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Two Spotted Spider Mite, Tetranychus
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Acaricidal Activity of Certain Botanicals on Two Spotted Spider Mite, *Tetranychus urticae* Koch (Acari : Tetranychidae) in Bhendi

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ABSTRACT

Okra or Bhendi, *Abelmoschus esculentus* L. (Moench) (Malvaceae), is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. The two-spotted spider mite, *Tetranychus urticae* Koch (Acari, Tetranychidae) is one of the most serious agricultural pest and polyphagous. Control measures commonly used against insect pests in horticultural crops mainly on consist of pesticides, but these products are often toxic to the environment and to non-target species. Botanicals are naturally occurring chemicals extracted from plants and used as pesticides. It is safer and biodegradable than synthetic pesticides. The present study was undertaken to evaluate the acaricidal activity of certain botanicals against two-spotted spider mite in bhendi. Botanicals, Neem oil, NSKE, Pungam oil, *Vitex negundo* leaf extract and Turmeric Powder extract were used for this investigation. Among the treatments, Neem oil (5%) caused maximum mortality was recorded under laboratory condition. The reduction in the mite population in different treatments was in the order of Neem oil > NSKE > Pungam oil > *Vitex negundo* leaf extract > Turmeric powder extract under both kharif and summer season in pot culture.

Key words: Bhendi, Two-spotted spider mite, Botanicals, Acaricidal activity

The origin of bhendi is Ethiopia [1]. It needs warm and humid conditions for better growth. Sandy to clay soils with good drainage are suitable for okra cultivation. Soil pH should range between 6.0 and 6.8 for best yield [2]. The area and production of okra in India during the year of 2017-2018 are 5,14,000 ha and 61,26,000 MT (Ministry of Horticulture and Farmers Welfare). The foremost crisis in limiting the productivity of okra crop is its receptiveness to a many number of pests including vectors and phytophagous mites [3]. Mite generally colonizes under the surface of leaves and it is found on all parts of the plant when population is very high [4]. Mite sucks out the cell content by penetrating the cell with its stylet and causes cell collapse and manifests as spotting on the upper leaf surface [5]. It causes indirect damage to plants like decrease in photosynthesis and transpiration which results in hyper necrosis, leaf drying and leaf drop [6]. At severe infestation, Tetranychid mites web profusely and cover the entire plant by forming a thick sheath of webbing [7]. In okra yield loss was 46% [8]. Mite can be controlled by application of

acaricides. It causes various ill effects on human health and environment. The present study was undertaken to evaluate the acaricidal activity of certain botanicals against two-spotted spider mite in bhendi.

MATERIALS AND METHODS

The present investigation entitled was carried out at the Department of Entomology, Faculty of Agriculture, Annamalai University. The materials used and the methods followed in various experiments are described here.

Details of treatments

| Treatments | Dosage (%) |
|-----------------------------------|------------|
| Neem oil | 5% |
| NSKE | 5% |
| Pungam oil | 5% |
| <i>Vitex negundo</i> leaf extract | 5% |
| Turmeric powder extract | 5% |
| Untreated control | - |

Bio efficacy of botanicals against adults of *Tetranychus* spp. under laboratory condition

Five botanicals were evaluated against *Tetranychus* spp. along with untreated control which received only water treatment. The experiment was laid out in complete

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randomized block design. Leaf dip bioassay method was employed. Bhendi leaf bits of size 2 cm × 2 cm were dipped in desired concentrations of botanicals for five seconds. They were dried under ceiling fan for 2 - 3 minutes to remove excess moisture and kept later on cotton wad. Ten adults were released on leaf bit kept on moist cotton wad in Petri plate which served as one replication and three such replications were maintained for each botanical. Mites released on water treated leaf bits served as untreated control.

