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Original Research

Investigation of the resistances of some verities of rose flower to *Tetranychus urticae* Koch and *Tetranychus cinnabarinus* mites under different fertilizers

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ABSTRACT:

It is well known that fertilizers increase density of mites and on the other hand farmers use fertilizers for increase in quality and quantity of products. The use of some varieties may be suitable choice for resistance to mites in plants reared with fertilizers. This study was conducted to investigation investigate the resistance of some rose cultivar to mites such as *Tetranychus urticae* Koch and *Tetranychus cinnabarinus* at different fertilizer levels under greenhouse condition. The commercial rose cultivars viz., Dolce Vita (DV), Polar Star (PS) and Magic Red (MR), were investigated. These cultivars were fertilized with iron and nitrogenous fertilizers. We have checked the resistance with a number of mature mites, immature mites and eggs. Also antibiosis, antixenosis, life and productivity parameters were examined for these cultivars. Our findings showed that fertilizers increase density of mites, especially on MR cultivar. On the other hand, life and productivity parameters of mites were higher for MR cultivar and were lower for DV cultivar. The DV cultivar had the highest antibiosis and antixenosis resistances. Thus mites prefer MR cultivar and it can be stated that DV cultivar is a suitable cultivar for integrated pest management program.

Keywords:

Antixenosis, life table, Nitrogenous fertilizer, Rose cultivars, *Tetranychus urticae*.

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INTRODUCTION

Rosa genus is belonging to the family Rosaceae which has at least 100 species (Horn, 1992). Roses are found in the most climates, such as arctic and tropic. Rose flower breeders cultivate more than 20,000 commercial varieties that these cultivars are originated from eight wild species (Kim *et al*., 2003). Flower breeders use fertilizers, nitrogenous fertilizers, to increase in the quality and quantity. It is well known that excessive use of fertilizers have negative effects on animals and plants (Conway, 1997; Conway and Pretty, 1991). Southwood (1973) has been shown that the high differences at nitrogen concentration sin plant tissues may be a reason for the herbivores which usually follow plants with high nitrogen level. The use of fertilizers, at high levels, can change morphological, biochemical and physiological properties of host plants and these alterations provide suitable nutritional conditions for herbivores (Bernays, 1990; Simpson and Simpson, 1990).

The excessive use of fertilizers play important role in the herbivore population by host selection and ecological fitness, i.e. survival, growth, fertility, reproductive capacity and resistance reduced in plants treated with fertilizers at high amount (Barbour *et al.,* 1991). It is well accepted that arthropods and diseases are responsible for the production of loss. In the recent decades, some mites have been reported as the first pest at all over worlds. MojibHaghghadam and Arbabi (2012) reported that the ornamental flowers and plants are sensitive to mites attack, because the attack reduces product quality; it also results in a significant decrease of marketability. The Tarsonemidae, Acaridae, Eriophidae, Tenuipalpidae and Tetranychidae families are the most important pests which damage ornamental flowers. Some mites, especially the families of *Tetranychidae* (spider mite) and *Tenuipalpidae* nourish on leaf chlorophyll that this feed system creates the yellow and sometimes brown spots on the upper or lower surface of leaves. These spots default photosynthesis and destroy chlorophyll; resulting in the weak growth of flowers and decrease of marketability (MojibHaghghadam and Arbabi, 2012). Zhang (2003) have introduced some mites such as *T. urticae* and *T. cinnabarinus* that create severe damages to greenhouses.

The species of *T. cinnabarinus* and *T. cucurbita* have also been reported on China rose in some cities of Iran (Khalilmanesh, 1972). Pesticides usually use for control of mites but increasing evidences are accepted the side-effects and pesticides toxicity for humankind and on the other hand, pesticide resistance has encouraged scientists to find suitable control methods. Integrated Pest Management (IPM), combination of biological control and the host plant's genetically based resistance, seems to be a suitable control procedure against the Acarina. Thus, the purpose of this study is to investigate the resistances of some varieties of rose flower to *Tetranychus urticae* Koch and *Tetranychus cinnabarinus* mites at different nitrogen levels under greenhouse condition.

MATERIALS AND METHODS

Rose Cultivars and mites culture

The experiment was conducted from June-

Table 1. Variance of analysis for different cultivars at different years

S. No	Source of Variation	df	Mean Square (M.S.)		F	
1	-	-	2013	2014	2013	2014
2	Treatment	2	3751.46	4150.24	154.39**	126.33**
3	Error	9	24.30	32.85	-	-
	CV (%)		11.14	17.36	-	

Table 2. The mean of density of spider mites on per leaf (mean± SEM)

S. No	Sampling date	Magic red	Polar star	Dolce vi*ta*
1	**2013**	33.752±0.05[a]	27.011±0.04[b]	21.715±0.05[c]
2	**2014**	34.831±0.07[a]	27.956±0.01[b]	22.510±0.03[c]

September during 2013 and 2014 years. The commercial rose cultivars, Dolce Vita (DV), Polar Star (PS) and Magic Red (MR) were prepared from the greenhouses of Khorram Abad, Lorestan-Iran. All the cultivars were originated from *Rosa* hybrid. One hundred and fifty seedlings, fifty/seedlings, were obtained. The seedlings were transplanted into separated plastic pots (25×20 cm, height×diameter and 2.5 kg volume). All the cultivars were maintained under greenhouse conditions, i.e. 22±2° C temperature, 40±5 % relative humidity and 16 h light/ 8 h darkness as light regime. The pots were filled with sandy soil and animal wastes (as a fertilizer) (ratio 2:1 v/ v) as a growing media. The *T. urticae* and *T. cinnabarinus* mites originated from the roses which were grown in the same greenhouse (separate population).

