Field evaluation of certain leaf extracts for the control of mussel scale (*Lepidosaphes piperis* Gr.) in Black pepper (*Piper nigrum* L.)

M. Sreekanth

ABSTRACT

Field experiments conducted on black pepper during summer, 2007 and 2008 to find out the efficacy of certain leaf extracts on mussel scale (*Lepidosaphes piperis* Gr.) reveal that all the leaf extracts were able to reduce the scale population significantly over control. *Cleome gynandra* (Spider flower) leaf extract 5% (9.8 scales / cm^2 / leaf), followed by *Azadirachta indica* (Neem) leaf extract 5% (10.8 scales/ cm^2 / leaf) were very effective and proved to be the best with 28.09% and 21.13% reduction of scales population respectively over control (13.6 scales / cm^2 / leaf). Similarly, *Azeratum conyzoides* (Goat weed), *Annona squamosa* (Custard apple), *Parthenium hysterophorus* (Congress weed) and *Lantana camara* (Yellow sage) respectively with 11.6, 11.8 11.9 and 12.2 scales per cm^2 per leaf have recorded 14.20 13.31, 12.19 and 9.92% reduction of population over control respectively. Results indicated that plant extracts could be used as potential botanical pesticides for organic farming.

Key words: Black pepper, leaf extracts, *Lepidosaphes piperis,* mussel scale, *Piper nigrum*

INTRODUCTION

Black pepper (*Piper nigrum* L.) (Piperaceae) famous as "Black Gold" and also known as "King of Spices" is one of the important agricultural commodities of commerce and trade in India since pre-historic period. It is the major source of income and employment for rural households in the predominantly pepper growing states of India. Pepper is grown in about 26 countries and occupies 4, 67,708 hectares with productivity of 790.2 kg per hectare. India is the leading producer of black pepper in the world with more than 40 per cent share of area contributes about 23 per cent of the production of the world. But the productivity of the crop is very low (310 kg per hectare) (Ankegowda *et al.,* 2012). Among the various factors responsible for the low productivity, infestation by insect pests has been identified as a major one. Thirty four species of insects have been reported to infest the crop in India. Among them four species *viz.,* 'pollu' beetle, top shoot borer, leaf gall thrips and scale insects are of importance.

Among the various species of scale insects recorded on black pepper in India, the mussel scale (*Lepidosaphes piperis* Gr.) is the most important pest (Devasahayam *et al*., 1988; Devasahayam and Koya, 1994; Koya *et al.,* 1996; Devasahayam and Koya, 1998) especially at higher altitudes in the field and on older cuttings in the nursery. The infestation is seen in the form of encrustations generally on leaves and stems and becomes more severe during summer months. They suck plant sap resulting in yellowing and drying of infested plant parts.

The pest control measures rely heavily on the use of synthetic pesticides. Researchers in the world for the past several years have been working very hard in trying to identify effective, economic, acceptable and sustainable pest control measures particularly for black pepper insect pests (Premkumar and Devasahayam, 1989; Devasahayam and Koya, 1998). Several insecticides have been evaluated and recommended for major insect pests. Indiscriminate use of broad spectrum insecticides has led to the development of insect resistance and causes a negative impact on natural enemies. They are relatively poisonous to mammals, including humans and very toxic to fish (Davis *et al*., 2001; Anand Prakash *et al*., 2008).

Botanical insecticides have long been touted as attractive alternatives to synthetic chemical insecticides for pest management (Venkat Reddy *et al*., 2012). They are ecofriendly, economic, target-specific and biodegradable. They have deterrent, antifeedent, anti ovipositional, growth disrupting and fecundity properties (Varma and Dubey, 1998; UVPP, 2001). Their greatest strength is their specificity as most are essentially non toxic and non-pathogenic to animals and humans. Considering the importance of ecofriendly approaches to manage the pests, the experiment was designed to determine relative efficacy of different botanical extracts against mussel scale.

