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Distribution of spider mite (*Tetranychus urticae* Koch) on rose plant (*Rosa chinensis* Lin.) and its environmentally sound control using plant extract

Sunil Kumar Ghosh

Abstract
Rose (*Rosa chinensis* L.) is very useful flower grown in everywhere of India as well as world. In Coochbehar, West Bengal, India mites causes heavy damage and limits its production. The plant is damaged by many pests of which mite, Tetranychus urticae. (Tetranychidae: Acarina) is most harmful. Higher population of mites is found on the upper canopy of the plant (52.75%). There were seven treatments in the experiment. Avermectin known as microbial toxin resulted in the best control of mite (88.42% mortality), closely followed by chemical insecticide, fenazaquin (82.25% mortality) and mixed formulation of botanical pesticide, azadirachtin known as botanical insecticide with phyto extract, Spilenthes (72.37% mortality). It is found from overall assessment that avermectin and mixture of azadirachtin with botanical extraction gave moderate to higher mite mortality (more than 65% mortality). Due to low toxicity to natural enemies and on human health microbial toxin, botanical pesticides, botanical extracts may be used in future Integrated Pest Management with organic farming in flower production. Results of Azadirachtinis not higherwhen used individually but produce higher mortality by using with botanical extracts. The general farmers may adopt this practice for their safe flower production.

Keywords: Neem, avermectin, *spilanthes*, bio-pesticides, IPM, organic farming

Introduction
Rose (*Rosa chinensis* L.) is very useful flower grown in everywhere of India as well as world. In Coochbehar, West Bengal, India mites causes heavy damage and limits its production . The plant is damaged by many pests of which mite, *Tetranychus urticae* (Tetranychidae: Acarina) is most harmful. Jeppson *et al., (*1975) [14] reported that dry with warm weather favours spread and multiplication of mite. Anitha and Nandihalli (2008) [3] reported that of mite incidence on summer crop was started from 16th standard meteorological week (2.12 mites/3leaves) and became peak on 2nd week of May (14.61 mites/3leaves), and on kharif crop became peak on 4th week of October (29.25 mites/3leaves). Puttaswami and Channabasavanna (1980) [18] reported that mite population reached peak on May-June. Ghosh (2013) [10] reported that population of mite was high on upper canopy of plants. Ghosh (2013) [10] also reported that weekly mite population had significant positive correlation with relative humidity and non-significant positive correlation (p=0.05) with temperature, maximum relative humidity and total rainfall. The mite infestation occurs on the undersurface of the leaves, so leaf cell contents are removed, and the chlorophyll is damaged. Those empty cells having no chlorophyll appear whitish or bronze. Highly infested leaves appear completely pale, dry up, and finally fall off.
Methanolic extraction of neem and karanj at 1% concentration provided 78.6 and 71.9 % mortality of *Tetranychus sp*. in laboratory experiment respectively (Kumar *et al*., 2007) [15]. Asari and Nair (1973) [4] reported that suspension of neem seed (*Azadirachta indica*) and silica gel dust were the best against *Aphis gossypii*. (Srivastava, 2003) [19] has demonstrated Direct contact toxicity of neem product against termites and aphids. Ghosh and Chakraborty (2014) [11] reported that Dicofol provided the best control of mite on brinjal/eggplant crop (83.16 % control), followed by mixed formulation azadirachtin-a botanical pesticide and chemical pesticide, dicofol (71.41 % mortality). Mann *et al*., (2001) [16] reported that Neem Azal (10,000 ppm) and Neem Gold (10,000 ppm) were effective against aphids, cotton whitefly and jassids. Propergite provided the best mortality of mite on brinjal/eggplant (88.55%) followed by mixed of azadiractin and propergite (85.55%). Azadiractin did not provide better results individually but when mixed with low dose of (1.5 ml/L) propergite resulted good results providing more

than 85% mortality (Ghosh, 2013) [12]. The mite mortality percent on chilli crop was found high from Propergite 57 EC @ 1.5 ml/lit which was at par with the treatments Prophenophos 50 EC and Fenazaquin 10 EC (Bala and Ghosh, 2016) [5]. Dicofol was most effective acaricide against *Aceris tulipae* on garlic and very low population (1.40 mites per sq. cm.) was found closely followed by ethion (3.0 mites per sq. cm.) as compared to untreated control (6.78 mites per sq. cm.) (Bala *et al*., 2015) [6]. Muraleedharan (1993) [17] reported that avermectin resulted good initial and residual control of immature and adult mites on many crops. Several workers reported the excellent efficacy of abamectin in mite control. It is widely used in the control of *Polyphagotarsonemus latus*, *Tetranychus cinnabarinus*, *Acephylla theae*, *Calacarus carinatus*, *Eriophyes discoridis*, *Aculops lycopersici* on castor, cotton, chilli, tea tomato and cucumber crops in different parts of the world (Huengens and Degheele, 1986 [13]; Donatoni *et al*., 1988 [7]; Ziu *et al*., 1992 [20]; Muraleedharan, 1993[7]). Acharya *et al*., (2002) [2] reported that the efficacy of new molecules like imidacloprid, abamectin were safer to lady bird beetles. To determine the efficacy of bio-pesticides against red spider mite, *Tetranychus urticae* on rose plant and formulation of suitable control measure was the objective of my study.