Sampling

After observation the first mites on leaves, were started recording, once in two days. At each sampling date, two shrubs per treatment (three leaves per shrub) were randomly selected from each of the treatments. We recorded samples of the lower leaf surface because spider mites generally feed and reproduce on the lower leaf surface. Mite counts were performed by using a stereomicroscope (magnification 10x). We registered number of mature mites, immature mites and eggs. In this study the numbers of mature and immature mites were mentioned together, because their discrimination is difficult under greenhouse condition. All plants were taken at 8:00 AM and positioned in plastic bags and maintained in a refrigerator (4°C). The leaves were later investigated by using a stereomicroscope. The counts of eggs and life stages, mature and immature of mites, were examined at per leaf (2 cm^2) scale. The randomized complete block design with three treatments (3 cultivars) and 4 replicates (4 spots) was conducted for the investigation of *T. urticae* and *T. cinnabarinus* density.

Investigation on the effects of iron and nitrogenous fertilizers in *T. urticae* and *T. cinnabarinus* population

In order to investigate the effects of iron and nitrogenous fertilizers on *T. urticae* and *T. cinnabarinus,* an experiment was done based on the randomized block design in factorial arrangement with nitrogenous fertilizer treatments (0, 50 and 100 kg/ha), three treatments from iron fertilizers (5, 10 and 15 kg/ha) and three replicates per treatment (control, DV, PS and MR) was used. Nitrogenous fertilizers (46% urea) and iron fertilizers (10% iron) were prepared accordingly. We calculated the needed fertilizer per plastic pot, for 2.5 kg. To minimize experimental errors and estimation of nitrogenous and iron in the soil, we prepared the samples for analysis of nitrogenous and iron. Infestation was artificially performed and the sampling was started one week after infestation and we subsequently recorded two days/once (as mentioned before).

Table 3. Chemical analyses for elements present in rose leaf on the basis of different levels of nitrogen

S. No	Treatment	Nitrogen (%)	Potassium (%)	Phosphorus (%)
1	Nitrogen 0	2.104±0.021[b]	0.332±0.001[a]	3.322±0.123[b]
2	Nitrogen 50	2.821±0.014[ab]	0.383±0.004[a]	3.911±0.121[b]
3	Nitrogen 100	3.114±0.048[a]	0.419±0.045[a]	4.278±0.234[a]

'a' and 'b' shows significant differences at per column (P<0.05).

Table 4. Chemical analyses for elements present in rose leaf on the basis different levels of iron

S. No	Treatment	% Iron	% Potassium	% Phosphorus
1	Fe 5	0.069±0.001[b]	0.321±0.002[a]	3.00±0.003[b]
2	Fe 10	0.102±0.004[a]	0.452±0.003[a]	3.62±0.001[b]
3	Fe 15	0.104±0.008[a]	0.524±0.005[a]	4.10±0.014[a]

'a' and 'b' shows significant differences at per column (P<0.05).

Table 5. Length of the period the of life stages (mean± SEM) at different cultivars for fertilizers

S. No	Stages	Rose cultivars and N levels			Rose cultivars and Fe levels		
		(Magic red)	(Polar star)	(Dolce vi*ta*)	(Magic red)	(Polar star)	(Dolce vi*ta*)
1	Egg	2.00±0.03[a]	2.00±0.04[a]	2.15±0.04[a]	2.00±0.03[a]	2.23±0.04[a]	2.00±0.03[a]
2	Larve	2.39±0.06[c]	4.21±0.06[b]	4.63±0.02[a]	5.21±0.02[c]	6.58±0.04[b]	6.96±0.11[a]
3	Protonymph	2.25±0.05[c]	3.35±0.02[b]	4.45±0.08[a]	4.86±0.06[c]	4.95±0.03[b]	5.86±0.06[a]
4	Deutonymph	2.36±0.03[c]	3.40±0.08[b]	4.21±0.09[a]	5.58±0.05[c]	5.98±0.06[b]	6.92±0.04[a]
5	Total	9.00±0.17[c]	12.96±0.20[b]	15.44±0.23 [a]	17.65±0.16[c]	19.74±0.17[b]	21.74±0.24[a]

'a, b' and 'c' shows significant differences at per row (P<0.05).

Investigation of the resistance to *T. urticae* and *T. cinnabarinus* in rose cultivars

In order to evaluation resistance to spider mites, we used three mechanisms including; tolerance, antixenosis and antibiosis. The sampling, number of eggs, mature and immature mites were taken as described in the previous parts. In this investigation. Two -way analyses variance was done using Minitab 14.1 software and the determination of difference in pest population was found and in case significant difference, Duncan test was used.

Tolerance mechanism

To investigate tolerance mechanism, each cultivar separately was planted in plastic pots (17.5×19 cm, height×diameter). Per cultivar was consisted of five replicates that two replicates were considered as control, without infestation, and fifty mite eggs were released in each replicate from the remaining replicates. After three weeks of infestation, all the replicates were investigated three times in a week. The cultivars were investigated for reaction to spider mites using a six point scale of visual damage:1: no visible damage; 2) lesser than 5% damage on the dorsal surface of the leaves; 3) about 5-25% damage on the dorsal surface of the leaves; 4) about 25-45% damage on the dorsal surface of the leaves; 5) about 45-65% damage on the dorsal surface of the leaves; 6)

