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A Research on Expansion and Adoption of the Wheat (Triticum aestivum L.)Varieties Certified as Esperia and Tosunbey: The Example of Polatlı District in Ankara

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ABSTRACT: *The aim of this study is to determine which wheat varieties developed by public and private sector extension organizations are preferred by producers. In addition, it has been determined which wheat varieties are preferred due to their characteristics. The study was conducted in Ankara-Polatlı district. In 2015, Polatlı district was chosen because of the widespread use of wheat varieties developed by public and private sector extension. Tosunbey wheat variety was used in public sector and Esperiye wheat variety was used in private sector extension. The data in the farmer registration system were used to identify the producers using both wheat varieties. Stratified sampling method was used to determine the sample volume. According to this method, the sample volume was determined as 74 producers. In June-August 2015, face-to-face interviews were conducted with producers to collect data. Chi-Square test was used to compare the relationships between the data obtained. According to the research findings; There was a statistically significant relationship between producer's wheat type preference and variables such as residence, irrigable land size and membership to agricultural unions (P<0.05). It was determined that high prices and advance payments given to the product were the main factors affecting the choice of wheat varieties. It has been concluded that private sector extension is more effective in adopting wheat varieties than public sector extension.*

Keywords: *Wheat varieties,* ***Triticum aestivum*** *L., public, private sector, adoption of varieties, Polatlı.*

Esperia ve Tosunbey Sertifikalı Buğday (Triticum aestivum L.) Çeşitlerinin Yayılması ve Benimsenmesi Üzerine Bir Araştırma: Ankara İli Polatlı İlçesi Örneği

ÖZ: *Çalışmanın amacı, kamu ve özel sektör tarafından geliştirilen buğday çeşitlerinin hangisinin üreticilerin tarafından tercih edildiğinin ortaya konulmasıdır. Ayrıca, buğday çeşitlerinin hangi özelliklerinden dolayı tercih edildiği tespit edilmiştir. Çalışma, Ankara-Polatlı ilçesinde yürütülmüştür. Çalışmanın yapıldığı 2015 yılında, kamu ve özel sektör tarafından geliştirilen buğday çeşitlerinin o bölgede yaygın olarak kullanılması nedeniyle Polatlı ilçesi seçilmiştir. Kamu sektöründe Tosunbey buğday çeşidi özel sektörde ise Esperiye buğday çeşidi kulllanılmıştır. Her iki buğday çeşidini kullanan üreticilerin belirlenmesinde çiftçi kayıt sistemindeki verilerden yararlanılmıştır. Örnek hacminin belirlenmesinde tabakalı örnekleme yöntemi kullanılmıştır. Bu yönteme göre örnek hacmi 74 üretici olarak belirlenmiştir. Haziran-Ağustos 2015 tarihinde üreticiler ile yüz yüze görüşülerek anketle veri toplanmıştır. Elde edilen veriler arasındaki ilişkilerin karşılaştırılmasında Khi-Kare testi uygulanmıştır. Araştırma bulgularına göre; üreticinin buğday çeşidi tercihi ile üreticinin ikamet ettiği yer, sulanabilir arazi büyüklüğü ve tarımsal biriliklere üyelik gibi değişkenleri arasında istatistiksel olarak önemli bir ilişki bulunmuştur (P<0,05). Buğday çeşitlerin tercih edilmesine etki eden faktörlerin başında, ürüne verilen yüksek fiyat ve peşin ödemelerin olduğu tespit edilmiştir. Bugday çeşitlerinin benimsetilmesinde özel yayım kuruluşlarının, kamu kuruluşlarından daha etkin olduğu sonucuna ulaşılmıştır.*

Anahtar Kelimeler: *Buğday çeşitleri,* ***Triticum aestivum*** *L., kamu, özel sektör, çeşitlerin benimsenmesi, Polatlı.*

INTRODUCTION

The humankind's agricultural activity that started when the seed's creative nature has been discovered thousands of years ago is a timeless and continuous occupation that primarily meets our basic needs such as nutrition and clothing (Erdem and Yücel, 2015). The seed growing industry in Turkey has sprung up after the formation of the new Turkish Republic. Until 1960's, the industry was limited with developing varieties in some species and producing seeds. However, once the Law Regarding the Controlling and Certification of Seeds were enforced in 1963, a new era has begun in the seed growing industry. It was with this new law that the Republic of Turkey Ministry of Agriculture and Forestry (MAF) assumed the responsibility of controlling the quality of and providing tests and certification for variety registered seeds. The Ministry has ever since taken over a more effective role in producing seeds. In the first, second and third 5-yearly development plans prepared for Turkey, a larger emphasis was placed on seeds and seed production. The fourth 5-yearly development plan made clear reference to the significance of establishing a seed production industry in our country (Anonim, 2013).

