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Taking Pattern of the Ability of Human Education in Greenhouse

M. Bakhtiari, A. Razavi Ebrahimi

***Abstract*— The need of human to food is more nowadays, so the cultivation of agricultural produce in intelligent greenhouses has converted to the economy activity. it seems that among the investigation sand studies ,which are done by researchers about intelligent greenhouses, the focus is in automatic control of the greenhouse situations , so that they can control the intelligent greenhouse various ways.**

Being intelligence should be in such special way that the intelligent system has some of the capabilities of human intelligent.

Since the humans is an intelligent creature, if we are able to design and implement such a greenhouse which has human learning in intelligent greenhouse.

in this article lead we can call it intelligent greenhouse we use the capability of human learning in intelligent green house in this artic lead we can control the future situation of green house with higher quality, lack of architectures in the past and makes the new way of intelligence in intelligent greenhouses.

***Keywords*— Architecture, Data and Knowledge, Education and Learning, Greenhouse, Intelligent.**

I. INTRODUCTION

THE GROWTH OF POPULATION INCREASES THE NEED OF HUMAN BEING TO FOOD. DEVELOPMENT OF TECHNOLOGY IMPROVES THEIR NEEDS AND EXPECTATIONS. ALL OF THE PEOPLE LIKE TO MAKE THEIR WISHES COME TRUE IN ANY SITUATION. THERE FOR THE HUMAN NEED TO FOOD IS INEVITABLE AND THIS IS THE REASON FOR MAKING THE GREEN HOUSES IN ANY SITUATION.

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AT FIRST, IT IS BETTER TO DESCRIBE THE GREENHOUSE AND THE INTELLIGENT ONE. GREEN HOUSE IS THE ENVIRONMENT FOR GROW AND CULTIVATING WHICH IS ARTIFICIALLY SIMULATES THE NATURAL CIRCUMSTANCES OF GROWING IN CLOSED ENVIRONMENT.

SO WE WILL ABLE TO HAVE A WELL PRODUCT ANY TIME AND SITUATION. THE INTELLIGENCE IN GREENHOUSE IS DEFINED IN THIS WAY: IF THE OPERATION INSIDE THE GREENHOUSE IS DONE AUTOMATICALLY BY A COMPUTER CONTROLLER, WE CAN CALL IT "INTELLIGENT"; BECAUSE IT KNOWS WHEN AND HOW TO CONTROL THE GREENHOUSE – WHICH IS THE VERY DEED THAT IS DONE BY THE GREEN HOUSE MANAGER.

THIS SURVEY IS DIFFERENT FROM THE OTHER ONES AND THE POINT IS IN THE VARIOUS DEFINITIONS ABOUT INTELLIGENT. IN THIS ARTICLE WE ARE GOING TO USE THE CAPABILITY OF LEARNING AND TRAINING OF HUMAN MIND IN GREEN HOUSE TO MAKE THE INTELLIGENT GREENHOUSES MORE SUMMER IN DIFFERENT WAY.

IN THIS ARTICLE, THE TERM "PRODUCE" MEANS FLOWERS, FRUITS, PLANTS, VEGETABLES, AND SUMMER VEGETABLES

II. HISTORY

In the past, cultivating has faced some problems and the products were not available at any time and place. They must pay attention to many points to cultivate the food stuffs. So there were a host of limitations for cultivating (like area's climate, kind of sort, temperature of the region, and so on.).

Troubles like the lack of access to agricultural produce in all seasons and all regions, natural incidents like flood, drought and the lack of appropriate situations for natural cultivating pushed the farmers to find some solutions.

They prepared artificial situations and made some special house for plants and fruits to make qualified products all the time. The first green house was built 30 year Ad in Room [14]. The countries that made the first greenhouse include Egypt, China, Greek and Italy.

In Automatic house, computer played the role of a consultant for farmer. It received the information about the

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greenhouse situation by sensors and then the farmer did all the necessary measures based on the data and the mediator user. After that the data were entered to the computer and the farmer tampered with green house instigators. In fact the computer was like a guide that lighted the road for the farmer to a certain extent.

Despite of this progress, the researchers never gave up their studies and tried to find a mechanism to make the greenhouse completely managed by the computer and the farmer didn't get involved in it. So they created an intelligent computer which made necessary decisions and implemented the best one by itself and without needing to the operator.

By this invention, the farmer had no relation with the green house and the computer was like an intelligent creature by itself. The inventing of controlled green house was reported at 1970 [2], [6], [7] and merging the engineering and the agricultural engineering for creating the skillful green house was reported at1998 in Greek [10].

In 1992, "sun", researched about control systems of environment situation of greenhouse [15].

Lipove, in 1992, devised an intelligent control system for computer which manages the environmental situation of greenhouse [16].

Hoon Jacetal , in 1995, studied the automatic control system for measuring the environmental situation of greenhouse [17].

But their intelligence arose from the automatically doing the operation of the green house, and it was not mean that the intelligence can think and use its previous knowledge to progress in future control of the green house.

III. MERGING THE CAPABILITY OF LEARNING IN HUMAN WITH THE INTELLIGENT GREENHOUSES

Every product must grow in special situation to reach their best quality and convenient growth. The factors that prove effective on the growth and quality of the agricultural produce include: the appropriate atmosphere, the particular species of soil, allowable temperature and humidity and another features. Cultivations face some limitations like: special environment, the quantity of irrigation, the amount of PH and EC in soil, and so on. Therefore, in order to cultivate a produce in an artificial situation of green house, we must apply these limitations [1].

If we want to have an intelligent green house, we should use as much the human mind as we can. It means that we copy the green house from the surrounding of human and simulate it's remote control based on human mind. When an infant was born, he or she has no knowledge or information about his other new world.

So he / she uses his/ her five senses to discover the facts of his / her world. He/she records everything he/she sees, hears and feels in his/her mind. And makes a data base for himself / herself. Gradually he/she uses his/her data base for achieving the knowledge.

The mechanism is like that whenever he/she see a thing, he/she backs to his/her data base and checks if that thing has been corded in his/her data based or not . If it has been recorded, he/she labels it as a repeated event and records all the information about it, which will be more and more during the time, in his/her new base called "knowledge base".

So the infants has an architecture in side himself/herself, that shows all of the details are placed carefully beside each other to help the infant to discover his/her power, perception and consciousness and offers the intelligence to him/ her .

Now we implement the infant architecture on the green house. One of the major principle in this architecture is data base. This part should record the necessary information from it's surrounding for the first time; as some of these data should be recorded in advance by the designer. We put this database in green house environment and ask it to behave like an infant. It should look around itself and record anything it can see and find useful. In fact, this information has been sent to database through the sensors.

These sensors play the role of five senses in an infant. Then the infant learns and experiences from these raw data and use then as repeated Experiences its knowledge data.

IV. THE CAPABILITY OF LEARNING IN GREENHOUSES BY COPING THE PREVIOUS BEHAVIOR

One of the easiest ability in human being is the capability of education and learning from information .there for if we can implement this capability in a greenhouse, we will achieve a high rank of intelligence in it, and we will be able to reduce repetition.

The proposed intelligent green houses, have two bases :a data base which includes the information given from the sensors , and a knowledge base , that includes the information achieved by searching the data base making a knowledge base, starts the learning and education in a greenhouse .

the act of coping is the most important factor for true education. If the green house can find a right pattern to reach the ideal condition, the control of its position will be quite easy and inexpensive. Receiving the information from data base and surrounding condition .

knowledge base draws pattern for appropriate condition in a greenhouse; this pattern is recorded as a new knowledge and information for future. If it will be clear that the greenhouse is adapted to one of the pattern in the knowledge base after receiving the greenhouse conation. It would apply that pattern on a green house.

This architecture is like a decision tree. there are 365branches on this tree and every branch has 24 clusters which are equal to 24 hours in a day.it can be seen the best decisions for completed and qualified growth of the produce and better control of the greenhouse in each seeds on this cluster .this architect true is shown below(fig1.).

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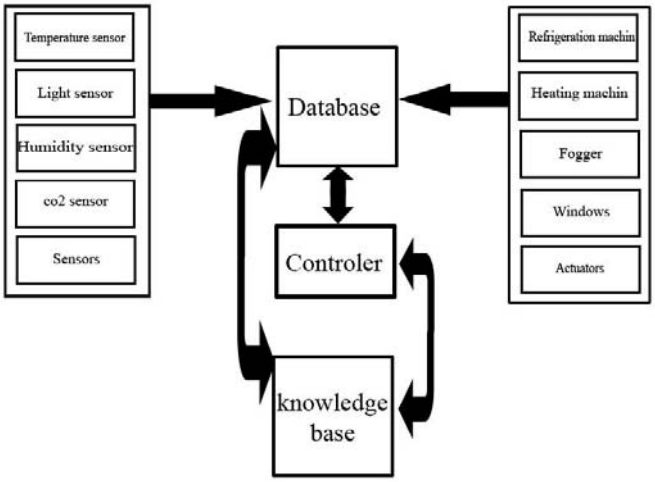

Fig1. The architecture of teachable intelligent greenhouse.

one of the major parameter in searching and filtering at knowledge base is the climate condition and atmosphere in the last and next 24 hours .so, we can get these parameters by using the internet and record them in our data base and use it for comparing in knowledge data more over internet is a connecting bridge between the green house and it's manager.so the manager can monitor the greenhouse from a distance.

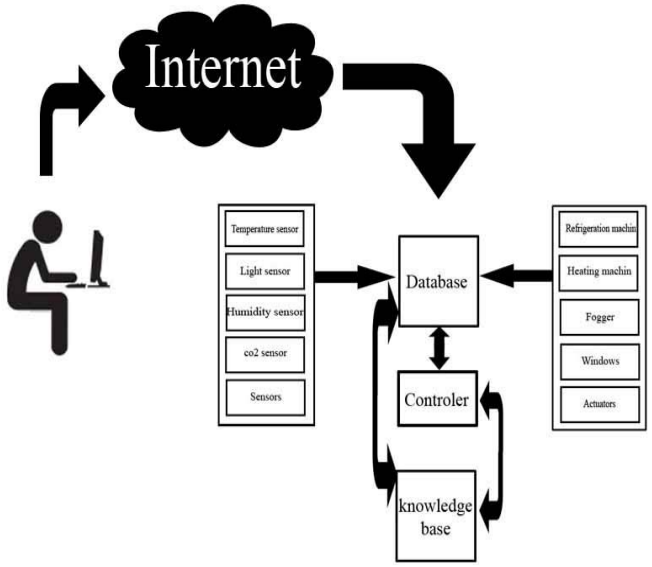

Fig2. The total architecture of teachable intelligent greenhouse with the internet.

V. ADVANTAGES

Coming back to the post and coping from the previous situation and using it in future, decreases the consumer energy of the control devices and sensors in a greenhouse .furthermore it increases the reliability and precision due to the point that all the measures were done inside the green house in advance and we are sure about it's correctness.

This displayed intelligent green house can be implemented in any place and situation since a strong knowledge base, records all of the features in itself and it is possible to duplicate the green house in all the conditions .moreover we can use the knowledge base as a data base in future and minimize the control operation.

VI. CONCLUSION

Establishing a knowledge base in intelligent green houses and learning from past experiences and coping the previous situation of the green house ,along with using then for the next condition and the future of the green house ,is a new and modern discussion which has proposed in any intelligent greenhouse .now a days there a house of attempts to make the equipments intelligent ,but this process must be in a way that the system has the utmost capabilities of human intelligent. Since it is possible to use the adequate knowledge along with the corrects thoughts for achieving the meticulous super vision, there must exist a knowledge data in the surrounding environment of greenhouse to make it intelligent.

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Application of Nano-Iron Chelate on Greenhouse roses In Recirculation Hydroponic System

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Abstract— Experiment conducted using three Rosa hybrida L. cultivars ('Fiesta', 'Sorbitavalanch' and 'Shiraz'). They were grown in a polyethylene greenhouse with a close hydroponics system. Four different levels of supplementary nano-iron chalete (0.5, 1.0, 1.5 and 2.0 g l-1) applied at 4 leaves´ growth stage of flowering stem. Morphological and biochemical Parameters such as were investigated. Results indicated that, nano-iron chalete treatments positively affected the flowering stem and flower head fresh and dry weight, length, and diameter in all cultivars. Furthermore, leaf chlorophyll content as an important factor to evaluate quality and quality index in all cultivars of roses that significantly increased in 1.0 and 1.5 g l-1 treatment of nano-iron chalet. Result showed antioxidant enzymes, such catalase (CAT) and peroxidase (POD) affected by nano-iron chelate treatment significantly in all rose cultivars studied. Based on the results obtained, nano-iron chelate had a stronger effect on CAT and chlorophyll content than other variables. Further studies are needed to clarify more the effect of nano-iron chelate on other enzymes and variables in different plant species.

Keywords: Cut roses, nano-fertilizer, Fe, quality index, flower.

