Madras Agric. J., 98 (7-9): 266-269, September 2011
https://doi.org/10.29321/MAJ.10.100293

Mite, *Tetranychus urticae* Varietal Resistance of Okra against Two Spotted Spider

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The present investigation was undertaken to evaluate the okra germplasm and identify the potential sources of two spotted spider mite resistance that can be exploited for the improvement of commercial okra. Based on the mean mite population and damage score six entries out of the 58 entries namely Kasturi bhendi, (R), Dharmapuri local (MR), Parbani Kranti (MR), Pusa Sawani (MR), COBhH1 (MR) and Mahyco 10 (S) with varied levels of resistance were identified.

Keywords: Okra, varietal resistance, *Tetranychus urticae*

Okra or bhendi *(Abelmoschus esculentus* (L.) Moench) is one of the world's oldest, traditional cultivated vegetable and an important source of vitamins (A, B and C), protein, minerals, phospholipids and an excellent supplement of iodine and calcium. The estimated area of okra in India is 0.78 million hectares with an annual production of 4.99 million tonnes with an average yield of 6.39 tonnes per hectare (Gopalakrishnan, 2007). It is also an important foreign exchange earner and accounts for 60 per cent of the fresh vegetable export. Okra is one of the best adopted vegetables in the tropical condition with the added advantages of early bearing and extended period of harvest coupled with short duration.

But the production and yield of this highly valued crop is quite often very much hampered by various insect species and a few mite species from early stage to maturity. Besides insect pests, several species of mites belonging to the genus *Tetranychus* (Srinivasa and Sugeetha, 1999) cause loss in the yield of okra fruits. Among the mites attacking this crop, the two spotted spider mite, *Tetranychus urticae* Koch one of the most serious pests that causes extensive damage. The mite infests the under surface of the leaves, where it produces profuse webbing and suck chlorophyll contents of the plant which leads to appearance of chlorotic spots. Damage of this mite includes webbing, fine stippling, leaf yellowing, leaf drop and even death (Helle and Sabelis, 1985; Martinez- ferrer *et al.,* 2006). Though several pest control methods are employed to combat the menace of this pest, acaricides are being the primary control tactic adopted by many farmers. Development of resistance to a wide range of acaricides and insecticides has been documented throughout the world. These acaricides that target two spotted spider mite also kill beneficial parasitoids and predators (Simmons and Jackson, 2000). Therefore, better alternative would be utilization of resistant varieties which would go a long way in the management system.

Therefore, there is a need to develop okra varieties with improved resistance to two spotted spider mite. This resistance, combined with the use of indigenous and natural enemies could form the basis of a sustainable Integrated Pest Management program for okra. Hence, the okra germplasm was evaluated to identify the potential sources of two spotted spider mite resistance that can be exploited for the improvement of commercial okra.

Material and Methods

Varietal screening

Field screening was carried with fifty eight okra entries representing varieties / hybrids / local or indigenous seeds/ parental lines and one wild type at Senthampalayam village near Coimbatore. Each test /accession/variety/local/wild type was sown in a five meter row. After every 10 rows of test entries two rows of the susceptible check (Mahyco 10) was raised to ensure the population. The screening experiment was carried out in Randomized Block Design with three replications. The susceptible check Mahyco 10 was sown in 5 rows surrounding the experimental area as border crop. This border rows served as a reservoir for the multiplication of mite population. In the field screening, instead of inoculation, natural population build up of mite was allowed and population assessment was made from 40 to 90 days after sowing (DAS). No acaricide or insecticide application was made to ensure maximum multiplication of mites under natural conditions.

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Method of assessing the mite population

In the screening experiment mite population was assessed 10 days after inoculation and recorded at 10 days interval starting from 40 DAS and continued till the population levels almost dwindled to nil. Mite numbers were assessed in one cm^2 area in the top, middle and bottom leaves of plants from each test entry with a cardboard template.

Damage grading index

Damage by mite feeding was judged on the basis of leaf spotting and loss of chlorophyll. A rating system for mite damage developed by Palanisamy (1984) was followed for estimating relative resistance / susceptibility. The test entries were evaluated / graded visually based on the injury levels exhibited on the plants. The grading was done on 55, 75 and 90 days after sowing both in pot culture and field experiments.

Injury level	Reaction	Grade
Plants with no feeding injury	Highly Resistant (HR)	0
Plants with slight injury - a few chlorotic spots on the leaves and a few mites on some leaves	Resistant (R)	1
Plants showing moderately high degree of injury - mites abundant on many leaves and leaves silvered by feeding and leaf size reduced	Moderately Resistant (MR)	2
Plants showing very high injury, yellowing of leaves and	Susceptible (S) stunting of plants	3
Plants showing severe damage and defoliation and / or of death of plants	Highly susceptible (HS)	4

