**ANKARA UNIVERSITY**
**GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**MASTER OF SCIENCE THESIS**

# DETERMINATION OF THE SEEDLING REACTIONS OF SOME TWO-ROWED BARLEY LANDRACES MAINTAINED AT OSMAN TOSUN GENE BANK TO *PYRENOPHORA TERES* F. *TERES*

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**DEPARTMENT OF PLANT PROTECTION**

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# ÖZET


Yüksek Lisans Tezi

OSMAN TOSUN GEN BANKASINDA MUHAFAZA EDİLEN BAZI İKİ SIRALI ARPA YEREL ÇEŞİTLERİNİN *PYRENOPHORA TERES* F. *TERES'*E FİDE DÖNEMİ TEPKİLERİNİN TESPİT EDİLMESİ

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Osman Tosun Gen Bankasından temin edilen ve Türkiye'nin değişik bölgelerini temsil eden 38 adet 2 sıralı arpa yerel çeşidinin 2 adet *Pyrenophora teres* f. *teres* izolatına karşı fide dönemi tepkileri tespit edilmiştir. Ek olarak, arpa çeşitleri Bülbül 89 ve Avcı 2002 denemeye dahil edilmiştir. Arpa yerel çeşitleri hastalığa değişik tepkiler vermiş olup tepkileri dayanıklı-orta derecede dayanıklı ile hassas arasında değişmiştir. Diyarbakır ilinden elde edilen 33 numaralı yerel çeşit hastalığa en dayanıklı olarak bulunurken Bilecik-Söğüt'ten elde edilen 10 numaralı yerel çeşit ve Bülbül 89 çeşidi en hassas olarak bulunmuşlardır.



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**Anahtar Kelimeler:** Arpa**,** yerel arpa çeşitleri, *Drechslera teres* f. *teres*, hastalığa dayanıklılık, arpa ağbenek hastalığı, *Pyrenophora teres* f. *teres*, Türkiye

## ABSTRACT

Master of Science Thesis

DETERMINATION OF THE SEEDLING REACTIONS OF SOME TWO-ROWED BARLEY LANDRACES MAINTAINED AT OSMAN TOSUN GENE BANK TO *PYRENOPHORA TERES* F. *TERES*

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Seedling stage reactions of thirty-eight 2-rowed barley landraces representing different areas of Turkey obtained from Osman Tosun Gene Bank to two *Pyrenophora teres* f. *teres* isolates were evaluated. In addition, barley cultivars Bülbül 89 and Avcı 2002 were included. Landraces exhibited different reactions to the disease and their reactions ranged from resistant- moderately resistant to susceptible. Landrace number 33 obtained from Diyarbakır was found the most resistant to the disease compared to all other landraces whereas landrace number 10 obtained from Bilecik-Söğüt and cultivar Bülbül 89 were the most susceptible.



**July 2021, 19 pages**

**Key Words:** Barley, barley landraces, *Drechslera teres* f. *teres*, disease resistance, net blotch, *Pyrenophora teres* f. *teres*, Turkey

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AWET ARAYA
Ankara, July 2021

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## SYMBOLS AND ABBREVIATIONS

°C: Centigrade

cm: Centimeter

ml: Millilitre

## ABBREVIATIONS

PDA: Potato Dextrose Agar

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## 1. INTRODUCTION

Barley is one of the oldest domesticated crops and an important cereal (FAO, 2015). It is ranked as the second most important cereal in Turkey (Geçit, 2016; TUIK, 2016). Today barley is used commercially as the main source of food in livestock production, healthful diets and in malting industry including alcoholic and some modern distilled beverages (Kün, 1996). In Turkey the average production of barley is estimated at 8.300.000 tonnes per year (TUIK, 2020).

Landraces are recognized for their importance as a germplasm source for barley breeding programs and for improving the genetic diversity of barley and they are adapted to stress factors (Brush, 1995; Attene *et al.*, 1996). Also, barley landraces are used as the main seed source in many of the traditional barley fields by the farmers (Ceccarelli and Grando, 2000).

