Tarla Bitkileri Merkez Araştırma Enstitüsü Dergisi, 2015, 24 (1):75-78
Araştırma Makalesi (Research Article)

Seedling Response of Two Barley Cultivars and Gamma Ray-Induced Advanced Barley Lines to *Rhynchosporium commune*

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Received (Geliş Tarihi): 05.06.2015 Accepted (Kabul Tarihi) : 17.06.2015

Abstract

Barley scald caused by *Rhynchosporium commune* is an important disease of barley (*Hordeum vulgare*). Barley mutants could be used for enhancing genetic diversity in barley. In this study, barley cultivar Tokak 157/37 was subjected to gamma irradiation using Cobalt- 60 as the radiation source and mutant barleys were obtained. Under greenhouse conditions, twenty-five advanced mutant barley lines (M_8 generation) and two barley cultivars (Tokak 157/37 and Bülbül 89) were tested for their resistance status to 3 *Rhynchosporium commune* single spore isolates obtained from Gaziantep, Eskişehir and Manisa provinces of Turkey. For evaluation of the lines and cultivars a 0-4 scale was used. Response of lines to isolates ranged between highly resistant and highly susceptible. Isolate obtained from Gaziantep was the most virulent followed by isolates obtained from Manisa and Eskişehir. Mutant barley line # 20 showed a resistant reaction to Gaziantep isolate. Mutant barley lines # 7, 13, 20, 21, 23 and 25 showed a highly resistant reaction to Eskişehir isolate and line #16 showed a resistant reaction to this isolate. Lines # 7 and 25 exhibited resistant and intermediate reactions to Manisa isolate, respectively. The other mutant barley lines showed susceptible and highly susceptile reactions to isolates. Barley cultivars Tokak 157/37 and Bülbül 89 exhibited highly susceptible reactions to all 3 isolates.

Keywords: *Rhynchosporium commune*, *Hordeum vulgare*, disease resistance, mutant barley lines, Cobalt-60 irradiation

İki Arpa Çeşidinin ve Gamma Işınlaması ile Elde Edilmiş İleri Kademe Arpa Hatlarının *Rhynchosporium commune*' a Fide Dönemi Tepkileri

Öz

Rhynchosporium commune tarafından meydana getirilen arpa yaprak lekesi hastalığı arpa (*Hordeum vulgare*) bitkilerinin önemli bir hastalığıdır. Arpa mutantları arpada genetik çeşitliliği zenginleştirmek için kullanılabilir. Bu çalışmada Tokak 157/37 arpa çeşidinin Kobalt-60 kaynağında gamma ışınlarıyla ışınlanması sonucu geliştirilen M_8 generasyon kademesindeki 25 mutant arpa hattının ve iki arpa çeşidinin (Tokak 157/37 ve Bülbül 89) Gaziantep, Eskişehir ve Manisa'dan elde edilen 3 *Rhynchosporium commune* tek spor izolatına sera koşullarında dayanıklılık durumları incelenmiştir. Çeşit ve hatların değerlendirilmesi için 0-4 ıskalası kullanılmıştır. Hatların izolatlara tepkileri yüksek derecede dayanıklı ile yüksek derecede hassas arasında değişmiştir. Gaziantep'den elde edilen izolat en virülent izolat olarak bulunmuş ve bu izolatı Manisa ve Eskişehir izolatları takip etmiştir. Yirmi numaralı mutant arpa hattı Gaziantep izolatına dayanıklı tepki vermiştir. Yedi, 13, 20, 21, 23 ve 25 numaralı mutant arpa hatları Eskişehir izolatına yüksek derecede dayanıklı tepki verirken 16 numaralı hat dayanıklı tepki vermiştir. Yedi numaralı mutant arpa hattı Manisa izolatına dayanıklı tepki verirken 25 numaralı hat Manisa izolatına orta derecede dayanıklı tepki vermiştir. Diğer mutant arpa hatları izolatlara hassas ile yüksek derecede hassas tepkiler vermişlerdir. Tokak 157/37 ve Bülbül 89 çeşitleri 3 izolata da yüksek derecede hassas tepki vermişlerdir.

Anahtar Kelimeler: *Rhynchosporium commune*, *Hordeum vulgare*, hastalıklara dayanıklılık, mutant arpa hatları, Kobalt-60 ışınlaması

Introduction

Scald disease of barley is caused by the fungus *Rhynchosporium commune*. The pathogen is formerly known as *Rhynchosporium secalis* (Zaffarano et al. 2011). Barley scald has been reported at least from 50 countries in Asia, Europe, Africa, Australia, North and Latin America continents (Shipton et al. 1974; Whittal et al. 2004). This disease has been observed in all barley grown regions, however, it is much more common in temperate, cold and humid regions of the world (Xue and Hall 1992; Robbertse et al. 2000; Witthal et al. 2004). Generally yield losses of 10-70% have been reported due to barley scald (Shipton et al. 1974; Zhang et al. 1992; Sheikh Jabbari 2008). Barley scald is controlled by means of chemical, agronomical, and biological (using resistant cultivars) measures (Avora and Knogge 2012), however, potential of other methods to control of this pathogen has been tested. Using gamma ray irradiation to prevent barley scald is one of the abovementioned methods (Jawher and Arabi 1997). In this study, Turkish barley cultivar Tokak 157/37 was subjected to gamma irradiation using Cobalt- 60 as the radiation source and mutants were obtained. Under greenhouse conditions, twenty-five advanced mutant barley lines (M_8 generation) and two susceptible barley cultivars were tested for their resistance status to 3 *Rhynchosporium commune* single spore isolates obtained from Gaziantep, Eskişehir and Manisa provinces of Turkey.

