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The Use of an Alternative Differential Set for Determination of *Pyrenophora teres* f. *maculata* Pathotypes

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ABSTRACT
Pyrenophora teres f. *maculata* incites spot form of barley net blotch disease. For determination of *Pyrenophora teres* f. *maculata* pathotypes, a differential set consisted of 22 international cultivars and genotypes and a susceptible Turkish barley variety Bülbül 89 were tested using 45 isolates obtained from different regions of Turkey. Nineteen pathotypes were determined out of 45 isolates used. It appears that this differential set could be useful for determination of *P. teres* f. *maculata* pathotypes.

Keywords: Spot form of net blotch; Barley differential set; *Drechslera teres* f. *maculata*

1. Introduction

Barley net blotch disease caused by the fungus *Pyrenophora teres* (anamorph: *Drechslera teres*) is a common and important disease which lowers the yield and quality of the barley in the world (Mathre 1982; McLean et al 2009; Karakaya et al 2014). *Pyrenophora teres* has two biotypes. *P. teres* f. *maculata* and *P. teres* f. *teres* incite spot and net forms of net blotch disease, respectively (Liu et al 2011). Resistant cultivars are preferred in disease control. However, pathotypes of the fungus complicate the resistance studies. In order to control the pathogen, information about the pathotypes of the fungus is necessary. For pathotype determination studies, different researchers used different cultivars and genotypes. However, most of the time, comparison of these pathotypes were difficult (Wu et al 2003; Grewal et al 2008; Boungab et al 2012; McLean et al 2014a; McLean et al 2014b). This study aimed at contributing to development of an international set for determination of *Pyrenophora teres* f. *maculata* (*Ptm*) pathotypes.

2. Material and Methods

This study was carried out in laboratory and greenhouse of Plant Protection Department of Faculty of Agriculture, Ankara University, Turkey.

Between 2015-2017 surveys were conducted in various provinces of Turkey and 1, 6, 5, 3, 1, 6, 2, 5, 2, 1, 2, 1, 1, 2, 1, 1, 2, 1, 1 and 1 *P. teres* f. *maculata* samples were obtained from Niğde, Diyarbakır, Ankara, Eskişehir, Adıyaman, Konya, Kırşehir, Şanlıurfa, Kayseri, Afyonkarahisar, Kahramanmaraş, Kırıkkale, Aksaray, Çankırı, Sivas, Yozgat, Mardin, Kilis, Edirne and Gaziantep provinces of Turkey, respectively. For obtaining samples, barley planting areas in

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each location were considered. In surveys, systematic sampling method was used (Aktaş 2001). Samples were obtained from a diverse set of provinces. Leaves showing characteristic spot form of net blotch symptoms were selected. These leaves were subjected to surface sterilization using 1% NaOCl for 1 minute and they were kept in blotter for 4-5 days. Under a stereomicroscope, single spores were taken and transferred to Potato Dextrose Agar plates. From diseased barley and wild barley (*Hordeum spontaneum*) plants 45 *Ptm* single spore isolates were obtained. Typical *Pyrenophora teres* f. *maculata* conidia were observed in a light microscope. Symptom morphologies of these isolates were verified using the susceptible barley cultivar Bülbül 89 (Mathre 1982; Çelik Oğuz & Karakaya 2017).

Barley differential cultivars and genotypes Chebec, Haruna Nijo, CI3576, Torrens, Keel, TR250, CI9214, Galleon, CI9819, CI11458, CI5286, CI5791, CI7584, CI9776, CI16150, Skiff, Steptoe, Kombar, Cape, Stirling, Summitt and Arimont were obtained from Mark S. McLean (Agriculture Victoria, Horsham, Australia). In addition, susceptible Turkish cultivar Bülbül 89 (Çelik Oğuz & Karakaya 2017) was added to the set.