Results and Discussion

Reaction of okra varieties against T. urticae infestation

Field screening

The mean mite population on susceptible check Mahyco 10 was 19.44/cm^2, which was the maximum on entries tested (Table 1). This was followed by HY 016 (13.61 mites/cm^2 leaf area) and Prerana (12.36 mites / cm^2 leaf area). The minimum number was observed on Kasturi bhendi 1.91/cm^2 leaf area AROH 465, Arka Anamika, Dharmapuri local, Parbani Kranti, Thanjavur local, JNOHO 2-2, PK-2, Etarai local, PK-3, Vayalur local, Thiruvarur local, BSS 596, Kolingianparai local, Slender, Jagruthi, Salem local and Makmali recorded up to 10 mites / cm^2. Many early workers had used mite population as the basis for categorizing the plant species into different level of resistance as in soybean (Sederatian *et al.*, 2009), strawberry (Shanks *et al.,* 1995), raspberry (Wilde *et al.,* 1991), tomato (Saeidi and Mallik, 2006), brinjal (Vinothkumar, 2009).

The damage score varied from 0.57 to 3.63 in the entries tested. The entry Kasturi bhendi recorded the minimum damage score of 0.57 and categorized as highly resistant, followed by Gujarat 2(1.63) and Theni local (1.77) was grouped as resistant.The other four entries, which recorded damage score below 2 were Pusa Sawani (1.93), Kulathur local (1.90), Villupuram local (1.97) and female parental line of COBhH1 (1.97). All the entries screened recorded significantly less damage score as against Mahyco 10 (3.63).

Selection of okra entries

Based on the mean mite population and damage score, six entries were selected. The entries were selected in such a way that they represent locals, varieties, hybrids and wild type with varied levels of resistance. Kasturi bhendi, a wild type (R), Dharmapuri local (MR), a popular local type and varieties Parbani Kranti (MR) and Pusa Sawani (MR) a commercially popular and potential varieties in the northern parts of the country, COBhH1 (MR) a TNAU release and Mahyco 10 (S) commercially cultivated popular among the farmers and high yield hybrids were selected. Kasturi bhendi, wild type recorded a mean mite population of 2.86 mites/cm^2 and mean damage score of 1.06 and categorized as Resistant. Mahyco 10 registered the maximum population and high damage score. It recorded a population of 19.44 mites /cm^2 and the corresponding damage score was 3.63 field screening and the reaction was categorized as highly susceptible. Dharmapuri local and Parbani Kranti showed moderately resistant reaction (2.13 and 2.13) with mean mite population ranged from 6.67 to 8.99 mites per cm^2 leaf area. The other variety Pusa Sawani and hybrid COBhH1 showed a moderately resistant reaction and registered a damage score of 2.37 and 2.40.

The findings are in agreement with Uckan and Eigin (2002) and Rajkumar *et al.* (2005) who point out plant species and varieties differ greatly in their levels of susceptibility or resistance to specific pests which is measured in terms of survival, development and reproductive rates. Shorter development time

