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Beef Research Report

Forage Value of Pasture Weeds in Southwestern Oregon [1]

Amy Peters [2], Shelby Filley [3], and Andrew Hulting [4]

Synopsis

Forage quality of common pasture weeds was determined through laboratory testing to compare feed value of weeds to desirable forage species and nutrient requirements for grazing livestock.

Summary

This study quantified forage quality of fourteen pasture weed species common to southwestern Oregon. Over three consecutive years, weed species were collected from varying sites in southwestern Oregon during the spring, summer, and fall. Collection sites were randomly sampled. The following weed species were analyzed: bog rush, bull thistle, Canada thistle, diffuse knapweed, French broom, gorse, Italian thistle, Scotch broom, spotted knapweed, yellow starthistle, Himalaya blackberry, sedge, Portuguese broom, and meadow knapweed. Collections were made at different times of the year to quantify forage quality for the following plant developmental stages: rosette/vegetative, bolt, and early bloom/boot. Each species was analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), net energy, and mineral content at each developmental stage. Results indicate that some weed species have nutrient profiles similar to more desirable forage species such as orchardgrass and ryegrass. Weed species forage values are low at some plant developmental stages, however, suggesting supplemental feeding would be required by livestock producers. Mineral profiles varied for each species, indicating possible livestock health problems might occur, such as nutrient imbalances, if certain weeds were the only available feed. Several weed species, including the thistles and knapweeds, had very high levels of potassium, calcium, and magnesium at all stages of plant development. We compared nutritional values of weeds to the nutritional requirements throughout the production cycle of beef cattle, sheep, and goats. Livestock producers can use this information to more accurately meet livestock nutritional needs while livestock are grazing weed species or when livestock grazing is utilized for weed suppression as part of an integrated weed management system. Further research of weed species used as forage will quantify anti-quality factors and palatability.

Introduction

Weeds continuously invade pastures and annual or perennial crops grown for livestock feed. Weeds in forages may reduce the quantity and quality of harvested hay or grazed forage, be toxic or poisonous to livestock (Cash et al., 2010; Hulting and Neff, 2010), or cause injury to the mouths of grazing animals (Colquhoun, 2003). Some weed species, including the thistles with their spiny leaves,

1. This document is part of the Oregon State University – 2010 Beef Research Report. Please visit the Beef Cattle Sciences website at http://beefcattle.ans.oregonstate.edu.
2. Professor, Oregon State University Extension Service, Myrtle Point 97458. Email: amy.peters@oregonstate.edu.
3. Associate Professor, Oregon State University Extension Service, Roseburg, 97470. Email: shelby.filley@oregonstate.edu.
4. Assistant Professor, Oregon State University, Corvallis, 97331. Email: andrew.hulting@oregonstate.edu.

may not be eaten by livestock, whether in pasture or hay. Many grass weed species are readily eaten and provide quality nutrition to grazing livestock. Intensive grazing of weed species can be an important biological control strategy as part of an integrated weed management plan for some invasive plants. When livestock producers consider using livestock grazing for weed management, the perception of weeds must be converted from one of pests to that of a feed source (Jones, et al, 2001). Quantifying the forage quality of individual weed species is essential for making weed management decisions that include planned livestock grazing. A more targeted grazing approach to control these weeds can provide feed for livestock, reduce weed infestations, and provide more light, water, and space for desirable forage species.

Forage testing laboratories often report that many weeds they have analyzed have adequate nutritional profiles but are usually coupled with bizarre mineral profiles, or high nitrate levels and other anti-quality components, which make these species undesirable as livestock feeds (Sirous, 2004). In some cases, nutrient analysis of a weed may be similar to forage but chemicals in the weed may cause livestock to avoid the plant. Marten et al. (1975) reported that ratios of minerals may be a factor in desirability of weeds as feed. Ratios of K/(Ca + Mg) (on a meq basis) of 2.2 or greater may indicate that a forage will predispose ruminants to grass tetany or hypomagnesemia (Grunes, 1973 in Marten, et. al. 1975), a serious, often fatal metabolic disease involving low Mg levels in the blood. Bosworth et al. (1986) found that high magnesium levels can also indicate problems in grazing livestock.

In order for grazing to be effectively used for weed control, the weeds need to be acceptable, i.e. palatable, to the livestock (Targeted Grazing, 2009). Some weeds, either part of the time or continuously, are unpalatable to the grazer for a variety of reasons (e.g. foul tasting, sharp points, or cause digestive upset). Previous experience may also influence whether not an animal chooses to eat a particular weed species. Choice of grazing animal type (browsers versus grazers) and timing of grazing to a period when plants are acceptable is important to successful use of grazing to control weeds.

In this paper we present results of a study which determined the approximate nutrient value of selected weeds found in southwestern Oregon sampled at various growth stages. Weed forage values were compared to nutrient requirements of livestock throughout the production cycle of the animal. Our objective was to provide information to be used by livestock producers, including those selling product on the "organic" market and those interested in pay-to-graze operations, to enable them to make informed livestock management and weed management decisions.

