DEDICATION

This thesis is affectionately

dedicated to my beloved

Grand parents, Parents

and Uncles

..... Sudhir

"BIOEFFICACY OF NEWER MITICIDES AGAINST TWO SPOTTED SPIDER MITE (*Tetranychus urticae* Koch.) ON ROSE UNDER POLYHOUSE CONDITION"

A thesis submitted to the

MAHATMA PHULE KRISHI VIDYAPEETH,
RAHURI - 413 722, DIST - AHMEDNAGAR
MAHARASHTRA STATE, (INDIA)

in partial fulfilment of the requirements for the degree

of

MASTER OF SCIENCE (AGRICULTURE)

in

AGRICULTURAL ENTOMOLOGY

by

SUDHIRKUMAR S.

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DEPARTMENT OF AGRICULTURAL ENTOMOLOGY,
COLLEGE OF AGRICULTURE,
PUNE - 411 005

2007

CANDIDATE'S DECLARATION

I hereby declare that the thesis entitled, **"BIOEFFICACY OF NEWER MITICIDES AGAINST TWO SPOTTED SPIDER MITE (*Tetranychus urticae* Koch.) ON ROSE UNDER POLYHOUSE CONDITION"** or part thereof, has not been submitted by me or any other person to any other University or Institute for a degree or diploma.

Place : Pune

Date : 17/05/2007

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CERTIFICATE

This is to certify that the thesis entitled, **"BIOEFFICACY OF NEWER MITICIDES AGAINST TWO SPOTTED SPIDER MITE (*Tetranychus urticae* Koch.) ON ROSE UNDER POLYHOUSE CONDITION"** submitted to Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra State, in partial fulfilment of the requirements of the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **AGRICULTURAL ENTOMOLOGY** embodies the result of the piece of bona-fide research work carried out by **SUDHIRKUMAR S.** under my guidance and supervision and that no part of this thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation and sources of literature referred to have been duly acknowledged.

Place : Pune

Date : 19th may 2007

Prof. S. S. Shelke

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Place : Pune

Date : 11/6/2065

(Dr. R. N. Sabale)

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Place : Pune
Date : 17 May, 2007.

Sudh

(Sudhirkumar S.)

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LIST OF ABBREVIATIONS

@	:	at the rate of
a.i.	:	Active ingredient
C.D.	:	Critical difference
^{0}C	:	Degree Celsius
DAS	:	Days after spraying
DAT	:	Days after transplanting
cm	:	centimeter (s)
e.g.	:	exampli gratia (for example)
et al.,	:	*et alli* (and others)
etc.	:	et cetera
EC	:	Emulsifiable concentration
Fig.	:	figure (s)
g	:	gram (s)
ha.	:	hectare (s)
hrs.	:	hours
kg	:	kilogram (s)
lit.	:	litre (s)
m	:	meter
mg	:	Milligram
ml	:	Mililitre
M.P.K.V.	:	Mahatma Phule Krishi Vidyapeeth
mt	:	Metric tonnes
No.	:	Number
N.S.	:	Non significant
Ltd.	:	Limited
qt.	:	quintals
%	:	Percentage

+	:	Plus
–	:	negative
r	:	correlation coefficient
RH I	:	Morning relative humidity
RH II	:	Afternoon relative humidity
SC	:	Soluble concentration
S.E.	:	Standard error
Sr.	:	Serial
S.L.	:	Soluble liquid
Spp.	:	species
t	:	tonne (s)
T_{max}	:	Maximum temperature
T_{min}	:	Minimum temperature
Fig.	:	Figure
i.e.	:	that is
var	:	variety
viz.,	:	Videlicet (namely)
wt	:	weight
WG	:	Wettable granules
WP	:	Wettable powder
WAT	:	Week after transplanting

ABSTRACT

"BIOEFFICACY OF NEWER MITICIDES AGAINST TWO SPOTTED SPIDER MITE (*Tetranychus urticae* Koch.) ON ROSE UNDER POLYHOUSE CONDITION"

By

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2007

Research Guide	:	Prof. S.S. Shelke
Department	:	Agricultural Entomology

The present investigations on seasonal incidence, varietal screening and bioefficacy of newer miticides against *Tetranychus urticae* Koch. on rose under polyhouse condition were carried out during September, 2006 to March 2007 at NARP, Ganeshkhind, Pune and Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune, Maharashtra.

Studies on seasonal incidence of *Tetranychus urticae* Koch. indicated that population began to build up from 36th meteorological week (T_{max} 31.13 ^{0}C, T_{min} 20.12 ^{0}C, RH-I 82.26% and RH-II 52.37%) and observed throughout the experimental period. However, there were two peaks of populations recorded with 33.87 mites per leaf at 42nd (T_{max}

34.24 ^{0}C, T_{min} 22.55 ^{0}C, RH-I 80.12% and RH-II 42.11%) and 42.81 mites per leaf at 11th (T_{max} 39.36, T_{min} 19.81 ^{0}C, RH-I 87.44 and RH-II 26.62%) meteorological weeks in the month of October and March respectively.

The population of the mites was positively correlated with maximum and minimum temperature while negatively correlated with morning and afternoon relative humidity.

Among the eleven cultivars screened to *Tetranychus urticae* Koch. Spinx and Temptation were Moderately susceptible; Aqua, Passion, Milwa, Nobleesse, Confity, Gold Stikes, Grand Gala and Biyanca were Susceptible and First Red was Highly susceptible. Spinx was promising cultivar recorded lowest population 6.37 mites per leaf. No single cultivar showed less susceptible reaction. The morphological characters of cultivars have no correlation with intensity of mite population.

Studies on bioefficacy of different miticides against *Tetranychus urticae* Koch. revealed that abamectin (0.004%) proved to be significantly superior and recorded minimum 2.68 mites per leaf with efficacy of 89.37 per cent. The next best treatment was clofentezine (0.006%) followed by fenazaquin (0.02%), fenpropathrin (0.02%), dicofol (0.05%) and amitraz (0.02%). Triazophos (0.03%) and wettable sulphur (0.2%) found to be least effective as compared to rest of the miticides.

INTRODUCTION

1. INTRODUCTION

Who would't like a rose or a dozen of them? Roses are lovely, any girl would agree. It's not only an expression of beauty but through time roses have become the symbol of love, especially during valentine's day when they fill up every flower shop. (Rita dela cruz, 2005).

Rose is universally acclaimed as the "Queen of flowers" because of its utility, different sizes, bewitching colours and most delightful fragrance.

Some countries such as England have adopted rose as their national flower. In India, the rose was referred in old Sanskrit literature as "Taruni pusha, Atimanjula, Semantika". In mythology, the rose was associated with venus, the Goddess of love and beauty. (Pal, 1991).

It is cultivated commercially for cut flowers, both for traditional flower market and contemporary florist shops. Rose flowers without stem and loose flower petals are used in traditional markets for making garland for offering temples while the florist shops sell cut roses with stems mainly for bouques and floral arrangements. Besides, rose cultivated for attar, gulkhand, gulabjal and pankhuri. (Chadha, 2001).

The estimated area under flower cultivation in the country is about 65,000 ha and the estimated production is 30,000 metric tonnes of loose flowers and over 500 million of cut flowers with stem. (Shashibhushan, 2006).

Rose crop grown throughout the world, is attacked by a number of pests during its different stages of growth. Of the pests attacking green house rose, the two spotted spider mite, *Tetranychus urticae* Koch. is one of the most destructive pest (Bhattacharya, 1997).

These creepy - crawly mites are almost microscopic and unless they come in large groups and one has a perfect vision. It's difficult to

notice them. They hide on the lower side of the leaves, in cracks or in other damaged parts of the plants.

These insects are dreadful as they have high tolerance for insecticides which are only effective after two applications. It is not even appropriate to call them insects as they have four pairs of legs and no antennae. They love to suck the cell sap from the thorn cells causing the foliage to topple. They have a pair of needle like stylets which they use to rupture the leaf cells when they feed.

The common symptoms are discolouration of leaves, stems become corky and the presence of cast skins and web in the affected areas. They are called spider mites because of their ability to produce web in the infested parts. However, webbing may not always be presented depending on the species but with the *Tetranychus* sp, the yellow, bronze or brown causing the leaves to bleach out and dry. Discolouration starts from the tip of the leaves until the leaves drop finally. Severe infestation may eventually kill the plant. (Rita dela cruz, 2005).

The tetranychid mites are causes heavy losses by reducing production and quality of flowers. These mites are of considerable economic importance and their control continue to be a major problem as they developed resistance to conventional miticides. No systemic work has so far been undertaken on bioefficacy of newer miticides against two spotted spider mite, *Tetranychus urticae* Koch. on rose under polyhouse condition.

Therefore, the present investigations were undertaken under polyhouse condition at NARP, Ganeshkhind, Pune and Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune, Maharashtra during 2006 - 2007 with the following objectives.

Plate 1 : Two spotted spider mites (*T. urticae* Koch.)

1. To study the seasonal incidence of *Tetranychus urticae* Koch on rose.
2. To screen the rose cultivars for their resistance to *Tetranychus urticae* Koch.
3. To study the bioefficacy of newer miticides against two spotted spider mite, *Tetranychus urticae* Koch.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1 Seasonal incidence of *Tetranychus urticae* Koch.

Oatman *et al.* (1981) studied the effect of releases and varying infestation levels of *T. urticae* Koch on fruit yields on strawberries in Southern California. Eight insect predators were present with the Cecidomyiid, *Arthrocnodax occidentalis* Felt, being the predominant species, followed by the six spotted thrips, *Scolothrips sexmaculatus* (Pergande) on a leguminous arrow root. The mite population density showed a typical bimodal pattern with peaks in June and October. 0. *kashmirica benefica* was most abundant and its population trends closely synchronized with those of its prey 0. *yasumatsui* was at a low density throughout the season. *Amblyseius longispinosus* was the predominant predatory mite and seemed to play a significant role as a natural enemy at low prey densities.

Sharma and Pandey (1981) studied the relative seasonal incidence of two spotted tetranychid species both in the nursery and transplanted brinjal crop under Udaipur conditions in 1977. The incidence of *T. cinnabarinus* started 3 weeks after transplanting (mid October) where as *T. neocaledonicus,* appeared later (end of October). Both species had almost similar population fluctuations during the season. Between October and January, population of both species was low. Thereafter, there was a rapid increase in their population. During May, their population reached a peak on all the varieties.

Puttaswamy and Channa Basavanna (1983) recorded the effect of weather factors on populations of *Tetranychus ludeni* Zacher on brinjal. Population of mite which occurred throughout the year, increased from April and reached peak numbers from May to July. Increase in population

was associated with periods of low rainfall, low relative humidity and high mean temperature.

Lal and Pillai (1984) reported that population of *T. cinnabarinus* (Andre) *T. neocaledonicus* (Andre) and *Eutetranychus orientalis* (Klein) on coconut were very low or absent on cassava between June and December but increased markedly thereafter. Peak infestation occurred from January to April. Population size was significantly negatively correlated to humidity but not significantly correlated to maximum temperature and minimum temperature.

On strawberry, the species found were *T. kanzawai* and *T. urticae* during 1977-80 and 1981, respectively. Mite population began to increase in January-February, reached peak numbers (225-502 mites/leaf) from late March to early April and declined rapidly thereafter (< 5 mites/leaf). The predators found were *Amblyseius* sp., *Oligota oviformis, Stethorus loi* and *Scolothrips sexmaculatus.* Predator population usually reached a peak of not more than 1/leaf between early March to late April. Spider mite population declined rapidly primarily due to high precipitation and high relative humidity. (Lo *et al.,* 1984).