I. INTRODUCTION

Roses are, one of the most beloved ornamental and economically important plants. The billions of cut flower roses are sold annually over the world (Khosh-Khui and Teixeira da Silva, 2006). One of the problems in the recirculation systems is changes in concentration nutrient solution of all macro and some micro-nutrients (Ehret et al., 2001; Ehret et al., 2005). Furthermore, the EC increased in recirculation system, and most micro-nutrients such as B, Mn, Mo and Zn is decreased. But, Iron was somewhat unusual in this respect, and the Fe were higher concentration in the recirculated solutions than in the non-recirculated control and damaged plant by superfluous of Fe in recirculation system (Ehret et al., 2005). Recirculation hydroponic systems lower the rose cut flowers, quantity and quality by a combination of factors, such as addition of specific amendments to the solution and increased concentrations of Ca, B or Si, reduced pH, and leaf chlorosis, or use of an adsorbent resin to remove specific organic molecules (Ehret et al, 2005). Mengel and Kirkby (1987) Modification in solutions pH can change the availability and absorption of some necessary nutrients, on the whole for plants such as roses which are vulnerable to pH-induced chlorosis (De Kreij, 1995). Also, mainly in newer recirculation hydroponic systems can significantly affect the rose scion flower yield and hence justify further investigation interests (Cabrera, 2001).

Decrease in Fe concentration may have resulted from nutrient precipitation. Chelated Fe may be a readily form of both soluble and insoluble precipitates within days of being added to a nutrient solution, particularly if the solution is not agitated (Lykas et al, 2001). Fe concentration in recirculation solutions was possibly upper than those in the non-recirculation solutions because of recovered agitation and therefore reduced precipitation. In addition, if plant requirement for Fe was low, even with some precipitation, Fe would have accumulated over time the same as some other minerals in recirculation system (Ehret et al., 2005).

Foliar application of some elements significantly increased tomato plants fruit number and yield in the aquaponics in the order of: K> Fe >Mn > Zn >Mg > B (Roosta and Hamidpour, 2011). Due to low level of K and other nutrients such as Mg, Fe, Mn and Zn in aquaponic system and afterward in the leaves of aquaponic grown plants, also foliar application of these elements increased their absorption in aquaponic-grown

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plants, significantly (Roosta and Hamidpour, 2011). According, Fe-EDTA a mobilizing complex and effective chelator is normally used (Wu et al., 2004; Liphadzi and Kirkham, 2006; Ruley et al., 2006), that poses several disadvantages. For example, It can reduce plant biomass, destroy the physiological barriers of the root, or inactivate transporter proteins to the extent that its metal mobilizing and translocation benefits are minimized (do Nacimento et al., 2006; Liphadzi and Kirkham, 2006; Luo et al., 2006). The effect of EDTA diverse for each metal as by the metal concentration in the biomass, it can be served in the hydroponic environment served as interference to metal uptake (January et al., 2008). To best our knowledge there is no report on using nano-iron to improve the rose cut flowers´ quantity and quality.

The aim of the present study was to achieve the best quantitative and qualitative characteristic of three rose cultivars (‘Fiesta’, ‘Sorbitavalanch’ and ‘Shiraz’) by application of different nano-iron chelate treatments in a hydroponic production system.

2. MATERIALS AND METHODS

2.1. Cultivars and experiment condition

In this Experiment, three species of Rosa hybrida L. cultivars; ‘Fiesta’, ‘Sorbitavalanch’ and ‘Shiraz’ were used in a polyethylene greenhouse with hydroponics system, located in Khatonak, Shiraz, Iran. The greenhouse was N–S oriented, and was ventilated by fan and pad supported by continuous roof opening system. The greenhouse tools for climatic control (consisting of convective heating, evaporative cooling pads and exhaust fans) was set to create mean day and night temperatures of 27–30 and 15–18 $_{o}$C, and relative humidity 60% - 65%, respectively.

2.2. Nano-iron chelate treatments

The Nano- iron chelate was applied in four concentrations of 0.5, 1.0, 1.5 and 2.0 g l-1 along with control treatment. Foliar application of nano-iron chelate took place four leaves˙ at growth stage of flowering stem.

Experiment was arranged as a factorial in the completely randomized model design with two factors of nano-iron chelate and cultivars. Dionized water was used for making nano-iron chelate solution. Stentling were potted in March and the first shoot was bent in April to May, 2011. The experiment was repeated two times during June to September, 2011. The data notation becomes analyzed by SPSS-17 software.

2.3. Measured variables

The stem fresh and dry weight, stem length, leaf number, leaflet number, diameter, and node and internode number of flowering stems; diameter, length, fresh and dry weights of flowers and also leaf chlorophyll content (Chlorophyll content was evaluated by SPAD-502 made in japan) and quality index were measured (Saini et al., 2001; Nazari et al. 2009). Also, comparison the flowering stem number, flower length and diameter, number of petals per flower, flowering stem length and diameter, flower fresh weight, number of nodes, internode length per flowering stem and Quality index (g cm_1). Quality index was calculated based on the fresh weight of flowering stem divided by its height (Darlington et al, 1992).

2.4. Data recording and analysis

Collected data in two times replications were statistically analyzed by t- test and not-significant (data not shown), their means used for further compared analysis. Means were compared with LSD test at 05% by using the SPSS-17 software.

3. Results

3.1. Flowering stems fresh and dry weight

The effect of foliar application of nano-iron chelate treatments and cultivars on flowering stem fresh weight was significant. cultivars ‘Fiesta’ and ‘Shiraz’ showed the higher flowering stem fresh and dry weight in 1.5 g l-1, and the cultivar ‘Sorbitavalanch’ in 1.0 g l-1 nano-iron chelate (Table 1).

3.2. Flowering stems length and diameter

According to analyzed data, the effect of nano-iron chelate treatments and cultivars on mean flowering stem length and diameter was significant, the highest flowering stem length observed in 1.5 g l-1 for cultivars ‘Sorbitavalanch’ and ‘Shiraz’, 1.0 g l-1 for ‘Fiesta’ flowering stem length. Furthermore, the highest flowering stem diameter was obtained in 0.5 and 1.0 g l-1 of nano-iron for ‘Fiesta’ and ‘Sorbitavalanch’, and 0.5 g l-1 for ‘Shiraz’. The results indicated that interaction between nano-iron chelate treatments and cultivars on mean flowering stem length and diameter was significant (Table 1).

3.3. Flowering stems node number and internode length

The number of nodes in flowering stem was also significantly increased by 1.0 g l-1 nano-iron treatments in all Rose cultivars. Furthermore, the internode length of flowering stem was significantly increased by 1.0 g l-1 nano-iron for ‘Fiesta’ and 1.5 g l-1 for ‘Sorbitavalanch’ and ‘Shiraz’ (Table 1). Data shown the highest number of stem nodes (14.10) in ‘Shiraz’ treated by 1.0 g l-1 and the lowest (8.00) in ‘Fiesta’ treated by 2.0 g l-1 nano-iron chelate (Table 1).

3.4. Leaf and leaflet number of flowering stem

Nano-iron chelate treatments significantly affected leaf and leaflet number of flowering stem indicated that, leaf and leaflet number of flowering stem in three rose cultivars for 1.0 g l-1 treatment produced more leaf and leaflet number than other treatments (Table 1).

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3.5. Flower fresh and dry weights
Analysis of data indicated that the nano-iron treatments significantly affected in flower fresh and dry weights, at 0.5 and 1.0 g l-1 significantly increased fresh weight in 'Fiesta'. However their effects on dry weight were not significant (Table 1). Furthermore, results showed the highest flower fresh and dry weights for 'Sorbitavalanch' and 'Shiraz' at 1.5 g l-1 nano-iron treatment (Table 1).

3.6. Flower diameter, length and petal number
The interaction between nano-iron chelate treatments and cultivars on flower diameter was significant, and this parameter was higher at 1.5 g l-1 for each of cultivar. Furthermore, nano-iron treatments had significantly effects on the flower length and petal number (Table 1). The larger flower length obtained 1.0 g l-1 for 'Fiesta' and 1.5 g l-1 for 'Sorbitavalanch' and 'Shiraz' were significantly different from other treatments. Therefore, petal number was significantly higher at 1.5 g l-1 for 'Fiesta' and 1.0 g l-1 for 'Shiraz' and 'Sorbitavalanch' (Table 1).

3.7. Number of flowering stems
Analyzed data showed the significant effect of nano-iron chelate treatments on mean flowering stem number. The highest flowering stem number was obtained in 'Fiesta' and 'Shiraz' at nano-iron 1.0 g l-1 and for 'Sorbitavalanch' at 2.0 g l-1 treatment (Table 1).

3.7. Leaf chlorophyll content
Leaf chlorophyll content was significantly affected by nano-iron chelate treatments in three rose cultivars. Nano-iron at 1.5 g l-1 for 'Fiesta' and 1.0 g l-1 for 'Sorbitavalanch' and 1.0 and 1.5 g l-1 for 'Shiraz' produced higher the leaf chlorophyll content. The maximum chlorophyll content observed in 'Shiraz' (0.93 mg g_1 fresh weight), and its minimum was observed in 'Fiesta' and 'Sorbitavalanch' (0.64 mg g^{-1} fresh weight) (Fig. 1).

3.8. Quality index
Analyzed data showed the significant effect of nano-iron chelate treatments on mean flowering stem number. The highest flowering stem number was obtained in 'Fiesta' and 'Shiraz' at nano-iron 1.0 g l-1 and for 'Sorbitavalanch' at 2.0 g l-1 treatment (Table 2). Quality index was affected by nano-iron chelate treatments and the higher quality index for all rose cultivars observed at 1.0 g l-1 treatment (Fig. 2).

3.9. CAT and POD activity
CAT and POD activity was significantly affected by nano-iron chelate treatments in three rose cultivars, Furthermore; results indicated some differences between CAT and POD activity.
Increased the concentration of nano-iron chelate significantly increased the CAT activity in all rose cultivars. However, maximum of CAT activity in 'Shiraz' obtained in 1.5 g l-1 treatment (Table 2). The POD activities were highest at 1.0 and 1.5 g l-1 treatment for Fiesta' and 'Shiraz', and at 2.0 g l-1 treatment for 'Sorbitavalanch' (Fig. 3, 4).

4. Discussion

Growing the roses in recirculation system showed less vigorous than grown in open systems (Tsujita and Roberts, 1995). Our results show that foliar application of nano-iron significantly increased vigor and quality index in all rose cultivars. Therefore a number of problems such changes in nutrient concentrations, EC and PH reduced growth of plants in closed systems (Ehret et al. 2005). Therefore, increased the concentration of Fe in nutrient solution may be resulted in precipitation and PH changes (Mengel and Kirkby, 1987; Ehret et al, 2005). However, some plants such as roses which are susceptible to pH-induced chlorosis (De Kreij, 1995). Foliar application of nano- iron was uninfluenced by precipitation and PH changes. Therefore, Leaf chlorophyll content was significantly increased by nano-iron chelate treatments in three rose cultivars. Leaf chlorophyll contents an important factor for quality and quantity flowering stem in roses (nazari et al, 2009). Qualities index an important factor for valuation of cut roses significantly affected by nano-iron chelat. The highest quality obtained in 1 g l-1 nano-iron chelat treatment. Therefore, increased the concentration of Fe in nutrient solution significantly decreased the quality index; this results was agreement with the results of Ehret et al. (2005) and Tsujita and Roberts (1995).
Furthermore, in present study the results show morphological factors of all rose cultivars affected by nano-iron chalete treatments. An inverse trend was observed between flowering stem length and diameter after treatment with nano-iron chelate. Therefore, Growth, yield, Quality index and other factors in three rose cultivars increased significantly by nano-iron treatments. Furthermore, results indicated some differences between treatments, the highest growth and yield observed in 1.0 and 1.5 g l-1, and quality index in 1.0 g l-1 nano-iron treatments. These results suggested in this study are agreement with the results of Roosta and Hamidpour (2011), bar-yosef et al (2009) and Lykas et al (2001). Furthermore, a study with roses showed that function of Si to the irrigation water reduced the incidence of black spot (Gillman et al., 2003).
The change of electrical conductivity and pH in nutrient solution of recirculation system may be increased the oxidative stress (Ehret and Plant, 1999; Dorais et al, 2001). Furthermore, the antioxidant enzymes activity alleviating of oxidative stress, and our study shown the nano-iron chelat effected in CAT and POD activity on three Rosa hybrida cultivars. This antioxidant enzyme had a possible role in resistance to oxidative stress.

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Table 1: The effects between nano-iron chelate treatments and cultivars regard to measured parameters in three rose cultivars .

