

'Cimarron' Switchgrass: A New Cultivar for Bioenergy Feedstock Production



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Introduction



Switchgrass (*Panicum virgatum* L.) is a perennial, warm-season grass which has high biomass productivity potential on marginal land, and is native to and widely distributed in North America. It was selected in 1991 as a model herbaceous species for cellulosic feedstock production by the DOE Bioenergy Feedstock Development Program (McLaughlin and Kszos, 2005). To improve the economic value of switchgrass as a dedicated bioenergy crop, developing new switchgrass cultivars with significantly greater biomass yields is needed. Here we report the release of a new switchgrass cultivar by the Oklahoma Agricultural Experiment Station in 2008.

Origin and Breeding History

The new cultivar, 'Cimarron' was experimentally tested as 'SL 93 2001-1'. Cimarron is a synthetic cultivar produced by polycrossing seven elite clonal parents by Dr. Taliaferro in 2001. Six parent plants (5-16, 6-8, 10-13, 10-30, 12-19, 16-27, and 22-28) were from a C1 selection nursery established in 1997 on the Stillwater Agronomy Farm. The seventh parent plant, 'SU93 12-19', is one of many lowland plants found as contaminants in an upland population (SU93) formed in 1993. The parent plants were selected on the basis of biomass yields of their half-sib families tested for General Combining Ability during 1998 and 1999. Clonal plants of each of the seven parents were planted in an isolated replicated (7 replications) polycross nursery in spring 2001 at Lake Carl Blackwell (Fig. 1).



Fig. 1. Polycrossing selected parents



Fig. 2. Morphology of four switchgrass cultivars

Description

Cimarron has the general morphology and growth characteristics of Alamo switchgrass. Plants are polymorphic, but generally robust, tall-growing, and have leaves and culms distinctly larger than upland ecotype cultivars like Blackwell (Fig. 2). Like Alamo, plant color tends to be blue-green with some variation among plants. The flowering time of Cimarron plant is approximately 10 to 14 days later than Kanlow, four weeks later than Blackwell, and similar to Alamo. Cimarron plants produce in excess of 12% more tillers per plant than Alamo and Blackwell, and 25% more than Kanlow (Fig. 3). First-year plants of Cimarron are approximately 12 cm taller than Alamo and Kanlow, and much higher than Blackwell (Fig. 4). Seed are smooth and shiny, with about 426,000 per pound. Fall color retention and growth of Cimarron is similar to Alamo and longer than Kanlow and Blackwell (Fig. 2). Cimarron is a tetraploid with $2n=4x=36$ chromosomes.