Landraces are well adapted to the different agroclimatic conditions, and they are emerged as a result of many years of selection. However, with the emergence of genetically uniform, high-yielding, and high-quality commercial varieties, farmers preferred to use commercial varieties. Overtime, the replacement of the landraces with a high degree of variation by commercial varieties has resulted in a loss of the genetic diversity (Ceccarelli *et al*., 2000; Ceccarelli and Grando, 2000). Genetic stock studies were started in Turkey in 1938 by Osman Tosun. Barley landraces have been collected by Osman Tosun and his colleagues from different parts of Turkey. Barley germplasm from several countries is also maintained in Osman Tosun Gene Bank, Ankara, Turkey (Çelik Oğuz *et al.*, 2019).

*Pyrenophora teres* (anamorphic stage: *Drechslera teres*) is an important pathogen of barley. The disease has spot and net forms. *Drechslera teres* f. *teres* incites the net form of the disease (Liu *et al.*, 2011).

The disease affects badly the quantity and quality of barley crop worldwide. In places where very susceptible varieties are cultivated, complete destruction of the crops is expected (Mathre, 1982).

If much focus is not taken for controlling this disease, great economic losses are expectable in areas where it forms a real threat to barley production. Various measures such as stubble destruction and application of fungicides can control the disease. However, since plant residues are still capable of producing numerous infectious spores, a complete elimination of stubble inoculum to prevent significant infection for the next season crop is a quite difficult task (Jordan and Allen, 1984). Cultural practices alone seem ineffective for management of the disease. Chemical fungicides are highly expensive and they are unaffordable for most of the farmers, reduced sensitivity of the pathogen is expectable, and a fungal population can develop resistant biotypes (Olvång, 1988). Therefore, the application of other methods such as crop rotation and using of disease-resistant barley genotypes has become necessary for the control of the pathogen (Mathre, 1982; McLean *et al.,* 2012). The use of disease-resistant barley genotypes is the most profitable and eco-friendly means of controlling the disease.

In this work, under greenhouse conditions, 38 Turkish barley landraces obtained from Osman Tosun Gene Bank to two *Pyrenophora teres* f. *teres* isolates have been evaluated at the seedling stage. In addition, two barley cultivars Bülbül 89 and Avcı 2002 were included in this study.

## 2. LITERATURE REVIEW

Importance of barley is well known in production of a variety of healthy foods, malting industry and animal production **(**Poehlman, 1985**).** Barley is grown in approximately 51 million hectares with total annual world production of 158.9 million tons (FAO, 2019).

In Turkey, barley is grown in an area of about 3 million hectares and the total production is 8.3 million tons per year (TUIK, 2020). Most of the barley production is used for animal production purposes (Geçit, 2016). Because of its growing capacity in a short period of time, in addition to its high adaptability to unfavorable climatic conditions, different types of barley can be grown in diverse areas, especially in South-East Anatolia and Central Anatolia regions which are known as important barley producing areas (Akar *et al*., 1999).

*P. teres* f. *maculata* and *P. teres* f. *teres* which cause the spot and the net forms of the net blotch disease respectively are morphologically identical. These diseases have different symptoms and molecular characterization will aid in diagnosis (Williams *et al*., 2001).

Growth of resistant cultivars is the preferred control method (Mathre, 1982; Yazıcı et al., 2015). Landraces are genetic variation sources in plant breeding programs (Yitbarek *et al*., 1998). Elucidation of the resistance status of barley landraces will be useful in breeding programs. Also some high yielding landraces could be used by farmers. Barley landraces can be planted either directly in the field or utilized in breeding programs for developing new resistant varieties. In Turkey, limited work exists on the net type resistance status of barley genotypes (Yazıcı *et al.,* 2015; Çelik Oğuz et al., 2017, 2019).

