Kentucky bluegrass (*Poa pratensis* L.) germplasm for non-burn seed production

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Abstract

This long-term study consists of 10 Kentucky bluegrass (*Poa pratensis* L.) entries; eight are USDA/ARS Plant Introduction (PI) accessions and two are commercial cultivars ('Kenblue' and 'Midnight'). The selected PI accessions had expressed high seed yield without burning of post-harvest residue and good turfgrass quality. Several agronomic yield parameters were then evaluated over a 2-yr period and individual plants were selected within each accession, or check, with the highest seed weight, highest seeds panicle^{-1}, highest panicles area^{-1}, and highest seed yield. Remnant seed of the original USDA/ARS population were also included. Turfgrass plots were established in 2006 and seed production plots (irrigated and non-irrigated) in 2007 at Pullman, WA. The turfgrass trial was evaluated monthly (2007 to 2009) according to NTEP (National Turfgrass Evaluation Program) protocol to determine turfgrass quality. In 2008 and 2009, seed production plots were harvested and seed yield was determined. Only 2009 results will be presented. The prior selection for seed yield components had a variable response and seed yield appeared to be dependent primarily on accession. Accession PI 368241 showed the best promise of being able to provide good turfgrass quality and good seed yield under non-burn management in both non-irrigated and irrigated production. Selection within Kenblue for seed head^{-1} had good turfgrass quality and seed yield under non-irrigated production. These studies will be followed for several additional harvests to determine if a non-burn Kentucky bluegrass can be developed for sustainable grass seed production in the Pacific Northwest, USA.

Introduction

Burning of Kentucky bluegrass seed production fields in the fall normally maximizes seed yield the following year. Open-field burning of post-harvest residue also allows seed fields to remain in production for many years (Canode, C.L. & Law, A.G., 1979). With the regulation of field burning in Washington, burning has become highly restricted (< 20 ha burned in 2009) and growers have been forced to utilize shorter rotations. Our work and others has shown that genetic variation in Kentucky bluegrass to improve grass seed production without burning (baling of post-harvest residue) does exist (Lamb, P.F. & Murray, G.A., 1999; Johnson *et al.*, 2003). To sustain grass seed production at economically viable levels, new bluegrass germplasm that maximizes yield potential for several years in non-burn management systems needs to be identified, selections made, germplasm enhancement carried out, and ultimately high seed yielding bluegrass cultivars capable of multiple harvests with good turfgrass quality be made available to growers.

Materials and Methods

The Kentucky bluegrass accessions used came from the previous work of Nelson (1996), Johnston *et al*. (1997), Johnston, W.J. & Johnson, R.C. (2000), and Johnson *et al*. (2003). Eight PI accessions possessing good turfgrass quality and seed yield under mechanical residue removal were further evaluated in a space-plant nursery at Pullman, WA for two years (Johnson *et al*., 2010) to identify, within each accession, the plant with the most panicles area^{-1}, the plant with the highest number of seeds panicle^{-1}, the plant with the highest seed weight, and the plant with the highest seed yield. A fifth category was seed from the original USDA/ARS population for each accession. This resulted in 50 entries (10 accessions x five selection criteria) used in this study. Turfgrass and seed production trials were established at the Washington State University (WSU) Turfgrass and Agronomy Research Center (TARC) at Pullman, WA. The soil was a Palouse silt loam (Pachic Ultic Haploxerolls, fine silty, mixed mesic).

The turfgrass evaluation trial was planted September 2006. Each experimental unit was 2.25 m^2 and was seeded at 11 g m^{-2}. The experiment was a randomized complete-block (RCB) design with three replications. Turfgrass quality ratings were based on National Turfgrass Evaluation Program (NTEP) protocol with a 1 to 9 scale, where 1 represented brown or dead turf and 9 represented ideal turfgrass quality. Two seed production plots were established in the summer of 2007 at the TARC. Whole-plot treatments consisted of two irrigation environments, irrigated and non-irrigated, and subplots consisted of the 50 entries with three replications. Each experimental unit was 2.1 x 1.8 m and consisted of seven rows spaced 30.5 cm apart (irrigated) and five rows planted on 35.5-cm-row spacing (non-irrigated). Seed production plots were harvested using a sickle-bar mower, residue put into cloth bags, and air dried. Panicles were threshed using a small-plot combine, hammermilled, and cleaned. Clean seed weight for each experimental unit was recorded. Analysis of variance was completed using SAS and means were separated with least significant differences (LSD) for all parameter with Fisher's Protected LSD ($P = 0.05$), or using LS Means comparisons ($P = 0.05$) (SAS Institute, 1990).

Results and Discussion

Since Kentucky bluegrass is a facultative apomictic species (Huff, D.R. & Bara, J.M., 1993), with the apomictic aspect dominating reproduction, uniformity is promoted from one generation to the next within a given genotype. However, the facultative component of Kentucky bluegrass reproduction allows for some genetic recombination (Huff, D.R. & Bara, J.M., 1993) and the introgression of new genes, albeit at a relatively low frequency. We have observed variation in plant type and seed yield within accessions (Johnson *et al*., 2003), suggesting there is a potential for seed yield improvement by selecting within accessions (Johnson *et al*., 2010).