MATERIALS AND METHODS

Field experiments were conducted in Regional Agricultural Research Station (Horticultural Research Station), Chintapalle, Visakhapatnam District, Andhra Pradesh, India during summer, 2007 and 2008 in Randomized Block Design (RBD) using Panniyur -1 variety. Each plot consists of five vines of 15 years old with mussel scale infestation. The treatments consisted of six plant leaf extracts *viz., Lantana camara* (Yellow sage) (T1), *Azeratum conyzoides* (Goat weed) (T2), *Parthenium hysterophorus* (Carrot grass / Congress grass) (T3), *Cleome gynandra* (Spider flower) (T4), *Annona squamosa* (Custard apple) (T5) *Azadirachta indica* (Neem) (T6) leaf extract each at 5% and untreated check (T7). The fresh leaves of different test plants were collected, washed with water to remove dirt and chopped into small pieces, then grounded using clean water in the ratio of 50 gm leaves in one liter of water to get 5% solution and filtered through double folded muslin cloth to prevent fiber particles from blocking the spray nozzle. Small quantity of starch and soap solution was also added to improve their rain fastness and spread on black pepper vines. Each treatment was replicated thrice. The treatments were imposed using a rocker sprayer at the rate of 500 liters spray fluid per hectare. Three rounds of application were done; first one was given when initial infestation was recorded, followed by second and third at 15 days interval. The mussel scale population per cm^2 per leaf per plant was recorded before spray and 1, 3, 7 and 15 days after each spray and percent reduction of scales over control was calculated. Data collected were analyzed using standard statistical procedures. The population/numbers were subjected to square root transformation.

RESULTS AND DISCUSSION

The experimental results (Table 1 and 2) reveal that all the treatments significantly reduced the mussel scale population over control. However, among the treatments, T4 followed by T6 recorded very low pest population at 1, 3, 7 and 15 days after spraying. The pooled data (Table 3) pertaining to mean percent reduction of scales reveals that T4 was the best treatment against mussel scales by recording 28.09% reduction and was followed by T6.

The literature on the efficacy of leaf extracts on mussel scales of black pepper is scanty. Hence, the literature obtained on other insect pests on different crops was discussed here.

In the present study it was found that *Cleome gynandra* leaf extract 5% proved to be the better treatment against mussel scales by recording highest mean per cent reduction of 28.09%. The superior efficacy of *Cleome gynandra* leaf extract was well documented by Nyalala and Grout (2007), who reported that companion planting of *Cleome gynandra*, in beds of cut-flower roses reduces significantly red spider mite (*Tetranychus urticae* Koch.) infestation without any

Table 1. Evaluation of leaf extracts on the population of mussel scales (*Lepidosaphes piperis*) of black pepper (*Piper nigrum)* during summer, 2007

Treatments	No. of scales per cm^2 per leaf				
	Before Spraying	1 DAS*	3 DAS	7 DAS	15 DAS
Lantana camara (Yellow sage) leaf extract 5%	13.53	11.60	10.31	12.20	12.42
Azeratum conyzoides (Goat weed) leaf extract 5%	14.13	11.66	8.76	11.58	12.91
Parthenium hysterophorus (Congress grass) leaf extract 5%	13.53	11.02	10.44	11.53	11.91
Cleome gynandra (Spider flower) leaf extract 5%	13.20	10.49	5.71	9.15	11.49
Annona squamosa (Custard apple) leaf extract 5%	13.40	11.44	9.69	11.64	12.78
Azadirachta indica (Neem) leaf extract 5%	13.27	11.02	6.58	9.98	12.05
Control	12.80	12.02	12.35	12.42	12.58
SEM	0.07	0.04	0.08	0.06	0.18
C.D 5%	NS	0.12	0.24	0.18	NS
C.V (%)	3.4	1.9	4.3	3.0	8.8

*DAS – Days after spraying

Table 2. Evaluation of leaf extracts on the population of mussel scales (*Lepidosaphes piperis*) of black pepper (*Piper nigrum)* during summer, 2008

Treatments	No. of scales per cm2 per leaf				
	Before Spraying	1 DAS*	3 DAS	7 DAS	15 DAS
Lantana camara (Yellow sage) leaf extract 5%	12.0	11.97	10.23	14.0	15.03
Azeratum conyzoides (Goat weed) leaf extract 5%	10.7	11.67	8.70	13.0	14.67
Parthenium hysterophorus (Congress grass) leaf extract 5%	12.0	11.77	9.90	13.67	15.10
Cleome gynandra (Spider flower) leaf extract 5%	10.7	10.13	6.57	11.13	13.43
Annona squamosa (Custard apple) leaf extract 5%	13.0	10.77	9.37	14.33	15.00
Azadirachta indica (Neem) leaf extract 5%	11.0	11.33	7.90	12.10	14.87
Control	13.3	14.43	15.10	15.30	14.80
SEM	0.08	0.06	0.04	0.05	0.04
C.D 5%	0.25	0.20	0.12	0.14	0.11
C.V (%)	4.0	3.1	2.1	2.1	1.5

