Future of Fig Production in Turkey

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Fig is a fruit that grows in warm and humid climates; therefore, it is widely cultivated in the countries of Mediterranean climate zone. It has an important role in human nutrition with the minerals and vitamins it contains. While fresh figs are offered for direct consumption, dried figs are used as the main or auxiliary ingredient in many desserts. Located in the Mediterranean climate zone, Turkey is an important fig producer and exporter with a share of 23% in world fig production. Although fig production is realized in 60 out of 81 provinces in Turkey, it is mostly produced in Aydin, İzmir, Bursa, Mersin, and Hatay provinces, which provide some 86 percent of the total production. The aim of this study is to predict the fig production trend of Turkey for the next 9 years from 2017 to 2025 using the fig production data from the period between 1991 and 2016 in order to enlighten the policy and decision makers regarding fig, an important export product of Turkey. The ARIMA model has been used to make the estimations in the study. According to the findings, it has been forecasted that Turkey's fig production will decrease in the next ten years from 2017 to 2025 and the total share of five leading provinces will increase by 1 percent in fig production. It has also been estimated that fig production will increase in leading fresh fig producer provinces, whereas it will decrease in leading dried fig producer provinces in Turkey. It has been concluded that there is a need to create fresh fig demand in other countries for new exporting possibilities.

Keywords*:* ARIMA, *Ficus carica*, Fig Production, Forecast, Turkey.

Türkiye'de İncir Üretiminin Geleceği

İncir sıcak ve nemli iklimlerde yetişen bir meyve olduğu için Akdeniz iklim kuşağındaki ülkelerde yaygın olarak yetiştirilmektedir. İncir içerdiği mineral ve vitaminler bakımından insan beslenmesinde önemli bir yere sahiptir. Taze incir doğrudan tüketime sunulurken kuru incir birçok tatlının yapımında ana veya yardımcı ürün olarak kullanılmaktadır. Akdeniz iklim kuşağında yer alan Türkiye'de önemli bir incir üreticisi ve ihracatçısıdır. Dünya incir üretiminin %23'ü Türkiye tarafından sağlanmaktadır. Türkiye'nin 81 ilinin 60'ında incir üretimi yapılmakla birlikte üretimin en yoğun yapıldığı iller Aydın, İzmir, Bursa, Mersin ve Hatay'dır. Bu beş il, Türkiye toplam incir üretiminin yaklaşık %86'sını sağlamaktadır. Bu çalışmanın amacı, 1991-2016 yılları verilerini kullanarak, 2017-2025 yıllarını kapsayan gelecek 9 yıl için Türkiye incir üretiminin seyrini tahmin ederek önemli bir ihraç ürünü olan incirle ilgili karar vericilere bilgi sağlamaktır. Çalışmada tahminler ARIMA modeli kullanılarak yapılmıştır. Elde edilen bulgulara göre, 2017-2025 yıllarını kapsayan gelecek 9 yıllık dönemde Türkiye incir üretiminin azalacağı buna karşın incir üretiminde önde gelen 5 ilin toplamdaki payı %1 artacaktır. Tahminlere göre yaş incir üretiminde önde olan illerde incir üretimi artmakta ve kuru incir üretiminde önde olan illerde ise incir üretimi azalmaktadır. Sonuç olarak, yeni ihracat imkânları için Türkiye'nin diğer ülkelerde sofralık incir talebi oluşturması gerekmektedir.

Anahtar Kelimeler: ARIMA, *Ficus carica,* İncir Üretimi, Tahmin, Türkiye.

Introduction

Fig (Ficus carica) is a member of Moraceae family and has partly evergreen leaves (Patil Vikas et al., 2010). It has more than 700 known species (Flaishman et al., 2008; Joseph and Raj, 2011; Kocatas, 2014). It is a very nutritious and healthy fruit with its high vitamin, mineral and fiber content (Vinson, 1999), especially calcium, fiber (Joseph and Raj, 2011; Hiwale, 2015) and polyphenols (Vinson et al., 2005), which control cancer development (Finley, 2005). It has a mildly sweet taste and notably sweet aroma and consumed in fresh and dried form. Dried figs have been used in different forms of desserts as the main element or ingredient (Silva et al., 2009; Hiwale, 2015). Fig fruit makes an important contribution to people's diets (Sezen et al., 2014).