Sarkar and Somchowdhury (1989) observed in coconut that increase in the population of *Raoiella indica* Hirst and *T. fijiensis* generally commenced from January with increase in atmospheric temperature. *R. indica* attained peak population twice (June 5.31 mites/leaflet; September 5.50 mites/leaflet) in a year, while the population of *T. fijiensis* reached its peak during June (3.98 mites/leaflet) and October (2.29 mites/leaflet). The population of both the species of mite declined significantly with the onset of the rainy season (July to August). Among these abiotic factors studied for their influence on the mite population, only temperature showed a significant positive correlation with the mite density.

The population dynamics of various mite species was investigated on brinjal during 1989-90 by Grewal (1992). *Tetranychus cinnabarinus* was the prevalent phytophagous species. Among 16 varieties of brinjal, variety Neelam was less attacked by *T. cinnabarinus* (Boissd.). The population of *T. cinnabarinus* was lowest in December-January, began to build up in May and peaked in September.

Lee *et al.* (1992) studied the development stages and damage symptoms of mites on gerbera. At 15^0C development from egg to adult takes 15-56 days but this was reduced to 6.8, 4.4 and 3.5 days at 20^0C, 25^0C and 30^0C respectively.

Chen and Ho (1993) observed that the population of *T. chinnabarinus* on brinjal peaked during June and August-September.

Incidence of *T. cinnabarinus* B. in relation to weather factor on ladies finger plant was studied by Singh and Singh (1993). They observed peak population of mites during the month of May and June which indicated that increase in population was associated with period of high temperature and low humidity. They concluded that temperature is major regulatory factor for population build up.

A field experiment was conducted on castor at Agricultural Research Station, Jodhpur to study the population incidence by Ahuja (1994). It revealed that the population of mite was found low in July-August to negligible in September-January with peak in February and March.

Sudharma *et al.* (1995) reported severe infestation of *T. urticae* on rose and co-existence of *T. ludeni* and *T. urticae.* Heavy infestation of *T. urticae* was observed twice during October-November and February-May. During peak infestation, population count of *Tetranychus* sp. on rose ranged from 45-60 mites/leaf.

Hole and Salunkhe (1997) carried out field trials in winter and summer seasons, which showed that number of mites (*T. urticae)* increased in the 2nd week of February, gradually reaching peak (69.65 mites/plant) in 2nd week of March and decline thereafter. The fluctuations in mite population were found to be positively correlated with maximum temperature and negatively correlated with relative humidity.

Gotoh (1997) observed seasonal prevalences of *Tetranychus urticae* population in four different Japanese pear orchards. The mite population appeared peaks in July and from September to early October. The population peak in July was formed by mites that migrated from ground cover vegetation onto the pear trees in spring. Thereafter, mite densities remained at low levels throughout the summer and a second peak occurred in autumn.

Kharmate (1998) studied the seasonal incidence of two spotted spider mite, *Tetranychus urticae* Koch. on rose under polyhouse condition at M/S Centuary International, Village-Shirgaon, Tal-Pune during 1996-97. His study revealed that the mite population increased gradually reaching its peak in the 12th meteorological week when maximum temperature 37.71^{0}C, minimum temperature 21.28^{0}C, RH-I 58.43 and RH-II 33.00 per cent was recorded which started declining thereafter in 27th meteorological week when Tmax 25.31, Tmin 16.00^{0}C, RH-I 89.6 and RH-II 78.6 per cent was present.

Syed Shakir Ali *et al.,* (1999) noticed mites incidence on roses from July to October and January to March.

Dhar *et al.* (2000) indicated that temperature and relative humidity were found to be important abiotic factors exerting influence on population build up on mite. Temperature is positively and relative humidity is negatively correlated with population. Highest incidence was observed with temperature 31.30^{0}C and relative humidity 78.5%.

Markoyiannaki *et al.* (2000) made observation on incidence of *Tetranychus pyri* in apple orchards of cultivars Red Delicious and Golden Delicious, located in four regions of central Greece. *Tetranychus pyri* reached peak during the month of July and August (summer).

Salman *et al.* (2002) studied the seasonal abundance of the *Tetranychus urticae* on soybean cultivars and observed that *Tetranychus urticae* was moderately low during July, peaked during August, then decreased to the lowest level in September.

Study of seasonal incidence of mites on rose showed that population builds from 2nd meteorological week and remained present throughout experimental period. The maximum range of population was from 0 to 112.4 mites/plant and it was observed highest build up in 9th meteorological week. *T.urticae* showed positively significant correlation with temperature while negatively significant with morning and afternoon relative humidity. (Abhyankar, 2003).

Gawade (2003) carried out seasonal incidence of mite on gerbera under polyhouse condition during 2001-02 at Hi-tech Floriculture and Vegetable Project, College of Agriculture, Pune-5. His study indicated that mite population was maximum 73.23 mites per leaf in 22nd meteorological week which was positively correlated with temperature and negatively correlated with humidity.

Jagtap (2004) carried out seasonal incidence of mites on carnation under plyhouse condition at Hi-Tech Floriculture and Vegetable Project, college of Agriculture, Pune-5 during 2003. His study indicated that the maximum mite population was registered during 22nd meteorological week (34.83 mites / leaf). The population of mites was positively correlated with maximum temperature, minimum temperature and evening relative humidity and negatively correlated with morning humidity.

Rajkumar *et al.* (2005) studied seasonal incidence of red spider mite, *Tetranychus urticae* on Jasmine (*Jasminum sambac*) in Raichur, Karnatka, India from May 2002 to April 2003. The mite incidence was maximum during the 19th standard week (first week of may) with 9.36 mites per leaf, followed by 8.50 mites per leaf during the 18th standard week (last week of April). There was no mite population during the 47th (third week of November) to 5th(last week of January) standard weeks due to non-availability of foliage because of pruning of the crop. The mite population appeared again during the 6th standard week (first week of February) and increased as summer progressed. Only the maximum and minimum temperature had positive and significant relationship with the mite population where as morning and evening relative humidity recorded negative and significant relationship. The maximum and minimum temperature affected the mite population by 60.34 and 34.02% respectively while morning and evening relative humidity affected the mite population by 27.61 and 22.11%, respectively.

2.2 Screening of rose cultivars against *Tetranychus urticae* Koch.

East and Edelson (1990) screened seven water melon cultivars American-sun Triploid, All-sweet, Black Diamond, Calhoun Gray, Charleston Gray, Crimson Sweet and Jubilee against experimentally inoculated populations of *Tetranychus urticae*. The mites were inoculated on 20th and 30th June and 10th July 1989 by placing 2-3 mite-infested *Phaseolus vulgaris* plants in the centre of each watermelon plant. Surveys were conducted on 18th July and 3rd August to determine mite populations. On both sampling dates, densities of *T. urticae* were significantly greater on Jubilee (0.038 and 0.035 mites/ cm^2 respectively) than on the other cultivars tested. On 18th July, densities were lowest on Black Diamond (0.008) and Crimson Sweet (0.006) but by 3 August

population had increased on Crimson Sweet (0.017) although they were still low on Black Diamond (0.008).

Gimenez *et al.* (1993) screened 76 strawberry cultivars for their resistance to two spotted spider mite, *Tetranychus urticae* in invitro condition. Cultivars for their resistance or susceptibility to *T. urticae* calssified into Highly susceptible: Canoga, Ozark Beauty, Scott and Tangi; Resistant : Aiko, Annapolis, Apollo, Bounty, Cardinal, Douglas, Dover, Fairfax, Fern, Floridabelle, Glooscap, Governor, Simcoe, Hecker, Kent, Pajaro, Parker, Rainier, Redcoat and Vesper; Highly resistant : Profumato di tortona.

Wisniewska and Witaszek (1994) evaluated resistance to twenty six rose cultivars grafted on *Rosa multiflora* rootstock to infection by *Peronospora sparsa* Berk. and damage caused by *Tetranychus urticae* Koch. The highest yield was obtained from the cultivars, Parfait, Sonia (standard), Lady Rose, Gabriella, Marina, Burgund 81, Mercedes (11-16 flowers per plant) and Ilona, Tatjana, Roter stern (9-10 flowers per plant).

Patel and Rote (1995) recorded *Tetranychus telarius* (*T.urticae*) greatest 17.51 mites per plant in the second fortnight of November on cotton under rainfed condition of south Gujarat.

Winiewska and Witaszek (1995) screended twenty one rose cultivars planted in glasshouse to spider mites, *Tetranychus urticae* Koch. The highest number of flowers produced by Cvs. Sabrina and Athena followed by the cultivars : Sonia, Jaguar, Jacaranda, Motrea, Mercedes and Helmut Schmidt. Spider mites caused damages on the cultivars Sabrina, Helmut Schmidt, Flamingo, Athena, Gabriella, Mercedes.

Ali *et al.* (1996) conducted experiments to assess the relative susceptibility of 23 mungbean (*Vigna radiata*) accessions to mite *Tetranychus urticae* infestation during 1992-93 at Assiut University, Egypt. The accessions VC 2768 A, VC 2778A, KPS_2, VC 3061 A and

VTT were tolerant while the accessions VC 2764 A, VC 2768 B and V 2272 were most susceptible to mite infestation.

Warabieda *et al.* (1999) studied the tolerance of apple cultivars to two spotted spider mite (*Tetranychus urticae* Koch.) in 1993 in Poland. Cultivars Lobo and Close were most severely infested with high *T. urticae* population while cultivars Jester, Kalja and Piros were low infestation by close to economic injury level.

Coman (2000) evaluated four cucumber cultivars, Fabrio, Cornichon, Wyskonsin and Bistrita in greenhouse for their resistance to the common red mite, *Tetranychus urticae*. All cultivars except Fabrio, had low susceptibility to *T. urticae.*

Salman *et al.* (2002) tested soybean cultivars Giza 111, Giza 35, Giza 21, Giza 32, Clark and Crawford for infestation with spider mite, *Tetranychus urticae* in Shandweed Research Station, Sohag Governorate, Egypt, during 1999 and 2001. The seasonal abundance of the *Tetranychus urticae* was moderately low during July, peaked during August, then decreased to the lowest level in September. Giza 21 and Crawford were susceptible, while Giza 111, Giza 35, Giza 82 and clark had low resistance.

Jagtap (2004) carried out screening of carnation cultivers for their resistance to mites under polyhouse condition at Hi-Tech Floriculture and Vegetable Project, college of Agriculture, Pune-5 during 2003. His study revealed that amongst the eight cultivars screened to *T. urticae*, Domingo was highly tolerant, Gaudina was tolerant, Garuda, Famosa, Cherry solar and Dover were medium tolerant, Yellow solar was susceptible and Rubisco was highly susceptible. Cultivar Domingo showed promising results against *T. urticae* recording lowest mean population of 4.93 mites per plant.

Hole (2005) screened thirty varieties of rose against mites *Tetranychus urticae* Koch. revealed that amongst thirty cultivars screened four, eight and nine were found to be less susceptible, moderately susceptible and susceptible . The cultivar Rajhans was found to be the most promising recording lowest population (16.08 mites / leaf), while Arjun had highest infestation (40.08 mites / leaf).

2.3 Bioefficacy of miticides against *Tetranychus urticae* Koch.

Seventeen chemicals were evaluated for their efficacy against red spider mite *Tetranychus* sp. attacking cotton. Of these chemicals, dicofol, akar, morestan and neuron performed well against red spider mites (Murega and Khaemba 1985).

