DISEASES OCCURRING ON *Hordeum bulbosum* FIELD POPULATIONS AT BİNGÖL PROVINCE OF TURKEY

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Summary

Hordeum bulbosum is one of the wild barley species naturally growing in Bingöl province of Turkey. This wild species is an important gene source for obtaining disease resistant plants. In 2018, a survey was carried out in order to determine the diseases occurring on *Hordeum bulbosum* plants in Bingöl province. Twenty-seven naturally growing *Hordeum bulbosum* populations from Bingöl central district and Genç, Adaklı, Kiğı, Karlıova and Solhan districts were examined. Five *Hordeum bulbosum* populations were disease free. Powdery mildew caused by *Blumeria graminis* f. sp. *hordei*, leaf rust (brown rust) caused by *Puccinia hordei*, spot form of net blotch caused by *Drechslera teres* f. *maculata* and scald caused by *Rhynchosporium commune* were observed in other populations. Powdery mildew was the most common pathogen followed by leaf rust (brown rust), spot form of net blotch and scald.

Keywords: *Hordeum bulbosum, disease resistance, Bingöl, wild barley, Turkey*

INTRODUCTION

Barley (*Hordeum vulgare*) is an important plant grown in vast areas of the world and it is a popular cereal crop in Turkey (Geçit, 2016). *Hordeum bulbosum* L., one of the wild barley species, grows naturally in Turkey. This species can be used in barley improvement as a source of genetic diversity (Wendler *et al*., 2015; Czembor *et al.*, 2017). *H. bulbosum* is an important gene source that helps us to obtain disease resistant plants (Pickering *et al.*, 2000; Walther *et al.*, 2000; Ruge *et al.*, 2003; Czembor, 2007). Proeseler *et al.* (1988) evaluated the barley accessions from the Gatersleben collection for their response to diseases. Regardless of geographic origin, *Hordeum bulbosum* was not infected by the barley yellow mosaic virus. One *H. bulbosum* accession was resistant to *Drechslera teres* and incompatible with *Puccinia hordei*.

Various researchers emphasized the importance of *H. bulbosum* in barley genetics and breeding and the role of *Hordeum vulgare* x *H. bulbosum* crosses in resistance to

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disease agents (Pickering *et al.*, 2004; Toubia-Rahme *et al.*, 2003; Wehling *et al.*, 2002). Leaf rust and stem rust resistance in these lines have been found and the researchers concluded that these lines could be used in breeding programs (Czembor *et al.*, 2017; Fetch *et al.*, 2009). Johnston *et al.* (2013) introgressed leaf rust resistance gene *Rph22* from *H. bulbosum* to *H. vulgare*.

Fischer *et al.* (2010) made interspecific crosses between *H. vulgare* and *H. bulbosum*. Mapping populations segregating with individuals towards barley yellow dwarf virus were observed. Genetic analysis of a BC_2F_4 family showed that inheritance of the resistance was dominant. *Hb* introgression on chromosome 3HL was observed. Also, *Hordeum bulbosum* method was used to obtain doubled-haploid lines for disease resistance studies (El-Attari *et al.*, 1998). These features make *H. bulbosum* plants valuable in disease resistance studies.

Barley is affected by a number of diseases. Among these barley scald, net blotch, powdery mildew and leaf rust cause significant yield losses (Mathre, 1997). In Turkey, several barley diseases have been reported from *Hordeum vulgare* and *Hordeum spontaneum*. These diseases include both forms of net blotch caused by *Drechslera teres* f. *teres* and *D. teres* f. *maculata*, scald caused by *Rhynchosporium commune*, powdery mildew caused by *Blumeria graminis* f. sp. *hordei* (syn: *Erysiphe graminis* f. sp. *hordei*), barley stripe caused by *Drechslera graminea*, leaf rust caused by *Puccinia hordei*, semi loose smut caused by *Ustilago nigra* and loose smut caused by *Ustilago nuda* (Çelik and Karakaya, 2015; Karakaya *et al*., 2016; İlgen *et al*., 2017; Özdemir *et al*., 2017; Ertürk *et al*., 2018).

Disease resistant *H. bulbosum* plants will be valuable sources of disease resistance.

In 2018, a survey was conducted in Bingöl province in Turkey for observation of disease status of *H. bulbosum* plants and determination of diseases occurring on *H. bulbosum* field populations.

MATERIALS AND METHODS

A survey was carried out at Bingöl province of Turkey during May and June of 2018. Twenty-seven naturally grown *Hordeum bulbosum* field populations were inspected in order to see the presence of diseases. Eight, 5, 6, 1, 3 and 3 *H. bulbosum* field populations were examined at Bingöl central district and Genç, Adaklı, Kiğı, Karlıova and Solhan districts. At each location 10-50 plants were inspected in order to see the presence of diseases. The incidence (number of plants infected of those examined) and severity [(1-9 scale developed by Saari and Prescott (1975)] values of the diseases were recorded. Plants were inspected visually. For identification of the diseases Mathre (1997), Zillinsky (1983) and Zaffarona *et al.* (2011) were used. For verification of net blotch types, Bülbül 89, a susceptible barley variety [(Taşkoparan and Karakaya (2009); Yazıcı *et al*., (2015)], and *Hordeum bulbosum* plants obtained from Bingöl province were used. Isolation, inoculation and evaluation studies were conducted according to Çelik Oğuz and Karakaya (2017). These studies were

carried out at the mycology laboratory and greenhouse of Department of Plant Protection, Faculty of Agriculture, Ankara University, Turkey.