Under greenhouse conditions, differential set genotypes were planted in plastic pots, 7 cm in diameter, containing topsoil. Each pot contained 5-10 seeds. There were three replications arranged in a completely randomized fashion. Ten days old cultures grown on Potato Dextrose Agar were used as inoculum. Fungal cultures were scraped using a paintbrush and washed through cheesecloth with water. Inoculum which consisted of mycelium pieces, was adjusted to $1.5\text{-}2.0 \times 10^5$ mycelium parts per mL. For each 100 mL of inoculum suspension, one drop of Tween 20 was added (Aktaş 1995). Inoculation of the barley seedlings were performed at the two to three leaf stages (Z12-13; Zadoks et al 1974). Fungal suspensions were sprayed onto barley differential set seedlings. Inoculated plants were kept in closed transparent lid boxes covered by transparent nylon covers for 72 h in a greenhouse at high humidity. The nylons were then removed and ventilation lids were opened for another 24 h. The temperature of the greenhouse was 18±1-23±1 ºC during night and day with a 14h/10h light/dark period. Following this period, box lids were opened. Seven days after inoculation, barley seedlings were assessed for disease severity using the spot form scale described by Tekauz (1985).

For pathotype determination, methods outlined in Wu et al (2003) and Çelik Oğuz & Karakaya (2017) were used. Seven days later following inoculation, plants were evaluated using a 1-9 scale developed by Tekauz (1985). For evaluation, second leaves were used. Scale values between 1-5 and 6-9 were considered as resistant and susceptible, respectively. Differential test genotypes were numbered 1 through 23 and pathotypes were determined according to their responses to these differential set genotypes. For example, isolate PTM 42 from Yozgat province showed susceptible reactions (>5) on genotypes 13 (Galleon), 18 (Steptoe) and 19 (Stirling) and showed resistant reactions (≤5) on the other differential set genotypes. Therefore, this pathotype was named as 13-18-19. Isolates exhibiting resistant reactions (≤5) to all differential test genotypes were termed as pathotype 0.

3. Results and Discussion

The scale values of 45 isolates ranged between 1-8 (Figure 1). Nineteen pathotypes were determined using 45 *Ptm* isolates based on their differential reactions to 23 barley genotypes (Tables 1 and 2). No genotype was either resistant or susceptible to all isolates. Genotypes Chebec, CI5286, CI7584, CI9819 and CI16150 exhibited resistant reactions to 43 isolates (95.5%). These genotypes were susceptible to only 2 isolates. Genotypes Arimont, CI5791, Skiff and TR250 showed resistant reactions to 42 isolates (93%). Genotypes CI3576, CI9214, CI9776 and Torrens exhibited resistant reactions to 91% of the isolates (41 isolates). Genotypes Cape, Keel, Galleon, Haruna Nijo, Kombar, Summitt, CI11458 and Stirling showed resistant reactions to 88%, 86%, 84%, 84%, 82%, 82%, 80 and 80% of the isolates, respectively. Cultivar Steptoe exhibited susceptible reaction to 18 isolates (40%) and cultivar Bülbül 89 showed susceptible reaction to 19 isolates (42%).

In previous studies, different differential test genotypes were used by different researchers. McLean et al (2014b) performed a study between 2008-2013 in Australia, South Africa, Finland and Canada and developed a new *Ptm* differential set. This set consisted of Arimont, Baudin, Beecher, Cape, Chebec, CI11458, CI3576, CI5286, CI5791, CI7584, CI9214, CI9776, CI9819, CI9831, CI16150, Galleon, Haruna Nijo, Keel, Kombar, Skiff, Steptoe, Stirling, Summitt, Torrens, TR250 and Yagan cultivars and genotypes. In this study, virulence diversity among the isolates was observed. Among these barley genotypes Arimont, Cape, Chebec, CI11458, CI5286, CI5791, CI7584, CI9214, CI9776, CI9819, CI16150, Galleon, Haruna Nijo, Keel, Kombar, Skiff, Steptoe, Stirling, Summitt, Torrens and TR250 were also used in our current study and it is concluded that these genotypes could be used as *Ptm* differential test genotypes.