Gavioli *et al.* (1987) evaluated the effect of abamectin and fenpropathrin. on *T. urticae* in cotton. Abamectin at 0.01 and 0.05 kg a.i. reduced the population of *T. urticae* up to 21 days after application while fenpropathrin at 0.2 and 0.3 kg a.i. reduced the population of the mite up to 7 days after application.

Freitas *et al.* (1988) evaluated the efficacy of triazophos (Hostathion) at 2 litres/ha against *T urticae* on beans. Triazophos gave residual protection of 78% efficiency even after 14 days.

Hernandez *et al.* (1988) studied the effectiveness of the acaricides binapacryl at 260 g a.i., trizophos at 400 g a.i., propargite at 570 g a.i. and sulphur at 680 g a.i./ha against *T. mexicanus*. Triazophos was the most effective and sulphr was the least effective.

Clofentezine at 2 and 3 ml and abamectin at 3 and 2.5 ml/plant were evaluated for the control of citrus mite, *Brevipalpus phoenicis,* in Brazil. Clofentezine and abamectin gave good results (77.9 and 80.3% control respectively) 7 days after application. (Rocha *et al.* 1988).

Brits and Vickers (1990) carried out field trails in Komatipoort and Hectorspruit areas of Lowveld, South Africa on cotton between 1987 and 1989. His results revealed that abamectin had sufficient residual activity to control the mite,*Tetranychus cinnabarinus* up to 8 days.

Singh *et al.* (1990) observed 100% mortality of all stages (egg, nymph and adult) of *T. urticae* on soybean with triazophos at 0.05% concentration.

Szabo (1992) revealed that application Apollo SC (Schering), an environmentally harmless preparation has ovicidal effect long, 60-120 days active period, due to its selectivity it dose not affect predators, no cross-resistance exists. The ovicide and larvicide efficiency could be increased by spraying when the over wintering population began mass egg laying.

Thulasi Ram *et al.* (1993) studied that in a field trial in Karnataka, India. Dicofol, Tetradifon and Wettable sulphur were significantly superior to other compounds in controlling *Tetranychus macfarlanei* on cotton.

Curkovic *et al.* (1994) evaluated the chitin synthesis inhibiting acaricides, clofentezine, flucycloxuron, flufenoxuron and hexythiazox. The acaricides applied early in the spring were able to maintain *Panonychus ulmi* populations practically below the economic injury levels upto harvest on pome fruits and plums.

A number of acaricides including abamectin, acrinathrin, diafenthiuron and hexythiazox with fenpropathrin gave excellent control of *T. cinnabarinus* on greenhouse tomato and cucumber in Poland. In all cases more than 98% mortality of the stages was found 14 days after treatment (Szwejda, 1994).

Aguiar *et al.* (1995) tested different concentration of clofentezine and abamectin against *Tetranychus urticae* on roses in greenhouse

experiments, clofentezine at 25 g and abamectin at 3.6 g a.i./100 litres of water were the most effective treatments against the mite.

Labanowska (1995a) obtained satisfactory control of *Tetranychus urticae* on black currant with mixtures of Mitac 200 EC (amitraz) + Apollo (clofentezine) at doses of 3.0 + 3.0 and 2.5 + 2.5 litres/ha.

Labanowska (1995b) afforded good control of *Tetranychus urticae* on strawberry with mixtures of propargite + hexythiazox, amitraz + clofentezine and hexythiazox + fenpropathrin and also by hexythiazox, azocyclotin and amitraz alone.

Five applications of abamectin applied at a concentration of 12 ppm and at 3 to 5 days interval as full canopy sprays provided effective control of *Tetranychus urticae* Koch. on greenhouse roses (Sanderson and Zhang, 1995).

Vostrel (1996) recorded 100% mortality of *T. urticae* on hop (*Themulus lupulus*) when sprayed with Fenazaquin at 0.12% and 0.06% concentration mortality was > 95%.

Ozawa and Ishii (1997) studied acaricides susceptibility of *Tetranychus urticae* Koch. on carnation in Japan. All populations showed low susceptibility to dicofol, fenbutaxin oxide and tetradifon.

Wang *et al.* (1997) found that 2% abamectin EC, applied twice at 3 days interval was effective in control of *T. urticae* on roses.

Baranowaski (1998) indicated that the vertimec 0.18 EC (0.05%) was highly effective against *Tetranychus urticae* Koch on chrysanthemum with no phytotoxic effect in Poland.

Sekulic *et al.* (1998) studied fenzaquin bioassay with *Tetranychus urticae* Koch in laboratory and glasshouse, acute lethality tests were carried out to determine LC 50 values for fenazaquin in all developmental stages. A glasshouse trial showed that fenazaquin at 80 and 120 mg/lit

had good efficiency 7 days after application but that efficiency was lower after 14 days.

Marcic (1999) tested the ovicidal activity of fenazaquin on *Tetranychus urticae* Koch. The first bioassay include treatment of genetically mixed eggs (diploid and haploid) laid by fertilized females. The II and III bioassay involved haploid eggs hatched by unfertilized females. It resulted that haploid offsprings were to be slightly more susceptible than genetically mixed offsprings

Dhar *et al.* (2000) reported that the fenazaquin 10 EC (Magister) at 2 ml / lit. and 1 ml/ lit., fenpropathrin 10 EC (Danitol) @ 1 ml/lit and 0.5 ml/lit and dicofol 18.5 EC (Colonels) @ 3 ml/lit. were found to be the most effective treatment against the motile stages of red spider mite, *Tetranychus urticae* Koch on Okra.

Khalid Ahmed *et al.* (2000) reported that triazophos at 750 g a.i./ha was found highly effective in reducing mite incidence and recoded highest yield. Fenazaquin 200 g a.i./ha was also equally promising.

Fenazaquin (Magister 10 EC) was evaluated in three different dose levels viz., 100, 125 and 150g a.i./ha against yellow mite, (*Polyphagotarsonemus latus* Banks) on chilli. The results revealed that fenazaquin provided effective control (>80%) of yellow mite when applied @ 125 to 150 g a.i./ha, fenazaquin @ 150 g a.i./ ha was superior to dicofol while all the three dosages of fenazaquin were superior to ethion (Somchoudhury *et al.* 2000).

Chinniah (2001) reported that Daintol at 0.1 per cent was highly effective against carmine spider mite, *Tetranychus urticae* Koch. in Tamil Nadu during 1997-98.

Four acaricides and nine botanical were evaluated for their bioefficacy against yellow mite *Polyphagotarsonemus latus* on chillies by Ramaraju (2002). Among acaricides tested, fenpropathrin (Danitol) at

0.01 and 0.02 per cent was found to be most effective causing cent per cent reduction under pot culture condition and 87.17 and 87.93 per cent reduction of mite population respectively under field conditions 24 hours after treatment and was at par with dicofol 0.05 per cent.

Abraham (2003) reported that among acaricides registered for use in soybeans, Danitol 10 EC (Fenpropatrin) was provided good results of control. The lowest acaricide efficacy was observed in treatment with Mitac 20 (amitraz).

Abhyankar (2003). Tested acaricides like fenazaquin 0.02 per cent, abamectin 0.005 per cent, fenpropathrin 0.02 per cent and wettable sulphur 0.004 per cent against devasting mites of rose. The result revealed that abamectin 0.005 per cent was found to be more efficacy against rose mites under polyhouse condition.

Two field experiments were carried out by Jayachandran (2003) to see efficacy of abamectin (Vertimec 1.8 EC) on rose mites, *Tetranychus urticae* Koch. In both experiments Vertimec @ 0.25 ml/lit. was very effective in controlling the population upto three weeks. Dicofol 2.5 ml/lit. and Ethion 2 ml/lit. was less effective.

Venugopal *et al.* (2003) evaluated new acaricides viz., flufenoxuran (0.01%), profenphos (0.1%) ethion (0.05%), dicofol (0.1%), abamectin (0.05%), imidacloprid (0.05%), phosalone (0.07%) and sulphur (0.2%) against *Tetranychus cinnabarinus* on okra. Abamectin and dicofol were found to be significantly superior to all treatments followed by flufenoxuran and profenphos. Treatments ethion, phosalone and sulphur were found to be moderately effective.

Akashe (2004) evaluated new miticides (sulphur at 0.2%, abamectin at 0.0045% amitraz at 0.026%, clofentezine at 0.006%, triazophos at 0.05% and dicofol at 0.05%) from different groups together against *T. urticae* infesting rose under field conditions in summer seasons

of 2000 and 2001. All treatments were significantly superior to the control in respect of mite population reduction. The highest mortality of 87.43 and 86.35% was recorded with abamectin and clofentezine respectively. These two treatments were at par with each other but significantly superior to all other treatments. However dicofol and amitraz recorded significantly higher mortality 82.63 and 80.41 per cent respectively. Sulphur recorded the lowest efficacy of 49.97 per cent.

MATERIAL AND METHODS

3. MATERIAL AND METHODS

The present investigations on mites, *Tetranychus urticae* Koch. with the main objectives of studying it's seasonal incidence, screening of rose cultivars for pest resistance and bioefficacy of newer miticides against pest were undertaken. The experiment on seasonal incidence and screening of rose cultivars for pest resistance was carried out under polyhouse condition at NARP, Ganeshkind, Pune and bioefficacy of newer miticides against pest was carried out under polyhouse condition at Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune, Maharashtra during 2006 - 2007. The materials used and methods employed for these studies are presented in this chapter.

3.1 Seasonal incidence of *Tetranychus urticae* Koch

Experiment on the seasonal incidence of mites, *Tetranychus urticae* Koch. was undertaken on eleven rose cultivars given in Table 1 planted in July 2005, each in a plot of 0.9 x 6 m. The distance between two rows and plants was 30 x 20 cm respectively.

3.1.1 Method of recording observations on mites

Seasonal incidence on mites, *Tetranychus urticae* Koch. was recorded from first week of September 2006 to last week of March 2007. The population count was taken at weekly interval in accordance with the meteorological weeks of the year.

Five plants from each of eleven cultivars selected randomly and tagged for recording observations. Three leaves, one from lower, middle and upper part of plant were considered for counting of mite population. The count was taken with the help of 10X magnifying lens. According to the method followed by Hole and Salunkhe (2005).

Plate 2 : Experimental polyhouse

Table 1 : Rose cultivars studied for seasonal incidence and varietal screening.

Sr. No.	Name of cultivars
1	First Red
2	Passion
3	Gold Stikes
4	Aqua
5	Milwa
6	Biyanca
7	Grand Gala
8	Spinx
9	Temptation
10	Confity
11	Nobleesse

3.2 Screening of rose cultivars for their resistance to *Tetranychus urticae* Koch.

The cultivars of rose given in Table 1 were used to find out their resistance to mites, *Tetranychus urticae* Koch.

3.2.1 Method of assessing rose cultivars for their resistance to mites

The data on mite population collected at weekly interval to see the seasonal incidence was further utilized to judge the susceptibility or resistance of each of these eleven cultivars to mites attack. The method for assessing rose cultivars for their resistance to mites was on the basis of number of mites per leaf. The cultivars are grouped as follows.

1	Less susceptible	< 5 mites / leaf
2	Moderately susceptible	5.1 to 15 mites / leaf
3	Susceptible	15.1 to 25 mites / leaf
4	Highly susceptible	> 25 mites / leaf

3.2.2 Morphological characters of rose cultivars

Morphological characters such as flower colour, number of petals per flower, depth and diameter of flower, plant height, growth habit, number of thorns per ten centimeters, foliage colour and stem thickness of each rose cultivar were recorded to find out their relation with the pest incidence.

