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Pyrenophora graminea in Fields Sown-spring Barley Angora in Arid District of Turkey

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Abstract: Barley leaf stripe caused by *Pyrenophora graminea* was detected for the first time in dryland district of Turkey. With the approximate 3.2% infection rate, the first symptom of the pathogen was detected at the tillering growth stage in 2002 growing season. In second surveys conducted at the milk-ripe stage of Angora barley cv, disease severity was measured approximately 5.3% as a sum. In this assessment, diseased plants were displayed three differ infection type as physiologically in the following; plants without ears, plants with ears but without seeds and plants with ears having deformed seeds. Rates of these symptoms were approximately 2.8, 1.5 and 1%, respectively. The yield loss from leaf stripe was estimated as 5% in 2002. When same crops were treated with experiments in 2003, 9.6% of seeds were displayed *P. graminea in vitro* tests, while 7.9% of plants demonstrated this infection in field experiments. According to the present results, it is suggested that the direct effect of leaf stripe on yield lose was minor but, it was very important when quarantine conditions are taken into consideration.

Key words: Barley, *Pyrenophora graminea*, seed-borne pathogen, quarantine conditions

INTRODUCTION

Barley (*Hordeum vulgare*) is one of the most important cereal sown in south-eastern Anatolian region, particularly in Sanliurfa district of this region in Turkey. Since native varieties in this country do not have the malt properties, this requirement has been mostly provided by imports. In an effort to produce suitable malting barley varieties in Turkey, experiments have been performed by using of different malt barley varieties in different districts of Turkey for about a decade year. Angora has been reported as the most suitable malting barley variety adapting in Sanliurfa district[1]. The cultivation of this variety has been adopted by the growers at the great extent and its sowing has been progressively increased in the region. In recent years, however, the observation of the barley leaf stripe caused by the fungus *Pyrenophore graminea* (Ito and Kuribayashi) anamorph *Drechslera graminea* (Rabenh.ex. Schlecht) on this genotype was the worst properties not wished in barley fields of district.

P. greminea has been reported as an important disease in America, Canada, Europe, Asia and Australia over 50 years ego[2]. It was also reported in some other districts of Turkey[3,4]. Yield losses previously reported are between 8-17% in French, 20-50% in America and this is a significant disease in some district of northern Europe, north and east Asia[5]. According to Wallwork[6] this infection is not important for some countries. However, in another country infection rate of barley leaf stripe is very high[7]. By using of the effective management programme, disease rates were decreased from 69-82% to 6.1-7.5% in Scottish[8]. *P. graminea* is an important seed-transmitted disease in UK[9], Germany, Italy and Scandinavia and routinely controlled for each year by the using of seed dressing fungicides in conventional farming systems[10].

There are no reports concerning about *P. greminea* on barley in dryland district of Turkey which named with south-eastern Anatolia district. This district includes 605.000 ha barley farmlands and has the second largest sowing areas for this plant at regional enumerate in Turkey[11]. This district has been protected to the barley leaf stripe disease by the quarantine laws. The main objective of this study was to determine the current status of this infection within the limitation of quarantine scope depending upon results derived from field and laboratory investigations.

MATERIALS AND METHODS

Disease severity and yield losses: The identification of *P. graminea* disease was made according to typical macroscopic symptoms on infected leaves and spore formation[12].

The disease severity was estimated in limited barley fields available in Sanliurfa region within south eastern Anatolian district. Infection severity of *P. greminea* was surveyed in about 2000 ha barley farmland sown with Angora cultivar (cv.) at the end of tillering, growth stage,

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(GS 29) and milk-ripe (GS 75) stages of barley[13] in 2002. After areas described above were differentiated into 20 conjectural equal fields, 5 different points, by 1x1 m^2 for each field were chosen randomly to determine the infected plant rate in 2002. Second surveys were conducted at GS 75 in same year and infected-plant averages were estimated according to their three infection symptoms as follow: plants without ears; plants with ears but not seeds and plants with ears and deformed seeds. Total infected plant rate was the gather of these three infected plant rates.

