ID # 02-03

COMPATIBILITY OF KURA CLOVER AND COOL SEASON GRASS MIXTURES IN MICHIGAN

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Abstract

Kura clover (*Trifolium ambiguum* Bieb.) is an alternative forage legume for rotational grazing in cool-season grass mixtures. However, compatibility with cool-season grasses is unknown. Seven cool-season perennial grasses were seeded into Kura clover in a rotational grazing experiment. The objectives of this study were to evaluate botanical composition, forage yield and quality of binary mixtures of cool-season grass with Kura clover. Field studies were conducted on a Nester (fine sandy loam) soil at Lake City Experiment Station, Lake City, MI. Botanical compositions in the first year of the study heavily favored grasses (avg. 74%) and Kura clover accounted for less than 20%. Crude protein (CP) concentration was negatively related with grass composition (r = -0.69**), however, positively related with Kura clover composition (r = 0.60**). Perennial ryegrass (*Lolium perenne* L.) was superior in total forage yield and good forage quality, while reed canarygrass (*Phalaris arundinacea* L.) was the least desirable species.

Keywords: clover, botany, grazing, mixture, crude protein, forage intake

Introduction

Kura clover (*Trifolium ambiguum* Bieb.) is a long-lived rhizomatous perennial legume, also known as Caucasian clover. However, its compatibility with cool-season grasses in

rotational grazing is unknown. Kura clover is slow to establish and has poor seedling vigor (Hill and Luck, 1991) but, once established it has good persistence and forage quality under grazing (Sheaffer and Marten, 1991). It will survive under extreme harsh conditions compared with other legumes like alfalfa (*Medicago sativa* L.) and birdsfoot trefoil (*Lotus corniculatus* L.) (Woodman et al., 1992). This experiment was conducted to evaluate botanical composition, forage yield and quality of Kura clover-grass mixtures.

Material and Methods

Seven cool-season perennial grass species (Table 1) were seeded into Kura clover using a nursery seeder in plots of 1.5 x 5.5 m in an RCBD replicated four times at Lake City Experiment Station, Lake City, MI. Potassium and phosphorus were added according to soil test and no supplementary nitrogen was added throughout the experiment.

Botanical composition, dry matter yield and forage quality were evaluated in each plot at the end of summer. Forage yields were estimated by sampling from a 0.25 m^2 quadrat randomly placed in each plot and plants clipped to 5-cm stubble height. These samples were hand separated into grass, legume and weed components and each measured separately, but only planted grass and clover were measured for total forage yield.

Plant samples by components were dried at 60^{o}C for 72 hr to determine dry matter yields. Dried composite samples were ground to pass a 1-mm screen in a cyclone mill for forage quality analyses. These samples were analyzed for total N by micro-Kjeldahl digestion of 0.100 g plant material in 12 M H_2SO_4 with 1.5 g K_2SO_4 and 0.075 g Se catalyst. Following digestion, total $NH4^+$ in samples was determined by Lachat QuickChem method #10-1-07-06-2-E (Lachat Chemicals, Mequon, WI). Total N was calculated as a product of dry matter content and N. Crude protein (CP) concentration was estimated by multiplying total N by 6.25. The acid- and neutral-detergent fiber (ADF and NDF) concentrations in the samples were determined by the procedures of Goering and Van Soest (1970). One millimeter of ✂-amylase was added to each

sample to digest starch before extracting NDF. Apparent *in vitro* dry matter digestibility (IVDMD) were estimated by cellulase solution according to a modified Bughrara and Sleper (1986) method and expressed as percentage of original dry weight after correcting for ash in the indigestible residue.

Results and Discussion

Botanical Compositions. Grasses comprised at least 70% of the sward except for Kentucky bluegrass and Timothy which were less than 50% of the sward (Table 1). Kura clover composition in mixtures ranged from 10 to 37% (Table 1) with Kentucky bluegrass (*Poa pratensis* L.) and Timothy (*Phleum pratense* L.) associated with the highest clover compositions. Weeds averaged 12% of the sward and the highest weed infestation was in Kentucky bluegrass mixture. Reed canarygrass (*Phalaris arundinacea* L.) suppressed the growth of Kura clover the most, presumably due to shading by the broader leaf base on this grass species.