## 3. MATERIALS AND METHODS

This study was accomplished in the laboratory and the greenhouse of the Ankara University, Faculty of Agriculture, Department of Plant Protection, Turkey. All trials in the greenhouse were executed as three replications. A total of 38 barley landraces were used in the study. The landraces used in this study were obtained from Osman Tosun Gene Bank, Ankara, Turkey. In addition, barley cultivars Bülbül 89 and Avcı 2002 were included in this study.

Inoculation was accomplished using 2 *Pyrenophora teres* f. *teres* isolates obtained from Ankara and Sivas provinces of Turkey (Figure 3.1). Isolates were obtained from Aziz Karakaya and Arzu Çelik Oğuz, Ankara University, Turkey.

Ankara and Sivas isolates differed in the nature of their growth on PDA medium. As shown in Figure 3.1 single spore culture of Sivas isolate appeared smooth whereas Ankara isolate had fluffy growth.

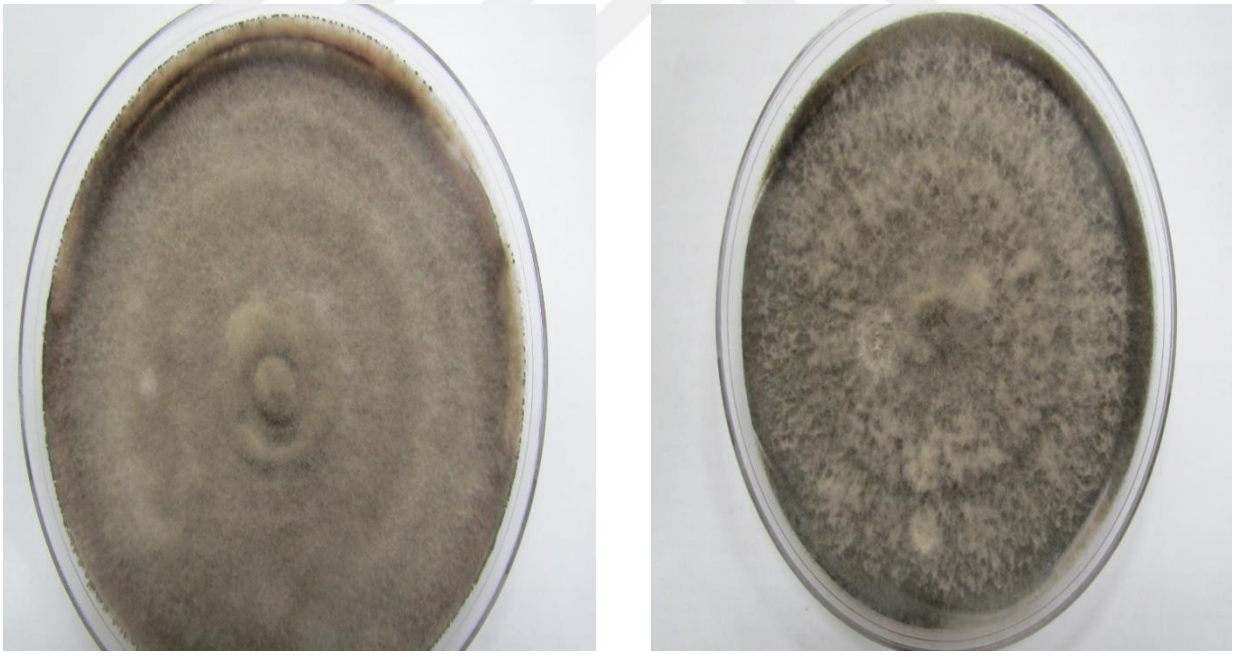

Figure 3.1 Single spore culture of Sivas isolate in Potato Dextrose Agar medium (left), single spore culture of Ankara isolate in Potato Dextrose Agar medium (right).

The Gene Bank Registration numbers of the thirty-eight landraces used in the study, the locations from which they were obtained and the color of their kernels are shown in Table 3.1.