Until 1982, the MAF has remained the single body responsible for the seed growing industry. However, after that, the free pricing system was adopted for seeds and the importing of seeds was allowed (Anonim, 2017). Soon after, in 1985, the "Seed Incentive Decree" has been passed together with new seed growing policies compatible with this decree which, in turn, brought about major improvements in the sector. After a number of such positive developments, the private sector became interested in seed production as well and the business gained a totally new structure. The seed production sector soon underwent a number of changes as concerned its basic policies and, in this new model, the public based seed supply system was taken over by the private sector (Anonim, 2017). The private sector investments rocketed in particular after the ban on seed imports was lifted and importing seeds was allowed. Once the private sector was given the go-ahead in this regard, numerous international and local companies formed collaboration and the number of companies doing business soared, as well as their capacities and activities. As a result of the rise in the number of private seed production companies, the industry ceased to be based on the public sector.

The public seed production companies within the seed supply system have traditionally focused on the limited production and distribution of open pollinated plants (wheat, barley and some feed crops). Recently, the private sector has also considerable increased their market share in open pollinated plants. In early 1980's, Turkey made major changes in basic policies regarding seed production and switched to a seed production industry model where private entrepreneurship dominated rather than the public sector. The economy was liberated and the ban on seed foreign trade was lifted which allowed private companies to take part in this sector and numerous local and international seed production companies to enter the business either directly or through partnerships. Hence, the private seed production companies have quickly soared in number, capacity and business leaving the Turkish seed sector to be predominated by private companies (Çelik and Nazlı, 2014). Today, the seed production sector is regulated by entities reporting to the MAF in their respective fields of authority. These entities are namely: General Directorate of Plant Production, General Directorate of Food and Control, General Directorate of Agricultural Research and Policies and General Directorate of Agricultural Enterprises (GDAE). These entities regulate the seed production sector pursuant to the following Laws that constitute the basis of the seed production law Law No. 5042 on The Protection of Breeder's Rights for New Plant Varieties (Anonim, 2004), Agriculture Law No. 5488 (Anonim, 2006), Seed Production Law No. 5553 (Anonim, 2006), Biosecurity Law No. 5977 (Anonim, 2010a) and Law No. 5996 on Veterinary Services, Plant Health, Food and Feed (Anonim, 2010b). Additionally, the sector has a firm legislative

infrastructure supported by various regulations. These laws and regulations provided the sector with a motive for instant growth which produced fast and good results in agricultural production and high yield from a unit area has swiftly risen. Moreover, as the seed production industry in Turkey flourishes, Turkey's exports of seeds are also mounting. Nevertheless, the improvement achieved to date is far from being satisfactory taking into consideration Turkey's huge agricultural potential, suitable conditions for seed production and regional position (Elçi, 2000).

In 2010 numbers, 315,676 tons of certified wheat seeds have been produced in Turkey out of which 48% has been produced by the private sector and 52% by the public sector. This amount has risen to 485,225 tons by 2016 out of which 69% has been produced by the private sector and 31% by the public sector. Recently, there has been a significant increase in the number of seed production companies in Turkey. In 2014, seed production in Turkey amounted to 776,000 tons and the exports were rated at $150 Million. The plans for 2023, however, are directed at a million tons of seed production and $500 Million in export value (Aksoy *et al*., 2017). According to the International Seeds Foundation (ISF) data, the value of the global seed market has reached $45 Billion as of 2012. The USA and China are the two leaders in the business with 26.7% and 22.1% of the market share, respectively. The third leader is France from EU with a share of 6.2%. Within the EU, France is followed in the global seed market by Germany (2.6%), Italy (1.7%) and Spain (1.5%) (Anonymous, 2015).

