasad *et al.* (2007) also reported almost similar

information.

Thus, analysis of the foregoing discussion revealed that the changing mite pest scenario of brinjal agro-ecosystem in Varanasi region of India. Because, earlier, *A. lycopersici* was pest of minor and negligible economic signicance (Grewal, 1992; Singh & Singh, 1996). But, now, it attained status of pest of considerable economic importance. Accordingly, Prasad & Singh (2007) reported that *A. lycopersici* caused loss in brinjal yield form 9 to 20 percent in the agro-climatic condition of Varanasi region of India.

It is an astonishing fact that during the first half of the year i.e. from January to June, an eriophyid mite, *Aceria lycopersici* Wolff. was found to be dominant whereas in the second part of the year, during kharif season and onward, a tetranychid mite, *T. urticae* dominated as a major pest that inflicted injury to brinjal crop in Varanasi region of Uttar Pradesh. Rest of the mite species behaved as pest of minor significance, as their population remained at negligible level round the year in all the cropping seasons i.e. spring, summer, kharif and autumn crops during the present investigation (Tables I & II)

It is a remarkable fact to note that *A. lycopersici* preferred more to feed on the lower surface of mostly younger leaves as compared to middle aged and older ones. However, during the hot summer the whole plant body was found to be infested with this mite as major pest in varying levels. In case of severe infestation, the mite was also observed to feed on soft tender growing stems, shoots, growing apical vegetative buds, flower buds as well as on the calyx of flower and newly formed fruits. During its higher multiplication, especially from April to June, very high population of the mite, even up to tune of 48 mites per sq. cm. of leaf area, was recorded on brinjal leaf and found intermingled with leaf hairs (trichomes) and feeding on the under surface of the foliage. The affected plants were found to have lesser number of leaves as compared to un-infested ones, because, mite fed younger leaves got undersized and shrinked and fallen off prematurely. As such, there was considerable reduction in the photosynthetic areas of the crop on account of severe incidence of the eriophyid mite on brinjal.

Thus, *A. lycopersici* emerged as extremely severe pest during the hottest summer (May to June) of Varanasi Zone of India. Afterwards, its population dropped down steeply as per the increasing trends of rainfall pattern during the period of rainy season in experimental months.

Literature survey shows that *A. lycopersici* was occurring earlier also on brinjal, though, as a minor, negligible and occasional pest of the crop (Singh & Putatunda, 1974; Arbabi *et al.*, 1994; Singh & Singh, 1996). But their dominace as the major pest of brinjal could not have been visualized and quantified, so far in the literature as yet. However, recently the occurrence of *A. lycopersici* on brinjal have been reported by Anonymous (1996) in the Bangalore region of Karnataka also and it was recorded just as a pest of brinjal but was not so injurious that may cause damage up to economic level. Moreover, the incidence of this mite was observed mostly on the younger leaves, which is almost in the line of findings of the present studies up to certain level.

It is an astonishing fact that the traditionally and commonly occurring major mite pest on brinjal of this area, *i.e.* the tetranychid mite, *Tetranychus urticae* was found to be almost absent (disappeared) from the brinjal plant during the entire hot summer months from April to June in 1997-2001 due to the highly pronounced population of *A.*

Table I : Seasonal variations in the pest status of mite fauna infesting brinjal recorded during 1997-2001 (Based on pooled mean of data of various locations for five years).

Mite pest species		Seasonal occurrence and status of mites in terms of range of number of mites per sq. cm. and their grades of pest status						Overall pest status
Scientific name of mites	Mite families	Spring	Summer	Rainy	Post rainy	Autumn	Winter	
Tetranychus urticae Koch	Tetranychidae	0.00 (Nil)	0.00 (Nil)	2-4 (Minor)	10-15 (Severe)	5-10 (mild)	1-2 (traces)	Major
Tetranychus macfarlenei Baker & Pritchard	Tetrancychidae	0.00 (Nil)	0.00 (Nil)	1-2 (traces)	1-2 (traces)	1-3 (traces)	0.00 (Nil)	Minor
Tetrancychus ludeni Zacher	Tetrancychidae	0.00 (Nil)	0.00 (Nil)	0.5-1 (traces)	0.5-1.0 (traces)	0.00 (Nil)	0.00 (Nil)	Minor
Brevipalpus phoenicis Geij	Tenuipalpidae	0.5-1.0 (traces)	0.5-1.0 (traces)	0.00 (nil)	0.5-1.0 (traces)	0.00 (Nil)	0.00 (Nil)	Minor
Polyphagotarsonemus latus Banks	Tarsonemidae	0.5-2.0 (traces)	1.0-3.0 (minor)	0.5-1.0 (traces)	1.0-4.0 (minor)	0.5-1.0 (traces)	0.00 (Nil)	Minor
Aceria lycopersici Wolff.	Eriophyidae	6-15 (mild-severe)	16-48 (severe - extremely severe)	1-3 (traces)	0.00 (Nil)	0.00 (Nil)	0.00 (Nil)	Major

