

An overview of the most important challenges of the pistachio production industry in Ardakan (Yazd Province)

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Information	Abstract
<p>Article Type: Review Article</p>	<p>Background: Due its special geographical location and being located in the center of the country, Ardakan has unique conditions, and despite having severe desert conditions, it has dynamic and diverse agriculture. Meanwhile, pistachio cultivation has long been flourishing in this city; with 8 thousand hectares of pistachio orchards, most of which are seedlings, it is considered as one of the important genetic sources of this product in the country. Despite the unfavorable conditions in terms of water, air and soil, the cultivated area of this crop has not decreased in recent years, although there are many challenges in the production of this crop in Ardakan.</p> <p>Materials and Methods: The problems and challenges of the pistachio industry in Ardakan region were investigated using 18 articles and books.</p> <p>Results: Among the most important of these challenges are issues such as small holdings, quantitative and qualitative problems of agricultural water, lack of proper and timely management of pests and diseases, yellowing of pistachio trees, simultaneous cultivation of pistachio with other crops, spring frosts, heat stress and hot spring and summer winds, failing to provide due care for the orchards, improper storage of pistachios, lack of proper development of processing industries, environmental pollution, lack of development of the only existing pistachio research station, and insufficient coordination between related departments. In order to reduce the problems of this product, it is required that the authorities have a strategic attitude towards the pistachio production industry in Ardakan. In addition, the awareness of gardeners is required to be promoted. Also, the productivity of current water resources and access to new and transitional water resources are required to be increased.</p> <p>Conclusions: it is of high significance to plan and pay due attention to applied research in order to solve the problems of pistachio crops in the region.</p>
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1. Introduction

As the largest city in Yazd province, Ardakan is located in the heart of the central desert of Iran. It has a unique geographical location as it is located in the center of Iran (being on the north-south transportation route of the country). Along with economic and social advantages and challenges, this city has dry and severe weather conditions. However, agriculture has long been sustainable in this city and various agricultural and horticultural products have been cultivated in orchards and fields inside and outside the city. Pistachio is one of the most important products of this city that has a strong bond with the economy of many families, especially the villagers of Ardakan. Pistachio is specially cultivated in the orchards of northern Ardakan and the villages including Ahmadabad, Chah Afzal and Turkabad in both traditional and mechanized manners [1].

Yazd province is known as the third producer of pistachios in the country. Along with Khatam and Mehriz, Ardakan is one of the most important areas for pistachio production in Yazd province with a cultivated area of 4 thousand hectares of fertile and non-fertile pistachio orchards. Despite the old seedling orchards, this province accounts for one of the most valuable genetic collections in the country [2]. Thus, it seems necessary to pay more attention to address and solve the challenges of pistachio production in order to increase productivity and yield.

2. Materials and Methods

The problems and challenges of the pistachio industry in Ardakan region were investigated using 18 articles and books.

Explanation and investigation of some challenges

1. Small holdings (ownerships)

The existence of numerous and often old gardens with a size of less than a few Qafiz (each Qafiz is equal to a thousand square meters), lacking the necessary care due to ownership problems, has actually caused problems in the production in the orchards. Due to the lack of care, not only the economic justification of the orchards is lost to a great extent, but it also become a source for the spread of pests and diseases in the cultivation area. It seems essential that the management of Agriculture Jihad and agricultural service centers identify such fields, and expert consultations and support are required to be provided to these orchards as much as possible so that such problems can be reduced to some extent [1,3].

2. Quantitative and qualitative problems of agricultural water

Given the hot and dry weather conditions of the region, the reduction of rainfall, numerous droughts, overusing underground water resources, the prevalence of traditional irrigation methods, etc., we are currently not only facing a water shortage, but the quality of this water has also greatly reduced. In terms of salinity and the presence of toxic solutes such as boron and magnesium, one can witness an unfavorable situation. Moreover, the EC of agricultural well water, especially in Chah Afzal area, has reached more than 15 deciSiemens per metre (dS/m), which normally causes the production of tree products to stop. However, with the adaptation of the tree over many years and the increased efforts of farmers for providing better nutrition

for the trees, this stoppage of yield has been replaced with a reduction in yield. It seems that by logically moving towards using better irrigation methods, wise saving in agricultural water consumption, proper placement of wells, dredging of existing canals, ionization and water purification methods, the possibility of using transfer water, etc., a main part of water problems can be significantly reduced [1, 4].

Salem (2017) has reported that the implementation of pressurized irrigation projects in Yazd province has always been associated with problems. Improper design and implementation of pressurized irrigation system, high interest rates of loans and short repayment time, imposing and forcing users to implement the system, lack of providing training courses on pressurized irrigation, and lack of wetting of the soil to the desired depth are among the most important reasons of pistachio producers for not using pressurized irrigation projects. The educational factor accounts for the most important factor, followed by the economic, technical, social and environmental factors. These factors together account for 74.74% of the factors affecting the lack of tendency for using pressurized irrigation systems [5].

