Biosaline Agriculture: Tomato Production in Egypt and Its Export Potential

Lal Almas[1], M. Usman[2], M. Hazman[3], M. El-Sayed[4], and A. Shams El-Din[5]

[1]Regents Professor, West Texas A&M University; [2]Visiting Research Fellow, PMAS Arid Agriculture University-Pakistan,
[3]Researcher, Agricultural Genetic Engineering Research Institute-Egypt; [4]Researcher, Soils, Water and Environmental Research Institute-Egypt; and [5]Egyptian Consultant

Abstract

Egypt, like many other countries in the world, has been facing water availability constraints especially for agricultural production and meet the food requirements of its growing population. Egypt is one of the largest wheat importing country. The Ministry of Agriculture and Land Reclaimation in Egypt and The Binational Fulbright Commission in Egypt (BFCE) under Egypt Food Security Research Project, funded by BFCE, are exploring research in biosaline agriculture to increase agricultural productivity. Tomato production in Egypt is considered a lucrative crop being one of the export commodity. An experiment at Agricultural Genetic Engineering Research Institute (AGERI) was conducted in 2020 to produce tomato with saline water. Study results reveal that an estimated yield of 9.92 tons/fedan with saline water combined with biochar can be achieved. It has been further derived that it can be a source of export value enhancement in the range of $24.8 million to $99.2 million that can be used to offset Egypt's wheat import bill.

Introduction

Tomato (Lycopersicon esculentum Mill.), an important vegetable, has the highest area under cultivation among vegetables at the global level. Egypt is one of the major tomato producing and exporting country (Figure 1 and 2). Most land is cropped at least twice a year, but agricultural productivity is limited by salinity, which afflicts an estimated 35% of cultivated land, and drainage problems. Another challenge to Egypt's agriculture is shortage of water. Water is a scarce resource in the region, the major source of this essential commodity is the Nile River. This shows that the challenge now for Egypt is to look for perennial solutions to lower its dependency on the Nile water supply and to find sustainable alternatives like desalination and biosaline agriculture. This study focuses on the production profitability of tomato and to identify strategies to increase its production and enhance its export in future in order to earn foreign exchange to cover expenses for its imported wheat. The study also provides an overview of all the available opportunities and challenges facing tomato production and its significance in Egypt's export contribution and potential.

Research Objectives

Objectives of the study include estimating the production profitability of tomato production using saline water and biochar soil amendments to enhance tomato production given the limited fresh water resources available in Egypt for irrigated agriculture, identifying factors causing production inefficiency, and finding ways to improve productivity and profitability.

Methodology

Drs. Hazman and El-sayed have conducted experiments at their research institutes, AGERI and SWERI, respectively, to determine crop productivity implications from irrigating with saline water and to quantify the potential benefits of adding biochar to the soil.

Selected tomato cultivar was cultivated under greenhouse conditions. The experiment was subject to four water treatments: Freshwater without biochar, Freshwater with biochar, Saline water without biochar, and Salinewater with biochar. Data from the experiment on various parameters such as root response to salt stress, physiological response to high salinity, tomato yield, quality and quantity of fruit were collected from the experiment. Tomato production cost data and Tomato Price Data was collected from the Ministry of Agriculture and Land Reclaimation, Egypt to conduct productivity and profitability analysis of tomato production under bio-saline conditions.

Results and Discussion

Tomato yield under each treatment in the experiment is presented in Table 1. Results of the study revealed that estimated tomato yield for each treatment was significantly different. As expected freshwater with biochar yield was the highest with 18.25 tons per feddan land area (Feddan = 4200 square meters or 2.38 Feddans= One Hectare). Saline water without biochar yield was lowest 6.49 tone /feddan and is evident that salinity has significant effect on yield. However, by adding biochar with saline water yield increased from 6.49 to 9.92 tons/fedan (Table 2). These results have indicated that there is at least potential of getting little over 50% of freshwater yield when saline water was used with biochar. With average market price of 1,840 EGP/ton, producers can gain a net profit of 6,328 EGP per fedan. Hence, biosaline agriculture has potential to bring more land under cultivation and adding value to agriculture in Egypt.

