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Scientific Note

Effect of plant extracts on the developmental stages of *Tetranychus urticae* Koch (Acari: Tetranychidae)

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Two-spotted spider mite (TSSM) *Tetranychus urticae* Koch (Acari: Tetranychidae) is the major pest on agricultural crops worldwide (Asada, 1978; Wu *et al.,* 1990; Takafuji *et al.,* 2000). It is distributed throughout the tropical and sub tropical parts of the world (Jeppson *et al.* 1975). The two-spotted spider mite is a detrimental pest, which has been reported to attack about 1200 species of plant (Zhang, 2003), of which more than 150 are economically important (Jeppson *et al.,*1997; Xie *et al.,* 2006). A number of common vegetable crops and ornamental plants are known to attack by this mite in Bangladesh (Biswas *et al.,* 2004). They also reported that infestation by spider mite may retarded growth and adversely influences the quality of flower, seed or fruit production, defoliation, and various types of plans deformities, resulting in loss of crop yield. A number of some common ornamental and vegetable plants attacked by *T. urticae* including corn, cotton, cucumber, beans, tomato, egg plant, peppers and rose (Navajas, 1998; Aucejo *et al.,* 2003). The acaricides propargite, aldicarb, lambda-cyhalothrin, and fenpropathrin are used for the control of TSSM (Herbert, 1999). Development of resistance by *T. urticae* to numerous acaricides has caused difficulties in controlling its outbreak (Carbonaro *et al.,* 1986). Many new acaricides are available in the market but they are high cost associated with their use and application restrictions listed on the label to prevent the development of resistance.

There is an increasing interest for natural pesticides derived from plants and microorganisms (Isman *et al.,* 2007) because they are generally perceived to be safer than the synthetics. Kwon *et al.,* (2002) made an experiment with different plant extracts and found that methanol extracts of *Sophora japonica* leaf and *Zanthoxylum piperitum* bark showed high insecticidal activity against *Spodoptera litura*. In another test with *T. urticae*, extracts from *Carpinus coreana* leaf, *Firmiana simplex* barks, *Eleagnus macrophylla* leaf, *Aralia elata* leaf, *Comus controversa* barks and *Chamaecyparis obtusa* leaf exibited strong acaricidal activity. They also commented that as a naturally pest control agent *Z. piperitum* barks could be useful as new insecticidal and acaricidal products against varias arthropod pests.

These concerns have resulted in a renewed interest in search for alternative control measures. Plant extracts are one of several non-chemical control options that have recently received attention (Derbalah, *et al.,* 2013). Plant extracts are relatively safe to the environment and to the applicator. Some indigenous plant materials of Bangladesh significantly retarded the development of

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immature period of two-spotted spider mite. Among them four plant extracts were selected to find out their potentiality on TSSM control.

Efficacy of four plant extracts viz. *Zingiber cassumunar* (Zingiberaceae), *Murraya koenigii* (Rutaceae), *Acorus calamus* (Acoraceae) and *Blumea lacera* (Compositae) against two spotted spider mite *T. urticae* were studied in the laboratory.

The test materials were collected from different areas of Rajshahi, Bangladesh. The rhizome and leaf were choped off into small pieces and dried in a shade for 2-3 days, and were dried in an oven at 40°C. After drying these parts were crushed by using a cyclotech grinding machine.

The prepared materials of *Z. cassumunar* and *A. calamus* were extracting with petroleum ether and the leaf dusts of *M. koenigii* and *B. lacera* were extracted with n-hexane in soxhlet apparatus. The solvent were evaporated in rotary vacuum evaporator at 40°C under reduced pressure yielding the petroleum ether and n-hexane extracts.

Stock solution of rhizome of *Z. cassumunar* was prepared by adding 3ml distilled water in 4ml raw extract (3:4 = water and rhizome extract). Then 0.1gm NaOH was added to emulsify the solution. The stock solution of rhizome of *A. calamus* was also prepared by the similar way as of the *Z. cassumunar*. Stock solution of leaf of *M. koenigii* was prepared by adding 3ml distilled water with 4ml of leaf extract (3:4 = water and leaf extract). Then the solution was emulsified with 0.1gm NaOH. Stock solution of leaf of *B. lacere* was also prepared in the similar way as of the *M. koenigii*. The prepared stock solutions then were collected in small reagent bottles and preserved at 4°C in a refrigerator.