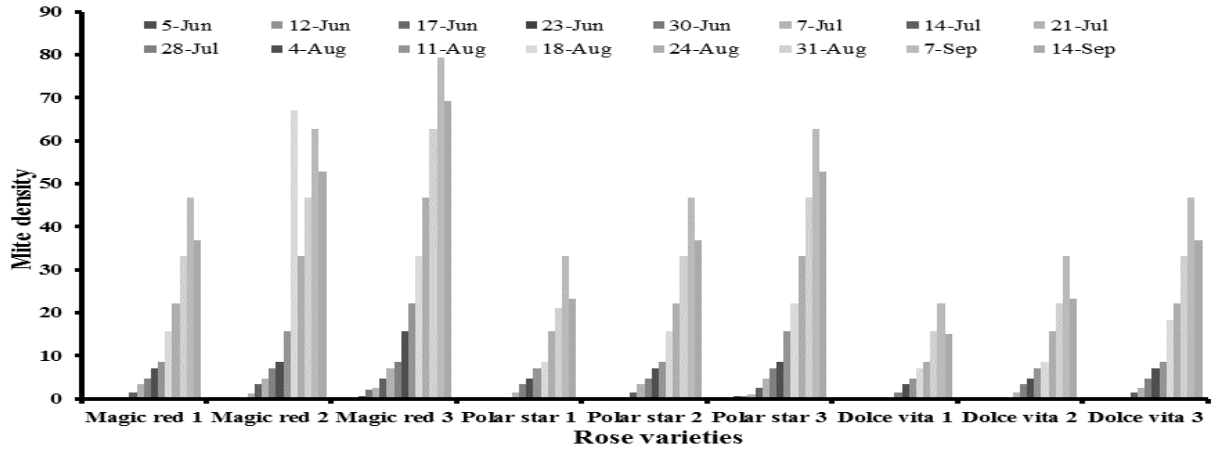

Figure 1. Effect of nitrogenous fertilizers on mite's density at different levels for different cultivars

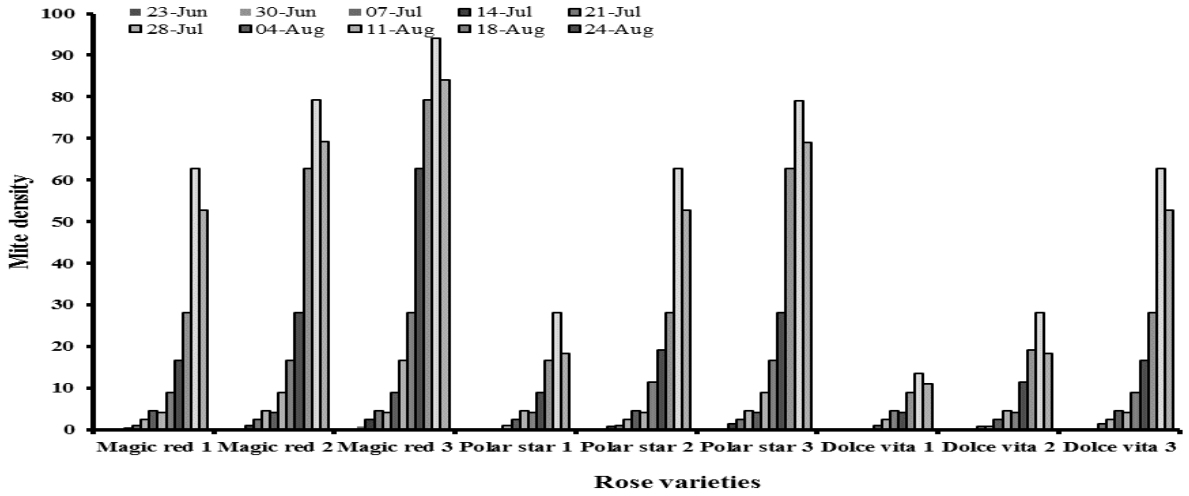

Figure 2. Effect of iron fertilizers on mite's density at different levels for different cultivars

about 25-45% damage on the dorsal surface of the leaves; 6) more of 65% damage on the upper surface of the leaves and necrosis of the leaf.

To investigate antixenosis mechanism, the rose cultivars (12 replications per cultivar) were transplanted circularly in a pot. Fifty mites were released in the center of the pot. After the release, a black cover was used for the prevention of entry of other insects and also for the prevention of phototropism effects. Four replicates of the twelve replicates, per cultivar, were recorded for a number of mites during 12, 24 and 72 h after the release of mites.

Antibiosis mechanism

The larvae cohort were used for antibiosis mechanism. Newly-hatched larvae were transferred to new leaf discs by using soft brush. Several life-history properties were investigated as follows; development time and mortality of immature stages, body length, longevity of adults and daily oviposition rate by females. The oviposition rate and number of newly-hatched larvae were considered as the criteria for antibiosis mechanism. This section was conducted at in an incubator (27±3°C temperature, 60±5% relative humidity and 12 h light/12 h darkness as light regime).

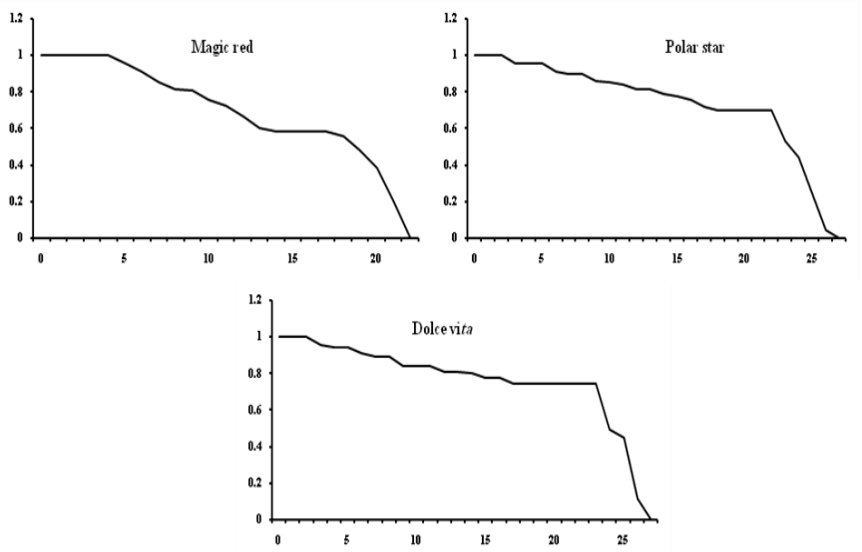

Figure 3. l_x for different cultivars (for nitrogenous fertilizer)

