The effects of cultural management on the Date spider mite (*Oligonychus afrasiaticus* McG) infestation

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**ABSTRACT:** The Date spider mite is one of the major pests of date palm in Iran. This research has been carried out in Khuzestan province for evaluating the effects of cultural practices on reducing the Date spider mite infestation. Incidentally cluster-sampling and survey research method applied in this experiment. Sampling society divided to 30 plots then one sample was selected randomly in each plot. 15 trees were selected randomly in each plot and their infestations were evaluated. Different cultural management factors including tillage, fertilizing, irrigation, pruning, chemical control, bunch covering and bunch arrangement were evaluated questionarily. Correlation analysis had been done then management factors that had significant correlation with pest infestation used for multiple regression analysis. Based on correlation analysis intercropping, chemical control, weed control, tillage, bunch covering and bunch remain pruning had suitable effects on decreasing of the Date spider mite infestation. Multiple regression analysis showed that the effect of intercropping, weed control, chemical control, bunch covering, irrigation, tillage and bunch remain pruning increased respectively and sum of effects decreased the pest infestation. The ultimate formula of the model is %infestation= 2.75-1.35cc-0.48wc-0.29brp-0.26ic-0.16bc-0.17t(R2=66.21and Durbin-Watson statistic=1.49).Integrated effects of tree factors are better than the effects of them alone.

**Keywords:** Date palm, The Date spider mite, cultural management

**INTRODUCTION**

The “Date or Dust Mite” *Oligonychus afrasiaticus* (fam.: Tetranychidae) is an important pest of the date palm, particularly in fruit stage and renders the crop totally unmarketable in heavy-infestation areas. It attacks the dates from their early stages of development, spinning its webs around the date bunches and multiplies in big numbers. Dust collects in the webs plus the exuviate of the different development stages of the mite making the date bunches look dusty. It feeds on the juices that sucks from the dates, rendering them unfit for human consumption. In Iraq, Dawson and Pansiot (1965) and Gharib (1976) stated that the mite, *Paratetranychus afrasiaticus* McG. infested date fruits and that inflicted serious damage on the quality of dates. Saleh and Hosny (1979) in Egypt, noticed that *Oligonychus* spp. were the common acari pests of date palms in Kharga Oasis. Kadjabf and Kamali (1993) in Iran, reported that the old world mite, *O. afrasiaticus* was a serious pest of dates in Khuzestan. Also, Palevsky . (2004) in Israel, found that the date mite, *O. afrasiaticus* was the dominant spider mite pest of date fruits in the Southern Arava Valley. In Saudi Arabia, Al-Jabr . (2001) revealed that the spider mite, *Tetranychus* sp. and the dust mite, *O. afrasiaticus* were the most abundant mite species which infested the bunches and leaflets of the tested date palm cultivars. Finally, the date mite infesting date fruits spins the fine web, which collects dust, and with heavy infestation the colour of branches turns black. Heavily infested dates are unmarketable and rejected as human food.
The bionomics of such mite has not thoroughly studied; however, Hussain (1969) reported that it has 6 generations/year, its peak infestation in Iraq occurs around the middle of July and that it prefers dryer areas. The infestation of this mite usually starts around mid-May to June when it builds dusty, creamy silken webs on date bunches around strands and date fruits, where adults and immature live. Dust and sand grains adhere to the webs on date fruits making the environment under such webbing suitable for reproduction, development and survival of mites. (Hussain, 1974; De Montaigne and Fall, 1986; Guissoum, 1986). Not only climatic conditions seem to be the cause for the distribution of tetranychid mites, but it also appears to be a response to food shortage (Helle and Sabelis, 1985; Margolies and Kennedy, 1985; Frilexner, 1991). Previous results revealed that performance of O. afrasiaticus varied greatly depending on the chemical composition of fruits (Palevsky, 2005; Aldosari and Ali, 2007; Ben Chaaban and Chermiti, 2009). In fact, the fruit infestation begins and increases during the Kimri stage, characterized by the green colour of fruit, rapid increase in size, weight, and reducing sugars. At this stage, moisture content and acid activity are at the highest (Barreveld, 1993; Palevsky, 2005; Aldosari and Ali, 2007; Ben Chaaban and Chermiti, 2009). Mite populations begin to decline with colour change of fruit to yellow or red at the khalal stage. Different methods were recommended for controlling of the pest (Buxton, 1921, Dowson, 1982, Gharib, 1990, Zaid, 1999) but the usage of cultural control method is reduced by pesticide application. It is the most ancient control method. Nowadays, pronounced understanding of biological relationships, social condition and restriction of pesticide application in date orchards resulted attention to the cultural control strategies again. The cultural control is covered under the following headings and subheadings: organization of crops (multiple cropping or intercropping; monoculture); soil management (preparation; amendments and fertilizers); water management; crop management (place and date of sowing; sowing density; transplantation; earthing up, staking and pruning; cover crops; living barriers; weed management); and postharvest management (Brar, 1996).