Negligible/traces pest : < 2 mites/ cm^2 of leaf area; minor pest : ≤ 5 & > 2 mites / cm^2 of leaf area; major pest : > 5 & ≤ 10 mites / cm^2 of leaf area : mild pest; severe pest : > 10 & ≤ 15 mites / cm^2 of leaf area, extremely severe pest : > 15 mites / cm^2 of leaf area and Nil : Zero (0) mites/ cm^2 of leaf area.

Description / extent in the parentheses are status of mite pest species in the corresponding seasons over the years.

Table II : Comparative competitiveness for host preferability between *Tetrancyhus urticae* and *Aceria lycopersici* on brinjal leaves under the influence of absence and pre-infestation with *A. lycopersici* during spring-summer season (Mean of 1999, 2000 & 2001).

Brinjal Varieties	Mean Number* of the mite *(T. urticae)* per leaf disc at hours (h) after their release on brinjal leaf bits under the two sets of conditions of :							
	Leaf discs free from *A. l.*				Leaf discs heavily infested with *A. l.* (> 18 ± 2 mties / cm^2 of leaf area			
	2h	4h	6h	Mean	2h	4h	6h	Mean
Pusa Purple Round	9.58	15.89	22.25	15.91	0.00	0.00	0.00	0.00
Pusa Purple Cluster	7.85	13.58	19.25	13.56	0.00	0.00	0.00	0.00
Pusa Purple Long	18.85	24.50	27.85	23.73	0.00	0.00	0.00	0.00
Mukta Keshi	16.65	29.25	33.86	23.58	0.00	1.06	0.00	0.35
Pant Samrat	23.60	32.35	39.25	31.73	0.00	1.03	0.00	0.34

* : Mean of 4 replications; A.L. : *Aceria lycopersici*

lycopersici on brinjal in the field conditions during the five consecutive years.

With a view to confirm and testify the results of field observations, thus obtained, an laboratory experiment was also conducted. As such, the results are mentioned here in brief on interspecies competition between *T. urticae* and *A. lycopersci.*

The findings (Table II) of the laboratory experiment on preferability of *T. urticae* towards the eriophyid mite infested leaves and healthy brinjal leaves revealed that only healthy brinjal leaves were preferred by *T. urticae* and the leaf discs heavily infested with *A. lycopersici* were not preferred by *T. urticae* at all. Astonishingly, very few (1–3) of the released mite (*T. urticae)* were found also to be occasionally and rarely present on very few of the eriophyid mite infested brinjal leaves. As such, it was found that brinjal leaf discs which were heavily infested with *A. lycopersici* (> 18 ± 2) mites per sq.cm. of leaf area) were almost not preferred by *T. urticae* for feeding in the present experiments.

Variations in the varietal preference of *A. lycopersici* on brinjal under the influence of presence and absence of *T. urticae*

The findings (Table II) of studies also revealed that five test brinjal varieties were found to be in order of : Pant samrat > Mukta keshi > Pusa purple long > Pusa purple round > Pusa purple cluster in terms of varietal preference made by *T. urticae* in laboratory conditions in the present studies in absence of *A. lycopersici.* But in heavy presence of *A. lycopersica, T. urticae* showed almost non-preference on brinjal as host plant.

Thus, results of field survey and surveillance conducted during 1997-2001 on mite pest fauna and that of laboratory experiments carried out in 1999-2001 on inter-species competition between *T. urticae* and *A. lycopersici* revealed that there is certainly some changes in scenario of mite pests of brinjal is now existing as compared to the results obtained by earlier workers in Varanasi region (Singh & Putatunda, 1974; Arbabi *et. al.,*1994; Singh & Singh, 1996) and that of Bangalore region also (Anonymous, 1996).

The disappearance and absence of commonly and traditionally occurring major mite pest species, *T. urticae* remained highly pronounced consistently in the presence of heavy population of *A. lycopersici* is of course, a matter of scientific interest, interrogation and thought provoking phenomenon which needs special attention for its further clarifications and in depth probing on this aspect by undertaking future research work. Though, some of the probable reasons attributed to the shift (absence) of traditionally occurring major mite pest, *Tetranychus urticae* from brinjal in the presence of very high population of *Aceria lycopersici* happened probably on account of :

- The capabilities and nature of *Aceria lycopersici* to become more and more closer to the epidermal layer of brinjal leaves (as found highly intermingled with the trichomes) as compared to that of *Tetranychus urticae* may also be one of the reason for the local extinction and displacement of the latter species (*T. urticae)* which might have some inferior competitive ability in this respect in the present studies. Because, two different species with very identical environmental needs and resources particularly habitat and food unlikely to coexist for long resulting in the competitive exclusion of one by the other species.