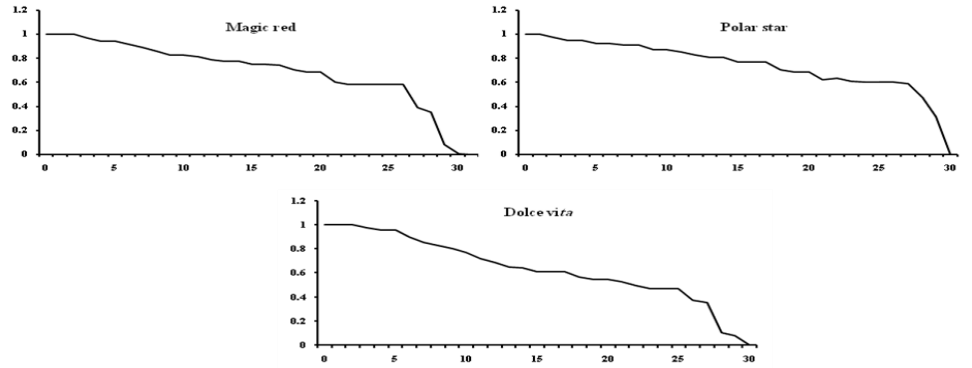

Figure 4. l_x **for different cultivars under fertilization with iron fertilizer**

Life table

Horizontal life table, on the basis of age, was used. In the present study, natural mortality at different growth stage of mites was measured. In these equations, l_x is the ratio of age-specific survivor; N_x is the number of age-specific survivor, N_0 is the primary individual, P_x presents survival probability in the range of x to x+1, q_x represents age-specific mortality, d_x shows the distribution of primary mortality, L_x is length of survival at ages of x to x+1 and T_x is the number of days that cohorts survive after x age.

1. $$lx = \frac{N_x}{N_0}$$

2. $$p_x = \frac{l_{x+1}}{l_x}$$

3. $$q_x = 1 - p_x$$

4. $$d_x = (l_x) - (l_{x+1})$$

5. $$L_x = \frac{(l_x) + (l_{x+1})}{2}$$

6. $$T_x = \sum_{x}^{\omega} L_x$$

This section was consisted from many equations as follows and l_x is presenting the age-specific survivor m_x shows fecundity rate.

Reproductive table and its rate

1. Gross fecundity rate = $\sum_{x}^{\beta} M_x$

2. Gross fertility rate = $\sum_{x}^{\beta} h_x M_x$

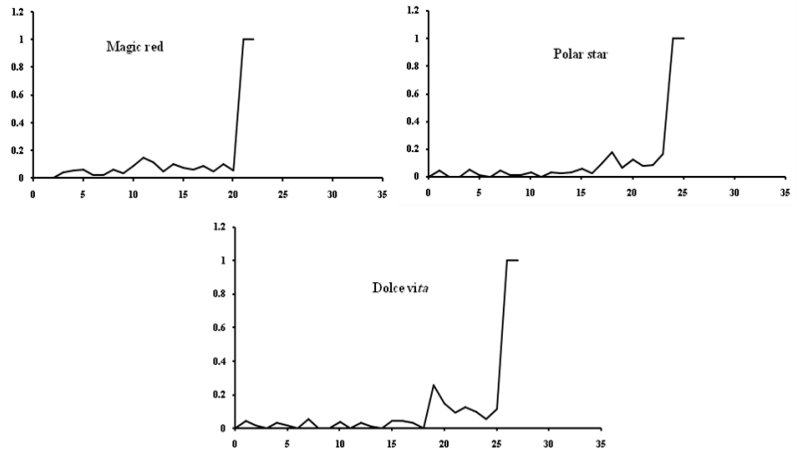

Figure 5. q_x **for different cultivars under fertilization with nitrogenous fertilizer**

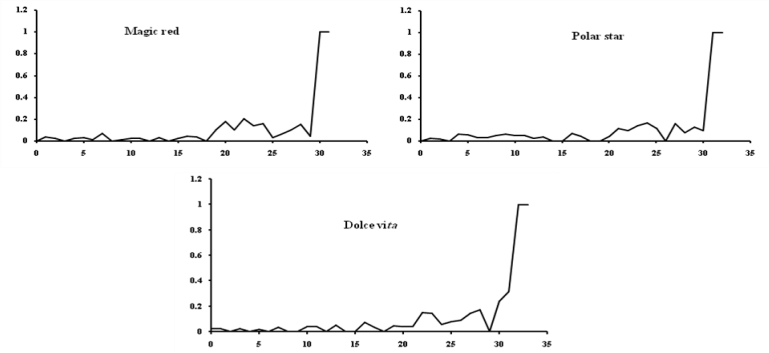

Figure 6. q_x for different cultivars under fertilization with iron fertilizer

3. Gross hatch rate = $\frac{\sum_{x}^{\beta} h_x M_x}{\sum_{x}^{\beta} M_x}$

4. Net fecundity rate = $\sum_{\alpha}^{\beta} L_x M_x$

5. Net fertility rate = $\sum_{\alpha}^{\beta} L_x h_x M_x$

6. Gross Reproductive Rate = $\sum_{\alpha}^{\beta} m_x$

7. Net Reproductive Rate or R_0 = $\sum_{\alpha}^{\beta} l_x m_x$

8. Intrinsic rate of increase = $e^{-rx}=1 \sum_{\alpha}^{\beta} l_x m_x$

9. Finite Rate of Increase or = $\lambda = e^{r}$

10. Doubling Time or DT = $\frac{\ln 2}{r_m}$

11. Mean Generation Time = T= $\frac{\ln R_0}{r_m}$

Daily reproductive rate

1. Mean egg per day = $\frac{\sum_{x}^{\beta} M_x}{\omega - \varepsilon}$

2. Mean of fertile egg per day = $\frac{\sum_{x}^{\beta} h_x M_x}{\varepsilon - \omega}$

Analyses for demography experiments

In this section, age is the most important parameter. In the mentioned equations, ε is the age of maturation of mites, α is the age of the first oviposition, β is age of the last oviposition and ω is the last of possible age. The analyses for reproductive and life tables were done by using excel software as previously explained by others (Birch, 1948; Carey, 1993). For the determination of significance differences, especially