Date palm orchards tillage is common in Iran that it performs once / twice per year. Chemical and manure fertilizers were used for date palm fertilizing. Chemical fertilizers were used based on soil experiment and manure disseminated and mixed with soil around of date palm trees. Date palm orchard irrigation performs as ebb and flow, superficial. Pruning of date orchards was done for annihilating dead and injured tissues. Five kinds of pruning are common in Iran date orchards including: Leaf pruning, midrib pruning, prickle pruning bunch remained pruning after harvesting and offshoot pruning (Dowson, 1982). Significant changes could be achieved in the date palm industry through the implementation of advanced cultural practices and dependable means of pest control. Improvement of date palm requires full understanding of all of the important cultural practices and the effects of them on date pests. This article is about the effects of cultural practices on reducing the Date spider mite infestation. These cultural practices include pollination, pruning, irrigation, fertilizing, tillage, bunch covering, bunch arrangement and chemical control.

**MATERIALS AND METHODS**

Incidentally cluster-sampling method was applcicated in this experiment (Dowson, 1982). At first, Sampling society divided into 30 plots then one sample was selected randomly in each plot in Khuzestan province for two years. Based experiment method was survey research (Dangerfield 1999). Data were collected by two methods that including:

**Estimation of the date spider mite infestation:**

Macheak method (Machacek, 1949) was used for estimating of pest infestation. 15 trees were selected randomly in each orchard then percentages of infestations were evaluated based on table 1.

<table>
<thead>
<tr>
<th>Infestation quality</th>
<th>Selective code</th>
<th>Infestation amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>No infestation</td>
<td>0</td>
<td>0 percentage</td>
</tr>
<tr>
<td>Little infestation</td>
<td>1</td>
<td>0-25 percentage</td>
</tr>
<tr>
<td>Mean infestation</td>
<td>2</td>
<td>25-50 percentage</td>
</tr>
<tr>
<td>Much infestation</td>
<td>3</td>
<td>50-75 percentage</td>
</tr>
<tr>
<td>Too much infestation</td>
<td>4</td>
<td>Up to 75 percentage</td>
</tr>
</tbody>
</table>

Infestation percentage of each tree was evaluated as:

\[
\text{% Infestation} = \frac{(a + 2b + 3c + 4d)}{n}
\]

a= Number of bunch with little infestation  
b= Number of bunch with mean infestation  
c= Number of bunch with much infestation  

d= Number of bunch with too much infestation
n= Total number of bunch in each trees
Infestation percentage of each orchard was evaluated based on 15 trees. The pest injury is a biological index that indicated on its infestation percentage (Southwood, 1975).

**Estimation of cultural management factors:**

Different cultural management factors were evaluated questionnaire by orchard survey, interview with date gardener and agriculture service centers. Cultural management factors including tillage, fertilizing, irrigation, pruning, chemical control, bunch covering and bunch arrangement.

**Analysis:**

Data had been analyzed by multiple regression. As matter of fact the date spider mite infestation was evaluated as dependent factor and other factors that sponsored on research theories as independent factors. Correlation analysis had been done before multiple regression then management factors that had significant correlation with pest infestation used for regression analysis

**RESULTS AND DISCUSSION**

**RESULTS**

**Correlation relationship between the infestation and management factors:**

The effects of performance / nonperformance of cultural management on pest infestation were studied by correlation relationships that their results pointed to fig1.

![Figure 1](image)

**Correlarogarm of relationship between the Date spider mite infestation and cultural management factors**

The effects of cultural management factors graded as:

- $R<0.5$ weak effect
- $0.5<R<0.7$ suitable effect
- $0.7<R<1$ powerful effect

In addition, the negative and positive signs pointed to decreasing and increasing effects of cultural management factors on the pest infestation respectively. Based on that intercropping, chemical control, weed control, tillage, bunch covering and bunch -remained pruning had suitable effects on decreasing of the Date spider mite infestation

**Integrated effects of cultural management factors:**

Integrated relationship between significant correlated factors with pest infestation was studied by multiple regression analysis that its results pointed in table 2 and 3.