To study the mortality of adults in different treatments, the numbers of adults found dead were recorded at 1,3,6,9,12,24,48 and after 48 hours of treatment and per cent mortality was computed treatment wise. Individuals which do not respond to the touch by the fine camel hair brush were considered as dead. Mortality recorded in control was used to correct the mortality in treatments using Abbott's formula [9].

Corrected %
mortality =

$$\frac{\% \text{ Mortality in treatment} - \% \text{ mortality in control}}{100 - \% \text{ mortality in control}} \times 100$$

Efficacy of botanicals against bhendi mite, *Tetranychus* spp. in pot culture experiment

The experiment was laid out with randomized block design (RBD) with three replications in kharif and summer seasons. Bhendi (F₁ hybrid) was raised in mud pots, following all the recommended practices excepting plant protection measures. The crop was found heavily infested by *Tetranychus* spp. at 45 DAS. Observations were recorded on number of mites per three leaves, one from top, middle and

bottom portion of plant. Pretreatment observations were recorded one day before the application and post treatment observations were recorded on 3, 5, 7, 10 and 14 days after botanicals sprayed. The second spray was imposed on fifteen days after first spray. To compare the efficacy of different botanicals, per cent reduction in the population of the mites over untreated control (water spray) were calculated using Henderson and Tilton formula [10].

Corrected Percent Reduction =

$$\frac{T_a \times C_b}{T_b \times C_a} \times 100$$

Where;

Ta = the number of mites in the treatment after spraying,

Tb = Number of mites in the treatment before spraying,

Ca = Number of mites in the untreated check after spraying,

Cb = Number of mites in the untreated check before spraying

RESULTS AND DISCUSSION

Under laboratory condition

Among the neem-based botanicals and other botanicals tested, neem oil (5%) showed superior over all other treatments showed a mortality of 71.42% (Table 1). [11] reported that neem oil was found to be effective against *Tetranychus urticae* which support the present finding. [12] reported NSKE @ 5% expelled over all other treatments in causing highest mortality of mites. [13] found that pungam oil to be effective against spider mites. [14] observed that neem products were effective compared to other plant products against mites which is also reported by [15].

Table 1 Evaluation of botanicals against adults of *Tetranychus* spp. (per cent mortality) under laboratory condition

| S. No. | Percent mortality | | | | | | | | Mean mortality |
|-----------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------|
| | 1hr | 3hr | 6hr | 9hr | 12hr | 24hr | 48hr | After 48 hr | |
| Neem oil | 28.67 (32.371) ^b | 48.33 (44.045) ^b | 63.67 (52.932) ^b | 72.67 (58.480) ^b | 83.33 (65.907) ^b | 85.33 (67.485) ^b | 93.67 (75.434) ^b | 95.67 (78.002) ^b | 71.42% |
| NSKE | 27.33 (31.520) ^b | 43.33 (41.169) ^c | 58.67 (49.991) ^c | 60.67 (51.159) ^c | 62.33 (52.141) ^c | 65.67 (54.131) ^c | 83.33 (65.907) ^c | 94.67 (76.660) ^c | 62% |
| Pungam oil | 20.33 (26.802) ^c | 30.67 (33.626) ^d | 32.67 (34.858) ^d | 45.67 (42.514) ^d | 46.67 (43.089) ^d | 50.67 (45.382) ^d | 68.67 (55.961) ^d | 83.67 (66.165) ^d | 47.37% |
| <i>Vitex negundo</i> leaf extract | 6.67 (14.954) ^d | 16.33 (23.835) ^e | 22.33 (28.201) ^e | 25.33 (30.219) ^e | 29.33 (32.792) ^e | 37.67 (37.859) ^e | 51.67 (45.955) ^e | 78.67 (62.493) ^e | 33.5% |
| Turmeric Powder extract | 2.67 (9.360) ^e | 4.67 (12.460) ^f | 8.67 (17.115) ^f | 12.67 (20.845) ^f | 20.33 (26.802) ^f | 21.33 (27.038) ^f | 23.33 (28.883) ^f | 36.67 (37.267) ^f | 16.29% |
| Untreated control | 0 (0.286) ^f | 0 (0.286) ^g | 0 (0.286) ^g | 0 (0.286) ^g | 0 (0.286) ^g | 0 (0.286) ^g | 0 (0.286) ^g | 0 (0.286) ^g | 0 |
| S.Ed. | 0.458 | 0.404 | 0.400 | 0.268 | 0.263 | 0.264 | 0.314 | 0.396 | |
| C.D. (p=0.05) | 0.983 | 0.867 | 0.858 | 0.576 | 0.564 | 0.568 | 0.674 | 0.849 | |