Materials and Methods

Turkish barley cultivar Tokak 157/37 was subjected to 150 Gray, 200 Gray and 300 Gray doses of gamma rays in Turkish Atomic Energy Authority, Sarayköy Nuclear Research and Training Center using Cobalt 60 as the radiation source and a mutant population was obtained. Mutants with reasonable agronomic traits were selected from the mutant population and carried to the next generation. A total of twenty-five advanced mutant barley lines which are in the M_8 generation were used in this study. In addition, Bülbül 89 and Tokak 157/37 cultivars were also evaluated as susceptible controls. Isolation, inoculation and growing conditions of the plants were the same as outlined by Mert and Karakaya (2004). There were three replications. Scald reactions on the first leaves were evaluated 18 days after inoculation using a modified scale (El-Ahmed 1981) of Ali and Boyd (1974). A scale value of 0 was considered as a highly resistant reaction and scale values 0.1–1.0, 1.1–2.0, 2.1–3.0 and 3.1–4.0 were considered as resistant, intermediate, susceptible and highly susceptible reactions, respectively.

Results and Discussion

Response of lines and cultivars to isolates ranged between highly resistant and highly susceptible (Table 1).

Table 1. Seedling response of 25 advanced mutant barley lines and 2 barley cultivars to three *Rhynchosporium commune* isolates. For evaluation, a 0–4 scale was used (El-Ahmed, 1981). Numbers are mean of three replications.

Çizelge 1. Yirmibeş ileri kademe mutant arpa hattının ve 2 arpa çeşidinin üç Rhynchosporium commune izolatına fide dönemi tepkileri. Değerlendirme için 0-4 ıskalası kullanılmıştır (El-Ahmed, 1981). Rakamlar 3 tekerrürün ortalamasıdır.

Lines/ Cultivars	Gaziantep isolate	Eskişehir isolate	Manisa isolate
1	3.7	3.0	4.0
2	3.7	4.0	4.0
3	4.0	3.0	4.0
4	3.3	3.0	3.3
5	3.0	2.7	2.3
6	3.7	3.0	2.7
7	2.3	0.0	1.0
8	3.0	3.3	3.7
9	3.7	4.0	4.0
10	4.0	3.7	3.0
11	4.0	3.7	4.0
12	4.0	4.0	4.0
13	4.0	0.0	3.7
14	4.0	3.0	4.0
15	4.0	3.0	4.0
16	3.0	1.0	4.0
17	4.0	4.0	4.0
18	3.3	3.7	4.0
19	4.0	4.0	4.0
20	1.0	0.0	2.7
21	3.0	0.0	3.3
22	4.0	3.7	4.0
23	4.0	0.0	3.7
24	4.0	3.3	3.7
25	3.3	0.0	2.0
Tokak 157/37	4.0	3.7	4.0
Bülbül 89	4.0	4.0	4.0
Mean	3.56	2.62	3.52

Mutant barley line # 20 showed a resistant reaction to Gaziantep isolate. Mutant barley lines # 7, 13, 20, 21, 23 and 25 showed a highly resistant reaction to Eskişehir isolate and line

#16 showed a resistant reaction to this isolate. Lines # 7 and 25 exhibited resistant and intermediate reactions to Manisa isolate, respectively. The other mutant barley lines showed susceptible and highly susceptile reaction to isolates. Barley cultivars Tokak 157/37 and Bülbül 89 exhibited highly susceptible reactions to all 3 isolates. In previous studies, these cultivars also showed highly susceptible reactions to *R. secalis* (Mert and Karakaya 2004; Düşünceli et al. 2008; Aydın et al. 2014).

Virulence differences among the isolates were observed. Isolate obtained from Gaziantep was the most virulent (scale value: 3.56) followed by Manisa (scale value: 3.52) and Eskişehir isolate (scale value: 2.62). Pathogenic variation among the *Rhynchosporium secalis* isolates has been reported previously (Tekauz 1991; Araz and Maden 2006; Arabi et al. 2008).

In our study, seedling response of mutant barley lines to *R. commune* isolates varied. Response of mutant lines to isolates ranged between highly resistant and highly susceptible. Aydın et al. (2014) also found variation in resistance status of barley cultivars and barley mutants obtained by gamma irradiation to *R. secalis*. Some researchers have used gamma rays to improve different traits of barley yield components as well as disease resistance and different kinds of results were obtained. Pre-plant exposure of seeds to gamma radiation of 3000 r not only induced drought tolerance in barley but also maintained an active metabolism in plants even under wilting conditions (Garg et al. 1972). Chauhan et al. (1985) found 5 high yielding mutants of six-rowed barley M_2 generation using 25 Krad dose. However, Siddiqu et al. (1985) studying on barley and triticale revealed that higher dose of gamma rays have inhibitory effects on yield and yield components of these crops. In another study on the effect of gamma rays on barley, Jawher and Arabi (1997) found that, in general, the exposure of three barley cultivars to 30 and 40 Gy of gamma rays decreased barley susceptibility to *R. commune* by 46 and 39%, respectively. The best response was obtained with V. Arabi Abiad and WI 2291. It appears that mutants could be a useful source for obtaining disease resistant genotypes. Studies should focus on pathogen variation and finding more resistant genotypes.

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