*DAS – Days after spraying

detrimental effect on productivity or flower quality. Among other leaf extracts, *Azadirachta indica* (Neem) at 5% concentration was recorded to be the next best treatment against mussel scales. The results of the present study were in conformity with the findings of Ghatak *et al.* (2005), who reported that Neem spray Aza 3000 EC at 5.0% reduced Epilachna beetle, *Henosepilachna vigintioctopunctata* (Fab.) population by 67.10% in brinjal. Singh *et al.* (2009) also found that the population of aphids, Jassids and whiteflies was significantly lower in greengram (*Vigna radiata*) when sprayed with neem oil. Superior efficacy of NSKE against brown plant hoppers in rice was also reported by Ramraju and Sundarababu (1989); Senthil Nathan *et al*. (2007); Punithavalli *et al.* (2011) and Venkat Reddy *et al.* (2012).

Further, in the present study all other treatments also significantly reduced the mussel scale population over control. The results are in agreement with the findings of Hiremath and Ahn (1997) who reported that the methanol extract of Parthenium (*Parthenium hysterophorus*) was superior to other insecticidal plants tested against paddy brown plant hopper (*Nilaparvata lugens*). The *Annona squamosa* leaf extract was also found to be comparatively better against plant hoppers (Anand Prakash *et al.,* 2008). Similarly, *Ageratum conyzoides* and *Lantana camara* showed good insecticidal activity against mustard aphids (*Lipaphis erysimi*) with percent mortality values ranging from 22.16 to 29.96% in Brassica (Ajai Srivastava and Sanjay Guleria, 2003).

Because botanical pesticides have many advantages over synthetic pesticides such as low mammalian toxicity, no risk of developing pest resistance, no adverse effect on plant growth, less expensive and easy availability, the botanical extracts may be utilized as an alternative to synthetic insecticides especially in organic cultivation. A potential reduction in costs of pest control through the use of botanicals encourages the farmers to produce black pepper in more eco-friendly ways and provides opportunities for attracting special price premiums on the international market.

Generally, the black pepper crop is harvested during January and the population of *L. piperis* increases during the subsequent summer months. Hence, adoption of control measures needs to be initiated after crop harvest which is also safer. The results obtained in the present investigation can very well be utilized as alternative to synthetic insecticides for the management of mussel scales in black pepper.

REFERENCES

Ajai Srivastava and Sanjay Guleria 2003. Evaluation of botanicals for mustard aphid, *Lipaphis erysimi* (Kalt.) control in Brassica. *Himachal Journal of Agricultural Research,* **29**(1/2): 116-118.

Table 3. Cumulative efficacy of leaf extracts on mussel scales (*Lepidosaphes piperis*) population of black pepper (*Piper nigrum*) during summer, 2007 and 2008.

Treatments	Mean No. of scales per cm^2 per leaf			Mean per cent reduction		
	2007-08	2008-09	Pooled	2007-08	2008-09	Pooled
Lantana camara (Yellow sage) leaf extract 5%	11.6	12.8	12.2	5.75	14.09	9.92
Azeratum conyzoides (Goat weed) leaf extract 5%	11.2	12.0	11.6	9.00	19.40	14.2
Parthenium hysterophorus (Congress grass) leaf extract 5%	11.2	12.6	11.9	9.00	15.37	12.19
Cleome gynandra (Spider flower) leaf extract 5%	9.2	10.3	9.8	25.37	30.81	28.09
Annona squamosa (Custard apple) leaf extract 5%	11.2	12.4	11.8	9.56	17.05	13.31
Azadirachta indica (Neem) leaf extract 5%	9.9	11.6	10.8	19.77	22.48	21.13
Control	12.3	14.9	13.6	–	–	–
SEM	0.04	0.03	0.04			
C.D 5%	0.11	0.10	0.11			
C.V (%)	1.9	1.5	1.7			

Anand Prakash, Jagadiswari rai and Nandagopal, V. 2008. Future of botanical pesticides in rice, wheat, pulses and vegetables pest management. *Journal of Biopesticides,* **1**(2): 154-169.

Ankegowda, S.J., Venugopal, M. N., Biju, C. N. and Senthil Kumar, R. 2012. Problems and prospects of spice crops production in Kodagu. *Spice India,* **25**(3): 9-16.