Table 3.1 Some characteristics of the landraces used in this study.

| No | Osman Tosun Gene Bank Registration No | Type | Location | Kernel color |
|---|---|---|---|---|
| 1 | 667 | 2-rowed | Eskişehir-Çifteler | Black |
| 2 | 885 | 2-rowed | Diyarbakır-Bismil | White |
| 3 | 930 | 2-rowed | Diyarbakır-Karabaş | White |
| 4 | 900 | 2-rowed | Diyarbakır-Nusaybin | Black |
| 5 | 933 | 2-rowed | Erzincan-Refahiye | White |
| 6 | 715 | 2-rowed | Kayseri-Pınarbaşı | White |
| 7 | 884 | 2-rowed | Urfa | White |
| 8 | 684 | 2-rowed | Ağrı-Tutak | White |
| 9 | 692 | 2-rowed | Ankara | White |
| 10 | 659 | 2-rowed | Bilecik-Söğüt | White |
| 11 | 638 | 2-rowed | Rize-Pazar | White |

Table 3.1 Some characteristics of the landraces used in this study (continued).

| | | | | |
|---|---|---|---|---|
| 12 | 868 | 2-rowed | Konya-Zıvarak | White |
| 13 | 671 | 2-rowed | Çorum-Mecitözü | White |
| 14 | 709 | 2-rowed | Sivas-Zara | White |
| 15 | 707 | 2-rowed | Niğde-Aksaray | White |
| 16 | 702 | 2-rowed | Kırşehir-Kaman | White |
| 17 | 799 | 2-rowed | Adana-Kadirli | White |
| 18 | 854 | 2-rowed | Nevşehir | White |
| 19 | 931 | 2-rowed | Malatya-Pötürge | White |
| 20 | 914 | 2-rowed | Erzurum-H.Kale | White |
| 21 | 825 | 2-rowed | Kayseri-Pınarbaşı | White |
| 22 | 707 | 2-rowed | Malazgirt | White |
| 23 | 660 | 2-rowed | Sinop-Gerze | White |
| 24 | 685 | 2-rowed | Hatay-Kırıkhan | White |
| 25 | 644 | 2-rowed | Gaziantep-Nur. | White |
| 26 | 664 | 2-rowed | Isparta | White |
| 27 | 844 | 2-rowed | Yozgat-Akdağmadeni | Black |

Table 3.1 Some characteristics of the landraces used in this study (continued).

| | | | | |
|---|---|---|---|---|
| 28 | 771 | 2-rowed | Konya | Black |
| 29 | 926 | 2-rowed | Urfa-Siverek | White |
| 30 | 915 | 2-rowed | Sivas-Divriği | Black |
| 31 | 640 | 2-rowed | Amasya-Taşova | White |
| 32 | 673 | 2-rowed | Isparta-Gelendost | White |
| 33 | 941 | 2-rowed | Diyarbakır | White |
| 34 | 786 | 2-rowed | Hatay-Korkuteli | White |
| 35 | 906 | 2-rowed | Konya-Ereğli | White |
| 36 | 888 | 2-rowed | Eskişehir-Ağapınar | White |
| 37 | 752 | 2-rowed | Niğde-Bor | White |
| 38 | 689 | 2-rowed | Erzurum | White |

Inoculation procedure was similar as described by several other investigators (Çelik Oğuz et al., 2019; Yazıcı et al., 2015; Douiyssi et al., 1998). Fifteen seeds from each landrace were seeded in 7 cm diameter plastic pots containing soil. Plants were watered as necessary. The temperature of the greenhouse was 18-23±2 ºC for night and day with a 14h/10h light/dark regime. For inoculum production, mycelia were scraped from Petri plates using a paintbrush. Inoculum concentration was adjusted using a

hemocytometer to 15-20x$10^4$ mycelial parts per ml. One drop of Tween 20 was added for each 100 ml of the inoculum (Aktaş, 1995). After inoculation, plants were placed in metal boxes and a plastic cover was placed on top of each box. In addition, boxes and plastic covers were wrapped with nylon sheets. Plants were inoculated at growth stages 12-13 (Zadoks et al., 1974). After four days nylon sheets and plastic covers were removed. Seven days after inoculation, plants were evaluated with a 1-10 scale developed for *D. teres* f. *teres* by Tekauz (1985). Description of the scale is as follows:

1: R (Resistant),
2: R-MR (Resistant-Moderately Resistant),
3: MR (Moderately Resistant),
4: MR-MS: (Moderately Resistant-Moderately Susceptible),
5: MR-MS (Moderately Resistant-Moderately Susceptible),
6: MR-MS (Moderately Resistant-Moderately Susceptible),
7: MS (Moderately Susceptible),
8: MS-S (Moderately Susceptible-Susceptible),
9: S (Susceptible),
10: VS (Very Susceptible).

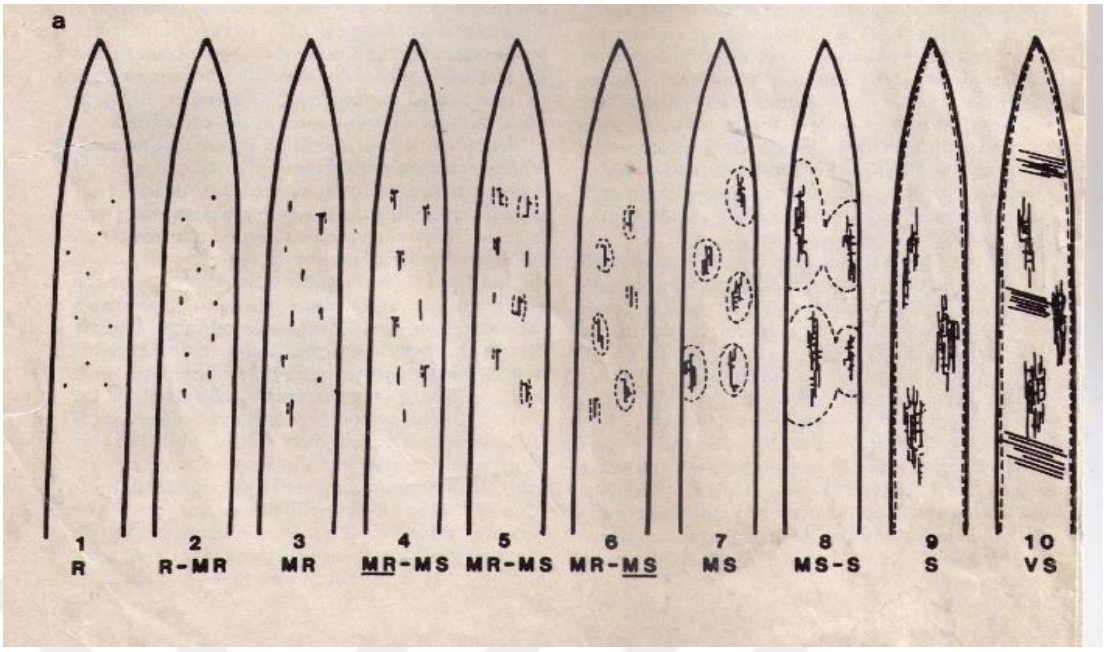


Figure 3.2 Schematic representation of the different degrees of disease severity used in the scale by Tekauz (1985).

## 4. RESULTS

First symptoms of the disease were observed on leaves of some landraces three days after inoculation. Leaf symptoms characteristic of the net form of the disease appeared first as narrow chlorotic lesions which gradually increased in size and length. Eventually severely infected leaves showed dark brown longitudinal and transverse striations (Figure 4.1).

Figure 4.1 Leaves of barley landraces showing different levels of resistance to *Pyrenophora teres* f. *teres* Ankara isolate (Photographs: Hatice Sevde Yüceler).

Evaluations were performed 7 days following inoculation. Results are presented in Table 4.1 in addition to some information concerning the 2- rowed barley landraces used in this study. Data on disease severity for each landrace are the mean scale values of the three replicates.

