

IMPROVEMENT OF FORAGE AND SEED YIELDS IN ORCHARD GRASS IN WESTERN CANADA

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ABSTRACT

Trials on orchard grass (*Dactylis glomerata* L.) were conducted on spaced plants in 1992 and 1993 in Lethbridge, Alberta to identify components that could be used for improvement of winterhardiness and seed yields in this species. Results showed that seed yield/plant was significantly higher in Kay than Chinook orchard grass but only in 1992. Seed yields were significantly correlated in each year with visual scoring for forage yield potential, seed yield potential, vegetative height, panicle length and panicle number/plant. Higher yielding plants were taller and had larger numbers of panicles/plant and longer panicles than lower yielding plants. A large amount of variability was found among individual plants of each cultivar in seed yield, indicating possibilities for selection of superior lines.

KEYWORDS

Dactylis glomerata L., cocksfoot, seed yield components, breeding, Canada

INTRODUCTION

Orchard grass, *Dactylis glomerata* L. is a desirable pasture crop and performs well especially under irrigation in western Canada (Alberta Agriculture 1981). In addition, the crop is also a good seed producer; seed yields ranging from 271 to 432 kg/ha under irrigation (Hanna *et al.*, 1977). In southern Alberta, there are nine cultivars that are recommended for irrigation and three cultivars for rainfed conditions in northern Alberta (Alberta Agriculture, 1996). Included in these are cvs. Kay and Chinook which were developed at the Ottawa and Lethbridge Research Centres respectively (Anon., 1988; Hanna *et al.*, 1977). A limitation preventing wider use of orchard grass is the lack of winterhardiness in a climate where winter temperatures can drop to -45°C, and where westerly Chinook winds reduce the amount of snow cover for insulation.

The objective of these trials was to identify components that could be used for improvement of winterhardiness and seed yields while improving dry matter production in orchard grass.

MATERIALS AND METHODS

The plants used for the study in 1992 and 1993 were cvs. Kay and Chinook from breeders nurseries at two sites at the Lethbridge Research Centre (latitude 49°43'N, longitude 112°48'W, 900 m a.s.l.) in the second production year. Plants were fertilized in April and irrigated at regular intervals from May to July each year. Ten plants spaced 1 m apart from within each of 6 blocks (1992) and 4 blocks (1993) were randomly selected for each cultivar. Characters (Table 1) were visually scored for each plant by the same individual each year. At the first sign of seed shattering in each cultivar, a subsample of five seed-bearing panicles/plant were taken for determination of seed weight, seed number and panicle length. The remaining panicles were hand-harvested for seed yields and 1000-seed weight. Winter survival (1=poor to 5=excellent) scores were taken on individual plants harvested in 1993. All statistical analyses were carried out using the GLM procedures on SAS (SAS Institute 1989) with the independent variables being cultivars and plants (replicates) in the model.

RESULTS AND DISCUSSION

The two cultivars differed significantly in 1992 for all variables with the exception of 1000 seed weight (Table 1). In 1993, there were again differences in all variables except seed weight and seed number/5 panicles, seed yield/plant and panicle number/plant. Kay had 30% higher seed yields than Chinook in 1992, corresponding with a 38% increase in seed number and a 38% longer average panicle length. Seed yields in 1993 averaged 76.1 and 68.4 g/plant for Kay and Chinook respectively but the difference was not significant (Table 1). This was due to the absence of significant differences in yield components such as seed number/5 panicles and panicle number/plant (Table 1); the latter being highly correlated with seed yield/plant ($P=0.0001$) in each year (Table 2). A large amount of plant to plant variability was found within each cultivar in many characters. For example, seed yields in Chinook orchard grass ranged from 22 to 153 g/plant, indicating possibilities for selection of superior lines.

Correlations of yield variables across cultivars in 1992 and 1993 showed that seed yield/plant was significantly correlated with forage yield potential, seed yield potential, vegetative height, panicle length and panicle number/plant (Table 2). When correlations were done by cultivar, it was found that seed yields were significantly correlated with growth type in Kay in 1992 only ($r^2=0.52$) but not in Chinook. For both cultivars in each year, seed yields were positively and significantly correlated ($P=0.001$) with panicle number/plant and vegetative height. Higher yielding plants were taller and had larger numbers of panicles/plant and longer panicles than lower yielding genotypes. Visual scores of forage yield potential and seed yield potential were also significant indicators of seed yielding ability in these two cultivars in each year (data not shown). In 1993, there were significant correlations between seed yield and winter survival ratings; $r^2=0.47$ ($P=0.01$) and $r^2=0.48$ ($P=0.01$) for Chinook and Kay respectively.

