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Study the Effects of Dusts Phenomenon on Date Palm Important Pests and Diseases

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Abstract: **The lesser moth (*Batrachedra amydraula*. Myer), spider mite (*Oligonychus afrasiaticus* (McGregor), date bunch fading and Khamedje disease (*Mauginiella scaettae* Cavara) are important injurious factors of date palm. This research has been carried out in Abadan region from 2001 to 2009 for 9 years. The aim of this research was study the effects of dust phenomena on date palm pests and diseases severity. Samples were taken monthly from 10 trees located in four different date palm orchards of four villages. The climatic data including maximum distance vision, the number incidence and the gravity of phenomena were obtained from Abadan meteorology station. Results showed that the injurious factors damages started at March and increased gradually by increasing temperature and relative humidity of weather so that the lesser moth, spider mite, date bunch fading and Khamedje disease injuries reached to the peak values in July, June, July, September and April respectively. The Dust phenomena indicators showed moderate to strong correlation with occurrence of studied pests and diseases. So that the dust phenomenon had significantly increased effects on the incidence of Date bunch feding and spider mite. The dust phenomena effects model for forecasting the lesser moth, spider mite, bunch feding and Khamedje disease were significant at 5, 1, 5 and 1 percent level respectively. All of the forecasting models had coefficient higher than 0.6 and the detection error less than 25 percent for spider mite and Khamedje disease and more than 25 percent for the lesser moth and bunch feding. The dust phenomenon had the highest increasing effects on the incidence of the spider mite (33.49) and the lowest effect on the lesser moth (3.77).**

Keywords: **Date, Injurious Factors, Dust.**

I. INTRODUCTION

Dust phenomenon is a seasonal meteorological phenomenon which affects much of Middle East sporadically during the summertime months. The dust originates in the deserts of Seudi Arabia, Iraq and Iran where high-speed surface winds and intense dust storms kick up dense clouds of fine, dry soil particles. In the last decade, it has become a serious problem due to the increase of industrial pollutants contained in the dust and intensified desertification in Iran, mainly for Date palm plantations [1].

The dust phenomenon has positive or negative effects on ecosystems. Dust storm effects divided into two groups as environmental and human. The effects of dust phenomenon on livestock production, agriculture, vegetation, and soil have been studied. Dust particles reduced plants production efficiency with decreasing plant photosynthesis and respiration. Some specific diseases and allergies were intensified by dust phenomenon [12].

In recent years Iran is a leading Country in the world, with annual production of 900000 metric tons from 218000 ha.of cultivated Land. Date palm s grown mainly in South, South East, and South West of the country, and with less important in central of Iran. The main producing areas in Iran are Hormozgan 21.6%, Khusistan17.6%, Bushehr13.4%, Beluchistan 12.2%, Fars12.3% and Kerman 21.1%. The date palm is dioeciously, that is, there are both male and female palms, the mail bearing only pollen and the female bearing the fruit. Date palms were attacked by more than 40, 24 and 16 species of pests, diseases and weeds respectively. The importance of those pests differs depending on date palm cultivars grown, agricultural practice, and geographical distribution of palm plantations. Pests, diseases and weeds of date palm cause decrease in production and quality of dates in the world [5], [21].

Hot- dry winds along with dust had damaging effects on Date palm (*Phoenix dactylifera* L.). This phenomenon has caused irreparable direct and indirect damage to date palm by increased severity of pests and diseases in Khuzestan province of Iran [10]. The wind carried and pasted dust and sand in the date palm fruits in the fruit softening stages (dates and Themar). The tight black spots were appeared on Date fruits by their tail wind and erode fruit clusters in the early stages of Date fruit growth (Hbabok). Strong winds break the tail clusters and disruption to nutrient transport into the clusters and causing them to be drying up. Wind can be transferred dusty Date mite (*Oligonychus afrasiaticus* McGregor) from one palm to anothers. Date dusty mite product very sticky and dust absorber. The infected fruits to this pest is highly dusty and therefore. Date growers called it dust. Date bunch feding is a Date palm disorder caused by environmental conditions such as hot, dry and dusty winds [16]. Pre-harvest fruit rots are intensified by the dust phenomenon. Date palm fruit rot is worse in rainfall, high humidity and dust phenomena condition during the ripening stages. The dust phenomenon will be considered the most important problems of Date growers in the research region if palm fruit rot control costs are added to the other economic losses of damages fruit [10].

