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The effect of cultivar and fungicide application on the yield and quality of late-seeded forage oats used for swath grazing

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ABSTRACT

The productivity and disease tolerance of annual forages may have large effects on the performance of beef cattle in a swath-grazing system. This study was conducted to evaluate the effects of crown rust (Puccinia coronata Corda f. sp. avenae Eriks.) on the forage yield performance of 2 oat (Avena sativa L.) cultivars (HiFi and CDC Baler) with or without fungicide application in a swath-grazing system. The cultivar HiFi has good resistance to crown rust, whereas CDC Baler is susceptible to crown rust. Unfortunately, barley yellow dwarf virus (BYDV) infected both cultivars and may have influenced the results of the current study. Forage DM yield, regrowth, and forage residue yield samples were collected from each treatment. The nutritional quality of the samples was also analyzed. Mixed-model ANOVA was used in the statistical analysis of forage yield and nutritional performance. The cultivar effect was significant ($P < 0.01$) for DM yield, regrowth, residue yield, and nutrient quality. The application of fungicide had no influence ($P > 0.61$) on the DM yield, regrowth, and residue yield of the cultivars. There was no interaction effect ($P > 0.16$) between cultivar and fungicide application for all yield performances. The results from this study suggest that using a resistant cultivar (HiFi) resulted in greater ($P < 0.01$) forage DM yield and gross margins. The application of fungicide on HiFi was not economical because of the cultivar's resistance to crown rust. The HiFi cultivar also showed moderate resistance to BYDV. Although agronomic traits need to be considered in selecting cultivars for swath grazing, it is also important for producers to select cultivars with good disease packages that are environmentally suited to the production area. Because of its susceptibility to BYDV, CDC Baler may not be suitable for swath grazing in areas with severe BYDV infestation.

Key words: oat, cultivar, fungicide, swath grazing, rust, beef cattle

INTRODUCTION

Oat (*Avena sativa* L.) is a cool-season annual crop that has been widely incorporated into beef production systems as a swath-grazing annual (Kibite et al., 2002; McCartney et al., 2008). In western Canada, swath grazing of annual cereals, especially in the fall and winter months, is a feeding management practice that may lengthen the grazing season (Entz et al., 2002; McCartney et al., 2008). This practice also reduces the duration of confined cattle feeding, potentially reducing costs associated with baling, hauling, bedding, and manure removal in beef production systems (Karn et al., 2005).

Winter swath grazing in the Canadian prairies usually involves late seeding of oat cultivars in late May or early June (Baron et al., 1994; Baron et al., 2012), but reports have shown that oat seeded after May could have greater susceptibility to crown rusts (*Puccinia coronata* Corda f. sp. *avenae* Eriks.; May et al., 2004). Chong et al. (2008) indicated that oat produced in

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Manitoba and eastern Saskatchewan is more vulnerable to crown rust, due to migrating urediospores from the southern United States (Fetch et al., 2011). Crown rust may also be introduced into the prairies through the alternate host, buckthorn (*Rhamnus cathartica* L.) found in the midwestern United States and Ontario, Canada (Chong et al., 2008); however, buckthorn in Manitoba and eastern Saskatchewan may introduce more inoculum than the *Puccinia* pathway (Chong et al., 2008; Fetch et al., 2011). Oat crown rust in these vulnerable regions causes yield losses of up to 40% because of reduced photosynthesis from the damaged leaves (Fetch et al., 2011).

Rust diseases may be controlled by selecting resistant cultivars such as HiFi (McMullen et al., 2005), which is resistant to crown rust and some stem rust races (*Puccinia graminis* Pers. f. sp. *avenae* Eriks. and E. Henn.). The cultivar CDC Baler (Rossnagel and Scoles, 1998) is susceptible to stem and crown rust (Fraser and McCartney, 2004), and foliar fungicide such as propiconazole (Tilt 250E, Syngenta Crop Protection Canada Inc., Guelph, ON, Canada) is commonly used for controlling the disease before swathing (McCallum et al., 2007). There is limited information on the forage yield, nutrient quality, and disease-resistance characteristics of these oat cultivars used for swath grazing. Such information will benefit livestock producers and stakeholders by improving management practices related to swath grazing.

