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Identification of Genetic Resistance to the Crown and Root Rot Caused by *Fusarium culmorum* and Cereal Cyst Nematode (*Heterodera filipjevi*) in the Turkish Cereal Varieties

Türk Tahıl Çeşitleri'nin Genetik Dayanıklılığı'nın Kökboğazı ve Kök Çürüklüğü Etmeni *Fusarium culmorum* ve Tahıl Kist Nematodu (*Heterodera filipjevi*)' ye Karşı Belirlenmesi

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Abstract: Soilborne pathogens associated with cereals cause significant yield losses throughout the world. Among soilborne pathogens *Heterodera filipjevi* and *Fusarium culmorum* are two main destructive causal agents that attack the roots and crowns of cereals and have been reported as the most prevalent species in Türkiye. A total of 245 Turkish cereal varieties consisting of wheat, oat, triticale and rye which were registered between 1931 to 2013; were tested for their resistance to *Fusarium culmorum* and *Heterodera filipjevi*. The varieties were screened under controlled and/or field conditions for two successive growing seasons. The bread wheat 'Murat-1' was the most resistant variety for both pathogens. The durum wheats 'Yelken 2000' and 'Yılmaz 98' were found the most promising varieties for resistance to *F. culmorum* and *H. filipjevi*, respectively. The triticale 'Umranhanim' ranked moderately resistant at adult plant stage while 'Presto' and 'Melez 2001' were ranked moderately resistant at seedling stage for *Fusarium culmorum*. The findings of this study are important for the global wheat breeding programs as those genotypes are still being used in crosses for new genotype development.

Keywords: Host reaction, soil borne pathogens, Triticum aestivum, Triticum durum, Turkish genotype

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Öz: Tahıllar ile ilişkili toprak kökenli patojenler Dünya genelinde önemli verim kayıplarına sebep olmaktadır. Toprak kökenli patojenler içinde *Heterodera filipjevi* ve *Fusarium culmorum* tahılların kök ve kökboğazı' na saldıran iki ana yıkıcı etmendir ve Türkiye' de en yaygın türler olarak rapor edilmiştir. 1931-2013 yılları arasında tescil edilmiş buğday, yulaf, tritikale ve çavdardan oluşan toplam 245 Türk tahıl çeşidi; *Fusarium culmorum* ve *Heterodera filipjevi*' ye karşı dayanıklılıkları için test edilmişlerdir. Çeşitler, iki ardışık büyüme sezonu boyunca kontrollü ve/veya tarla koşullarında taranmışlardır. Ekmeklik buğday 'Murat-1' her iki patojen için de en dayanıklı çeşit olarak belirlenmiştir. Durum buğdayı 'Yelken 2000' ve 'Yılmaz 98' sırasıyla *F. culmorum* ve *H. filipjevi*'ye karşı dayanıklılık açısından en umut verici çeşitler olarak bulunmuşlardır. Tritikale 'Presto' ve 'Melez 2001' fide aşamasında *Fusarium culmorum*' a karşı orta derecede dayanıklı iken 'Umranhanim' yetişkin bitki döneminde orta derecede dayanıklı olarak sınıflandırılmıştır. Bu çalışmanın bulguları, bu genotiplerin yeni genotip geliştirilmesi için melezlemede hala kullanılması nedeniyle küresel buğday ıslah programları için önemlidir.

Anahtar kelimeler: Konukçu reaksiyonu, toprak kökenli patojenler, *Triticum aestivum*, *Triticum durum*, Türk genotipi

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INTRODUCTION

Wheat, barley, rye, oats and triticale are the cool climate cereals that have economic importance worldwide. Their adaptability is very high and they can be grown in a wide range of climatic and soil conditions (Soysal et al., 2020). The production area of the cool climate cereals produced in Türkiye is as following, wheat (67446655 da), barley (301544431 da), rye (85540 da), oats (1369490 da), triticale (468835 da) (TUIK 2021). Türkiye is among the 10 largest wheat producers worldwide with an annual wheat production of between 16 and 21 million tonnes (t). The national average grain yield is around 2 t per hectare (ha), however, due to the agroecological conditions, it varies from 1 t/ha in the eastern part of Türkiye to 3 t ha^{-1} in Thrace and southern Türkiye (Braun *et al*., 2001). The Central Anatolian Plateau (CAP) is the Türkiye's most important wheat-growing area with 2,5 million ha land and 6500 tonnes of wheat production (Benli *et al*., 2007; TMO, 2019). About 90% of all wheat cultivation in Türkiye is produced under rainfed or semi-supplementary irrigation conditions, where drought stress is common (Braun *et al*., 2001) and is considered a favorable environment for the dryland root and crown rots. Cereal cyst nematodes (*Heterodera avenae* complex, CCNs) and dryland root and crown rots are found worldwide and cause significant economic yield losses in many countries, particularly where rainfed cereal systems predominate (Nicol *et al*., 2003 and 2004b). Crown rot and dryland foot rot are common names being used to describe diseases caused by *Fusarium* spp. resulting in necrosis of root, crown, basal stem and root tissues (Burgess *et al*., 2001; Chakraborty *et al*., 2006). The dryland root rots (foot rot, crown rot) caused by *Fusarium culmorum*, *F. pseudograminearum* (formerly *F. graminearum* Group 1) and *F. graminearum* (formerly *F. graminearum* Group 2) are important diseases of cereals around the globe and occur especially under drought conditions in rainfed and wheat monoculture systems (Cook, 1992; Smiley *et al*., 2005). They have been reported from West Asia, North Africa (Egypt, Tunisia, Morocco), USA, Canada, Australia and Türkiye (Smiley *et al*., 2005; Tunali *et al*., 2008; Chakraborty *et al*., 2010). *Fusarium culmorum* has been reported as the prevalent species causing foot rot in Türkiye (Aktaş *et al*., 1996; Nicol *et al*., 2004b; Hekimhan *et al*., 2004; Bentley, 2006; Tunali *et al*., 2008; Akgul, 2008; Hekimhan, 2010; Gebremariam *et al*., 2018). Diseased plants are characterized by colonization of wheat stems, crown and root tissues leading to a honey-brown discoloration of the leaf sheaths and lower stem, and necrosis of the crown region (Cook, 1981; Cook and Veseth, 1991; Klein, 1991). In Bursa province of Türkiye, the most frequently isolated fungi from wheat fields were *Fusarium* spp., *Rhizoctonia cerealis, Alternaria alternata* and *Drechslera sorokiniana* with aggressive pathogenic behavior (Arslan and Baykal, 2001). In Konya province of Türkiye, the intensity foot and root rot diseases was found at 36% in sampled field sites with *F. culmorum* as the most dominant species (Aktas *et al*., 1999). Another study was conducted by Uckun and Yıldız (2004) showed that *F. culmorum* was the most pathogenic and widespread species in Denizli, Aydın, and Izmir provinces of Türkiye. Tunali *et al*. (2006) studied the virulence of the 13 *Fusarium* spp. originated from CAP and they found that the main three *Fusarium* spp. (*F. culmorum, F. pseudograminaerum, F. graminaerum*) were the most pathogenic species causing the greatest disease severity on the susceptible wheat variety Pehlivan. In the Thrace region of Türkiye, Hekimhan (2010) reported *F. culmorum* as the most common pathogen and he investigated the resistance levels of 63 wheat varieties against *F. culmorum* and disease intensity values ranged between 25 and 55%. It is concluded that out of 63 varieties, only 3 had disease intensities of less than 25%. In Sakarya province of Türkiye, 11 *Fusarium* species including *F. culmorum* and *F. graminearum* were tested on 18 wheat cultivars and were found to be pathogenic (Araz *et al*., 2009). In 2013, an extensive survey was conducted in major wheat-growing areas in Türkiye. In this study, a total of 339 samples were collected and 17 *Fusarium* species were isolated and identified. Among the aggressive species, *F. culmorum* (13.6%), *F. pseudograminearum* (1%) and *F. graminearum* (0.5%) were the predominant species in the surveyed field sites of the Aegean region, Black Sea, Central Anatolia, and South East Anatolia regions (Gebramarium *et al*., 2018). Several studies have been conducted to identify resistance sources in cereals (wheat, barley, and triticale) against root rot diseases such as *Bipolaris sorokiniana, Rhizoctonia cerealis,* and *Ophiobolus* spp.*)* which were applied as mixture inoculum under field conditions or inoculated singly under controlled conditions (Aktas et al., 1996, 1997; Bagci *et al*., 2001). Cereal cyst and root lesion nematodes are considered the most important plant-parasitic nematodes associated with wheat production and are widely distributed in Türkiye (Nicol

et al., 2004a; Riley *et al*., 2009). *Heterodera filipjevi* was first reported from Türkiye in 1995 and detected in 87% of the collected samples (Rumpenhorst *et al*., 1996). Riley *et al*. (2009) reported that 78% of the surveyed areas of CAP were infested with *H. filipjevi*. These species caused yield losses of up to 50% in wheat in CAP in Türkiye (Nicol *et al*., 2003; Sahin, 2009). A recent survey conducted during the 2014 cereal growing season across five regions in Türkiye (Central Anatolia, Marmara, Aegean, Southeast Anatolia, and Black Sea Regions) where the three species, *H. filipjevi*, *H. latipons*, and *H. avenae* have been found in 64 samples. *H. filipjevi* was the predominant in all surveyed regions (Cui *et al.*, 2017). Control of soil-borne pathogens (SBP) is one of the most significant challenges facing agriculture (Cook, 1980). Crop rotation is still an alternative option to control root rots. However, *F. culmorum* has a wide range of hosts such as wheat, barley, oat, rye, corn, sorghum and various grasses, making this option not applicable (Cook, 1981; Cook and Veseth, 1991; Klein, 1991). So far, several effective management strategies have been developed to control numerous diseases caused by soil borne fungi and nematodes, including chemical control (Pariyar *et al*., 2014), crop rotation (Cook, 2001), cultural practices (Singh *et al*., 2005), and development of resistant varieties (Dababat *et al*., 2014, Gebremariam *et al*., 2020). Using resistant crops of high-yielding potential is the most efficient and economical way to increase wheat productivity and manage SBP, especially in dryland fields (McIntosh, 1997; Cook, 2001). Although the SBP program at CIMMYT Türkiye has screened 1000s of genotip against root rots, the Turkish varieties were not fully studied for such diseases. Therefore, the main objective of this study was to investigate the Turkish varieties for their resistance reaction to crown rot agent *F. culmorum* and cereal cyst nematode *H. filipjevi*. This is a critical first step in controlling those root rot diseases by using genetic resistance, especially for the International Breeding Programs as well as the Turkish breeding programs as these cultivars are used for new genotype development.

MATERIALS AND METHODS

Genotype Selection

A total number of 245 genotype (BW#177, DW#56, Triticale #9, Rye #1, Oat#2) provided by the Republic of Türkiye Ministry of Agriculture and Forestry Institues and private companies were screened for resistance against *F. culmorum* and *H. filipjevi* (Table 2). The set of genotype represented a collection of 56 lines of durum wheat, 177 lines of bread wheat, nine lines of tiriticale, one line of rye, and two lines of oat. The well known checklines resistant to *F. culmorum* and *H. filipjevi* was used as standard (Table 1). A local highly pathogenic *Fusarium* species isolated from naturally infested field in Kırsehir, Türkiye (39º 39′ 709″ N, 32º 37′ 14″ E) which was molecularly identified as *F. culmorum* according to Nicholson et al. (1998) was used in all screening tests. For CCN, screening tests were carried out using a population of *H. filipjevi* collected from another naturally infested field in Kırsehir, Türkiye (39º 39′ 709″ N, 32º 37′ 14″ E), and molecularly identified according to the Peng *et al*. 2013**.**

Table 1. List of check lines with their resistance reactions to the *Fusarium culmorum* and *Heterodera filipjevi.*
Çizelge 1.Kontrol hatları ve Fusarium culmorum and Heterodera filipjevi' ye karşı dayanıklılıklarını gösteren liste.