Investigation the effects of dust phenomenon on the important date's pests and diseases severity such as the lesser date moth (*Batrachedra amydraula* Myer), dusty palm mite (*O. afrasiaticus*), inflorescence rot (*Mauginiella scaettae* Cav) and bunch feding were very necessary in the Khuzestan province. So providing methods to forecasting of the effect of dust intensity on the care palm network management is very basic.

II. Material and Methods

Time and place of conducting research

This study had been conducted during 2001 to 2009 for 9 years in Abadan city of Khuzestane province of Iran (Fig1). The studied region climate is dry desert with average rainfall of 139.8 mm, which mostly occurs in autumn and winter. The temperature has been over 45 °C for 60 days. Monthly average maximum temperature id of 54 °C in July. Evaporation rate of more than 4500 mm per month.

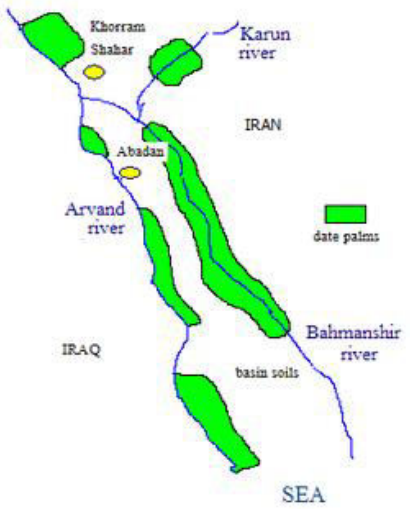


Fig 1- Date palm plantations in studied region (Abadan, Khuzestan, Iran)

The dust phenomenon data

Dust local meteorological station data were used for simulating the models [4], [19]. The phenomenon data include maximum distance visibility and number of occurrences that collected monthly throughout the year. The severity of the phenomenon was estimated using equation 1.

$$GI = [Log \frac{1}{D_{max}}].N \qquad (1)$$

In equation, the severity of phenomenon GI, maximum horizontal visibility D_{max} and N is the number of occurrences. 12 index for dust phenomenon were defined by using weather station data and applicate in the simulation [9], [15] (Table 1).

Table 1- Dust phenomenon parameters used in the simulation

Parameters	Symbol
maximum annual severity	H_1
total annual occurrence	H_2
total severity of first quarter months	H_3
total severity of second quarter months	H_4
maximum severity of the first quarter	H_5
maximum severity of the second quarter months	H_6
total number of annual occurrence	H_7
maximum number of monthly occurrences	H_8
total number of occurrences of the first quarter	H_9
total number of occurrences of the second quarter	H_{10}
maximum number of first quarter occurrences	H_{11}
maximum number of second quarter occurrences	H_{12}

Identification studied pests and diseases

A- Khamedj disease

The first visible symptom of the disease appears on the external surface of unopened spathes and is in the form of a brownish or rusty-colored area. It is most apparent on the internal face of the spathe where the fungus has already begun to infect the inflorescence. When the infected spathes split, they reveal partial or complete destruction of the flowers and strands. Severely damaged spathes may remain closed and their internal contents may be completely infected. The inflorescences become dry and covered with powdery fructifications of the fungus (Fig 2a).

B- The lesser Date moth

This pest injured fruits usually fall, although the stout webbing spun by the larvae attaches some of fruits to the stands or to other fruits before perforation. The larva enters the fruit by making a small hole near the calyx and then feeds on the pulp and immature seed. A larva seldom eats more than a third of the fruit before it seeks another one and may damage three or four fruits during its life time. The larvae that attack fruit just before ripening leave and debris, so that affected fruit must be culled (fig 2b).

C- The spider Date mite

This mite attacks the date palm fruits on the early developmental stages. Its adults and nymphs suck the sap of immature green date fruit causing severe fruit scarring, distorting, turn date to brown with scabbed appearance. The skin of infested fruit become hard and then cracks and shrivels. In spite of its direct feeding this mite spins its webs around the date palm bunches and multiplies in big numbers. Dust and/or sand granules accumulate on infested bunch and turn fruits to dusty appearance unfit for human consumption (Fig 2c).