- The erinose mite *(A. lycopersici)* is oligophagous in nature whereas *T. urticae* is polyphagous in nature having very wider host range and much more and quicker mobility of its own. So, *T. urticae* might have preferred to be shifted itself to the other host plants, other than brinjal to avoid the competition for food (*i.e.* the same niche) for their better chance of survival.
- Very heavy feeding by *A. lycopersici* might have induced some biochemical changes in the composition of brinjal plants due to their feeding, which is not preferable for feeding and inhabitation of two spotted mite *(T. urticae).*
- Erineum mites in general and *A. lycopersici* in particular have more close association with the host plant as compared to tetranychid mite (*T. urticae).* Hence, it might be possible that heavy buildup population of *A. lycopersici* on brinjal plants would induce heavy interspecies competition. In order to avoid this competition, *T. urticae,* being a polyphagous in nature coupled with higher mobility of its own, might have shifted to another host plant and niche.
- Existence of heavy population of this eriophyid mite on brinjal might have exerted some unknown and undetermined antagonistic effects against the co-existence of *T.urticae* on the same host plant (*i.e.* brinjal) or niche.
- Although, in spite of all these probable explanations, it seems worthwhile probing on this aspects so as to enable us to explore information on adequate, proper, appropriate and realistic understanding of major bio-ecological, bio-chemical and bio-physical and bio-mechanical factors, whatever may be involved in the inter-species competition by undertaking on going scientific endeavor in future too for revealing the facts for their proper documentation.

On the other side, post rainy season and autumn crop of brinjal during the same years (1998-2000) were observed to be infested with traditionally occurring spider mite, *T. urticae.* Its population were found to be fluctuated between mild to high (severe) level between September and October, then came down to attain traceably low to rare level of occurrence in November to December and onwards on account of lowering down of atmospheric temperature.

A very thought provoking finding of present studies is the occurrence of very high population of *Aceria lycoperisice* Wolff. (Acari: Eriophyidae) as an outbreak on brinjal, particularly during dry hot summer seasons that posed a serious threat for the crop cultivation consistently for the entire experimental years, 1997-2001, is almost the new and first record in India and abroad is general and Varanasi region in particular. This shows drastically changing scenario's of pest spectrum in the modern agro-ecosystem. Accordingly, on the some line, the absence and disappearance of commonly and traditionally occurring mite as major pest on brinjal, *T. urticae* in the presence of very high population of *A. lycopersici* on the same crop (i.e. brinjal) consistently for the entire periods of summer (1997-2001) is also the first record and astonishing observation of its own kind and unique in nature pertaining to inte-species competition in phytophagous mites.

Lowton & Hassel (1984) opined that two different species having very similar environmental needs and resources *viz* nutrition, host, shelter and space are unlikely to co-exist for long because competition for food will lead to local extinction or displacement of the species that has slightly inferior competitive capability. In the present studies, possibility of any interspecies competition between the red spider mite, *T. urticae* and the eriophyid mite, *lycopersici* on brinjal was studied by observing their population (number) trend. It was found that heavily pre-infested brinjal leaves with *A. lycopersici* could be able to displace the traditionally dominant spider mite, *T. urticae* during spring-

summer season from its preferred host plant (*i.e.* brinjal) on account of superior competitive ability of *A. lycopersici* over *T.urticae.* Devi & Rai (1996) obtained almost similar results to that of the present investigation. Accordingly, they reported that the red

spider mite, *T. cinnabarinus* became dominant over the leaf hopper, *Amrasca bigutulla bigutulla* Ishida on okra on accounts of superior competitive ability of the mite to that of jassid. As such, the findings of Devi and Rai (1996) and that of the present studies are the clear examples of species with very similar niches being unable to co-exist for long in the competitive exclusion of one(s) by the other (s) species of mite(s).

Remarks : On the basis of the overall findings of the present studies, it may be concluded that *T. urticae, T. macfarlenei, T. ludeni,B. phoenicis, P. latus* and *A. lycopesici* appeared as the mite pest species of brinjal. Of them, *T. urticae* and *A. lyeopersici* remained the major mite pests of brinjal in agro-climatic condition of Varanasi, region.

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