The fact that major legal arrangements such as the Seed Production Law and the Law on Breeders' Rights were passed has had enourmous effects on the recent increase in seed production and its value. Additionally, such improvement was also encouraged by the facts that production and use of certified seeds was given an extra support that R&D Projects of universities and private companies were supported by the MFAL research institutes and that close cooperation with the sector was achieved in such studies (Şimşek, 2014). The public and private certified seed production companies are in a cutthroat competition to get their seed varieties adopted. Hence, agricultural producers act in such manner to expect the highest financial yield for their labour while preferring one seed over another. The impact of this situation on the producers' choice of seed varies according to the benefit the public or private seed will bring. The social, psychological and personal factors as well as the factor of the infrastructure of the facility in question all have an impact on the choice of the seed variety.

Esperia and Tosunbey bread wheat varieties are widely produced in Polatlı district. It is not known sufficiently which features these varieties are preferred. However, there are almost no studies showing the relationship between socio-economic characteristics of farmers and variety preference.

The aim of this study is to;

i) Investigate whether there is a difference between the adoption of public and private sectors,

ii) Reveal the relationship between socio-economic and farm infrastructure characteristics of farmers and variety preference,

iii) Determine which varieties are preferred due to their characteristics,

iv) Determine where the Esperia and Tosunbey varieties are obtained.

MATERIAL and METHODS

MATERIAL

The primary data for this study consists of data collected by questionnaire from producers using Esperia and Tosunbey varieties. The characteristics of the Esperia and Tosunbey varieties are shown in Table 1. Secondary data includes observations in the study area (status of cultivated wheat varieties in the area), results of previous studies (previous wheat surveys), District agriculture directorate, Polatlı Commodity Exchange (amount of wheat coming to the stock exchange, wheat purchase of flour factories), Polatlı Chamber of Agriculture and seed companies (seed sales amounts).

METHODS

In the sampling phase, the sampling criteria have been the size of the field owned by the wheat producers. Data from the 2015 Farmer Registration System has been used in evaluating the size of the wheat fields in Polatlı to draw up the framework table. The sample volume has been calculated as shown in the below formula according to the stratified sampling method taking into consideration the wheat production area (Yamane, 2001).

$$n = \frac{\left(\sum N_h S_h\right)^2}{N^2 D^2 + \sum N_h S_h^2}$$

n: Number of producers to be interviewed.

N: Total number of producers

D^2: The margin of error allowed on the mean at the required confidence level ($D^2 = \left(d / t\right)^2$

N_h: *h*. Total number of producers in the stratum,

S^2_h: *h*. Stratum variance.

Table 1. Characteristics of varieties studied.
Çizelge 1. İncelenen çeşitlerin özellikleri.

Variety features Çeşit özellikleri	Tosunbey	Esperia
Morphological features Morfolojik özellikler	Spined, white glume, white, hard grain, medium height/ Kılçıklı, beyaz kavuzlu, beyaz, sert taneli, orta boylu	Spined, spike color white, grain color red, hard grain/ kılçıklı, başak rengi beyaz, dane rengi kırmızı, sert taneli
Agricultural features Tarımsal özellikler	In the nature of alternative development, Good cold resistance, Drought resistant, Reaction to fertilizer is good / Alternatif gelişme tabiatında, Soğuğa dayanıklılığı iyi, Kuraga dayanıklı, Gübreye reaksiyonu iyidir.	Winter development nature, Mid-Early, The handle is solid, high performance in irrigated areas / Kışlık gelişme tabiatlı, Orta-Erkenci, Sapı sağlam, sulanan alanlarda performansı yüksektir.
Amount of seeds to be per decare Dekara atılacak tohumluk miktarı	18-20 kg/da	16-18 kg/da
Yield feature Verim özelliği	350-450 kg/da in dry conditions/Kuru şartlarda 350-450 kg/da 350-700 kg/da irrigated conditions/Sulu şartlarda 350-700 kg/da	Wheat yield is 601.9 kg/da / Buğday verimi 601,9 kg/da'dır.
Resistance to diseases and pests Hastalık ve zararlılara dayanıklık	Medium resistant to yellow and black rust, Medium rust resistant, Brown rust is sensitive/ Sarı ve Kara pasa orta dayanıklı, Kara pasa orta dayanıklı, Kahverengi pasa hassastır.	Black rust, brown rust resistance is very good, It has medium resistance to yellow rüşt, Resistance to root and root collar diseases is good/ Kara pasa, Kahverengi pasa dayanımı çok iyi, Sarı pasa dayanımı ortadır, Kök ve kök boğazı hastalıklarına dayanımı iyidir.
Technological features Teknolojik özellikler	1000 grain weight 30-35 g, Hectoliter weight 79-80 kg, Sedimentation 50-66.3, Protein percentage 13-14%/ 1000 tane ağırlığı 30-35 g, Hektolitre ağırlığı 79-80 kg, Sedimantasyon 50-66,3, Protein oranı %13-14	1000 grain weight 35-40 g, Hectoliter weight 80-82 kg/hl, Sedimentation 70, Protein percentage 14-14.5%/ 1000 tane ağırlığı 35-40 g, Hektolitre ağırlığı 80-82 kg/hl, Sedimantasyon 70, Protein oranı % 14-14,5
Recommended regions Tavsiye edilen bölgeler	Recommended for semi-bottom, bottom and irrigation areas of Central Anatolia and Passage Regions/ İç Anadolu ve Geçit Bölgelerinin yarı taban, taban ve sulama yapılabilen alanlarına tavsiye edilmektedir	Recommended for Central Anatolia, Western and Eastern gate regions, Inner Aegean, Marmara and Thrace/ Orta Anadolu, Batı ve Doğu geçit bölgeleri, İç Ege, Marmara ve Trakya kesiminde tavsiye edilmektedir.