D- Date bunch feding

The symptoms of disorder are suddenly wilting fruit and clusters, drying fruits, sometimes brown stripes on the upper or lower tail cluster (Fig 2d).

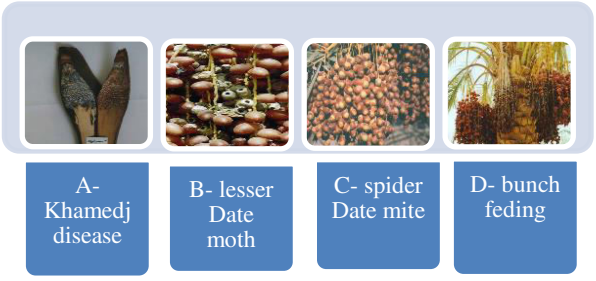


Fig 2- Symptoms of date palm pests and diseases

Estimation of pests and diseases infestations

Macheak method [12] was used for estimating of pest infestation. 15 trees were selected randomly in each

orchard then percent of infestation was evaluated based on table 2.

Table 2- Estimation of the pests and diseases infestation

Infestation quality	Selective code	Infestation amount
No infestation	0	0 percent
Little infestation	2	1-25 percent
Mean infestation	3	26-50 percent
Much infestation	4	51-75 percent
Too much infestation	5	> 75 percent

Then infestation percent of each tree was evaluated as equation 2:

$$\%infestation = \frac{a+2b+3d+4d}{n} \quad (2)$$

a= Number of bunch or trees with little infestation
b= Number of bunch or trees with mean infestation
c= Number of bunch or trees with munch infestation
d= Number of bunch or trees with too much infestation
n= Total number of bunch or trees in each trees

Infestation percent of each orchard are evaluated based on 15 trees. Pest and disease injury was a biological index that indicated on its infestation percent [20].

Simulation modeling effect of dust phenomenon on pests and diseases injury severity

The multiple regressions function were used to simulate the relationship between maximum pests and diseases injury and dust phenomenon. Among the 12 factors defined in the Table 2, each of them which they had significant correlations with the dust phenomenon of regression were applied to simulate models. The stepwise multivariate regression analysis method was used because one the basic conditions of the model suitability is simplicity. This method can reduce the number of factors in models. Statistical software was applicate for Statistical analysis and simulation models [7], [11], [17]. Resonance index injury of each studied pests and diseases were calculated by using Equation 3 and the ultimate model.

$$PRC = \sum_{i=1}^{n} B_i - C \quad (3)$$

In equation, the correlation index injury resonance of studied pests and diseases PRC, the coefficients of the variables in the final model parameters Bi and the constant of model is C [14], [18].

III. Results and Discussion

Seasonal fluctuations of dates fruit injurious agents

The lesser date moth

Pest damage has started in April and gradually the severity increasing each year by temperature and relative humidity adding (Fig 3). The pest damage reach to maximum in June and July, and then gradually decreased. In September, along with overwintering larvae, damage also stopped.

The date spider mite

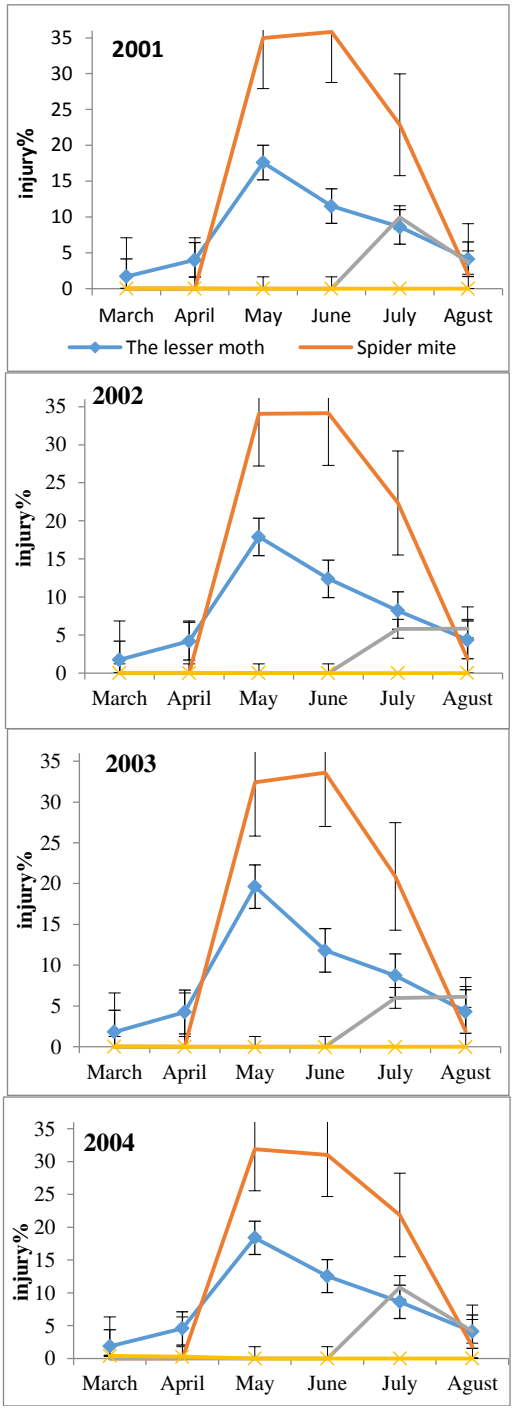
Pest damage has started in June and gradually the severity increasing so that it reach to maximum in July (Fig 3). In August, along with ripening date fruits, damage also stopped.