RESULTS AND DISCUSSION

Two *Hordeum bulbosum* populations in central district of Bingöl province and three *Hordeum bulbosum* populations in Adaklı district were disease free (Table 1). In other locations, powdery mildew disease caused by *Blumeria graminis* f. sp. *hordei* was the most common disease followed by leaf rust (brown rust), spot form of net blotch and scald. In Bingöl province of Turkey, powdery mildew disease was observed on 20 *H. bulbosum* populations. The incidence of powdery mildew ranged between 5% and 85%. The severity of this disease ranged between 3 and 7. Leaf rust caused by *Puccinia hordei* was found in 7 *H. bulbosum* populations. The incidence of leaf rust ranged between 3% and 70%. The severity of this disease ranged between 3 and 5. Typical spot form of net blotch symptoms were observed on both susceptible cultivar Bülbül 89 and *H. bulbosum* seedlings inoculated with *Drechslera teres* (teleomorph: *Pyrenophora teres*) isolates. Spot form of net blotch caused by *Drechslera teres* f. *maculata* was found in 4 *Hordeum bulbosum* populations. The incidence of spot form of net blotch ranged between from 1% and 10%. The severity of this disease ranged between 3 and 5. Scald caused by *Rhynchosporium commune* was found in 3 *H. bulbosum* populations. The incidence of scald ranged between 2% and 10% and the severity of this disease ranged between 3 and 5.

Powdery mildew disease was found in all districts surveyed. The highest powdery mildew incidence was observed in a population in the central district (85%) and the lowest incidence was observed in a population in Solhan district (2%). *Puccinia hordei* was found in the central district and in Genç, Adaklı and Karlıova districts. The highest leaf rust incidence was observed in a population in Genç district (70%) and the lowest incidence was observed in a population in Adaklı district (3%). Spot form of net blotch was found in central district and in Genç and Adaklı districts. Scald was found in Genç and Karlıova districts. Spot form of net blotch and scald incidences were low.

Various researchers identified resistance sources using *H. bulbosum* plants. Jie and Snipe (1989) found resistance to powdery mildew in the diploid and tetraploid clones of *H. bulbosum* and hybrids of crosses between *H. bulbosum* and susceptible cultivars of *H. vulgare.* Tetraploid *H. bulbosum* genotypes also showed resistance to *Puccinia striiformis* and *P. hordei.*

Prasad *et al*. (1983) determined the reaction types of *H. bulbosum* strains to Japanese races of *Erysiphe graminis* f. sp. *hordei*. The highest proportion of highly resistant or immune plants was found in strain Turkey. Czembor (2007) obtained six recombinant lines from crosses and backcrosses of barley cultivars (backcrossing parents) and accessions of *H. bulbosum* and tested these plants with 18 differential isolates of *Blumeria graminis* f. sp. *hordei*. Resistance to powdery mildew was found in all tested recombinant lines. In one line, outstanding resistance to powdery mildew

was identified. Czembor *et al*. (2017) obtained 26 recombinant lines from crosses of barley cultivars of *H. vulgare* and *H. bulbosum* and tested these crosses with 8 differential leaf rust isolates. Leaf rust resistance was found in 22 recombinant lines. Resistance to leaf rust was outstanding in 7 lines.

CONCLUSIONS

Hordeum bulbosum is an important gene source that helps us to grow disease resistant plants. In this current study, five naturally grown *H. bulbosum* field populations were found to be disease free. In terms of diseases, a wide variation was observed in natural populations of *H. bulbosum* in Bingöl province in Turkey. The incidence and severity values of these diseases also showed variation. The disease free populations of *H. bulbosum* could be used as resistance sources.

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Table 1. Diseases occurring on *Hordeum bulbosum* field populations at Bingöl province of Turkey. For determination of disease severity, a 1-9 scale developed by Saari and Prescott was used (Saari and Prescott, 1975).

No	District	Presence of the disease	*Blumeria graminis* f. sp. *hordei*		*Puccinia hordei*		*Drechslera teres* f. *maculata*		*Rhynchosporium commune*	
			Incidence (%)	Severity	Incidence (%)	Severity	Incidence (%)	Severity	Incidence (%)	Severity
1	Central	present	20	5	5	5				
2	Central	present	85	5						
3	Central	present	10	5						
4	Central	present	15	5	10	5				
5	Central	no disease								
6	Central	present	5	3						
7	Central	no disease								
8	Central	present	20	3			1	3		
9	Genç	present	15	5			10	5		
10	Genç	present	5	5	70	5	5	5		
11	Genç	present	5	5	20	5				
12	Genç	present	20	5					10	5
13	Genç	present	40	5	70	5			5	5
14	Adaklı	no disease								
15	Adaklı	present	5	3	3	3	3	3		

Table 1. Diseases occurring on *Hordeum bulbosum* field populations at Bingöl province of Turkey. For determination of disease severity, a 1-9 scale developed by Saari and Prescott was used (Saari and Prescott, 1975) (continued).

No	District	Presence of the disease	*Blumeria graminis* f. sp. *hordei*		*Puccinia hordei*		*Drechslera teres* f. *maculata*		*Rhynchosporium commune*	
			Incidence (%)	Severity	Incidence (%)	Severity	Incidence (%)	Severity	Incidence (%)	Severity
16	Adaklı	no disease								
17	Adaklı	present	4	3						
18	Adaklı	no disease								
19	Adaklı	present	70	5						
20	Kiğı	present	70	5						
21	Karlıova	present	50	3						
22	Karlıova	present			50	5				
23	Karlıova	present							2	3
24	Karlıova	present	20	3						
25	Solhan	present	2	3						
26	Solhan	present	15	7						
27	Solhan	present	5	3						