In this study, the margin of error allowed on the mean is 25% and the confidence level has been 95% (z=1.96). The number of farmers using Esperia and Tosunbey wheat varieties was determined as 1250. Out of these producers, the sampling volume has been calculated as 74 using the stratified random sampling method. The reason for choosing this method is that the land widths are different in size. In order to increase the representation ability, the sampling was done in proportion to the width of the land. (Yamane, 2001).

In 2015, farmers were interviewed face-to-face and the data were collected through a survey.

Data Analysis

Data has been coded on digital media. Using the Kolmogorov-Smirnov test, it has been checked whether the variable distribution is normal. The chi-square test was used to compare the relationships between categorical variables and the results were interpreted at a significance level of α=0.05 (Özkan *et al*., 2013). The variables taken into account in the study are given in Table 2 with their definitions.

Table 2. Variables used in research.
Çizelge 2. Araştırmada kullanılan değişkenler.

Section titles Bölüm başlıkları	Variable Değişkenler	Level Düzey
Socio-economic variables Sosyo-ekonomik değişkenler	Farmer's age / Üreticinin yaşı	
	Education / Eğitim düzeyi	Primary school, Middle school, High school, University/ İlkokul, ortaokul, lise, üniversite
	Residence / İkamet yeri	Rural / Kırsal, Urban / Şehir
	Annual income / Gelir düzeyi	Low, Intermediate, High / Düşük, orta, yüksek
	Membership status of agricultural professional organizations/ Tarımsal meslek kuruluşlarına üyelik durumu	Member /üye, not member /üye değil
Enterprise infrastructure İşletme alt yapısı	Land presence / Arazi varlığı	Dry /Kuru, Irrigated / Sulu
	Presence of instrument equipment /Alet ekipman varlığı	Enough /yeterli, insufficient /yetersiz
The way producers supply their seeds Tohum temin yeri	Where do you get the seed? Tohumu nerede temin ediyorsunuz?	Seeds distributor, General Directorate of Agricultural Enterprises, Home produced seeds, Agricutural cooperative, Research Institutes/ Tohum dağıtıcıları, Tarımsal İşletmeler Genel Müdürlüğü / TİGEM), Kendi üretimi, Tarımsal kooperatifler, Araştırma Enstitüleri
The reasons why producers prefer a certain variety Üreticilerin tohum tercih nedenleri	The first three reasons of seed preference/ Tohum tercihinin ilk üç nedeni	High yield, Ease of selling, Good quality/ Yüksek verim, satış kolaylığı, iyi kalite
Factors Affecting Seed Adoption Tohum benimsenmesine etki eden faktörler	What factors are effective when deciding on the use of seeds?/ Tohum kullanımına karar verirken hangi faktörler etkilidir?	Market price, Yield, Suggestion of neighbours and relatives, Reliability of the seed, Size of land, Suggestion of the agricultural directorates / Pazar fiyatı, komşu ve akraba önerileri, Tohumun güvenilirliği, arazi varlığı, Tarım müdürlüklerinin önerisi
Where do you hear the new seed variety? Yeni tohum çeşitlerini nerden duyorsunuz?	What information sources do you learn about seed varieties?/ Tohum çeşitlerini hangi bilgi kaynaklarını öğreniyorsunuz?	Neighbours and relatives, Seed Compony, Television, Agricultural cooperatives, Internet, Provincial agricultural directorate/ Komşu ve akrabalar, tohum dağıtıcıları, televizyon, tarımsal kooperatifler, internet, İlçe tarım müdürlükleri