Khamedje disease

Disease damage has started in February and gradually the severity increasing each year by increasing spathe appearing (Fig 3). So that it reach to maximum in March.

The Date bunch feding

Disorder damage has started in August and the severity increasing suddenly by iterance fruit phenology from Kharak to Rotab (Fig 3). So that it reach to maximum in August.



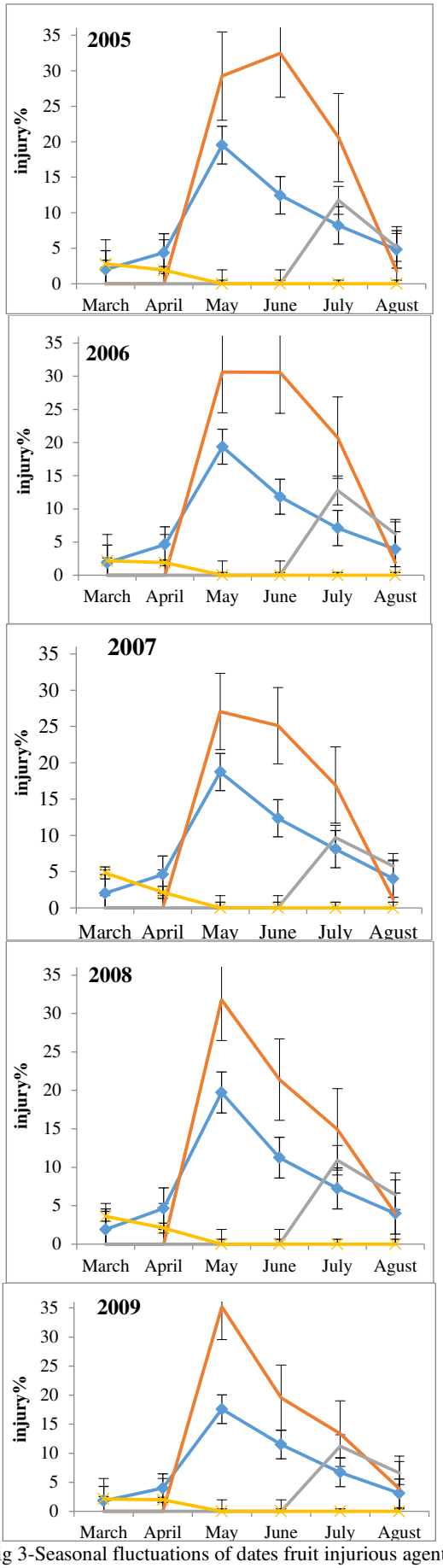


Fig 3-Seasonal fluctuations of dates fruit injurious agents

Seasonal variations dust phenomenon

Abadan region was confronted with the dust phenomenon since 2000. This phenomenon happened 10, 11, 9, 12, 19, 31, 55, 59, in 58 episodes in the years 2001, 2002, 2003, 2004, 2005. 2006, 2007, 2008 and 2009 respectively. Average monthly changes in the phenomenon dust have been recorded in Figures 4 and 5 in Abadan during the years 2001-2009. Although dust phenomenon began in 2001, but its intensity has been increased from 5 years ago.

