Crop Protection 67 (2015) 7–12

Contents lists available at ScienceDirect

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

Barley spot blotch intensity, damage, and control response to foliar fungicide application in southern Brazil

Lenita Agostinetto [a], Ricardo Trezzi Casa [a], Amauri Bogo [a, *], Cristiano Sachs [a], Clovis Arruda Souza [a], Erlei Melo Reis [b], Isabel Cristina da Cunha [c]

[a] Crop Production Graduate Program, Santa Catarina State University, Av. Luis de Camões 2090, Lages, SC 88.520-000, Brazil
[b] Plant Pathology Department, Passo Fundo University, Rodovia 285 Km 171, Passo Fundo, RS 99.052-900, Brazil
[c] Distance Education Department, Santa Catarina State University/UDESC, Av. Madre Benvenuta, 2007, Florian_opolis/SC CEP. 88.035-001, Brazil

ARTICLE INFO

Article history:
Received 26 April 2014
Received in revised form
13 September 2014
Accepted 17 September 2014
Available online

Keywords:
Bipolaris sorokiniana
Hordeum vulgare
Chemical control
Grain yield

ABSTRACT

Barley spot blotch (SB) is a frequent foliar disease of the brewing barley crop in southern Brazil. At present, there are few reports regarding the efficacy of fungicide spray programs in relation to the severity of SB damage to barley crop yield. The goals of this study were as follows: 1) to determine the crop growth stage at which severity of SB was most strongly related to grain yield (GY), thousand kernel weight (TKW), and granulometry (G) damage in brewing barley and 2) to evaluate the efficacy of fungicides in controlling SB and the effect of fungicide application timing on disease intensity and yield. The experiments were performed using the BRS Cauê barley cultivar at Muitos Capões municipality, Rio Grande do Sul State, southern Brazil, during the 2009 and 2010 growing seasons. The experiments involved a randomized complete block design with five treatments and four replicates. The treatments varied by the number of fungicide applications. The control received no fungicide application. SB severity assessments were performed at the following growth stages: main stem and one tiller developed, main stem and four tillers developed, swelling 2nd node detectable, flag leaf ligule just visible, full boot, and 50% of spikes visible. SB severity data were integrated as a function of time to determine the area under the disease progress curve (AUDPC). SB resulted in damage of up to 49.2% and 34.6% in GY, 19.9% and 19.7% in TKW, and 26.0% and 11.2% in G in the 2009 and 2010 growing seasons, respectively. A frequency of three and four foliar fungicide applications controlled 70.1% and 78.3% of SB in the 2009 growing season and 85.8% and 88.6% in the 2010 growing season, respectively. GY and SB severity showed a significant negative relationship in both the 2009 and 2010 growing seasons and at all growth stages evaluated. The greatest GY damage related to SB severity occurred at the final growth stages at full boot and 50% of spikes visible. There was a significant negative relationship between AUDPC and GY, with damage coefficients of 17.19 and 22.94 in the 2009 and 2010 growing seasons, respectively. There was a positive net return on barley GY, TKW, and G when four fungicide applications were used for SB control.

1. Introduction

Barley (*Hordeum vulgare* L.) is the fourth most important cereal crop in the world after maize, wheat, and rice. Barley is cultivated as a summer crop in temperate areas and as a winter crop in tropical areas for malt production. Brazil is one of the largest barley-importing countries, producing only 30% of the national brewing industry's demand. Brazil's 2011 barley production area was approximately 88.4 thousand ha, with a productivity of 3145 kg ha^{-1} (Conab, 2012).

Barley foliar fungal diseases are some of the most important diseases and can substantially impact crop production and grain yield (GY). Foliar diseases caused by powdery mildew (*Blumeria graminis* DC. f. sp. *hordei* Em. Marchal.), leaf rust (*Puccinia hordei* Otth), net blotch [*Drechslera teres* (Sacc.) Shoemaker], and spot blotch (SB) [(*Bipolaris sorokiniana* (Sacc.) Shoemaker] are directly related to cultivar susceptibility, cultural practices, and rainfall during crop growing (Mathre, 1997). Most of these factors lead to reduced GY and increased production costs arising from the need for aerial fungicide application.

SB damage can reduce GY by 10%–20% when the temperature is between 15 °C and 22 °C during the first two weeks after the appearance of full ears (Steffenson, 1997). Clark (1979) in Canada

* Corresponding author. Tel.: +55 48 3321 8152; fax: +55 48 3321 8001.
E-mail address: amauribogo@udesc.br (A. Bogo).

http://dx.doi.org/10.1016/j.cropro.2014.09.012

and Karov et al. (2009) in Macedonia showed that SB damage can reduce GY by 16%–33% and 30%, respectively. In Brazil, GY can be reduced by 25.5% because of SB (Reis et al., 1999) and by 22% for the BR-2 cultivar in particular (Picinini and Fernandes, 1996).