In each case of the four plant extracts the 0.1425μl/cm^{2-} concentration was established by mixing 1ml stock solution with 400ml distilled water. The same amount of stock solution were mixed with 200, 100 and 50ml of distilled water and were prepared 0.2850μl/cm^{2-}, 0.5700μl/cm^{2-} and 1.1400μl/cm^{2-} concentrations respectively.

An amount of 0.1ml of stock solution was evenly spread over a leaf disc of 1cm^2. Then the leaf discs were dried in the room temperature and fully mature adult female *T. urticae* were placed on each of the leaf disc. The females were allowed to oviposit on the leaf discs. After laying egg the females and excess eggs were removed from the petridish, keeping only one egg in each petridish. The petridishes were then covered with the lid, leaving a small gap to check excess evaporation. Thus sets of 15 eggs on 15 leaf discs treated with different concentrations of the experimental plants in 15 petri dishes were taken. Another set of 15 eggs on 15 leaf discs which were untreated were also taken in 15 petri dishes as control in case of each of the plant extracts.

Leaf discs of both treated and control batches were replaced with a treated and untreated fresh leaf disc respectively, after 3-4 days. Daily observation was made for the time taken for each moulting up to adult emergence. The whole experiment was completed during May to September 2012, when the average room temperature was 30 ± 2°C.

The mean duration of developmental periods of *T. urticae* with the application of *Z. cassumunar*, *M. koenigii, A. calamus* and *B. lacera* are presented in Table 1. *A. calamus* rhizome extract exhibited the highest duration of egg developmental period (3.40±0.13) at the concentration of 1.1400*μ*l/cm^{-2}. In the

case of *Z. cassumunar* rhizome extract the highest duration of egg developmental period (3.27±0.13) at the concentration of 0.5700µl/cm^{-2}. The leaf extract of *M. koenigii* and *B. lacera* did not play any significant role on egg developmental period of *T. urticae* in comparison to the control. The data was analysed by analysis of variance and observed that egg developmental period of *T. urticae* differed significantly among different plant extracts (F= 7.38**, P < 0.01).

The calculated LSD value (0.34) among different plant extracts showed significant differences. The egg duration of *T. urticae* found highest with the application of *A. calamus* and differed much from other extracts. Considering the highest dose the efficacy followed the order: *A. calamus* > *Z. cassumunar* > *B. lecera* > *M. koenigii.* On the contrary the larval period of *T. urticae* did not show significant difference among different concentrations as well as among different plant extracts.

Efficacy of four plant extracts showed more or less similar trend of activity on the protonymphal period of *T. urticae* (Table-1) but differed significantly among different concentrations (F=34.69, P<0.001). With increasing dose concentration the protonymphal periods were increased.

Table 1. Duration of developmental periods of *T. urticae* with the application of different concentrations of four plant extracts

Developmental Stages	Concentrations (µl/cm^{-2})	*Z.cassumunar*	*M. koenigii*	*A. calamus*	*B. lacera*
		Duration in days			
Egg	0.1425	3.20±0.16	2.67±0.19	3.47±0.13	3.20±0.15
	0.2850	3.13±0.17	2.87±0.13	3.27±0.12	3.20±0.15
	0.5700	3.27±0.12	2.60±0.13	3.27±0.12	3.00±0.09
	1.1400	3.13±0.19	2.67±0.13	3.40±0.13	2.87±0.09
	Control	3.03±0.15	3.27±0.12	3.33±0.13	3.53±0.17
Larval period	0.1425	2.23±0.17	2.50±0.14	2.13±0.09	2.13±0.09
	0.2850	2.46±0.14	2.43±0.14	2.13±0.09	2.13±0.09
	0.5700	2.33±0.13	2.27±0.12	2.53±0.17	2.27±0.12
	1.1400	2.20±0.15	2.13±0.09	2.53±0.13	2.27±0.12
	Control	2.33±0.13	2.33±0.13	2.20±0.11	2.27±0.12
Protonymphal period	0.1425	2.08±0.08	2.08±0.08	1.93±0.13	2.08±0.08
	0.2850	2.08±0.15	2.23±0.12	2.08±0.15	2.29±0.13
	0.5700	2.50±0.15	2.40±0.13	2.33±0.14	2.33±0.14
	1.1400	2.69±0.13	2.79±0.19	2.92±0.08	2.57±0.17
	Control	1.92±0.08	1.86±0.09	1.93±0.08	2.00±0.00
Deutonymphal period	0.1425	1.75±0.13	1.92±0.08	1.85±0.15	1.69±0.13
	0.2850	1.92±0.08	2.23±0.12	2.17±0.11	2.50±0.15
	0.5700	3.25±0.22	2.75±0.18	2.50±0.15	3.17±0.17
	1.1400	5.50±0.17	5.36±0.15	5.90±0.18	5.40±0.16
	Control	1.83±0.11	1.67±0.14	1.58±0.15	1.75±0.13
Egg-adult duration	0.1425	9.25±0.30	9.15±0.19	9.46±0.27	9.15±0.22
	0.2850	9.33±0.23	9.77±0.20	9.75±0.22	10.17±0.27
	0.5700	11.25±0.37	9.92±0.31	10.58±0.40	10.58±0.19
	1.1400	13.70±0.30	13.00±0.23	14.70±0.21	13.10±0.32
	Control	8.92±0.29	9.08±0.23	9.25±0.13	9.54±0.18