Fig is well adapted to mainly hot and humid Mediterranean countries (Eriten, 2005; Stover et al., 2007). Fig cultivation is carried out in about 50 countries around the world. The main eight fig producing countries are Turkey (29%), Egypt (16%), Algeria (13%), Iran (7%), Morocco (6%), Syrian Arab Republic (4%), United States of America (3%) and Brazil (3%) (FAOSTAT, 2017). Although fig is grown and farmed in 60 out of 81 provinces in Turkey, 86% of the total production is shared by Aydin, Izmir, Bursa, Mersin, and Hatay provinces. Aydin province alone has a share of about 63.5% in the total (TURKSTAT, 2017). Dried fig is mainly produced in Aegean region especially in Aydin and Izmir provinces (Cobanoglu et al., 2007), while fresh fig is mainly farmed in the Southern Marmara region, especially in Bursa province. Bursa Black Fig of Turkey is one of the best fig cultivars for fresh consumption which is characterized by large dark-colored firm fruit (Flaishman et al., 2008; Turhan et al., 2013). The Sarilop variety, which is characterized by a light colored soft and thin skin and large size, sweet and fleshy fruit, on the other hand, is generally grown for standard dried fig production (Bulbul et al., 1997; Isin et al., 2007). Both dried and fresh figs are exported mostly to European Union countries (Bal, 2012). 30% of the fig production in Turkey is consumed fresh in the domestic market and 70% is consumed as dry in the foreign and domestic markets (DFAR, 2017).

This study was carried out to estimate the fig production of Turkey general and its top five provinces relating to the period between 2017 and 2025.

Materials and Methods

Materials

The study data were obtained, from Food and Agricultural Organization (FAO), Turkish Statistical Institute (TURKSTAT), International Trade Centre (ITC) and Aegean Dried Fruits and Products Exporters' Union.

Methods

ARIMA model was applied to FAOSTAT and TURKSTAT annual time series data of fig production quantities of Turkey for the last 26 years (1991-2016) for forecasting the fig production trend for the next 9 years between 2017 and 2025. ARIMA model estimates were obtained using SAS 9.4, while MS Excel was employed to prepare the tables.

ARIMA models

ARIMA models have been suggested as the most prudent forecasting model by Box and Jenkins (1970). These models have been one of the most often used methods in forecasting in recent years (Abdullah, 2012; Teoh et al., 2012; Mombeini and Yazdani-Chamzini, 2014; Wasseja and Mwenda, 2015). These models have been applied for many practical purposes (Moharrampour et al., 2013). The ARIMA function is expressed as regression function in which the predictors consist of lags of the dependent variable and/or the forecast errors (Anonymous, 2017a).

ARIMA models consist of the steps known as identification, estimation, and checking of parameters, and forecast of the model (Ramesh et al., 2014) and represented as p, d, and q in three terms where p represents the number of autoregressive terms, d represents the number of non-seasonal differences, and q represents the number of lagged forecast errors in the prediction equation (Anonymous, 2017a; Wang et al., 2015).

That is, predicted a value of Y = a constant and/or a weighted sum of one or more recent values of Y and/or a weighted sum of one or more recent values of the errors. First, let y denote the d^{th} difference of Y, which means:

If d=0: $y_t = Y_t$ (1)

If d=1: $y_t = Y_t - Y_{t-1}$ (2)

If d=2: $y_t = (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}) = Y_t - 2Y_{t-1} + Y_{t-2}$ (3)

All unvaried time series variables in this study are integrated at the order of (1), (2), and (3), after conducting appropriate unit root tests, which indicate that the variable in question reaches a constant mean, variance and the covariance between t and t + 1 time span after first changing the series. Once the stationary is achieved, we then proceed with and for ARIMA model to conduct a forecast. Several different ARIMA models were conducted to pick a model representing the best series (Yavuz et al., 2013). In this study, the number of non-seasonal differences is assumed to be zero. Thus ARMA (p+d,q)=ARIMA (p,d,q). The model with smallest BIC was the ARIMA (0,0,0) equal to ARMA (0,0) for Mersin, and Hatay or ARIMA (0,0,2) equal to ARMA (0,2) models for Aydin, or ARIMA

(2,0,0) equal to ARMA (2,0) models for Turkey. Thus they were selected in the models.