Cultivars	'Fiesta'					'Sorbitavalanch'					'Shiraz'				
	Nano-iron chelat treatment (g l^{-1})					Nano-iron chelat treatment (g l^{-1})					Nano-iron chelat treatment (g l^{-1})				
Treatment	0.5	1	1.5	2	0	0.5	1	1.5	2	0	0.5	1	1.5	2	0
Flowering stem fresh weight (g)	44.65c*	57.67ab	60.10a	47.00c	27.50d	43.25c	79.00a	56.25bc	46.00c	44.45c	44.50b	45.26b	49.00a	48.00a	44.00b
Flowering stem dry weight (g)	26.05c	35.70b	39.09a	27.35c	21.00d	28.52d	40.30a	35.02b	25.37cd	24.00d	16.28d	23.52ab	26.50a	18.57c	16.27d
Flowering Stem length (cm)	56.87c	71.25a	60.00bc	62.75b	60.00bc	73.00c	76.25bc	82.00a	80.00ab	66.50d	79.50b	77.50b	87.29a	77.00b:	70.75c
Flowering Stem diameter (mm)	7.25a	7.50a	6.75b	7.00ab	6.50b	10.00a	9.75a	8.00b	7.50bc	7.25c	9.00a	8.00b	8.50ab	7.00c	6.50cd
Leaf number of flowering stem	10.75b	13.00a	9.75bc	8.25c	8.50c	11.75bc	14.35a	13.00ab	11.00c	10.50c	11.50bc	15.00a	13.00b	1.35c	11.00c
Leaflet number of stem	57.42a	55.25ab	52.00b	50.75c	51.00c	52.50b	52.75b	57.50a	51.75bc	51.50bc	54.25bc	61.25a	55.50b	2.00c	52.25c
Node number of stem	9.70b	12.42a	9.50b	8.00c	8.50bc	11.00b	13.50a	13.00a	10.75b	9.50c	11.00bc	14.10a	11.80b	11.25b	10.50c
internode length (cm)	5.12c	7.75a	5.50bc	7.00ab	5.20c	5.10c	5.77bc	7.50a	6.85ab	4.80c	6.45ab	4.9bc	7.40a	5.47bc	4.77c
Flower fresh weights (g)	29.00a	27.00a	25.00b	25.50b	24.00b	32.75b	37.00a	38.00a	36.00ab	32.00b	24.50c	27.00bc	32.00a	29.25ab	27.00bc
Flower dry weights (g)	4.15a	4.43a	4.08a	4.15a	3.97a	3.87c	5.22b	5.75a	4.97b	3.82c	3.95b	4.03b	5.20a	4.22b	3.97b
Flower diameter (cm)	4.67b	5.20ab	5.87a	5.10ab	5.12ab	4.92b	5.95a	6.17a	5.30b	4.92b	4.92b	5.37ab	6.10a	4.97b	5.07b
Flower length (cm)	5.80ab	6.45a	5.70ab	5.52ab	5.37b	5.07b	5.85ab	6.20a	5.22b	5.10b	5.75b	5.97ab	6.58a	5.52b	5.12b
Petal number	38.25c	42.50ab	48.25a	39.25b	38.75c	40.00c	44.75a	43.50b	38.75d	37.50e	44.50c	52.25a	47.75b	41.75d	4.50cd
Number of flowering stems	8.81b	10.00a	7.50c	8.75b	7.00d	6.75c	8.00b	8.00b	9.51a	5.50d	7.50d	11.51a	10.23b	8.75c	7.50d

* In each row and each cultivar means with the same letter(s) are not significantly different at %05 level of LSD test.

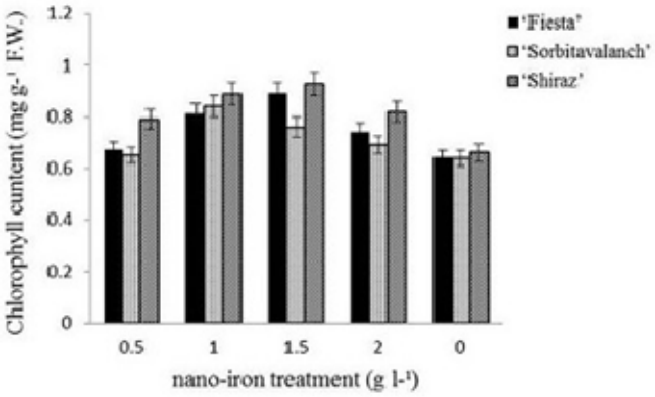

Fig 1: effects of nano-iron chelate on chlorophyll content.

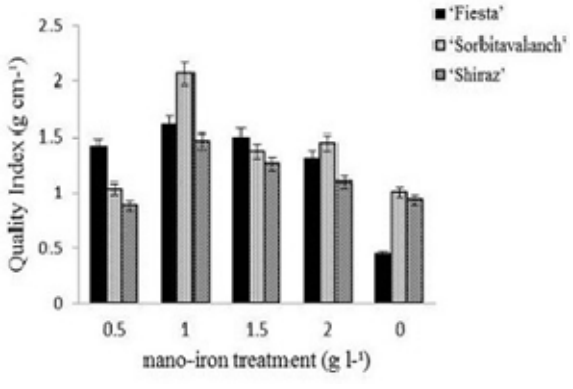

Fig 2: effects of nano-iron chelate on quality index.

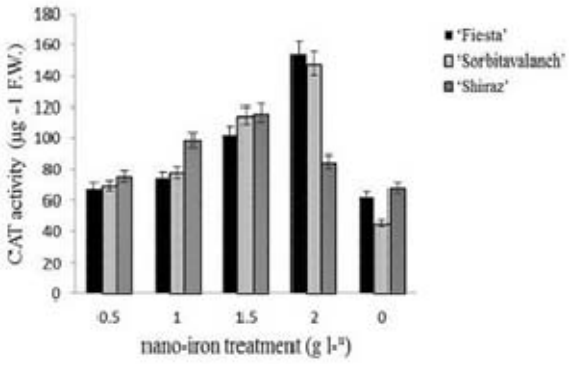

Fig 3: effects of nano-iron chelate on CAT activity.

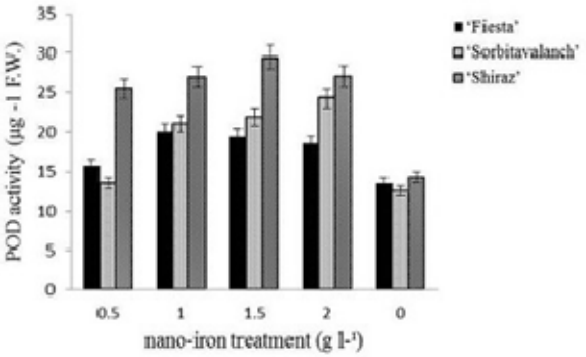

Fig 4: effects of nano-iron chelate on POD activity.

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The role of modern technologies in improvement of increasing the greenhouse-farmscrops products

Arezu Jahanshir

Abstract—one of the most important goals of scientificresearch communities is utilizationof modern technologies in order to achievehigh industrial systems and applicationsin human daily life. The growth rate of the human populationand the food crisis areprimarily causing global growthin using hightechnologies in the food industries and agricultural productions.

Therefore, optimizingthe cultivation conditions,managingandfightingwith gardenpestare very important.This may be accomplished withusing high tech air ionizationsupplies in the greenhouses or big gardens/farms. Injection of negative ions into the air can be improved the quality and quantity of agricultural products by this equipment i.e., NGI (Negative Ion Generator). In this paper,it is shown thatbased on corona discharge air ionization in the greenhouses or around the trees in the gardenscan be fixedsome of the agricultural problemsby using this method.

Keywords—corona electric discharge, greenhouse products, photosynthesis, plants respiration, pest control.

I. INTRODUCTION

Revision in recent research shows that the existence of ion in nature has a vital value for every living creature such plants.Plants like any other creature, in order to maintain and evolution of lifeneed to anions /cationsexchangecapacity of the air particles. Some surveyresults show that reduction of negative ion concentrations has direct and mentionable influence on plant growth, quality and quantity of agriculturalproducts.

Unfortunately, increasing of abnormalrates of pollutant productions and entering different chemical pollution into the lower layers of troposphereduring the climate change have been expanded;therefore itcauses unequal ion standard concentration in urban and nature air.Thus, human must interfere in the equilibrium concentration of the surrounding ionsand monitoring air quality.In addition, human have to achieve appropriate strategies to deal air pollution and artificially obtain the photosynthesis suitable conditions in farms and greenhouses. Since the photosynthesis, respiration and transpiration of plants are formed on the basis of chemical reactions, theair electric discharge may play a huge role in increasing concentration or can be effective factor in changing anions density.For this reason, various structure and model based on corona discharge are being designedin some of post-industrial and developing countries [1-5], which widely and significantly used in agriculture,cultivation, plant breeding, reduction of approximate time toseeds germination and healthyproducts.

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Generally,ionization is one of the techniques used to eliminate particulate matter from air. By this method we can increase the concentration of negative ions in indoor airand improveairquality. It is the process whereby atoms and molecules become electrically charged, forming ions positive or negative. Ionization can take place as a result of various natural or artificial processes in order to bring health benefits directly or through air purification.Here,we can discussthe modern air ionization technology that has an important role in agricultural crops productions, and also in improvementof industrial greenhouse and gardenproductions. It should be noted that this equipment by increasingnegative ion volumes in gardens and farmscan be directly affected and influenced significantly in products improvement and plants health.Research results of some expertsin medicine, veterinarian and agriculture indicate that increase and decrease of anions and cations density in air, are caused disease and biological changes in every living organism.For this regard, recentdevelopments of advanced technologies in the application of controllable air ionization equipment have a close relation with the experimental observations andtheoretical research results.

Air ionization technology has been around a long time, but got the attention of the agriculturalindustries about 10 years ago. Air ionizers generally work by applying a high voltage electric current to a metal needle.It works by continuously emitting a high concentration of negatively/ positively charged ions into the air or environmental air of farms and greenhouses. The ions transfer their charge to airborne particles, which are then indirectly or directlyaffected on plants.

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As we know the ions are dispersed into the air from electrical discharge process named corona discharge.The original version of hightech equipment of air ionization featured a wire suspended at high voltage potential (above 20 kV) with direct current (~ 4 mA). Its major advantage is the ability to change the ions concentration in the air and therefore it can provide a higher concentration and balance level of charged particles in the air.

Hence, the artificial application of air ionization has found special position in different branches of agriculture science, livestock, aviculture, industrial, medicine and therapy [1,2].Using the mentioned mechanism(i.e., air ionization in the industrial greenhouses), not only compensate the reduction of anions density by scientific controlling way, but also increase their density in the volume unit. Utilization of artificial air ionization technology in agriculture and cultivation section in Iran,because of global development high tech competitionand improving the advanced industrial science and technologyis considered a necessary matter.

II. ELECTRICAL DISCHARGE PROCESS IN COMPRESSIBLE FLUIDS

The processesby any factor that increase and concentrate the electrical field in the vicinity of conductive material and ionized ambientgas (air)is called electrical discharge. According to outward signs, shape and kind of chosen electrodes, the electrical discharge are distinguished under the names of corona, electrical arc, etc. In this project, the corona discharge process is considered appropriate in order to produce anion in high volume and highconcentration. According to application structures in external electric field, by choosing the negative/positive phase in the tipper electrodes the corona discharge is divided into two different kinds of discharge i.e., soft (dark) and hard (luminous).

With a colorful halo around the discharge electrode and sound of sparkle and diffusion of high density of ozone gas, the hard corona discharge, is recognized from the soft discharge corona, which is without any sound, sparkle, radiation and has a slight trace of ozone gas. By controlling and maintaining the boundary and critical voltage and very small current in the supply source, the soft corona process is stabilized and in this state, the desired condition of massive ionization plan of gaseous environment around electrodes is prepared. During electrical corona discharge in ionization chamber (area between electrodes (figure 1)), particles behavior look like the fourth state of matter i.e.,plasma. The structure of free electrons, atoms and ionized molecules, in the scale of neutral macroscopic with interactions between each other is called plasma.

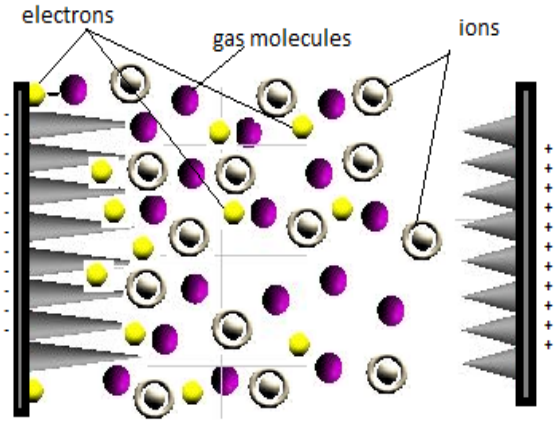

Figure 1: Air ionization between electrodes.

In other words, plasma is referred to a semi-neutral gas of charged particles that have similar behavior and generally in this stateare equal the amount of free electrons and positive ions. For this reason, being charged in the space between electrodes, inverted that area to a very good conductor for the transmission of current and electron-ion flow and in some cases, it has an even better behavior than metal conductors.

According to these subjects, in compressible fluids, semi-electron particlesthat have initial energy and high speed during theircollisions with a neutral atom or molecule, the energy is transferred into that atom or molecule. Sothe collided electron converts it into theion, if the achieved energy has the enough powerto separate an electron from a neutral atom, otherwise the ion producing in multiple stages of collision should take place if the colliding particles get the energy from the field.

In other words, the initial charge of the particle doesn't have the enough energy to extract an electron, because it gives the energy to the electron and the electron doesn't have enough energy for total departure; it achieves the enough energy in the next stage and then completely separate from the atom[4-6]. By establishing high potential difference in the distance of between two electrodes, a channel is drawn from the tipper electrode into the absorbing electrode (figure 1), so the gas or channel enclosure air is being ionized.

Two different regions of ionization and drift will be createdwhen the area between electrodes is being ionized [2]. Therefore, collision of free electrons in gaseous space will excite and ionize the particles.It is so obvious thatresulting from the excitationof atoms and molecules by emitting with high speed electron which exit from the front electrode was ionized the air/gaseous environment. Thus, in high voltage corona discharge, the air which surrounded the electrodes will be ionized and then big amount of charged molecules will be produced.

For example, by ionizing the environment, we can create the negative oxygen molecule which is very necessary in photosynthesis and plants respiration, so by this method, the optimized greenhouse management is becoming possible. According to the above mentioned topics,in order to improve growth in plants and productivity of plants, using the

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controlled electrical corona discharge, the capability of direct influence on the air inside greenhouse is being obtained.