Egypt is one of tomato exporting country. Total export value from 1994 through 2019 is presented in Figure 2. Egypt tomato export value was $72.87 million in 2015 and $48.96 million. It is evident that increase in tomato production in Egypt through biosaline agriculture and bringing reclaimed land could increase export value for Egypt amounting to $24.80 million even with the least export price of $500/ton (Table 3)

Table 1a. Tomato Yield (kilograms) for each biological replicate/treatment

Rep\Trt	Fresh w/o bch	Fresh w bch	Salinity w/o bch	Salinity w bch
Harvest 1	9728.00	9100.00	3449.74	6396.00
Harvest 2	9440.00	6372.00	3735.45	4131.22
Harvest 3	8200.00	4220.00	2543.92	4349.21
Average	9122.67	6564.00	3243.03	4958.81
st.dev	811.92	2445.66	622.08	1249.41
st.error	468.76	1412.00	359.16	721.35

Table 1b. Tomato Yield (kilograms) for each technical replicate/treatment

Rep\Trt	Fresh w/o bch	Fresh w bch	Salinity w/o bch	Salinity w bch
Plant 1	3.24	3.03	1.15	2.13
Plant 2	3.15	2.12	1.25	1.38
Plant 3	2.73	1.41	0.85	1.45
average	3.04	2.19	1.08	1.65
st.dev	0.27	0.82	0.21	0.42
st.error	0.16	0.47	0.12	0.24

Source: Study results

Table 2. Tomato Profitability Analysis for each treatment per feddan area

Treatment-	Fresh w/o bch	Fresh w bch	Salinity w/o bch	Salinity w bch
Estimated Yield (Tons)	18.25	13.13	6.49	9.92
Price (EGP/ton)	1,840	1,840	1,840	1,840
Total Revenue (EGP)	33,580	24,159	11,942	18,253
Total Cost (EGP)	11,871	11,871	11,871	11,871
Profit (EGP)	21,709	12,288	71	6,382

Data Source: Estimated Yield from Study Results; Price and Cost Data from the Ministry of Agriculture and Land Reclaimation (MALR), Egypt.; Exchange Rate US$ = 15.68 EGP

Table 3. Biosaline Tomato Production in Egypt and Its Export Potential Value

Scenario	Low Price	Average Price	High Price
Yield (Tons/feddan)	9.92	9.92	9.92
Export Price ($/ton)	500*	1326**	2000***
Additional Area (Feddans)	5000	5000	5000
Export Value ($ Mil)	24.8	65.77	99.2

*Pakistan imported tomatoes at $520/ton in 2018; **Average Export Price of tomatoes in 2018-19
***Germany imported tomatoes at $2,017/ton in 2018

Conclusion

The profitability analysis based on the estimated yield from study results and current cost of tomato production data revealed that tomato producers in Egypt can earn 6,382 EGP per feddan from biosaline tomato production. Results also indicated that there is potential to increase tomato export value ranging from $24.8 million to $99.2 million every year by increasing only 5,000 fedans area under biosaline tomato cultivation. This additional export value can be used to offset wheat import bill for Egypt. Results of the study can be used by the stakeholders and policy makers who are involved in the decision making process to overcome food security challenges in Egypt given the constraints on water availability for irrigated agriculture in the country and its ever increasing population.

Acknowledgments

Partial funding support has been provided by the Binational Fulbright Commission in Egypt (BFCE) under Fulbright Alumni Activity: Egypt Food Security Research Project (EFSP) grant, 2019-2021.

Visiting Research Fellow from Pakistan has been funded by Punjab Higher Education Commission, Pakistan through his institution, PMAS Arid Agriculture University, Rawalpindi, Pakistan.

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Figure 1. Tomato Production in Egypt, 1961-2019

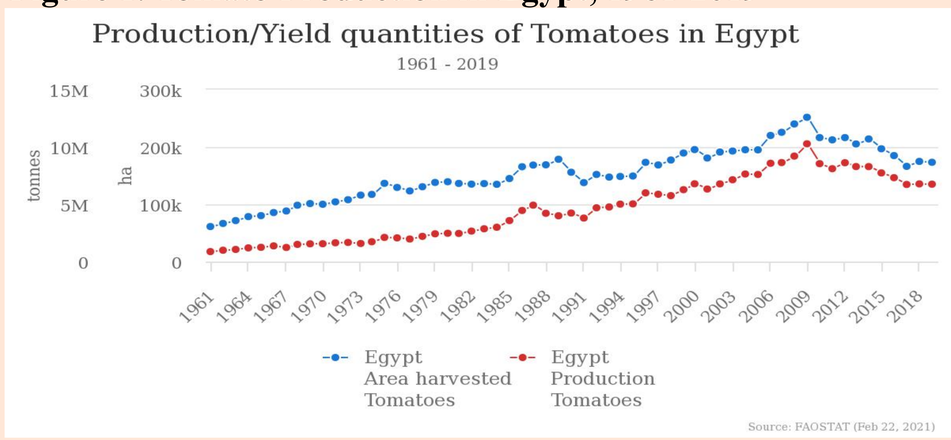

Figure 2. Tomato Export Value, 1994-2019