The objectives of the current project were i) to compare the yields of 2 cultivars with different disease resistance abilities and ii) to determine the economic benefit (if any) from applying fungicides when susceptible cultivars are used. The approach taken to meet the objectives of the project was to grow 2 oat cultivars, HiFi and CDC Baler, with or without fungicide application and then determine their yield and nutritive value in a beef swath-grazing system and consequent economic relevance to producers.

MATERIALS AND METHODS

Location, Seeding, and Fungicide Application

The experiment was conducted in 2006 and 2007 at the Agriculture and Agri-Food Canada, Brandon Research Centre, Brandon, Manitoba. The location for the experiment was chosen based on availability of infrastructure and site history, which had supported the development of rust in the past. The 20-ha area used for the experiments was surrounded with a semi-permanent perimeter fence. It was divided into 2 equal paddocks, thus each half served as a block. Each block was further divided into four 2.5-ha plots. Each plot was sown with either HiFi or CDC Baler in longitudinal strips. Subsequently, foliar application of fungicide (Tilt) was assigned to one plot of each cultivar within each block, thereby giving 4 treatments: HiFi with fungicide (HiFi+), HiFi without fungicide (HiFi−), CDC Baler with fungicide (Baler+), and CDC Baler without fungicide (Baler−).

Seeding was carried out on June 16 in 2006 and on June 20 to 22 in 2007. Fertilizer (46-0-0) was applied (at 109 kg/ha of nitrogen) before seeding according to soil-test recommendations. The cultivar HiFi was sown at 77 kg/ha, whereas CDC Baler was sown at 87 kg/ha. The seeding rate was balanced according to germination percentage and thousand-kernel weight to achieve uniform plant densities across the treatments. Plant counts to assess stand establishment were carried out on June 27 in 2006 and on June 28 in 2007.

Foliar disease ratings for rust were determined with the McFadden scale (McFadden, 1991; Knox et al., 2008). The disease ratings under this scale range from 0 to 11 based on the percentage of leaf area with lesions in the upper, middle, and lower leaf canopies. Greater numbers on the scale indicate increased severity of the disease. The ratings were taken at flag leaf stage (Zadoks 37) before the application of fungicide and 3 wk after fungicide application, before swathing at Zadoks's scale 85 (Zadoks et al., 1974). The initial disease ratings were taken on August 2 and August 1 for 2006 and 2007, respectively. Propiconazole (Tilt 250E, Syngenta Crop Protection Canada Inc., Guelph, ON, Canada) was applied once on August 3 in both years to the appropriate plots at approximately 0.5 L/ha. Subsequent ratings in both years were taken on August 23 and August 30 for HiFi and CDC Baler, respectively.

Stocking and Sampling

The targeted time for swathing was when the grain was at the soft dough stage. There were incidences of barley yellow dwarf virus (**BYDV**) in both years (Mario Therrien, 2007, Brandon Research Center, Brandon, MB, Canada, personal communication). Because of significant disease pressure from BYDV, there was severe leaf damage and retardation of development on CDC Baler. Therefore, swathing of CDC Baler was delayed by a week after HiFi was swathed. Unfortunately, CDC Baler still did not reach soft-dough stage in either year because of leaf damage. In both years, HiFi was swathed on August 24 and CDC Baler on August 31. The swaths were left undisturbed in the plots until grazing was initiated in September.

Using a temporary electric fence, all 8 plots in the 2 replicates were strip grazed simultaneously by a single large group of animals for approximately 30 d each year. The care provided to all animals in this study was in accordance with the standards of the Canadian Council on Animal Care (1993), and the BRC Animal Care Committee approved usage. The animals were allocated to new sections of all plots daily using a temporary electric fence. In 2006, 151 dry cows with average BW of 600 kg (SD = 81) were used. In 2007, 58 cow-calf pairs [average BW of 640 kg (SD = 86) for cows and 160 kg (SD = 18) for calves], 2 dry cows (average BW of 600 kg), 90 bred yearling