Genotypes	Wheat Habit	Source	Fc/Hf	Resistance Reaction
Bezostaja	WW	Russia	Hf	S-HS
Kutluk	WW	Türkiye	Hf	S-HS
Katea	WW	Russia	Hf	MR-MS
Sonmez	WW	Türkiye	Hf	MR-MS
Altay 2000	WW	Türkiye	Fc	MR-MS
2-49	SW	Australia	Fc	MR-MS
Sunco	SW	Australia	Fc	MR-MS
Seri 82	FAC	Mexico	Fc	S-HS
Kiziltan 91	FAC	Türkiye	Fc	S-HS

Abbreviations stand for: MR=Moderately Resistant, MS=Moderately Susceptible, S=Susceptible, HS=Highly Susceptible, WW=Winter Wheat, SW= Spring Wheat, FAC= Facultative, Fc = *Fusarium culmorum*, Hf = *Heterodera filipjevi*

Growth Room Screening

Seeds were surface sterilized with 3% sodium hypochlorite and rinsed several times in sterilized distilled water, then placed onto moist blotting paper in sterilized Petri dishes, and left to germinate for 3 days at 23 °C. Seeds were left until 1-2 cm long radicules were formed. A single pregerminated seed was sown in each plastic tube (16 cm in height x 2.5 cm in diam.) containing a potting mixture of sterilized sand, field soil, and organic manure (50:40:10, v/v/v) and (70:29:1 v/v/v) for *F. culmorum* and *H. filipjevi*, respectively. Sand and field soils were sterilized at 110 °C for 2 h and organic fertilizer was sterilized at 70 °C for 5 h. A monosporic isolate of *F. culmorum* was cultured on Synthetic Nutrient Agar (SNA) medium at 23 °C for 10 days. Propylene bags (48 cm x 20 cm) (Unicorn, Amsterdam, Netherlands) were quarter filled with wheat bran, and autoclaved at 121 °C for 20 min for three consecutive days. One week later, 15 ml of sterilized water consisting of mycelium from the monosporic culture was transferred into each bag and left for 2 to 3 weeks at 23 ºC to enhance sporulation and thereafter used as the source of inoculum. One week after transplanting pregerminated seeds, each seedling stem base (3 cm above soil level) was inoculated with 1 ml of spore suspension of *F. culmorum* at a rate of $1x10^6$ spore per ml of water. Inoculated tubes were covered with a plastic tent for 48 h to maintain high relative humidity (RH) for better disease development. Then seedlings were left to grow under the growth chamber conditions for 49-56 days with 16 h of artificial photoperiod and at 23 °C with RH of 75 ± 5% (Mitter et al., 2004). Cysts of *H. filipjevi* were extracted from soil using Cobb's decanting and sieving method (Cobb, 1918). The extracted cysts were surface sterilized with 0.5% NaOCl for 10 min and rinsed several times in distilled water. The cysts were kept at 4 °C until they were used. Freshly hatched second-stage juveniles (J2) under room temperatues were used as an inoculum source in the screening tests. As described above, one pregerminated seed was planted per tube, a total of 300 J2 of *H. filipjevi* were inoculated into 3 holes made with a plastic rod around the stem base. The plants were left to grow in the growth room at 23 °C and 75 ± 5% RH for 63 days. Seedlings in all trials were bottom irrigated. Each treatment was replicated 5 times and tubes were placed in a completely randomized block design (CRBD). Each experiment was repeated twice for data validation.

Greenhouse and Field Screening

For the greenhouse trials, a single seed was sown individually in plastic tube (21 cm in height x 3.8 cm in diam.) filled with the same potting mixture abovementioned. Each tube received 0.25 g of wheat bran of *F. culmorum* inoculum consisting of about $5x10^5$ spore mL^{-1}. The plants were left to grow in the greenhouse from October to June (normal growing season) and harvested at maturity. The method used in this test was similar to that described by Wallwork et al., (2004). Plants were watered whenever needed. In order to enhance disease symptoms, water was reduced near heading stage to stimulate post-anthesis drought stress. Each treatment was replicated 6 times placed in a randomized block design. For field screening; seeds were hand planted (5 g seeds per 1 m long row) and replicated 3 times in a CRBD. At harvest time 15-20 tillers of each treatment was randomly selected and scored for *F. culmorum* crown symptoms. The trials were conducted during two growing season.

Assessment and Statistical Analyses

Assesment of crown rot was done based on the harvested plants' browning percentage on the crown which described the stem (1 cm above soil level) and root (1.5 cm below soil line), according to 1-5 scale: 1= 1-9% (R), 2= 10-29% (MR), 3= 30-69% (MS), 4= 70-89% (S), 5= 90-100% (HS) that modified from Wildermuth and McNamara, (1994) (Erginbas et al., 2016, 2018). For *H. filipjevi*, the grouping was performed based on cyst numbers per plant compared to that cyst numbers on the known checks. The following ranking was followed: 1= resistant (R), 2= moderately resistant (MR), 3= moderately susceptible (MS), 4= susceptible (S) and 5= highly susceptible (HS) (Dababat et al., 2019). The experiments were repeated twice. Data were normalized using the Anderson-Darling normality test before they were analyzed using analysis of variance (ANOVA). Significant differences between studied lines were detected using protected least significant difference at $P < 0.001$ using SPSS statistical software V 17.0 (SPSS Inc., Chicago, IL, USA). A Linear Discriminant Analysis (AFD) was conducted using R 3.4.3 software to distinguish the groups of

main lines according to their disease index. All other analyses were conducted using XLSTAT software 2016.02.28451 (Addinsoft, USA).

RESULTS AND DISCUSSION

Resistance Screening to F. culmorum

Disease symptoms caused by *F. culmorum* (brown discoloration) were seen on crown and stem parts of each plant harvested from all environments. Genotypes showed disease severity values that ranged between 1 to 89%. The genotypes were categorized into five groups based on their reactions ranging from Resistant (R) to Highly Susceptible (HS). Analysis of population structure based on genotypes (resistance reaction) displayed three distinct groups among the evaluated 56 durum wheat genotypes (including checks) under field conditions and 4 distinct groups under greenhouse and growth room conditions (Figure 1). Significant differences ($P < 0.001$) were detected among durum wheat genotypes tested against *F. culmorum*. The results showed that 28.5% (16 genotypes) of durum wheat genotypes were selected as promising genotype in terms of their resistance to *F. culmorum* in all environments. Under field conditions, 2, 16 and 38 durum wheat genotypes were grouped as moderately susceptible, susceptible, and highly susceptible, respectively. Durum wheat genotypes screened (56) were classified into four groups under greenhouse conditions; 5 MR, 12 MS, 34 S and 5 HS. While, under growth room conditions, the same genotypes were divided into four groups as 10 MR, 11 MS, 34 S, 1 HS based on their reactions against *F.culmorum.*

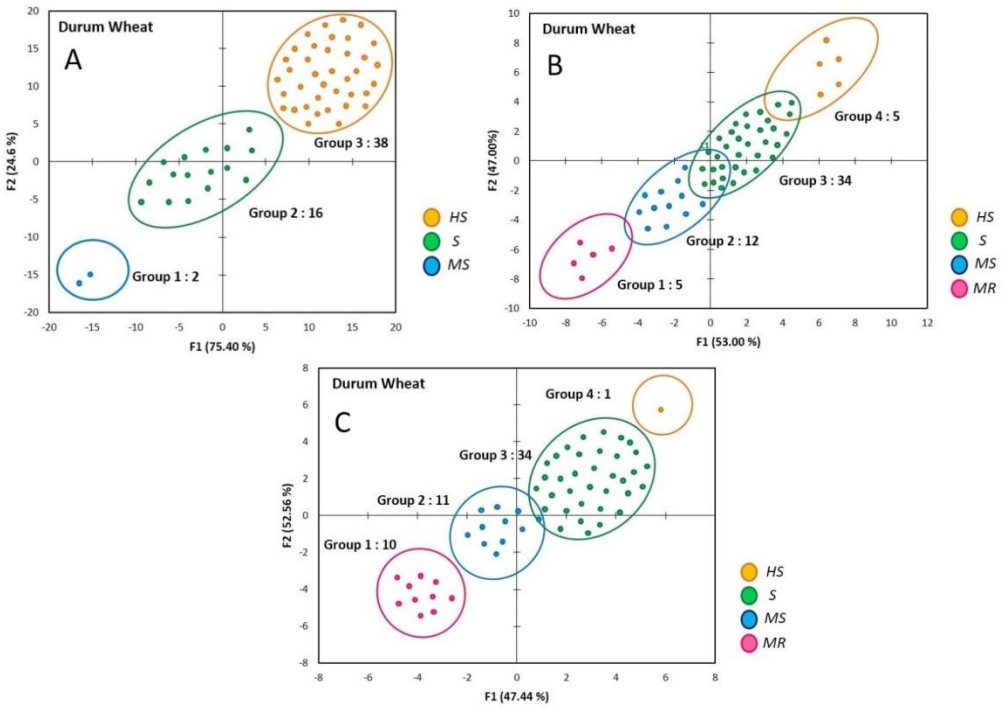

Figure 1. Discriminant Factorial Analysis (AFD) showing the population structure for a set of 56 lines from durum wheat nursery based on their resistance reaction against crown rot disease caused by *Fusarium culmorum*. (A) Field conditions (mean of two years 2013-14). (B) Greenhouse conditions. (C) Growth room conditions. Abbreviations stands for: R: resistant; MR: moderately resistant; MS: moderately susceptible; S: susceptible; HS: highly susceptible.

Çizelge 1. Fusarium culmorum tarafından meydana getirilen kökboğazı çürüklüğü hastalığına karşı gösterdikleri dayanıklılık reaksiyonları'na dayalı olarak 56 makarnalık buğday hattının popülasyon yapısını gösteren Diskriminant Faktör Analizi (DFA). (A) Tarla koşulları (ortalama iki yıllık 2013-14). (B) Sera koşulları. (C) Büyütme odası koşulları. Kısaltmalar şu anlama gelir: R: dayanıklı; MR: orta derecede dayanıklı; MS: orta derecede hassas; S: hassas; HS: son derece hassas.

The same analyses described the population structure of bread wheat based on genotype (resistance reaction) and displayed four distinct groups among the assessed 177 bread wheat genotypes (including checks) under field conditions, five and four distinct groups under greenhouse and growth room conditions, respectively (Figure 2). Significant differences ($P < 0.001$) were detected in bread wheat

genotypes tested to *F. culmorum*. Genotypes were classified into four groups; 10 MR, 51 MS, 71 S, and 45 HS under field conditions, five groups; 1 R, 23 MR, 68 MS, 82 S, and 3 HS under greenhouse conditions and four groups under growth room conditions; 23 MR, 61 MS, 85 S, and 6 HS.