Figure 1- Reactions of barley differential set genotypes to *Pyrenophora teres* f. *maculata* isolates according to Tekauz (1985) scale; R, resistant; R-MR, resistant-moderately resistant; MR, moderately resistant; MR-MS, moderately resistant-moderately susceptible; MS, moderately susceptible; MS-S, moderately susceptible-susceptible; S, susceptible

Using 11 differential set genotypes, Akhavan et al (2016) identified 13 pathotype groups out of 27 isolates used. Two groups contained 52% of the isolates. Wu et al (2003) used a differential set containing 25 barley genotypes. In their study, 4 pathotypes were distinguished among the 8 isolates. Tekauz (1990) used 11 barley differential set genotypes. From 42 isolates 20 pathotypes were distinguished. Using 16 differential set genotypes and 60 *Ptm* isolates, McLean et al (2014a) determined 33 pathotypes.

In Turkey, Çelik Oğuz & Karakaya (2017) used 25 differential set genotypes. From a total of 50 isolates, 26 *Ptm* pathotypes were determined. In our current study, we used 23 differential set genotypes and from a total of 45 isolates, 19 pathotypes were distinguished. Karki & Sharp (1986) used a differential set which consisted of 20 genotypes. In their study, 6 groups were evident among the 14 isolates used. Gupta et al (2012) used a differential set which consisted of 26 genotypes. In their study, 7 groups were found among the 49 isolates used.

In our current study, differential genotypes Chebec, CI5286, CI7584, CI9819 and CI16150 exhibited resistant reactions to 43 isolates (95.5%) and susceptible reactions to 2 isolates. Karki & Sharp (1986), using isolates obtained from Montana (USA) and other countries, reported different reactions on genotypes CI7584 and CI9819. McLean et al (2012) reported Chebec and CI16150 genotypes as moderately resistant. McLean et al (2014a) reported different reactions of the genotype CI5286 to the isolates.

Table 1- Response of barley differential genotypes to 45 *Pyrenophora teres* f. *maculata* isolates. For evaluation, a 1-9 scale developed by Tekauz (1985) was used. Numbers are mean of 3 replications. R, resistant; S, susceptible

	Isolate numbers and the provinces where the isolates obtained																	
Barley genotypes	*PTM 1*	*Konya*	*PTM 2*	*Şanlıurfa*	*PTM 3 Ankara*		*PTM 4 Kahramanmaraş*		*PTM 5 Aksaray*		*PTM 6*	*Mardin*	*PTM 7*	*Diyarbakır*	*PTM 8*	*Şanlıurfa*	*PTM 9*	*Eskişehir*
1 Arimont	5	R	3	R	3	R	5	R	5	R	5	R	1	R	2	R	1	R
2 Cape	3	R	3	R	3	R	5	R	3	R	5	R	3	R	1	R	3	R
3 Chebec	1	R	2	R	1	R	3	R	2	R	3	R	1	R	2	R	2	R
4 CI3546	3	R	3	R	5	R	5	R	5	R	5	R	2	R	2	R	2	R
5 CI11458	2	R	3	R	3	R	7	S	3	R	7	S	2	R	2	R	1	R
6 CI5286	3	R	2	R	1	R	5	R	2	R	3	R	2	R	1	R	1	R
7 CI5791	1	R	1	R	5	R	5	R	2	R	5	R	1	R	1	R	1	R
8 CI7584	2	R	3	R	1	R	5	R	2	R	5	R	1	R	2	R	2	R
9 CI9214	2	R	1	R	5	R	5	R	3	R	3	R	2	R	2	R	2	R
10 CI9776	1	R	1	R	2	R	5	R	3	R	5	R	1	R	1	R	2	R
11 CI9819	2	R	3	R	3	R	5	R	2	R	5	R	2	R	2	R	1	R
12 CI16150	2	R	1	R	3	R	5	R	5	R	3	R	1	R	2	R	2	R
13 Galleon	3	R	1	R	2	R	5	R	3	R	2	R	1	R	2	R	2	R
14 Haruna Nijo	3	R	2	R	3	R	5	R	5	R	7	S	3	R	2	R	2	R
15 Keel	3	R	1	R	3	R	3	R	5	R	3	R	2	R	1	R	1	R
16 Kombar	5	R	1	R	2	R	5	R	3	R	5	R	1	R	2	R	2	R
17 Skiff	3	R	2	R	2	R	3	R	3	R	3	R	1	R	2	R	1	R
18 Steptoe	5	R	3	R	3	R	5	R	5	R	7	S	2	R	3	R	1	R
19 Stirling	5	R	2	R	5	R	5	R	3	R	7	S	1	R	2	R	1	R
20 Summitt	3	R	2	R	3	R	7	S	2	R	2	R	2	R	1	R	1	R
21 Torrens	3	R	1	R	5	R	5	R	2	R	5	R	2	R	1	R	1	R
22 TR250	3	R	1	R	3	R	5	R	2	R	3	R	3	R	1	R	1	R
23 Bülbül 89	7	S	3	R	7	S	7	S	7	S	5	R	3	R	3	R	3	R

