Banana: a very profitable tropical crop for Turkey

Hamide Gubbuk, Lokman Altınkaya and Recep Balkıç

Introduction

Banana growing areas of the world are situated mainly in tropical regions, between the equator and latitudes 20°N and 20°S. Climatic conditions in these areas are tropical, with relatively small temperature fluctuations from day to night and from summer to winter (Robinson, 1996). In addition, bananas are also grown in subtropical areas such as Western Australia, South Queensland, South Africa, Israel, Taiwan, Spain (The Canary Islands), Egypt, Morocco and parts of Brazil and Turkey (Galán Saúco et al., 2004), many of which are situated between the latitudes 20 and 30°N (Stover and Simmons, 1987). Although the banana growing areas in Turkey are located further north than the subtropical zone (36°N), bananas have been grown economically in Turkey for over a century. Turkey has seven geographical regions. The main crops for each region are different. Banana production is found only in the coastal Mediterranean region, where the northern areas are protected by the high altitude Taurus Mountains. Alanya and Gazipaşa, a district of Antalya province, and Anamur and Bozyazı, districts of Mersin province, are the most important banana growing locations in Turkey (Figure 1). In recent years, banana growing has expanded towards other towns in the coastal regions including Antalya (Kumluca, Finike and Manavgat districts), Mersin (Erdemlı), Adana (Yumurtalık) and Hatay (İskenderun) provinces (Figure 1). Banana growing areas and total production figures in Turkey have continued to increase over the past 10 years (Table 1) (TÜİK, 2016). The total banana growing area in Turkey increased to 6,225 ha by 2016, with 305,926 t total production. In the last six years, the majority of the increase in banana production, in terms of both area and production quantity, was in protected cultivation: 252,077 t of bananas was produced from 4,078 ha of protected cultivation (Table 2). Turkish domestic banana consumption is over 521,000 t. As a result, Turkey imports nearly 217,000 t of bananas. Furthermore, banana consumption per capita has reached nearly 6 kg annum⁻¹ and is expected to increase in the future. Banana is considered a very profitable crop for farmers in Turkey. Local importers pay very high import taxes (over 140%) to bring bananas into the country. As a result, banana

<table>
<thead>
<tr>
<th>Years</th>
<th>Production areas (ha)</th>
<th>Production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>1,309</td>
<td>35,000</td>
</tr>
<tr>
<td>1995</td>
<td>1,150</td>
<td>31,000</td>
</tr>
<tr>
<td>2000</td>
<td>1,725</td>
<td>64,000</td>
</tr>
<tr>
<td>2005</td>
<td>3,600</td>
<td>150,000</td>
</tr>
<tr>
<td>2010</td>
<td>4,428</td>
<td>210,178</td>
</tr>
<tr>
<td>2015</td>
<td>5,838</td>
<td>270,500</td>
</tr>
<tr>
<td>2016</td>
<td>6,225</td>
<td>305,926</td>
</tr>
</tbody>
</table>

Table 1. Changes in the growing area and total production of bananas in Turkey over the past 15 years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production areas (ha)</th>
<th>Production (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>2,686</td>
<td>1,821</td>
</tr>
<tr>
<td>2012</td>
<td>2,679</td>
<td>1,813</td>
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<tr>
<td>2013</td>
<td>2,852</td>
<td>1,819</td>
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<tr>
<td>2014</td>
<td>2,976</td>
<td>2,373</td>
</tr>
<tr>
<td>2015</td>
<td>3,298</td>
<td>2,540</td>
</tr>
<tr>
<td>2016</td>
<td>4,078</td>
<td>2,146</td>
</tr>
</tbody>
</table>

Table 2. Banana growing areas and production quantities in Turkey between 2011 and 2016 according to cultivation system.
Retail prices remain high, which makes local banana production a very profitable enterprise. Additional reasons for bananas being a highly desirable crop include: fruit can be harvested in the same year as planting, less labour costs than that of protected vegetable production, and stable pricing because of a lack of overproduction. If the expansion in banana production under protected cultivation continues as it is, Turkey will be self-sufficient and will be able to stop importing bananas for domestic consumption within five years.