Mean of three replications; Values within parenthesis are square root transformed

Pot culture condition

In the present study (Tables 2-5) showed neem oil was highly effective against *Tetranychus* spp. on bhendi compared to other treatments. The reduction in the mite population in different treatments was in the order of Neem oil > NSKE > Pungam oil > *Vitex negundo* leaf extract > Turmeric powder extract. Azadirachtin showed the property of antifeedant, reduced fecundity, fertility and shortened the life span of adult mite [16]. Application of different neem products effectively controlled the mite on okra [17]. The present findings clearly indicates that, neem-based botanicals performed well compared to other botanicals due to their high repellent and antifeedant properties whereas

other botanicals possess low repellent and antifeedant activity and also poor persistence nature. [18] reported that the higher acaricidal activity on motile stages of *T. urticae* was observed by treated with neem oil 2 per cent and NSKE 5 per cent. [19] observed that nimbicidene spray for four times showed a reduction of 66.89 per cent of population. [20] reported that among the extracts of neem, tobacco and tooh, neem showed highest reduction of mite of 64.63 per cent. [21] recorded that mite population reduction by neem oil was 81.15% followed by NSKE was 52.78% which supports the present finding. In contrast to the above findings, [22] reported that pungam oil is effective (46.32% reduction) followed by neem oil (42.68% reduction).

Table 2 Evaluation of botanicals against *Tetranychus* spp. in bhendi after first spray during *kharif* 2019 under pot culture experiment

| S. No. | Precount (4 cm ² leaf) | Mean no of mite per 4 sq.cm leaf | | | | | Pooled mean | Per cent reduction |
|--------------------------------------|--------------------------------------|----------------------------------|-------------------------------|------------------------------|-------------------------------|--------------------------------|----------------|-----------------------|
| | | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | | |
| Neem oil | 13 (3.606) | 6.67 (2.580) ^e | 5.33 (2.307) ^e | 3.67 (1.911) ^f | 7 (2.646) ^e | 8.33 (2.886) ^e | 6.2 | 55.71% |
| NSKE | 13.33 (3.651) | 8.33 (2.886) ^d | 6.67 (2.580) ^d | 5 (2.236) ^e | 7.67 (2.768) ^d | 10 (3.162) ^d | 7.53 | 46.21% |
| Pungam oil | 14 (3.742) | 9 (3.000) ^{cd} | 7.33 (2.707) ^d | 6.33 (2.515) ^d | 8.33 (2.886) ^c | 10.67 (3.265) ^{cd} | 8.33 | 40.5% |
| <i>Vitex negundo</i> leaf extract | 13.67 (3.696) | 9.67 (3.108) ^c | 8.67 (2.943) ^c | 7.67 (2.768) ^c | 9 (3.000) ^c | 11.33 (3.366) ^{bc} | 9.27 | 33.79% |
| Turmeric Powder extract | 13.33 (3.651) | 11.33 (3.366) ^b | 10 (3.162) ^b | 8.67 (2.943) ^b | 10.33 (3.214) ^b | 12 (3.464) ^b | 10.47 | 25.21% |
| Untreated control | 13.67 (3.696) | 12.67 (3.558) ^a | 13.33 (3.651) ^a | 14 (3.742) ^a | 14.67 (3.829) ^a | 15.33 (3.915) ^a | 14 | - |
| S.Ed | 0.048 | 0.069 | 0.076 | 0.062 | 0.049 | 0.052 | - | - |
| C.D. (p=0.05) | NS | 0.162 | 0.180 | 0.154 | 0.115 | 0.119 | - | - |

