

Evaluation and Determination of Tensile Force of Saffron Flower for Mechanical Harvesting

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ABSTRACT

According to the production of more than 90% of saffron in Iran, any study in order to progress in the field of mechanical harvesting and increase the quality of this product, seems to be logical and economical. Mechanical harvesting of saffron is needed to determine the required force for picking. Therefore, picking force of flowers was carried out in three different fields. In each field, the measurement was performed for 10 flowers by appropriate equipment. The results showed that the average force required for picking the flowers which was around 0.8N. Picking force for saffron leaves were performed in three replications in the fields for 2 and 6 years. The results showed that the force depended on several factors: the type of irrigation water, soil type and saffron farm life. Average tensile force in the second year and in the sixth year was about of 3N and 8N.

Keywords: Saffron harvest, Mechanized harvesting, Picking force.

Introduction

Saffron (*Crocus sativus*) commonly known as the "Saffron Crocus". Saffron grows to 20–30 cm and bears up to four flowers, each with three alive bloody stigmas, which are the distal end of a carpel [7]. The styles and stigmas are collected and dried to be used mainly as a flavoring and coloring factor in food. Saffron, long between the world's most expensively spices by weight [10, 5] is locally to Southwest Asia [5, 4] and was maybe first cultivated in or nearby Greece. [9]Iran now produces for approximately 95% of the world production of Saffron[3].The research found that the cost of traditional Saffron harvesting is about 25% of its final price, therefore, the most important problem for Iran's Saffron industry, can be found Saffron's lack of mechanization process. Because each worker cannot be able to pick Saffron's flowers more than 3-4 kg per day, so one of the major problems in the way of cultivation, is supply and management of the workers. Although the construction of any device on the harvesting of Saffron and separation of the stigmas of the Saffron flower is very important in reduce of costs, but is in the secondary importance, because prices of the Saffron is well above in the domestic market, so planting of Saffron is economically in the traditional conditions, therefore, economic issues are not included in the mechanical harvesting of Saffron. Since in recent years, Iran is allocated itself more than 90 percent of world production of Saffron, the export of this product has been very good income for the country [6]. Acreage of Saffron in Iran is amounted to 47,000 hectares and the total production is about 170 to 200 tonnes, so any study in order to progress and improve the quality of the most precious plant of the world, it seems logical and economical. Harvesting of Saffron is 100% traditionally in Iran, and this work is in the extremely cold weather and also is time consuming and also the labor cost is very high, this has caused, Saffron cultivation has been not increased significantly [6,2,1]. On the other hand, because, the picking flowers from the bushes is done by hand, and due to the contamination of the hands and the potential for contact of the product with soil, due to the proximity of the flowers to soil, contamination may be enhanced and this contamination could be an important risk in export industry of the product. So early studies, in order to mechanically harvest the Saffron is essential to this valuable product. Figure 1 shows a farm of Saffron in Iran.



Figure1. Saffron on the field

Materials and Methods

Saffron flowers must be picked up with steam, otherwise the yield decreases. In this study, to determine the force required to separate the flower from the soil, three farms with age of 2, 4 and 6 years were considered and in every field and the separation force of 10 flowers were measured during the harvest season of Saffron flowers. In every field the force required to separate the flower was measured by appropriate tool. The results are inserted in Table 1. Many tests were done for determining the separation force of Saffron needle leaves from the soil. Measurement of this force was due to determine the difference between suction force of the needle leaves and flowers by suction devices. Suction devices must be designed based on this information to prevent damage to the leaves of Saffron plant [8]. The useful life of a Saffron farm is approximately 6 to 7 years, and the diameter of the needle-shaped leaves of Saffron farms is distinct with different ages. Due to this, to determine the force of separation of needle-shaped leaves of Saffron, three farms with age of 2, and three farms with age of 6 years were considered and in every field and the separation force of 10 leaves were measured. The results are shown in Tables 2 and 3.

Results

Results of separation force of Saffron flower from the soil shows that this force is variable in farms with different ages. For example in replication 2, the average picking force is more than replication number 1, also average picking force in replication 3 is more than other replications, these results show that the age of Saffron farm is an important factor in design the appropriate machine in harvesting industry.

Results of separation force of Saffron needle leaves from the soil shows that this force is variable in farms with different ages. For example in replication 2, the average picking force is more than replication number 1, also average picking force in replication 3 is more than other replications, these results show that the age of Saffron farm is an important factor in design the appropriate machine in harvesting industry. Measurement of this force is very important to determine the difference between suction force of the needle leaves and flowers by suction devices. Results show the picking force is significantly difference between these two picking forces.

Table 1. Results of separation force of Saffron flower from the soil

Number of flower	The force required for picking Saffron flowers (Newton)		
	Replication 1	Replication 2	Replication 3
1	0.80	0.80	0.85
2	0.75	0.80	0.80
3	0.90	0.75	0.90
4	0.75	0.80	0.80
5	0.75	0.75	0.85
6	0.80	0.90	0.75
7	0.75	0.80	0.80
8	0.80	0.75	0.75
9	0.70	0.80	0.90
10	0.80	0.85	0.80
The average of replication	0.78	0.80	0.82
Average three replication	0.80		

Table 2. Results of separation force of Saffron needle leaves from the soil (second year)

Number of leaves	The force required for picking leaves of Saffron in the second year (Newton)		
	Replication 1	Replication 2	Replication 3
1	3.2	2.7	2.8
2	2.9	2.8	3.2
3	3.5	2.9	2.8
4	3.2	2.8	3.2
5	3.0	3/2	3.1
6	3.1	3.1	3.2
7	2.8	3.2	2.4
8	3.2	2.6	3.2
9	3.4	2.7	3.5
10	2.3	3.2	3.3
The average of replication	3.1	2.9	3.1
Average three replication	3		

Table 3. Results of separation force of Saffron needle leaves from the soil (Sixth year)

Number of leaves	The force required for picking leaves of Saffron in the Sixth year (Newton)		
	Replication 1	Replication 2	Replication 3
1	7.5	8.2	8.4
2	7.8	8.5	8.1
3	8.0	7.8	8.2
4	8.2	7.6	7.8
5	7.8	8.0	8.2
6	7.5	7.8	7.6
7	8.0	8.2	8.0
8	8.5	8.2	8.2
9	8.3	8.0	8.3
10	7.6	8.0	7.6
The average of replication	7.9	8.1	8.04
Average three replication	8		

Conclusion

In multiple experiments, the following results were obtained: picking force for needle leaves of Saffron depends on several factors as the type of irrigation water and soil and also Saffron farm life and it was 3N and 8N, in the first year and Sixth-year. The picking force of flowers and leaves was measured for determination of difference between the suction forces of the needle leaves and flowers for design a suction device to prevent damage to the leaves. Results showed that the average force of flower picking is approximately 0.8N.

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