Duringair ionization by corona discharge, it will producea large number of anion,so the most important and effective physical quantities in this ambience (around electrodes) are the Coulomb force and electric field intensity.In this paper because of technical and specialized content, the formulas, calculation and mathematical equations are not provided and the technical calculations are referred to the [6-9] references.

III. AIR IONIZATION ROLE IN THE GREENHOUSES

Greenhouses have played a major role in providing bulk food products because of population growthand agricultural products needed. For this reason, modification and improvement greenhouse's air are needed for the best photosynthesis process. Using of modern technologies especially the artificial air ionization in greenhouses and farms, we can have massive and healthy products. So ithas an undoubted role in the product's augmentation.According to growth/breath in a variety of creatures (plants), as we know, it is dependent on oxygen molecules. Generally in closed greenhouse environments, thereis not enough negative ion of oxygen molecule and the main reason for this problem, is the structure of today's architecture ofbuildings that they have been built mostly with iron grids and metal-concrete(the cement or binder) structures.

These structures reduce the natural effects of environmental factors like electromagnetic fields, ultraviolet ray, infrared ray, natural air ionization and etc., the lack of natural factors mentioned above, will lead to reduction in negative ion density in the environmental air of greenhouses [3]. Hence, using the modern and high technology of air ionization in order to product negative ions, has a direct influence on evolution process of plants and their growth (the air ionization process is the artificial injection of anion or cation into the environments). For this regard, the scientific method and mechanism of anion production in greenhouses is considered a part of modern technologies subjects in agricultural industries (figure 2).

Figure 2: The schematic macro- air ionization system with HV – DC supply and thin electrodes.

Air gaseous molecules after ionization, can transfer the electrical current from one place to another one. Low potential with the presence of electrical current is equivalent to influence photosynthesis process andit causesgrowth of plants or changes and corrects growth conditions in the greenhouses or farms.

The negative ion molecules especially oxygen, will provide a healthy environment for plants growth and optimize the photosynthesis process. On the other hand, using the air ionization technologies in greenhouses, anions have the ability to conquest the microbes and environmental pollution. Also they can reduce the pests and crops disease.

In massive scale, the practical structure of anion production and air ionization in thegreenhouses and farm environments, are directly dependent on physical topics of air electrical discharge.So, artificial air ionization in greenhouses can be done by different methods like single electrode discharge or multi-electrode discharge (figure 3).

According to the required anions, the electrical discharge parameters and external design of electrodes will be changed.

It is necessary to mention that using the composite electrode grids with 5-20 kV discharge source (higher if needed) and locate them on the wall border or greenhouseroof are more affordable and suitable than other various designs[10].

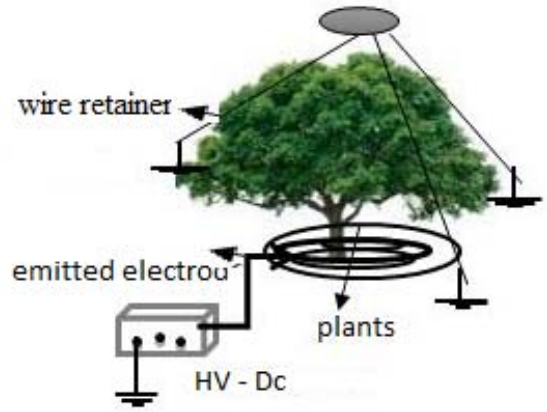

Figure 3: Air ionization by single electrode discharge around trees and plants (HV-DC supply).

IV. CONCLUSION

In the present, airionization of farms/greenhouses environment is one of the offering methods/guideline of controlling way of food crisis and industrial agricultural technologies in the scale of macro farms/greenhouses that directly is dependent on the air particles structure.Artificial air ionization is a high-modern technology that extensively in recent years havetaken into consideration asa supplement to the natural factors for changing and improving the farms and

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method or process of growing plants. This technology has more importance in improvement of plants living conditions in greenhouses.According to the performed research, utilizing the agricultural modern technologies, have an important effect on the quantity and quality of greenhouses and farm products. For this reason, artificial production of greenhouses and farms and negative ion injectionsinto the greenhouses and farm's environmentis a part of research policies in developingcountries for effective exploitation and correction of agricultural conditions and also it is the major milestone in 20th century to increase crops quantity and quality, andreduces the rate of horticultural crop deteriorations.

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Assessment of Knowledge, attitude and Practice of Kermanshahi households about status of solid waste recycling

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Abstract— This cross - sectional study has been performed to assessment of knowledge attitude and practice of people in Kermanshah city, with aim to identify needs and provide appropriate solutions for applying proper management of solid waste recycling in 2014. From different areas of Kermanshah (6 districts), 400 persons were questioned using a self-administered questionnaire. Data analysis was performed by SPSS software (version 16). Results indicated that most people tend to separate waste at home, but due to lack of knowledge recycling is carried improper recovery.

Keywords— Attitude, Kermanshah, Knowledge, Recycling.

I. INTRODUCTION

Population growth, urban development and expansion of major cities, has led to an increase in the amount of waste generated, which increased risk to human health and the environment [1]. In addition, the health hazards of waste disposal, which today is considered one of major problems in development countries, which in turn could threaten the health of human communities. So having health plans and sustainable policies on the collection, transportation, disposal as well as having applicable legislations for solid waste separation and recycling can help the human communities to escape from health problems due to production and release of landfill gas, leachate production and penetrate of it into surface and ground water resources [2]. The recovery process in addition to resolve the mentioned problems can lead to substantial reduction in the amount of waste, reducing consumption of natural resources and prevent extra discharge of pollutants in environment. Finally, reduce the space needed for landfills. It also led to the improvement of health and environmental protection and has large economic benefits [3]. In many countries, recycling is considered as a useful and applicable method in municipal solid waste management system. This method, after waste reduction program has been at the forefront of solid waste management programs [4],[5]. Complete success in the recycling programs except to technical matters need to more cooperate between people and authorities, as well as depends on socio-cultural conditions of society [6], [7], [8], [9]. Because the first and most important step in the recycling is separation of recyclable waste at the source of generation. Therefore, increasing public awareness and encouraging them for separating the recyclable solid wastes, reduces costs and improves the quality of recyclable materials such as paper [2]. Encouraging people to think about recycling can improve amount of recycling waste in society. In practice, some prerequisites must be provided to increase the tendency of households for waste recycling. Increasing public awareness about advantages of recycling in various fields such as health, environment and economic, also training how recyclables wastes can be separate from other waste and maintenance of them can be a suitable solution for creating a culture of thinking in the community for achieving high level of recycling [10]. In this regard, several studies have been conducted in recent years. Ahrampoush and partners carried out a study on knowledge, attitude and practice of Ramesheh region households about solid waste recycling [11]. Bagheri Ardebilian conducted a research about knowledge, attitude of medical students of Zanjan university about importance of waste recycling [2] Samadi et al in Hamedan performed a study on knowledge, attitude of Razan rural households about solid waste management [12].

Therefore, this study aimed to assess the knowledge, attitude and practice of Kermanshahi citizens about solid wastes recycling was carried out in 1391 through a questionnaire survey, with the hope that the results will help the directors to improve the current situation by encourage people to cooperate in recycling programs.

II. MATERIALS AND METHODS

The study used a cross - sectional study was conducted in 1391. The sampling carried out by standard method according to Cochran equation; 400 person randomly selected from six regions of Kermanshah and they questioned by self-administered questionnaire. The questionnaire consisted of four parts; demographic, functional, knowledge and attitude questions that their reliability was determined by Cronbach's alpha test. The questions for knowledge, attitude and practical

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parts were consisting of 18, 11 and 8, respectively. To determine the validity of questionnaire, the content validity method was used with selecting 20 households randomly and the questionnaires were filled at two different times. The result of the test- retest showed 80% correlation. In order to investigate the household knowledge ratings in the range of 0 to 16 was about to ask questions. In order to better clarify the attitude and performance score; the grade was determined in the range of 0 to 20 for each question, which poor performance was zero and high levels was 20. Data analysis using SPSS software version 16 through the t-test was performed.

III. RESULTS AND DISCUSSION

Based on the findings; 208 persons (52%) and 220 persons (48%) of respondents were male and female, respectively. The age of 69% was in range of 20-40 years, 20% in the age range 60-40 years 9% less than 20 years and 2 percent range for more than 60 years. In terms of education level 2 percent were illiterate, 23% of respondents were without diploma, 13 % diploma, 28 percent had a bachelor's Degree and 10% higher. As shown in figure 1, other main variable was job, which according to questionnaire divisions; 28% were employees, 20% were housewives, 11% were students, 25 percent were workers and 9% were without work. From all respondent 57% were married and 43% were unmarried.

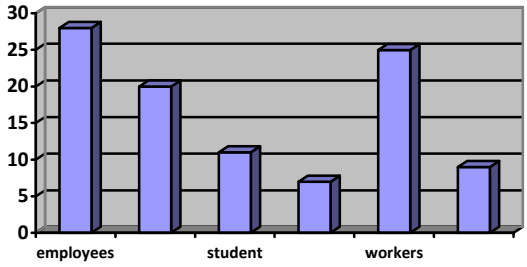

Fig1. Relative abundance of jobs respondents

In this study, the mean knowledge score 8.72 ± 2.47 obtained, which show high knowledge. The mean attitude score of 16.72 ± 2.23 depicted positive attitude of respondents. Mean performance scores was 6.8± 2.4, which indicated poor performance of people for recycling. Results show that the rate of awareness among men and women (sig=0.545) and between married and unmarried (sig=0.403) did not show significant differences. Also, the level of knowledge between different professions (sig = 0.316) are not significantly different. Results show that the rate of awareness among people with different educational levels (sig = 0.00) and different ages (sig = 0.004) correlated significantly, resulting the amount of knowledge increases with age and education level increases (Figure 1).

The study was carried out in Kashan city to show that there is a statistically significant relationship between knowledge and educational levels that correspond with results of present study [13]. The same result was obtained in a study conducted in the city of Ramesheh [11]. Regarding the effect of educational level on knowledge of people about various topics such as solid waste, must raise the level of education as a strategy for better recycling, which should be taken to improve. However, knowledge of the bachelor's degree is high, but the difference between them is very small (Table 1).

As represented in Table 1, the attitude among people with different education levels (sig = 0.762) and different ages (sig = 0.491) have not significant relationship. No significant relationship between attitude and education in present study are same as achieved results of study carried out by Warner and Makla (1998), Meneses and Palacio in 2005 [14] , [15]. On the other hand, results of some studies; Jakus et al. (1996), Owens et al. (2000) and Saphores et al. (2006) reported that people with higher education have a better attitude towards recycling [16], [17], [18].

Table 1 - Comparison of the mean and standard deviation of the knowledge and attitudes of the respondents according to educational level

education levels	frequency	percent	knowledge		attitudes	
			mean	standard deviation	mean	standard deviation
illiterate	8	2.0	3.57	1.01	16.98	1.68
without diploma	92	23.0	7.98	2.88	16.70	2.83
diploma	96	24.0	8.40	1.99	16.25	2.10
higher	52	13.0	8.58	2.30	16.93	1.90
bachelor's Degree	112	28.0	9.14	1.87	16.68	2.64
higher	40	10.0	11.27	1.95	17.61	1.66
Result of analytical test			sig=0.000		sig=0.76	

The results indicated that between the mean scores of variables namely attitude and profession (sig = 0.019) exists significant correlation statistically. So that students, staff members, and housewives have better attitude than unemployed and workers. While the level of attitudes among men and women (sig = 0.897) and between single and married (sig = 0.228) are not significantly different.

However, the level of practice among men and women (sig=0.040) are significantly different and men had better performance for waste recycling, but the results of some previous researches indicated that woman's performance is better than men; Saphores et al (2006) , Ekere et al. (2009) and Sidique et al. (2010) found that women more involved in recycling activities than men[18], [19], [20]. but results show

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that the rate of performance among married and unmarried people (sig=0.971)with different educational levels (sig=0.324) and different ages (sig=0.17) and different jobs (sig=0.963) no correlated significantly. Werner and Makela (1998) found there is no relationship between the performance and age of respondents, same as results of the present study [15]. on the other hand, results of severeal studies such as; Jakus et al. (1996) , Scott (1999), Meneses and Palacio in 2005 and Saphores et al. (2006) determined that older people have better performance and attitude about recycling than younger people [14], [16], [18], [21].

According to Table 2, the source of information about recycling for 51% of people is radio and television and 26% through free study. Therefore, mass media are suitable means to provide education and awareness to the public. Meanwhile, only 8% of the people through training by municipalities were familiar with the recycling plan as mentioned by previous studies [12]. Mee et al. (2004), conducted a study in the UK by using advertising and distribution of pamphlets, banners, email and internet to improve recycling in society. They achieved a successful in raising awareness recovery rates from less than 10% to about 50% [22].

Table 2. Frequency of the source of information in city of Kermanshah on recycling

source of information	Frequency	Percent
Radio & TV	204	51%
Free study	104	26%
News papers	36	9%
training by municipalities	32	8%
Family	24	6%

According to the results, 38% of people giving garbage bags, 25% of people purchasing recycled solids, 18% replace of recycled solids with iodized salt and 9% fiscal incentives to encourage people known as best method for source separation and recycling of waste. Among them giving garbage bags and purchasing recycled solids have been confirmed highly by people.

According to result, 53% Of respondents have stated that the most important factors in the success of the recovery plan is corporation of all people. So 84% of people wishing to participate in the recycling program, as well as 35% represented that the municipalities affected in the successful implementation of this program. And only 12% have stated the private institutions has effect on recycling.