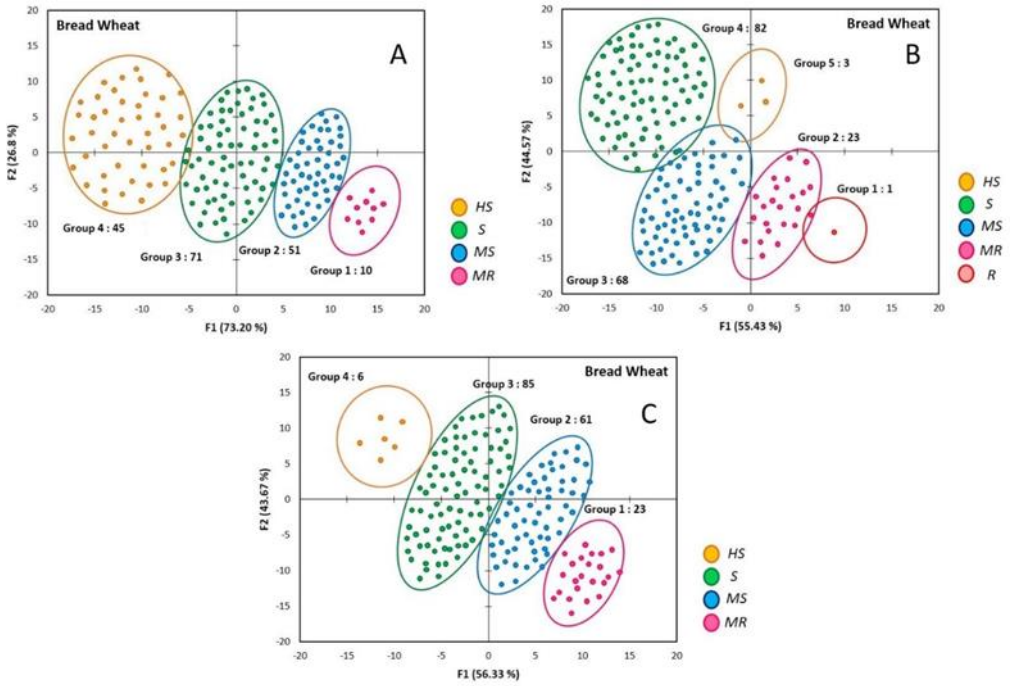

Figure 2. Discriminant Factorial Analysis (AFD) showing the population structure for a set of 177 lines from bread wheat nursery based on their resistance reaction against crown rot disease caused by *Fusarium culmorum*. (A) Field conditions (mean two years 2013-14). (B) Greenhouse conditions. (C) Growth room conditions. Abbreviations stands for: R: resistant; MR: moderately resistant; MS: moderately susceptible; S: susceptible; HS: highly susceptible.
Çizelge 2. Fusarium culmorum tarafından meydana getirilen kökboğazı çürüklüğü hastalığına karşı gösterdikleri dayanıklılık reaksiyonları'na dayalı olarak 177 ekmeklik buğday hattının popülasyon yapısını gösteren Diskriminant Faktör Analizi (DFA). (A) Tarla koşulları (ortalama iki yıllık 2013-14). (B) Sera koşulları. (C) Büyütme odası koşulları. Kısaltmalar şu anlama gelir: R: dayanıklı; MR: orta derecede dayanıklı; MS: orta derecede hassas; S: hassas; HS: son derece hassas.

Crown Rot Disease Index

Among the 177 bread wheat genotypes Murat-1 was found as the most resistant genotype for both *F. culmorum* and *H. filipjevi*. Kınacı-97, Murat-1, Gelibolu and Turan cultivars showed adult and seedling resistance for *F. culmorum*. Murat-1, Atilla-12 and Bone de gave the lowest disease rating at adult stage (Figure 3). Kaan, Bancal, Kınacı-97, P8-8 genotypes were the most resistant (seedling plant resistance) genotypes under growth room conditions (Figure 3c). Thirteen percent of bread wheat genotype (13%) found MR, 34,4% MS, 48,02% S and 3.3% was HS at seedling stage. Twenty bread wheat genotypes (11.2%) were found R-MR at adult stage under greenhouse/field conditions (Figure 3a, b). Among the 177 genotypes tested 124 entry found as MS-S or S under the different tested environments.

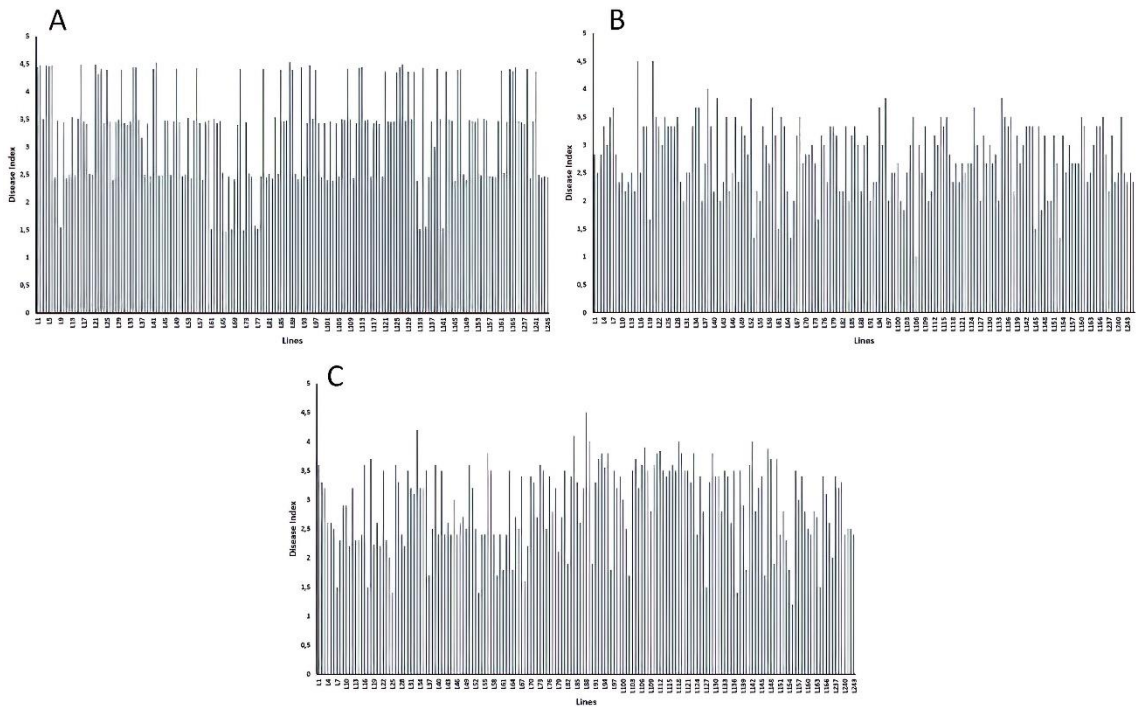

Figure 3. Index variation for crown rot disease caused by *Fusarium culmorum* for a set of 177 lines from bread wheat nursery based on their resistance reaction against crown rot disease. (A) Field conditions (mean two years 2013-14). (B) Greenhouse conditions. (C) Growth room conditions

Çizelge 3. Fusarium culmorum tarafından meydana getirilen kökboğazı çürüklüğü hastalığına karşı gösterdikleri dayanıklılık reaksiyonları'na dayalı olarak 177 ekmeklik buğday hattının kökboğazı çürüklüğü hastalığı indeksi varyasyonu. Tarla koşulları (ortalama iki yıllık 2013-14). (B) Sera koşulları. (C) Büyütme odası koşulları.

There was a significant difference ($P < 0.001$) in the reactions of the Turkish durum wheat genotypes to *F. culmorum* in terms of resistance ranging from resistant to susceptible which varied between 1 to 5 ratings in all conditions (Figure 4). From fifty-six durum wheat genotypes screened, Yelken 2000 and Gokgol gave the lowest disease ratings in greenhouse and field conditions (Figure 4a, b). Five genotypes (Berkmen 469, Diyarbakir 81, Sarı Canak 98, Guneyyildiz, Svevo) and 10 (Akbaşak 073/144, Yılmaz 98, Yelken 2000, Harran 95, Tuten 2002, GAP, Sham-1, Ozberk, Pinau-2001, Durbel) were grouped as MR under greenhouse (adult plant resistance) and growth room (seedling resistance) conditions, respectively. Sham 1, Durbel and Yılmaz 98 were found as the most promising genotypes under growth room conditions (Figure 4c), while durum wheat cultivar Yelken 2000 was the best under all environments. Forty durum wheat genotypes (71%) were tested as MS, S and/or HS to *F. culmorum* in all test environments. The durum wheat varieties Kumbet 2000, Zenit, Gündaş, Alibaba, and Dumlupınar were recorded as the most susceptible durum genotypes against *F. culmorum* at adult stage while Kızıltan 91, and Altıntas 95 were the most susceptible genotypes at the seedling stage. The durum wheat genotypes Durbel, Yılmaz 98, Özberk, Akbaşak 073/144, GAP, and Yelken 2000 showed disease resistance to *F. culmorum* and *H. filipjevi*.

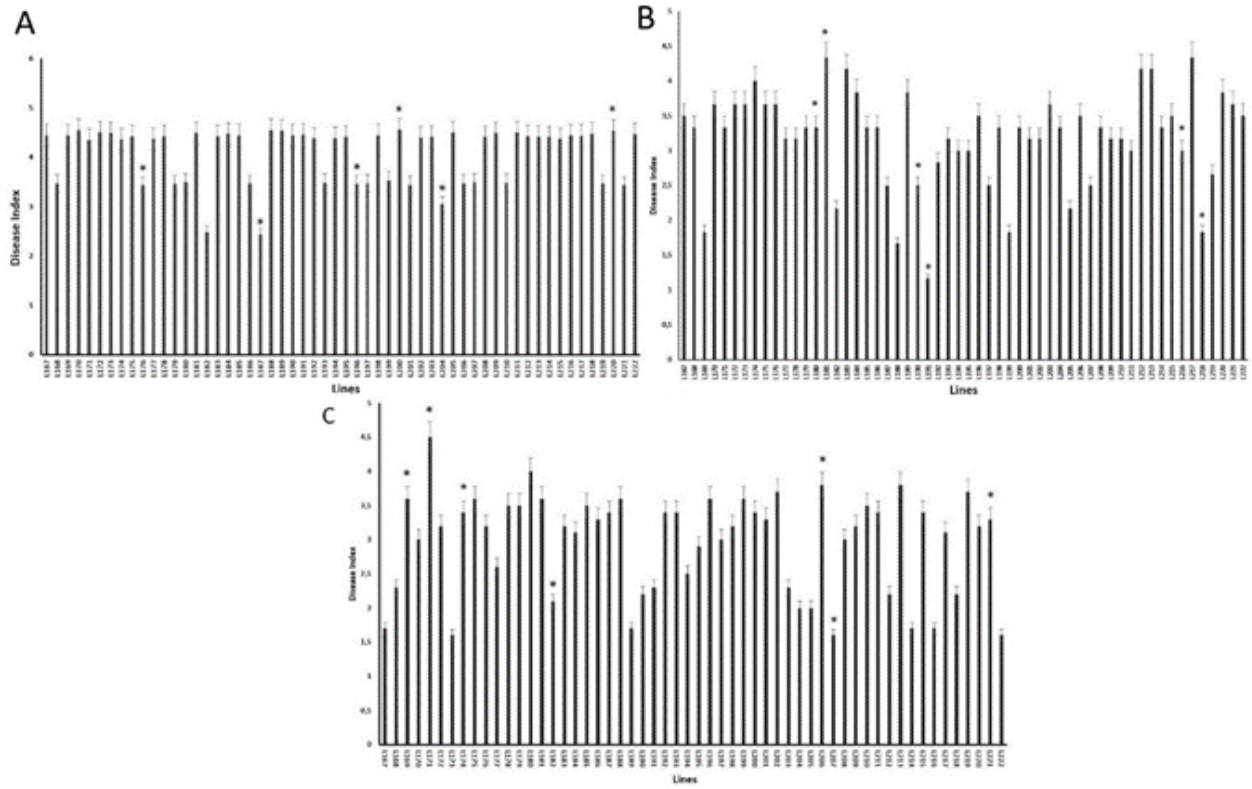

Figure 4. Disease index of 56 durum wheat lines to crown rot disease caused by *Fusarium culmorum.* (A) Disease Index in field conditions (mean of two years 2013-14). (B) Greenhouse conditions. (C) Growth room conditions. Stars represent homogeneous groups based on protected least significant difference test for each variable at $P < 0.001$. Error lines on bars represent the standard error (n = 5).

Çizelge 4. Fusarium culmorum' un 56 makarnalık buğday hattında sebep olduğu kökboğazı hastalık indeksi. (A) Tarla koşullarında hastalık indeksi (ortalama iki yıllık 2013-14). (B) Sera koşulları. (C) Büyütme odası koşulları. Yıldızlar, P < 0,001'de her değişken için korunan en az anlamlı fark testine dayalı homojen grupları temsil eder. Çubuklardaki hata çizgileri standart hatayı (n = 5) temsil eder.