The deutonymphal period of *T. urticae* with the application of four plant extracts are presented in Table 1. Significant impact was observed among different concentrations (F=160.03, P<0.001) of extracts. In all the cases prolonged deutonymphal period was occurred at the concentration of 1.1400μl/cm^2.

The egg–adult duration of the above mentioned pest species differd significantly different due to different concentrations (F= 64.18, P< 0.01) but not due to different plant extracts. Within the four plant extracts, the developmental period of *T. urticae* highly delayed for the rhizome extract of *A. calamus*. The order of efficacy was *A. calamus* > *Z. cassumunar* > *B. lacera* > *M. koenigii* (Table 1).

The results receive supports from the result of Motazedan *et al.,* (2012) who reported the LC_{50} values of essential oils of *M. longifolia*, *M. communis* and *S. officialis* against *T. urticae* were 20.08, 53.22 and 60.93 μl^{-1} air respectively. Similarly, lemon eucalyptus (*Corymbia citriodora*), pennyroyal (*Mentha pulegium*) and peppermint (*Mentha piperita)* have fumigant activity against *T. urticae* (Choi *et al.,* 2004). Our result is in conformity with the result of Isman and Michial (2006) who reported the toxicity of rosemary oil based pesticides against *T. urticae*. Antonious *et al.* (2006) and Kumral *et al.* (2009) reported the acaricidal, ovicidal and repellent activities against *T. urticae* when treated with ethanolic extracts of *Datura stramonium* leaves and seeds. Yanar *et al.* (2011) reported that methanolic extracts of *Lolium perenne* (flower and leaf), *Anthemis vulgaris* (flower) and *Chenopodium album* (flower and leaf) exhibited significant adult mortality of *T. urticae*. Contrasting result was obtained by Naher *et al.* (2006) who reported that developmental period of *T. urticae* egg delayed treated with *Nerium oleander* seed and *Calotropis procera* flower juice in comparison with the control. They also noted that both the plant extracts delayed the protonymplhal period but the deutonymphal period of the same species was not affected by them.

Among the four plant extracts the rhizome has great potentiality than the leaf. More specific research is essential for use of plant extract in pest control instead of chemicals.

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References

Antonious, G.F. & Snyder, J.C. 2006. Repellency and toxicity of wild tomato leaf exracts to two-spotted spider mite, *Tetranychus urticae* Koch. *J. 11750 African J. Biotechnol. Environ. Sci. Health Natural Products*. **41B:** 43-55.

Asada, M. 1978. Genetic and biochemical mechanisms of acaricide resistance in phytophagous mites. *J. Pestic. Sci.* **3:** 61-68.

Aucejo, S., Foo, M., Gimeno, E., Gomez, A., Montort, R., Predes, E., Ramis, M., Ripolles, J. L. & Tirado, V. 2003. Management of *Tetranychus urtic*ae in Citrus in Spain acarofauna associated to weed. *IOBC/WPRS Bull*. **26:** 213-220.

Biswas, G.C., Islam, W. & Haque, M.M. 2004. Seasonal abundance of spider mites (Acari: Tetranychidae) on some economic plants in Rajshahi . *J. bio. Sci.* **7**(12)**:** 1-6.