RESULTS and DISCUSSION

The findings of the study are presented under different headings**.**

Socioeconomic variables affecting use of seed

One of the issues discussed in the research is to determine the effect of socio-economic characteristics of producers on the use of seeds. According to the results of this research, the producers' ages vary from 30 to 66 making the median age 50.1. Over 50% of the producers are aged among 46 to 60. Accordingly, it can be stated that the wheat producers in the research area are middle aged. In a study focusing on the adoption and expansion of cotton varieties, it has been stated that young farmers are more prone to adopting new cotton variables (Kaynak and Boz, 2015). Separately, it has been stated that a farmer's age influences his behaviour in reaching various sources of information as one of the factors affecting the adoption of new information and communication technologies (Mittal and Mehar, 2016). Elsewhere, it has been stated that the age factor is not statistically significant when assessing whether an agricultural incentive has been used for agricultural purposes or for non-agricultural purposes (Aslan and Boz, 2005). Our study has pointed out that the age factor is not significant in the adoption of the new wheat varieties improved by the public or private sector. It has been calculated that 51.4% of the producers are primary school graduates. It has been found out that the producers using the Tosunbey variety are more educated than those using the Esperia variety. At this age of information where knowledge is power and investment, technological innovations should be adopted by individuals and used in making further innovations. Taking into consideration that education is one of the key factors in shaping a society, technological innovations should be implemented in education to equip individuals with innovative skills (Kılıçer, 2009). It has been clearly pointed out that educated farmers are highly prone to adopting new cotton seeds. Likewise, studies carried out regarding the adoption of agricultural innovations also support this finding. Out of 275 studies focusing on the impact of education level on adoption, 204 have shown that education has a positive effect on adoption (Rogers, 2003). Educated producers that adopt technological innovations have had an average yield of 4.7 tons of rice per acre whereas producers that have not adopted the new technology have remained at around 1.3 - 1.8 tons per acre. The study has shown that there is a high potential to increase yield through farmer education (Nakano *et al*., 2018).

Our study has demonstrated that the producers' level of education is not as high as desired thereby preventing innovations from expanding in the case area. It has been found out that 48.6% of the producers is settled in the countryside while 51.4% is residing in the city. It has been also stated that the ratio of Tosunbey variety users living in the city is higher than Esperia variety users. Innovative people have cosmopolitan relations and are in general in contact with sources of information despite considerable distances (Padel, 2001). It has been observed that the income level of Tosunbey variety users is higher than that of Esperia variety users. This finding was supported by the fact that Tosunbey variety users have incomes other than that of agricultural production in addition to their agricultural income. In a research focusing on the adoption and expansion of cotton varieties, no statistical relation could be established between the income levels of producers that do or do not adopt a certain cotton variety. In our study, likewise, no statistical relation could be found between the adoption of varieties improved by the public sector or the private sector. It was found out that 77% of the producers are members of various agricultural production organizations. 87.5% of Esperia variety users are members of such an organization whereas, when it comes to Tosunbey variety users, this ratio remains at 64.7%. It can be stated that the reason behind the lower ratio of Tosunbey variety users being members to such agricultural organizations is that the producers in this category are more likely to reside in the city. Another study made in the research area on a similar topic has shown similar findings in some results and different findings in others. In such study made by

Köksal and Cevher (2015), it has been underlined that 60% of producers face difficulties in supplying seeds and the major problem is that the desired seed variety is too expensive, they cannot find good and quality seeds and they are short on cash. Another study made on this subject has shown that one of the most important factors for improving and expanding organic agriculture is reaching the target audience with the right discourse and the right education through means of publications. According to the logistical regression analysis results in this study, there is a statistical relation ($P<0.05$) between the adoption of organic agriculture and rural women who have older ages, higher incomes, larger fields and watch television (Kaya and Atsan, 2013).