The reactions of nine triticale genotypes tested under greenhouse and field conditions ranged between R to S. Among the triticale genotypes Umranhanim was identified as MR-R at the adult stage, Presto and Melez 2001 identified as MR/R at the seedling stage. Among the oat genotypes Seydisehir rated as MR-MS at the adult stage while it was susceptible at the seedling stage. Triticale cultivar Faikbey rated as MS-S under all conditions. Rye genotype Aslım was susceptible under all conditions (Figure 5).

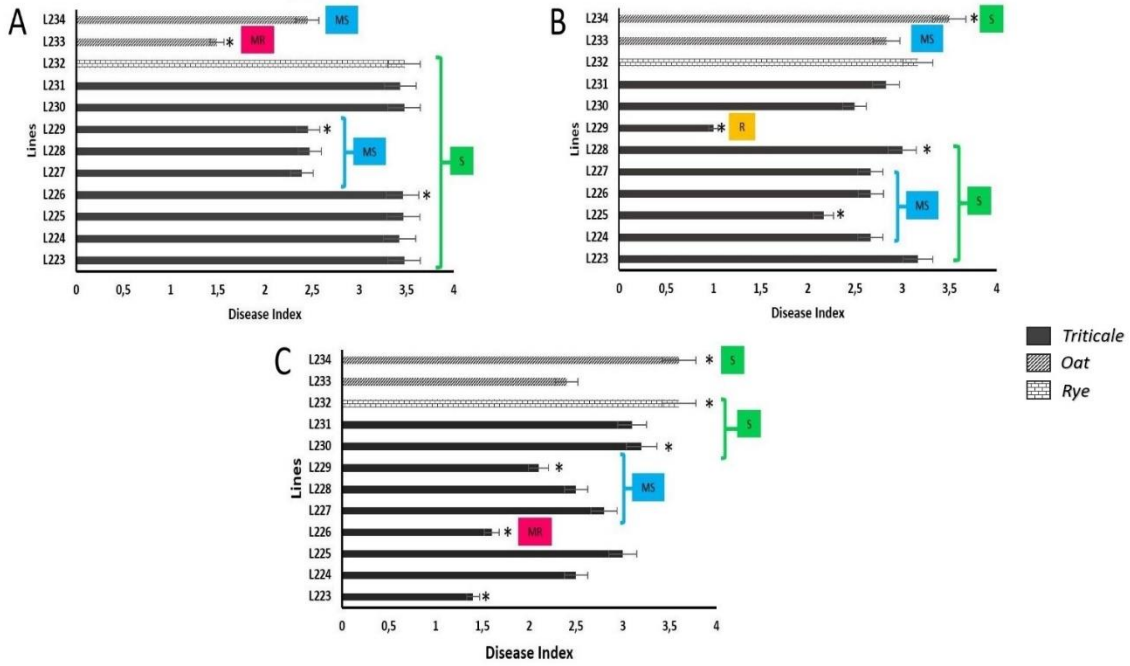

Figure 5. Disease index of 12 triticale, rye and oat genotypes to crown rot disease caused by *Fusarium culmorum*. (A) Disease index under field conditions (mean of two years 2013-14). (B) Greenhouse conditions. (C) Growth room conditions. Stars represent homogeneous groups based on protected least significant difference test for each variable at $P < 0.001$. Error lines on bars represent the standard error (n = 5). Abbreviations stand for: R: resistant; MR: moderately resistant; MS: moderately susceptible; S: susceptible; HS: highly susceptible.
Çizelge 5. Fusarium culmorum' un 12 tritikale, çavdar, ve yulaf) hattında sebep olduğu kökboğazı hastalık indeksi. (A) Tarla koşullarında hastalık indeksi (ortalama iki yıllık 2013-14). (B) Sera koşulları. (C) Büyütme odası koşulları. Yıldızlar, P < 0,001'de her değişken için korunan en az anlamlı fark testine dayalı homojen grupları temsil eder. Çubuklardaki hata çizgileri standart hatayı (n = 5) temsil eder. Kısaltmalar şu anlama gelir: R: dayanıklı; MR: orta derecede dayanıklı; MS: orta derecede hassas; S: hassas; HS: son derece hassas.

Arslan and Baykal (2001) screened some Turkish wheat varieties (Çakmak 79, Gediz 15, Katea1, Kırkpınar 79, Seri 82) against *F. culmorum,* and they found that all of these varieties were susceptible which also supports our findings. Demirci and Dane (2003) showed that Bezostaja 1 and Gün 91 were moderately resistant against *F. culmorum* whereas, in our study, these two varieties were susceptible in all tested environments. Aktas et al. (1997) examined 26 wheat varieties/lines grown in Sakarya province of Türkiye against six root rot pathogens including *F. culmorum*, and they concluded that all tested wheat genotypes were susceptible to these pathogens. In Konya province of Türkiye, two barley varieties Erginel 90, Kıral 97 and triticale Tatlıcak 97 were found resistant to *F. culmorum* and other pathogens (Aktas et al., 1999). Different species of *Fusarium* originated from the Thrace region of Türkiye have been tested for their pathogenicity on seven widely grown wheat varieties, *viz.*, Gelibolu, Golia, Esperia, Krasunya, Nina, Sagittario and Sana. Preemergence damping-off and disease severity in seedlings were at the lowest in cultivars Gelibolu and Esperia (Köycü and Özer, 2019). In the present study, similar results were obtained with cultivar Gelibolu whereas cultivar Esperia was found susceptible. The reactions of cereals were recorded as different to the different pathogens (Aktas et al, 1999). In a similar study, Hekimhan (2010) investigated the pathogenicity of 63 wheat varieties against *F. culmorum*. He stated that both Altay-2000 and Tekirdağ exhibited the lowest disease ratings which supports our results. In our study Tatlıcak 97 showed a susceptible reaction under all environments. The fluctuations that occurred between field and greenhouse data could be attributed to the different climatic changes, water and other microflora in the field (Mitter et al., 2006).

Reaction to the Cyst Nematodes (CCN)

The varieties were tested against *H. filipjevi* under growth room conditions to select the best ones for yield trials under naturally infested field conditions. Cyst numbers ranged from 8 to 68 and 10 to 47 in bread wheat and durum wheat, respectively (Figure 6).

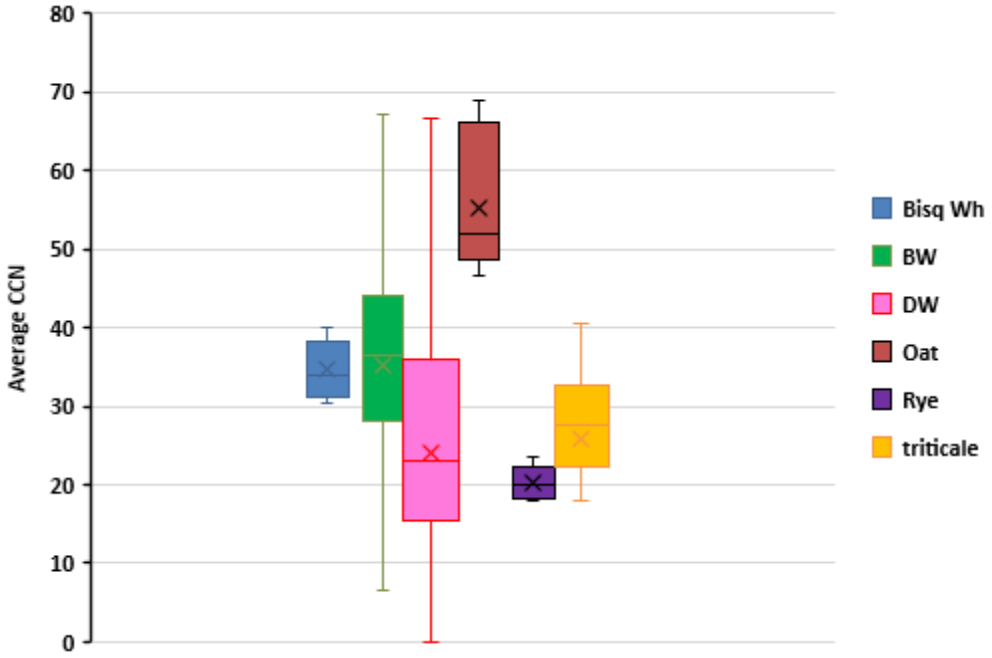

Figure 6. Box and Whisker plot showing the average of cyst nematodes for six cereal crops under growth room conditions. Data are mean ± SE of five replicates (n=5) per crop. Abbreviations stand for: BisqWh-Bisquit Wheat, BW-Bread Wheat, DW- Durum Wheat.

Çizelge 6. Büyütme odası koşullarında altı tahıl ürünü için ortalama kist nematodlarını gösteren Box ve Whisker grafiği. Veriler, ürün başına beş tekerrür'ün (n=5) ortalamasıdır. Kısaltmalar şu anlama gelir: BisqWh-Bisküvilik Buğday, BW-Ekmeklik Buğday, DW- Makarnalık Buğday.

A total of 164 bread wheat genotypes out of 177 were tested for cereal cyst nematode - *H. filipjevi.* Murat-1, Melez, Aldane and 4-22 were found as the most promising genotypes in terms of resistance. Genc-88, Ekiz and Kinaci-97 were the most susceptible genotypes to *H. filipjevi* from the tested 56 durum wheat genotypes against *H. filipjevi.* The cultivars Yılmaz 98, Mirzabey 2000, Altın 40/98, and Akbaşak 073/144 were identified as the potentially resistant genotypes with the lowest cyst numbers, while Kunduru 414/44, Gökgöl 79, Güneyyıldız, and Berkmen 469 were identified as the most susceptible genotypes with the highest cyst numbers. Among the triticales tested Tatlicak 97 had the lowest cyst number (#19). Oat genotypes Seydisehir and Faikbey had the highest cyst numbers among the genotypes tested and grouped as highly susceptible. Rye genotype Aslim showed moderately susceptible reaction to the cereal cyst nematode, *Heterodera filipjevi*. The results from our current study clearly showed that the infection rate and number of cysts per plant were significantly lower in resistant genotypes. In a similar study, Pariyar et al. (2016) evaluated the resistance levels of two hundred ninety-one hexaploid wheat accessions (breeding lines, cultivars, and landraces) originated from 17 different countries against the *H. filipjevi*. They concluded that one percent of the wheat accessions were ranked as resistant, and 16% as moderately resistant. In another study carried out by (Dababat et al., 2014), 719 hexaploid wheat lines with a broad geographical spectrum originated from Europe and Central Asia provided through International Winter Wheat Program at CIMMYT were evaluated against *H. filipjevi*. According to their results, 15.8% and 12.5% of the screened genotypes were found resistant and moderately resistant, respectively. In the current study, 13% of bread wheat genotypes were found R-MR for the nematode whereas all durum wheat varieties and other cereal crops were identified as susceptible to *H. filipjevi*. In the present study, the wide range of Turkish wheat

varieties tested against both organisms under multiple test environments (growth room, greenhouse and/or field) in Türkiye is reported here in for the first time (Table 2). In all test environments, disease expression was observed well and clearly differentiated. Soil borne diseases are difficult to work with as the roots are below ground and symptoms appear when the disease is advanced. There are a variety of management strategies that have been studied to control root rots such as rotation with non-host crops, stubble-burning and integrated management (Cook, 2001). Although many studies on identifying resistant genotypes for root diseases are available, there are just a few partially resistant genotypes that have been reported globally (Chakraborty et al., 2006; Liu et al., 2015, Gebremariam et al 2020). To date, a wide range (thousands) of wheat genotypes/lines originated from more than 30 countries including Türkiye have been tested against soil borne pathogens in terms of their resistance by the CIMMYT-SBP program in Türkiye with the Turkish Ministry of Agriculture and Forestry (Dababat et al., 2014; Erginbas-Orakci et al., 2018). In our study, wheat varieties registered by Turkish Agricultural Research Institutes and by private sector have been evaluated. The purpose of this study was to identify genetic resistance to both *Fusarium culmorum* and *Heterodera filipjevi* on cereal crops which are the principal disease causal agents in Türkiye. In our screening tests, Turkish varieties showed different reactions to the test organisms. Currently, there are no known effective sources of resistance against dryland crown and root rots available in commercially grown varieties. Growing resistant cultivars not only will reduce yield loss of the crop itself but also yield loss in other cereal crops by reducing the inoculum level. Effective breeding of resistant genotypes needs quality sources of resistance and understanding the genetics may help the breeding efficiency. In further studies, the promising wheat accessions can be included in a genome-wide association study to identify loci/genes conferring resistance to *F. culmorum* and *H. filipjevi.*

CONFLICT OF INTEREST

The author declares that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

DECLARATION OF AUTHOR CONTRIBUTION

G.E.O and A.D. conceived and designed the research. G.E.O., A.D., A.T.K., performed the screening trials. S.L. conducted data analysis. G.E.O wrote the manuscript. A.D. and F.M. reviewed the manuscript.