**Cultivation systems**

As indicated above, banana growing areas in Turkey are located in the Mediterranean coastal strip. The northern borders of plantations are mountainous, which provides protection from wind and frost damage. Both open-field and protected cultivation (plastic greenhouse) are used for production (Figure 2). The Anamur and Bozyazı districts in Mersin province are the main protected cultivation areas for banana (Figure 3 and 4), whereas bananas are grown in both open-field and protected cultivation in the Alanya and Gazipasa districts of Antalya. Some of the banana plantations are established on steep-sloped areas and some of them are on flat land (Figures 5 and 6), which has enabled protected cultivation of banana to develop in the districts of Erdemli (Mersin), Finike and Kumluca (Antalya), İskenderun (Hatay) and Yumurtalık (Adana).

In Turkey, greenhouse structures are made of round galvanized poles, are 7.5-8 m high at the peak and 5-6 m high below the gutters, and are covered with plastic (Figure 7). Generally, greenhouses are not heated in any of the current growing locations. Currently, greenhouses cost approximately €12-16 m², including the plastic cover and the irrigation system. However, banana plants bear fruit in the same year as planting and the production cost outlays are recovered within a few years.

Mean yearly minimum/maximum/average temperatures in open-field cultivation and under protected cultivation are 16/26/20°C and 15/33/23°C, respectively, in the Alanya district of Antalya. Yearly minimum/maximum/average relative humidity values in open-field cultivation and under protected cultivation are 47/82/66% and 54/88/75%, respectively (Gubbuk et al., in press). Temperature and relative humidity (minimum, maximum and average) over the year for both open-field and protected cultivation are shown in Figures 8 and 9. Shading powder is applied onto the plastic covers during the summer season to protect plants and fruit from sunburn damage under protected cultivation.
The main differences between the two cultivation systems are the number of days from shooting to harvest and the yield. While one crop per year is produced in open-field conditions, either one or two crops per year are obtained under protected cultivation. The number of days from shooting to harvest is shorter (between 90 and 120 days) in protected cultivation. Thus, bunches are harvested earlier in protected cultivation than in open-field cultivation (Figures 10 and 11). The shorter interval is a great advantage in subtropical regions, especially if there is a risk of frost damage. After mid-November, the temperature begins to drop in the cooler subtropical climate. Frost damage can be seen from time to time in open-field plantations, however, it is rarely seen under protected cultivation. Average yield is between 25-30 t ha⁻¹ in open-field and 50-70 t ha⁻¹ under protected cultivation. Therefore, income is doubled using protected cultivation. Gubbuk and Pekmezci (2004) compared yield and quality of ‘Dwarf Cavendish’ banana (Musa spp. AAA), cultivated in open fields and in protected (plastic greenhouse) cultivation. Protected cultivation was found to be better than open-field cultivation in terms of total production, expressed as the number of hands and fingers per bunch and bunch weight (Figures 12 and 13). Average annual yield in plastic greenhouses was 53% higher than in the open field (65.5 t ha⁻¹ compared with 42.8 t ha⁻¹). Gubbuk et al. (in press) also found that some of the yield and fruit quality components were superior in the greenhouse production system compared to those observed in the open-field production system, and no wind damage was observed in protected cultivation. Average bunch weight obtained was 40 kg in greenhouse-produced bananas versus 27 kg in bananas produced under open-field conditions.

There are many advantages in protected cultivation compared with open-field cultivation in subtropical conditions, including: (a) reduction of time from planting to harvest; (b) reduction in water consumption; (c) extended duration of temperatures above 20°C; (d) higher rate of photosynthesis; (e) protection against wind and other harsh weather conditions (e.g., sunburn and hail); and (f) increased bunch and finger weight (Galán Saúco et al., 1998). No heating systems are used in protected cultivation in Turkey. Therefore, significant temperature fluctuations between day and night in winter can sometimes affect plants negatively in a similar way to that observed in open-field production. The main constraints of banana growing in Turkey, as in other cooler subtropics, are high diurnal temperature fluctuations, low night temperatures, insufficient rainfall and wind damage. Furthermore, win-
ter leaf sunburn, under-pee discoloration and growth cessations are typical physiological problems associated with banana production in the subtropics (Robinson, 1996).