Table 6. Length of the period the of oviposition, daily fecundity and total fecundity (mean± SEM) at different cultivars for fertilizers

S. No	Stages	Rose cultivars and N levels			Rose cultivars and Fe levels		(Dolce vi*ta*)
		(Magic red)	(Polar star)	(Dolce vi*ta*)	(Magic red)	(Polar star)	
1	**Oviposition period**	11.35±1.24^{a}	11.11±1.50^{a}	10.95±1.68^{ab}	10.86±1.89^{a}	10.18±1.15^{b}	10.08±1.38^{b}
2	**Daily Fecundity**	16.16±1.25^{a}	13.33±1.47^{b}	12.09±1.69^{bc}	10.98±1.89^{b}	12.39±1.98^{a}	12.63±1.12^{a}
3	**Total Fecundity**	142.05±2.5^{a}	116.54±2.98^{b}	99.55±2.23^{c}	90.52±2.54^{a}	89.05±2.21^{b}	82.45±2.89^{c}

'a, b' and 'c' shows significant differences at per row (P<0.05).

Table 7. Generation time, egg hatchability, immature mortality and sex ratio at different cultivars for fertilizers

S. No	Stages	Rose cultivars and N levels		(Dolce vi*ta*)	Rose cultivars and Fe levels		(Dolce vi*ta*)
		(Magic red)	(Polar star)		(Magic red)	(Polar star)	
1	**Generation time (day)**	20.35±1.08^{c}	24.07±1.70^{b}	26.39±1.91^{a}	28.51±1.05^{c}	29.92±1.32^{b}	31.82±1.62^{a}
2	**Egg hatchability (%)**	97.20	97.40	96.05	95.25	97.50	96.25
3	**Immature mortality %**	11.65	12.35	15.77	14.02	16.55	18.75
4	**Sex ratio (♂:♀)**	1:4.71*	1:4.62*	1:4.31*	1:4.09*	1:4.00*	1:3.81*

'a, b' and 'c' shows significant differences at per row (P<0.05).

intrinsic rate of increase, Jackknife procedure and SAS software were used (Maia *et al.,* 2000; Meyer *et al.,* 1986). The Jackknife procedure was used because there was not replicate for cultivars. The Jackknife equation was as follows;

$$r_{m\,(j)} = n \times r_{m\,(all)} - (n\text{-}1) \times r_{\,m\,(i)}$$

Variances (VAR), r_m (mean) and standard error of means (SEM) were as follows;

1. $\mathbf{r_{m(mean)}} = \dfrac{\sum_{j=1}^{n} r_{m(j)}}{n}$

2. VAR $r_{m\,(mean)} = \dfrac{\sum_{j=1}^{n}\left(r_{m(j)} - r_{m(all)}\right)^2}{(n-1)}$

3. 2. SEM $r_{m\,(mean)} = \sqrt{\dfrac{VAR_{r_{m(mean)}}}{n}}$

In vitro biologic studies

To investigate in vitro biologic studies, complete leaf as rearing unit was considered. We considered 30 replicates, 30 complete leaves, for each cultivar. Each leaf, consisting of five leaflets, was placed in micro-tubes having 2cc distilled water and positioned in a glass. To suitable ventilation, per glass was covered by a lace cloth. To perform biological studies, cohort eggs were used. The cohort eggs were obtained as follows; five glasses were prepared for per cultivar at first. Fifteen female and male mites were released to per glass. After 12 h, the all mites were removed. The produced eggs as cohort eggs were used for later stages. One cohort egg was transferred to per replicate by using soft brush. Hatching, changes in egg and other changes in biological stages of mites were recorded. The hatching of eggs (%), larva mortality (%), length of embryo stages, length of larva stages, longevity of mature mites and growth period (larva-oviposition) were registered with complete mites. A male and female mite was devoted to each petri having the complete leaf and we subsequently the

Table 8. Survival percentage of mites for different cultivars and under various fertilizers

Rose cultivars	Eggs survival (%)	Developmental periods		Adults survival (%)
		Larvae survival (%)	Nymphs survival (%)	
		N levels		
(Magic red)	83.35±1.98^{a}	63.47±1.10^{a}	77.54±1.15^{a}	89.65±1.23^{a}
(Polar star)	81.74±1.66^{b}	58.45±1.93^{ab}	76.07±1.91^{ab}	87.35±1.55^{b}
(Dolce vi*ta*)	76.63±1.41^{c}	59.15±1.40^{b}	75.63±1.36^{b}	82.12±1.60^{c}
		Fe levels		
(Magic red)	70.14±1.82^{a}	54.73±1.36^{a}	68.52±1.98^{a}	81.41±1.88^{a}
(Polar star)	62.40±1.08^{b}	53.93±1.97^{ab}	59.42±1.75^{b}	75.26±1.48^{b}
(Dolce vi*ta*)	56.95±1.27^{c}	50.24±1.01^{c}	53.74±1.69^{c}	73.11±1.44^{c}

'a, b' and 'c' shows significant differences at per column (P<0.05)

Table 9. Other parameters of life table

S. No	Parameters	(Magic red)	(Polar star)	(Dolce vita)
1	r_m(♀/♀/day)	0.269±0.031 [a]	0.203±0.063 [b]	0.187±0.055 [c]
2	R_0(♀/♀/generation)	62.38±1.65 [a]	60.39±1.48 [b]	51.84±1.55 [c]
3	T (day)	15.24±1.12 [c]	20.19±1.18 [b]	21.09±1.10 [a]
4	λ(♀/♀/day)	1.30±0.02 [a]	1.22±0.01 [b]	1.20±0.08 [c]
5	DT(day)	2.54±0.14 [c]	3.40±0.22 [b]	3.70±0.20 [a]

'a, b' and 'c' shows significant differences at per row (P<0.05).

number of the produced eggs per female mite and lengths of laying period were measured.