Davis, M., Dinhan, B. and Williamson, S. 2001. Growing coffee with Integrated Pest Management. A brief for the IPM in developing countries project funded by the European Commission Environment in Developing countries. *Pest Management Notes* No. 9. www. Pan.uk.org.

Devasahayam, S. and Koya, K. M.A. 1994. Field evaluation of insecticides for the control of mussel scale (*Lepidosaphes piperis* Gr.) on black pepper (*Piper nigrum* L.). *Journal of Entomological Research,* **18**(3): 213-215

Devasahayam, S. and Koya, K. M.A. 1998. IPM in spices – challenges for the future. Advances in IPM for horticultural crops. Proceedings of the First National symposium on Pest Management in Horticultural Crops: environmental implications and thrusts, Bangalore, India, 15-17 October 1997. 157-164 PP.

Devasahayam, S., Premkumar, T. and Abdulla Koya, K. M. 1988. Insect pests of Black pepper (*Piper nigrum* L.) in India. *Journal of Plantation crops,* **16** (1): 1-11

Ghatak, S. S., Reza, M. W., Bhattacharya, M. and Sarkar, P. 2005. Bio-efficacy of indigenous plant products on Epilachna beetle, *Henosepilachna vigintioctopunctata* (Fab) (Coccinellidae: Coleoptera). *Environment and Ecology,* **23**(4): 746-748.

Hiremath, I. G. and Ahn, Y. J. 1997. Parthenium as a source of pesticide. In: *First international conference on Parthenium management*, Dharwad, India, 6-8 October, 1997. 86-89 PP.

Koya, K.M.A., Devasahayam, S., Selvakumaran, S. and Mini Kallil. 1996. Distribution and damage caused by scale insects and mealy bugs associated with black pepper (*Piper nigrum* Linnaeus) in India. *Journal of Entomological Research,* **20**(2): 129-136

Nyalala, S. and Grout, B. 2007. African spider flower (*Cleome gynandra* L. / *Gynandropsis gynandra* (L.) Briq.) as a red spider mite (*Tetranychus urticae* Koch) repellent in cut-flower rose (*Rosa hybrida* L.) cultivation. *Scientia Horticulturae,* **114** (3): 194-198.

Premkumar, T. and Devasahayam, S. 1989. Control of pests of black pepper. *Indian Farming,* **38**(10): 33-34

Punithavalli, M., Raguraman, S. and Rajkumar, M. B. 2011. Field evaluation of botanicals against, *Cnaphalocrocis medinalis* and effects on natural enemies in rice. *Annals of Plant Protection Sciences,* **19**(1): 221-222.

Ramraju, K. and Sundarababu, P.C. 1989. Effect of plant derivatives on brown plant hopper (WBPH) nymphs emergence in rice. *International Rice Research News Letter*, **14**(5): 30.

Senthil Nathan, S., Choi, M.Y., Paik, C.H., Seo, H.Y., Kim, J.D. and Kang, S.M. 2007. The toxic effects of neem extract and Azadirachtin on the brown plant hopper, *Nilaparvatha lugens* (Sta). *Chemosphere*, **67**: 80-88.

Singh, K., Sharma, U.S., Swaminathan, R. and Dashora, P.K. 2009. Management of insect pests of *Vigna radiata* (L.) Wilczek. *Applied Ecology and Environmental Research,* **7** (2): 99-109.

Urban Vegetable Promotion Project (UVPP) 2001. Tumia Muarobaini Katika Kilimo; Ministry of Agriculture and Co-operation (MAC) and German Technical cooperation Dare es salaam – Tanzania, P. 26.

Varma, J. and Dubey, N. K. 1998. Prospectives of botanical and microbial products as pesticides of tomorrow. Department of botany, Banaras Hindu University, Varanasi 221 005 India, P. 55.

Venkat Reddy, A., Sunitha Devi, R. and Vishnu Vardhan Reddy, D. 2012. Evaluation of botanical and other extracts against plant hoppers in rice. *Journal of Biopesticides,* **5**(1): 57-61.

M. Sreekanth, AICRP on Pigeonpea, RARS, Lam, Guntur – 522 034, Phone: 0863 2524017 Ext. 204 (Off), Fax: 0863 2524245, Email: meragana.angrau@gmail.com

Received: 22.6.2012 Revised: 6.11.2012 Accepted: 4.2.2013