Producers have stated that local sources of information and implementations are in satisfactory for today's agricultural conditions. They believe that their priorities and conditions are not sufficiently taken into consideration by the local research and publishing entities. Moreover, it has also been found that the connection between producers and public publication entities is rather weak. The producers believe that the suggestions made by such public entities remain merely theoretical and bear limited economic validity. The data found in former studies share some commonalities and some differences with our findings. Our study has established that the producers using the Esperia (private sector) wheat variety are primary or secondary school graduates, that they change their certified seeds once in every 3 years, and that they sift through the private sector seeds to use them in the next 2 years. On the other hand, producers using the Tosunbey (public) wheat variety have larger fields, that they use certified seeds 2 times in almost 3 years, and that they prefer this variety because of its desirable market price. In both varieties, the quality preference comes in third place.

Enterprise infrastructure variables affecting use of seed

Research related to the adoption behaviour of producers show that the relation between the size of the agricultural field and the adoption behaviour is variable. Therefore, the overall sizes of the field used by the producers have been calculated. Of the land owned, hired or shared by the producers, 20.3% is less than 100 decares; 35.1% is between 101 to 200 decares; 25.7% is between 201 to 400 decares and 18.9% is over 400 decares. This data showing the field ownerships in the study area is above Turkish averages. Therefore, it can be stated that the fields owned by the producers in the study area is large. Statistical analysis shows that there is no statistical significance between the size of the field owned and choice of wheat seed variety ($P>0.05$). It is a known fact that dry and irrigated land is an important factor in choosing a wheat seed variety. Hence, we have analysed the level of relation between the dry and irrigated land size of the producers adopting these varieties (public - private) and their choice of variety.

According to Table 3, the ratio of producers that own less than 100 decares of dry land is 35.1%; those who own between 101 to 200 decares of dry land is 33.8%; the proportion of those who own 201 decares and more of dry land is 31.1%. It can also be seen that dry land size of Esperia variety users that own over 201 decares (40%) is greater than Tosunbey variety users of the same category (20.6%). Analysis demonstrates that there is no statistical significance between the size of dry land owned by the producers and their preference of wheat variety ($P>0.05$). We can also notice in Table 3 that 44.4% of producers own irrigated land smaller than 100 decares whereas 28.6% own irrigated land between10 to 200 decares and 27.0% own irrigated land over 201 decares. The ratio of Tosunbey variety users that own over 201 decares of irrigated land (34.5%) exceeds that of Esperia users (20.6%). As a result of the statistical analysis, it was found that there was a significant relationship between the irrigated land size of the producers and the use of wheat varieties ($P <0.05$). Accordingly, one factor that affects the preference of a variety over another is the type of the land used in production due to the characteristics of that variety. Hence, the yield and the quality of the produce would be positively influenced in case publications would take into consideration the type of land at hand when promoting the adoption of certified seeds.

Investigation of seed location, reasons of choice and variables affecting seed selection

It was determined that the producers took seed varieties from different places for reasons such as characteristics of seed varieties, climatic conditions and not being able to find the desired variety in the same place. However, the producers stated that they used the certified seed varieties they received in the first year and used them in the following years (home produced seeds).Therefore, it has been determined that producers provide seed varieties from different sources. It was determined that the producers bought seed varieties from different places in a production season. Therefore, different seed supply sources are shown in the same row (Table 4). The seed supply locations of the producers are shown in Table 4.

The way producers supply their seeds (Table 4) exhibits that the producers mostly supply their seeds from certified seeds distributors (27.0%) followed by GDAE (23.0%). These two are followed by producers that supply the need from both GDAE and their home-produced seeds (21.6%), and by producers that supply a major part of their seed need from both Seed Company and their home-produced seeds (20.3%) and finally by producers that supply their seed need from agricultural cooperatives and their home-produced seeds (8.1%). As can be seen in these results, producers have a wide variety of suppliers. There are many reasons why the producers have such a wide variety. One of the major reasons is the producers' lack of cash at hand at the time the seeds are to be supplied. This results in seeds alone being purchased more expensively and in installments.

The two factors affecting quality and high yields in wheat are the methods used in production and the use of high quality wheat seed variety suitable for the climate in the area. Most techniques and materials used in agricultural production are intended to bring out the genetically and physiological potential in the seeds. Hence, the most important factor in quality and high yields in wheat production are using certified seeds. For that reason, we have tried to assess the reasons why producers prefer a certain variety. Table 5 shows the data collected from producers and the interpretation of these reasons.