Statistical analyses

We described statistical analyses and software's for per section and the data were presented as mean ± SEM.

RESULTS

Mites population, antixenosis and antibiosis

Table 1 shows variances in the analysis of mites during 2013 and 2014. There were significant differences among cultivars for the density of spider mites (Table 2). The MR and DV showed the most and lowest density of mite, respectively. These findings showed the high antixenosis and antibiosis resistance in DV. It is believed that greenhouse condition is the best criteria for the investigation of antixenosis mechanism. The population of mites in DV cultivar is the lowest; showing that DV is not a desirable host for spider mites.

Analyses for nitrogen and iron in the soil and leaf

Our findings showed that contents of nitrogen and iron were similar at all soils and we did not observe significant differences among different soils (P>0.05; the data are not shown). Our findings also showed that at similar levels of nitrogenous fertilizer, nitrogen content was equal in leaves, but we observed significant differences among nitrogenous fertilizer for nitrogen and phosphorous but no potassium (Table 3). Treatment with iron fertilizer had not showed significant effect on iron content at the same level of iron (P>0.05). The tissue contents of nitrogenous and phosphorus were higher in soils fertilized with higher levels of nitrogenous (100) fertilizer compared with the control group. We also observed significant differences for iron and phosphorus of leaf tissue, so that the tissue levels of iron and phosphorus were higher in the soils fertilized with iron at 15 kg/ha compared with other levels (Table 4).

Effects of different levels of nitrogenous and iron fertilizers on mite population

Figures 1 and 2 show effects of different levels of nitrogenous and iron fertilizers on mite's population at different cultivars. The most population was found at

Table 10. Reproductive parameters of mites for rose cultivars in the presence of iron and nitrogenous fertilizers

Reproductive parameters	Rose cultivars and 'N' levels			Rose cultivars and 'Fe' levels		
	(Magic red)	(Polar star)	(Dolce vi*ta*)	(Magic red)	(Polar star)	(Dolce vi*ta*)
GFcR	149.44±1.19[a]	121.31±1.59[b]	100.89±1.13[c]	99.28±1.56[a]	91.80±1.12[b]	84.76±1.81[c]
NFcR	78.68±1.93[a]	77.70±1.66[ab]	70.43±1.69[b]	50.94±1.88[a]	48.78±1.25[b]	39.78±1.70[c]
GFrR	146.46±1.67[a]	117.67±1.93[b]	96.85±1.48[c]	95.31±1.56[a]	88.12±1.29[b]	80.52±1.40[c]
NFrR	77.10±1.44[a]	75.37±1.19[b]	67.61±1.16[c]	48.91±1.50[a]	46.34±1.73[b]	38.19±1.68[c]
Mean eggs per female per day	5.04±0.28[a]	3.87±0.24[b]	3.39±0.27[b]	2.37±0.15[a]	2.16±0.33[b]	2.09±0.25[c]
Mean fertile eggs per female per day	4.94±0.23[a]	3.25±0.21[b]	3.25±0.24[b]	2.27±0.12[a]	2.05±0.20[b]	2.00±0.28[b]

'a, b' and 'c' shows significant differences at per row (P<0.05).

soils fertilized with nitrogenous and iron fertilizers at high levels, 100kg/ha for nitrogenous fertilizer and 15 kg/ha for iron fertilizer and the lowest density was seen at low levels, control group for nitrogenous fertilizer and 5 kg/ha for iron fertilizer ($P<0.05$). Our findings also showed that the most population was found at MR cultivar and the lowest population was observed in DV cultivar (for both the fertilizers). Significant interactions were observed between nitrogen levels and rose cultivars ($P<0.05$) and also between iron levels and rose cultivars ($P<0.05$); showing that soil nitrogen and iron are related with mites population.

Our observation Table 5 showed that, embryogenesis period was not influenced by treatment with fertilizers (F_N=3.98; df_N=3,254; F_{Fe}=4.11; df_{Fe}=3,251; $P<0.05$), but other stages were affected by fertilizers (F_N=8.23; df_N=3,231; F_{Fe}=9.65; df_{Fe}=3,228; $P<0.05$). The most immature stages in mites were found at DV cultivar which was fertilized with both the fertilizers and the lowest was found in MR cultivar (under same condition). Under treatment with fertilizers, oviposition period, daily fecundity and total fecundity were higher at MR cultivar compared with other cultivars (Table 6). Generation time was higher in DV cultivar compared with other cultivars, under same condition (Table 7), but egg hatchability and immature mortality (%) were not affected at different cultivars. Sex ratio also was different at the all cultivars (X^2, $P = 0.05$).

Life table of mites

On the basis of our findings (Table 8), the most mortality, is for both the fertilizers, and were related. The mites reared on DV cultivar and the lowest was associated to mites raised on MR cultivar. Eggs survival, larvae survival, nymph's survival and adult's survival were higher at MR cultivar and were also lower for DV cultivar. Survival rate (l_x) for nitrogenous fertilizer was 29, 75 and 61%, and for iron fertilizer was 70, 73 and 63 for DV, PS and MR, respectively (Figures 3 and 4).

Age-specific mortality (q_x) was started at 2, 3 and 4 for nitrogenous fertilizer and was also started at 1, 2 and 3 for iron fertilizer. The age-specific mortality was started at later ages (Figures 5 and 6). The DV cultivar had lowest survival and the highest mortality; showing that this cultivar is not suitable for mites growth. The most survival and the lowest mortality was related to MR cultivar which showed that MR is the suitable cultivar for mite's growth. The analysis of other life parameters (R_0, r_m, T and DT) showed significant differences among cultivars, so that R_0, r_m and λ were highest for MR cultivar and were lowest for DV cultivar. Other parameters, T and DT were lowest for MR cultivar and were highest for DV cultivar; confirming previous findings.