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Table 2. Mean disease ratings of Turkish cereal varieties tested for the Crown rot (*Fusarium culmorum*) and cereal cyst nematode (*Heterodera filipjevi*) under controlled and/or field conditions

Çizelge 2. Kökboğazı çürüklüğü (*Fusarium culmorum*) ve tahıl kist nematodu (*Heterodera filipjevi*) için kontrollü ve/veya tarla koşullarında test edilen Türk tahıl çeşitlerinin ortalama hastalık derecelendirmeleri

#	Variety name	Applicant Name	Tescil Tarihi	Type	CR-FF	CR-GH	CR-GR	SE-FF	SE-GH	SE-GR	CR-RR-FF	CR-RR-GH	CR-RR-GR	CCN-GR	SE-CCN	CCN-RR
1	Ankara 093/44	Tarla Bitkileri Merkez Arş.Ens. Müd.	1950	BW	4.4	2.8	3.6	2.42	1.52	0.45	HS	MS	S	34.6	8.26	S
2	Köse 220/39	Tarla Bitkileri Merkez Arş.Ens. Müd.	1939	BW	4.5	2.5	3.3	2.45	1.34	0.55	HS	MS	S	27.6	5.98	MS
3	Sivas 111/33	Tarla Bitkileri Merkez Arş.Ens. Müd.	1936	BW	3.5	2.8	3.2	1.90	1.52	0.55	S	MS	S	32.0	4.12	S
4	Sürak M. 1593/51	Tarla Bitkileri Merkez Arş.Ens. Müd.	1968	BW	4.5	3.3	2.6	2.43	1.87	0.45	HS	S	MS	37.8	3.56	S
5	Haymana 79	Tarla Bitkileri Merkez Arş.Ens. Müd.	1979	BW	4.5	3.0	2.6	2.45	1.64	0.55	HS	S	MS	44.2	6.22	HS
6	Gün-91	Tarla Bitkileri Merkez Arş.Ens. Müd.	26.04.1991	BW	4.5	3.5	2.5	2.43	1.64	0.55	HS	S	MS	39.0	6.89	S
7	İkizce 96	Tarla Bitkileri Merkez Arş.Ens. Müd.	16.04.1996	BW	2.4	3.7	1.5	1.32	1.87	0.55	MS	S	MR	29.2	3.77	MS
8	Mızrak	Tarla Bitkileri Merkez Arş.Ens. Müd.	12.05.1998	BW	3.5	2.8	2.3	1.91	1.64	0.45	S	MS	MS	36.0	7.58	S
9	Türkmen	Tarla Bitkileri Merkez Arş.Ens. Müd.	12.05.1998	BW	1.5	2.3	2.9	0.86	1.34	0.00	MR	MS	MS	33.2	4.15	S
10	Uzunyayla	Tarla Bitkileri Merkez Arş.Ens. Müd.	12.05.1998	BW	3.4	2.5	2.9	1.90	1.34	0.45	S	MS	MS	32.0	4.53	S
11	Yakar-99	Tarla Bitkileri Merkez Arş.Ens. Müd.	26.04.1999	BW	2.4	2.2	2.2	1.33	1.34	0.00	MS	MS	MS	22.2	4.38	MR
12	Aksel 2000	Tarla Bitkileri Merkez Arş.Ens. Müd.	28.04.2000	BW	2.5	2.3	3.2	1.35	1.34	0.55	MS	MS	S	25.8	6.22	MR
13	Bayraktar 2000	Tarla Bitkileri Merkez Arş.Ens. Müd.	28.04.2000	BW	3.5	2.5	2.3	1.94	1.10	0.55	S	MS	MS	35.2	6.50	S
14	Demir 2000	Tarla Bitkileri Merkez Arş.Ens. Müd.	28.04.2000	BW	2.5	2.2	2.3	1.36	1.10	0.45	MS	MS	MS	28.2	5.54	MS
15	Atlı-2002	Tarla Bitkileri Merkez Arş.Ens. Müd.	05.05.2002	BW	3.5	4.5	2.4	1.94	2.41	0.55	S	HS	MS	37.0	5.57	S
16	Zencirci-2002	Tarla Bitkileri Merkez Arş.Ens. Müd.	12.05.2002	BW	4.5	2.5	3.6	2.47	1.34	0.55	HS	MS	S	25.6	2.41	MR
17	Eser	Tarla Bitkileri Merkez Arş.Ens. Müd.	02.05.2003	BW	3.5	3.3	1.5	1.90	1.87	0.55	S	S	MR	40.0	5.87	HS
18	Seval	Tarla Bitkileri Merkez Arş.Ens. Müd.	01.04.2004	BW	3.4	3.3	3.7	1.90	2.05	0.00	S	S	S	24.4	16.83	MR
19	Tosunbey	Tarla Bitkileri Merkez Arş.Ens. Müd.	01.04.2004	BW	2.5	1.7	2.2	1.35	1.00	0.45	MS	MR	MS	32.8	4.15	S
20	Kenanbey	Tarla Bitkileri Merkez Arş.Ens. Müd.	06.04.2009	BW	2.5	4.5	2.6	1.36	2.41	0.55	MS	HS	MS	39.2	4.32	S
21	Lütfibey	Tarla Bitkileri Merkez Arş.Ens. Müd.	30.03.2010	BW	4.5	3.5	2.2	2.50	1.87	0.00	HS	S	MS	41.6	7.16	HS
22	4-11	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1952	BW	4.3	3.3	3.5	2.37	2.05	0.55	HS	S	S	40.8	4.02	HS
23	4-22	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1966	BW	4.4	3.0	2.3	2.42	1.64	0.45	HS	S	MS	17.0	2.55	R
24	P 8-6	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1966	BW	3.4	3.5	2.0	1.84	1.87	0.55	S	S	MR	19.8	2.59	R
25	P 8-8	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1966	BW	4.4	3.3	1.4	2.37	1.87	0.55	HS	S	MR	41.8	2.77	HS
26	Melez13	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1944	BW	3.5	3.3	3.6	1.88	1.64	0.55	S	S	S	13.6	1.52	R
27	Ak 702	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1931	BW	2.4	3.3	3.3	1.32	1.87	0.55	MS	S	S	50.4	3.44	HS
28	Sertak52	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1936	BW	3.5	3.5	2.4	1.86	2.05	0.55	S	S	MS	19.2	3.63	R

29	Yayla 305	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1939	BW	3.5	2.3	2.2	1.91	1.34	0.00	S	MS	MS	34.2	3.42	S
30	Yektay 406	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1955	BW	4.4	2.0	3.5	2.36	1.10	0.55	HS	MR	S	31.6	3.78	S
31	Bolal 2973	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1970	BW	3.4	2.5	3.2	1.88	1.34	0.55	S	MS	S	27.8	5.36	MS
32	Kıraç 66	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	27.04.1970	BW	3.4	2.5	3.1	1.85	1.52	0.55	S	MS	S	31.4	3.13	S
33	Porsuk-2800	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1976	BW	3.5	3.3	4.2	1.89	1.87	0.55	S	S	HS	40.2	9.63	HS
34	Gerek 79	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	15.05.1979	BW	4.4	3.7	3.2	2.42	2.05	0.55	HS	S	S	19.0	2.74	R
35	Atay-85	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	25.04.1985	BW	4.4	3.7	3.2	2.43	2.19	0.45	HS	S	S	31.8	4.49	S
36	Kutluk 94	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1994	BW	3.5	2.5	3.5	1.90	1.34	0.45	S	MS	S	36.4	1.82	S
37	Kırgız 95 (Empty)	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1995	BW	3.2	2.7	1.7	1.87	2.05	0.55	S	MS	MR	26.0	1.58	MS
38	Sultan 95	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1995	BW	2.5	4.0	2.5	1.39	2.19	0.55	MS	HS	MS	23.0	1.58	MR
39	Süzen 97	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	06.05.1997	BW	3.4	3.3	3.6	1.88	2.05	0.55	S	S	S	43.4	4.04	HS
40	Aytın 98	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	12.05.1998	BW	2.5	2.2	2.4	1.34	1.79	0.55	MS	MS	MS	25.2	2.28	MR
41	Yıldız 98	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	12.05.1998	BW	4.4	3.8	3.5	2.45	1.34	0.55	HS	S	S	29.8	2.59	MS
42	Harmankaya-99	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	26.04.1999	BW	4.5	2.0	2.4	2.50	1.34	0.55	HS	MR	MS	23.8	2.59	MR
43	Altay 2000	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	28.04.2000	BW	2.5	2.3	2.6	1.34	1.64	0.55	MS	MR	MS	40.2	3.77	HS
44	Çetinel 2000	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	28.04.2000	BW	2.5	3.5	2.4	1.35	1.10	0.55	MS	S	MS	36.0	2.55	S
45	Alpu 2001	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	24.04.2001	BW	3.5	2.2	3.0	1.93	1.34	0.55	S	MS	S	39.8	5.22	S
46	İzgi 2001	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	24.04.2001	BW	3.5	2.5	2.4	1.92	2.00	0.55	S	MS	MS	49.8	6.10	HS
47	Sönmez 2001	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	24.04.2001	BW	2.5	3.5	2.6	1.36	1.34	0.55	MS	S	MS	23.2	1.92	MR
48	Soyer02	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	02.05.2002	BW	3.5	2.3	2.7	1.88	1.34	0.55	S	MS	MS	25.8	2.59	MR
49	Müfitbey	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	14.04.2006	BW	4.4	3.3	2.5	2.39	2.05	0.55	HS	S	MS	52.4	3.71	HS
50	Nacibey	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	02.04.2008	BW	3.4	3.2	3.6	1.89	1.34	0.45	S	S	S	48.6	8.14	HS
51	ES 26	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	30.03.2010	BW	2.5	2.8	3.2	1.34	1.87	0.55	MS	MS	S	52.0	6.08	HS
52	Dağdaş 94	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	17.05.1994	BW	2.5	3.8	2.5	1.33	1.64	0.55	MS	S	MS	52.4	3.36	HS
53	Kınacı-97	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	06.05.1997	BW	3.5	1.3	1.4	1.93	1.52	0.45	S	MR	MR	60.6	5.59	HS
54	Göksu-99	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	26.04.1999	BW	2.4	2.2	2.4	1.32	2.19	0.55	MS	MS	MS	39.2	1.64	S
55	Karahan-99	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	26.04.1999	BW	3.5	2.0	2.4	1.89	0.84	0.55	S	MR	MS	34.6	3.58	S
56	Bağcı-2002	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	02.05.2002	BW	4.4	3.3	3.8	2.41	1.34	0.55	HS	S	S	40.6	4.34	HS
57	Konya-2002	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	02.05.2002	BW	3.4	3.0	3.5	1.90	1.34	0.55	S	S	S	41.8	5.76	HS
58	Ahmetağa	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	01.04.2004	BW	2.4	2.7	2.4	1.32	1.87	0.55	MS	MS	MS	34.6	2.70	S
59	Ekiz	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	01.04.2004	BW	3.5	3.7	1.7	1.88	1.64	0.55	S	S	MR	61.4	6.88	HS

