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A comparative Financial Analysis of Grafted vs non-Grafted watermelon in arid Area: case of Tunisia.

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Abstract – In addition to controlling soil-borne diseases, grafting with selected rootstocks has the potential to enhance growth and yields in Watermelon production. However, information is rather limited regarding its economic viability in different production systems in Tunisia. The objective of this study was to compare the costs and returns of grafted vs. non grafted watermelon production fields in northern centre of Tunisia. The field trials were conducted in Jendouba and Zaghouan governorates during spring 2016. The estimated costs of grafted and nongrafted transplants were 0.75TND and 0.175 per plant, respectively, resulting in an additional cost of 1200TND per hectare for using grafted transplants as compared with nongrafted plants. Grafting also led to lower costs of phytosanitary treatments and irrigation water. Partial budget analyses showed that using grafted transplants increased watermelon production costs by about 500 TND/ha. However, compared with non-grafted watermelon, the net revenue of grafted watermelon production was increased by 5785 TND/ha due to the improvement of the yields which move from 40T/ha in the non-grafted systems to 56T/ha in the grafted systems. The increase in marketable fruit yield generated significant gross returns to offset costs associated with the use of grafted watermelon transplants. Since the results show substantial potential benefits from an outreach program to diffuse the new technology.

Keywords: Financial analysis, Grafting, Watermelon, Arid area, Tunisia

1. Introduction

Vegetable Grafting has been practiced in Asia with respect to cope with soil pathogens and has been much studied since 20th century (Oda, 1999). In the last few decades, vegetable grafting has also been performed to enhance tolerance to abiotic stresses, increase efficiency of water and nutrient uptake, and improves fruit yield and quality (Bletsos & Passam, 2010; King et al., 2010).

Various researchers approved that grafting has been used successfully in vegetable production for disease control and yield improvement (Lee and Oda, 2003; Lee et al., 2010). This technique offers resistance/tolerance to biotic and abiotic stressors in a variety of cucurbitaceous and solanaceous crops (Kubota et al., 2008; Lee et al., 2010; López-Pérez et al., 2006; Louws et al., 2010; Rivard et al., 2010; Venema et al., 2008).

Furthermore, Owing to their utilization of the vigorous root system of the rootstocks, grafted plants usually show increased uptake of water and minerals when compared with self-rooted plants (Lee, Oda 2003). Thus, grafting may be as a tool to cope with drought in arid area.

Regarding to these effects described above, grafting may be a valuable tool for vegetable growers to cope with pest management challenges in production of cucurbits and solanaceous crops and water shortage.

In Tunisia, where land use is very intensive and continuous cropping is a common practice, vegetable grafting is considered an innovative technique and is in increasing demand by farmers. The continued increase in demand for safety foods may also have increased the interest in vegetable grafting in Tunisia. However, grafting in this country has not yet practiced enough by farmers as a control for soil borne pathogens and nematodes.

Moreover, grafting increases the yield of grafted vegetable due to the improvement of abiotic stresses and enhancement of the nutrient and water up take. (Semiz and Yurtseven, 2010).

Since, it approved that grafting has many agronomics advantages, however, there are concerns regarding the higher costs associated with the use of grafted plants in Tunisia. Limited information is available as

to whether grafting can be used economically in open field production. Considering the multifaceted benefits of vegetable grafting, a comprehensive approach involving production efficiency

The use of grafted watermelon as a technique to prevent losses due to diseases is widespread throughout the world but other positive aspects may be equally important to the producer/decision maker regarding the potential to harvest watermelons during a market window where high prices exist that were previously unreachable (Ioannou et al., 2000).

However, to our knowledge, there have been few studies examining both the cost of grafted watermelon systems and their expected return. This information could help growers decide if the extra cost of grafted transplants could be justified by increased output or by the reduction of production inputs when using grafting to overcome soil-borne diseases and drought. growers and transplant producers interested in vegetable grafting need information based on local production systems.

2. Material et Methods

2.1. Importance of watermelon crops

Watermelon is economically one of the most important vegetable crops in Tunisia, covering approximately 28000 ha representing 15% of the vegetable area with a production of 541000 tons (FAO,2016). This importance results from the strong demand by the consumer and from the good economic profitability of these crops compared to other speculations. In fact, it ranks second in surface among vegetable crops. In addition, that it's much appreciated as an excellent refreshing summer fruit, watermelon contains vitamin A, C, E, potassium, citrulline, argentine and a variety of natural antioxidants suggesting protective roles in reducing the risk of certain types of cancers and cardiovascular diseases (Giovannucci 1999; Rao 2006). Despite these facts this sector is stagnating in terms of the performances achieved: caused mainly by the low efficiency of farmers and low innovative production practices.