Reproductive table

Gross Fecundity Rate (GFcR), Net Fecundity Rate (NFcR), Gross Fertility Rate (GFrR), Net Fertility Rate (NFrR), mean eggs per female per day and mean fertile eggs per female per day were different for rose cultivars, so that the most rates were related to MR cultivar and the lowest rates were related to DV cultivar (for the both fertilizers; Table 10).

DISCUSSION

As results showed MR had most density for spider mites and DV cultivar had lowest density for mites; showing that DV cultivar is the optimum host for spider mites. These results also showed that MR cultivar is a suitable cultivar for IPM program. Unfortunately, we could not find any study showing that rose cultivars have various resistances to mites. However, mites did not prefer DV cultivar, which may be related to some physical properties of DV cultivar, such as number of low leaf and low growth of DV cultivar. As mentioned before, the present study was conducted under greenhouse condition and it is well-known that mite's population increases at 12°C temperature and above. On the other hand, greenhouse, in our study, was suitable for

the increase of mite's population. Thus, the differences in density of mites related to rose cultivars. These differences are presenting antibiosis and antixenosis mechanisms.

Antibiosis is a biological process which is related to like survival, growth, generation time, fecundity and longevity of insects (Van Emden, 1997), but antixenosis process is related to the insect and plant factors. The quantity and quality of primary and also secondary plant metabolites are frequently related to antibiosis (Pedigo, 1999). Wrensch and Young (1978) have shown that plant quality could be influenced by mites population. The so called quality may include nutrition quality, tissue type, osmotic pressure, etc., (Kibritci and Kazak, 2004). Some characteristics such as poisoning substances, digestive reducer and nutritional balancer are different in difference plants; resulting in these factors may affect mite's population. Some researchers have believed that diet type is an influencing factor on productivity parameters of mites (Uckan and Ergin, 2002). Emden (1997) believed that morphological and biochemical properties of plants are efficient factors on mites and their enemies. Similarly, DV cultivar has antixenosis resistance. Secondary metabolites, nitrogenous, carbon, etc, efficiently influence herbivores (Emden, 1997). In this association, Zalom *et al.,* (1991) showed that some amino acids, inorganic nitrogen and phenolic compounds affect productivity parameters of mites. It is concluded that DV cultivar is a suitable choice for IPM program.

However, fertilizers, at high levels, efficiently increased mite's density (especially on MR cultivar). It may be related to changes in the nutritional values. Emden (1997) showed that alterations in nutritional values of plant can affect insect's population. We believed that iron quality, similar to nitrogenous fertilizer, can absorb mites. However, our study showed that fertilizers increase mites population and on the other hand, DV cultivar had lowest density. These findings confirm the use of DV for IPM program and also confirm its resistance. Thus fertilizers can be highly used for increasing the quality and quantity of DV cultivar.

Our observations showed that immature mortality was lower in DV cultivar and it was higher in MR cultivar (even for fertilizers). Survival parameters were higher for MR cultivar and were lower for DV cultivar; showing that MR is an optimum cultivar for mites' growth. Similarly, Adango *et al.* (2006) stated that immature mortality of *Tetranychus ludeni* was lower in *Amaranthus cruentus* compared with *Solanum macrocarpon*. The differences between these cultivars may be explained by plant quality, environmental factors, the needed food for mites and secondary metabolites (Tsaiand Wang, 2001). Other investigations have been shown that leaf age, feeding of host plant, compounds of leaf surface and secondary compounds can change density of mites (Skorupska, 2004; Pietrosiuk *et al.* 2003; Krips 1998).

Other findings for reproductivity parameters also showed that MR cultivar is an optimum cultivar for the reproduction of mites. Similar to other findings, DV cultivar is was not a suitable cultivar for mites and thus this cultivar is a suitable cultivar for IPM program. The net reproductive rate (R_0) and the intrinsic rate of natural increase (r_m) are main indexes of tetranychid population dynamics Krips *et al.* (1998). These parameters often provide 'm' the independent analysis of individual life history parameters (Zhang *et al.,* 2007). Because the population development of two-spotted spider mite was the shortest on MR cultivar. It may be explained by development time, an early peak in reproduction, high daily egg production and high total fecundity in MR cultivar. Najafabadi (2012) believed that fertilizers are responsible for the increase of R_0 and Razmjou *et al.*, (2009) showed that Sayyad cultivar was the most favorable host for two-spotted spider mites with r_m=0.295 and Talash cultivar with r_m=0.214 was an unfavorable host. Sabelis (1991) has been shown that r_m values of *T. urticae* were from 0.219 to 0.336. Ahmadi

et al. (2007) has also estimated r_m values from 0.038-0.142 females/female/day on common bean. In the present study, r_m values were ranged from 0.19-0.27. Ahmadi *et al*. (2007) reported that spider mites had r_m values between 0.220 and 0.340.

CONCLUSION

On the basis of our findings, iron and nitrogenous fertilizers increased density of mites. On the other hand reproductively and life parameters were higher for mites grown on MR cultivar. The DV cultivar had lowest indexes for mites and thus it has antibiosis and antixenosis resistance. It is concluded that DV cultivar is optimum for IPM programs.

REFERENCES

Etienne Adango, Alexis Onzo, Rachid Hanna, Pierre Atachi and Braima James. 2006. Comparative demography of thespider mite, *Tetranychus ludeni,* on two host plants in West Africa. *Journal Insect Science*, 6 (49): 1536-1545.

Ahmadi M, Fathipour Y and Kamali K. 2007. Population growth parameters of two spotted spider mite, *Tetranychus urticae* (Acari: Tetranychidae) on different bean cultivars. *Journal of Iranian Entomological Society,* 22: 1-10.