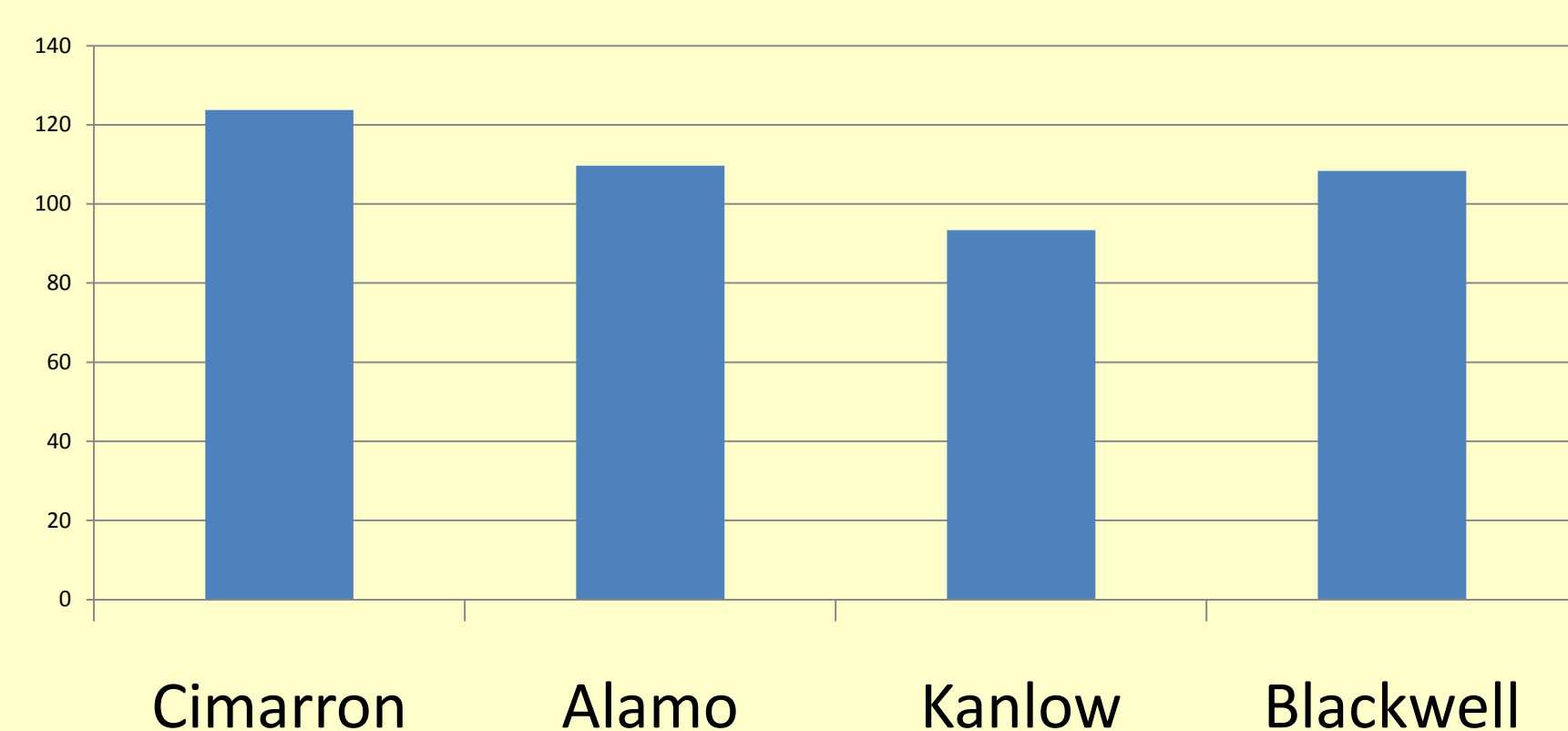


Fig.3. Tiller number of four switchgrass cultivars

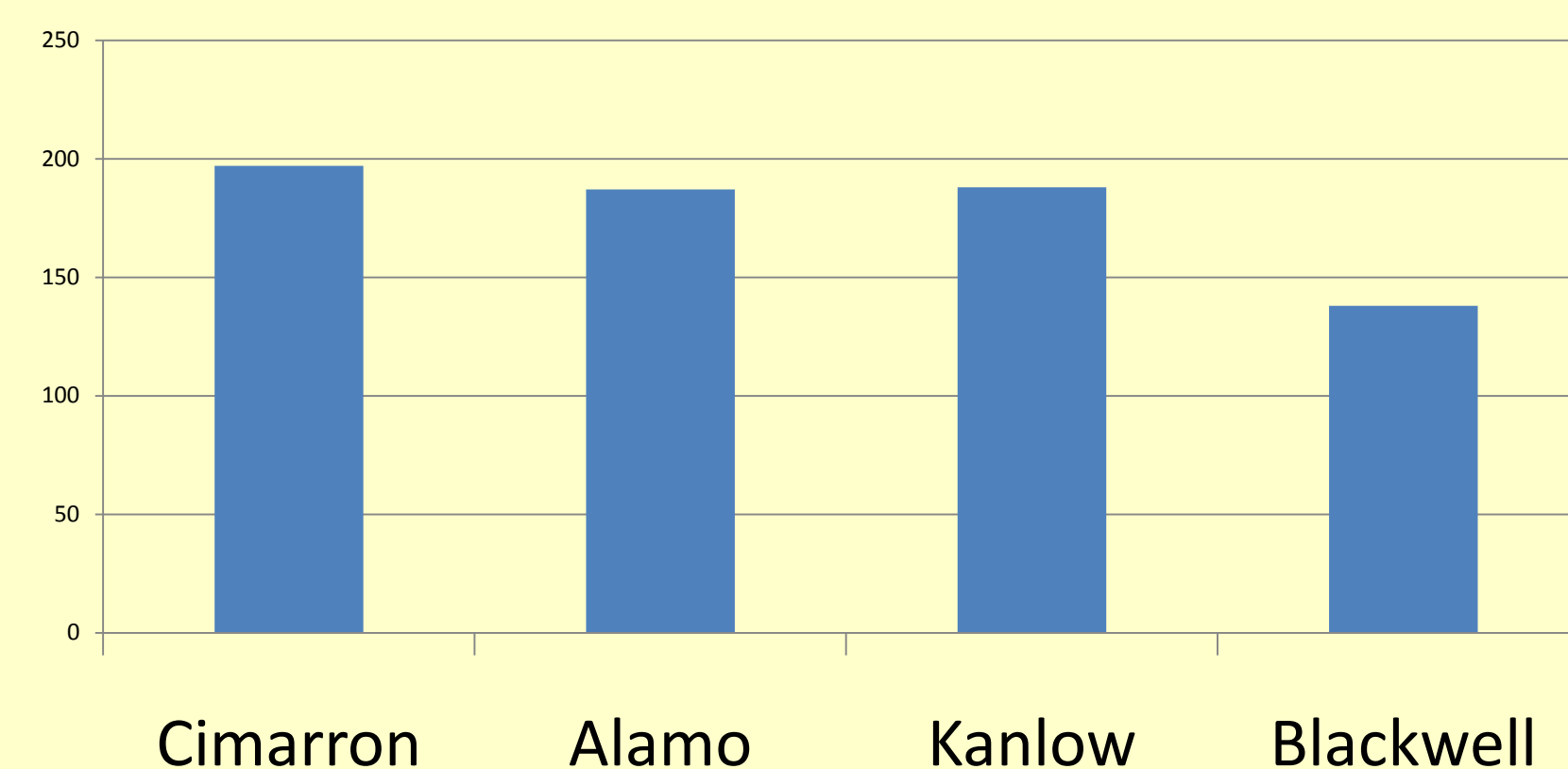


Fig. 4. Plant height (cm) for four switchgrass cultivars

Biomass Yield

Biomass yields of Cimarron and standard cultivars have been compared in one test at the Cimarron Valley Research Station (CVRS), Perkins, OK and three tests at the Agronomy Research Station (ARS), Stillwater, OK. Tests 2002-1 (CVRS) and 2002-2 (ARS), established in 2002, compared Cimarron, Kanlow, Alamo and other experimental strains from 2003 through 2005. Tests 2006-1 (ARS) and 2006-2 (ARS) established in 2006, compared Cimarron, Alamo, Kanlow, and other standard and experimental cultivars in 2007. Biomass yield data from all tests are from one harvest near the end of each growing season. Biomass yields of Cimarron were numerically and consistently higher than Alamo, the best check performer, by 4.2-12.1% in all trials and by 4.3-9.1% over all years. Yield of Cimarron was significantly greater than Alamo in Test 2002-2 (CVRS) for the 3-year mean ($P<0.05$). Cimarron also had significantly (<0.10) higher yield than Alamo in Test 2006-2 in 2007. When analyzed over all environments (locations and years), Cimarron had a mean annual biomass yield (16.06 tons/ha) 1.12 tons/ha (8%) greater than Alamo (14.94 tons/ha), which was significant ($P=0.0049$) (Table 1). Biomass yields of Cimarron were significantly greater than those of Kanlow in all environments (<0.05). Analyzed over environments, the mean biomass yield of Cimarron (16.06 tons/ha) exceeded that of Kanlow (12.89 tons/ha) by 3.17 tons/ha (25%) ($P=0.0001$) (Table 1). Biomass yields of Cimarron, Alamo, and usually Kanlow were substantially and significantly greater than those of upland cultivars.