Table 3. Dry and irrigated land distribution of producers (%).
Çizelge 3. Üreticilerin kuru ve sulu arazi dağılımı (%).

Variety name Çeşit adı		Dry land / Kuru alan (decare / dekar)					Irrigated land / Sulu alan (decare / dekar)				
		≤100	101-200	≥201	Total	χ2	≤ 100	101-200	≥ 201	Total	χ2
Esperia	Number / Sayı	15.0	9.0	16.0	40	0.059	12.0	15.0	7.0	34	0.013*
	%	37.5	22.5	40.0	100		35.3	44.1	20.6	100	
Tosunbey	Number / Sayı	11.0	16.0	7.0	34		16.0	3.0	10.0	29	
	%	32.4	47.1	20.6	100		55.2	10.3	34.5	100	
Total / Toplam	Number / Sayı	26.0	25.0	23.0	74		28.0	18.0	17.0	63	
	%	35.1	33.8	31.1	100		44.4	28.6	27.0	100	

*: Statistically significant at 5% level (% 5 seviyesinde istatistiksel olarak önemli; Non-significant/ Önemli değil).

Table 4. The way producers supply their seeds (%).
Çizelge 4. Üreticilerin tohum temin yerleri (%).

Seed supply locations / Tohum temin yerleri	Percentage / Yüzde (%)
Seed company / Tohum şirketleri	27.0
General Directorate of Agricultural Enterprises (GDAE) / Tarım İşletmeleri Genel Müdürlüğü (TIGEM)	23.0
GDAE + Home produced seeds / TIGEM + Kendi üretimi	21.6
Seed company + Home produced seeds / Tohum şirketleri + Kendi üretimi	20.3
Agricutural cooperative + Home produced seeds / Tarım kooperatifleri + Kendi üretimi	8.1
Total / Toplam	100.0

The most important factor affecting preference of certified seeds is the high yield. 60.8% of producers use the seed produced by the private sector due to its high yield whereas the same ratio is realized as 45.9% in the case of the public sector seed. According to this result, we can say that Esperia variety is more adopted in terms of yield. In the study area, it was determined that Esperia variety was more efficient than Tosunbey variety in terms of disease and agronomic applications. The ratio of producers that make their preference according to the quality of the seed is 29.8% for the public sector variety and 18.9% for the private sector variety. As can be seen in Table 5, it can be said that Tosunbey variety is preferred more in terms of quality. However, the superiority of Esperia variety in terms of agronomics and diseases compared to Tosunbey variety (in the study area) contributed to the further adoption of Esperia variety. According to this result, the fact that the net income in terms of yield is higher than the net income in terms of quality is an important factor in the choice of variety.

The ratio of producers that make their preference according to the ease of selling is 24.3% for the public sector variety and 20.3% for the private sector variety. It was determined that wheat varieties were demanded by Polatlı Commodity Exchange, Flour mills, rations and other farmers. The demand of both varieties by the above mentioned buyers is considered as ease of sale in the market. A similar study performed with respect to certified (cotton) seeds has shown that producers take into consideration high yield by 66.1%, seed prices by 15.7%, quality by 10.2% and market position by 7.9% (Kaynak and Boz, 2015). There are differences between our study result and the other colleague finding. The reason behind these differences can be that we have our focus on wheat seeds as opposed to the cotton seeds therein studied. This is an indication of the changes in the producers' preferences being built on the types of seed.

We have analysed the factors affecting the producers' adoption of wheat varieties improved by the public and private sectors in Table 6 where we can see that 23.3% of the producers expect their produce to have a high market price when they make their decision on a variety. The second major factor in choice of seed variety is its high yield (23.0%). Another important factor is the seeds' reliability (resistance to drought and winter and diseases, germination power) (20.7%). The ratio of producers that make their preference upon the suggestion of neighbours and relatives is 21.2% while 5.3% of producers decide according to the suggestion of agricultural directorates. Hence, the most important factors affecting the preference of a variety over another are its market price and yield. In Turkey, publications related to agricultural activities are, by tradition, made by the public sector. However, the recently developed communication techniques have made it much faster for farmers to learn about agricultural innovations. Especially ever since the enactment of the seedling law, the companies in the seed industry have acted with higher promptness than public institutions in making publications about their seed varieties. Hence, we have studied the way producers in the study area keep up-to-date about the agricultural technologies and innovations and the way they act when faced with an agricultural problem. In this context, we have analysed the sources from which producers learn about the newly improved wheat varieties. The data collected is seen below in table 7.