60	Kırkpınar 79	Trakya Tarımsal Araştırma Ens.Müd.	1979	BW	3.5	3.2	2.4	1.85	1.52	0.55	S	S	MS	32.6	2.41	S
61	Murat-1	Trakya Tarımsal Araştırma Ens.Müd.	1991	BW	1.5	1.5	1.8	0.81	2.05	0.55	MR	MR	MR	13.4	1.67	R
62	Kate A-1	Trakya Tarımsal Araştırma Ens.Müd.	26.04.1988	BW	3.5	3.5	2.4	1.92	1.64	0.55	S	S	MS	8.6	1.67	R
63	Pehlivan	Trakya Tarımsal Araştırma Ens.Müd.	12.05.1998	BW	3.4	3.3	3.5	1.90	1.00	0.55	S	S	S	18.6	3.58	R
64	Prostor	Trakya Tarımsal Araştırma Ens.Müd.	26.04.1999	BW	3.5	2.2	1.8	1.89	2.05	0.00	S	MS	MR	48.0	2.74	HS
65	Saroz 95	Trakya Tarımsal Araştırma Ens.Müd.	26.04.1999	BW	2.5	1.3	2.7	1.40	1.87	0.00	MS	MR	MS	20.0	1.22	MR
66	Atilla-12	Trakya Tarımsal Araştırma Ens.Müd.	24.04.2001	BW	1.5	2.0	2.5	0.82	1.10	0.55	MR	MR	MS	41.6	6.02	HS
67	Saraybosna	Trakya Tarımsal Araştırma Ens.Müd.	24.04.2001	BW	2.5	3.2	3.4	1.31	0.84	0.55	MS	S	S	27.4	1.82	MS
68	Gelibolu	Trakya Tarımsal Araştırma Ens.Müd.	30.03.2005	BW	1.5	3.5	1.6	0.82	1.34	0.55	MR	S	MR	29.0	13.80	MS
69	Tekirdağ	Trakya Tarımsal Araştırma Ens.Müd.	30.03.2005	BW	2.4	2.7	2.2	1.32	1.64	0.00	MS	MS	MS	49.4	5.22	HS
70	Aldane	Trakya Tarımsal Araştırma Ens.Müd.	06.04.2009	BW	3.4	2.8	3.4	1.89	1.87	0.55	S	MS	S	14.4	2.88	R
71	Selimiye	Trakya Tarımsal Araştırma Ens.Müd.	06.04.2009	BW	4.4	2.8	3.3	2.43	1.34	0.55	HS	MS	S	39.4	2.70	S
72	Bereket	Trakya Tarımsal Araştırma Ens.Müd.	30.03.2010	BW	1.5	3.0	2.7	0.83	1.64	0.45	MR	S	MS	23.4	2.07	MR
73	Lancer	Doğu Anadolu Tarımsal Araştırma Ens. M.	1977	BW	3.4	2.7	3.6	1.85	1.64	0.45	S	MS	S	24.6	1.67	MR
74	Doğu 88	Doğu Anadolu Tarımsal Araştırma Ens. M.	10.04.1990	BW	2.5	1.7	3.5	1.37	2.19	0.55	MS	MS	S	32.2	2.17	S
75	Karasu 90	Doğu Anadolu Tarımsal Araştırma Ens. M.	16.04.1990	BW	2.5	3.2	2.5	1.37	1.64	0.55	MS	S	MS	40.4	2.07	HS
76	Palandöken 97	Doğu Anadolu Tarımsal Araştırma Ens. M.	06.05.1997	BW	1.6	3.0	3.4	0.86	1.00	0.55	MR	S	S	40.2	1.64	HS
77	Alparslan	Doğu Anadolu Tarımsal Araştırma Ens. Müd.	24.04.2001	BW	1.5	2.3	2.8	0.82	1.87	0.00	MR	S	MS	42.2	3.11	HS
78	Nenehatun	Doğu Anadolu Tarımsal Araştırma Ens. M.	24.04.2001	BW	2.5	3.3	3.2	1.39	1.64	0.55	MS	S	S	37.4	1.14	S
79	Daphan	Doğu Anadolu Tarımsal Araştırma Ens. M.	2002	BW	4.4	3.3	2.1	2.41	1.34	0.45	HS	S	MS	36.0	1.58	S
80	Yıldırım	Doğu Anadolu Tarımsal Araştırma Ens. M.	02.05.2002	BW	2.4	3.2	2.7	1.33	1.87	0.45	MS	S	MS	38.2	0.84	S
81	Karacadağ 98	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	12.05.1998	BW	2.5	2.2	3.5	1.37	1.87	0.55	MS	MS	S	39.8	2.39	S
82	Nurkent	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	24.04.2001	BW	2.4	2.2	1.9	1.33	1.87	0.45	MS	MS	MR	37.0	2.35	S
83	Cemre	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	02.04.2008	BW	3.5	3.3	3.4	1.93	1.30	0.55	S	S	S	58.8	2.68	HS
84	İnia 66	Mısır Araştırma İstasyonu Müd. CIMMYT-INIA	1966	BW	2.5	2.0	4.1	1.39	1.10	0.55	MS	MR	HS	38.6	1.67	S
85	Bezostaja 1	Mısır Araştırma İstasyonu Müd.	19.03.1968	BW	4.4	3.2	3.3	2.36	1.87	0.55	HS	S	S	37.8	3.03	S
86	Bandırma 97	Mısır Araştırma İstasyonu Müd.	06.05.1997	BW	3.5	3.3	2.6	1.88	1.10	0.55	S	S	MS	48.6	2.70	HS
87	Karacabey 97	Mısır Araştırma İstasyonu Müd.	06.05.1997	BW	3.5	3.0	3.2	1.94	1.79	0.55	S	S	S	38.0	2.12	S
88	Pamukova 97	Mısır Araştırma İstasyonu Müd.	06.05.1997	BW	4.5	2.2	4.5	2.48	1.87	0.55	HS	MS	HS	36.6	2.07	S
89	Momtchill	Mısır Araştırma İstasyonu Müd.	28.04.2000	BW	4.4	3.0	4.0	2.37	1.64	0.55	HS	S	HS	48.8	2.59	HS
90	Tahirova 2000	Mısır Araştırma İstasyonu Müd.	28.04.2000	BW	2.5	3.2	1.9	1.36	1.34	0.55	MS	S	MR	29.8	1.92	MS
91	Beşköprü	Mısır Araştırma İstasyonu Müd.	05.04.2007	BW	2.4	2.0	3.3	1.32	1.64	0.55	MS	MR	S	57.8	2.86	HS
92	Hanlı	Mısır Araştırma İstasyonu Müd.	05.04.2007	BW	4.4	2.3	3.7	2.43	1.87	0.45	HS	MS	S	29.2	3.35	MS

93	Sakin	Mısır Araştırma İstasyonu Müd.Karadeniz Tarımsal Arş.Enst. Müd.	02.05.2002	BW	2.5	2.3	3.8	1.32	1.10	0.00	MS	MS	S	59.0	4.18	HS
94	Canik 2003	Karadeniz Tarımsal Arş.Enst. Müd.	02.05.2003	BW	3.4	3.7	NA	1.89	1.34	NA	S	S	.	38.4	4.67	S
95	Özcan	Mısır Araştırma İstasyonu Müd.Karadeniz Tarımsal Arş.Enst. Müd.	01.04.2004	BW	4.5	3.0	3.6	2.52	1.34	0.55	HS	S	S	35.4	5.41	S
96	Köksal-2000	Uludağ Üniversitesi Ziraat Fakültesi	24.04.2001	BW	3.5	3.8	3.8	1.93	2.05	0.00	S	S	S	25.6	4.83	MR
97	Turan	Prof.Dr.Turan TATLIOĞLU	24.04.2001	BW	4.4	2.0	1.8	2.38	1.64	0.00	HS	MR	MR	45.4	3.65	HS
98	Martar	Prof.Dr.Turan TATLIOĞLU	24.04.2001	BW	3.4	2.5	3.5	1.88	2.19	0.55	S	MS	S	42.8	7.12	HS
99	Cumhuriyet 75	Ege Tarımsal Araş. Ens. Müd.	13.05.1976	BW	2.5	2.5	3.2	1.33	1.10	0.55	MS	MS	S	28.2	5.89	MS
100	Ata-81	Ege Tarımsal Araş. Ens. Müd.	1982	BW	3.4	2.7	3.4	1.89	1.34	0.55	S	MS	S	45.0	11.29	HS
101	İzmir 85	Ege Tarımsal Araş. Ens. Müd.	1985	BW	2.4	2.0	3.0	1.33	1.52	0.00	MS	MR	S	27.8	5.07	MS
102	Marmara 86	Ege Tarımsal Araş. Ens. Müd.	1986	BW	3.5	1.8	2.5	1.89	1.34	0.55	S	MR	MS	39.0	5.79	S
103	Kaklıç 88	Ege Tarımsal Araş. Ens. Müd.	1988	BW	2.4	2.5	1.7	1.29	1.00	0.00	MS	MS	MR	44.8	4.32	HS
104	Basri Bey 95	Ege Tarımsal Araş. Ens. Müd.	20.04.1995	BW	3.4	3.0	3.5	1.88	1.00	0.55	S	S	S	37.0	5.00	S
105	Kaşif Bey 95	Ege Tarımsal Araş. Ens. Müd.	20.04.1995	BW	2.5	3.5	3.7	1.32	1.52	0.00	MS	S	S	43.4	5.32	HS
106	Gönen 98	Ege Tarımsal Araş. Ens. Müd.	12.05.1998	BW	3.5	1.0	3.2	1.94	1.64	0.55	S	R	S	36.2	1.64	S
107	Ziyabey 98	Ege Tarımsal Araş. Ens. Müd.	12.05.1998	BW	3.5	3.0	3.6	1.94	2.05	0.45	S	S	S	37.4	5.50	S
108	Meta 2002	Ege Tarımsal Araş. Ens. Müd.	02.05.2002	BW	4.4	2.5	3.9	2.39	0.55	0.00	HS	MS	S	37.8	2.68	S
109	Alibey	Ege Tarımsal Araş. Ens. Müd.	01.04.2004	BW	3.5	3.3	3.5	1.91	1.64	0.55	S	S	S	37.0	4.53	S
110	Menemen	Ege Tarımsal Araş. Ens. Müd.	01.04.2004	BW	2.4	2.0	2.8	1.31	1.52	0.00	MS	MR	MS	39.4	5.13	S
111	Çukurova 86	Çukurova Üniversitesi Ziraat Fakültesi	1986	BW	3.4	2.2	3.6	1.86	1.87	0.45	S	MS	S	36.0	3.94	S
112	Doğankent 1	Doğu Akdeniz Tarımsal Arş.Enst.Müd.	20.04.1991	BW	4.4	3.2	3.8	2.42	1.10	0.00	HS	S	S	32.4	7.23	S
113	Seri 82	Çukurova Üniversitesi Ziraat Fakültesi	26.04.1991	BW	4.4	3.0	3.8	2.42	1.10	2.19	HS	S	S	46.0	7.75	HS
114	Seyhan 95	Çukurova Üniversitesi Ziraat Fakültesi	1995	BW	3.5	3.5	3.5	1.90	1.87	0.55	S	S	S	38.8	4.09	S
115	Adana-99	Doğu Akdeniz Tarımsal Arş.Enst.Müd.	26.04.1999	BW	3.5	3.3	3.4	1.94	1.64	0.55	S	S	S	46.0	7.38	HS
116	Ceyhan-99	Doğu Akdeniz Tarımsal Arş.Enst.Müd.	25.04.1999	BW	2.5	3.5	3.5	1.35	2.05	0.55	MS	S	S	30.4	6.66	MS
117	Balattila	Çukurova Üniversitesi Ziraat Fakültesi	28.04.2000	BW	3.4	2.8	3.6	1.86	1.87	0.55	S	MS	S	33.0	4.42	S
118	Pandas (Panda)	Çukurova Üniversitesi Ziraat Fakültesi	24.04.2001	BW	3.5	2.3	3.5	1.89	1.87	0.55	S	MS	S	49.0	11.42	HS
119	Yüreğir-89	Çukurova Üniversitesi Ziraat Fakültesi	02.05.2002	BW	3.4	2.7	4.0	1.87	1.64	0.45	S	MS	HS	36.8	4.44	S
120	Karatopak	Doğu Akdeniz Tarımsal Arş.Enst.Müd.	14.04.2006	BW	2.5	2.3	3.8	1.35	1.34	0.00	MS	MS	S	36.6	17.71	S
121	Osmaniyem	Çukurova Üniversitesi Ziraat Fakültesi	14.04.2006	BW	4.4	2.7	3.5	2.39	1.64	0.55	HS	MS	S	29.8	4.97	MS
122	Abuşbey	GAP-EYAM/ŞURF	unknown	BW	3.5	2.5	3.5	1.89	1.34	0.55	S	MS	S	37.4	4.62	S
123	Genç 88	Çukurova Üniversitesi	1988	BW	3.5	2.7	3.3	1.86	1.34	0.55	S	MS	S	61.4	8.96	HS
124	Genç-99	Çukurova Üniversitesi	1999	BW	3.5	2.7	3.8	1.89	1.52	0.55	S	MS	S	38.0	7.31	S
125	Dariel	Hazera Tohumculuk ve Tic. A.Ş.	02.05.2002	BW	4.4	3.7	2.4	2.38	1.34	0.55	HS	S	MS	55.0	9.92	HS
126	Galil	Hazera Tohumculuk ve Tic. A.Ş.	02.05.2002	BW	4.4	3.0	3.4	2.47	1.52	0.55	HS	S	S	46.0	8.92	HS
127	Negev	Hazera Tohumculuk ve Tic. A.Ş.	02.05.2002	BW	4.5	2.0	2.8	2.41	2.19	0.55	HS	MR	MS	29.0	4.53	MS