From 2007 to 2009, the prior selection methodology (Johnson *et al*., 2010) was evaluated to determine how to improve seed yield and turfgrass quality in Kentucky bluegrass. In 2009, non-irrigated and irrigated seed production plots planted in 2007 were harvested for the second year (2009 data presented). Turfgrass trials were evaluated for the third year (2009 data presented). In 2009, as in 2008, the selection for yield components had a variable response and appeared to be dependent on accession. Overall, there was an increase in seed yield due to irrigation; however, regardless of non-irrigated or irrigated seed production, accession PI 368241 continued to show promise of being able to provide good turfgrass quality and good seed yield under non-burn residue management (Fig. 1 and 2). Under non-irrigated seed production, selection within Kenblue for seed head^{-1} had good seed yield and turfgrass quality (Fig. 1). It is critical to to follow these studies for several additional harvests to determine if a non-burn Kentucky bluegrass can be developed for sustainable grass seed production in the Pacific Northwest.

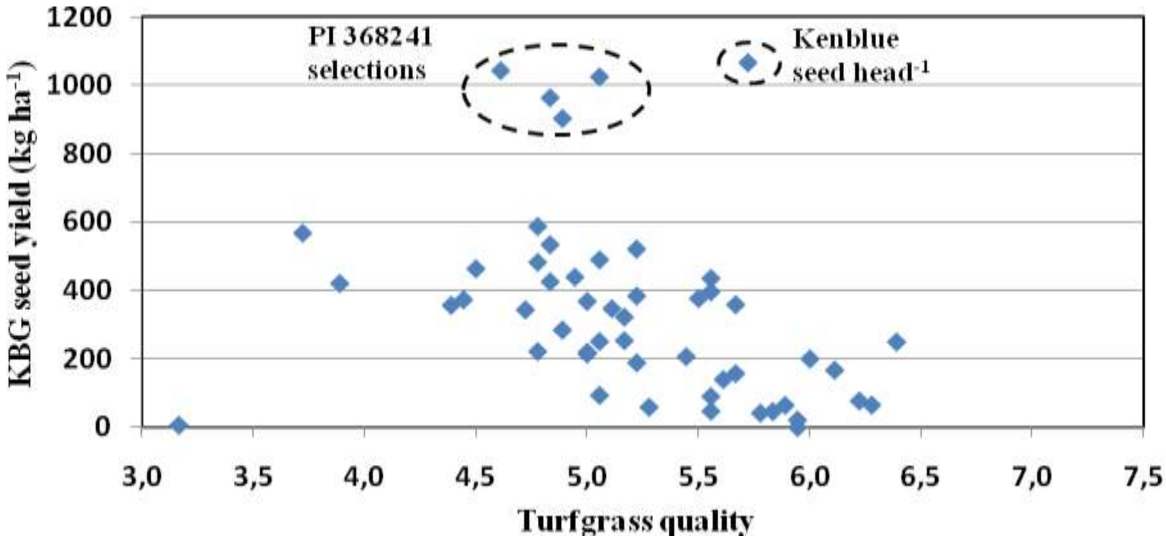

Figure 4. Kentucky bluegrass non-irrigated seed yield vs. turfgrass quality (rated 1-9; 9 = excellent quality) at Pullman, WA, 2009.

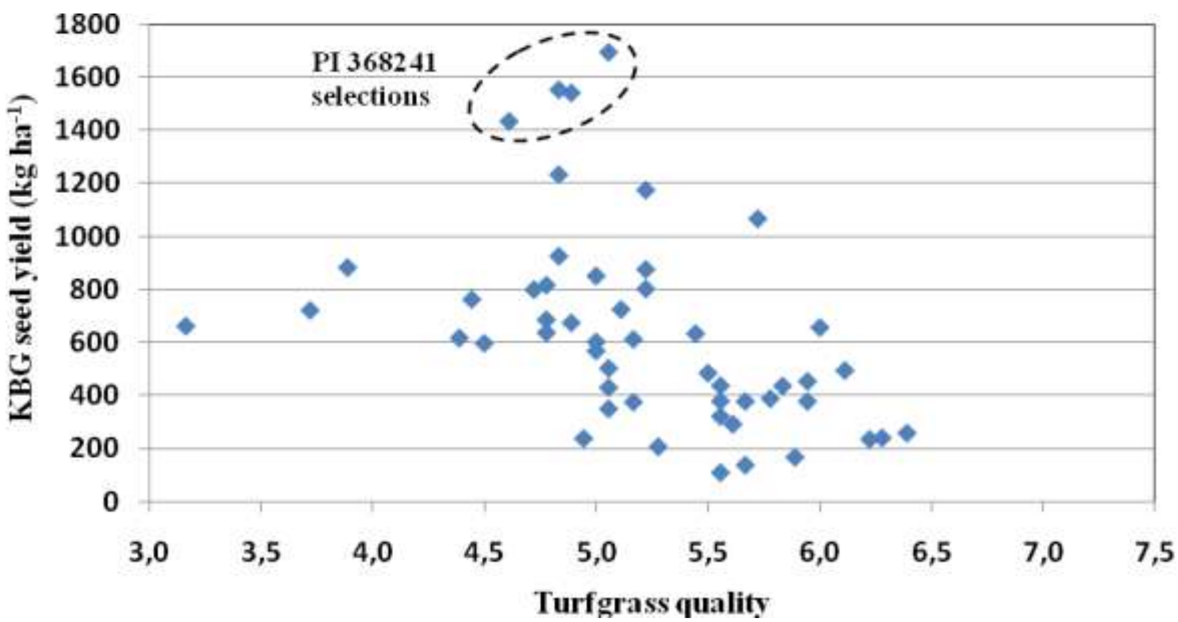

Figure 2. Kentucky bluegrass irrigated seed yield vs. turfgrass quality (rated 1-9; 9 = excellent quality) at Pullman, WA, 2009.

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