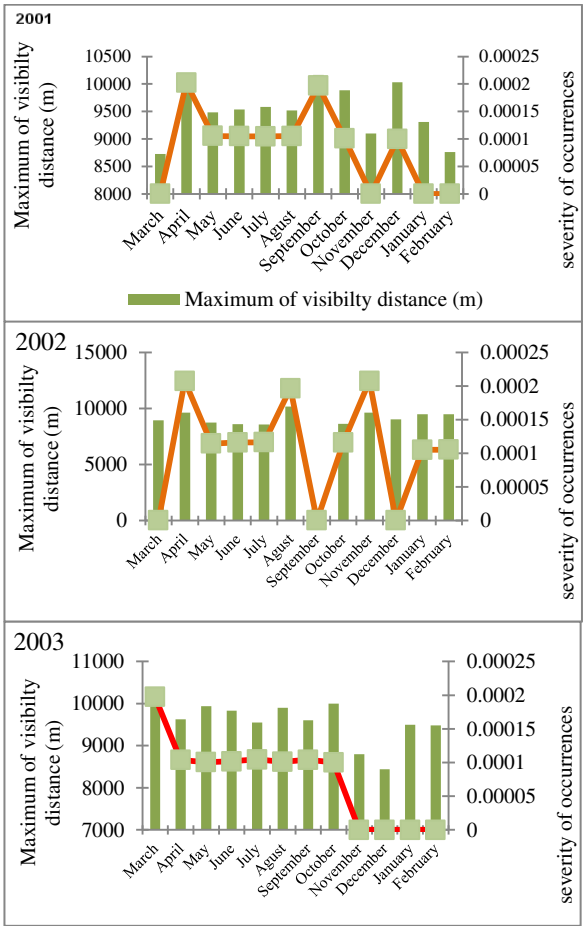
The peak of dust occurred in April, June, September, and October, respectively, to coincide with the Khamdje disease, Spider mite and bunch feding. The occurrence of phenomenon synchronized with Spider mite life cycle and thus it affected pests damaging capable more than others.

The effects of dust on the injury severity model

Step one: Check the correlation

The correlation analysis showed that between the lesser moth with parameters H_1, H_2, H4, H_9 and H_{11}, spider mite with parameters H_1, H_7 and H_{10}, bunch feding with parameters H_2, H_4, H_5, H_6 and

H_7 Khamedje with parameters H_1, H_2, H_3, H_5 and H_{11} had moderate to strong correlation. Therefore, these parameters can be used to simulate the effects of pests and diseases severity damage on dust condition.



