Chemical Composition of Leafy Spurge and Alfalfa

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Attempts to control leafy spurge (*Euphorbia esula* L.) have met with varying degrees of success. Control efforts range from cultural and herbicidal to biological methods. Tillage effectively controls leafy spurge on cropland but is not feasible on rangeland where leafy spurge is best adapted (Evans and Torrell, 1986). Herbicides have comprised the backbone of range and pasture control efforts to date. Herbicides have been only partially effective, however, and are too expensive to treat widespread infestations. Present and future concerns over groundwater quality may eliminate many herbicides presently used to control leafy spurge.

Cattle do not utilize leafy spurge and totally or partially avoid leafy spurge infested sites (Lym and Kirby, 1987). Infestations can reduce livestock carrying capacity of pasture 50 to 75 percent (Lym and Messersmith, 1987). Such reductions generally are associated with lost forage production from leafy spurge competition and avoidance of infested sites by cattle.

Sheep or goats have long been used to control noxious broadleaf weeds. Grazing trials using sheep on leafy spurge infested lands were started as early as 1937 (Helgeson and Longwell, 1942; Helgeson and Thompson, 1939). Ranchers in Montana have used sheep to control leafy spurge for the last 40 years (Lacey et al., 1984). Sheep gained popularity in Montana after efforts to control leafy spurge with 2,4-D were not satisfactory. Many ranchers felt that herbicide application was difficult in rough terrain, resulting in missed patches of leafy spurge in rocky areas and along stream banks. Sheep did a better job of controlling leafy spurge in these areas.

After a three-year grazing study in Montana, Bartz et al. (1985) reported that leafy spurge was a good range forage for lambs and lactating ewes. Following a brief adjustment period, ewes selected diets consisting of as much as 50 percent leafy spurge. Lacey et al. (1984), also in Montana, observed that grazing sheep selected all growth stages of leafy spurge and consumed a significant amount of leafy spurge without harmful physiological effects.

The purpose of this study was to compare the seasonal chemical composition of leafy spurge to alfalfa (*Medicago sativa* L.). This information should enable ranchers and land managers to better predict the production potential of sheep or goats when grazing rangeland or pastures infested with leafy spurge.

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METHODS

Leafy spurge and alfalfa were collected at four growth stages in 1990 from four North Dakota sites, Dickinson, Minot, Valley City, and Fargo. Soil texture classes from the collection sites were loam, loamy sand, silty loam and silty clay for Dickinson, Minot, Valley City and Fargo, respectively.

Two randomly selected samples of each species were harvested and composited from each site. Harvests were taken to represent four plant growth stages: vegetative (May 15), flowering (June 15), mature (July 15), and regrowth (September 1). Harvested plant material was 4 inches or greater in height. Samples were oven dried at 150 degrees and ground in a Wiley mill prior to chemical analyses.

Chemical analyses were conducted in the Animal and Range Sciences Forage Nutrition Laboratory at NDSU. Analyses included crude protein (nitrogen x 6.25), estimated available crude protein (crude protein - acid detergent insoluble crude protein), phosphorus, acid detergent fiber, and *in vitro* dry matter digestibility.

Chemical composition changes for each species across season were analyzed using the general linear models procedure of the Statistical Analysis System (SAS 1985) with sites representing replications. Variation across season by species was tested and found linear for each chemical component. Means are reported as least square means and separated at the 0.10 level of probability using a pairwise comparison test (SAS 1985).

RESULTS

In both leafy spurge and alfalfa, crude protein, available crude protein, phosphorus, and *in vitro* dry matter digestibility declined linearly as the season progressed (Table 1). Acid detergent fiber increased linearly with season for both species.

Percentage crude protein and available crude protein in alfalfa were higher than in leafy spurge throughout the growing season (Table 1). However, seasonal declines in crude protein and available crude protein levels in alfalfa exceeded 30 percent and declined to near 20 percent after maturity.

Phosphorus concentration was higher in leafy spurge than in alfalfa at all sampling times (Table 1). Seasonal declines in phosphorus were similar for the two species. Initial phosphorus levels exceeded 0.5 percent in leafy spurge and decreased to near 0.3 percent during the latter part of the growing season.

Table 1. Chemical composition of leafy spurge and alfalfa at four stages of growth.