128	Carisma	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	08.04.2011	BW	3.5	3.2	1.5	1.92	1.64	0.55	S	S	MR	.	.	.
129	Esperia	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	08.04.2011	BW	4.4	2.7	3.3	2.37	1.10	0.55	HS	MS	S	32.2	5.81	S
130	Sagittario	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	24.04.2001	BW	3.5	3.0	3.8	1.92	1.87	0.00	S	S	S	45.8	3.70	HS
131	Axis	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	2003	BW	4.4	2.7	3.4	2.37	1.52	0.55	HS	MS	S	39.6	5.13	S
132	Alacris	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	2005	BW	2.4	2.8	3.4	1.30	1.64	0.55	MS	MS	S	31.6	16.59	S
133	Bone de	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	12.04.2013	BW	1.5	2.0	2.8	0.83	1.52	0.00	MR	MR	MS	41.0	9.95	HS
134	**Krasunia**	Marmara Tohum Geliştirme A.Ş.	02.04.2008	BW	4.4	3.8	3.5	2.45	1.64	0.55	HS	S	S	42.2	9.42	HS
135	Sirena Odeska	Marmara Un	02.04.2008	BW	1.6	3.5	3.4	0.84	1.10	0.55	MR	S	S	43.6	11.87	HS
136	Nota	Marmara Un	12.04.2013	BW	2.5	3.3	2.6	1.34	2.19	0.55	MS	S	MS	39.2	1.92	S
137	Yubileynaya	Marmara Un	12.04.2013	BW	3.5	3.5	NA	1.91	2.05	NA	S	S	.	43.6	10.53	HS
138	Özdemirbey-97	Sapeksa / Adana	2003	BW	3.0	2.2	3.5	1.64	2.05	0.55	S	MS	S	47.2	6.46	HS
139	Bancal	Fito Tohumculuk	1996	BW	4.4	3.2	1.4	2.40	2.05	0.55	HS	S	MR	53.0	6.60	HS
140	Pinzon	Fito Tohumculuk	08.04.2011	BW	3.5	2.7	3.5	1.91	1.34	0.55	S	MS	S	44.0	10.86	HS
141	Flamura 85	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	26.04.1999	BW	1.5	3.0	2.9	0.84	1.64	0.55	MR	S	MS	58.2	6.69	HS
142	Dropia	Tareks Tar.Ür. A. G. İth.İhr.Tic.A.Ş.	02.05.2003	BW	4.4	3.3	1.8	2.39	1.52	0.55	HS	S	MR	48.0	4.18	HS
143	Golia	Tarım İşletmeleri Genel Müdürlüğü	26.04.1999	BW	3.5	3.3	3.6	1.88	1.64	0.45	S	S	S	38.0	3.39	S
144	Guadalupe	Tarım İşletmeleri Genel Müdürlüğü	05.04.2007	BW	3.5	3.3	4.0	1.90	1.87	0.45	S	S	HS	60.0	5.00	HS
145	Tina	Bc Institut Dd Zagreb Türkiye Ankara Şubesi	30.03.2005	BW	2.4	1.5	2.8	1.30	1.87	0.00	MS	MR	MS	49.8	6.38	HS
146	Nina	Bc Institut Dd Zagreb Türkiye Ankara Şubesi	30.03.2005	BW	4.4	3.3	3.2	2.36	1.87	0.55	HS	S	S	47.4	2.07	HS
147	Claudio	Progen Tohum A.Ş.	08.04.2011	BW	4.4	1.8	3.4	2.41	0.84	0.55	HS	MR	S	.	.	.
148	Bezostaja 1	Özbuğday Tar. İşl. ve Toh. A.Ş	30.03.2010	BW	2.5	3.2	1.7	1.33	1.87	0.45	MS	S	MR	35.8	4.09	S
149	Vittorio	Progen Tohum A.Ş.	17.04.2012	BW	2.4	2.3	3.9	1.35	1.34	0.00	MS	MR	S	57.2	5.40	HS
150	Mane Nick	Limagrain Tohum Islah ve Üretim San.Tic.A.Ş	08.04.2011	BW	3.5	2.0	3.7	1.91	1.87	0.00	S	MR	S	49.2	4.97	HS
151	Quality	Ata Tohumculuk	17.04.2012	BW	3.5	3.2	1.9	1.94	1.10	0.45	S	S	MR	30.8	3.90	MS
152	Geya I	Kartaş Tarım Ürünleri Tic. Ltd. Şti	08.04.2011	BW	3.5	2.7	3.7	1.94	1.10	0.55	S	MS	S	33.0	3.46	S
153	May8059	May-Agro Tohumculuk San ve Tic A.Ş.	17.04.2012	BW	3.5	1.3	2.4	1.91	1.87	0.55	S	MR	MS	27.4	4.22	MS
154	May 8462	May-Agro Tohumculuk San ve Tic A.Ş.	30.03.2010	BW	2.5	3.2	2.8	1.37	1.34	0.00	MS	S	MS	39.4	4.16	S
155	Anapo	Pioneer Tohumculuk A.Ş.	08.04.2011	BW	3.5	2.5	2.3	1.91	0.84	0.45	S	MS	MS	54.0	5.92	HS
156	Yunak	Trakya Tarım	06.04.2009	BW	3.5	3.0	1.8	1.91	1.87	0.71	S	S	MR	30.2	4.15	MS
157	Kaan	Trakya Tarım ve Vet Tic. Ltd.Şti.	06.04.2009	BW	2.5	2.7	1.2	1.35	1.52	0.55	MS	MS	MR	26.0	4.18	MS
158	Hakan	Trakya Tarım ve Vet Tic. Ltd.Şti.	06.04.2009	BW	2.5	2.7	3.5	1.34	1.64	0.55	MS	MS	S	23.6	2.70	MR
159	TT-601	Trakya Tarım	30.03.2010	BW	2.5	2.7	3.0	1.35	1.64	0.55	MS	MS	S	35.4	4.04	S
160	Rumeli	Trakya Tarım	17.04.2012	BW	3.5	3.5	3.4	1.94	1.64	0.55	S	S	S	31.8	3.83	S
161	Turkuaz	Trakya Tarım	17.04.2012	BW	4.4	3.3	2.8	2.38	1.64	0.00	HS	S	MS	31.2	3.56	S
162	Tekira	Trakya Tarım	unknown	BW	2.5	2.3	2.5	1.36	2.05	0.55	MS	MS	MS	44.2	3.90	HS

163	Tosun 21	Ankara Ziraat Fak.	1975	BW	3.5	2.5	2.4	1.92	1.34	0.55	S	MS	MS	34.6	9.48	S
164	Tosun 144	Ankara Ziraat Fak.	1975	BW	4.4	3.0	2.8	2.40	1.52	0.55	HS	S	MS	28.6	4.28	MS
165	Hawk (Şahin)	Doğu Anadolu Tarımsal Araştırma Ens. M.	1987	BW	4.4	3.3	2.7	2.38	1.64	0.45	HS	S	MS	48.6	3.91	HS
166	Ukrayna		unknown	BW	4.4	3.3	1.5	2.37	2.05	0.55	HS	S	MR	49.8	7.12	HS
167	Akbaşak 073/144	Tarla Bitkileri Merkez Arş.Ens. Müd.	1951	DW	4.5	3.5	1.7	0.115	1.87	0.55	HS	S	MR	11.1	1.66	MS
168	Kunduru 414/44	Tarla Bitkileri Merkez Arş.Ens. Müd.	1963	DW	3.5	3.3	2.3	0.029	1.87	0.55	MS	S	MS	46.6	6.92	MS
169	Berkmen 469	Tarla Bitkileri Merkez Arş.Ens. Müd.	1968	DW	4.4	1.8	3.6	0.076	1.10	0.55	HS	MR	S	43.8	4.78	MS
170	Çakmak 79	Tarla Bitkileri Merkez Arş.Ens. Müd.	1979	DW	4.6	3.7	3.0	0.087	2.19	0.55	HS	S	MS	40.4	7.21	MS
171	Kızıltan 91	Tarla Bitkileri Merkez Arş.Ens. Müd.	26.04.1991	DW	4.4	3.3	4.5	0.150	2.05	0.55	HS	S	HS	15.4	3.37	MS
172	Altın 40/98	Tarla Bitkileri Merkez Arş.Ens. Müd.	12.05.1998	DW	4.5	3.7	3.2	0.126	1.87	0.55	HS	S	S	10.5	1.90	MS
173	Yılmaz 98	Tarla Bitkileri Merkez Arş.Ens. Müd.	12.05.1998	DW	4.5	3.7	1.6	0.115	2.05	0.55	HS	S	MR	9.7	2.31	MS
174	Ankara 98	Tarla Bitkileri Merkez Arş.Ens. Müd.	12.05.1998	DW	4.4	4.0	3.4	0.058	2.19	0.55	HS	S	S	18.2	2.97	MS
175	Çeşit-1252	Tarla Bitkileri Merkez Arş.Ens. Müd.	26.04.1999	DW	4.4	3.7	3.6	0.058	2.05	0.55	HS	S	S	17.9	1.73	MS
176	Mirzabey 2000	Tarla Bitkileri Merkez Arş.Ens. Müd.	28.04.2000	DW	3.4	3.7	3.2	0.087	2.19	0.55	MS	S	S	10.0	1.63	MS
177	Eminbey	Tarla Bitkileri Merkez Arş.Ens. Müd.	06.04.2009	DW	4.4	3.2	2.6	0.087	1.64	0.55	HS	S	MS	14.8	1.69	MS
178	İmren	Tarla Bitkileri Merkez Arş.Ens. Müd.	06.04.2009	DW	4.4	3.2	3.5	0.132	1.64	0.55	HS	S	S	20.1	2.18	MS
179	Kunduru 1149	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	26.04.1967	DW	3.5	3.3	3.5	0.029	1.87	0.55	MS	S	S	15.9	2.85	MS
180	Altıntaş 95	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1995	DW	3.5	3.3	4.0	0.029	1.87	0.45	MS	S	S	16.0	4.08	MS
181	Kümbet 2000	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	28.04.2000	DW	4.5	4.3	3.6	0.058	2.59	0.55	HS	HS	S	20.0	2.49	MS
182	Yelken 2000	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	28.04.2000	DW	2.5	2.2	2.1	0.104	1.10	0.45	MR	MS	MR	20.7	2.79	MS
183	Dumlupınar	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	14.04.2006	DW	4.4	4.2	3.2	0.132	2.41	0.55	HS	HS	S	29.2	3.33	MS
184	Selçuklu-97	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	06.05.1997	DW	4.5	3.8	3.1	0.087	2.19	0.55	HS	S	S	25.8	7.38	MS
185	Meram-2002	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	02.05.2002	DW	4.5	3.3	3.5	0.173	1.87	0.55	HS	S	S	42.3	7.44	MS
186	Tunca 79	Trakya Tarımsal Araştırma Ens.Müd.	15.05.1979	DW	3.5	3.3	3.3	0.029	1.87	0.55	MS	S	S	42.7	6.40	MS
187	Gökgöl 79	Trakya Tarımsal Araştırma Ens.Müd.	1979	DW	2.4	2.5	3.4	0.144	1.52	0.55	MR	MS	S	46.6	6.92	MS
188	Diyarbakır-81	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1986	DW	4.6	1.7	3.6	0.087	1.00	0.45	HS	MR	S	28.8	3.58	MS
189	Harran 95	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1995	DW	4.5	3.8	1.7	0.076	2.05	0.55	HS	S	MR	25.2	4.08	MS
190	Ceylan 95	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	1995	DW	4.5	2.5	2.2	0.115	1.52	0.00	HS	MS	MS	36.6	3.47	MS
191	Sarı çanak 98	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	12.05.1998	DW	4.5	1.2	2.3	0.202	0.55	0.45	HS	MR	MS	28.2	5.27	MS
192	Altıntoprak 98	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	12.05.1998	DW	4.4	2.8	3.4	0.126	1.52	0.45	HS	MS	S	37.8	6.37	MS
193	Aydın-93	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	02.05.2002	DW	3.5	3.2	3.4	0.058	1.87	0.55	MS	S	S	36.8	8.88	MS