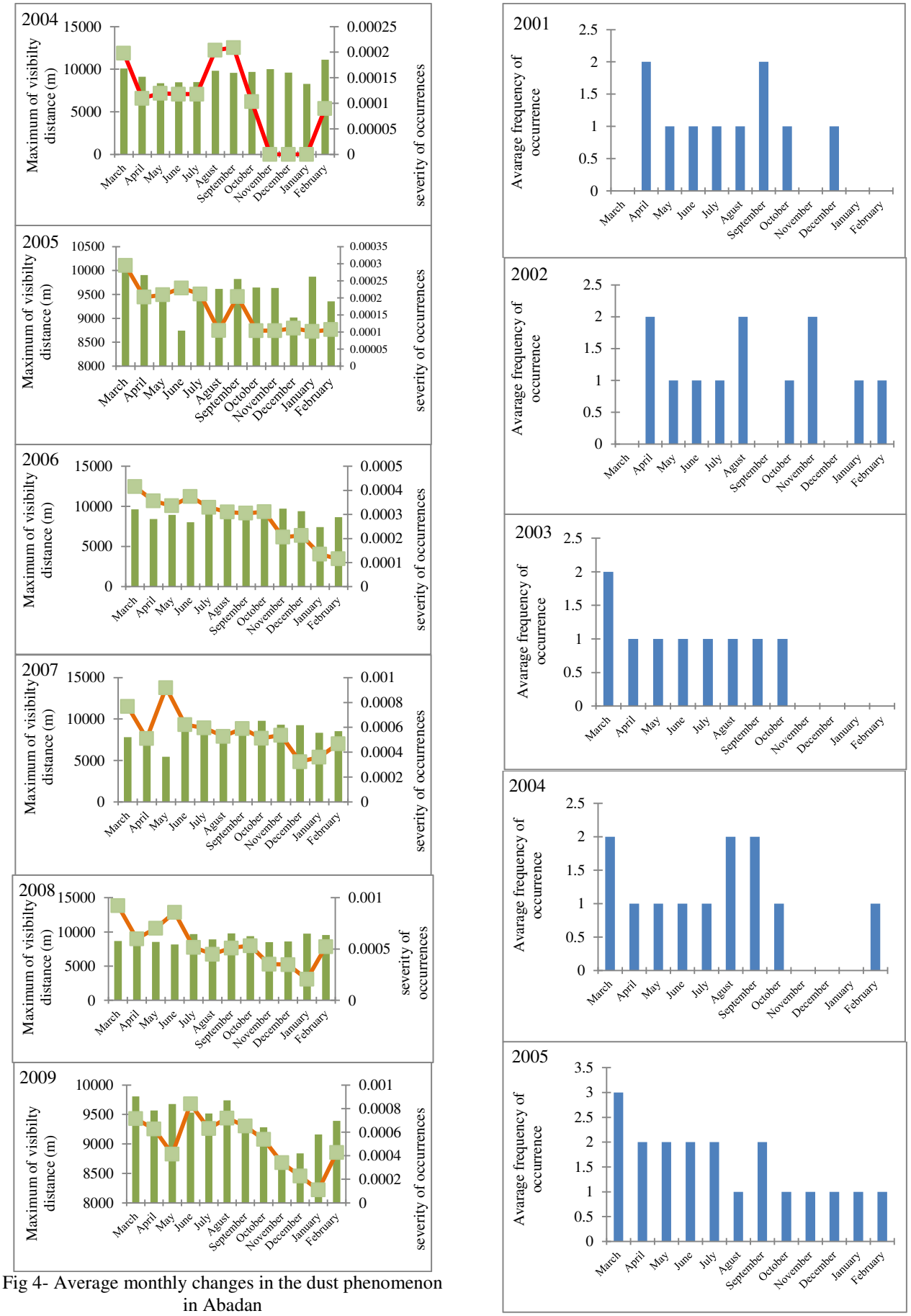


Fig 4- Average monthly changes in the dust phenomenon in Abadan

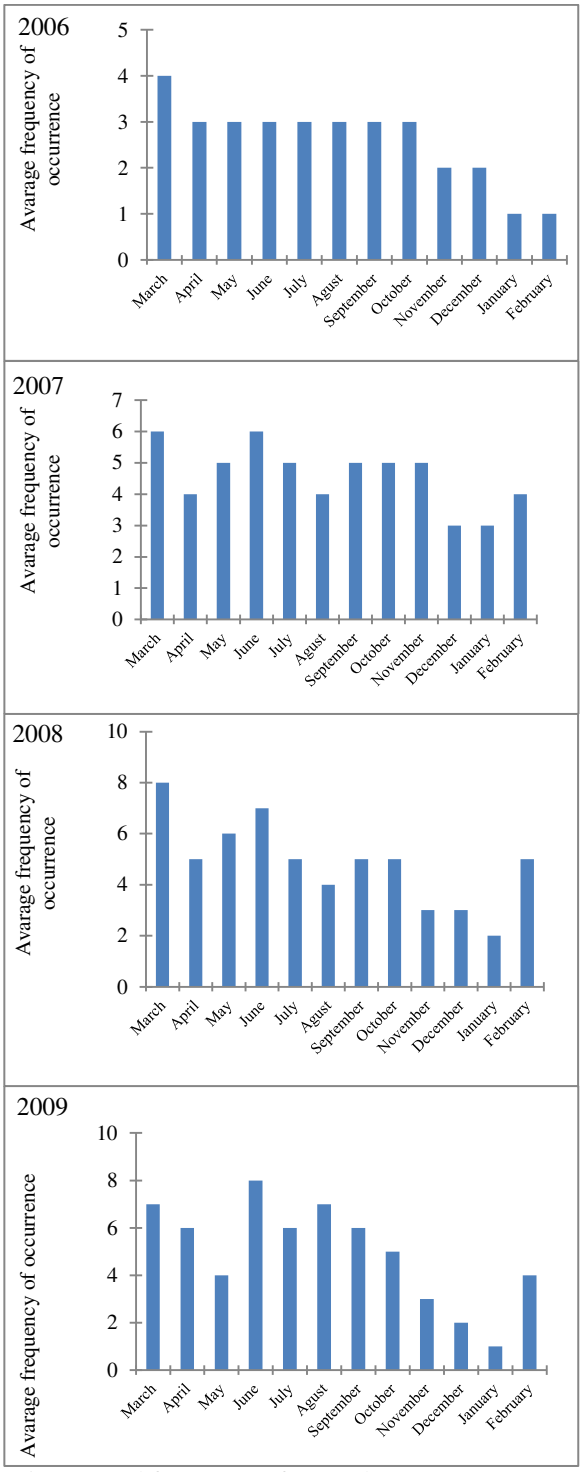


Fig 5- Seasonal frequency of Dust phenomenon occurence

The effects of dust on the injury severity model

Step one: Check the correlation

The correlation analysis showed that between the lesser moth with parameters H_1, H_2, H4, H_9 and H_{11}, spider mite with parameters H_1, H_7 and H_{10}, bunch feding with parameters H_2, H_4, H_5, H_6 and H_7 Khamedje with parameters H_1, H_2, H_3, H_5 and H_{11} had moderate to strong correlation. Therefore, these parameters can be used to simulate the effects of pests and diseases severity damage on dust condition (Table 3).

Table 3- Correlations between Seasonal changes of damage with variables of dust phenomenon

Injurious agent	Dust phenomenon index	Correlation index	Significant level
Lesser Moth	H_1	-0.55	0.007000
	H_2	-0.65	0.051649
	H_3	-0.1	0.797972
	H_4	0.666667	0.008646
	H_5	-0.16667	0.668231
	H_6	-0.01667	0.966055
	H_7	0.041841	0.914886
	H_8	0.219089	0.571145
	H_9	0.840366	0.008298
	H_{10}	0.033615	0.931585
	H_{11}	0.522233	0.0089385
	H_{12}	-0.07869	0.840512
Spider mite	H_1	0.666667	0.006682
	H_2	0.233333	0.545699
	H_3	0.166667	0.668231
	H_4	0.066667	0.86469
	H_5	0.3	0.432845
	H_6	0.1	0.797972
	H_7	0.836827	0.00830
	H_8	0.365148	0.333899
	H_9	0.168073	0.665562
	H_{10}	0.672293	0.008635
	H_{11}	0.243709	0.527442
	H_{12}	0.087437	0.823005
Bunch feding	H_1	-0.18333	0.63682