Table 5. The reasons why producers prefer a certain variety (%).
Çizelge 5. Üreticilerin çeşit tercih nedenleri (%).

Reason for seed preference Tohum tercih nedeni	Variety of private sector Esperia (%)	Variety of public sector Tosunbey (%)
High yield / Yüksek verim	60.8	45.9
Ease of selling / Satış kolaylığı	20.3	24.3
Good quality / Kalitesinin iyi olması	18.9	29.8
Total / Toplam	100.0	100.0

Table 6. Factors affecting the choice of seed (%).
Çizelge 6. Tohum seçimine etki eden faktörler (%).

Factors / Faktörler	Percentage / Yüzde
Market price / Pazar fiyatı	23.3
Yield / Verim miktarı	23.0
Suggestion of neighbours and relatives / Komşu ve akraba tavsiyesi	21.1
Reliability of the seed / Tohumun güvenirliliği	20.7
Size of land / Arazi genişliği	6.6
Suggestion of the agricultural directorates / Tarım müdürlüklerinin önerisi	5.3
Total / Toplam	100.0

Table 7. Sources of awareness of new varieties (%).
Çizelge 7. Yeni çeşitlerden haberdar olma kaynakları (%).

Factors /Faktörler	Percentage / Yüzde
Neighbours and relatives / Komşu ve akraba	26.3
Seed company / Tohum şirketleri	20.2
Television / Televizyon	19.2
Agricultural cooperatives / Tarım kooperatifleri	17.2
Internet / İnternet	10.0
Provincial agricultural directorate / Tarım ilçe müdürlüğü	7.1
Total / Toplam	100.0

Table 7 demonstrates that producers learn about newly improved wheat varieties by large from neighbours and relatives (26.3%). In second place comes the seed company (20.2%) (GDAE distributors, seed company). Separately, 19.2% of producers learn about wheat varieties from TV channels that broadcast about agriculture. 17.2% of producers make use of the agricultural cooperatives in this regard. 7.1% of the producers learn about varieties from the provincial agricultural directorate that is the public body responsible for making agricultural publications. Diffusion of innovations is the acceptance and implementation of innovations by the members of a social system through various channels within a certain period of time (Karasar, 2004). In other words, adoption has been defined as the process of communication among members of a social system through various channels within a certain period of time (Rogers, 2003). Our study has shown that the diffusion of seed varieties continues to be within the traditional information sources system. This has not changed despite the heavy efforts put in place by private sector extension. It can be said that the fact that private sector extension have made more public sector extension about varieties than public institutions is due to the Seedling Law No. 5553 published in the Turkey - Legal Gazette No. 26340 dated November 8th, 2006. It would be useful if public sector extension and private sector extension worked hand in hand in order for innovations to be diffused and implemented.

CONCLUSION and SUGGESTIONS

The result of the statistical analysis made on the data acquired in this study is that there is no statistically significant relationship between the preference of a certain variety (public or private) and the producers' age, level of education, non-agricultural incomes, ownership of dry land, agricultural produce insurance or produce selling criteria ($P>0.05$). On the other hand, there is a statistically significant relationship between the preference of a certain variety (public or private) and the producers' place of residence, membership in an agricultural producers' association and ownership of irrigated land ($P<0.05$). Accordingly, it has been demonstrated that there is no major difference between the social-economic, entrepreneurship infrastructure and seed variety use variables of the producers using the Esperia (private) and Tosunbey (public) variety. It has been demonstrated that the most important factors affecting the choice of a variety are its high yield and ease of selling. Although wheat varieties were

good in terms of quality and yield, Esperia cultivar was found to be more preferred. This result was reached because of superiority of Esperia in terms of agronomic and disease resistance properties compared to Tosunbey variety. It has been shown that private sector extension is more effective in teaching about new seed varieties than public bodies. This study suggests that the public sector extension should take a more active role in extension regarding wheat varieties. The high price of certified seeds partially causes a decline in their use. Hence, keeping the seed prices low would result in higher use of certified seeds.

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