Results and Discussion

Fig production in Turkey

Fig was produced approximately 240,000 to 315,000 tons during the period between 1991 and 2016 in Turkey. The number of provinces producing fig was 60 in 2016 (TURKSTAT, 2017). However, the share of the production by the first 5 provinces among these 60 provinces was approximately 86%. Also, the share of production by the first 2 provinces among the top 5 provinces was approximately 77%. These provinces were Aydin and Izmir. During 1991 to 2016, Turkey fig production was approximately 270,000 tons. Most of the fig production (63.22%) was in Aydin province (Table 1).

Çizelge 1. Türkiye'de incir üretiminde önde gelen illerin ortalama incir üretimi (illerin yüzdelik payları)
Table 1. Average fig production of the leading provinces in Turkey (as percentages of the province totals)

Province	1991-1995	1996-2000	2001-2005	2006-2010	2011-2016	1991-2016
Aydin	63.82	62.61	65.92	61.89	62.06	63.22
Izmir	15.89	15.56	12.66	9.73	11.30	13.01
Bursa	1.49	2.72	4.04	5.49	8.27	4.67
Mersin	1.65	2.60	2.45	4.45	2.48	2.58
Hatay	2.88	2.04	1.95	2.63	0.81	2.33
Antalya	0.96	1.66	1.59	1.95	2.19	1.50
Balikesir	1.30	1.32	1.46	1.33	1.45	1.32
Gaziantep	1.41	0.92	1.24	1.57	1.21	1.24
Adana	1.65	1.00	0.93	0.67	1.13	1.01
Samsun	0.77	0.84	0.86	0.97	0.88	0.86
Manisa	0.51	1.35	0.60	0.82	0.70	0.78
Ordu	0.69	0.71	0.31	0.69	0.63	0.62
Trabzon	0.56	0.45	0.37	0.49	0.39	0.47
13 Provinces	93.58	93.78	94.38	92.68	93.50	93.62
Turkey (ton)	282610	260600	265000	240912	290126	268705

Source: TURKSTAT, 2017.

Fig is a subtropical fruit and can be grown in coastal areas of Turkey such as Aegean, Marmara, Mediterranean and the Black Sea Regions due to its wide ecological adaptability. It can also be grown in Southeastern Anatolia Region with edible quality (Anonymous, 2017b). Turkey has a distinguished place among other fig producer countries in the world in terms of high quality and a huge amount of production. This ranks and maintains Turkey as one of the top countries in the world regarding both production and export.

Particularly in Aydin province, the main source of income for most farmers is the fig production. Favorable ecology makes Turkey have a leading position worldwide in fig production and export.

Şekil 1. Türkiye'nin önde gelen incir üreticisi illeri

Figure 1. Leading fig producer provinces of Turkey

Countries importing dried fig from Turkey

According to Turhan et al. (2013), dried fig fruit is an important agricultural export product among Turkey's exported agricultural products ranking the fifth or the sixth. Fresh fig varieties have an important economic potential for the drying process. Fresh figs lose 70-75% its water content when dried (Hiwale, 2015). Shortly 1 kg dried figs are obtained from approximately 4 kg fresh figs. Table 2 presents the major countries importing dried fig from Turkey during 2007-2016.

As seen in Table 2, European Union countries are the main importers of dried fig product from Turkey. They have a share of about 50% of Turkey's total dried fig exports. These dried fig importer countries are France, Germany, Italy, Netherlands, Spain, and UK in descending order regarding the quantity of dried fig imports from Turkey. Especially, France, Germany, and Italy imported about 40% of Turkey's dried fig exports during 2007-2016. An important fact is that many of the dried fig importer countries, especially France, Germany, and Italy, re-import Turkey's dried fig product to other countries.

Major fresh fig importing countries from Turkey

Turkey is the main supplier of fresh fig to the European countries. Fresh fig has a high nutritive value but very short shelf life. It decays in a short time after harvest (Turk, 1988).Fresh fig export quantities from Turkey to the major importing countries are given in Table 3.