**Cultivars**

‘Dwarf Cavendish’ is the most common cultivar for open-field, and ‘Grande Nain’ and ‘Azman’ (local cultivars) are the most widely planted cultivars for greenhouse conditions. An evaluation of ‘Cavendish’ cultivars under open-field and protected cultivation was undertaken. The cultivars ‘Grand Nain’, ‘Petit Nain’, ‘Poyo’, ‘Williams’, ‘Basrai’ and ‘Dwarf Cavendish’ were compared under open-field and greenhouse conditions in terms of yield and quality characteristics (Gubbuk et al., 2004). Cultivars ‘Williams’ and ‘Grand Nain’ were superior to ‘Dwarf Cavendish’ in greenhouse cultivation, while these two cultivars and ‘Petit Nain’ and ‘Basrai’ were superior to ‘Dwarf Cavendish’ in open-field cultivation. ‘Poyo’ was not suitable for greenhouse cultivation because of its excessive height nor for open-field cultivation because of its sensitivity to wind damage. Greenhouse cultivation of bananas was superior to open-field cultivation for all cultivars, with yield increases of 19 to 28% according to the cultivar. Güven and Gubbuk (2014) evaluated agronomic performance of four new banana cultivars (‘Williams’, ‘MA 13’, ‘Jobo’ and ‘CV 902’) under plastic greenhouses. Cultivar ‘Dwarf Cavendish’ was used as a control. The results showed that all tested cultivars were superior to ‘Dwarf Cavendish’ under an unheated plastic greenhouse.

**Cultural practices**

Plants are planted in March for open-field cultivation. However, there are two planting times for protected cultivation, early spring (February-March) and fall (September). The first ratoon crop (crop from the suckers) is not very productive under open-field conditions while this is not the case for protected cultivation. While suckers are used for open-field cultivation, virus-free tissue culture plants are mainly used for protected cultivation. Plant spacing is 2.5×2 m (2000 plants ha⁻¹) in open-field conditions, and 3×1.8 m (1850 plants ha⁻¹) in protected cultivation (Gubbuk and Pekmezci, 2004). Single row planting is preferred over double rows. However, after the second ratoon crop, plant density is increased to 2100 or 2200 plants ha⁻¹ in both cultivation systems. The important soil properties are: pH 7.6, 8.3% lime content, loamy texture and less than 3% organic matter (Gubbuk et al., in press). Organic manure (goat manure) is applied at about 20 to 40 kg annum⁻¹ plant⁻¹. Fertilizers are applied either by hand around the plant or via irrigation. The main fertilizers are NPK, which are applied at the rate of 250-270, 400, and 1000 g plant⁻¹ cycle⁻¹ respectively. A drip irrigation system is used in both cultivation systems. An extra fine droplet sprinkler irrigation system (like fogging) is mounted in greenhouses to increase air humidity. There are no bacterial or viral issues as found in the tropics. While the most common pest is nematode, spider mite (Tetranychus lambi) can also affect bananas grown in protected cultivation.

**Storage and ripening**

Harvest time for open-field and protected cultivation is different. The harvesting period for open-field production is from November to March, while it is October to January in
highest volume of bananas in the market is the quantity of bananas available in a given time. However, the most influential factors in the market and consumer demand at any time are the harvest, imported bananas, the availability of bananas in maturation facilities, the volume of bananas produced in protected cultivation, the retail prices of bananas, and the influence of farmer associations and banana maturation facilities located in production regions. As in other parts of the world, wholesalers market bananas to retailers on behalf of the farmers, whereas banana maturation facilities buy from farmers and sell to retailers. Retailing bananas to consumers is generally through fresh produce markets, marketplaces, greengrocers, or mobile retailers (less common). Pricing is commonly affected by the following guidelines: the influence of farmer associations and banana maturation facilities, the volume of bananas imported, the availability of bananas in the market and consumer demand at any given time. However, the most influential driver is the quantity of bananas available in the market for consumers. For example, the highest volume of bananas in the market is found in the winter months when prices are the lowest, whereas prices increase after the month of March when domestic production declines. Typical wholesale prices in winter are €0.60-0.80 kg⁻¹, while it is above €1.00 in spring months. Similarly, retail prices are around €1.00 in winter and €1.50-2.00 in spring months. While the price of bananas produced in protected cultivation is higher compared to the price of open-field produced bananas, prices of exported bananas are also higher than domestic prices. The rules for importing bananas into other countries are very strict, though, and the export market from Turkey is almost non-existent. Bananas are marketed at a stage earlier than eating maturity stage.