	H_2	-0.83483	0.00636
	H_3	-0.01667	0.966055
	H_4	-0.58333	0.046003
	H_5	-0.83983	0.003084
	H_6	-0.73767	0.004879
	H_7	-0.61799	0.040432
	H_8	-0.31038	0.416291
	H_9	-0.14286	0.713868
	H_{10}	-0.26051	0.498392
	H_{11}	-0.33945	0.371482
	H_{12}	-0.21859	0.572039
Khamedje disease	H_1	0.73	0.00432
	H_2	0.62	0.00605
	H_3	0.95	0.00224
	H_4	0.216667	0.57551
	H_5	0.833333	0.00636
	H_6	0.283333	0.46003
	H_7	0.19247	0.619806
	H_8	0.054772	0.888697
	H_9	0.43699	0.239545
	H_{10}	0.235302	0.542216
	H_{11}	0.631334	0.041161
	H_{12}	0.078693	0.840512

Step Two: Determine the multivariate regressions

The results of effect of dust on the damage severity to Dates fruit simulations are provided in equations 4 to 7.

Lesser moth

$$I = -3.1H_1 - 13.6H_2 + 12.2H_4 + 0.5H_9 - 0.7H_{11} + 8.6 \quad (4)$$

Spider mite

$$I = 60H_1 - 0.9H_7 + 0.6H_{10} - 26.2 \quad (5)$$

Bunch feding

$$I = -90.1H_2 + 83.5H_4 + 91.7H_5 + 12.5H_6 - 1.2H_7 - 73.1 \quad (6)$$

Khamedje Disease

$$I = -15.3H_1 - 2.01H_2 + 17.5H_3 - 4.6H_5 + 0.4H_{11} + 18.7 \quad (7)$$

The analysis of variances were used to evaluate the likelihood fit of models that results are listed in Table 4. The effect of dust on the damage severity of the lesser moth, Spider mite, and Khamedje disease and bunch feding were significant at 5, 5, 1, 5 and 1 percent respectively. All models have significant coefficient higher of that and detected error w less than 25% for Khamedje disease and Spider mite more than 25 percent for bunch feding and lesser moth.