Table 1 (Continued)- Response of barley differential genotypes to 45 *Pyrenophora teres* f. *maculata* isolates. For evaluation, a 1-9 scale developed by Tekauz (1985) was used. Numbers are mean of 3 replications. R, resistant; S, susceptible

	Isolate numbers and the provinces where the isolates obtained																	
Barley genotypes	*PTM 10 Kayseri*		*PTM 11 Mardin*		*PTM 12 Hordeum spontaneum Kilis*		*PTM 13 Gaziantep*		*PTM 14 Konya*		*PTM 15 Ankara*		*PTM 16 Sivas*		*PTM 17 Hordeum spontaneum Şanlıurfa*		*PTM 18 Ankara*	
1 Arimont	3	R	5	R	5	R	7	S	1	R	3	R	5	R	8	S	5	R
2 Cape	1	R	7	S	5	R	5	R	1	R	2	R	3	R	8	S	3	R
3 Chebec	2	R	1	R	1	R	7	S	1	R	3	R	5	R	7	S	3	R
4 CI3546	2	R	7	S	5	R	5	R	3	R	3	R	3	R	7	S	3	R
5 CI11458	2	R	7	S	7	S	7	S	2	R	2	R	5	R	8	S	3	R
6 CI5286	1	R	5	R	5	R	5	R	1	R	2	R	3	R	7	S	3	R
7 CI5791	1	R	5	R	5	R	7	S	3	R	3	R	3	R	8	S	3	R
8 CI7584	2	R	3	R	5	R	5	R	1	R	3	R	2	R	7	S	2	R
9 CI9214	1	R	5	R	3	R	5	R	1	R	2	R	2	R	7	S	5	R
10 CI9776	1	R	5	R	5	R	7	S	1	R	3	R	3	R	7	S	7	S
11 CI9819	2	R	5	R	5	R	7	S	2	R	2	R	3	R	7	S	3	R
12 CI16150	2	R	5	R	5	R	8	S	2	R	2	R	2	R	7	S	5	R
13 Galleon	1	R	3	R	5	R	8	S	2	R	3	R	5	R	7	S	7	S
14 Haruna Nijo	1	R	5	R	7	S	7	S	1	R	1	R	3	R	8	S	5	R
15 Keel	2	R	3	R	5	R	8	S	1	R	3	R	5	R	7	S	5	R
16 Kombar	1	R	8	S	7	S	8	S	3	R	3	R	3	R	8	S	3	R
17 Skiff	2	R	3	R	3	R	7	S	2	R	5	R	5	R	7	S	5	R
18 Steptoe	1	R	5	R	5	R	8	S	2	R	7	S	7	S	8	S	7	S
19 Stirling	2	R	7	S	7	S	7	S	2	R	3	R	5	R	8	S	5	R
20 Summitt	2	R	7	S	7	S	7	S	2	R	3	R	3	R	8	S	5	R
21 Torrens	1	R	5	R	5	R	5	R	2	R	5	R	5	R	8	S	5	R
22 TR250	2	R	5	R	5	R	5	R	1	R	2	R	2	R	7	S	3	R
23 Bülbül 89	7	S	7	S	5	R	8	S	2	R	7	S	8	S	8	S	8	S

