Recurrent Phenotypic Selection for Seed Size in Kura Clover

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Introduction

Kura clover (*Trifolium ambiguum* M. Bieb.) evolved in the cool, temperate environments in the Caucasian regions of Central Asia. This perennial legume is rhizomatous, drought tolerant, winterhardy and persistent—desirable attributes for a pasture and soil conservation legume in many of the temperate regions of the world. Established kura clover persists under frequent defoliation, has excellent forage quality and is extremely winterhardy. However, a major disadvantage of kura clover is poor or slow initial establishment. Increasing seed size in other forage legumes has been successful in enhancing initial establishment. This paper reports on the response in the diploid (2x), tetraploid (4x) and hexaploid (6x) forms of kura clover to two cycles of phenotypic selection for seed size and to the influence that increased seed size had on the initial establishment of the hexaploid form.

Materials and Methods

Selection procedures. The base populations (Cycle 0) used for the initial selection of large seed were plant introductions provided by the National Plant Germplasm System. Plant Introductions 225828 and 225827 represented the diploid (2x) form, 108699, 258787, 405119, 405120, and 405121 the tetraploid (4x) form and 258788, 405122, 405123, 405124, 440703 and 440714 the hexaploid (6x) form. Seed was saved that would not pass through 1.6, 1.7 and 1.8 mm diam. metal sieves for the 2x, 4x and 6x forms, respectively. Seventy plants from the large seed lots in each ploidy form were intercrossed to produce cycle 1 (C1) seed. This C1 seed was screened, and seed was saved that did not pass through 1.7, 1.8 and 1.9 mm diam. metal sieves for the 2x, 4x and 6x forms, respectively. Sixty-five large-seeded C1 plants were intercrossed to produce cycle 2 (C2) seed. Finally, to avoid the influence of environment on seed size, fifty representative plants in each cycle and each ploidy level (9 populations) were intercrossed in one environment, the Agric. Res. Sta., Arlington, WI. Honeybees (*Aphis* spp.) were used as the pollinator. Seed size is reported as seed weight in grams per 1000 seed.

Agronomic evaluations. To evaluate the influence of increased seed size on seedling establishment and vigor, the cycle 0 and cycle 2 populations of the hexaploid form were established in 0.9 x 7.5 m five row plots on the Agric. Res. Sta., Arlington, WI in May, 1994 and 1995. Seeding rate was approximately 500 plants m^{-2}. Seedling emergence (plants m^{-2}) was determined 8 wk after planting, forage yield (Mg dry matter ha^{-1}) was measured on 15 Aug. 1994 and 25 Aug. 1995, and visual estimates of the degree of ground cover (% stand) recorded 2 weeks after harvest. In 1995, two harvests were taken (20 Jun. and 8 Aug.) on the 1994 established study.

Results and Conclusions

Recurrent phenotypic selection for seed size in kura clover was effective in all three ploidy levels. Seed size increased from 1.23 g per 1000 seeds in the C0 to 1.84 g in the C2 for the diploids, from 1.81 g to 2.02 g in the tetraploids, and from 1.92 to 2.33 g in the hexaploids (Fig. 1). The largest increase per cycle was detected in the diploid population (0.36 g per 1000 seeds) in contrast to 0.11 g for the tetraploids and 0.22 g for the hexaploid.

Averaged over two seedling year tests, the larger seeded hexaploid population (C2) had improved seedling emergence (265 vs. 177 seedlings m^{-2}), higher forage yield (1.23 vs. 0.95 Mg ha^{-1}) and percent ground cover (83 vs. 52) in contrast to the original population (C0) (Table 1).

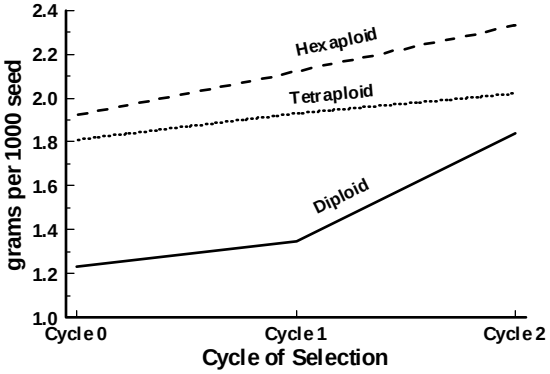

Figure 1. Response of diploid, tetraploid and hexaploid kura clover to recurrent selection for seed size.

The higher forage yield (6.0 Mg ha^{-1}) of the large seeded hexaploid population in the second year of the 1994 established test reflects the advantage this population had in the seedling year in contrast to the original population (Table 1).

Recurrent phenotypic selection was effective in increasing seed size in kura clover and appeared to have an influence on seedling establishment and subsequent forage production. Further selection appears to be possible and should further improve seedling establishment.

Table 1. Seedling emergence, forage yield and percent ground cover of hexaploid kura clover selected for seed size.

	Emergence			Yield			Percent stand		
	1994	1995	Avg.	1994	1995	Avg.	1994	1995	Avg.
Seedling year data									
	plts/ m sq			Mg/ha			%		
Cycle 0	144	210	177	0.33	1.57	0.95	36	68	52
Cycle 2	289*	240	265*	0.67*	1.79	1.23*	83*	84*	83*
Forage yield (Mg per ha) for 1994 seeded test									
	Cut I	Cut II	Total						
Cycle 0	3.85	1.10	4.95						
Cycle 2	4.74*	1.26*	6.00*						

*Differences between cycles significant at the 5% level of probability.