As seen in Table 3, European countries are the main importers of the fresh fig produced and exported by Turkey. About 93% of the total fresh fig exports were realized to the countries with close location to Turkey. Considering the perishability and short shelf life of fresh fig, this is an important advantage. Especially, Germany, France, Netherlands, and the UK are the four leading fresh fig demanding countries. The import of these countries accounted for about 65% of Turkey's fresh fig exports during 2007 and 2016 period.

Turkey's fig production forecasts

Turkey is the most important fig producing and exporting country in the world. Turkey supplies approximately 80% of dried fig marketed worldwide (Isin et al., 2007).

Fig production forecasts for the leading provinces of Turkey are given in Table 4.

Çizelge 2. Ana ithalatçı ülkelere Türkiye'nin incir ihracatı (toplam kuru incir ihracatının yüzdesi olarak)

Table 2. Dried fig exports of Turkey to major importers (as percentage of total dried fig exports)

Countries	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2007-2016
France	16.29	19.52	17.17	15.55	14.89	13.06	13.33	13.09	14.58	15.43	15.29
Germany	17.63	18.10	17.02	18.93	15.37	15.59	13.34	13.31	12.31	13.03	15.46
Italy	7.43	8.11	9.00	7.94	8.36	6.53	5.52	5.10	6.60	5.34	6.99
Russian	7.50	5.70	7.57	6.23	7.34	8.16	7.70	5.61	4.44	1.85	6.21
Switzerland	4.62	4.93	4.14	4.64	3.68	3.93	3.82	3.42	2.69	3.27	3.91
Netherlands	3.64	3.02	3.61	4.30	4.51	4.40	3.11	2.71	3.04	2.76	3.51
USA	2.56	2.71	2.64	3.07	3.75	5.24	6.33	7.97	7.90	8.31	5.05
Spain	3.06	3.14	3.07	2.53	2.49	2.37	3.23	3.20	2.36	1.79	2.72
UK	4.72	3.37	1.94	1.86	1.41	1.46	2.08	2.99	3.16	2.75	2.57
Israel	1.98	2.67	2.37	2.54	2.17	2.22	2.00	1.57	1.60	1.99	2.11
Canada	1.30	1.35	2.08	1.81	2.02	1.88	1.78	1.34	1.85	1.54	1.70
Australia	2.80	1.39	1.48	1.81	1.75	1.88	1.59	2.18	2.92	3.16	2.10
12 Countries	73.53	74.01	72.09	71.21	67.74	66.74	63.85	62.49	63.46	61.23	67.64
All of the exported (tons)	40152	44045	49949	46992	44823	50536	61014	58796	52786	55647	50474

Source: (FAOSTAT, 2017; ITC, 2017 and Anonymous, 2017c).

Çizelge 3. Önemli incir ithalatçısı olan ülkelere Türkiye'nin taze incir ihracatı (toplam taze incir ihracatı yüzdesi olarak)

Table 3. Fresh fig exports of Turkey to major importers (as percentage of total fresh fig exports)

Countries	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2007-2016
Germany	23.63	29.35	31.53	19.61	33.81	27.00	28.38	31.74	37.03	32.33	29.44
France	17.34	18.90	15.86	18.03	11.58	16.31	14.12	15.98	9.24	6.44	14.38
Netherlands	13.95	7.92	13.66	10.02	8.51	8.81	9.39	9.53	11.72	9.95	10.35
UK	12.87	9.66	9.86	9.69	9.99	10.05	13.59	12.63	12.68	8.94	11.00
Austria	11.56	4.70	5.16	1.04	2.55	2.02	1.96	4.01	3.84	9.16	4.60
Belgium	4.89	8.65	2.45	8.99	2.26	6.64	2.49	1.39	2.31	1.75	4.18
Russian	4.41	5.54	0.76	6.45	4.10	6.68	8.24	7.08	4.65	4.93	5.28
Switzerland	5.29	5.32	5.24	4.81	6.23	3.86	1.75	4.41	3.40	3.56	4.39
Saudi Arabia	3.00	1.94	4.42	6.76	3.43	3.24	2.62	2.10	2.46	5.16	3.51
Bulgaria	0.11	1.39	5.80	10.60	9.18	4.31	2.23	2.02	0.16	0.05	3.59
10 Countries	97.05	93.36	94.74	95.99	91.62	88.91	84.78	90.88	87.50	82.28	90.71
All of the exported (tons)	7490	9575	12942	11260	13546	13634	15254	14699	14400	14036	12684