3.2.3 Analysis of experimental data

In order to find out the significance of differences in various cultivars towards the extent of infestation by pest, all observations were subjected to statistical analysis and the significance was assessed at 5% level.

3.3 Bioefficacy of miticides against *Tetranychus urticae* Koch.

To find out the bioefficacy of newer miticides against two spotted spider mite, *Tetranychus urticae* Koch. on rose eight miticides were used. The details of the experiment as follows.

Design	:	Randomized Block Design
Replications	:	Three
Treatments	:	9 (8 + 1 Control)
Cultivar	:	First Red
Plot size	:	0.9 x 2.4 m
Spacing	:	45 x 30 cm
Location	:	Hi-tech floriculture and vegetable project, College of Agriculture, Pune-5, Maharashtra.

Treatment Details :

T_1 – Fenpropathrin (0.02%)

T_2 – Wettable Sulphur (0.2%)

T_3 – Fenazaquin (0.02%)

T_4 – Abamectin (0.004%)

T_5 – Clofentazine (0.006%)

T_6 – Amitraz (0.02%)

T_7 – Triazophos (0.03%)

T_8 – Dicofol (0.05%)

T_9 – Control

PLAN OF EXPERIMENTAL LAYOUT

T_1	T_9	T_4
T_2	T_7	T_6
T_3	T_8	T_5
T_4	T_1	T_9
T_5	T_3	T_7
T_6	T_2	T_8
T_7	T_4	T_1
T_8	T_6	T_3
T_9	T_5	T_2

N ↑

Dates of spraying

First : 29th December 2006

Second : 13th January 2007

Third : 28th January 2007

3.3.1 Preparation of spray fluid

The quantity of spray fluid required for each plot was estimated by spraying water alone on the control plot. The quantity of miticides required for preparing spray fluid of required concentration was calculated for each miticide. At the time of preparation of spray fluid, the required quantity of water was taken in a bucket and measured quantity of miticide was added to water. It was thoroughly stirred with the help of a long wooden stick to make miticide uniform mixing with water.

3.3.2 Method of application of spray fluid

Treatment wise spraying was undertaken with the help of a manually operated hydraulic knapsack sprayer. Three replications of each treatment were sprayed at the same time by avoiding drift of spray fluid on neighbouring plot and thorough coverage of foliage was ensured. Care was taken to wash the spray pump with water thoroughly well before using each miticide. Three sprays of each miticide were given at fortnightly interval.

3.3.3 Method of recording observations

To record the pre and post treatment observations, five plants from each treatment were randomly selected and tagged. Observations were recorded in morning hours. Pre treatment counts of mite population were recorded one day before application of each spray and observations on post treatment were recorded on One, Third, Seventh and Twelth days after each spraying.

Three leaves each from lower, middle and upper part of each randomly selected and tagged plants were selected. The surviving mite population was recorded with the help of magnifying lense 10X as per the methodology followed by Hole and Salunkhe (2005).

3.3.4 Assessment of effectiveness of miticides

The data on average pest population of pre treatment and post treatment was transformed to $\sqrt{x + 0.5}$ and then subjected to analysis of variance in RBD (Panse and Sukhatme, 1985). The percent efficacy of different treatments were worked out using formula suggested by Handerson and Tilton (1955).

$$\text{Per cent efficacy} = \left[1 - \frac{T_a}{C_a} \times \frac{C_b}{T_b} \right] \times 100$$

Where,

T_a = Infestation in treated plot after application

T_b = Infestation in treated plot before application

C_a = Infestation in control plot after application

C_b = Infestation in control plot before application

Table 2 : Details of miticides used to study of bioefficacy of miticides for their effectiveness against *T. urticae* Koch.

Sr. No.	Common Name	Trade Name	Formulation used	Concentration (%)	Source
1	Fenpopathrin	Danitol	10EC	0.02%	M/S Rallis India Ltd 21 Rave line, St. Fort, Mumbai
2	Wettable sulphur	Agrosulf	80WG	0.2%	M/S Excel Industied Ltd., Mumbai
3	Fenazaquin	Magister	10 EC	0.02%	M/S Indofil Chemical Company, Mumbai
4	Abamectin	Vertimec	1.9 EC	0.004%	M/S Novartis India Ltd, Mumbai
5	Clofentezine	Apollo	50SC	0.006%	Hoechst Schering Agro. Evo Ltd 54/A, Hoechst centre Sir, Mathuradas Vasanj Rd, Andheri (E), Mumbai.
6	Amitraz	Mitac	20EC	0.02%	Hoechst Schering Agro. Evo, Ltd. Ennor Express Highway, Emavoor, Ennore, Chennai-600057.
7	Triazophos	Hostathion	40EC	0.03%	M/S Bayer Crop Science India Ltd., Chakala, Andheri (E), Mumbai-400093
8	Dicofol	Nomite	18.5% EC	0.05%	M/S Samvardhini Agro Pvt. Ltd. M-14,Additional M.I.D.C. Satara-415004,M.S. India

RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

The present investigations were undertaken to record seasonal incidence, varietal screening and studies on bioefficacy of miticides on *Tetranychus urticae* Koch. using various miticides under polyhosue condition at NARP, Ganeshkhind, Pune and Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune, Maharashtra.

The results obtained on various aspects mentioned above on *Tetranychus urticae* Koch. infesting Rose are presented and discussed in this chapter.

4.1 Seasonal incidence of *Tetranychus urticae* Koch.

Seasonal incidence of *Tetranychus urticae* Koch. was studied by taking count of mite population from randomly selected and tagged plants. The data presented in Table 3 and graphically presented in Fig.1. In order to know the intensity of pest infestation, observations on seasonal incidence on mites were recorded at a weekly interval starting from 3rd September 2006 to 1st March 2007. The weekwise meteorological data for this period are presented in Appendix.

It could be observed from the data presented in Table 3 that mite population build up started from 36th meteorological week on all the 11 cultivars at weekly average, T_{max}, T_{min}, RH-I and RH-II were 31.13, 20.12, 82.26 and 52.37 respectively.

The mean seasonal population of the pest on rose, irrespective of cultivars given in Table 3, indicated that the build up of pest population started from 36th meteorological week. Then population was increased slowly in the subsequent weeks and recorded its first peak at 42nd meteorological week when weekly average, T_{max}, T_{min}, RH-I and RH-II were 34.24, 22.25, 80.12 and 42.11 respectively.

Table 3 : Average number of mites per leaf

Name of cultivars	Meteorological weeks										
	36	37	38	39	40	41	42	43	44	45	46
	Months										
	September				October					November	
	Date of observation										
	3	10	17	24	1	8	15	22	29	5	12
First Red	6.62	8.42	10.28	24.45	39.46	42.42	55.68	53.10	45.43	35.44	26.44
Passion	4.72	4.87	7.68	16.24	30.10	30.16	33.56	33.45	27.12	20.59	20.90
Gold Stikes	4.98	6.56	8.26	20.12	34.30	34.98	39.57	37.52	29.10	25.33	22.13
Aqua	5.22	6.68	8.55	26.74	35.54	36.42	40.52	39.12	29.23	26.43	24.12
Milwa	4.78	5.80	7.88	23.96	33.45	34.52	38.44	36.94	27.13	24.58	21.10
Biyanca	5.88	7.42	10.11	24.42	37.88	39.22	43.66	40.72	33.98	32.44	24.56
Grand Gala	4.70	4.88	7.66	20.12	29.87	30.11	33.48	32.44	27.10	22.58	20.87
Spinx	1.10	1.22	2.36	5.55	8.43	8.95	9.86	8.12	6.32	5.23	4.68
Temptation	2.12	2.16	3.53	8.67	10.89	14.22	14.87	13.13	10.28	7.65	7.43
Confity	3.83	4.13	7.12	15.90	26.80	27.54	30.55	29.59	23.22	21.18	19.68
Nobleesse	4.22	4.82	7.42	16.18	27.14	29.54	32.43	30.46	29.87	22.12	20.12
Mean	4.38	5.18	7.35	18.40	28.53	29.83	33.87	32.24	26.25	22.14	19.28
SE±	0.48	0.65	0.73	2.03	3.07	3.05	3.84	3.77	3.19	2.73	2.07
CD at 5%	2.24	2.62	2.78	4.64	5.70	5.68	6.37	6.32	5.81	5.37	4.69

Name of cultivars	Meteorological weeks										
	47	48	49	50	51	52	1	2	3	4	5
	Months										
	November				December					January	
	Date of observation										
	19	26	3	10	17	24	1	7	14	21	28
First Red	22.18	16.18	12.11	9.18	8.11	4.66	1.46	4.57	7.46	8.32	19.18
Passion	16.36	10.73	8.48	8.26	5.47	1.66	0.87	2.97	5.92	6.68	11.83
Gold Stikes	18.14	11.13	9.13	8.65	6.98	2.14	1.12	3.45	7.12	8.21	12.83
Aqua	19.33	11.14	10.12	8.86	7.12	2.57	1.87	4.11	7.22	8.33	12.99
Milwa	17.13	10.88	8.86	8.16	6.57	1.98	0.93	3.43	6.87	7.73	12.66
Biyanca	21.44	13.57	10.43	8.97	7.42	3.86	1.96	4.25	7.42	8.56	14.28
Grand Gala	16.12	10.66	8.45	8.22	5.44	1.54	0.84	2.31	5.82	6.62	11.58
Spinx	4.28	3.87	3.14	2.68	1.47	0.65	0.28	1.22	1.44	2.43	3.48
Temptation	7.13	6.87	6.26	4.36	2.57	0.98	0.33	1.32	1.68	3.34	4.56
Confity	13.12	9.67	8.88	7.65	4.28	1.18	0.68	2.24	4.98	6.44	10.87
Nobleesse	15.16	9.88	7.46	8.22	4.98	1.22	0.79	2.29	5.12	7.57	11.43
Mean	15.49	10.42	8.48	7.56	5.49	2.04	1.01	2.92	5.55	6.75	11.43
SE±	1.67	0.96	0.71	0.63	0.63	0.37	0.17	0.35	0.65	0.62	1.30
CD at 5%	4.21	3.18	2.73	2.58	2.57	1.99	1.33	1.91	2.63	2.56	3.71

Name of cultivars	Meteorological weeks										
	6	7	8	9	10	11	12	13	Mean	SE±	CD at 5%
	Months										
	February				March						
	Date of observation										
	4	11	18	25	04	11	18	25			
First Red	22.12	26.78	38.78	43.45	46.56	57.64	53.57	48.47	26.62	3.35	5.29
Passion	19.63	20.18	22.84	28.68	37.56	43.67	42.57	39.63	18.78	2.41	4.49
Gold Stikes	20.88	21.63	25.74	30.32	39.33	48.56	44.21	41.98	20.81	2.62	4.68
Aqua	21.10	21.84	26.22	31.37	40.87	49.63	46.45	44.12	21.79	2.71	4.76
Milwa	20.80	20.98	24.67	29.76	38.83	47.60	43.82	40.63	20.36	2.58	4.64
Biyanca	21.22	22.46	26.57	32.63	41.58	50.22	48.68	44.27	23.00	2.80	4.84
Grand Gala	19.43	20.14	22.63	27.87	36.46	43.58	42.46	38.57	18.75	2.39	4.47
Spinx	4.35	4.48	7.32	13.87	18.12	21.63	18.36	16.14	6.37	1.06	2.98
Temptation	6.36	6.78	8.48	16.40	20.18	22.35	19.18	17.45	8.38	1.14	3.09
Confity	18.36	18.97	21.68	25.88	35.14	42.87	40.66	35.60	17.29	2.27	4.35
Nobleesse	18.99	19.36	22.32	26.57	35.44	43.13	41.88	36.43	18.09	2.34	4.42
Mean	17.57	18.51	22.48	27.89	35.46	42.81	40.17	36.66	18.20	2.31	4.40
SE±	1.86	2.03	2.59	2.38	2.62	3.37	3.37	3.16			
CD at 5%	4.43	4.63	5.24	5.02	5.27	5.97	5.98	5.79			