Table 1 (Continued)- Response of barley differential genotypes to 45 *Pyrenophora teres* f. *maculata* isolates. For evaluation, a 1-9 scale developed by Tekauz (1985) was used. Numbers are mean of 3 replications. R, resistant; S, susceptible

	Isolate numbers and the provinces where the isolates obtained																	
Barley genotypes	*PTM19*	*Eskişehir*	*PTM 20*	*Diyarbakır*	*PTM 21*	*Kahramanmaraş*	*PTM 22*	*Kayseri*	*PTM 23*	*Çankırı*	*PTM 24*	*Kırşehir*	*PTM 25*	*Afyonkarahisar*	*PTM 26*	*Edirne*	*PTM 27*	*Çankırı*
1 Arimont	2	R	3	R	5	R	1	R	5	R	2	R	2	R	5	R	5	R
2 Cape	2	R	3	R	5	R	1	R	3	R	1	R	2	R	7	S	3	R
3 Chebec	2	R	2	R	3	R	1	R	3	R	2	R	2	R	5	R	3	R
4 CI3546	2	R	5	R	5	R	2	R	5	R	2	R	2	R	7	S	3	R
5 CI11458	2	R	5	R	5	R	3	R	3	R	2	R	2	R	8	S	5	R
6 CI5286	2	R	3	R	3	R	1	R	3	R	1	R	2	R	5	R	3	R
7 CI5791	2	R	5	R	5	R	3	R	3	R	1	R	2	R	5	R	3	R
8 CI7584	1	R	5	R	3	R	2	R	3	R	1	R	2	R	5	R	3	R
9 CI9214	2	R	3	R	2	R	2	R	2	R	2	R	2	R	5	R	5	R
10 CI9776	1	R	5	R	2	R	1	R	3	R	1	R	1	R	7	S	3	R
11 CI9819	2	R	5	R	5	R	2	R	3	R	2	R	1	R	5	R	3	R
12 CI16150	2	R	5	R	2	R	1	R	3	R	1	R	2	R	5	R	3	R
13 Galleon	1	R	5	R	2	R	2	R	5	R	2	R	1	R	7	S	5	R
14 Haruna Nijo	1	R	3	R	5	R	2	R	3	R	1	R	2	R	7	S	3	R
15 Keel	3	R	2	R	1	R	1	R	3	R	2	R	1	R	5	R	7	S
16 Kombar	3	R	5	R	5	R	2	R	3	R	3	R	2	R	7	S	7	S
17 Skiff	3	R	3	R	3	R	3	R	5	R	3	R	1	R	5	R	5	R
18 Steptoe	5	R	5	R	3	R	2	R	7	S	3	R	3	R	7	S	8	S
19 Stirling	3	R	5	R	5	R	1	R	5	R	2	R	2	R	7	S	5	R
20 Summitt	2	R	3	R	3	R	2	R	3	R	3	R	1	R	7	S	3	R
21 Torrens	1	R	3	R	5	R	2	R	5	R	3	R	2	R	7	S	5	R
22 TR250	1	R	5	R	3	R	2	R	2	R	2	R	1	R	5	R	3	R
23 Bülbül 89	5	R	5	R	3	R	2	R	7	S	7	S	5	R	5	R	8	S

Table 1 (Continued)- Response of barley differential genotypes to 45 *Pyrenophora teres* f. *maculata* isolates. For evaluation, a 1-9 scale developed by Tekauz (1985) was used. Numbers are mean of 3 replications. R, resistant; S, susceptible