The results show that the models had suitable applicability for evaluating the effects of phenomenon effects on Khamedje disease and spider in Date palm caring network in Abadan region.

Table 4. Analysis variance of phenomenon effects on seriously injured date pests and diseases models

Injurious agent	D_f	)SS(	)ms(	F
Lesser moth	Regression	3.291609	0.658322	0.967576*
	Residual	2.041147	0.680382	
	Total	5.332756		
Spider mite	Regression	31.887	10.629	5.923766**
	Residual	8.971489	1.794298	
	Total	40.85849		
Bunch feding	Regression	24.36057	4.872114	1.415046*
	Residual	10.32923	3.443077	
	Total	34.6898		
Khamedje	Regression	17.46235	3.49247	54.5871**
	Residual	0.191939	0.06398	
	Total	17.65429		

The phenomenon synergistic effects

The synergistic effect phenomenon on the pests and diseases damage severity were calculated by using the simulation results and equation 3 and the results were showed in fig 5.

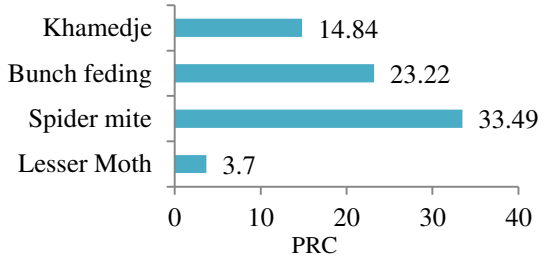


Fig 5- The synergistic effect phenomenon on the pests and diseases damage severity

The dust phenomenon had the most influence on Spider mite and less effective than others on the lesser moth. The life stages of spider mite covered under the dusty and sticky blurry to be protective against unfavorable environmental factors. None of the beneficial species protected by such an approach. Accompany inoculum of some pathogenic fungi such Khamedje and sensitive date palm stage opportunity to for further optimum condition of the disease expansion. One of the causes of bunch feding is environmental moisture loss during fruits ripening dates from Khark to Rotab so occurrence of dust phenomenon at this stage to can further reduce humidity resonance disorder. Other research studies have shown that dispersion of dust from the limestone mines in some plants such as grapes have been effective leaf disease. Trees in areas at risk of dust dispersion had more infection of fungal leaf diseases than those without dust. Studies have shown that different types of bacteria and fungi spores brown causing leaf spots were more in the air dust polluted regions [6].

The maximum damaging pest can be programmed control and Forecasted appropriately by using this model. Such planning's are the basis of date palm integrated pest management. The risks of confusion in the pest controls applications were very high without these forecasting models. The effect of various factors on each other is so complex which it is impossible to predict them without the use of mathematical models. Therefore, pest management professionals should using these models for aware the population and status of beneficial and harmful factors in date palm Date plantations [2]- [3]. The important point is that forecasting pests and diseases biological events at the regional level have numerous problems. Such as simulation systems which support them to be considered climatological models and simultaneously analyze the variations of pest's populations and diseases severities. Then they provided information in forecasting plan of the region [2]. Recent studies indicated the effects of dust phenomenon in increasing in fungal diseases by incrementing their spores transmit ions [8]. It is possible that spore transmitted fungal type's diseases of Date palm by this way so it is necessary for further research.

IV. CONCLUSION

The presented results are a contribution to understanding the effect of dust phenomenon on injury severity of important pest and diseases of Date palm. This phenomenon had significant resonance effects on injurious factors of date palm especially on spider mite (*O. afractiaticus*). The simulated model can be applicative for forecasting and monitoring of these factors for decision making on integrated pest management of Date palm pests. Plant disease and pest forecasting systems have been developed to help date palm growers make decisions about disease and pest management. Plant disease and pest forecasting systems may support a producer's decision-making process with regard to the costs and benefits of pesticide applications. The principle behind plant disease

and pest forecasting systems is to determine the risk that a pest or disease will occur, or that the intensity of it will increases.

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