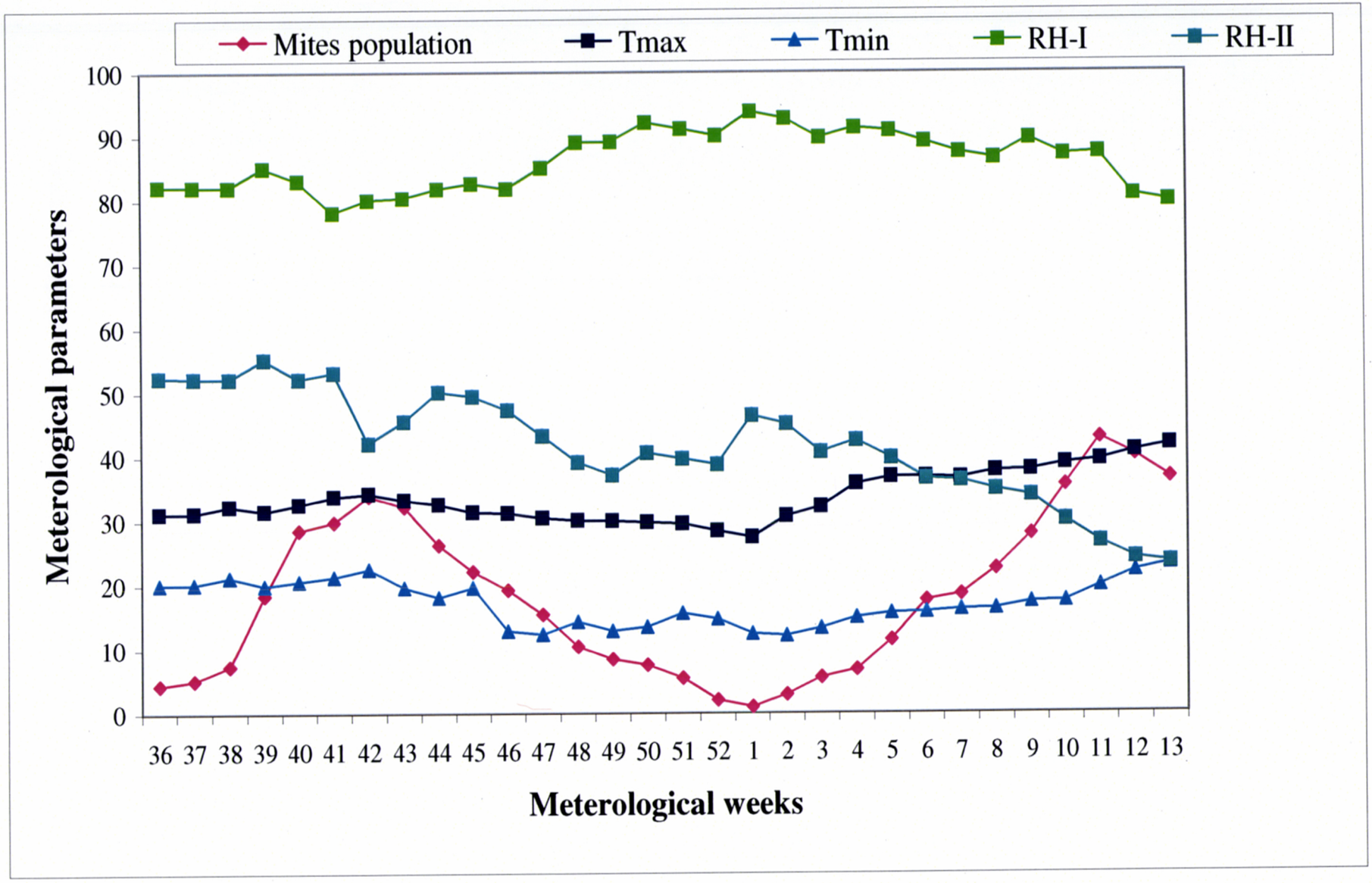

Fig. 1 : Relationship between meteorological parameters and mite population

From 43rd meteorological week onwards pest population was started to decrease and reached its lowest population at 1st meteorological week when weekly average, T_{max}, T_{min}, RH-I and RH-II were 27.43, 12.39, 93.84 and 46.35 respectively.

The pest population was started to increase from 2nd meteorological week and reached its 2nd peak at 11th meteorological week when weekly average, T_{max}, T_{min}, RH-I and RH-II were 39.36, 19.81, 87.44 and 26.62 respectively. From 12th meteorological week onwards pest population was decreased due to higher temperature and low relative humidity. The results are in the line of Hole and Salunkhe (2005).

4.1.1 Effect of meteorological parameters on seasonal incidence of *Tetranychus urticae* Koch.

4.1.1.1 Correlation coefficient

Correlation coefficients of meteorological parameters with population of *Tetranychus urticae* Koch. were determined and presented in Table 4. The meteorological parameters *viz.*, maximum (T_{max}) and minimum (T_{min}) temperature, morning (RH-I) and afternoon (RH-II) relative humidity were recorded in the experimental plot from 1st week of September 2006 to last week of March 2007 and are given in Appendix and are presented graphically in Fig.1.

Correlation analysis of *Tetranychus urticae* Koch. incidence with meteorological parameters revealed positive significant correlation with T_{max} (r=0.741), T_{min} (r=0.648) while it was negative significant correlation with RH-I (r=-0.582) and RH-II (r=-0.412). The results are confirmative with the results of Hole and Salunkhe (1997).

Table 4 : Correlation between weather parameters and mite population

Weather parameters	Correlation coefficient ('r' values)
Tmax	0.741**
Tmin	0.648**
RH-I	–0.582**
RH-II	–0.412*

* Significant at 5%, ** Significant at 1%

4.1.1.2 Regression analysis

Pest incidence = 82.53 + 1.41 T_{max} + 0.38 T_{min} – 1.22 RH-I – 0.31 RH-II (R^2 = 0.73)

Regression coefficient ('b'values), Regression constant ('a'values) and R^2 values were worked out by multiple linear regression analysis of meteorological parameters ('x' as independent variable) with incidence ('y' as dependent variable) of *Tetranychus urticae* Koch.

The significant positive regression coefficient of T_{max} (1.41) and T_{min} (0.38) observed, it indicates that an increase in T_{max} by one unit could increase mites incidence by 1.41 per cent and increase in T_{min} by one unit could increase mite incidence by 0.38 per cent. However, significant negative regression coefficients of RH-I (–1.22) and RH-II (–0.31) indicated that decrease in RH-I by one unit could increase mites incidence by 1.22 per cent and decrease in RH-II by one unit could increase mite incidence by 0.31 per cent. The multiple regression constant was 82.53, while R^2 value was 0.73, which indicate that 73% variation in mite population was caused due to the metrological parameters, *viz.*, T_{max}, T_{min}, RH-I, RH-II and 27% was caused due to other factors.

4.2 Screening of rose cultivars for their resistance to *Tetranychus urticae* Koch.

During the period of present investigation, eleven cultivars of rose (Table 1) were screened for their resistance to *Tetranychus urticae* Koch. under polyhouse conditions. The observations on the population of *Tetranychus urticae* Koch. were recorded at weekly interval from 3rd September, 2006 to 1st March, 2007 and the same are presented in Table 3 and graphically represented in Fig.1.

It was observed from the population data presented in Table 3 that mite population noticed from 36th meteorological week on all the varieties. However, the intensity of infestation was very negligible.

In the 39th meteorological week mite population ranges from 5.55 to 28.45 with an average of 20.57 mites per leaf. The cultivar Spinx herboured least population followed by Temptation where as cultivar First Red recorded highest population. The pest incidence showed an increasing trend up to 42nd meteorological week in all the cultivars.

At 42nd meteorological week the mite population recorded ranged from 9.86 to 55.68 mites per leaf on different cultivars. The cultivar Spinx noticed minimum population followed by Temptation while cultivar First Red recorded the maximum population.

The pest incidence from 42nd meteorological week onwards showed decreasing trend up to 1st meteorological week. In the 1st meteorological week pest population considerably decreased. This meteorological week showed lowest pest population per leaf ranged from 0.28 to 4.57 with average 2.04 on all the cultivars. The cultivar Spinx recorded least population followed by Temptation while the cultivar First Red noticed maximum mite population as compared to other cultivars.

In the 11th meteorological week there is increase in population with rapid rate. The pest population recorded during this week was highest

among all the meteorological weeks with average population of 42.80 mites per leaf. The cultivar Spinx noticed lowest population followed by Temptation whereas cultivar First Red recorded highest population.

At 12th and 13th meteorological week there was decline in population with average 40.16 and 36.66 mites per leaf.

The screening of rose cultivars to mite infestation on the basis of average population recorded at weekly intervals from 3rd September, 2006 to 1st March, 2007 grouped into less susceptible, moderately susceptible, susceptible and highly susceptible and presented in Table 5 and graphically presented in Fig.2.

Data presented in Table 5 revealed that the cultivars Spinx and Temptation were moderately susceptible; Confity, Nobleesse, Grand Gala, Passion, Milwa, Gold Stikes, Aqua and Biyanca were susceptible and First Red was highly susceptible. No single cultivar showed less susceptible reaction.

4.2.1 Morphological characters

During the experimental period, the various morphological characters of eleven cultivars of rose were recorded. These various character have no correlation with the intensity of mite infestation. These morphological characters are given in Table 6.

Table 5 : Reaction of rose cultivars to *Tetranychus urticae* Koch.