Table 1. Resistance in okra entries to two spotted spider mite

Entry	Mite population/cm^2				Mean damage trade			
	50DAS	70DAS	90DAS	Mean	55DAS	75DAS	95 DAS	Resistance Category
Dharmapuri local	3.67	20.17	5.43	8.99	0.4	1.13	2.13	MR
Vridhunagar local	5.97	20.70	6.35	10.49	0.8	1.43	2.37	MR
Thanjavur local	4.47	19.93	5.50	9.23	0.4	1.27	2.15	MR
Madurai local	5.37	21.00	5.33	10.13	0.6	1.20	2.27	MR
Coimbatore local	6.27	21.17	6.41	11.02	0.6	1.43	2.50	MR
Etarai local	4.53	20.60	5.44	9.41	0.4	1.33	2.27	MR
Cumbum local	4.37	21.67	5.51	9.90	0.4	1.30	2.37	MR
Dindigul local	4.27	24.50	6.08	10.64	0.4	1.43	2.47	MR
Manargudi local	7.57	19.23	5.15	11.36	1.0	1.17	2.63	MR
Theni local	6.50	14.33	3.90	8.01	0.8	1.07	1.77	R
Kulathur local	5.43	14.40	5.25	8.49	0.8	1.20	1.90	R
Vayalur local	7.50	15.50	4.10	9.99	1.0	1.07	2.47	MR
Tiruvarur local	6.47	14.07	4.27	9.09	0.8	1.03	2.17	MR
Salem local	6.80	14.97	4.31	9.27	1.0	1.17	2.23	MR
Kolingianparai local	7.03	15.83	4.18	9.53	1.0	1.20	2.07	MR
Vilupuram local	5.23	17.73	5.83	10.00	0.8	1.30	1.97	R
Raasi	10.30	17.23	5.73	11.98	1.3	1.14	2.33	MR
PK-1	4.17	23.47	6.20	10.76	0.4	1.33	2.47	MR
Arka Anamika	4.87	20.40	6.23	9.58	0.6	1.30	2.20	MR
Pusa Sawani	8.43	17.53	6.43	10.74	1.1	1.50	1.93	R
Parbhani Kranti	2.73	19.20	4.60	8.23	0.2	1.20	2.13	MR
Parbhani Kranti2	5.93	19.37	5.31	9.13	0.6	1.20	2.33	MR
Arka Abhay	6.63	17.20	4.80	10.08	0.8	1.20	2.37	MR
Gujarat 2	6.07	11.27	4.49	8.10	0.8	1.03	1.63	R
Male parent of COBhH1	10.20	19.60	6.24	12.03	1.2	1.40	2.47	MR
Female parent of COBhH1	8.27	15.83	5.83	10.12	1.1	1.33	1.97	R
PK-3	7.07	14.27	4.33	9.32	1.0	1.20	2.17	MR
+NOH100	7.53	23.00	6.43	12.47	1.2	1.43	2.67	MR
Binti Amil51	5.03	30.50	7.30	12.69	0.6	1.40	2.83	MR
Kranti 5003	5.20	26.53	5.28	11.35	0.6	1.33	2.57	MR
AROH 465	3.97	22.27	5.30	9.58	0.4	1.20	2.33	MR
Champion 101	7.40	19.57	6.53	11.44	1.0	1.40	2.47	MR
COBhH1	5.97	20.30	5.30	10.37	0.6	1.23	2.40	MR
JNOH02-2	5.23	19.67	6.21	9.75	0.6	1.40	2.13	MR
HY 016	10.53	22.50	7.24	13.61	1.3	1.53	2.60	MR
Tulsi Hybrid	4.10	26.30	6.13	10.75	0.4	1.23	2.40	MR
BSS	593	4.50	17.80	5.80	0.4	1.37	2.00	MR
JOH 05-9	5.63	17.17	6.13	9.72	0.8	1.27	2.13	MR
HY 152	9.67	20.37	4.50	10.82	1.2	1.03	2.33	MR
AOH 23	7.93	16.40	5.37	10.20	1.0	1.10	2.22	MR
SPHB 7	8.90	16.23	6.40	10.98	1.1	1.47	2.30	MR
Komal	5.80	17.93	5.47	9.77	0.6	1.27	2.30	MR
AROH 218	(4.50	17.20	6.43	9.36	0.6	1.30	2.07	MR
Prerana Hybrid	11.07	22.63	6.40	12.36	1.2	1.40	2.40	MR
Bejo Sheetal	5.77	23.03	7.33	11.45	0.6	1.40	2.50	MR
Nirmal 147	7.47	18.87	4.93	10.54	0.8	1.27	2.43	MR
HY.404	8.30	16.63	4.40	10.32	1.1	1.20	2.27	MR
Mahyco 10 (check)	17.00	31.77	9.22	19.44	1.8	1.73	3.63	S
Spic Surya	6.23	16.33	6.30	10.12	0.8	1.40	2.30	MR
Sharwan	10.07	15.00	4.59	10.50	1.3	1.20	2.30	MR
B-S-51	5.90	16.90	6.63	10.09	0.6	1.17	2.50	MR
BSS 596	5.47	17.89	5.31	9.99	0.6	1.30	2.33	MR
Slender	6.83	16.57	5.48	9.79	0.8	1.23	2.13	MR
Jagruthi	5.87	14.40	5.21	8.70	0.6	1.40	2.07	MR
US7109	5.13	25.97	6.83	11.82	0.6	1.37	2.73	MR
Raasi 20	8.37	14.30	5.05	10.12	1.1	1.10	2.07	MR
Makmali	6.53	13.33	4.47	9.23	1.0	1.10	2.03	MR
Kasturi Bhendi	2.17	2.10	2.57	1.91	0.2	0.30	0.57	HR
SEd	0.336	0.318	0.165	-	-	-	-	-
CD (0.5 %)	0.667	0.633	0.328	-	-	-	-	-

and greater reproduction in the susceptible varieties indicate susceptibility of the variety. Resistance of wild species to *Tetranychus urticae* has been reported in several crops. *Lycopersicon pimpinellifolium* in tomato by Saeidi *et al.* (2007), *Solanum mammosum* and *Solanum sisym brifolium* in *Solanum* sp. by Schalf *et al.* (1975), *Arachis* sp. by Johnson *et al.* (1980), *Nicotiana* sp Patterson *et al.* (1974) and *Solanum retroflexum* and *Solanum khasianum* by Palanisamy (1984).

The present study revealed that out of 58 entries screened, six entries *viz.,* Kasturi bhendi (R), Dharmapuri local (MR), Parbani Kranti (MR), Pusa Sawani (MR), COBhH1 (MR) and Mahyco 10 (S) were selected based on the mean mite population and damage score, for detailed investigations. Studies on the antibiotic effect revealed that fecundity was higher, but egg incubation and hatchability was lower on the susceptible Mahyco 10. Shorter oviposition period (4.1days), longer incubation period (5.5 days), lower egg hatchability (49.7 %) and the highest mortality of all the three nymphal stages were observed on the resistant entry. The resistant variety kasthuri bhendi can be effectively utilized to develop okra varieties with improved resistance to two spotted spider mite.

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Received: May 3, 2011; Accepted: August 25, 2011