Forage Yield. Total forage yield ranged from 0.79 Mg ha^{-1} to 2.67 Mg ha^{-1}, with mixtures with Reed canarygrass, and with Perennial ryegrass (*Lolium perenne* L.) associated with the lowest and highest dry matter yields, respectively. Total forages were as follows, starting with the highest to the least: Perennial ryegrass > orchardgrass (*Dactylis glomerata* L.) > tall fescue (*Festuca arundinacea* Schreb.) > timothy > Kentucky bluegrass > smooth bromegrass (*Bromus inermis* Leyss.) > reed canarygrass.

Forage Nutritive Value. Crude protein concentrations of the grass-clover mixtures ranged from 103 to 148 g kg^{-1} (Table 2). This range compares well with alternative forages in the north central region such as annual medics (Shrestha et al., 1998), but are lower than alfalfa or berseem clover (Zhu et al., 1996) and cool-season grass mixtures with birdsfoot trefoil (Beuselinck et al., 1992).

Perennial ryegrass, reed canarygrass and tall fescue were associated with the lowest CP concentrations (Table 2). This can be explained by the botanical composition that favored grass

in these mixtures. Crude protein concentrations were negatively correlated with grass composition (r = -0.69**). As the grass compositions increased the CP concentrations were reduced and this relationship explained 68% of the variations in CP concentrations. Timothy and Kentucky bluegrass produced the highest CP concentrations because of the high clover compositions in those mixtures since clover composition was positively correlated with CP concentrations (r = 0.60**).

Acid-detergent fiber (ADF) and neutral-detergent fiber (NDF) concentrations were highest for bromegrass (*Bromus inermis* Leyss.) and reed canarygrass, while lowest with Timothy and perennial ryegrass mixtures (Table 2). At the time of sampling, grasses were at different growth stages due to the different competition levels with Kura clover. Timothy and perennial ryegrass were less mature than other grasses at sampling, hence the low ADF and NDF. The ADF and NDF concentrations obtained in this study are comparable with alfalfa (Shrestha et al., 1998). Neutral detergent fiber was positively correlated with grass composition (r = 0.41**) and negatively related with Kura clover composition (r = -0.40**). Thus higher NDF concentrations were obtained as the grass composition increased and the reverse was true with Kura clover.

Apparent *in vitro* dry matter digestibility (IVDMD) was highest with Kentucky bluegrass, perennial ryegrass and Timothy, in that order, and lowest with bromegrass and reed canarygrass (Table 2). However, IVDMD was not correlated to neither grass nor Kura clover composition. The highest IVDMD were obtained with Kentucky bluegrass, perennial ryegrass and timothy (60-64%) because these mixtures contained a greater proportion of leaves. Perennial ryegrass was superior in total forage yield and good forage quality, while reed canarygrass was the least desirable species in mixture with Kura clover.

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Table 1 - Percent botanical species composition and total forage yield in Kura clover and cool season grass mixtures in November, 1999 at Lake City Experiment Station, Lake City, MI.

Mixture	Grass	Clover	Weed	Forage yield
	----------% ----------			Mg ha^{-1}
Bromegrass	70	19	11	1.10
Kentucky bluegrass	34	37	29	1.14
Orchardgrass	73	17	10	1.81
Perennial ryegrass	86	10	4	2.67
Reed canarygrass	79	18	3	0.79
Tall fescue	72	19	9	1.76
Timothy	49	36	15	1.23
LSD (0.05)	15	12	8	0.64

Table 2 - Average crude protein (CP), acid-detergent fiber (ADF), neutral-detergent fiber (NDF), and *in vitro* dry matter digestibility (IVDMD) of Kura clover-grass mixtures in 1999 at Lake City Experiment Station, Lake City, MI.

Mixture	CP	ADF	NDF	IVDMD
	----------	----------	g kg^{-1} ----------	----------
Bromegrass	145	267	490	528
Kentucky bluegrass	147	239	410	644
Orchardgrass	125	248	463	576
Perennial ryegrass	103	224	425	605
Reed canarygrass	110	261	507	528
Tall fescue	115	245	459	559
Timothy	148	225	411	604
LSD (0.05)	21	27	45	50