2.2. Research field and survey

The data used in the current study is about the production structure of 57 farms over two geographic regions with different climatic conditions, heterogeneity is likely to characterize the sample (different farm sizes, uneven management skills, etc.). Farm-level data are obtained by interviewing farmers that produce watermelon crops. The sample was compounded by 32 farms located at the province of Jendouba in the sub humid bioclimatic stage with annual precipitation of 800 mm and 25 farms located in the province of Nadhour in the higher semi arid bioclimatic stage with an annual precipitation of 450mm.

The survey was carried out in 2017 by interviewing farmers face to face using questioner prior elaborated. Through this questioner we trend to characterize the faming system and to gather technical and economical data regarding the watermelon activity experienced during the previous crop year 2016. Fields ranged in size from 1 to 5 ha with an average area of 2.4 ha. The area cultivated by the grafted plants is 106 against 40 ha by non grafted plants.

2.3. Analysis Approach

The purpose of this study is to compare the production costs between open field watermelon production systems using non-grafted versus grafted plants to determinate the shift of cost and gains generated by adopting grafted plants.

The use of grafted transplants results in an increase in plants costs early in the production season as grafted transplants are typically more expensive compared with non grafted plants. However, Other non transplant production costs as well as yields could also be affected. A comparative approach was used to identify any cost or revenue-related items that could be affected by grafting technology adoption and is proposed here as a tool to facilitate grafting technology adoption decisions.

3. Results

The use of grafted watermelon plants needs an average density of 2600 plants/ha. The cost is 0.75 TND per unit which equals a cost of 1950 TND per hectare. However, the non-grafted plants cost is approximately 0.175 TND per unit, which is equivalent to a per hectare cost of 753 TND for an average density of 4300 plants/ha. Since the shift of the plants' purchase cost is about 159% which is pursued heavy for watermelon growers. This increase of the purchase cost may not encourage them to grow grafted plants. Since, they need more information about grafting economic benefits.

Table 1. A summary of production costs and revenues for field watermelon production systems using non grafted and grafted plants

Items	Grafted watermelon	Non Grafted watermelon	Shift (%)
Planted area (ha)	**106**	**40**	
Yields (T/ha)	**56**	**40**	41%
Gross Product (TND/ha**): A**	**14579**	**8300**	76%
Irrigation water (M3/ha)	**4038**	**7025**	-43%
Irrigation water expenses (TND/ha)	463	909	-49%
Machinary (TND/Ha)	201	168	19%
Labor charges (TND/ha)	448	534	-16%
Chemical fertilizers (TND/ha)	935	1085	-14%
Manure (TND/ha)	373	525	-29%
Phytosanitary expenses (TND/ha)	556	1103	-50%
Plants (TND/ha)	1950	753	159%
Other expences (TND/ha)	985	340	190%
Total variables Charges : B	**5910**	**5416**	**9%**
Gross Margin: C= A-B	**8669**	**2884**	201%

Results presented in table1 show, that the use of crafted plants reduces significantly many others items of the production cost.

First grafting led to an important decrease of the per hectare irrigation water consumption which moves from 7025 to 4038m3/ha indicating a shift of -43% and reducing the water expenses by 49%. This proves that grafting improves the water up take and may cope with water shortage.

Findings indicate too, that grafting reduces phytosanitary treatments' expenses by about 50%. Since grafting reduces the need for pesticide application and increases the longevity and sustainability of the plant this is explained by the useful effect of grafting in controlling diseases and pathogens concerns.

The average operational cost was 5910 TND/ha in grafting systems realizing an increase of 9% with regard to the average cost in non grafting systems.

In the other hand grafting improve the yields by about 41% which move from 40 T/ha in fields planted by non grafted plants to 56 T/ha in fields planted by grafted plants. Grafting, also improve the fruit quality as the gross product is improved by 76% indicating a difference in price. Since this is higher for the best quality.

Net revenue (gross Margin) is obtained by the difference between the value of the production and the operational cost. The results show that net revenue in grafting systems is 8669 TND/ha vs 2884 TND/ha in the non grafting systems realizing a shift of 201%.

4. Conclusion

The objective of this study was to compare the costs and returns of grafted vs. non grafted watermelon production fields in northern centre of Tunisia. The main results showed that the increase of purchase cost carried by using grafted watermelon plants is covered by a decrease of the phytosanitary treatment cost and the irrigation water cost due to the effect of grafting on plants resistance to soil-borne disease and the improvement of the rootstock water up take... Furthermore, grafting improves the production yield and fruit quality which led to a higher gross production value and consequently to a higher net revenue. Since the results show substantial potential benefits from an outreach program to diffuse the new technology.

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