<table>
<thead>
<tr>
<th>Factors</th>
<th>B</th>
<th>Standard Errors</th>
<th>t</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.75</td>
<td>0.19</td>
<td>14.78</td>
<td>-</td>
</tr>
<tr>
<td>Chemical control(cc)</td>
<td>-1.35</td>
<td>0.23</td>
<td>5.81</td>
<td>0.001</td>
</tr>
<tr>
<td>Weed control(wc)</td>
<td>-0.48</td>
<td>0.20</td>
<td>2.42</td>
<td>0.001</td>
</tr>
<tr>
<td>Bunch remain pruning (brp)</td>
<td>-0.29</td>
<td>0.19</td>
<td>1.71</td>
<td>0.009</td>
</tr>
<tr>
<td>Intercropping(ic)</td>
<td>-0.26</td>
<td>0.12</td>
<td>1.32</td>
<td>0.001</td>
</tr>
<tr>
<td>Bunch covering(bc)</td>
<td>-0.16</td>
<td>0.11</td>
<td>0.91</td>
<td>0.001</td>
</tr>
<tr>
<td>Tillage(t)</td>
<td>-0.17</td>
<td>0.20</td>
<td>0.76</td>
<td>0.002</td>
</tr>
</tbody>
</table>
According to table 2, the effect of intercropping, weed control, chemical control, bunch covering, irrigation, tillage and bunch remain pruning increased respectively.

Table 3. Analysis variance of multiple regression models

<table>
<thead>
<tr>
<th>Factors</th>
<th>Df</th>
<th>Ss</th>
<th>Ms</th>
<th>F</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>4</td>
<td>32.23</td>
<td>5.54</td>
<td>17.31</td>
<td>0.0001</td>
</tr>
<tr>
<td>Residue</td>
<td>55</td>
<td>14.95</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>50.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R^2=66.21$
Durbin-Watson statistic=1.49

According to table 3, the model is significant at 1% and sum of the processes have decreased effects on pest infestation. The ultimate formula of the model is:

\%
infestation= 2.75-1.35cc-0.48wc-0.29brp-0.26ic-0.16bc-0.17t

**DISCUSSION**

**Chemical control:**

Chemical control is done in mid to late June. Too high palm trees will reduce the efficiency of chemical control. The efficiency of the factor is low ($r=-0.59$) because resistance to insecticides and low efficiency of sprayers. In several areas, control of *O. afrasiaticus* populations is done mainly by sulfur (Coudin and Galvez, 1976; Guessoum, 1986; Dhouibi, 1991; Djerbi, 1993; Palevsky , 2004). Similar programs have been conducted in California for many years for the control of the new world date mite *Oligonychus pratensis* (Banks) (Carpenter and Elmer, 1978). Mite damage was higher on palms that had their fruit bunch infestation was not prevented by glue barriers or dense netting. Indigenous phytoseiids were not found on fruit between mid-July till the end of August, when pest populations peaked. In contrast, a single treatment with the acaricides fenbutatin oxide, hexythiazox or abamectin, applied when the first mites were found on the fruit, provided seasonal pest control (Al Doghairi, 2004).

**Weed control:**

Literature reported that the dust mite migrates to rejections, fibres, palms, inflorescence, male date palms and infertile date palms, on grasses as *Cynodon dactylon* L. and *Lolium* sp. (Hussain, 1969; Guessoum, 1986; Dhouibi, 1991; Palevsky, 2003). Also moving on cucumber, watermelon, fig, grapevine (Guessoum, 1986). Therefore, weed control groves important role in the dynamics of populations and reduce the damage that is being disrupted. Different herbicides viz. diuron, glyphosate, atrazine, gramoxone alongwith hand weeding and cultivation was conducted to control the weeds in date palm. The herbicide sprays were repeated at six months interval. All the herbicides brought about a significant reduction in weed population over control. Treatment diuron followed by glyphosate was the most effective among all the herbicides used which killed 80.24 per cent monocot and 82.12 per cent dicot weeds over control. No phytotoxic effects were observed on date-palm trees with any of the herbicides used.