In conclusion, these preliminary results suggest that simple visual ratings for forage and seed yield potential and winter survival can be useful as indicators for seed yield potential in orchard grass selections and are certainly less labour intensive than sampling panicles for yield and yield components. Improvements in seed yields in orchardgrass may also be done through selecting tall plants with long panicles and high numbers of panicles/plant.

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Table 1

Mean values of yield characters in Kay and Chinook orchard grass in spaced plants in the second production year

Character	Kay		Chinook	
	1992 ^w	1993 ^w	1992	1993
Growth type ^x (1=lax to 3=upright)	2.6***	2.3***	1.6	1.4
Leaf width ^x (1=narrow to 3=wide)	2.7***	2.2***	1.9	1.4
Forage yield potential ^x (1=poor to 3=excellent)	2.5***	2.3***	2.1	1.8
Seed yield potential ^x (1=poor to 3=excellent)	2.5***	2.5***	2.1	2.1
Vegetative height (cm) ^x	72**	75***	66	54
Panicle emergence (when first panicle 2/3 emerged)	May 22***	May 22***	May 9	May 13
Anthesis (when first anthers seen)	June 11***	June 16***	June 4	June 4
Panicle length (cm/panicle) ^{y,z}	15.9*	13.8***	11.5	10.5
Seed weight, g/5 panicles ^{y,z}	2.41***	1.38 ^{ns}	1.68	1.56
Seed number/5 panicles ^{y,z}	2671***	1658 ^{ns}	1932	1485
Seed yield, g/plant ^z	62.5*	76.1 ^{ns}	47.9	68.4
Panicle number/plant ^z	140*	189 ^{ns}	176	178
1000-seed weight (g) ^z	0.90 ^{ns}	0.84***	0.86	1.12

^w Differences between cultivars: *, **, ***, P-0.05, 0.01, 0.001 respectively; ns=not significant^x Scored on June 18 1992 and July 2 1993; ^y Subsample of 5 seed-bearing panicles/plant on harvest date; ^z Harvest dates: Kay, July 20 1992, July 16 1993; Chinook, July 9 1992, July 5-6 1993.**Table 2**

Correlation coefficients between seed yield and component characters in Kay and Chinook orchard grass in 1992 (n=120) and 1993 (n=80)

Character ^x	Year	Seed yield g/plant	Panicle number /plant	Seed number /5 panicles	Seed wt /5 panicles
Growth type	1992	0.40***	0.06 ^{ns}	0.32***	0.32***
	1993	-0.01 ^{ns}	-0.06 ^{ns}	0.02 ^{ns}	-0.20 ^{ns}
Leaf width	1992	-0.10 ^{ns}	-0.39***	0.38***	0.30***
	1993	0.25*	0.10 ^{ns}	0.27**	0.16
Forage yield potential	1992	0.44***	0.31***	0.31***	0.25**
	1993	0.65***	0.61***	0.26**	0.07 ^{ns}
Seed yield potential	1992	0.77***	0.56***	0.06 ^{ns}	0.24**
	1993	0.63***	0.69***	0.09 ^{ns}	-0.07 ^{ns}
Vegetative height	1992	0.68***	0.34***	0.19*	0.31***
	1993	0.49***	0.42**	0.20**	-0.02 ^{ns}
Panicle emergence date	1992	0.31***	-0.13 ^{ns}	0.52***	0.48***
	1993	0.15 ^{ns}	0.12 ^{ns}	0.12	-0.12 ^{ns}
Anthesis date	1992	0.25**	-0.18*	0.45***	0.39***
	1993	0.20 ^{ns}	0.05 ^{ns}	0.20 ^{ns}	-0.07 ^{ns}
Panicle length	1992	0.24**	-0.18*	0.48***	0.47***
	1993	0.35***	0.20	0.42***	0.22*
Seed weight /5 panicles	1992	0.22**	-0.18*	0.78***	1.00
	1993	0.19 ^{ns}	-0.10 ^{ns}	0.79***	1.00
Seed number /5 panicles	1992	0.07 ^{ns}	-0.30***	1.00	0.78***
	1993	0.23*	0.001 ^{ns}	1.00	0.79***
Seed yield g/plant	1992	1.00	0.68***	0.07 ^{ns}	0.22**
	1993	1.00	0.61***	0.23*	0.19 ^{ns}
Panicle number/ plant	1992	0.68***	1.00	-0.30***	-0.18*
	1993	0.61***	1.00	-0.001 ^{ns}	-0.10 ^{ns}
1000-seed weight	1992	0.24**	0.05 ^{ns}	0.09 ^{ns}	0.67***
	1993	-0.08 ^{ns}	-0.14 ^{ns}	-0.38***	0.19 ^{ns}

^x ns = not significant; *, **, *** = significant at P-0.05, P-0.01, P-0.001 respectively