Carbonaro, M.A., Moreland, D.E., Edge, V.E.N., Motoyama, R.G.C.& Dauterman, W.C. 1986. Studies on the mechanisms of cyhexatin resistance in the two-spotted spider mite, *Tetanychus urticae* (Acari: Tetranychidae). *J. Econ. Entomol.* **79:** 576-579.

Choi, W.I., Lee, S.G., Park, H.M. & Ahn, Y.J. 2004. Toxicity of Plant Essential Oils to *Tetranychus urticae* (Acari: Tetranychidae). *J. Econ. Entomol.* **97**(2)**:** 553-558.

Derbalah, Aly S., Keratrum, Attiah Y., El- dewy, Madeha, E. & El-Shamy, Elhussein H. 2013. Efficacy of some insecticides and plant extracts against *Tetranychus urticae* under laboratory conditions. *Egy. J. Plant Pro. Res.* **1(3):** 47-69

Herbert D. A., Jr. 1999. *Peanut production guide: Insect control in peanuts.* Tidewater Agricultural Research and Extension Center. http://vaes.vt.edu/tidewater/ peanut.

Isman, M.B. & Machial, C.M. 2006. Botanical Insecticides, Deterrents, and Repellents in Modern Agriculture and an Increasingly Regulated World. *Ann. Rev. Entomol.* **51:** 45-66.

Isman, M.B, Machial, C.M., Miresmailli, S. & Bainard, L.D. 2007. Essential oilbased pesticides: new insights from old chemistry In: *Pesticide Chemistry* (eds. Ohka-wa, H., Miyagawa, H, & Lee, P.) Wiley, Weinheim. 201-209 pp.

Jeppson, L.F., Keifer, H.H. & Baker, E. W. 1975. *Mites Injurious to Economic Plants.* University of California Press, USA, pp. 614.

Jeppson, L. R., Keifer, H. H. & Baker, E. W. 1997. *Mites Injurious to Economic Plants.* University of California Press, Berkeley, CA. pp. 458.

Kumral, N.A, Çobano-lu, S. & Yalcin, C. 2009. Acaricidal, repellent and oviposition deterrent activities of *Datura stramorium* L. Against adult *Tetranychus urticae* Koch. *J. Pest Sci*. DOI 10.1007/s10340-009-0284-7.

Kwon, P; Ji-Doo, P., Chul-Su, K., Sang-Chul, S., Young-Joo, A., Seung-Chan, P. & Sang-Gil, L. 2002. Insecticidal and acaricidal activities of domestic plant extracts against five major arthropod pests. *Korean J. Pestic. Sci*. **6**(4)**:** 171-178

Motazedan, N., Ravan, S., & Bandani, P.R. 2012. Toxicity and Repellency Effects of Three Essential Oils against *Tetranychus urticae* Koch (Acarig Tetranychidae). *J. Agr. Sci. Tech*. **14:** 275-284.

Naher, N., Islam, T., Haque, M.M. & Parween, S. 2006. Effects of native plants and IGRs on the development of *Tetranychus urticae* Koch (Acari: Tetranychidae). *Univ. j. zool., Rajshahi Univ.* **25:** 19-22.

Navajas, M. 1998. Host plant association in the spider mite *Tetranychus urticae* (Acari Tetranychidae): in sights from molecular phylogeography. *Exp. Appl. Acarol* . **22:** 201-214.

Takafuji, A., Ozawa, A., Nemoto, H. & Gotoh, T. 2000. Spider mites of Japan: their biology and control. *Exp. Appl. Acarol.* **24:** 319-335.

Wu, K.M., Liu, X.C., Qin, X.Q. & Luo, G.Q. 1990. Investigation of Carmine Spider Mite (*Tetranychus cinnabarinus*) Resistance to Insecticides. *Acta Agricultura Boreali-Sinica,* **5:** 117-123.

Xie, J.T., Chang, W.T., Wang, C.Z., Mehendale, S.R., Li, J., Ambihaipahar, R., Fong, H.H. & Yuan, C.S. 2006. *Am. J. Chin. Med*. **34:** 279-284.

Yanar, D., Kadioglu, I. & GöKce, A. 2011. Acaricidal effects of different plant extracts on two-spotted spider mite *(Tetranychus urticae* Koch). *J. African Biotech.* **10**(55)**:** 11745-11750.

Zhang, Z. 2003. *Mites of Greenhouses*. CABI Publishing Oxon, UK. pp. 244.

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