Waste separation and segregation in origin as important activities have confirmed by 85% of people. While, only about 70 percent have attempted to separate their waste at home, which most of the waste is food waste (39%) after that nylon and plastic (20%) and metals (18%) are included.

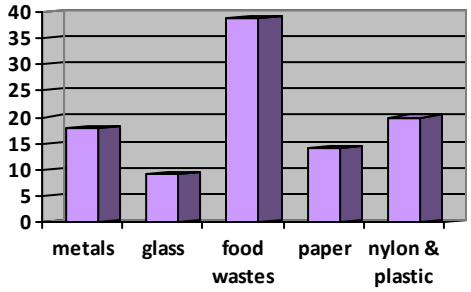

Fig2. Percent of waste separation by people

For storing waste, people using different methods; 34% using bags, 27% container equipped with bags, 20 percent of every pot that is available to use and only 12% of people using separate containers for each of their wastes. The majority of people were against the selling of unwanted material to Vendor, but unfortunately, 57% of people sell their recycle able waste to them. It could be one of the weaknesses in the MSWM in Kermanshah city.

IIII. CONCLUSION

Most residents of the Kermanshah city have moderate knowledge in the field of waste recycling. Most people have a positive attitude towards this issue but their performance is poor. Most people tend to have separation trash at home. But due to lack of knowledge in this field and lack of planning and lack of sustained support from the different areas of this municipality do not separate at the origin. Educational programs to raise awareness households seem necessary. Training if approved by the people through the media (radio and television) can be done to increase the knowledge, attitude and ultimately be beneficial to public health. Purchase of recyclable materials persuasion method is reasonable. Therefore, purchasing recycled materials by municipal and bodies responsible for waste separation at source in addition to encouraging people to control Peddlers would be feasible. Women as the house manager have main role to perform the recovery and separation of source separation. Therefore, should promote women's knowledge and attitudes about recycling plan. Recovery with proper planning and education can provide suitable conditions for people to participate in MSWM programs.

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Probability Distribution of Annual Precipitation in Iran in the period of 1991-2010

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Abstract— Probability distributions are used widely in understanding the rainfall pattern. A comprehensive understanding of precipitation and its distribution pattern in both space and time is essential to the proper design of many structures. This study uses data from the annual rainfall of 140 synoptic stations in the period of 1990 to 2010. Sixty five statistical distribution functions were fitted to the studied time series. The best fit probability distribution was identified based on the minimum deviation between actual and estimated values. The Wakeby distribution was found as the best fit probability distribution for the 47% of synoptic stations. While in about 18% of stations Johnson SB distribution function selected as the best fit and other functions accepted for less than 10% of stations.

Keywords: Johnson SB, Probability distribution function, Rainfall, Wakeby

I. INTRODUCTION

Precipitation is a key component of the hydrological cycle and one of the most important parameters for various natural and socio-economic systems (Schmidli, 2005). Statistical distributions can be employed for the studies such as the design of water structure, the management of water resource and watershed, and the determination of effective factors about hydrologic cycle. However, it is necessary to determine the best-fitted distribution to studied data. The primary aim of frequency analysis is to relate the magnitude of extreme events to their frequency of occurrence using the probability of distributions (Chow et al., 1988). Probability distributions of precipitation have been studied by many experts.

In Iran and other countries, many hydrologist and other experts have analyzed precipitation data. Mashayekhi (1972) considered Iran precipitation as normal distribution. Khalili (1973, 1976) studied 90-year Tehran precipitation data and 10-year central Alburz precipitation data and indicated credibility of gamma distribution. After investigating probability density function of monthly and yearly precipitation data of oldest station of Iran. Markovich (1965) used minimum Square method for flowing assessment and concluded that gamma distribution had the best fitness among other distributions. Keshtkar (2001, 2006) compared moment and L-moment Methods to determine the probability of distributing parameters and suitable distributin for annual discharge series. 20 and 17 hydrometric station was chosen for meaning, maximizing and minimizing annual discharges and maximizing peak discharges respectively. In the central plateau watershed, the best fitted distribution for different annual discharges was studied. Results showed the best fitted distributions: for minimum discharges: Pearson distribution type III (L moment method); for Medium annual discharges: Pearson type III and Log Pearson type III distributions (L moment method); for Maximum annual discharges: Pearson type III (L moment method), Log Pearson type III and two-parameter Log normal (moment method) distributions; for Maximum annual momentous discharges: Log Pearson type III (moment), Pearson type III, three-parameter Log normal and two-parameter Log normal (L moment method) distributions. Haghighatjou (2002) found that log Pearson type III is the best-fitted distribution to monthly data and there are no suitable distributions for yearly precipitation. After investigating of probable suitable distributions for meaning, maximizing and minimizing discharges in Mazandaran hydrological stations. Dinpashoh (2004) studied the regionalization of Iran's precipitation climate by using Data from 77 synoptic stations in Iran. After selecting twelve variables from the 57 candidate variables, using Procrustes Analysis, the selected variables used to regionalize Iran's precipitation climate by factor analysis and clustering techniques. The H and Z-statistics, which were based on the L-moment technique, were used to test the homogeneity of each region and selected the distribution which best-fitted annual precipitation records- in that region. The countrywide area was divided into six regions with homogeneous and one with heterogeneous precipitation climates. They demonstrated Southern coastal of Caspian Sea as B homogeneous region i.e. the best-fitted distribution for annual precipitation records in that region of Generalized Logistic. Mahdavi et al. (2010) selected the best frequency distribution to estimate average annual precipitation of Mazandaran province in the north of Iran. Relative frequency of first classes of fitted distributions showed that normal and Pearson distributions fitness decreased and Gumbel distribution had more fitness with data series by increasing statistical period length. Nazeri Thrudi et al. (2013) studied peak flow data of Babolrood River located in the Babol city of Mazandaran province in the north of Iran for frequency analysis and selected log-Pearson III distribution function among different distribution functions.

Campbell (1981) found that the log Pearson type III distribution was the best distribution for culvert design in small-forested watersheds. Whereas Gumbel distribution

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with L-Moment method has been found to be a suitable distribution for peak flows by Gingras and Adamowski (1992), Pilon, and Adamowski (1992) and Wallis(1988). Tase (1982) assessed 50-year precipitation data of 82 meteorological stations in Japan and considered normal distribution for these data. Reich (1983) indicated monthly precipitation as a function of Gumbel distribution based on 15-year data. Aksoy (2000) used two parametric Gamma distributions in hydrological analysis. Based on results of a research conducting in the Seyhan river basin in Turkey (Topaloglu, 2002), Gumbel, log-Logistic, Pearson type III, log-Pearson type III and log-normal-3 distributions were applied to the series of annual instantaneous flood peaks and annual peak daily precipitation for 13 flow gauging and 55 precipitation gauging stations. According to the evaluations of chi-squared tests, Gumbel (the moments methods) for both hydrological and precipitation stations were founded to be the best models. Based on the K-S test, log-normal-3 (the moments methods) and log Pearson type III (Method of moments) models were determined to be the best for hydrological and precipitation stations, respectively. Husak et al. (2004) fitted Gamma distribution on monthly precipitation to analyse African droughts. Suhaila and Jemain (2007) used exponential distribution for daily precipitation of Penin Sular Malaysia. Dahamsheh et al. (2007) described the structural characteristics and temporal and spatial variation of annual precipitation data in Jordan, together with possible projections for the future and using the probability distribution. Based upon their results, annual precipitation in Jordan was consistent in time with evidence of randomness. Finally they identified three distinct regions as 3-parameter lognormal distribution in the east, gamma distribution in the south and log-Pearson Type III distribution in the remainder of the country based on the chi-square goodness of fit test.

II. MATERIALS and METHODS

The study area

The study area encompasses the entire region of Iran's geographical area of about 1650,000 km^2. Iran is located in Asia, approximately between 25°00′N and 38°39′N latitudes and between 44°00′E and 63°25′E longitudes (Fig. 1). The mean annual precipitation of Iran is about 224 mm. The data were compiled from the Iran Meteorological Organization, and 140 stations with sufficient length of records during the period of 1991–2010 were selected for the present analysis. Amount of annual average precipitation recorded at selected stations presented in Table 1.

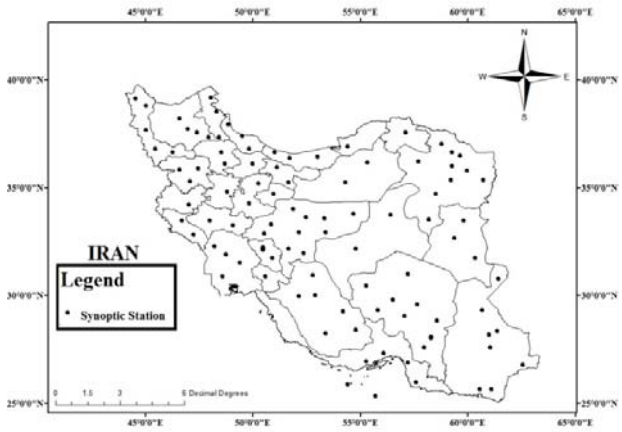

Figure 1 - Location of the synoptic stations in Iran

Table 1 – Annual average precipitation Data of 140 synoptic stations in Iran

Station	P (mm)	Station	P (mm)	Station	P (mm)	Station	P (mm)	Station	P (mm)
Khoramdareh	301.4	Garmsar	119.3	Ghchan	312.5	Tabas	84.2	Mashad	**242.6**
Kohrang	1358.3	Ardestan	126.6	Abomosa	133.5	Qom	148.6	Abadan	**161.7**
Lar	203.4	Bandare dair	210.5	Aghajari	269.4	Kermanshah	405.8	Ahvaz	**222.5**
Malayer	317.9	Bandare Mahshar	205.9	Qaemshahr	724.2	Orumiyeh	301.3	Arak	**306.2**
Manjil	208.0	Behbahan	305.3	Konarak	108.3	Dezfol	376.6	Babolsar	**907.2**
Marivan	926.3	Bijar	331.8	Karaj	250.1	Gorgan	514.4	Bandarabbas	**169.3**
Miyaneh	273.0	Berojen	273.7	Serakhs	192.5	Hamedan	321.7	Birjand	**158.4**
Maraveh	353.2	Bashroeyeh	93.1	Parsabad	268.1	Shahrud	156.5	Boshehr	**266.2**
Naeen	96.1	Bostan	193.7	Ferdous	136.7			Isfahan	**131.9**
Natanz	188.4	Borojerd	463.1	Sirjan	140.8	Zabol	59.1	Gazvin	**314.8**
Neyshabur	237.7	Daran	327.6	Dogonbadan	428.9	Chabahar	121.5	Khoramabad	**476.9**
Piranshahr	643.9	Dehloran	267.3	Jolfa	206.8	Iranshahr	109.7	Khoy	**251.8**
Ramhormoz	310.3	Islamabad	457.8	Mako	295.2	Semnan	139.7	Ramsar	**1177.7**
Ravansar	512.6	Qorveh	343.6	Masjed Soleyman	425.4	Bandare Lengeh	135.0	Rasht	**1315.7**
Robat-Poshtbadam	106.3	Golmakan	197.2	Minab	207.9	Kashan	134.2	Sabzevar	**187.4**
Dorodzan-Dam	478.8	Golpayegan	258.0	Nehbandan	129.2	Fasa	290.2	Saqes	**452.5**
Sarab	242.6	Gonabad	137.6	Dezfol	329.1	Jask	120.1	Sanandaj	**389.0**
Saravan	104.2	Ilam	570.5	Qaeen	156.9	Doshan-Tapeh	248.7	Shahrekord	**328.4**
Sardasht	849.6	Izeh	653.5	Baft	253.3	Ardabil	284.8	Shiraz	**331.5**
Sarepol-	417.8	Kabutarabad	115.0	Kahnoj	198.6	Eest Isfahan	105.9	Tabriz	**239.8**

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Zahab									
Saveh	191.8	Gangam-Jam	328.5	Jiroft	210.6	Hamedan Airport	311.5	Tehran	**239.8**
Shahreza	139.2	Kangavar	385.0	Rafsanjan	80.4	Abadeh	134.3	Torbat-Heydariyeh	**265.3**
Tekab	313.2	Kashmar	194.9	Shahrbabk	149.4	Bojnord	260.9	Yazd	**53.7**
Torbat-Jam	172.4	Khalkhal	367.5	Anar	69.0	Noshahr	1274.9	Zahedan	**75.1**
Yasoj	829.4	Khash	159.9	Ahar	277.3	Kish	161.8	Zanjan	**284.7**
Zahak	45.7	Khodabandeh	392.7	Aligodarz	399.2	Omideyh Paygahi	269.5	Bam	**53.5**
Zarqan	323.5	Khor-Biyabanak	80.6	Astara	1354.9	Siri	133.7	Kerman	**129.3**
Zarineh	388.7	Khor-Birjand	88.1	Boshehr	272.7	Meragheh	287.4	Bandare Anzaly	**1649.4**

Before any modeling and fitting data in order to estimate return period, it is necessary to test for independency, trend and homogeneity. Therefore Wilcoxon and Mann-Kendall tests employed.