Categories	Name of cultivars	No of mites per leaf
Moderately susceptible (5.1 to 15 mites/ leaf)	Spinx, Temptation	6.37 8.38
Susceptible (15.1 to 25 mites/leaf)	Confity Grand Gala Nobleesse Passsion Aqua Biyanca Gold Stikes Milwa	17.29 18.75 18.09 18.78 21.79 23.00 20.81 20.36
Highly susceptible (> 25 mites/leaf)	First Red	26.62

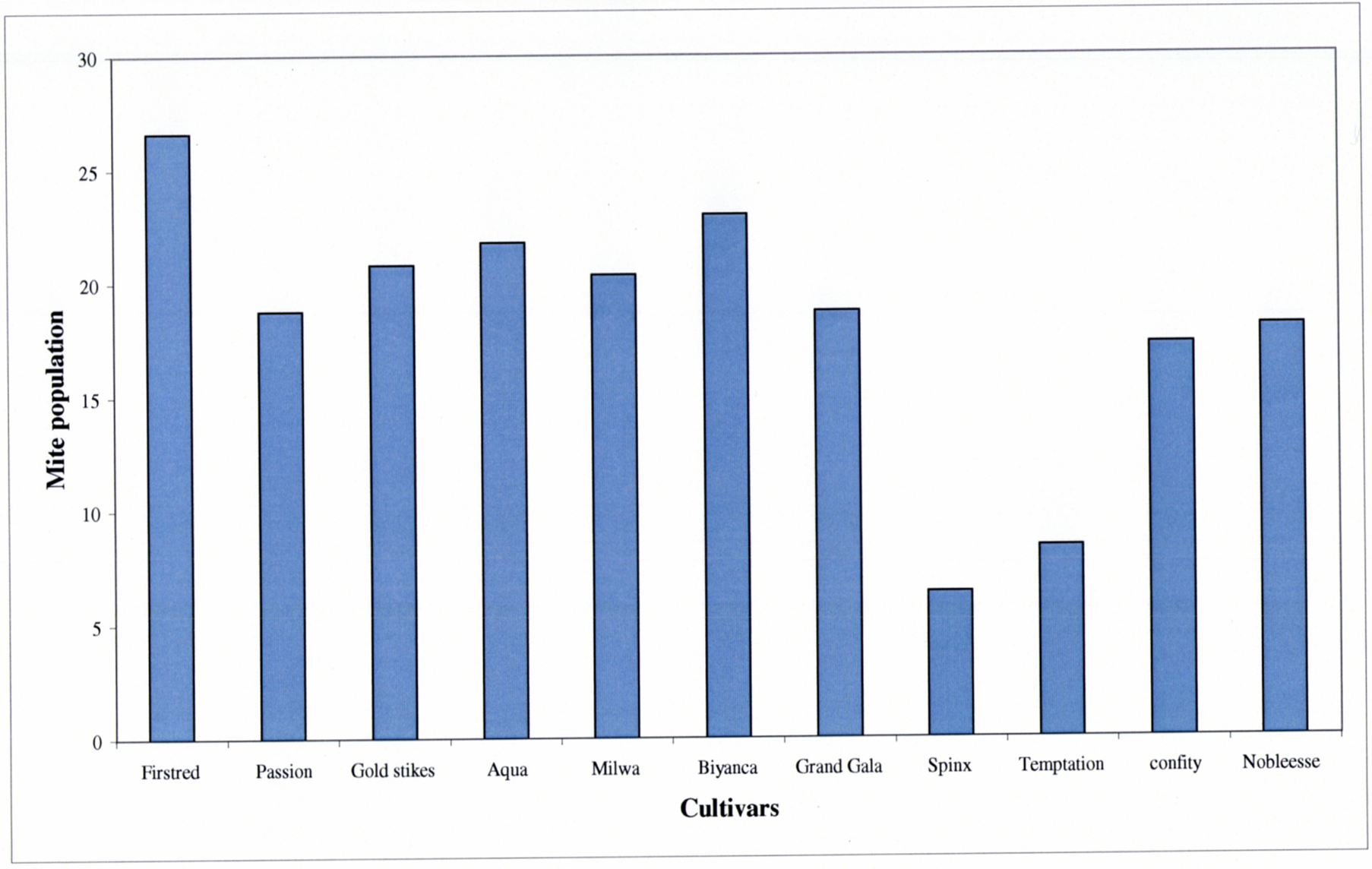

Fig. 2 : Relationship between rose cultivars and incidence of mites, *Tetranychus urticae* Koch.

Table 6 : Morphological characters of rose cultivars studied in screening experiment

Name of cultivars	Growth habit	Plant height (cm)	Stem thickness in Dia.(cm)	No of thorns (per 10 cm)	Foliage colour	Colour of flower	Diameter of flower (cm)	Depth of flower (cm)	No of petals per flower
First Red	Branching	90.47	3.36	11.6	Dark green	Dark red	4.62	2.20	20.5
Passion	Medium branching	56.36	3.2	22.8	Green	Pink red	5.15	2.35	24.51
Gold Stikes	Medium branching	88.24	3.04	9.8	Light green	Yellow	4.63	2.44	22.12
Aqua	Low branching	51.92	3.04	3.2	Light green	Light pink	4.20	1.91	26.21
Milwa	Branching	61.83	3.44	15.2	Green	Yellowish	4.75	2.57	21.16
Biyanca	Branching	53.24	3.06	14.6	Light green	White	5.26	2.72	66.38
Grand Gala	Low branching	62.18	3.46	9.8	Light green	Pink red	4.74	2.33	24.62
Spinx	Low branching	52.13	2.74	3.6	Light green	Yellow	3.21	1.83	18.16
Temptation	Branching	60.42	3.26	24.2	Green	Pink red	4.73	2.55	26.54
Confity	Medium branching	55.18	2.8	13.1	Dark green	Yellow	4.31	2.25	14.18
Nobleesse	Branching	66.56	3.32	17.2	Green	Dark pink	5.50	2.55	66.12

4.3 Bioefficacy of miticides against *Tetranychus urticae* Koch.

Studies were undertaken to find out efficacy of different miticides against *Tetranychus urticae* koch. on rose. Fenpropathrin (0.02%), wetteble sulphur (0.2%), fenazaquin (0.02%), abamectin (0.004%), clofentazine (0.006%), amitraz (0.02%), triazophos (0.03%) and dicofol (0.05%) were tested for their efficacy against *Tetranychus urticae* Koch.

The data on average survival mite population recorded One, Third, Seventh, and Twelth days after spraying are presented in Table 7. The per cent efficacy of different miticides are presented in Table 8 and graphically presented in Fig.3.

4.3.1 Incidence of mites before spraying

The data of observations on mites recorded one day before spraying are given in Table 7.

These observations on incidence of mite population were found to be statistically non significant.

4.3.2 First spray

4.3.2.1 One day after spraying

The data on average survival mite population recorded revealed that the average number of mite population ranged from 2.21 to 7.84 mites per leaf in treated plots as against higher number of 26.33 mites per leaf in untreated plot.

Amongst the miticides evaluated, abamectin (0.004%) proved to be most promising miticide, recorded least of 2.21 mites per leaf and 91.76 per cent efficacy against mites and it was significantly superior over all other miticides. Clofentezine (0.006%) was the next best treatment with efficacy of 88.56 per cent followed by fenazaquin (0.02%) with efficacy of 76.15 per cent. Fenpropathrin (0.02%) dicofol (0.05%) and amitraz (0.02%) were next to fenazaquin (0.02%) with an efficacy 74.63 , 74.05

and 72.94 per cent respectively. Triazophos (0.03) having efficacy 71.71 per cent and wetteble sulphur (0.2%) with efficacy 70.61 per cent did not prove much effective in controlling mites.

4.3.2.2 Three days after spraying

The data recorded three days after spraying indicated that abamectin (0.004%) was most effective with 91.70 per cent efficacy and it was significantly superior over all treatments. Clofentezine (0.006%) was the succeeding treatment with efficacy 88.76 per cent follwed by fenazaquin (0.02%) with efficacy 76.05 per cent. Fenpropathrin(0.02%) with efficacy 74.53 per cent was at par with dicofol (0.05%) with efficacy 73.85 per cent. Amitraz (0.02%) was next best to diccfol (0.05%). Triazophos (0.03%) with efficacy 71.01 and wettable sulphur (0.2%) having 70.47 per cent efficacy did not perform well against mites.

4.3.2.3 Seven days after spraying

The data recorded on seven days after spraying revealed that all the miticidal treatments were significantly superior over untreated control. The treatment with abamectin (0.004%) recorded minimum 2.19 mites per leaf and found to be significantly superior over other treatments with efficacy 91.86 per cent. Clofentezine (0.006%) was the next best treatment recorded 89.06 per cent efficacy. Succeeding treatment was fenazaquin (0.02%) with 76.44 per cent efficacy followed by fenpropathrin (0.02%) having efficacy of 74.77 per cent. Dicofol (0.05) was at par with fenpropathrin (0.02%) with efficacy 74.55 per cent. The treatment triazophos (0.03%) having efficacy of 71.89 and wettable sulphur(0.2%) with efficacy 70.80 per cent were less effective against mites.

4.3.2.4 Twelve days after spraying

The surviving population recorded on twelve days after spraying revealed that abametin (0.004%) was found to be significantly superior

Plate 3 : Mites damaged leaves with webbing

Plate 4 : Mites damaged leaves without webbing and healthy leaves

Plate 5 : Mites damaged flower with webbing

Plate 6 : Mites damaged flower without webbing and healthy flower

with efficacy 83.58 per cent. The next best treatment was clofentezine (0.006%) with efficacy 82.13 per cent. The succeeding treatment was fenazaquin (0.02%) recorded efficacy 68.21 per cent. The treatment fenpropathrin (0.02%) was next best treatment with efficacy 67.44 per cent and which was at par with dicofol (0.05%) with efficacy 66.24 per cent followed by amitraz (0.02%) having efficacy 64.98 per cent. The treatment triazophos (0.03) with efficacy 62.89 per cent and wettable sulphur (0.2%) with 62.51 per cent efficacy were less effective against mites as compared to other treatments.

4.3.3 Second spray

4.3.3.1 One day after spraying

It is evident from the data on mean population of mites after one day after second application that all the miticidal treatments were significantly superior over untreated control. The average 26.35 mites per leaf were recorded in untreated control. Here again the abamectin (0.004%) proved to be most effective which recorded minimum of 2.18 mites per leaf and 91.87 per cent efficacy against mites. It was also found significantly superior over all other miticidal treatments. Clofentezine (0.006%) was the next best treatment with efficacy 88.86 per cent followed by fenazaquin (0.02%) with efficacy 76.35 per cent. Fenpropathrin (0.02%) was succeeding treatment with efficacy 74.87 per cent and was at par with treatment dicofol (0.05) with 74.14 per cent efficacy. It was followed by amitraz (0.02%) with efficacy 72.91 per cent. The least effective treatments were triazophos (0.03) with efficacy 71.23 per cent and wettable sulphur (0.2%) having 70.67 per cent efficacy against mites among tested miticides.

Table 7 : Efficacy of different miticides against mites, *Tetranychus urticae* Koch. under polyhouse condition