Table 4.1 Some characteristics of the barley landraces used in this study and the response of these landraces to 2 *P. teres* f. *teres* isolates at the seedling stage.

| No | Osman Tosun Gene Bank Registration No | Type | Location | Kernel color | Sivas isolate scale value (Tekauz 1985) | Ankara isolate scale value (Tekauz 1985) |
|---|---|---|---|---|---|---|
| 1 | 667 | 2-rowed | Eskişehir-Çifteler | Black | 5 | 5 |
| 2 | 885 | 2-rowed | Diyarbakır-Bismil | White | 8 | 8 |
| 3 | 930 | 2-rowed | Diyarbakır-Karabaş | White | 6 | 6 |
| 4 | 900 | 2-rowed | Diyarbakır-Nusaybin | Black | 6 | 5 |
| 5 | 933 | 2-rowed | Erzincan-Refahiye | White | 7 | 6 |
| 6 | 715 | 2-rowed | Kayseri-Pınarbaşı | White | 7 | 6 |
| 7 | 884 | 2-rowed | Urfa | White | 7 | 6 |
| 8 | 684 | 2-rowed | Ağrı-Tutak | White | 6 | 6 |
| 9 | 692 | 2-rowed | Ankara | White | 6 | 5 |

Table 4.1 Some characteristics of the barley landraces used in this study and the response of these landraces to 2 *P. teres* f. *teres* isolates at the seedling stage (continued).

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | 659 | 2-rowed | Bilecik-Söğüt | White | 9 | 8 |
| 11 | 638 | 2-rowed | Rize-Pazar | White | 7 | 6 |
| 12 | 868 | 2-rowed | Konya-Zıvarak | White | 7 | 7 |
| 13 | 671 | 2-rowed | Çorum-Mecitözü | White | 7 | 7 |
| 14 | 709 | 2-rowed | Sivas-Zara | White | 8 | 7 |
| 15 | 707 | 2-rowed | Niğde-Aksaray | White | 5 | 6 |
| 16 | 702 | 2-rowed | Kırşehir-Kaman | White | 7 | 6 |
| 17 | 799 | 2-rowed | Adana-Kadirli | White | 7 | 7 |
| 18 | 854 | 2-rowed | Nevşehir | White | 8 | 7 |
| 19 | 931 | 2-rowed | Malatya-Pötürge | White | 7 | 7 |
| 20 | 914 | 2-rowed | Erzurum-H.Kale | White | 6 | 6 |
| 21 | 825 | 2-rowed | Kayseri-Pınarbaşı | White | 6 | 6 |
| 22 | 707 | 2-rowed | Malazgirt | White | 5 | 5 |
| 23 | 660 | 2-rowed | Sinop-Gerze | White | 5 | 5 |
| 24 | 685 | 2-rowed | Hatay-Kırıkhan | White | 5 | 6 |

Table 4.1 Some characteristics of the barley landraces used in this study and the response of these landraces to 2 *P. teres* f. *teres* isolates at the seedling stage (continued).

| | | | | | | |
|---|---|---|---|---|---|---|
| 25 | 644 | 2-rowed | Gaziantep-Nur. | White | 7 | 7 |
| 26 | 664 | 2-rowed | Isparta | White | 7 | 7 |
| 27 | 844 | 2-rowed | Yozgat-Akdağmadeni | Black | 7 | 7 |
| 28 | 771 | 2-rowed | Konya | Black | 7 | 7 |
| 29 | 926 | 2-rowed | Urfa-Siverek | White | 7 | 6 |
| 30 | 915 | 2-rowed | Sivas-Divriği | Black | 7 | 7 |
| 31 | 640 | 2-rowed | Amasya-Taşova | White | 5 | 5 |
| 32 | 673 | 2-rowed | Isparta-Gelendost | White | 7 | 6 |
| 33 | 941 | 2-rowed | Diyarbakır | White | 2 | 2 |
| 34 | 786 | 2-rowed | Hatay-Korkuteli | White | 8 | 7 |
| 35 | 906 | 2-rowed | Konya-Ereğli | White | 6 | 6 |
| 36 | 888 | 2-rowed | Eskişehir-Ağapınar | White | 6 | 6 |
| 37 | 752 | 2-rowed | Niğde-Bor | White | 7 | 6 |
| 38 | 689 | 2-rowed | Erzurum | White | 8 | 8 |
| 39 | Bülbül 89 | 2-rowed | | White | 9 | 8 |