Yield losses due to leaf stripe were estimated in infected plants having with and without ears. This was calculated in ten fields, which was also considered as ten replicate, on 100 randomised-infected plants per field. Hundred ears without infected were also chosen randomly in same fields as control. After removed of straw residues, all grain yields from both infected and control were weighted separately. Data were processed using the analysis of variance with mean separately performed. Yield loss from leaf stripe was determined by comparing the yield components of infected plants with those of the control plants using t test.

Determination of the pathogen on seeds

In vitro: The percent of infected grains were calculated on randomised 100 seeds per field, in ten different field, after harvesting. The presence of the pathogen in or on seeds were determined by the observing of mycelial growth that produced on PDA medium. After surface sterilised in 5% sodium hypochlorite solution (NaOCI) for 5 min, rinsed three times in sterile distilled water and dried between sterilised filter paper, seeds were plated on the PDA and incubated for 72 h in a growth chamber at 21±1°C in the dark. Infected seeds developed typical mycelial growth and these were rated as percent of contaminated and healthy. To confirm that these mycelial growth were *P. graminea*, petri dishes were incubated under UV light with 12 h dark-light cycle for additional 4 days[14].

In field: Field experiments were conducted at the treatment station of the Agriculture Faculty in the Harran plain. This plain includes 180.000 ha of farmland as alone and represent the most largest and important barley areas of dryland districts of Turkey. Seeds were derived from ten different fields in 2002 after harvesting. They were sown with approximate 400 seed/m^2 density in plots, 2x3 m dimensions with three replicates, without treated any fungicide in 2003. Ten plots with same sizes were also sown as control after treated by tebucunazole (Raxil). Plots were scattered as randomized complete block design. Results were assessed at GS 75[13] at randomized 2 separate 1 m^2 per plot by counting all infected and healthy plants in 1 m^2.

RESULTS

Surveys: In surveys performed at the tillering growth stages, 3.3% plants were diseased by the *P. graminea*. Leaves of infected tillers could be distinguished with the characteristic longitudinal lesions and microscopic findings. In second surveys conducted at the milk-ripe stage, disease severity was measured approximate 5.3% as a sum. In this assessment, diseased plants were displayed three differ infection type as physiologically in the following. Plants without ears, plants with ears but without seeds and plants with ears having deformed seeds. Rates of these symptoms were approximately 2.8, 1.5 and 1%, respectively (Table 1). Very dwarf plants having small or deformed flag leaves were the other typical and common symptoms of this disease.

Average-100 ears weight was 8.27 g for *P. graminea*-infected plants in 2002. In control plants for same year, average-100 ears weight was 75 g. When numeric values mentioned above were expressed with "%" there was approximately 80% decreasing in grain yield on total infected ears with and without seed (Table 2). Seeds of infected plants generally did not display the normal seed properties.

Experiments: Mycelial growth of *P graminea* was observed on 9.6% of seeds when they plated on Petri dishes containing PDA. The infected plant rate was approximately 7.9% in field experiments in 2003, when seeds derived from previous crops were sown without treated any fungicide. In control plots, there were very rarely plants with infected by *P. graminea*. They could be averaged as 0.5% (Table 3).

DISCUSSION

In the current study, infection rate and yield loss from *P. graminea* on Angora barley variety in 2002 growing season were approximately 5.3% (Table 1) and 4.9% (Table 2), respectively. These mentioned rates appear very low compared to literature reported[5,7] when direct damage of this infection are taken into consideration. However, same infection rate can be significant if crops harvested from Angora barley fields in Sanliurfa will be used as seedings in later years. Pathogen was transmitted to second year by previous harvested crops. There were important numeric increase of infection on crops of Angora barley cv in both laboratory and field experiments compared to the previous year. In

Table 1: Infection rates of leaf stripe disease in Sanliurfa barley fields in 2002