	Isolate numbers and the provinces where the isolates obtained																	
Barley genotypes	*PTM 28*	*Şanlıurfa*	*PTM 29*	*Şanlıurfa*	*PTM 30*	*Niğde*	*PTM 31*	*Ankara*	*PTM 32*	*Diyarbakır*	*PTM 33*	*Kırıkkale*	*PTM 34*	*Diyarbakır*	*PTM 35*	*Adıyaman*	*PTM 36*	*Ankara*
1 Arimont	5	R	3	R	1	R	1	R	5	R	1	R	1	R	1	R	2	R
2 Cape	7	S	5	R	1	R	1	R	5	R	1	R	1	R	2	R	1	R
3 Chebec	5	R	3	R	1	R	1	R	5	R	1	R	1	R	1	R	2	R
4 CI3546	7	S	3	R	1	R	2	R	3	R	1	R	2	R	3	R	1	R
5 CI11458	7	S	7	S	2	R	1	R	5	R	2	R	1	R	1	R	2	R
6 CI5286	5	R	3	R	2	R	1	R	3	R	1	R	1	R	2	R	1	R
7 CI5791	7	S	5	R	1	R	2	R	5	R	2	R	1	R	1	R	1	R
8 CI7584	7	S	5	R	1	R	1	R	5	R	2	R	2	R	2	R	1	R
9 CI9214	7	S	5	R	1	R	1	R	7	S	2	R	1	R	1	R	1	R
10 CI9776	5	R	5	R	1	R	1	R	5	R	2	R	1	R	1	R	2	R
11 CI9819	5	R	5	R	1	R	2	R	5	R	2	R	1	R	2	R	1	R
12 CI16150	5	R	5	R	1	R	1	R	3	R	1	R	1	R	2	R	2	R
13 Galleon	8	S	5	R	2	R	1	R	5	R	2	R	2	R	2	R	2	R
14 Haruna Nijo	7	S	5	R	1	R	1	R	5	R	2	R	2	R	2	R	2	R
15 Keel	7	S	5	R	2	R	1	R	5	R	2	R	2	R	2	R	2	R
16 Kombar	7	S	5	R	1	R	1	R	5	R	2	R	1	R	1	R	2	R
17 Skiff	7	S	3	R	1	R	1	R	5	R	2	R	2	R	2	R	2	R
18 Steptoe	7	S	5	R	2	R	5	R	5	R	7	S	5	R	2	R	3	R
19 Stirling	7	S	5	R	1	R	2	R	5	R	2	R	2	R	2	R	1	R
20 Summitt	7	S	5	R	1	R	1	R	5	R	2	R	1	R	2	R	1	R
21 Torrens	7	S	5	R	1	R	1	R	5	R	2	R	1	R	2	R	1	R
22 TR250	7	S	3	R	1	R	1	R	5	R	1	R	1	R	1	R	1	R
23 Bülbül 89	5	R	3	R	1	R	5	R	5	R	2	R	3	R	1	R	3	R

Table 1 (Continued)- Response of barley differential genotypes to 45 *Pyrenophora teres* f. *maculata* isolates. For evaluation, a 1-9 scale developed by Tekauz (1985) was used. Numbers are mean of 3 replications. R, resistant; S, susceptible