Treatments	Average number of surviving mites/leaf																
	Pre count	First application					Second application					Third application					Cum. Av.
		1	3	7	12	Av	1	3	7	12	Av	1	3	7	12	Av	
Fenpropathrin 0.02%)	26.38 (5.18)	6.78 (2.69)	6.76 (2.69)	6.76 (2.69)	8.66 (3.02)	7.24 (2.77)	6.72 (2.68)	6.77 (2.69)	6.73 (2.68)	8.57 (3.01)	7.19 (2.76)	6.80 (2.70)	6.74 (2.69)	6.74 (2.69)	8.50 (3.00)	7.19 (2.77)	7.20 (2.76)
Wettable sulphur (0.04%)	26.43 (5.18)	7.84 (2.88)	7.83 (2.88)	7.81 (2.88)	9.95 (3.23)	8.35 (2.96)	7.83 (2.88)	7.83 (2.88)	7.76 (2.87)	9.83 (3.21)	8.31 (2.96)	7.85 (2.89)	8.18 (2.94)	8.16 (2.94)	9.87 (3.22)	8.51 (2.99)	8.39 (2.97)
Fenazaquin (0.02%)	26.27 (5.17)	6.40 (2.62)	6.40 (2.62)	6.35 (2.61)	8.49 (2.99)	6.91 (2.71)	6.37 (2.62)	6.39 (2.62)	6.35 (2.61)	8.34 (2.97)	6.86 (2.70)	6.38 (2.62)	6.37 (2.62)	6.33 (2.61)	8.30 (2.96)	6.84 (2.70)	6.87 (2.70)
Abamectin (0.004%)	26.55 (5.20)	2.21 (1.64)	2.19 (1.64)	2.19 (1.64)	4.34 (2.20)	2.73 (1.78)	2.18 (1.63)	2.21 (1.64)	2.17 (1.63)	4.08 (2.14)	2.66 (1.76)	2.21 (1.64)	2.17 (1.63)	2.18 (1.63)	4.13 (2.15)	2.67 (1.76)	2.68 (1.76)
Clofentazine (0.006%)	26.62 (5.20)	3.03 (1.87)	2.98 (1.86)	2.93 (1.85)	4.71 (2.28)	3.41 (1.96)	2.97 (1.86)	3.04 (1.88)	2.89 (1.84)	4.56 (2.24)	3.36 (1.95)	2.96 (1.85)	2.83 (1.82)	2.71 (1.78)	4.51 (2.23)	3.25 (1.92)	3.34 (1.94)
Amitraz (0.02%)	26.63 (5.20)	7.18 (2.77)	7.16 (2.76)	7.19 (2.77)	9.23 (3.11)	7.69 (2.85)	7.18 (2.77)	7.19 (2.77)	7.22 (2.77)	9.14 (3.10)	7.68 (2.85)	7.18 (2.77)	7.18 (2.77)	7.17 (2.77)	9.09 (3.09)	7.65 (2.85)	7.67 (2.85)
Triazophos (0.03%)	26.67 (5.21)	7.62 (2.85)	7.61 (2.84)	7.45 (2.82)	9.76 (3.20)	8.11 (2.92)	7.61 (2.84)	7.61 (2.84)	7.62 (2.85)	9.66 (3.18)	8.12 (2.92)	7.25 (2.78)	7.59 (2.84)	7.24 (2.78)	9.70 (3.19)	7.94 (2.89)	8.05 (2.91)
Dicofol (0.05%)	26.41 (5.18)	6.95 (2.73)	6.94 (2.72)	6.89 (2.71)	8.97 (3.07)	7.43 (2.80)	6.91 (2.72)	6.92 (2.72)	6.89 (2.71)	8.87 (3.06)	7.39 (2.80)	6.91 (2.72)	6.92 (2.72)	6.87 (2.71)	8.79 (3.04)	7.37 (2.79)	7.39 (2.79)
Control	26.76 (5.22)	26.33 (5.18)	26.15 (5.16)	26.40 (5.18)	26.20 (5.16)	26.27 (5.17)	26.35 (5.18)	25.31 (5.08)	26.34 (5.18)	26.69 (5.21)	26.17 (5.16)	26.41 (5.18)	26.24 (5.17)	26.37 (5.18)	26.24 (5.17)	26.31 (5.17)	26.25 (5.16)
S.E. ±	0.058	0.013	0.010	0.017	0.022	0.015	0.017	0.021	0.016	0.023	0.019	0.024	0.023	0.041	0.022	0.027	0.020
CD at 5% level	N.S	0.039	0.030	0.053	0.067	0.047	0.051	0.063	0.048	0.070	0.058	0.072	0.069	0.125	0.066	0.083	0.062

N.S= Non significant.
Figures in parentheses indicates $\sqrt{x + 0.5}$ transformed values.

Table 8 : Percent efficacy of miticides against mites, *Tetranychus urticae* Koch.

Treatments	Average per cent efficacy															Cum. Av.
	First application					Second application					Third application					
	1	3	7	12	Av.	1	3	7	12	Av.	1	3	7	12	Av.	
Fenpropathrin (0.02%)	74.63	74.53	74.77	67.44	72.84	74.87	73.65	74.83	68.37	72.93	74.63	74.69	74.82	68.09	73.05	72.94
Wettable sulphur (0.04%)	70.61	70.47	70.80	62.51	68.59	70.67	69.46	70.98	63.64	68.68	70.66	69.30	69.50	62.87	68.08	68.45
Fenazaquin (0.02%)	76.15	76.05	76.44	68.21	74.21	76.35	75.23	76.35	69.34	74.31	76.30	76.18	76.45	69.49	74.60	74.37
Abamectin (0.004%)	91.76	91.70	91.86	83.58	89.72	91.87	91.34	91.83	84.85	89.97	91.70	91.80	91.80	84.40	89.92	89.87
Clofentazine (0.006%)	88.56	88.76	89.06	82.13	87.12	88.86	88.06	89.09	83.01	87.25	88.85	89.27	89.78	83.20	87.77	87.38
Amitraz (0.02%)	72.94	72.78	72.94	64.98	70.91	72.91	71.76	72.75	65.96	70.84	72.97	72.80	72.97	65.56	71.07	70.94
Triazophos (0.03%)	71.17	71.01	71.89	62.89	69.24	71.23	70.05	71.18	63.95	69.10	72.65	71.19	72.65	63.18	69.91	69.41
Dicofol (0.05%)	74.05	73.85	74.55	66.24	72.17	74.14	73.04	74.20	67.23	72.15	74.20	73.99	74.31	66.97	72.36	72.22

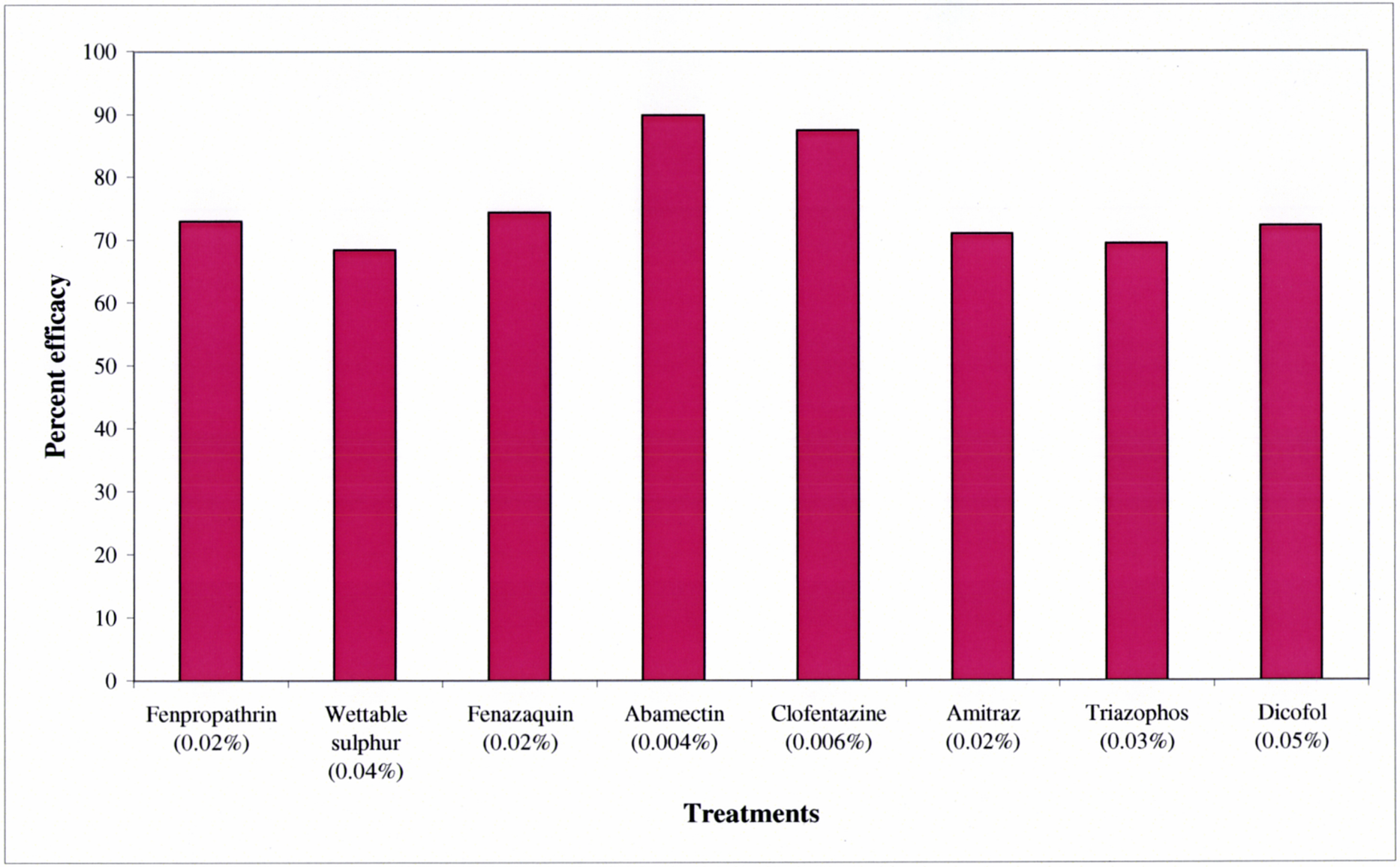

Fig. 3 : Percent efficacy of miticides against mites, *Tetranychus urticae* Koch.

4.3.3.2 Three days after spraying

The data on mites population recorded three days after spraying revealed that the most promising treatment was again abamectin which recorded a minimum number of 2.21 mites per leaf and it was also found significantly superior over all other treatments with efficacy 91.34 per cent. Clofentezine (0.006%) with efficacy 88.06 per cent was the next best treatment . Fenazaquin (0.02%) with efficacy 75.23 per cent was succeeding treatment to clofentezine (0.006%). This was followed by fenpropathin (0.02%) with efficacy 73.65 per cent and which was at par with dicofol (0.05%) with efficacy 73.04 per cent. The treatment amitraz (0.02%) with efficacy 71.76 per cent was next best to dicofol (0.05%). Triazophos (0.03%) with efficacy 70.05 per cent and wetteble sulphur (0.2%) with 69.46 per cent efficacy were proved to be less effective against mites on rose.

4.3.3.3 Seven days after spraying

Data indicated that treatment with abamectin (0.004%) was significantly superior over all other miticidal treatments recorded 2.17 mites per leaf with highest efficacy 91.83 per cent. Clofentezine (0.006%) was next best treatment with efficacy of 89.09 per cent. Succeeding treatments were fenazaquin (0.02%) with efficacy 76.35 per cent and fenpropathrin (0.02%) with efficacy 74.83 per cent and was at par with dicofol (0.05%) with efficacy 74.20 per cent. This was followed by amitraz (0.02%) with efficacy 72.75 per cent. Treatments triazophos (0.03%) having efficacy 71.18 per cent and wettable sulphur (0.2%) with 70.98 per cent efficacy did not perform well against mites.

4.3.3.4 Twelve days after spraying

The survival mite population recorded on twelve days after spraying revealed that abamectin (0.004%) was found to be significantly superior over all the treatments recorded 4.08 mites per leaf with efficacy

of 84.85 per cent. Clofentezine (0.006%) was next best treatment with efficacy 83.01 per cent followed by fenazaquin (0.02%) with efficacy 69.34 per cent. Fenpropathrin (0.02%) was the succeeding treatment with efficacy 68.37 per cent. Dicofol (0.05%) was at par with fenpropathrin (0.02%) with efficacy 67.23 per cent followed by amitraz (0.02%) with efficacy 65.96 per cent. Treatment triazaphos (0.03%) and wettable sulphur (0.2%) with efficacy 63.95 and 63.64 per cent respectively were found to be least effective against mites.

4.3.4 Third spray

4.3.4.1 One day after spraying

The data against mites one day after spraying indicates that the treatment with abamectin (0.004%) recorded a minimum 2.21 mites per leaf was most effective and significantly superior over all the remaining treatments with highest efficacy 91.70 per cent. Clofentezine (0.006%) was succeeding treatment with efficacy 88.85 per cent followed by fenazaquin (0.03%) with efficacy 76.30 per cent. Next best treatment was fenpropathrin (0.02%) with efficacy 74.63 per cent. Treatments dicofol (0.05%) and amitraz (0.03%) were at par with fenpropathrin (0.02%) with efficacy 74.20 and 72.97 per cent respectively. Triazophos (0.03%) having efficacy 72.65 per cent and wettable sulphur (0.2%) having efficacy 70.66 per cent did not perform well against mites.