The best foliar disease management for barley can be achieved by developing cultivars with genetic resistance (Czembor, 2000; Kumar et al., 2002; Roy et al., 2010). However, for SB susceptible cultivars, other crop management practices must be used, such as seed treatment, aerial fungicide application, seeding date and seeding rate, balanced soil fertility, weed control, and volunteer crop plant control and harvesting (Mathre, 1997; Krupinsky et al., 2002; Reis et al., 2011). Moreover, aerial fungicide application has been one of the most important strategies in some countries, including Brazil, to control most foliar diseases in winter cereal crops (Reis et al., 2002; Antoniazzi and Deschamps, 2007; Cunha and Bonaldo, 2008; Dalla Favera et al., 2009). Fungicides are routinely applied to control fungal diseases of barley and other cereal crops with the main goal of increasing yield and maximizing economic returns. Fungicide application performed late in the season or without regard to effectiveness of increased spray frequency can increase production costs with possibly no additional improvement to crop production. Most reports are based only on disease intensity and do not quantify crop damage, yield reduction, and overall cost. In addition, most farmers cultivating barley and other winter cereal crops do not consider the effect of the presence of disease inoculum on seeds or cultural residues, which can provide cost-effective improvements to disease mitigation.

The efficient application of an integrated disease management program requires accurate information on the relationship between disease intensity and crop damage. In barley, several foliar diseases can occur simultaneously in the same plant, making disease control difficult and resulting in increased and unmitigated crop damage.

In this study, damage means reduction in the quantity and/or quality of crop production, as reported by Bergamin Filho and Amorim (1996). The objectives of this work were as follows: 1) to determine the crop growth stage at which severity of SB was most strongly related to GY, thousand kernel weight (TKW), and granulometry (G) damage in brewing barley and 2) to evaluate the efficacy of fungicides in controlling SB and the effect of fungicide application timing on disease intensity and yield.

2. Materials and methods

The experiments were conducted using the commercial barley cultivar BRS Cauê, and crops were grown in Muitos Capões municipality, State of Rio Grande do Sul, southern Brazil (28°15′51 S and 51°10′54 W), 937 m above sea level. The study occurred during the 2009 and 2010 growing seasons. The climate of the region is humid mesothermic. The region's soil is of basaltic rock origin, classified as brown latosol aluminic cambic (Oxisol – class A) with

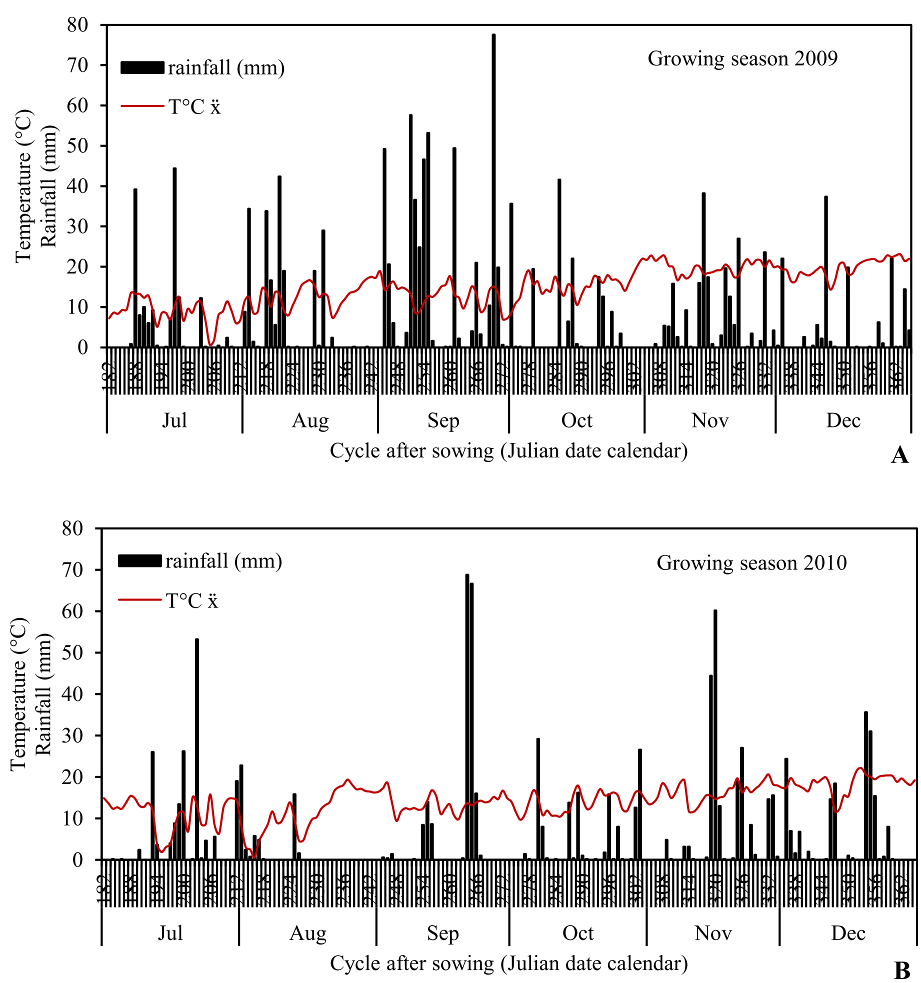

Fig. 1. Rainfall (mm) and average temperature (°C) between July and December during the 2009 (A) and 2010 (B) growing seasons in Muitos Capões municipality, southern Brazil (INMET, 2013).