2. Materials and Methods

2.1 Period of study with location

During the years (2010-11) Study was done in the Farm of UBKV- Agricultural University, Coochbehar, West Bengal, India. The area is situated is situated between $25^0$57' and 27^0 N latitude and $88^0$25' and $89^0$54' E longitude. This is called terai region of West Bengal under the foothill of the Himalaya. Soil type of this area is mostly sandy loam and pH value 6.9 having subtropical humid climate. There is prevailed a short winter season during mid November to mid February.

2.2 Distribution of mite within plants

A commonly grown one year old rose standing crop, variety "Bengal crimson" was grown during 2010-2011 in both years under local recommended horticultural practices in 4.0 meter x 5.0 meter plots. The treatments had five replications in a Design of RBD. Five plants were selected randomly from each plot. Mite population per leaf basis from bottom, middle and top leaves was recorded with the help of a magnifying glass at weekly interval throughout the year during 2010-2011. The outcome of the experiment had a graphical presentation.

2.3 Control of mite

Studied were done on commonly grown one year old rose standing crop, variety "Bengal crimson" during 2010-2011 in both years under local recommended horticultural practices in 4.0 meter x 5.0 meter plots. The treatments had five replications in a Design of RBD. One microbial toxin avermectin (Vertimec 1.9 EC) @ 1ml/L, one phyto-chemical, azadirachtin i.e. neem (neemactin 0.15 EC) @ 2.5 ml/L, two plant extracts viz. *Spilanthes paniculata* floral parts extract @ 7.0%, and garlic (*Allium sativum*) extract@ 7.0%, two treatments having mixture of azadirachtin and *Spilanthes* @ 2.5 ml + 70 ml/L and mixture of azadirachtin and garlic @ 2.5 ml + 70 ml/L were tested. Their activity was compared with the ability of Fenazaquin (Magister 10EC) @ 2ml/ L to control the mite pest.

2.3.1 Preparation of extracts

The plant parts, *Spilanthes paniculata* flower and bulb of garlic were extracted in methanol. utilizing the following process. First they were washed with clean water. The plant parts were grinded in powder form with the help of a grinder. 50 g of powder sample of each plant were kept separately to a conical flask (500 ml). Then they are dipped in 250 ml methanol. The material was not disturbed for 72 hours at room temperature. Occasional stirring of the flask was done. After 72 hours the extract was filtered after seventy two hours through Whatman 42 filter paper. The residue was washed two times with methanol.

2.3.2 Data recording

At 10 day intervals the sprays were done. There were four sprays in this experiment. Pest population was counted at 3, 6 and 9 days after spraying. Five plants were selected randomly from each plot. Mite population per leaf basis from bottom, middle and top leaves was recorded with the help of a magnifying glass. The results were presented as mite population mortality per cent with a comparison to densities found on the controled treatment. Percent mortality of mite over control was calculated by using the Abbott's formula (Abbott, 1925) [1]:

$$Pt = \frac{Po - Pc}{100 - Pc} \times 100$$

Where, Pt = Corrected mortality, Po = Observed mortality and Pc = Control mortality.

$$\text{Percent reduction over control} = \frac{\text{Percent reduction in treatment} - \text{Percent reduction in control}}{100 - \text{Percent reduction in control}} \times 100$$

Indo-Stat- software was used for variance analysis. CD Test (critical difference) at 5% level of significance was calculated followed RBD.

3. Results and Discussion

3.1 Distribution of mite within plants

Fig. 1 represents the incidence distribution of mite population on upper, middle and lower canopy within the rose plant. Higher population of mite was found on the upper canopy (52.75% population) followed by middle canopy (30.64% population) and lower canopy (16.61% population). On the upper canopy leaves were young and succulent and so it can be said that mites prefered young and new leaves of rose plant. In a study on the spatial distribution of mites in brinjal/eggplant, Dutta *et al*., (2011) [8] reported in his study on eggplant that higher population of mites were found in the upper canopy (44.24%) followed by middle (30.57%) and lower canopy (25.19%). Howerever, in his study of spatial distribution of different mite species in strawberry plants Fitzgerald *et al*., (2008) [9] observed that *T. urticae* was most densely populated on older leaves (lower canopy). There is an explanation about this variation in result. Mite population generally moves from lower canopy towards upper canopy. When food material in the lower canopy is scanty the population moves upper. In a study in the same location, Ghosh (2013) [10] reported that the upper canopy contained larger number of mite population (54.32% population) followed by middle canopy (28.79% population) and then lower canopy (16.89% population). This result shows that

mites accumulated mostly in the young and succulent leaves of ladyfinger/ okra plant.