4.3.4.2 Three days after spraying

Data revealed that abamectin (0.004%) remained superior by recording minimum 2.17 mites per leaf with the efficacy 91.80 per cent followed by clofentezine (0.006%) with the efficacy 89.27 per cent. Fenazaquin (0.02%) was the next best treatment having efficacy 76.18 per cent followed by fenpropathrin (0.02%) with efficacy 74.69 per cent. Dicofol (0.05%) with efficacy 73.99 per cent was at par with

fenpropothrin (0.02%). Amitraz (0.02%) with efficacy 72.80 per cent was at par with dicofol (0.05%) while tirazophos (0.03%) with efficacy 71.19 per cent and wettable sulphur (0.2%) with efficacy 69.30 per cent were least effective in controlling mite population and inferior to all other treatments.

4.3.4.3 Seven days after spraying

Data indicated that the treatment with abamectin (0.004%) with efficacy 91.80 per cent was significantly superior over all other miticidal treatments which recorded least population of 2.18 mites per leaf. Clofentezine (0.006%) was the next best treatment with efficacy of 89.78 per cent followed by fenazaquin (0.02%) with efficacy 76.45 per cent. Fenpropathrin (0.02%) was next best treatment to fenazaquin (0.02%) with efficacy of 74.82 per cent. Dicofol (0.05%), amitraz (0.02%) and trizophos (0.03%) were at par with fenpropathrin (0.02%) with efficacy of 74.31, 72.97 and 72.65 per cent respectively. Wettable sulphur (0.2%) having 69.50 per cent efficacy was found to be least effective against mites.

4.3.4.4 Twelve days after spraying

Abamectin (0.004%) recorded minimum 4.13 mites per leaf and remain significantly superior over all the treatments with the efficacy 84.40 per cent followed by clofentezine (0.006%) with efficacy 83.20 per cent. Fenazaquin (0.02%) was succeeding treatment with efficacy 69.49 per cent. Fenpropathrin (0.02%) with efficacy 68.09 per cent was next best treatment to fenazaquin (0.02%). Dicofol (0.03%) was at par with fenpropathrin (0.02%) with efficacy 66.97 per cent followed by amitraz (0.02%) with efficacy 65.56 per cent. Triazophos (0.03%) with 63.18 per cent efficacy and wettable sulphur (0.2%) with 62.87 per cent efficacy did not perform well in controlling mite population.

4.3.5 Overall efficacy of miticidal treatments in controlling mites,*Tetranychus urticae* Koch.

The data on cumulative mean population of *Tetranychus urticae* Koch. recorded one, three, seven and twelve days after each three sprays of miticidal treatments given in Table 7 and 8 revealed that all the treatments were significantly superior over untreated control in reducing population of pest.

The treatment with abamectin (0.004%) found to be significantly superior over others treatments with average 89.87 per cent efficacy and recorded minimum of 2.68 mites per leaf. The treatment with clofentezine (0.006%) was the next best treatment with efficacy 87.38 per cent and herboured 3.34 mites per leaf. It was followed by fenazaquin (0.02%), fenpropathrin (0.02%), dicofol (0.05%) and amitraz (0.02%). The triazophos (0.03%) and wettable sulphur (0.2%) were found to be less effective as compared to all other treatments.

The present findings in respect of effectiveness of abamectin and clofentezine against mites are similar with result of Akashe (2004) and Jagtap (2004).

The treatments with the fenazaquin and fenpropathrin were found to be effective against mites. The results are confirmative with the results of Jagtap (2004) and Dhar *et al.* (2000).

The dicofol and amitraz were superior treatments over triazophos and wettable sulphur in controlling mite population. This results are in the line with the results reported by Akashe (2004).

SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

Rose is one of the most important commercial flower crop of the world and also of India. It is also grown on commercial scale in Maharashtra State. However, crop is attacked by a number of pests, among them mite, *Tetranychus urticae* Koch. is the most important pest and drastically reduces economic value of flower. The scanty of literature available on seasonal incidence, screening of rose cultivars and bioefficacy against mites. Hence, the present investigations were undertaken on seasonal incidence, varietal screening and bioefficacy of miticides against mites at NARP, Ganeshkhind Pune-7 and Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune-5, Maharashtra during 2006-2007.

Efficacy experiment was laid out in Randomised Block Design (RBD) with three replications and nine treatments. The results obtained are summarized and conclusions drawn from the present experiment are presented in this chapter.

5.1 Summary

5.1.1 Seasonal incidence of *Tetranychus urticae* Koch.

The incidence of mites under polyhouse condition starts to build up from 36th meteorological week and remained present throughout the experiment. However, population reached two peaks, first peak in 42nd meteorological week with 33.87 mites/leaf in the month of October and 2nd peak in 11th meteorological week with 42.81 mites/leaf in the month of March. The pest population ranged from 0.28 to 57.64 mites per leaf during the experimental period.

5.1.2 Correlation between weather parameters and mite population

It was observed that *Tetranychus urticae* Koch was positively correlated with maximum and minimum temperature where as negatively correlated with morning and afternoon relative humidity.

5.1.3 Screening of rose cultivars for their resistance to *Tetranychus urticae* Koch.

Eleven cultivars of rose were screened against mites and the data recorded revealed that all the cultivars shown variability in respect of number of mites per leaf.

Based on their resistance/susceptible, cultivars were categorized into Moderately susceptible: Spinx and Temptation; Susceptible: Confity, Nobleesse, Grand Gala, Passion, Milwa, Gold Stikes, Aqua and Biyanca and Highly susceptible : First Red. No single cultivar found as less susceptible.

The cultivar Spinx was found to be most promising recorded the lowest mean population 6.37 mites per leaf followed by cultivar Temptation with mean population 8.38 mites per leaf where as the cultivar First Red was highly susceptible with highest mean population 26.62 mites per leaf.

5.1.4 Bioefficacy of miticides against *Tetranychus urticae* Koch.

Eight miticides were tested for their efficacy against *Tetranychus urticae* Koch. on rose under polyhouse condition. Data recorded during experiment revealed that all the miticides caused significant reduction in mite population as compared to untreated control. Amongst the miticides tested the treatment with abamectin (0.004%) proved to be most effective in reducing mite population after all there rounds of application and recorded 2.68 mites per leaf against 26.25 mites per leaf in untreated control. It was significantly superior over other treatments and recorded

highest efficacy 89.87 per cent over all other treatments. Clofentezine (0.006%) was the next best treatment in controlling mites with efficacy 87.38 per cent which was followed by fenazaquin (0.02%) with efficacy 74.37 per cent. Fenpropathrin (0.02%) with efficacy 72.94 per cent was at par with dicofol (0.05%) having efficacy 72.22 per cent. Amitraz (0.02%) with efficacy 70.94 per cent was succeeding treatment to dicofol (0.05%). Triazophos (0.03%) with efficacy 69.41 per cent and wettable sulphur (0.2%) with efficacy 68.45 per cent. were found to be least effective in controlling mite population.

5.2 Conclusion :

The maximum and minimum temperature, morning and afternoon relative humidity prevailing during the month of October and March appeared to be most congenial for multiplication of *Tetranychus urticae* Koch. The peak mite population recorded 33.87 and 42.81 mites per leaf during 42^{nd} and 11^{th} meteorlogical weeks in the months of October and March respectively.

It was observed from the studies carried out on seasonal incidence of *Tetranychus urticae* Koch that the mite population was significantly and positively correlated with maximum and minimum temperature where as significantly and negatively correlated with morning and afternoon relative humidity. The cultivars shown variability in their reaction to *Tetranychus urticae* Koch. in screening experiment. Spinx appeared to be most promising cultivar recorded the lowest mean population 6.37 mites per leaf followed by Temptation with mean population 8.38 mites per leaf and found moderately susceptible where as cultivar First Red was highly infested with mean population 26.62 mites per leaf and appeared to be highly susceptible.

Among the eight miticides tested aginst *Tetranychus urticae* Koch. the abamectin (0.004%) was the most effective and significantly superior treatment recorded 89.87 per cent efficacy with the mean population 2.68 mites per leaf. Clofentezine (0.006%) was next best treatment showed 87.38 per cent efficacy. Fenazaquin (0.02%), fenpropathrin (0.02%), dicofol (0.05%) and amitraz (0.02%) were also found effective succeeding treatments in controlling of mite population on rose. Triazophos (0.03%) and wettable sulphur (0.2%) were found to be least effective.

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6. LITERATURE CITED

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* Original not seen.

APPENDIX

7. APPENDIX

Weekly averages of meteorological parameters during the experimental period in the polyhouse.

M. W.	Meteorological Month and Date	Temperature ^0C		Relative humidity %	
		T_{max}	T_{min}	RH-I	RH-II
36	03-09-06 to 09-09-06	31.13	20.12	82.26	52.37
37	10-09-06 to 16-09-06	31.19	20.21	82.17	52.22
38	17-09-06 to 23-09-06	32.32	21.24	82.12	52.18
39	24-09-06 to 30-09-06	31.56	19.93	85.14	55.18
40	01-10-06 to 07-10-06	32.56	20.67	83.18	52.14
41	08-10-06 to 14-10-06	33.78	21.33	78.16	53.18
42	15-10-06 to 21-10-06	34.24	22.55	80.12	42.11
43	22-10-06 to 28-10-06	33.26	19.63	80.42	45.52
44	29-10-06 to 04-10-06	32.62	18.16	81.86	50.11
45	05-11-06 to 11-11-06	31.37	19.68	82.72	49.46
46	12-11-06 to 18-11-06	31.22	12.88	81.85	47.29
47	19-11-06 to 25-11-06	30.45	12.36	85.14	43.27
48	26-11-06 to 02-12-06	30.12	14.34	89.12	39.16
49	03-12-06 to 09-12-06	29.98	12.87	89.16	37.18
50	10-12-06 to 16-12-06	29.79	13.49	92.16	40.58
51	17-12-06 to 23-12-06	29.53	15.65	91.18	39.66
52	24-12-06 to 30-12-06	28.38	14.73	90.13	38.78
1	31-12-07 to 06-01-07	27.43	12.39	93.84	46.35
2	07-01-07 to 13-01-07	30.68	12.12	92.80	45.11
3	14-01-07 to 20-01-07	32.13	13.28	89.76	40.67
4	21-01-07 to 27-01-07	35.72	14.92	91.33	42.51
5	28-01-07 to 03-02-07	36.82	15.64	90.87	39.73
6	04-02-07 to 10-02-07	36.82	15.78	89.16	36.52
7	11-02-07 to 17-02-07	36.63	16.18	87.54	36.29
8	18-02-07 to 24-02-07	37.69	16.28	86.57	34.88
9	25-02-07 to 03-02-07	37.82	17.32	89.62	33.88
10	04-03-07 to 10-03-07	38.84	17.42	87.12	30.06
11	11-03-07 to 17-03-07	39.36	19.81	87.44	26.62
12	18-03-07 to 24-03-07	40.72	22.12	80.82	24.16
13	25-03-07 to 31-03-07	41.72	23.25	79.83	23.48

VITA'

8. VITA

SUDHIRKUMAR S.

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of
MASTER OF SCIENCE (AGRICULTURE)
in
AGRICULTURAL ENTOMOLOGY

2007

Title of thesis : **"BIOEFFICACY OF NEWER MITICIDES AGAINST TWO SPOTTED SPIDER MITE (*Tetranychus urticae* Koch.) ON ROSE UNDER POLYHOUSE CONDITION"**

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