Wilcoxon test

Nonparametric Wilcoxon test is used to compare a variable in two different situations without considering normality assumption. This test according to the difference between positive and negative data, attempted to estimate homogeneity of the data (Mohagheghi Tajdari, 2009 and Albert and Bowker, 1972).

$$Z = \frac{T - \frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}}} \quad (1)$$

Where n is sample size and T is sum of ranks that showed increasing (or reducing) in the difference. Z-Statistic is tested by two-sided or one-sided hypothesis testing. If the sample size was small this statistic is compared with the value of the Wilcoxon table and in large sample sizes normal distribution is used to accept or reject the null hypothesis.

For testing randomness of data, Run test nonparametric test is applied. This test presented by Abraham Wald and Jacob Wolfowitz that defined as: (Nazeri et al. 2013).

$$R = r_a + r_b \quad (2)$$

$$Z = \frac{R - \left(\frac{2n_a n_b}{n_a n_b} + 1\right)}{\sqrt{\frac{2n_a n_b (2n_a n_b - n_a - n_b)}{(n_a + n_b)^2 (n_{a*} n_b - 1)}}} \quad (3)$$

In these equations, n_a is number of data less than median, n_b defined as the number of data more than median and r_a and r_b are sequence of data that are less and more than central index respectively. Calculated Z value is tested at confidence level of 90, 95 and 99% as follows:

Confidence level of 90%: -1.645 <Z <1.645

Confidence level of 95%: -1.96 <Z <1.96

Confidence level of 99%: -2.575 <Z <2.575

Mann – Kendall Test

Mann - Kendall test presented by Kenall (1930) based on a correlation coefficient. Correlation coefficients measure relation between two sets of variables and determine whether one variable increases, the second variable increases, decreases, or it is not associated with changes in patterns. Mann-Kendall defining statistic S is defined as follows:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} sign\left(X_i - X_j\right) \quad (4)$$

Where X_j and X_i are sorted sample values and n is the number of samples. Value of sign(X_i-X_j) for (X_i-X_j) <0, is equal to -1, for (X_i-X_j) = 0, is equal to zero and zero for (X_i-X_j)> 0, is equal to 1. Standardize value of Z and variance of S is calculated as follows:

$$Z_c = \begin{cases} \frac{S-1}{\sqrt{Var(S)}} & ,S > 0 \\ 0 & ,S = 0 \\ \frac{S+1}{\sqrt{Var(S)}} & ,S < 0 \end{cases} \quad (5)$$

Positive Z values indicate increasing trends and negative z values indicate a decreasing trend.

$$Var(S) = \frac{1}{18}[n(n-1)(2n-5) - \sum_{p=1}^{q} t_p (t_p - 1)(2t_p + 5)] \quad (6)$$

t_p is the number of node for pth value and q is the number of nodes.

After testing data almost 65 distribution functions fitted and the best fitted models to the rainfall data determined. The best-fitted distribution functions described as follows:

1- Exponential Distribution

$$F(x) = \lambda \exp\left[-\lambda (x - \gamma)\right] \quad (7)$$

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Where, λ is the inverse scaled parameter and γ is the location parameter.

2- Gen Pareto distribution

$$F(x)=\begin{cases}\frac{1}{\sigma}\left(1+k\,\frac{x-\mu}{\sigma}\right)^{-1-1/k} & k\neq 0\\ \frac{1}{\sigma}\exp\left(-\frac{x-\mu}{\sigma}\right) & k=0\end{cases} \quad (8)$$

Where α, k and β are function parameters (Mohagheghi and Tajdari, 2005).

3- GEV distribution

$$F(x)=\frac{1}{\alpha}[1-\frac{k}{\alpha}(x-\mu)]^{\frac{1}{k}-1}\exp\{-[1-\frac{k}{\alpha}(x-\mu)]^{\frac{1}{k}}\}\ (9) \quad (9)$$

Where, α is the inverse scaled parameter, μ is the average of data and k is the shape parameter (ALentron, 2007).

4- Log Logistic Distribution

$$F(x)=\frac{\alpha}{\beta}\left(\frac{x-\gamma}{\beta}\right)^{\alpha-1}\left(1+\left(\frac{x-\gamma}{\beta}\right)^{\alpha}\right)^{-2} \quad (10)$$

Where β, α and γ are function parameters.

5- Weibull distribution

$$F(x)=\frac{c}{\alpha}(\frac{x-\gamma}{\alpha})^{c-1}exp\left[-(\frac{x-\gamma}{\alpha})^{c}\right] \quad (11)$$

Where, c is the shape parameter, α and γ are standard deviation and mean of data respectively.

6- Normal distribution

$$F(x)=\frac{1}{\sigma\sqrt{2\pi}}\exp\left\{-\frac{(x-\mu)^2}{2\sigma^2}\right\} \quad (12)$$

Where, σ is the shape parameter, α and γ are standard deviation and mean of data respectively.

7- Lognormal distribution

$$F(x)=\frac{1}{x\sigma\sqrt{2\pi}}\exp\left\{-\frac{[\ln x-\mu]^2}{2\sigma^2}\right\} \quad (13)$$

Where, σ and μ are standard deviation and mean of data respectively.

8- Gamma distribution

$$F(x)=\frac{(x-\gamma)^{\alpha-1}}{\beta^{\alpha}\Gamma(\alpha)}\exp\left(-\frac{(x-\gamma)}{\beta}\right) \quad (14)$$

Where, α is the shape parameter, β and γ are standard deviation and mean of data respectively.

9- Log Pearson type 3 distribution

$$F(x)=\frac{1}{x\beta\Gamma(\alpha)}\left(\frac{\ln(x)-\gamma}{\beta}\right)^{\alpha-1}e^{\left(-\frac{\ln(x)-\gamma}{\beta}\right)} \quad (15)$$

Where, α is the shape parameter, β and γ are standard deviation and mean of data respectively.

10- Wakeby Distribution

$$X(f)=\xi+\frac{\alpha}{\beta}(1-(1-f)^{\beta})-\frac{\gamma}{\delta}\left(1-(1-f)^{-\delta}\right) \quad (16)$$

Where, α, β, γ, δ, ξ are model parameters. The following conditions are considered:

$$\alpha\neq 0 \quad \text{or} \quad \gamma\neq 0$$
$$\beta+\delta>0 \text{ or } \beta=\gamma=\alpha=0$$
$$\text{if } \alpha=0 \text{ then } \beta=0 \text{ and if } \gamma=0 \text{ then } \delta=0$$

11- Johnson SB Distribution

$$F(x)=\frac{\delta}{\lambda\sqrt{2\pi}z(1-z)}\exp\left(-\frac{1}{2}\left(\gamma+\delta\ln\left(\frac{z}{1-z}\right)\right)^2\right) \quad (17)$$

Where, λ, γ, δ, ξ are model parameters.

12- Cauchy Distribution

$$F(x)=\left(\pi\sigma\left(1+\left(\frac{x-\mu}{\sigma}\right)\right)^2\right)^{-1} \quad (18)$$

Like the normal distribution, σ and μ are the standard deviation and mean of data respectively.

A number of methods can be used for parameter estimation. These include the method of moments (MOM), the maximum likelihood method (MLM), the probability weighted moments method (PWM), the least squares method (LS), maximum entropy (ENT), mixed moments

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(MIX), the generalized method of moments (GMM), and incomplete means method (ICM). one of the more commonly used method is considered here, namely, the maximum likelihood method (Ramachandra and Khaled, 2000).

Maximum likelihood method (MLM)

The maximum likelihood method (MLM) is considered the most efficient method since it provides the smallest sampling variance of the estimated parameters, and hence of the estimated quantiles, compared to other methods. However, for some particular cases, such as the Pearson type III distribution, the optimality of the ML method is only asymptotic and small sample estimates may lead to estimates of inferior quality (Bobeé and Ashkar, 1991). Also, the ML method has the disadvantage of frequently giving biased estimates, but these biases can be corrected. Furthermore, it may not be possible to get ML estimates with small samples, especially if the number of parameters is large. The ML method requires higher computational efforts, but with the increased use of high-speed personal computers, this is no longer a significant problem. Estimation by the ML method involves the choice of parameter estimates that produce a maximum probability of occurrence of the observations. The Likelihood function of f(x) is:

$$L = \prod_{i=1}^{n} f\left(x_i\right) \tag{19}$$

Since the probability density functions, which are used in hydrology, are mainly power or exponential, therefore, following equation can be used (Chin-Yu Lee, 2004 and Bhakar et al. 2005):

$$LnL = \sum_{i=1}^{n} Ln\left[f\left(x_i\right)\right] \tag{20}$$

Kolmogorov–Smirnov Test

A statistic based on the deviations of the sample distribution function $F_N(x)$ from the completely specified continuous hypothetical distribution function $F_o(x)$ is used in this test. The test statistic D is defined:

$$D_N = \max\left|FN\left(X\right) - F0\left(X\right)\right| \tag{21}$$

The values of $F_N(x)$ are estimated as where N_j is the cumulative number of sample events at class limit j. $F_o(x)$ is then 1/k, 2/k, ... etc., where k is the number of class intervals. Class limits are obtained the same way as in the chi-square test. The value of D_N must be less than a tabulated value of D_N at the required confidence level (Kolmogorov, 1933; Table VIII) for the distribution to be accepted.

III. RESULTS and DISCUSSION

Before fitting distribution functions on annual precipitation data, primary tests have been used and studied data accepted by Wilcoxon and Mann-Kendall tests at 1 and 5 percents significant. Results of Mann-Kendall summarized in Table 2.

Table 2 –Trend analysis results of annual precipitation by Mann-Kendall test in Iran

Station	P-value	**Station**	P-value	**Station**	P-value	**Station**	P-value	Station	**P-value**
Khoramdareh	0.837	Garmsar	0.837	Ghchan	0.854	Tabas	-0.333	Mashad	**0.156**
Kohrang	0.450	Ardestan	1.000	Abomosa	0.058	Qom	-0.156	Abadan	**-0.111**
Lar	0.119	Bandare dair	0.173	Aghajari	0.951	Kermanshah	0.022	Ahvaz	**-0.022**
Malayer	0.465	Bandare Mahshar	0.243	Qaemshahr	0.951	Orumiyeh	0.333	Arak	**-0.022**
Manjil	0.251	Behbahan	0.917	Konarak	0.760	Dezfol	0.067	Babolsar	**0.422**
Marivan	0.175	Bijar	0.064	Karaj	0.951	Gorgan	0.333	Bandarabbas	**-0.022**
Miyaneh	0.631	Berojen	0.008	Serakhs	0.127	Hamedan	-0.022	Birjand	**0.111**
Maraveh	0.465	Bashroeyeh	0.876	Parsabad	0.583	Shahrud	-0.289	Boshehr	**0.467**
Naeen	0.348	Bostan	0.492	Ferdous	0.951			Isfahan	**-0.200**
Natanz	0.917	Borojerd	0.533	Sirjan	0.058	Zabol	0.289	Gazvin	**-0.200**
Neyshabur	1.000	Daran	0.350	Dogonbadan	0.760	Chabahar	0.111	Khoramabad	**0.333**
Piranshahr	0.450	Dehloran	0.858	Jolfa	0.032	Iranshahr	0.422	Khoy	**0.111**
Ramhormoz	0.243	Islamabad	0.064	Mako	0.099	Semnan	-0.022	Ramsar	**-0.333**
Ravansar	1.000	Qorveh	0.350	Masjed Soleyman	0.246	Bandare Lengeh	0.022	Rasht	**0.200**
Robat-Poshtbadam	0.754	Golmakan	0.631	Minab	0.299	Kashan	0.067	Sabzevar	**-0.067**
Dorodzan-Dam	0.640	Golpayegan	0.917	Nehbandan	0.945	Fasa	-0.067	Saqes	**-0.067**
Sarab	0.837	Gonabad	0.537	Dezfol	0.537	Jask	0.111	Sanandaj	**0.333**
Saravan	0.837	Ilam	0.731	Qaeen	0.047	Doshan-Tapeh	-0.022	Shahrekord	**-0.111**
Sardasht	0.243	Izeh	1.000	Baft	0.119	Ardabil	0.022	Shiraz	**0.022**

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Sarepol-Zahab	0.537	Kabutarabad	1.000	Kahnoj	0.350	Eest Isfahan	0.022	Tabriz	**-0.289**
Saveh	0.076	Gangam-Jam	0.007	Jiroft	0.275	Hamedan Airport	-0.333	Tehran	**-0.200**
Shahreza	0.047	Kangavar	0.945	Rafsanjan	1.000	Abadeh	-0.111	Torbat-Heydariyeh	**0.289**
Tekab	0.731	Kashmar	0.945	Shahrbabk	0.149	Bojnord	-0.156	Yazd	**-0.422**
Torbat-Jam	0.917	Khalkhal	0.064	Anar	0.073	Noshahr	-0.067	Zahedan	**0.422**
Yasoj	0.372	Khash	0.033	Ahar	0.945	Kish	0.062	Zanjan	**-0.022**
Zahak	0.251	Khodabandeh	0.901	Aligodarz	0.945	Omideyh Paygahi	0.154	Bam	**0.000**
Zarqan	0.086	Khor-Biyabanak	0.731	Astara	0.450	Siri	0.299	Kerman	**0.156**
Zarineh	0.161	Khor-Birjand	1.000	Boshehr	0.064	Meragheh	0.100	Bandare Anzaly	**0.022**

Different distribution functions fitted to the time series of annual precipitation that recorded at synoptic stations of Iran and among sixty five distribution functions only twelve functions had the best fit. Result of selected distribution functions for each station presented in table 3.