3.2 Control of mite

There were seven treatments in this experiment (table 1). Best mortality of mite (88.42 % mortality) was recorded from avermectin (microbial toxin) treatment closely followed by fenazaquin (chemical insecticide) and mixed formulation of azadirachtin (botanical insecticide) with plant extraction, *Spilenthes* (82.25 % and 72.37% mortality respectively). Among the bio-pesticides avermectin was found very effective against mite (88.42 % mortality) followed by mixed formulation of azadirachtin with plant extraction, *Spilenthes* and another mixed formulation azadirachtin with plant extraction, garlic (72.37% and 65% mortality respectively). From overall observation it was found that azadirachtin and plant extraction individually did not give better results (moderate mite mortality) but when azadirachtin is mixed with plant extraction provided good results providing more than 65 % mortality.

Avermectin treatment was better (86.28% mortality) three days after treatment followed by fenazaquin (89.36 % mortality) and mixed formulation of phyto pesticide, azadirachtin with plant extract *Spilanthes* (75.41 % mortality) for controlling mite. The avermectin treatment is significantly different from all other treatments. Neem and botanical extracts individually does not produce higher result but when azadirachtin mixed with plant extracts provided good results providing more than 64 % mortality. Treatments after six and nine days the findings of the other treatments followed the findings like three days after treatment. Avermectin was better (87.22 and 91.75% mortality respectively) for controllong mite followed by mixed formulation of phyto pesticide, azadirachtin with botanical extracts *Spilanthes* (72.24 and 69.45% mortality respectively) and garlic (59.01 and 71.41% mortality respectively). Avermectin is microbial toxin extracted from soil *Actinomycetes*, *Streptomyces avermitilis* which is eco-friendly and provide higher level of mite control. Azadirachtin is a phytochemal extracted form neem seed carnel. *Spilanthesis* is locally available weeds and floral parts are used for extraction indigenously. In this experiment mixture of these two phyto-chemicals are better for mite control may have synergistic effect.

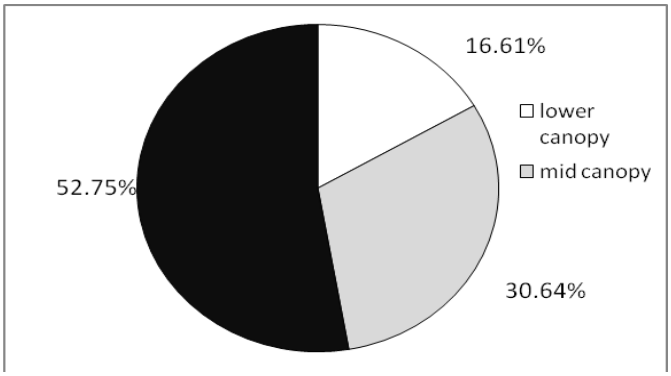

Fig 1: Per cent distribution of mites within rose plant

Table 1: Overall efficacy of pesticides for controlling spider mite (*Tetranychus urticae)* infesting rose

Treatment schedule	Doses ml or g/L (%)	Pretreatment observation (mites/Leaf)	Overall bio- efficacy (% mortality) Days after spraying			
			3	6	9	Mean
T_1=Avermectin (Vertimec 1.9% EC)	1 ml/L	12.12	86.28 (67.92)	87.22 (69.56)	91.75 (72.87)	88.42 (70.12)
T_2= *Spilanthes* flower extract (7%)	70 ml/L	13.55	42.51 (40.68)	37.55 (37.77)	42.98 (40.84)	41.06 (39.76)
T_3= Neem (Nemactin 0.15% EC)	2.5 ml/L	14.00	38.39 (38.02)	44.71 (41.94)	45.60 (42.65)	42.90 (30.87)
T_4= *Garlic 7%*	70 ml/L	11.21	43.29 (41.13)	35.18 (36.32)	43.65 (40.85)	40.71 (39.43)
T_5= Azadiractin+*Spilanthes* extract (7%)	2.5 ml/L+ 70 ml/L	11.56	75.41 (58.57)	72.24 (58.29)	69.45 (56.86)	72.37 (57.91)
T_6= Neem+*Garlic* extract (7%)	2.5 ml/L+ 70 ml/L	12.54	64.59 (53.50)	59.01 (51.49)	71.41 (57.37)	65.00 (54.12)
T_7= Fenazaquin(Magister 10EC)	2ml/L	12.00	89.36 (71.42)	83.98 (68.32)	73.42 (60.35)	82.25 (66.70)
T_8=Controlled plot	-	13.21	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)
SEm(±)	-	---	1.62	1.95	1.66	-
CD(p=0.05)	-	NS	4.86	5.85	5.13	-

Not significant =NS, Parentheses figures are the value of angular transformation

4. Conclusion/recommendation

It was found that avermectin and mixed formulation of azadirachtin with plant extracts provided moderate to higher mite mortality (more than 65% mortality). Dueto moderate to higher efficacy and lower toxicity to natural defenders and lower effect on human health microbial toxin, phyto insecticides, plant extracts can be used in Integrated Pest Management and organic farming for flower production. Azadirachtin individually did not provide good results but when used as a mixture with plant extracts provide better results of mite mortality. General farmers may use the findings of this experiment. There is further scope of chemical characterization of plant extract in chemistry laboratory.

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