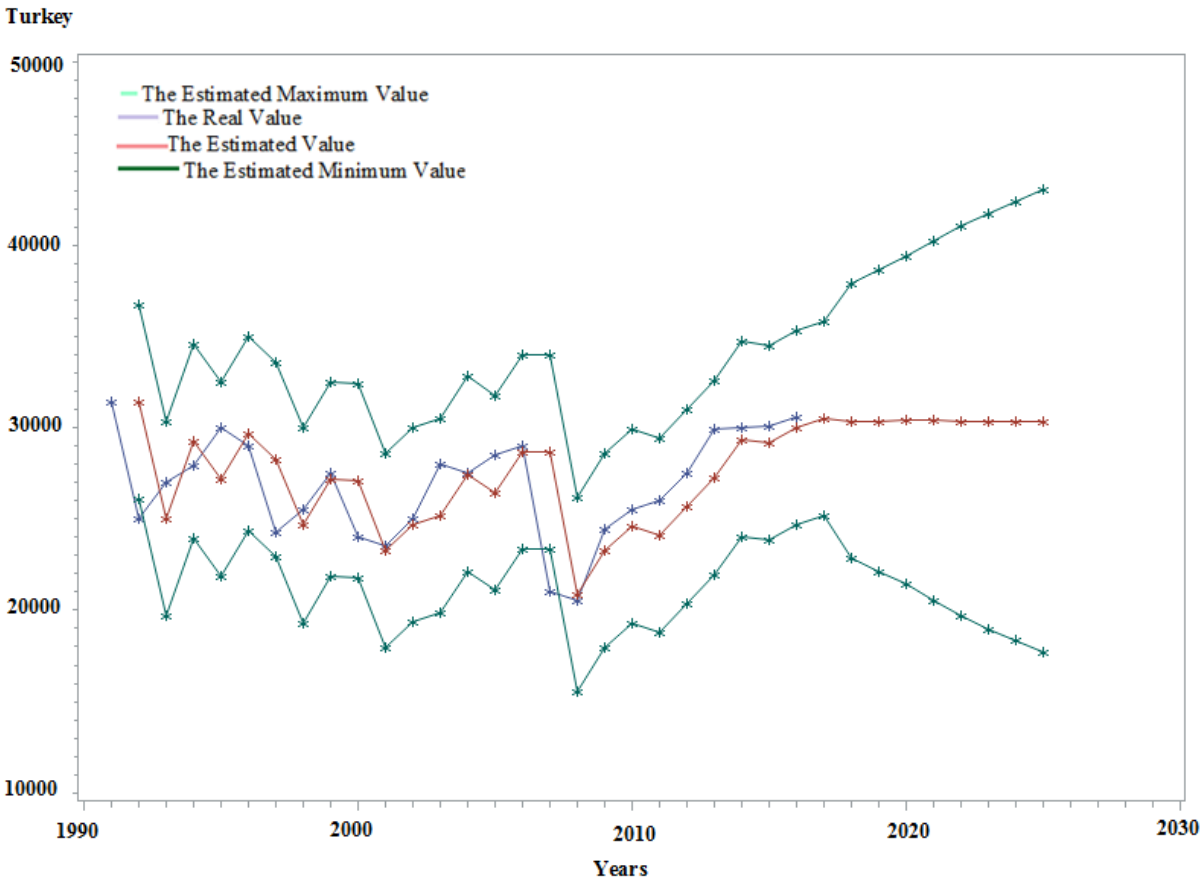
Source: (FAOSTAT, 2017; ITC, 2017 and Anonymous, 2017c).

Çizelge 4. Türkiye'deki önde gelen üretici iller için incir üretimi tahminleri (bin ton)
Table 4. Fig production forecasts for the leading producer provinces in Turkey (thousand tons)