Mean of three replications; Values within parenthesis are square root transformed

Table 3 Evaluation of botanicals against *Tetranychus* spp. in bhendi after second spray during *kharif* 2019 under pot culture experiment

| S. No. | Precount (4 cm ² leaf) | Mean no of mite per 4 sq.cm leaf | | | | | Pooled mean | Per cent reduction |
|--------------------------------------|--------------------------------------|----------------------------------|-------------------------------|-------------------------------|------------------------------|-------------------------------|----------------|-----------------------|
| | | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | | |
| Neem oil | 8.33 (2.886) ^e | 5 (2.236) ^f | 3.67 (1.911) ^e | 2.33 (1.520) ^e | 4 (2.000) ^e | 5.33 (2.307) ^d | 4.07 | 70.66% |
| NSKE | 10 (3.162) ^d | 8.33 (2.886) ^e | 7 (2.646) ^d | 6.33 (2.515) ^d | 7.33 (2.707) ^d | 8.33 (2.886) ^c | 7.46 | 46.21% |
| Pungam oil | 10.67 (3.265) ^{cd} | 9 (3.000) ^d | 7.67 (2.768) ^d | 7 (2.646) ^{cd} | 8 (2.828) ^{cd} | 9.33 (3.054) ^{bc} | 8.2 | 40.88% |
| <i>Vitex negundo</i> leaf extract | 11.33 (3.366) ^{bc} | 10.33 (3.214) ^c | 9 (3.000) ^c | 7.67 (2.768) ^c | 8.67 (2.943) ^c | 9.67 (3.108) ^c | 9.07 | 34.61% |
| Turmeric Powder extract | 12 (3.464) ^b | 11.33 (3.366) ^b | 10.67 (3.265) ^b | 9.33 (3.054) ^b | 9.67 (3.108) ^b | 10.33 (3.214) ^b | 10.27 | 25.96% |
| Untreated control | 15.33 (3.915) ^a | 13.33 (3.651) ^a | 13.67 (3.696) ^a | 13.67 (3.696) ^a | 14 (3.742) ^a | 14.67 (3.829) ^a | 13.87 | - |
| S.Ed | 0.052 | 0.048 | 0.058 | 0.085 | 0.053 | 0.076 | - | - |
| C.D. (p=0.05) | 0.119 | 0.109 | 0.146 | 0.221 | 0.122 | 0.183 | - | - |

Mean of three replications; Values within parenthesis are square root transformed

Table 4 Evaluation of botanicals against *Tetranychus* spp. in bhendi after first spray during summer 2019 under pot culture experiment

