SEARCHING FOR GENETIC TOLERANCE TO CHOKE IN ORCHARDGRASS GERMPLASM

B.S. Bushman, N.P. Anderson, J. Robins, D. Singh, R. Lamp, B. Schroeder, and P. Boren

Introduction

The sexual cycle of the endophtye *Epichloe typhina* can "choke" seed production in certain forage and turf grasses (Kirby, 1961). Orchardgrass (*Dactylis glomerata*) in particular is susceptible to choke in Oregon's Willamette Valley. Several years ago, seed yield losses were reported at 9% (Pfender and Alderman, 2006); losses likely are much higher now.

Multiple reports have studied the occurrence, spread, yield loss, and possible fungal infection routes of choke in orchardgrass, as well as insect vectors that aid in fertilization of the sexual fungus. What has emerged is a complicated pattern. Incidence of choke has spread throughout the Willamette Valley since 1997. Once choke is detected within a field, it pervades in a quadratic response (Pfender and Alderman, 2006). The fungus is considered weak when outside a plant, and it grows slowly once inside the plant. Its lackadaisical growth changes abruptly upon an unknown flowering signal from the plant; at that time, stroma quickly grow, engulf the seed head, and prevent seed production.

Thus far, fungicides have had little or no effect (Pfender and Alderman, 2003). Although several insect vectors have been studied, none has proven to account for the majority of fertilization of the fungus (Rao et al., 2012). Thus, no efficacious treatment or control for choke has been found.

Tolerance or resistance to fungal pathogens is often found in plants, and variation in these traits is used to breed superior cultivars. Development of tolerant or resistant cultivars is a lengthy process; however, when feasible management options are lacking, this approach is a viable direction. In the case of choke and orchardgrass, tolerance vs. resistance is difficult to define, but it may include gene products that prevent or dilute the plant flowering signal that induces rapid fungus growth, as well as plant structure or natural plant chemicals that limit fungal entry or survival in mature plants. Although the exact cause cannot be efficiently determined and assessed, resistance or tolerance (hereafter deemed tolerance) can be indicated in replicated field trials by a lack or paucity of choke incidence in some varieties over time. The objective of our research has been to assess whether there is variation for incidence of choke among orchardgrass collections and varieties.

Materials and Methods

Forty-eight orchardgrass varieties and wild collections (hereafter called entries) were planted in two sites: one near Albany, OR and the other near Corvallis, OR. The accessions represented the wide range of flowering times present in orchardgrass, as well as a number of accessions from Mediterranean origin. Each location was planted with 3 replications of 16 plants for each entry, in a randomized complete block design. Seedlings of each entry were germinated in Logan, UT and transplanted at the two Willamette Valley locations in the summer of 2012. Plots were maintained with fertilizer, pesticide, and herbicide as needed, and data were collected from 2013 through 2015.

For each year of data collection, heading and swathing dates were determined at the Albany site (Table 1). Choke scoring occurred at anthesis and was recorded as the number of plants in each 16-plant plot that had one or more choked panicles. The location of the choked plants was also recorded for nearest neighbor analysis using the Smith and Casler (2004) method. Plots were swathed at both locations based on maturity of seed at the Albany location and were not swathed in one single event. Plant material was discarded 1 week after swathing.

Preliminary analysis for 2014 and 2015 observations was conducted to indicate patterns of infection and identify varieties that are likely tolerant. Correlations between heading dates for each year, and between heading dates and the average number of plants with choke for each variety, were estimated using the Corr procedure of SAS.

Results and Discussion

From a starting date of January 1, heading dates ranged from 104 to 140 days, with correlation coefficients of 92% between replications. One of our previous studies in the Willamette Valley examined choke incidence without swathing; we found no choke after 3 years of observation, despite the presence of highly infected border plants, insects, and ascospores each year. This previous data suggested that swathing is necessary for choke infection. Swathing dates in the current study ranged from 180 to 190 days from January 1 and were moderately but negatively correlated with heading dates at $r = -0.39$ ($P < 0.05$). Further analysis of heading date, swathing date, and choke incidence will be completed after one more season of data collection.

Nearest neighbor analysis indicated no pattern of spread in the first and second year after plot establishment, consistent with previous studies and consistent with the mobile ascospores of *E. typhina*. Some entries appeared particularly susceptible to choke, however, with more than 50% of the plants showing one or more choked panicles after 2 years. These "susceptible" entries can be used to test inoculation techniques and to look for plant signals that induce choke growth.

After 2 years, the number of entries at the Albany field with no choke was seven. At the Corvallis field, which had more plant mortality due to deleterious planting conditions, eight entries had no choke after 2 years. Two entries with no choke and little mortality were shared by both sites: the Canadian cultivar 'AC Killarney' and the Israeli accession PI578597 (Table 1). Seven other entries had only one plant with choke across all replications in both sites (Table 1).

References

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Table 1. Entries showing little or no signs of choke after 2 years and their collection origin, heading dates, and swathing dates at the Albany site.

Entry	Origin	Heading date[1]	Swathing date[1]
AC Killarney	Ag. Canada	135	178
PI 578597	Israel	118	185
PI 223250	Afghanistan	117	191
Barlegro	Barenbrug USA	140	189
PI 250928	Iran	124	178
PI 231484	France	121	175
PI 371948	Bulgaria	115	189
PI 538922	Russia	140	183
PI 634258	Albania	123	189

[1]Dates represent the number of days since January 1.