Fallah et al. (2019) reported that based on the comparisons made between pistachio water needs, actual evapotranspiration and the amount of water consumed by pistachio orchards in Yazd province, it is possible to recommend a managed deficit irrigation strategy for pistachio trees for the investigated area. Optimizing the traditional irrigation systems, changing the water utilization system with the aim of reducing the irrigation cycle, giving due attention to the spatial changes of pistachio water needs in the region, washing the soil salts in the off-season and correct agricultural management at the

orchard level are some of the solutions that can be useful to overcome salinity and water shortage problems and prevent yield reduction [6].

3. Lack of proper and timely management of pests and diseases

The reduced awareness of farmers and owners about pests and diseases, along with failing to give due attention to the timing of controlling these pests and diseases, have caused an outbreak of pests in many gardens at different times throughout the year. This not only results in reduced yield, but also has caused the emergence of resistance of many pests and the emergence or rapid spread of diseases in recent years. Also, it has been repeatedly seen that horticulturists start spraying without paying attention to the condition of their orchards in terms of pest and disease; they start spraying merely based on the start of this operation in the surrounding orchards, and even in some cases there was no need for spraying. This has resulted in the death of beneficial insects and has made the garden susceptible to many pests and diseases. Moreover, the owner's financial problems and the lack of workers have caused this process to be delayed when the garden is required to be taken care of and pests are required to be controlled. Currently, orchard owner are facing numerous problems including pests and diseases such as psyllium (dry sap), cicadas (wet sap), green bug, pistachio fruit-moth, wood-bearing moth, pistachio twig borer beetle, scale insects, and other diseases including pistachio endocarp lesion, *Phytophthora* root and crown rot, and yellowing of pistachio trees [4, 7]. It seems that as the awareness of farmers increase an orchard calendar is created, especially to deal with these problems, it is possible to increase the readiness

of orchard owners to take care of their orchards more intelligently.

4. Yellowing of pistachio trees

This problem, which has been noticed in Ardakan since about a decade ago, has caused the drying and severe reduction of the yield of many trees, especially the middle-aged trees. This problem causes the leaves to turn yellow at the beginning of the season and blackens or dries the branch and reduces the yield. This problem has been seen in small and large trees and has been observed in many rural properties and orchards. Moreover, it has been reported in orchards with low irrigation interval and orchards that are irrigated for more than 90 days. It seems that the conditions of the gardens and many management factors such as failure to conduct proper irrigation management including long irrigation blocks, close irrigation intervals, old age of trees and their high density on the surface, failure to perform proper ventilation between trees (trees are not in rows), the abandonment of some gardens, failure to conduct proper fertilization for many years, low root growth in some trees, failure to control plant pests, failure to conduct pruning and possible effects caused by some bacteria and viruses can be involved in the occurrence of yellowing of pistachio trees [4].

Abdolahi et al. (2022) reported that heavy soil texture, low cultivation density, deficit irrigation and heavy irrigation, non-uniform distribution of water in the garden, use of cow manure and phosphates as fertilizers, shoveling around the trees, the use of dune sand, the use of plaster, the presence of all kinds of weeds in the orchard, and the improper control of pistachio psyllium are some of the characteristics of pistachio orchards suffering from yellowing. In contrast, yellowing is less commonly observed in pistachio orchards

where sheep, chicken, potassium and nitrogen fertilizers are used, organic and chemical fertilizers are applied every year (instead every other years), micro-fertilizers are used in the soil and on the fertilizer hole, branches are pruned and spurs are cut in pistachio gardens. On average, this problem damages 30% of pistachio yield every year. Leaf yellowing did not affect pistachio split rate and ounce, but it increased the porosity rate [8].

5. Simultaneous cultivation of pistachio with other crops

Cultivation of pistachio, especially in the early stage with products such as fodder, kitchen garden products, rose madder, etc., has led to the interference of irrigation interval and increased water consumption. Thus, problems such as water core, pistachio root and crown rot, etc. are observed in pistachio orchards. However, this has significantly decreased in recent years due to water shortages [1].

6. Spring frosts

Given the global climate changes and some related issues, as well as the special weather conditions of the region, spring frosts are observed in pistachio orchards almost every year with high and low intensity. Although this late/early frost is considered an environmental problem, problems such as gardeners' little knowledge of ways to deal with frost, lack of belief in dealing with this problem, and lack of success in controlling this problem, small ownerships, lack of sufficient labor force, etc. have caused irreparable damage in pistachio orchards in the early growing season. According to the report of Abdolahi et al. (2008), nearly 40% of the damage caused to the country's pistachio crop is due to frost. Thus, it is clear that every year a huge amount of income from

pistachio production is lost due to frost; in some years, it accounts for up to 25% of the country's pistachio income [9]. The results of the research of Omidvar and Banadaki (2013) have that in terms of frost (especially severe spring frost of pistachio), in Yazd Province, Dehshir, Marvast, Ashkezar, Ardakan and Bahadoran stations are high-risk areas for agricultural activities, especially for pistachio orchards. As the awareness of orchard owners increase, ways to deal with frost are promoted (including selective inverted sink and thermal fogging machine), successful examples are introduced in this field, and timely agricultural meteorological information is provided on the region, the severity of these damages can be reduced to some extent [10].