Table 4.1 Some characteristics of the barley landraces used in this study and the response of these landraces to 2 *P. teres* f. *teres* isolates at the seedling stage (continued).

| | | | | | | |
|---|---|---|---|---|---|---|
| 40 | Avcı 2002 | 6-rowed | | White | 4 | 5 |

Landrace reactions to Sivas isolate ranged between Resistant-Moderately Resistant and Susceptible. Landrace number 33 obtained from Diyarbakır had a 2 scale value and this landrace was rated Resistant-Moderately Resistant to the disease. Fourteen other landraces exhibited Moderately Resistant-Moderately Susceptible disease reaction. These include landraces with the numbers 1,3,4,8,9,15,20,21,22,23,24,31,35, and 36. The rest of the landraces showed moderately susceptible (MS) to moderately susceptible-susceptible (MS-S) disease responses with the exception of the landrace obtained from Bilecik-Söğüt. This landrace showed a susceptible (S) reaction (scale value 9). Cultivar Bülbül 89 showed a scale value of 9 and cultivar Avcı 2002 showed a scale value of 4. Responses of the landraces to Ankara isolate ranged between Resistant-Moderately Resistant and Moderately Susceptible-Susceptible. Again the landrace number 33 from Diyarbakır was found Resistant-Moderately Resistant (R-MR). Landraces 1, 3, 4, 5, 6, 7, 8, 9, 11, 15, 16, 20, 21, 22, 23, 24, 29, 31, 32, 35, 36, 37 exhibited Moderately Resistant-Moderately Susceptible (MR-MS) reaction to Ankara isolate. Other landraces showed Moderately Susceptible (MS) to Moderately Susceptible-Susceptible (MS-S) reactions. Cultivar Bülbül 89 showed a scale value of 8 and cultivar Avcı 2002 showed a scale value of 5. Sivas isolate appeared to be slightly more virulent.

## 5. DISCUSSION AND CONCLUSION

Results of the present study indicated that reactions of the landraces tested against two *P. teres* f. *teres* isolates ranged between R-MR to S. Among the thirty-eight landraces screened in this study, only one landrace from Diyarbakır exhibited R-MR response to the isolates (scale value: 2). Fourteen and 22 landraces exhibited MR-MS responses to Sivas and Ankara isolates, respectively. The other landraces exhibited susceptible group reactions to the isolates.

Çelik Oğuz et al. (2017), using three *P. teres* f. *teres* isolates, tested 198 landraces of barley. The researchers reported that among the total number of landraces, seven landraces were resistant.

In another study conducted in 2019 by Çelik Oğuz *et al*., responses of seedlings of 25 barley landraces obtained from Iran against 3 isolates of *P. teres* f. *teres* under a controlled environment were determined. Different degrees of virulence were found among the isolates. Two landraces exhibited MR reactions to one of the *Ptt* isolates.

Barley landraces represent a wide genetic variation for desirable agronomic characteristics (Ergün *et al*., 2017), and successful transfer of desired agronomical traits with specific genes to new varieties of crops is possible (Newton *et al*., 2010). In addition, emphasis on collection of those genetic resources from their natural range or habitat and also their conservation should be undertaken (Frankel and Hawkes, 1975).

This study showed the variation in barley landraces obtained from Osman Tosun Gene Bank in Turkey to *P. teres* f. *teres*. Landraces with good resistance such as the one obtained from Diyarbakır (Osman Tosun Gene Bank Registration Number 941) could be employed as source of resistance genes in barley breeding programs.

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