Species		Growth Stages: Vegetative	Flower	Mature	Regrowth
		Crude Protein (%)[1]			
Leafy spurge	Mean	27.3	23.4	19.5	15.6
	Range	23.2-34.8	14.8-24.7	10.1-26.0	10.5-29.0
Alfalfa	Mean	32.8	29.2	25.6	22.0
	Range	32.2-35.1	22.3-35.5	17.7-31.8	13.1-33.4
		Available Crude Protein (%)[1]			
Leafy spurge	Mean	26.4	22.4	18.4	14.4
	Range	22.3-34.1	13.9-23.4	5.6-24.7	9.4-27.9
Alfalfa	Mean	31.8	28.0	24.2	20.2
	Range	31.4-34.2	21.3-34.9	16.6-30.8	11.2-32.7
		Phosphorus (%)[1]			
Leafy spurge	Mean	0.53	0.46	0.39	0.32
	Range	0.41-0.47	0.40-0.80	0.37-0.59	0.23-0.46
Alfalfa	Mean	0.44	0.38	0.32	0.26
	Range	0.45-0.50	0.38-0.63	0.35-0.44	0.23-0.48
		In Vitro Dry Matter Digestibility (%)[1]			
Leafy spurge	Mean	80	73	66	60
	Range	79-84	65-78	53-76	54-71
Alfalfa	Mean	84	79	74	69
	Range	82-85	73-85	64-78	49-83
		Acid Detergent Fiber (%)[2]			
Leafy spurge	Mean	17.9	23.2a	28.5a	33.8a
	Range	11.3-18.8	23.7-30.2	19.5-40.9	21.0-34.9
Alfalfa	Mean	18.1	21.7b	25.3b	28.9b
	Range	17.1-18.2	14.5-27.3	21.0-34.3	15.2-40.7

[1]Means of species differ ($P > 0.10$) within a growth stage.

[2]Means of species within a growth stage followed by a different letter differ ($P > 0.10$).

In vitro dry matter digestibility of alfalfa was greater than in leafy spurge throughout the growing season (Table 1). The *in vitro* dry matter digestibility of each species decreased similarily with maturity. *In vitro* dry matter digestibility values indicated that both species were highly digestible and still exceeded 60 percent at the fall regrowth stage.

Acid detergent fiber was the only chemical constituent that increased in both species as the season progressed (Table 1). This chemical constituent generally is negatively correlated with digestibility of forages. Leafy spurge had a higher acid detergent fiber content compared to alfalfa in the latter three growth stages. Both species had early season acid detergent fiber levels of approximately 18 percent increasing to near 30 percent following maturity.

DISCUSSION

Opinions expressed regarding the "feed value" of leafy spurge are numerous. Overall, we found leafy spurge to have less crude protein and available crude protein, lower *in vitro* dry matter digestibility, and a higher prosphorus content throughout the growing season when compared to alfalfa. The chemical composition values for alfalfa agree with previously published data for the Northern Great Plains (Ferebee, et al., 1972; Meyer and Erickson, 1985). Chemical composition data for leafy spurge are limited and collection conditions in previous studies were not well documented. Despite these limitations, crude protein and *in vitro* dry matter digestibility (roughly equivalent to total digestible nutrients) of leafy spurge were generally higher in our study when compared to Christensen et al. (1938) (crude protein = 15.3 percent; total digestible nutrients = 45 percent) and Bartz et al. (1985) (crude protein = 8.4 - 20.6 percent). However, if mature leafy spurge had been collected in the previous studies, then our results would compare favorably.

Maintenance and lactating requirements of 150-pound ewes are, respectively, 9.4 and 10.7 percent crude protein, 55 and 59 percent total digestible nutrients and 0.20 and 0.23 percent phosphorus (NRC 1985). Similar requirements for 100-pound angora goats are 11.1 and 12.4 percent crude protein, 61 and 66 percent total digestible nutrients and 0.18 and 0.22 percent phosphorus (Enzminger and Olentine, 1978). Leafy spurge exceeds the maintenance requirements of both livestock species for crude protein, phosphorus, and *in vitro* dry matter digestibility (roughly equivalent to total digestible nutrients) throughout the growing season. Lactating requirements for crude protein, phosphorus, and *in vitro* dry matter digestibility for ewes and crude protein and phosphorus for goats also are met by leafy spurge throughout the growing season. Lactating requirements for *in vitro* dry matter digestibility in goats were not met by leafy spurge late in the season. However, kids normally would be weaned before this time and *in vitro* dry matter digestibility requirements for goats would then be much lower and met by leafy spurge.

CONCLUSION

The forage value of leafy spurge, based on its chemical composition, compares favorably with widely used regional forages such as alfalfa, smooth brome (*Bromus inermis* Leyss.) (Ferebee et al., 1972) and crested wheatgrass (*Agropyron desertorum* Fischer ex Link) Shulters) (NRC, 1985). The high crude protein, phosphorus, and *in vitro* dry matter digestibility values can be attributed to the extensive leaf production of this species and the characteristic high quality of forbs. Palatability aside, leafy spurge should provide adequate nutrients for optimum growth and lactation in young or mature sheep or goats throughout the growing season.

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