**Bunch remained pruning:**

Some of the Date spider mite hibernated population overwinter on bunch remain and transfers to warehouse by infested fruits. So bunch remained pruning decreased overwintering locations and therefore, pest population will be reduced on future generations.

**Tillage:**

Populations of *O. afrasiaticus* responds to the decrease of temperature in autumn, by leaving dates bunches and migrating to the pinnae and ground cover. Plowing around trees shading an important role in creating an imbalance in the dynamics of date palm spider mite populations.

**Bunch covering:**

The Date spider mite migration on bunch is prevented by bunch covering and reduced the pest damage. Also, the factor reduces the wasps and birds damages. During May and June, fewer or no motile forms were detected crawling towards bunches. But despite this, there were infestations of fruits. Mites infest dates by not reaching stalks coming from fronds but by airborne infestation. Similar results were founded by Palevsky . (2004), they demonstrated
that fruit bunch infestation was not prevented or even alleviated by glue barriers or dense netting covering bunches. Gispert , (2001), who studied the temporal and spatial distributions of O. pratensis on Deglet Noor, showed fruit bunch infestation to be generally clumped, with heavily infested bunches being adjacent to non-infested ones, and suggested that infestation resulted from random arrivals of individual mites. In the case of O. afrasiaticus and O. pratensis, even one mated female is enough to establish a colony that will rapidly infest an entire bunch (Gispert ., 2001; Palevsky ., 2004).

**Irrigation:**

Date palm tree is usually irrigated by basin method, delivering an abundant amount of water based primarily on a farmer's experience. The annual water requirements for a mature date palm range between 115 and 306 cubic meters (1.15 - 3.06 m/ha) (Al-Baker, 1972). Greater heat and a midsummer drought caused O. afrasiaticus population growth in fruits. Monthly mean temperatures of 32 °C in July and August in Tozeur seemed to be very favourable for an increase in the pest mite population according to a life table study (Ben Chaaban ., 2008). The decreased in water content with elevated sugar contents at this stage, render the date extremely resistant to O. afrasiaticus (Palevsky ., 2005; Aldosari and Ali, 2007; Ben Chaaban and Chermiti, 2009). Regular watering with decreasing temperature and increasing humidity has a significant role in reducing pest populations.

**Intercropping:**

An important aspect of intercropping systems is their ability to reduce the incidence of pests and diseases. However, this is a very complex aspect and both beneficial and detrimental effects have been observed. Indeed, components of intercrops are often less damaged by various pest and disease organisms than when grown as sole crops, but the effectiveness of this escape from attack often varies unpredictably (Bucher, 1970; Trenbath, 1993; Javanshir, 2000). Generally any type of crop can be used for intercropping. Forage crops are the common crop which are cultured between date palm lines in Khuzestan province. In this system not only there are not any competition between crops and trees but also provide economy benefit in early years of horticulture establishment. Forage selection for intercropping depends in some factors such as economy aspect, soil fertility, land equality ratio, environment condition, and crop cooperation. Intercropping with the increasing diversity of natural enemies and adjust environmental conditions have the highest impact on the pest population is reduced.

**Integrated effects:**

Integrated effects of six factors are better than application each of them alone and reduce the pest damage below of the economic injury level.

Studies about other pest showed similar results. Cultural practices have great potential for developing integrated management schemes to control Bemesia tabaci. Some of the most promising practices are crop-free periods, planting dates, crop rotations, crop residue disposal, weed destruction, seedbeds covered with fine netting, floating covers, high planting densities, living barriers, ground covers, companion crops and sprinkler irrigation (Hilje 2000). The effect of different combinations of three cultural practices (shredding, burning and conventional tillage) on the carryover population of hibernating larvae of Scirpophaga incertulas in a rice-wheat system was observed in Ludhiana, India, during 1992-93 and 1993-94. The mean number of larvae and percentage of tiller infestation were significantly less in the combinations of cultural practices having conventional tillage as a component than those having no tillage. Furthermore, the combination of conventional tillage with shredding proved superior in reducing the carryover of hibernating larvae compared with all the other treatments (Brar 1996).

Field studies were carried out during 1995-96 in Egypt to investigate the influence of sowing date, water regime and spacing after transplanting on Hydrellia prosternalis incidence in rice (Sherif 1997). Farmers' insect management practices on tomato in Dalat, Vietnam, were evaluated by a formal survey of farmers, agricultural officers and extension officers between January to March, 1997. The results showed that cultural insect control practices were primarily chemical, followed by cultural practices and physical removal.

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