Table 3 – The best fitted distribution functions for annual precipitation in Iran

Station	Distribution Function	Station	Distribution Function	Station	Distribution Function	Station	Distribution Function	Station	Distribution Function
Khoramdareh	GEV	Garmsar	Wakeby	Ghchan	J. SB	Tabas	G. Pareto	Mashad	**L. logistic**
Kohrang	J. SB	Ardestan	**Wakeby**	Abomosa	GEV	Qom	GEV	Abadan	**Wakeby**
Lar	Wakeby	Bandare dair	Wakeby	Aghajari	J. SB	Kermanshah	Wakeby	Ahvaz	**Wakeby**
Malayer	J.SB	Bandare Mahshar	Cauchy	Qaemshahr	Wakeby	Orumiyeh	Wakeby	Arak	**J. SB**
Manjil	L. logistic	Behbahan	Wakeby	Konarak	Wakeby	Dezfol	Normal	Babolsar	**Wakeby**
Marivan	J. SB	Bijar	Cauchy	Karaj	J.SB	Gorgan	GEV	Bandarabbas	**J. SB**
Miyaneh	Wakeby	Berojen	GEV	Serakhs	Wakeby	Hamedan	Wakeby	Birjand	**L. logistic**
Maraveh	GEV	Bashroeyeh	Wakeby	Parsabad	Wakeby	Shahrud	Wakeby	Boshehr	**Wakeby**
Naeen	Wakeby	Bostan	Lp3	Ferdous	Wakeby			Isfahan	**GEV**
Natanz	Cauchy	Borojerd	Wakeby	Sirjan	J. SB	Zabol	Wakeby	Gazvin	**Wakeby**
Neyshabur	Wakeby	Daran	lp3	Dogonbadan	Wakeby	Chabahar	J. SB	Khoramabad	**L.Normal**
Piranshahr	J. SB	Dehloran	Wakeby	Jolfa	J. SB	Iranshahr	J. SB	Khoy	**J. SB**
Ramhormoz	J. SB	Islamabad	Wakeby	Mako	GEV	Semnan	Wakeby	Ramsar	**Wakeby**
Ravansar	J. SB	Qorveh	L. logistic	Masjed Soleyman	G. Pareto	Bandare Lengeh	Weibull	Rasht	**Wakeby**
Robat-Poshtbadam	GEV	Golmakan	Wakeby	Minab	Wakeby	Kashan	J. SB	Sabzevar	**Wakeby**
Dorodzan-Dam	Cauchy	Golpayegan	Wakeby	Nehbandan	Wakeby	Fasa	Wakeby	Saqes	**J. SB**
Sarab	Wakeby	Gonabad	Wakeby	Dezfol	Wakeby	Jask	L normal	Sanandaj	**Cauchy**
Saravan	J. SB	Ilam	NORMAL	Qaeen	L.N.3	Doshan-Tapeh	G. Pareto	Shahrekord	**J.SB**
Sardasht	J. SB	Izeh	Gamma	Baft	J. SB	Ardabil	J. SB	Shiraz	**Cauchy**
Sarepol-Zahab	GEV	Kabutarabad	L. logistic	Kahnoj	Wakeby	Eest Isfahan	Wakeby	Tabriz	**Wakeby**
Saveh	Gamma	Gangam-Jam	Wakeby	Jiroft	Wakeby	Hamedan Airport	GEV	Tehran	**G. Pareto**
Shahreza	Wakeby	Kangavar	Gamma	Rafsanjan	Wakeby	Abadeh	L logistic	Torbat-Heydariyeh	**LP3**
Tekab	GEV	Kashmar	Wakeby	Shahrbabk	Wakeby	Bojnord	LP3	Yazd	**Cauchy**
Torbat-Jam	Wakeby	Khalkhal	J. SB	Anar	Wakeby	Noshahr	L. logistic	Zahedan	**weibull**
Yasoj	Cauchy	Khash	Normal	Ahar	Gamma	Kish	Exponintial	Zanjan	**Wakeby**
Zahak	Wakeby	Khodabandeh	Wakeby	Aligodarz	Wakeby	Omideyh Paygahi	Wakeby	Bam	**J. SB**
Zarqan	Wakeby	Khor-Biyabanak	Wakeby	Astara	Wakeby	Siri	L logistic	Kerman	**Wakeby**
Zarineh	Wakeby	Khor-Birjand	Weibull	Boshehr	Wakeby	Meragheh	G. Pareto	Bandare Anzaly	**Wakeby**

To determine the best function, the Kolmogorov–Smirnov test, P-P and Q-Q plots used. A P-P plot compares the empirical cumulative distribution function of a data set with a specified theoretical cumulative distribution function. But a Q-Q plot compares the quantiles of a data distribution with the quantiles of a standardized theoretical distribution from a specified family of distributions. For example P-P and Q-Q plots of Urmia synoptic station presented in Figure 2. Also best-fitted distribution function for Urmia synoptic station showed in figure 3.

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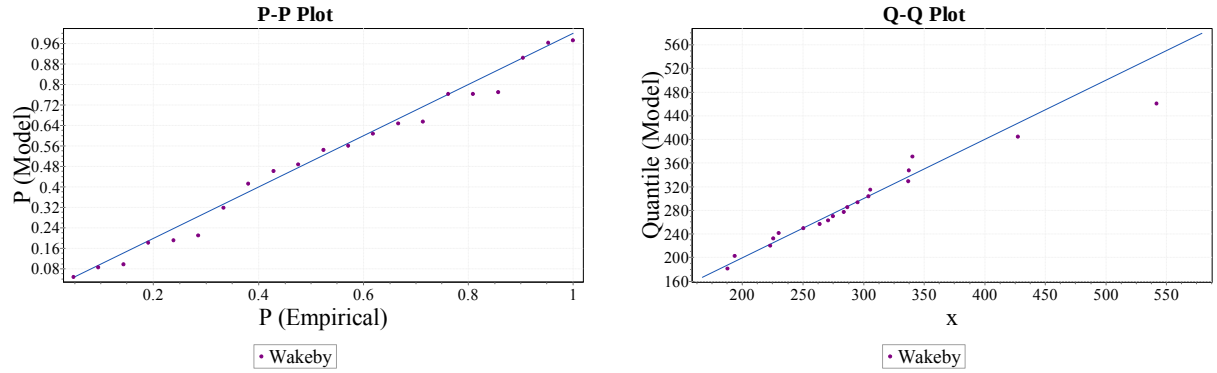

Figure 2 – P-P and Q-Q plots for Urmia synoptic station

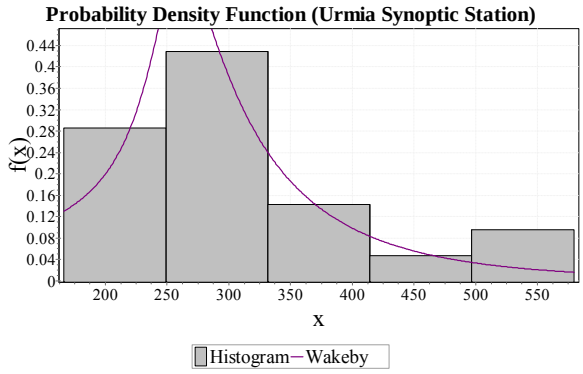

Figure 3 – PDF of fitted distribution for Urmia synoptic station

Descriptive statistics of the sample data (consist of mean, variance, maximum, minimum, skewness and etc.) and modeled data by selected distributions compared. Correlation between samples and models confirmed selected distribution functions as presented in Figure 4 in Isfahan synoptic station.

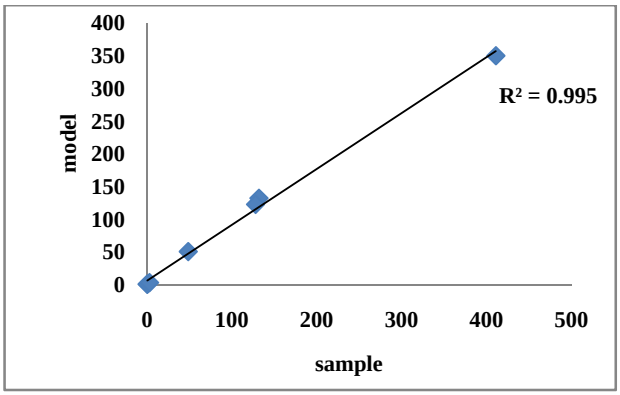

Figure 4 – Sample and model correlation in Isfahan synoptic station

IV. CONCLUSION

In this study 140 synoptic stations of Iran that recorded annual precipitation used to identify the best distribution function in the last two decades. Among 65 different distribution functions only 12 functions confirmed as the best distribution for each station via Kolmogorov - Smirnov and P-P and Q-Q plots. As results showed almost 47% and 18% of stations follow Wakeby and Johnson SB distribution functions. Other distribution functions accepted for less than 10% of studied stations. It can be concluded that distribution functions with more parameters had the best results in compare with the others that is in accordance with results of Keshtkar (2006). Finally Wakeby distribution suggested as the best fitted model for the most stations of Iran in the last 20 years.

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Recognition of Red Grape Bunches Using Image-Processing for Application in Designing Grape-Harvester Robots

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Abstract—Considering the increase in the extent of the grape fields and expenses of work force, mechanizing the harvesting process has become one of the important issues in the recent years. In this study, an algorithm has been designed to enable harvester robots to spot the location of the red grape bunches on the grape tree. In order to design this algorithm, first, five hundred pictures of red grape bunches in their natural status on the grape tree were provided. Then, color data for each element of the picture including the grape bunch and background (leaves, branches, and sky) were extracted and analyzed. Finally, for the recognition of the red grape bunches RGB color environment was used. Results indicate that the algorithm can extract 98% of a red grape shape in a picture.

Keywords—Red grape, Picture processing, Vision machine.

I. Introduction

Grape is considered of the most important farm products in Iran and in the world for its high economical and nutritive value and is widely harvested. Currently, having 306,000 hectares of grape fields and a production of over 3 million tons of grape every year, Iran is one of the major producers of grape in the world (FAO 2000). In the West-Azerbaijan province of Iran, particularly in cities such as Urmia and Sardasht, the production of grape and its other sub-products is prevalent. Grape production has a major role in the economy and the income of the residents and farmers of the region. Various factors and conditions must be considered in the storing of the grape products such as its species, harvesting time, method of harvesting, and transportation. One of the important ways for increasing consumer access to farm products is to decrease wastes in the harvest time. In recent years, farmers have noticed that workers can face many problems in harvesting farm products such as grape. So, mechanizing the process of harvesting process (especially for grape) has gained much importance. Mechanization process requires new techniques such as vision machines which will decrease the wastes, increase efficiency, and bring about increased quality in the production of the product.

Up until now, several studies on harvester vision machines haves been conducted. Feng et al. (2008) used the OHTA algorithm introduced by Yu-Ichi and Takeo (1980). The results showed that this algorithm could recognize the species of the strawberry with 93% precision.

Choi (2005), Arefi et al. (1389), both devised algorithms which could recognize ripe and green tomatoes. In these studies, the color-relations were written in a mixture of RGB, HIS, and YIQ environments. In both studies the algorithm was able to recognize the size of the tomatoes in respectively 77% and 96% percent of the cases - but under laboratory conditions and with artificial lights.

Tanigaki et al. (2008) designed a cherry-harvester vision-robot which used three types of pictures (infrared, red, and range image) for harvesting. Their image processing and algorithm operation only consisted of partitioning the images. Bulanon et al. (2005) designed a robot for harvesting red Fuji apples. The algorithm was designed in a way that it could only recognize the largest fruit in a single image.

Henten et al (2002) designed a robot for harvesting greenhouse cucumbers. The designed vision algorithm could recognize cucumbers with 95% precision. Because the color and the leaves of cucumbers have the same color, recognition based on color prism technique was used to identify product and the bush.

Zand et al (1390) proposed a model for the recognition of greenhouse cucumbers with a focus on neural networking. For this purpose, after stabilizing the light histograms, an image is multiplied by another picture containing a cucumber. This will produce larger indices in the suspected regions which may contain cucumbers. With the extraction of this regional background, primary spots supposed to have cucumbers are identified. Then, in order to exactly identify the position of the cucumbers, these spots and locations are referred to the neural network which uses a number of cucumber and non-cucumber picture, and finally, an appropriate answer is deducted. This network identifies spots containing cucumbers with 93% precision.

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One of the general goals of this study is to develop an algorithm with a high precision for identifying red grape bunches on grape trees using digital images for the purpose of decreasing work-force expenses of harvesting red grapes by replacing robots in the farm operations.

II. Materials and Method

The images used in this study were provided from four varieties of seedless red grape species in Urmia city. A number of 500 digital images of red grape bunches with seven mega pixel resolution were taken by a CanonPowerShot SX30 IS digital camera.The pictures were taken from the front, above, and below with a distance of one meter in different conditions of natural light (cloudy and sunny). For saving and processing the pictures, a Core i3 (Dell) notebook, and for implementing the vision algorithm of grape-recognition MATLAB R2010b software was used. In order to analyze the effects of environmental light on the algorithm, imaging was done under different conditions in seven days of Shahrivar and Mehr (Persian months) of 1390 - the best time for harvesting grapes. The images were taken between 9 a.m. to 6 p.m. Because of sudden changes in weather conditions, there is some variability in the clarity of the images, so clarity and vividness of the objects in the pictures are different in every picture. The amount of light in the obtained pictures ranges from dark (in a cloudy weather) to direct sun light reflected inside the grape tree or reflected from behind.