**Farmer incentives**

Governmental support, e.g. as subsidies and incentives, are available for growers. These may include:
- Money support for planting material;
- 50% subsidy for pressurized irrigation systems (drip, sprinkler);
- Subsidy for fertilizer;
- Subsidy for gasoline;
- Incentive for biological pest control (€1,220 ha⁻¹);
- Money support for agricultural advisory service through agricultural chambers and farmer cooperations;
- Support for Good Agricultural Practices (GAP) applications;
- 50% subsidy for insurance;
- €7500 grant for young (18-40 years old) entrepreneurs;
- 50% cost support for cold storage and/or packing houses established within rural development programs;
- 50% cost support for greenhouse and/or solar energy system establishment;
- Loan and/or interest support for greenhouse establishment and/or modernization.

**Ongoing and future studies**

There are studies already completed on selection breeding and in vitro propagation of selected types, supported by the Turkish Scientific and Technological Research Council – TUBITAK. There have also been studies conducted on irrigation, yield and quality comparison of bananas produced in greenhouses. Other completed studies include: effects of production systems on biochemical parameters of fruits, taste and aroma components, and research on cultural practices, fruit storage and maturity conditions. In addition to these, there are completed graduate studies on cultivar adaptations and effects of cover types on quality parameters. Currently, there are ongoing studies on banana residue management, irrigation management and water use efficiency, improvement of cultural practices and GAP practices.

**Problems**

As in other subtropical regions, low temperatures are the primary problem of banana production in Turkey. Also, strong winds and hail can create big problems for plants in both open fields and protected plantations. There are problems with cultivation practices, determination of harvest time and postharvest practices, however, solutions are being developed. Fortunately, there are no devastating diseases as found in tropical conditions.

**Conclusion**

Although its production area stretches far beyond the tropical and subtropical banana...
production zones of the world, banana is the only tropical species produced on a commercial scale in open-field and protected conditions in Turkey. Popularity of banana production in Turkey is the result of: fruiting in the same year as planting, lower labour costs compared with many other alternative species, low pest and disease pressure, governmental incentives for banana farmers, no over-production pressure and ease of marketing with stable pricing. Currently, banana production in Turkey does not meet the domestic demand. However, if the increase in protected cultivation continues at its current pace, it is highly likely that within a few years production will be sufficient to meet this demand. In conclusion, banana production remains quite a profitable agricultural activity for farmers, as well as providing agricultural employment in Turkey.

References

About the authors
Dr. Hamide Gubbuk received her PhD from the Horticultural Sciences Department at the University of Akdeniz, Turkey, in 1999. She is currently full time Professor of the Department of Horticulture at the University of Akdeniz, Antalya, Turkey. She is engaged in teaching tropical and subtropical fruit growing and breeding courses, conducting research, and supervising MSc and PhD students in these areas. Dr. Gubbuk conducts research on tropical and subtropical fruit production, mainly on banana, carob, papaya, avocados, pitaya and passiflora cultivation. She has published more than 100 research papers in these areas. She was one of the conveners of the International Symposium on Banana at the 28th International Horticultural Congress in Lisbon in 2010. She is one of the conveners of the International Symposium on Banana and the International Symposium on Carob at the 30th International Horticultural Congress, to be held in Istanbul in 2018. She is a member of the International Society for Horticultural Science (ISHS). E-mail: gubbuk@akdeniz.edu.tr
Lokman Altinkaya has been working in consultation with Prof. Dr. Hamide Gubbuk in the Faculty of Agricultural and Department of Horticulture, Akdeniz University, since 2011. He is currently a PhD student. His specialty is tropical fruits. He was also an assistant researcher for other research projects such as “Investigations on Propagation and Seedling Growing of Passiflora (Passiflora edulis Sims)” and “Net Cover System Under Banana Cultivation Facilities” in 2015-2016. E-mail: lokmanaltinkaya@hotmail.com
Recep Balkič is an agriculture engineer (MSc). He has been working in consultation with Prof. Dr. Hamide Gubbuk in the Faculty of Agricultural and Department of Horticulture, Akdeniz University, since 2011. He is currently a PhD student. His specialty is tropical and subtropical fruits. E-mail: recepbalkic@hotmail.com