Table 1. Biomass yields (tons dry matter/ha) of two experimental and two best commercial switchgrass cultivars and their comparisons across four field tests (Test 2002-1, Test 2002-2, NF-OSU Switchgrass 2006-1, and OSU Switchgrass 2006-2) over four years (2003, 2004, 2005, and 2007).

Cultivar	Biomass Yield (tons/ha)	Biomass Yield Advantage (tons/ha) (%) and Significance Level		
		NSL 2001-1	Alamo	Kanlow
Cimarron	16.06	0.80 (5%) $P=0.0870$	1.12 (8%) $P=0.0049$	3.17 (25%) $P<0.0001$
NSL 2001-1	15.26	-----	0.33 $P=0.3710$	2.38 $P<0.0001$
Alamo	14.94	-----	-----	2.05 $P<0.0001$
Kanlow	12.89	-----	-----	-----

Commercialization

The new cultivar has been exclusively licensed to Johnston Seed Company (<http://www.johnstonseed.com/seedhome.do>) for certified seed production and marketing. An application of a utility patent has been filed with the US Patent Office. A significant potential use of Cimarron switchgrass is as a bioenergy feedstock crop. Anticipated uses of Cimarron also include the traditional ones for soil conservation, wildlife, and livestock grazing and haying. Switchgrass is also frequently included as a component of native grass seed mixes for revegetation purposes.

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Cited Reference

McLaughlin, S.B., and L.A. Kszos. 2005. Development of switchgrass (*Panicum virgatum*) as a bioenergy feedstock in the United States. *Biomass & Bioenergy* 28: 515-535.