Fig.1 red grape bunch (to see the colors in the picture use color printing or digital version of the article)

Identification of the grape bunches were done in two stages of omitting the background and identification of the grape bunch (Picture 1). For the recognition of the red grape bunch on the tree and separating it from other image classes a color recognition algorithm was designed. The RGB color environment was used to do the processes. This algorithm operates based on separate color components of red, green, and blue and puts these components on each other (addressing the color components). The algorithm categorizes everything in the picture to four groups of things, namely gape bunches, green leaves, branches, and sky. These groups of images are called classes. Thus, the output of the algorithm is defined as red grape bunch class, leaves class, branches class, and sky class.

The first stage in the recognition of the red grape bunch is cutting out the background. Complete and correct elimination of the background is very effective in the process of identification of the red grapes. In order to be able to omit the background, first, it is necessary to extract color components of each of the elements of the image. For extracting the color characteristics of grapes, leaves, trunk, and sky the components of R, G, and B form the RGB color environment were used.

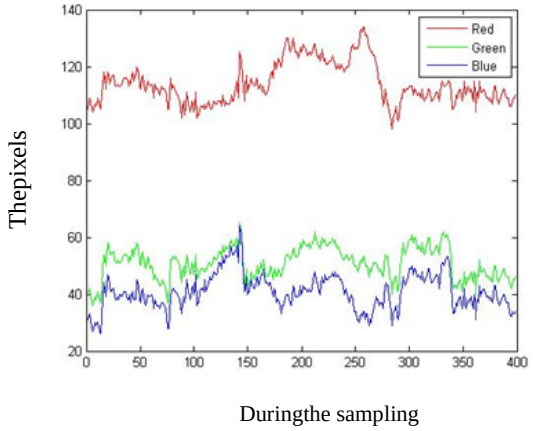

Fig. 2(a) Intensityprofilesof graylevelvaluesto theclassof redgrapes

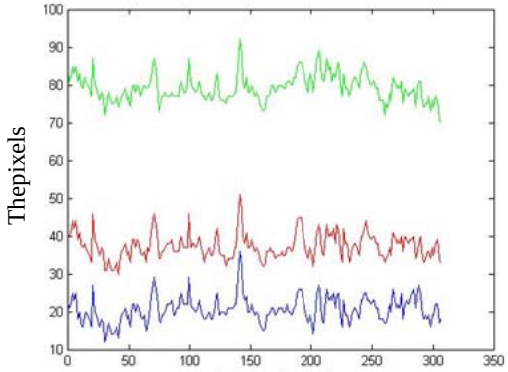

Fig. 2(b) Classof Leaves

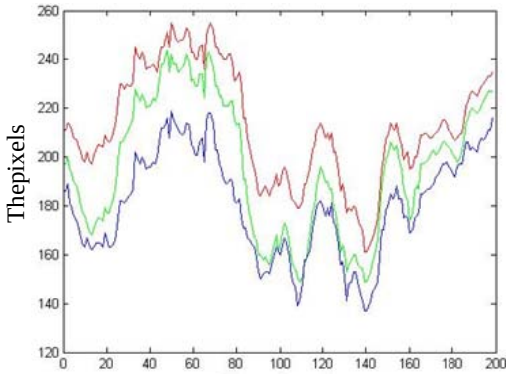

Fig. 2(c) Classof branches

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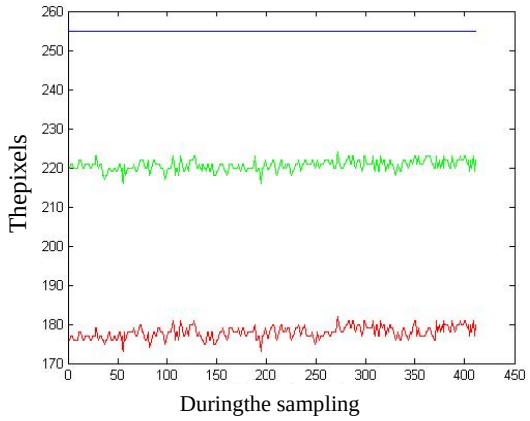

Fig. 2(d) ClassSky

The obtained profiles of the red grape bunch, leaves, branches and sky are shown in Picture 2 below. As is obvious from the profiles, the difference in the red and green components of the grape bunch in comparison with the red and green components of the background have a higher amount of gray level. This component difference can be used for the identification of the red grape bunch. To put it another way, the differences of the red and green components can be effectively used for eliminating the background.

After identifying the average for the color components of the red grape, the conclusion was reached that the density of the gray areas of the pixels on the red component (R) had the largest amount and the number of pixels on the green component (G) and the number of pixels on the blue component (B) had the largest amounts after the red component, respectively. To put it mathematically:

$$R > G > B \qquad (1)$$

numbers larger than this threshold amount, a binary image is achieved. In this binary image the number [1] shows the grape bunch and [0] shows gray areas of the background. Now, the R-G image has been converted to a binary image. Then, the resulted binary image is multiplies by gray images of red, green, and blue components. In order to achieve an image without background, red, green, and blue components are combined together. The results of eliminating the background and the extracted red grape bunch are shown in Picture 3.

III. Results and Discussion

The first stage in identifying a grape bunch was eliminating its background. An image with eliminated background and only consisting of the grape bunch can simplify the identification process greatly. Analysis of 200 digital pictures showed that the shapes, locations, and sizes of objects in the background were different in every picture. In most of the images the only background objects seen were branches and leaves, however in in others, as well as branches and leaves, soil or cement pillars used in the garden were also visible. Because the leaves usually cover some arias of the grape fruit in most of the images, therefore it was not feasible to eliminate them. Plus, using the features of the images to omit the leaves was impossible because of the large number of the leaves and their variable sizes, this would take a very long time. Finally, in order to cut out the backgrounds, color features were used. First, the algorithm was run on all the images. The results are shown on Table 1:

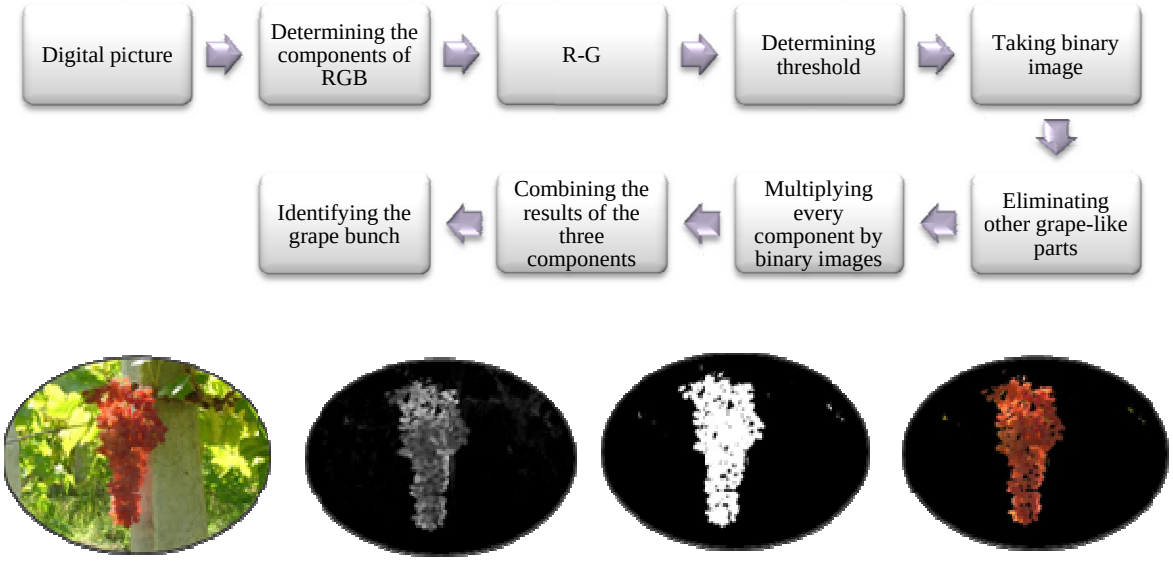

Fig3. Resulted pictures from running the algorithm of the red grape bunch (read from lefttoright; to see the colors on the picture use color printing or digital format of the article)

The color data related to each part of the picture has been obtained in RGB color environment. Considering the resulted number (or numbers?) from the measuring the threshold (OTSO) and putting a filter on the image that only shows the gray level

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Table 1.theresults obtained from the initial algorithm

Number of images	The number of the grape bunches in the picture	The number of the recognized images	Processing precision
200	790	25	96.83%

Considering the results of the initial algorithm and the rather low percentage of recognition during this process, after a careful, one by one analysis of the images it was concluded that the amount of light in each picture was greatly affected by the weather. In sunny weather the amount of light in the pictures increased and consequently the pictures had homogeneous histograms so, they did not need preprocesses such as leveling of histograms; this would save time for the needed processes. However when the environment's light decreased (e.g. in the cloudy weather), the details inside the images would disappear too, in which case the images required some preprocesses before the implementation of the primary algorithm.

Errors in the extraction of classes of the red grape bunch:

While running the algorithm on the red grape pictures, it was noticed that in some images in which the sun reflects directly on the grape bunch a completely bright spot is formed on the picture4a. The existence of this bright spot causes the disappearance of the color components of the red grape on that particular spot and thus these points, instead of having red color, have a shiny white color. If we sample the color of these light-reflecting spots on the images, in the achieved profile we will only have the blue component of the sun light.

Thus subtracting the red components of the image from green to show the red grape class in these regions will not be effective and the results for these regions will not be extracted with other regions of the red grape. This phenomenon has causes a misclassification of some small regions of the grape surface in the sky class.

It is worth noting that this problem occurs only in noon-time imaging around 12:30 and 2 when there is a direct radiation of sunlight on the earth. Also note that, because of the amount of the light in a summer noon, using color environments which are not sensitive to light changes of the environment such as HSI will not prove effective. An HSI color image is illustrated in 4d. shown in this picture, the sensitivity of these images to light is more than the RGB color model. In Picture 4d.the sunlit spots are shown in blue. In order to solve this problem, a shade which can prevent direct sun light during the imaging can be used or the imaging process can be stopped these hours of the day for about one and half hour. The same issue has been reported by researchers such as Biolanon et al (2005) and Majidi et al (1389).

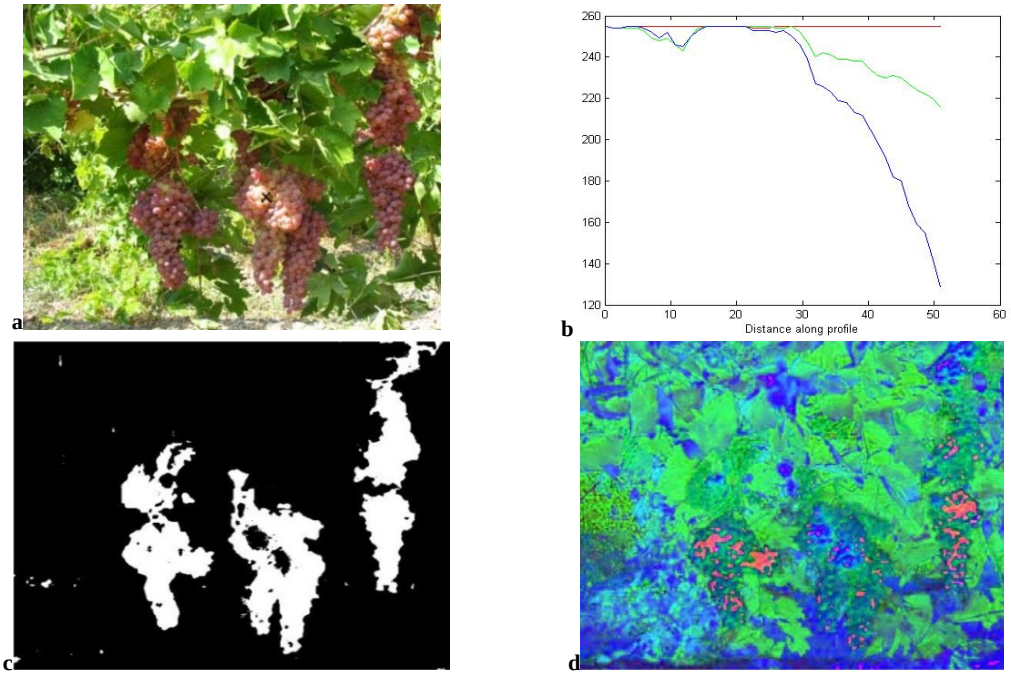

Figure 4- a:Colorimage ofred grapesin the sun, b: Sampling oftheluminousred grapes, c: Binary image, d: HSIcolor imagefrom acolor image (to see the colors on the picture use color printing or digital format of the article)

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Table 2.comparison of the initial algorithm with the corrected one

	Number of pictures	Total number of bunches in the picture	The number of unrecognized bunches	Precision of processing
initial algorithm	200	790	25	**96.83%**
corrected algorithm	200	790	12	**98.01%**

After making some amendments on the algorithm and processing the images the results (brought on Table 2) showed that, the algorithm could recognize a red grape bunch with a high percentage of precision; therefore, a robot using these data can proceed to the next stage of harvesting.

IV. Conclusion

The results show that RGB color environment is greatly affected by changes in the amount of light in the environment. The differences in light level will affect all the three color components of this color model. The proposed algorithm can recognize the shape of grape brunches completely. This success can bring about ease for designing harvester robots. Also it can decrease the amount of time necessary for image processing by 0.34 seconds.

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