7. Heat stress and hot spring and summer winds

This problem, especially in summer, causes severe damage and increases the percentage of infertility and porosity rate of pistachio trees. If there is a sudden increase in temperature in the last third of March, it will cause the lack of proper fertilization and as a result the newly formed fruits will fall. By strengthening trees, creating windbreaks around the garden to prevent hot wind, using canopy in small orchards, etc., the damage can be reduced to some extent [4].

8. Providing due care for the orchards

Providing due and ideal care for the orchards have failed for numerous reasons including the old age of many pistachio orchards in Ardakan, the lack of high-quality inputs and pesticides, the lack of knowledge of a codified garden calendar for pistachio planting, growing, and harvesting, etc. [1].

9. Improper processing

The most important part in processing is using pistachio peeling (11 and 12) and drying machines (13 and 14) with proper efficiency. Moreover, the proper sorting of dry pistachios plays an effective role in reducing stained pistachios (especially brown, yellow, and black stains) and thus reducing aflatoxin contamination in pistachios [15-17]. Since there are few pistachio processing units in Ardakan, providing facilities and encouraging orchard owners and traders in this field are of high significance.

10. Improper storage of pistachios

Proper storage of pistachios (especially in terms of temperature and relative humidity and proper ventilation) plays an important role in maintaining quality, reducing storage pests, oxidation of kernel fat and its shelf life [4]. The lack of proper and controlled warehouses for pistachio storage and its supply at the right times (that can bring great benefits to pistachio growers) brings a lot more benefits for dealers and retailers. Given the extent of orchards and the importance of the issue, the public sector (especially Agriculture Jihad or the private sector active in this field) can create suitable warehouses and cold storages for this product.

11. The need to increase conversion industries

Currently, the technical knowledge of production of pistachio processing industry products (pistachio milk, pistachio butter, pistachio Halva, pistachio breakfast cream, pistachio chocolate and pistachio marmalade) has been produced by the Pistachio Research Center [4]. Using these processing industries, especially with the development of new technologies in the region, can play a significant role in creating new added value for gardeners

and thus, increasing the export of these products [4]. Currently, pistachio kernel is mostly used in industries related to sesame products and a few limited workshops of pistachio kernels in Ardakan; it does not correspond to the number of orchards and the level of pistachio production in the city. The presence of small pistachios at a reasonable price is an advantage for their being used in processing industries.

12. Environmental pollution

In recent years, due to numerous reasons including climate change and social and development issues, we have witnessed the spread of pollution worldwide, and our country is no exception. Moreover, Ardakan has suffered from a number of environmental problems due to the economic and industrial development and the creation of large industrial units such as iron pellets, steel, glass, tiles, etc. [18]. It is not possible to close and transfer these large industrial units, yet it is necessary to take measures including the implementation of the social obligations of industries in the field of agriculture. Moreover, it is essential that research projects be conducted so that the problems of pistachio orchard owner be solved; as the pistachio orchards are like the lungs of every city, most of the problems of this sector will be solved as well.

13. The need for effective inter-departmental coordination of related city departments and organs

It seems that there is a greater need for effective coordination between related departments and organs, including Agriculture Jihad, Yazd Agricultural and Natural Resources Research and Education Center, Regional Water Department and senior officials of the city to follow up on the problems of pistachio gardeners

in Ardakan with a clear prioritization. Thus, it is necessary that the formed councils (such as the agricultural council of the city) focus more on the process of producing products such as pistachio; it is effective both in terms of the cultivated area and economy for Ardakan [4]. Most of the gardeners' problems are definite and known, and they have been expressed by gardeners and farmers in different ways. Given the existence of the Ardakan Pistachio Research Station, being in direct connection with Yazd Province Agricultural Research and Training Center and Natural Resources and the National Pistachio Research Institute, it is expected that by strengthening this station, we will see more dynamics and cooperation in the implementation of projects that attempt to practically solve the problems of pistachio industry of Ardakan. It is necessary a main part the province's funds be allocated to pistachio research.

5. Conclusion

Pistachio production in Ardakan has a long history, and given the fact that this city is one of the important areas of pistachio production in the country, especially with the presence of diverse seedling cultivars, the need to address the problems of pistachio gardeners in Ardakan is, thus, doubled. It seems that in order to reduce or overcome these problems, the officials are required to have prioritized and purposeful attitude towards the pistachio industry of Ardakan. Thus, it will be possible to raise issues and challenges such as pests and diseases, yellowing, frost, inadequacy of processing units, warehousing and processing industries, and environmental pollution at the national and regional levels; special facilities and funds will be allocated to address the problems. It is also necessary to increase the awareness of orchard owners, especially those in charge of orchards

that are still managed traditionally. Moreover, paying due attention to research and implementing applied research projects that can solve the technical problems of pistachio production will be helpful. Given the current alarming conditions, supplying suitable water for agriculture through the extraction of water from recycled sources and transfer sources should be taken into account as well.

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conflicts of interest

The authors declare that there is no conflict of interests regarding the publication of this article.

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