194	Fırat-93	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	02.05.2002	DW	4.4	3.0	2.5	0.029	1.64	0.55	HS	MS	MS	26.3	3.83	MS
195	Artuklu	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	02.04.2008	DW	4.4	3.0	2.9	0.076	1.64	0.00	HS	MS	MS	26.7	4.40	MS
196	Eyyubi	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	02.04.2008	DW	3.5	3.5	3.6	0.050	1.87	0.55	MS	S	S	19.1	4.04	MS
197	Şahinbey	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	02.04.2008	DW	3.5	2.5	3.0	0.076	1.34	0.00	MS	MS	MS	22.5	4.65	MS
198	Zühre	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	30.03.2010	DW	4.5	3.3	3.2	0.076	1.87	0.55	HS	S	S	21.1	2.69	MS
199	Güneyyıldız	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	30.03.2010	DW	3.5	1.8	3.6	0.050	1.00	0.55	MS	MR	S	44.7	6.11	MS
200	Gediz-75	Ege Tarımsal Araş. Ens. Müd.	13.05.1976	DW	4.6	3.3	3.4	0.173	1.87	0.55	HS	S	S	19.0	2.75	MS
201	Ege 88	Ege Tarımsal Araş. Ens. Müd.	26.04.1988	DW	3.4	3.2	3.3	0.000	1.64	0.55	MS	S	S	25.4	4.74	MS
202	Salihli 92	Ege Tarımsal Araş. Ens. Müd.	12.05.1992	DW	4.4	3.2	3.7	0.104	1.64	0.45	HS	S	S	42.6	6.98	MS
203	Şölen 2002	Ege Tarımsal Araş. Ens. Müd.	02.05.2002	DW	4.4	3.7	2.3	0.100	2.19	0.45	HS	S	MS	36.5	4.30	MS
204	Tüten 2002	Ege Tarımsal Araş. Ens. Müd.	02.05.2002	DW	3.1	3.3	2.0	0.000	1.87	0.55	MS	S	MR	30.9	8.02	MS
205	GAP	Ege Tarımsal Araş. Ens. Müd.	01.04.2004	DW	4.5	2.2	2.0	0.104	1.34	0.55	HS	MS	MR	20.4	3.57	MS
206	Turabi	Ege Tarımsal Araş. Ens. Müd.	01.04.2004	DW	3.5	3.5	3.8	0.050	2.05	0.45	MS	S	S	20.6	3.10	MS
207	Sham-1	Çukurova Üniversitesi Ziraat Fakültesi	26.04.1991	DW	3.5	2.5	1.6	0.058	1.64	0.55	MS	MS	MR	43.6	4.88	MS
208	Amanos-97	Çukurova Üniversitesi Ziraat Fakültesi	06.05.1997	DW	4.4	3.3	3.1	0.153	1.87	0.00	HS	S	S	40.7	8.42	MS
209	Fuatbey 2000	Çukurova Üniversitesi Ziraat Fakültesi	28.04.2000	DW	4.5	3.2	3.2	0.202	1.64	0.45	HS	S	S	40.1	4.04	MS
210	Balcalı 2000	Çukurova Üniversitesi Ziraat Fakültesi	28.04.2000	DW	3.5	3.2	3.5	0.029	1.64	0.55	MS	S	S	21.2	2.62	MS
211	Akçakale-2000	GAP Tarımsal Araştırma Enstitüsü Müd./Şanlıurfa	02.05.2002	DW	4.5	3.0	3.4	0.173	1.64	0.55	HS	MS	S	33.3	5.50	MS
212	Alibaba	GAP-EYAM/ŞURF	2010	DW	4.4	4.2	2.2	0.126	2.41	0.71	HS	HS	MS	32.7	5.12	MS
213	Gündaş	GAP Tarımsal Araştırma Enstitüsü Müd./Şanlıurfa	17.04.2012	DW	4.4	4.2	3.8	0.173	2.41	0.55	HS	HS	S	20.7	2.36	MS
214	Özberk	Harran Üniversitesi Ziraat Fakültesi	30.03.2005	DW	4.4	3.3	1.7	0.208	2.05	0.55	HS	S	MR	15.6	1.90	MS
215	Urfa 2005	Harran Üniversitesi Ziraat Fakültesi	30.03.2005	DW	4.4	3.5	3.4	0.076	2.05	0.55	HS	S	S	14.6	1.96	MS
216	Pınar-2001	Uludağ Üniversitesi Ziraat Fakültesi	24.04.2001	DW	4.4	3.0	1.7	0.050	1.64	0.00	HS	MS	MR	42.2	7.50	MS
217	Zenit	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	24.04.2001	DW	4.4	4.3	3.1	0.104	2.41	0.00	HS	HS	S	38.4	4.45	MS
218	Svevo	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	24.04.2001	DW	4.5	1.8	2.2	0.144	1.00	0.55	HS	MR	MS	17.2	2.94	MS
219	Levante	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	08.04.2011	DW	3.5	2.7	3.7	0.050	1.52	0.45	MS	MS	S	41.7	4.45	MS
220	Saragolla	Tasaco Tarım Sanayi ve Tic.Ltd.Şti.	08.04.2011	DW	4.5	3.8	3.2	0.153	2.19	0.55	HS	S	S	25.4	8.93	MS
221	Burgos	Fito Tohumculuk	08.04.2011	DW	3.4	3.7	3.3	0.076	2.05	0.00	MS	S	S	15.9	2.42	MS
222	Durbel	Fito Tohumculuk	unknown	DW	4.5	3.5	1.6	0.153	2.05	0.55	HS	S	MR	18.4	3.60	MS
223	Presto	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	1989	Trt	3.5	3.2	1.4	0.132	1.64	0.55	S	S	MR	.	.	.
224	Karma 2000	Geçit Kuşağı Tarımsal Arşt.Enst.Müd.	2000	Trt	3.4	2.7	2.5	0.189	1.52	0.55	S	MS	MS	31.8	5.81	MS

225	Tatlıcak 97	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	1997	Trt	3.5	2.2	3.0	0.029	1.34	0.00	S	MS	MS	19.0	2.74	MS
226	Melez-2001	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	2001	Trt	3.5	2.7	1.6	0.076	1.64	0.45	S	MS	MR	26.8	3.35	MS
227	MİKHAM-2002	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	2002	Trt	2.4	2.7	2.8	0.076	1.52	0.00	MS	MS	MS	37.2	2.86	MS
228	Alperbey	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	30.03.2010	Trt	2.5	3.0	2.5	0.104	2.05	0.55	MS	S	MS	22.4	2.41	MS
229	Ümranhanım	Doğu Anadolu Tarımsal Araştırma Ens. M.	unknown	Trt	2.5	1.0	2.1	0.076	0.55	0.00	MS	R	MS	25.6	4.22	MS
230	Egeyıldızı	Ege Tarımsal Araş. Ens. Müd.	2005	Trt	3.5	2.5	3.2	0.087	1.52	0.55	S	MS	S	36.4	5.03	MS
231	TT-201	Trakya Tarım	unknown	Trt	3.4	2.8	3.1	0.050	1.52	0.00	S	MS	S	32.4	2.41	MS
232	Aslım	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	unknown	Rye	3.5	3.2	3.6	0.029	1.64	0.55	S	S	S	21.8	2.59	MS
233	Seydişehir	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	unknown	Oat	1.5	2.8	2.4	0.1	2.0	0.5	MR	MS	MS	51.6	3.78	HS
234	Faikbey	Bahri Dağdaş Uluslar arası Tar. Araş. Ens. Müd.	unknown	Oat	2.5	3.5	3.6	0.067	1.64	0.55	MS	S	S	64.0	10.54	HS
235	Chonte	CIMMYT	2008	BW	3.5	3.5	3.4	1.88	2.05	0.55	S	S	S	.	.	.
236	Munal	CIMMYT	2008	BW	3.4	2.8	3.1	1.90	1.52	0.00	S	MS	S	.	.	.
237	Quaiu	CIMMYT	2008	BW	3.4	2.2	2.6	1.89	1.34	0.55	S	MS	MS	.	.	.
238	DATAE Aday Buğday	Doğu Anadolu Tarımsal Araştırma Ens. M.	unknown	BW	4.4	3.2	2.0	2.41	1.64	0.55	HS	S	MR	.	.	.
239	Aday 9	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	unknown	BW	2.4	2.3	3.4	1.30	1.34	0.55	MS	MS	S	.	.	.
240	Aday 14	GAP Uluslar arası Tarımsal Araş. Ve Eğitim Merk. Müd./Diyarbakır	unknown	BW	3.5	2.5	3.2	1.91	1.64	0.55	S	MS	S	.	.	.
241	Saar	Ege Tarımsal Araş. Ens. Müd.	1995	BW	4.4	3.5	3.3	2.36	1.87	0.45	HS	S	S	.	.	.
242	Burbot	Oregan State Uni-TCI	1998	BW	2.5	2.5	2.4	1.42	1.34	0.45	MS	MS	MS	.	.	.
243	249	CIMMYT	unknown	BW	2.4	2.0	2.5	1.35	1.34	0.55	MS	MR	MS	.	.	.
244	Sunco	University of Sydney Plant Breeding Institute, Cobbitty	1986	BW	2.5	2.0	2.5	1.10	1.10	0.55	MS	MR	MS	.	.	.
245	Prostor	Trakya Tarımsal Araştırma Ens.Müd.	26.04.1999	BW	2.5	2.3	2.4	1.32	1.34	0.55	MS	MS	MS	.	.	.