	Isolate numbers and the provinces where the isolates obtained																	
Barley genotypes	*PTM 37*	*Konya*	*PTM 38*	*Konya*	*PTM 39*	*Konya*	*PTM 40*	*Kırşehir*	*PTM 41*	*Diyarbakır*	*PTM 42*	*Yozgat*	*PTM 43*	*Diyarbakır*	*PTM 44*	*Konya*	*PTM 45*	*Eskişehir*
1 Arimont	3	R	1	R	1	R	1	R	7	S	5	R	2	R	2	R	5	R
2 Cape	3	R	2	R	2	R	1	R	7	S	5	R	1	R	3	R	3	R
3 Chebec	2	R	1	R	2	R	1	R	5	R	3	R	1	R	5	R	3	R
4 CI3546	2	R	2	R	3	R	1	R	5	R	2	R	5	R	3	R	3	R
5 CI11458	2	R	2	R	2	R	5	R	5	R	3	R	2	R	3	R	3	R
6 CI5286	2	R	1	R	1	R	1	R	7	S	3	R	5	R	3	R	3	R
7 CI5791	2	R	1	R	1	R	1	R	5	R	5	R	2	R	3	R	3	R
8 CI7584	2	R	1	R	1	R	1	R	5	R	5	R	2	R	3	R	3	R
9 CI9214	1	R	1	R	2	R	1	R	7	S	2	R	2	R	3	R	5	R
10 CI9776	2	R	2	R	2	R	1	R	5	R	3	R	2	R	3	R	3	R
11 CI9819	2	R	2	R	2	R	1	R	3	R	5	R	2	R	3	R	3	R
12 CI16150	5	R	2	R	1	R	1	R	5	R	3	R	2	R	3	R	2	R
13 Galleon	2	R	2	R	2	R	1	R	7	S	7	S	2	R	5	R	2	R
14 Haruna Nijo	2	R	1	R	2	R	2	R	7	S	3	R	2	R	3	R	5	R
15 Keel	3	R	3	R	3	R	2	R	7	S	5	R	3	R	7	S	5	R
16 Kombar	2	R	1	R	3	R	1	R	7	S	5	R	1	R	5	R	3	R
17 Skiff	2	R	2	R	3	R	3	R	5	R	5	R	2	R	3	R	5	R
18 Steptoe	7	S	7	S	7	S	5	R	7	S	7	S	2	R	7	S	7	S
19 Stirling	2	R	2	R	1	R	1	R	7	S	7	S	3	R	5	R	3	R
20 Summitt	2	R	2	R	2	R	1	R	7	S	3	R	3	R	5	R	3	R
21 Torrens	1	R	2	R	1	R	1	R	8	S	5	R	2	R	3	R	3	R
22 TR250	2	R	1	R	1	R	1	R	7	S	3	R	1	R	3	R	3	R
23 Bülbül 89	7	S	7	S	7	S	5	R	8	S	5	R	3	R	5	R	7	S

Table 2- Nineteen pathotypes of *Pyrenophora teres* f. *maculata* using a differential set containing 23 barley genotypes and isolate locations

Isolates	*Locations*	*Genotype numbers showing susceptible reactions/ Pathotype numbers*	*Numbers of susceptible genotypes*	*Virulence value*
PTM 30	Niğde	Pathotype 0	0	1.17
PTM 34	Diyarbakır			1.47
PTM 31	Ankara			1.52
PTM 9	Eskişehir			1.56
PTM 36	Ankara			1.60
PTM 35	Adıyaman			1.65
PTM 14	Konya			1.69
PTM 40	Kırşehir			1.69
PTM 7	Diyarbakır			1.73
PTM 8	Şanlıurfa			1.73
PTM 22	Kayseri			1.78
PTM 25	Afyonkarahisar			1.86
PTM 2	Şanlıurfa			1.95
PTM 19	Eskişehir			2.17
PTM 43	Diyarbakır			2.26
PTM 21	Kahramanmaraş			3.60
TM 20	Diyarbakır			4.04
PTM 33	Kırıkkale	Pathotype 18	1	1.91
PTM 10	Kayseri	Pathotype 23	1	1.82
PTM 24	Kırşehir			2.13
PTM 1	Konya			3.04
PTM 3	Ankara	Pathotype 23	1	3.17
PTM 5	Aksaray			3.34
PTM 29	Şanlıurfa	Pathotype 5	1	4.47
PTM 32	Diyarbakır	Pathotype 9	1	4.82
PTM 38	Konya	Pathotype 18-23	2	2.08
PTM 39	Konya			2.26
PTM 37	Konya			2.60
PTM 15	Ankara			3.17
PTM 45	Eskişehir			3.69
PTM 23	Çankırı			3.78
PTM 16	Sivas			3.91
PTM 44	Konya	Pathotype 15-18	2	3.82
PTM 42	Yozgat	Pathotype 13-18-19	3	4.30
PTM 4	Kahramanmaraş	Pathotype 5-20-23	3	5
PTM 27	Çankırı	Pathotype 15-16-18-23	4	4.39
PTM 6	Mardin	Pathotype 5-14-18-19	4	4.47
PTM 18	Ankara	Pathotype 10-13-18-23	4	4.47
PTM 12 *Hordeum spontaneum*	Kilis	Pathotype 5-14-16-19-20	5	5.08
PTM 11	Mardin	Pathotype 2-4-5-16-19-20-23	7	5.13
PTM 26	Edirne	Pathotype 2-4-5-10-13-14-16-18-19-20-21	11	6
PTM 41	Diyarbakır	Pathotype 1-2-6-9-13-14-15-16-18-19-20-21-22-23	14	6.21
PTM 28	Şanlıurfa	Pathotype 2-4-5-7-8-9-13-14-15-16-17-18-19-20-21-22	16	6.43
PTM 13	Gaziantep	Pathotype 1-3-5-7-10-11-12-13-14-15-16-17-18-19-20-23	16	6.65
PTM 17 *Hordeum spontaneum*	Şanlıurfa	Pathotype 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23	23	7.47