Barbour JD, Farrar RR, Kennedy GG. 1991. Interaction of fertilizer regime with host plant resistance in tomato. *Entomologia Experimentails et Applicata,* 60 (3): 289-300.

Bernays EA. 1990. Insect-plant Interactions VII. Florida: CRC Press. 176 P.

Birch LC. 1948. The intrinsic rate of natural increase of an insect population. *Journal of Animal Ecology* 17(1): 15-26.

Carey JR. 1993. Applied demography for biologist with special emphasis on insects. U.K. Oxford University Press. 222 Ps

Conway GR. 1997. The doubly green revolution: Food for all in the 21st Century. New York: Cornell University Press. 352 P.

Conway GR and Pretty JN. 1991. Unwelcome harvest: agriculture and pollution. London: Earth scan Publications Ltd, 672 P.

Horn WAH. 1992. Micropropagation of rose (*Rosa* L.). In: Bajaj Y.P.S. (ed.) Biotechnology in agriculture and forestry, Springer, Berlin, 20: 320–342.

Khalilmanesh B. 1972. Fauna of mites of Iran. *Journal of pest and disease plants*, 35: 30-38.

Cemal Kibritci and Cengiz Kazak. 2004. Population development of *Tetranychus cinnabarinus* Boisd. (Acarina: Tetranychidae) on various strawberry cultivars under greenhouse conditions in Adana-Turkey. *Phytophaga*, 14: 533-539.

Kim CK, Chung JD, Jee SO and Oh JY. (2003). Somatic embryogenesis from *in vitro* grown leaf explants of *Rosa hybrid* L. *Journal of Plant Biotechnology,* 5 (3):169-172.

Krips OE, Witul A, Willems PEL and Dicke M. 1998. Intrinsic rate of population increase of the spider mite *Tetranychus urticae* on the ornamental crop gerbera: intraspecific variation in host plant and herbivore. *Entomologia Experimentails et Applicata,* 89(20):159-168

Maia AHN Ade H, Luiz AJB and Campanhola C. 2000. Statistical inference on associated fertility life table parameters using jackknife technique: computational aspects. *Journal of Economic Entomology,* 93(2): 511-518.

Joseph S Meyer, Christopher G Ingersoll, Lyman L

McDonald and Marks S Boyce. 1986. Estimating uncertainly in population growth rates: jackknife vs. bootstrap techniques. *Ecology*, 67(5): 1156-1166.

ModarresNajafabadi SS. 2012. Resistance to *Tetranychus urticae* Koch (Acari: Tetranychidae) in *Phaseolus vulgaris* L. *Middle-East Journal of Scientific Research,* 11(6): 690-701.

Zahra MojibHaghghadam and Masoud Arbabi. 2012. Study of Mites' fauna and their natural enemies on the ornamental plants in greenhouses of Guilan and West Mazandaran province. *International Journal of Agriculture and Crop Science*, 4 (11): 674-679.

Pedigo LP. 1999. Entomology and pest management. Prentice Hall Inc., New Jersey, USA. 646 P.

Pietrosiuk A, Furmanowa M, Kropczysnka D, KawkaB and Wiedenfeld H. 2003. Life history parameters of the two-spotted spider mite (*Tetranychus urticae* Koch) feeding on bean leaves treated with pyrrolizidine alkaloids. *Journal of Applied Toxicology,* 23(3): 187-190.

Razmjou J, Vorburger C, TavakkoliH and Fallahi A. 2009. Comparative population growth parameters of the two-spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), on different common bean cultivars. *Systematic and Applied Acarology,* 14(2): 83-90.

Sabelis MW. 1991. Life-history evolution of spider mites. In: Schuster R and Murphy PW. (eds.). The acari reproduction, development and life-history strategies. London, Chapman and Hall, 23-49 P.

Simpson SJ and Simpson CL. 1990. The mechanisms of nutritional compensation by phytophagous insects. In: Bernays EA .Insect-plant Interactions, New York: CPC Press, Inc. 2: 111-160.

Skorupska A. 2004. Resistance of apple cultivars tospotted spider mite, *Tetranychus urticae* Koch (Acarina, Tetranychidae) Part II. Infeluence of leafepubescence of selected apple cultivars on fecundityof two-spotted spider mite. *Journal of Plant Protection Research,* 44(1): 69-74.

Southwood TRE. 1973. The insect/plant relationship – an evolutionary perspective. In: Emden FV. Insect-plant relationship. Symposia of the Royal Entomological Society of London. No 6. Oxford: Blackwell, 3-30.

James H Tsai and Jin-Jun Wang. 2001. Effect of host plants on biology and life table parameters of *Aphisspiraecola*. *Environmental Entomology,* 30(1): 44-50.

Uckan F and Ergin E. 2002. Effect of host diet on the immature developmental time, fecundity, sex ratio, adult longevity and body size of *Apanteles galleriae* (Hymenoptera: Braconidae). *Environmental Entomology,* 31(1): 168-171.

Van Emden HF. 1997. Host plant resistance to insect pests. In: D Pimentel (ed.) Techniques for Reducing Pesticide Use. John Wiley and Sons, Chichester, UK, 129-152 P.

Dana L, Wrensch and SSY Young. 1978. Effect of density and host quality on rate of development, survivorship and sex-ratio in carmine spider mite. *Environmental Entomology,* 7: 499-501.

Zalom FG, Phillips PA and Toscano NC. 1991. UC IPM pest management guidelines: Strawberry, insects and mites. http://www.ento.vt.edu/Fruitfiles/Strw2Spotted.html

Zhang ZJ, Wu QJ, Li XF, Zhang YJ, Xu BY and Zhu GR. 2007. Life history of western flower thrips, *Frankliniella occidentalis* (Thysan, Thripidae), on five different vegetable leaves. *Journal of Applied*

Entomology, 131(5): 347-354.

Zhang ZQ. 2003. Mites of greenhouses, Identification biology and control the natural history museum, London, UK.CBAI pub. 244 P.