Years	ARIMA (0,0,2)			ARIMA (4,0,0)			ARIMA (3,0,0)			ARIMA (0,0,0)			ARIMA (0,0,0)			ARIMA (2,0,0)		
	Aydin			Izmir			Bursa			Mersin			Hatay			Turkey		
	Min	Avr	Max	Min	Avr	Max	Min	Avr	Max	Min	Avr	Max	Min	Avr	Max	Min	Avr	Max
2017	122.49	173.42	224.34	31.19	43.93	56.67	20.14	24.20	28.26	3.63	7.30	10.96	2.89	4.12	5.36	252.06	305.26	358.45
2018	100.38	172.40	244.42	25.16	43.79	62.42	25.96	31.71	37.45	2.20	7.39	12.58	2.18	3.93	5.67	228.25	303.48	378.71
2019	96.56	171.57	246.58	20.58	43.65	66.71	23.67	30.70	37.74	1.13	7.48	13.84	1.59	3.73	5.87	220.68	303.46	386.24
2020	92.85	170.74	248.63	16.73	43.50	70.28	26.73	33.79	40.84	0.24	7.58	14.91	1.07	3.53	6.00	214.31	304.01	393.70
2021	89.25	169.91	250.57	13.33	43.36	73.39	21.97	29.04	36.12	-0.53	7.67	15.87	0.58	3.34	6.10	205.28	303.93	402.59
2022	85.74	169.08	252.43	10.25	43.22	76.18	24.57	31.67	38.77	-1.22	7.77	16.75	0.12	3.14	6.16	196.79	303.66	410.53
2023	82.31	168.26	254.20	7.41	43.07	78.73	22.80	30.76	38.71	-1.84	7.86	17.56	-0.32	2.95	6.21	189.92	303.61	417.30
2024	78.96	167.43	255.89	4.76	42.93	81.10	27.89	36.62	45.35	-2.42	7.95	18.33	-0.74	2.75	6.24	183.50	303.62	423.75
2025	75.68	166.60	257.51	2.27	42.79	83.30	26.67	36.10	45.54	-2.95	8.05	19.05	-1.15	2.55	6.26	177.08	303.56	430.04

Source: Original calculations

According to Table 4, in parallel to a gradual decrease in fig production in Turkey general, the production will gradually decrease in Aydin, Izmir, and Hatay provinces. Contrary to this prediction, there will be a rise in Bursa and Mersin provinces. While the share of Aydin province in fig production in 2016 was approximately 60%, this ratio will drop to 55% in 2025. The production is expected to also fall in Izmir province from 14.3% to 14.0% in the same period. A similar decline, from 1.41% to 0.85%, will be experienced in Hatay province. Surprisingly, the production is expected to increase in Bursa distinctively form 8.4% in 2016 to 11.9% in 2025. While the share of Mersin province in fig production in 2016 was approximately 2.4%, this ratio will increase to 2.7% in 2025. Also, the minimum estimate value has been negative in Hatay and Mersin provinces in recent years. The reason for this is the increasing uncertainty because the minimum and maximum values in the models have been taken into account according to the values of 26 years. If the changes are too great, then the uncertainties in the minimum values increase and in this case, the minimum estimates are negative values, and also the maximum estimate value may be very high. Both very sharp drops and very sharp increases can make the minimum value negative and therefore the difference between the minimum and maximum values gradually increases. Figure 1 shows the fig production quantity estimates of Turkey for the 2017-2025 periods .



Şekil 2. Türkiye'de 2017-2025 yılları için tahmini incir üretim rakamları

Figure 2. Fig production estimates for 2017-2025 years in the Turkey

Conclusions

Turkey is the leading country in fig production and trade in the world. The fig production in Turkey is ahead of the world production and trade, and it is of great importance to its 5 provinces. But fig production of Turkey will great possibly experience a nominal reduction in the next decade. It is generally expected that this decrease will be in provinces that produce dried figs and grow fresh figs. As the share of fig production and marketing in Bursa and Mersin provinces increase, the share of other three provinces will decrease. An average of 300 thousand tons of figs is produced annually in Turkey. Only 10-15% of this production is consumed in the domestic market. A large proportion of the figs in the domestic and foreign markets are introduced as fresh figs. Both fresh table and dried figs from Turkey are mostly exported to European countries. Increased production estimates for the fresh fig for 2020s show that Turkey will export more fresh figs to the neighboring, closely located countries. Due to the rapid decay and short shelf life property of fresh figs, new markets should be explored in neighboring countries such as Georgia, Iran, Iraq, Syria, and Greece. In addition, it is necessary to carry out studies to improve the production and work out the problems in dried fig farming areas. The information obtained from this study is expected to guide companies engaged in fig production and marketing in both domestic and international markets.

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