Genotypes CI3576, CI9214, CI9776 and Torrens exhibited resistant reactions to 91% of the isolates in our current study. These genotypes showed susceptible reactions to 4 isolates. Akhavan et al (2016) reported that CI9214 genotype was resistant to all *Ptm* isolates except two. In another study, genotypes CI9214 and CI9776 showed a resistant reaction to all isolates used (Karki & Sharp 1986). Differential cultivar Torrens exhibited moderately resistant-moderately susceptible reactions (McLean et al 2012) and different infection responses among the isolates were observed (McLean et al 2014a).

In our current study, Arimont, CI5791, Skiff and TR250 genotypes exhibited resistant reactions to 42 isolates (93%). These genotypes showed susceptible reactions to 3 isolates. Akhavan et al (2016) reported the virulence of 19 (70.4%) *Ptm* isolates on genotype CI5791. Cultivar Arimont was reported as susceptible in a previous study (Karki & Sharp 1986). Cultivar Skiff was reported as generally moderately resistant and genotype TR250 was reported as moderately susceptible (McLean et al 2012).

Cape, Keel, Galleon, Haruna Nijo, Kombar, Summitt, CI11458 and Stirling genotypes exhibited low infection responses to 88%, 86%, 84%, 84%, 82%, 82%, 80% and 80% of the isolates, respectively, in our current study. In other studies, cultivar Keel was found resistant to all isolates, however, genotypes Cape, CI11458 and Summitt were moderately susceptible and cultivar Galleon was moderately resistant. Cultivar Kombar exhibited a susceptible reaction to more than half of the isolates (McLean et al 2012, 2014a). Cultivar Stirling showed different reactions to different isolates (Gupta et al 2012).

In our current study, cultivar Steptoe was susceptible to 40% of the isolates. In Akhavan et al (2016) study, this cultivar was susceptible to 81.5% of the isolates.

Barley cultivars and genotypes Cape, CI11458, CI5791, CI7584, CI9819, Kombar and Bülbül 89 were also used in Çelik Oğuz & Karakaya (2017) study. In their study, genotypes Cape, CI11458, CI5791, CI7584, CI9819, Kombar and Bülbül 89 showed susceptible reactions to 10, 16, 9, 13, 10, 20 and 44 out of 50 isolates, respectively. In our current study, genotypes Cape, CI11458, CI5791, CI7584, CI9819, Kombar and Bülbül 89 exhibited susceptible reactions to 5, 9, 3, 2, 2, 8 and 19 out of 45 isolates, respectively.

In the current study, cultivars Steptoe and Bülbül 89 exhibited susceptible reactions to 18 and 19 isolates, respectively. These cultivars were the most susceptible cultivars. Cultivar Bülbül 89 could be used as universal susceptible genotype in an international *Ptm* differential set. The genotypes used in this study were useful in differentiating *Ptm* pathotypes.

4. Conclusions

For determination of *Pyrenophora teres* f. *maculata* pathotypes, a differential set consisted of 22 international cultivars and genotypes and a susceptible Turkish barley variety Bülbül 89 were tested using 45 isolates obtained from different regions of Turkey. Nineteen pathotypes were determined out of 45 isolates used. Cultivar Bülbül 89 could be used as universal susceptible genotype in an international *Ptm* differential set. The genotypes used in this study were useful in differentiating *Ptm* pathotypes.

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