Field numbers	Ds[a] Infected tillers (%)	Ds[b] Infected plants without ears (%)	Infected ears without seeds (%)	Infected ears with deformed seeds (%)
1	2.3	2.62	1.20	0.86
2	2.7	1.82	1.31	1.20
3	3.1	1.84	0.95	0.90
4	3.6	3.88	1.41	0.72
5	2.8	3.41	1.04	1.60
6	2.5	2.98	2.20	1.94
7	3.9	2.95	0.68	1.40
8	4.4	1.34	1.60	0.85
9	4.2	3.52	1.10	0.57
10	3.7	3.37	1.23	0.80
11	2.8	2.86	1.54	1.00
12	4.6	4.38	1.28	1.37
13	4.5	1.31	1.42	0.72
14	2.7	2.82	1.16	0.51
15	3.3	3.17	2.94	1.20
16	4.1	2.12	1.90	0.60
17	3.0	2.40	2.98	0.36
18	2.9	3.94	0.80	0.78
19	1.8	2.44	1.22	1.14
20	3.2	2.90	1.32	1.15
Ave.	3.3	2.80	1.53	0.98
Total	3.3%		5.31%	

Ds[a] = Disease severity (%) at tillering stage DS[b] = Disease severity (%) at milk-ripe stage

Table 2: Yield results of 10 fields (g/100 ears). Average yields of control and infected ears and the comparison of them

Field no	1	2	3	4	5	6	7	8	9	10	Average ±S.E	**
Control yields	81.0	75.0	76.0	72.0	78.0	75.0	69.0	77.0	74.0	73.0	75.00±1.1	90.7%
Infected yields	7.6	7.3	10.2	7.7	9.4	8.7	9.1	8.8	5.7	8.2	8.27±0.40	11.0%
											*P<0.00001	

*=Differences are statistically significant (P>0.05) **=Percent share within total yield amount

Table 3: The infected seed and plant rates in experiments for second years

In vitro	12	11	14	8	7	11	9	5	13	6	9.6%
In field	8.6	7.4	6.3	7.2	6.6	9.4	10.2	9.5	7.1	6.4	7.87
Control	0.3	0.4	0.6	0.6	0.2	0.7	0.8	0.5	0.4	0.5	0.50

experiments performed in 2003, the infection rate of seeds plated on Petri dishes containing PDA was 9.6% *in vitro* tests. The infection rates of plants was approximately 7.9% in field experiments. These rates of infection may also not be very important with respect to quantitative lose of barley production in 2003 as mentioned above. However, when quarantine conditions are taken into consideration rates of infection mentioned were very important as reported[15]. Sanliurfa province within the South-eastern Anatolian district formed the new region of the *P. graminea*.

Although crop losses from barley leaf blight for Angora barley variety is minor for the present, the contaminated level of pathogen in harvested crops is a high level. In procedure, it is not used as a seeding without treated any effective control method pre sowing. In addition, if these crops are treated with effective seed-dressing fungicide or another effective methods, it is considered that they must not be sown in a region that *P. graminea* has not been observed earlier. These infected crops may be source of barley leaf stripe and it may be decrease the barley production in district for next years if a barley variety with more susceptible to this pathogen is sown without treated any effective management method.

Based on results of field experiments, it is considered that Tebucunazole (Raxil) is an effective fungicide decreasing infection rate of *P. graminea* as reported previously[8,16-19]. However other beneficial methods reducing the effect of this infection on barley genotypes may give better results.

The effect of climate on barley leaf stripe is very important. Total rainfall, relative humidity and temperature degrees during germinating of seeds are important effective factors affecting epidemic occurrence of barley leaf stripe. It has been reported that infection is generally favoured by temperatures below 12°C during germination[20]. Very dry and very wet conditions seem to be unsuitable for fungal development[21].

Typical barley sowings in district make within the November and it can be extended until beginning of December for some years. Also, first raining generally begin from early November and maintain during winter season. Since this district is generally characterised with the arid climate it is considered that the epidemic outbreaks of *P. graminea* is generally not occur.

However, in some years climate may suitable for epidemic outbreaks of this pathogen when infected-susceptible varieties are shown and temperature and rainfall is become suitable during germination of seeds.

As a result, Angora can be sown in district as a malt barley but, seeds must be treated with an effective control method prior to sowings. However, to be used of a genetically resistant variety will become already sound and economic in district when considered the negative aspects of chemicals and other protective methods.

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