| S. No. | Precount (4 cm ² leaf) | Mean no of mite per 4 sq.cm leaf | | | | | Pooled mean | Per cent reduction |
|--------------------------------------|--------------------------------------|----------------------------------|-------------------------------|-------------------------------|------------------------------|------------------------------|----------------|-----------------------|
| | | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | | |
| Neem oil | 7.67 (2.768) | 4 (1.989) ^c | 3 (1.732) ^e | 2.33 (1.520) ^e | 3.33 (1.821) ^d | 4.33 (2.079) ^c | 3.40 | 56.41% |
| NSKE | 7.33 (2.707) | 5.67 (2.378) ^b | 4.67 (2.157) ^d | 4 (2.000) ^d | 4.67 (2.157) ^c | 5 (2.236) ^c | 4.80 | 38.46% |
| Pungam oil | 6.67 (2.580) | 6 (2.449) ^b | 5.33 (2.307) ^{cd} | 4.67 (2.157) ^{cd} | 5.67 (2.378) ^b | 6 (2.449) ^b | 5.53 | 29.10% |
| <i>Vitex negundo</i> leaf extract | 7.67 (2.768) | 6.33 (2.515) ^{ab} | 6 (2.449) ^{bc} | 5.33 (2.307) ^{bc} | 6 (2.449) ^b | 6.33 (2.515) ^b | 6 | 23.08% |
| Turmeric Powder extract | 7 (2.641) | 6.67 (2.580) ^{ab} | 6.33 (2.515) ^b | 6 (2.449) ^b | 6 (2.449) ^b | 6.67 (2.580) ^b | 6.33 | 18.85% |
| Untreated control | 7.67 (2.768) | 7.33 (2.707) ^a | 7.67 (2.768) ^a | 7.67 (2.768) ^a | 8 (2.828) ^a | 8.33 (2.886) ^a | 7.8 | - |
| S.Ed | 0.095 | 0.089 | 0.066 | 0.068 | 0.074 | 0.067 | - | - |
| C.D. (p=0.05) | NS | 0.214 | 0.161 | 0.166 | 0.185 | 0.161 | - | - |

Mean of three replications; Values within parenthesis are square root transformed

CONCLUSION

The studies revealed that, among the treatments, Neem oil (5%) was found to be effective in reduction of

mite population in bhendi. Neem oil 5% can be used in alternate application in the integrated management of the Two spotted spider mites in bhendi eco system.

Table 5 Evaluation of botanicals against *Tetranychus* spp. on bhendi after second spray during summer 2019 under pot culture experiment

| S. No. | Precount (4 cm ² leaf) | Mean no of mite per 4 sq.cm leaf | | | | | Pooled mean | Per cent reduction |
|--------------------------------------|--------------------------------------|----------------------------------|-------------------------------|------------------------------|------------------------------|-------------------------------|----------------|-----------------------|
| | | 3 DAS | 5 DAS | 7 DAS | 10 DAS | 14 DAS | | |
| Neem oil | 4.33 (2.079) ^c | 3 (1.732) ^d | 2.33 (1.520) ^e | 2 (1.414) ^d | 2.67 (1.626) ^d | 3.33 (1.821) ^{de} | 2.67 | 68.21% |
| NSKE | 5 (2.236) ^c | 4.33 (2.079) ^c | 4 (2.000) ^d | 3.33 (1.821) ^c | 3.67 (1.911) ^c | 4 (2.000) ^d | 3.87 | 53.93% |
| Pungam oil | 6 (2.449) ^b | 5.67 (2.378) ^b | 5 (2.236) ^c | 4 (2.000) ^c | 4.33 (2.079) ^c | 5.33 (2.307) ^c | 4.87 | 42.02% |
| <i>Vitex negundo</i> leaf extract | 6.33 (2.515) ^b | 6 (2.449) ^b | 5.67 (2.378) ^{bc} | 5 (2.236) ^b | 5.33 (2.307) ^b | 5.67 (2.378) ^{bc} | 5.53 | 34.17% |
| Turmeric Powder extract | 6.67 (2.580) ^b | 6.33 (2.515) ^b | 6 (2.449) ^b | 5.33 (2.307) ^b | 6 (2.449) ^b | 6.33 (2.515) ^b | 6 | 28.57% |
| Untreated control | 8.33 (2.886) ^a | 8 (2.828) ^a | 8.33 (2.886) ^a | 8.33 (2.886) ^a | 8.67 (2.943) ^a | 8.67 (2.943) ^a | 8.4 | - |
| S.Ed | 0.067 | 0.073 | 0.059 | 0.077 | 0.069 | 0.082 | - | - |
| C.D. (p=0.05) | 0.161 | 0.179 | 0.145 | 0.201 | 0.171 | 0.199 | - | - |

Mean of three replications; Values within parenthesis are square root transformed

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