Materials and Methods

Over three consecutive years from 2004-2007, 14 weed species in southwestern Oregon were analyzed including bog rush (*Juncus effuses),* sedge *(Juncus spp),* spotted kanpweed (*Centaurea maculosa Lam.*), diffuse knapweed (*Centaurea diffusa),* Scotch broom (*Cytisus scoparius L.),* French broom (*Cytisus monspessulanus),* bull thistle (*Cirsium vulgare),* Canada thistle (*Cirsium arvense),* yellow starthistle (*Centaurea solstitialis L.),* meadow knapweed *(Centaurea pratensis),* gorse *(Ulex europaeus L.),* Himalaya blackberry (*Rubus armeniacus*), Portuguese broom (*Cytisus striatus*), and Italian thistle (*Carduus pycnocephalus L.*). Weed samples were collected in spring, summer, and fall, corresponding to physiological stages of plant development including the rosette/vegetative, bolt, and early bloom/boot. Plant parts most likely to be eaten by livestock, including new shoots and leaves, were sampled by clipping. Lower stems and leaves were excluded from the sample because we speculated that there would be little or no consumption of these plant parts by grazing livestock. Samples were randomly collected from five or more plants and a composite sample from various sites at each sample date was made. These samples were immediately placed in a cooler with ice, later frozen, and then shipped to a laboratory for analysis (Dairy One Forage Lab, Ithaca, NY).

Laboratory tests for nutritive value during each of 3 years included dry matter (DM), crude protein (CP: Kjeldahl N x 6.25), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients (TDN), net energy, and mineral content including the macrominerals Ca, P, K, Na, and Mg and the microminerals Fe, Zn, Cu, Mn, and Mo.

Results

Nutrient content of weed species fluctuated over the sampling period. Quality was generally high, often meeting livestock nutritional needs (Table 1). For many of the weed species analyzed, CP content was highest in the spring, decreased in summer, and increased in fall. This pattern of

nutrient content fluctuation is similar to that of improved grass and legume forages. The TDN content appeared to fluctuate less than that of CP, however, it decreased in some weed species for the summer sampling. Macro- and micro-mineral content of the various weeds are listed in Tables 2 and 3, respectively. In general, the mineral content of weeds analyzed would meet the nutrient requirements of grazing livestock during part of the reproductive cycle. However, there are some instances with either deficient or toxic levels of minerals present compared to minimum requirements or maximum tolerable amounts for the animals.

Table 1. Average crude protein (CP) and total digestible nutrients (TDN) for common pasture weeds sampled for 3 years and compared to standard values for common forages and livestock nutrient requirements.

	%CP			%TDN		
Forage						
Alfalfa hay	22			51		
SW OR grass hay	8			57		
Orchardgrass pasture, veg.	18			65		
Weed	*Spring*	*Summer*	*Fall*	*Spring*	*Summer*	*Fall*
Bog rush	10	11	6	54	54	54
Sedge	11	13	10	55	57	56
Spotted knapweed	20	13	8	63	61	59
Diffuse knapweed	18	12	7	62	62	59
Scotch broom	21	20	17	61	58	57
French broom	20	15	14	62	60	59
Bull thistle	18	19	9	60	59	60
Canada thistle	21	18	12	58	58	61
Yellow starthistle	13	10	10	60	61	59
Meadow knapweed	21	17	8	63	63	58
Gorse	18	17	11	60	58	56
Himalaya blackberry	15	15	16	64	64	62
Portuguese broom	19	20	7	58	58	53
Italian thistle	15	14	7	61	59	58
Cow[1]	12.3	7.4	7	67	54	48.8
Ewe[2]	15	13.4	9.2	65	55	59
Doe[3]	8.6	8	-	58.2	54.9	-

[1] Nutrient requirements based on a 1,000 lb, spring calving cow. Spring represents early lactation, superior milking ability (20 lb/day); summer late lactation, early gestation; and fall mid gestation. Winter CP and TDN for late gestation would be 7.9 and 53.6%, respectively (NRC 1984).

[2] Nutrient requirements based on a 154 lb, spring lambing ewe. Spring represents last 4 to 6 weeks lactation, suckling twins; summer maintenance, dry ewe; and fall flushing and early gestation. Winter CP and TDN for last 4 weeks of gestation would be 11.3 and 65.0%, respectively (NRC 1985).

[3] Nutrient requirements based on a 110 lb, spring kidding meat goat doe. Spring represents early lactation; summer dry doe at maintenance and medium activity; and fall breeding. Winter CP and TDN for late gestation would be 9.1 and 55.0, respectively (NRC 1981).

Table 2. Average macromineral content in percentages for common pasture weeds sampled for 3 years in spring (Sp), summer (Su), and fall (F).

	% Ca			% P			% K			% Na			% Mg		
Item	Sp	Su	F	Sp	Su	F	Sp	Su	F	Sp	Su	F	Sp	Su	F
Bog rush	0.21	0.2	0.26	0.13	0.19	0.09	1.52	2.08	1.82	0.1	0.05	0.5	0.13	0.15	0.1
Sedge	0.22	0.41	0.5	0.15	0.17	0.15	1.2	22.6	2.17	0.05	0.03	0.04	0.09	-	0.13
Spotted knapweed	1	0.87	1.1	0.32	0.25	0.21	2.85	2.14	1.84	0.03	0.01	0.02	0.28	0.3	0.21
Diffuse knapweed	1.06	1.02	1.05	0.28	0.26	0.22	3.13	2.69	1.81	0.013	0.06	0.01	0.26	0.26	0.22
Scotch broom	0.51	0.42	0.3	0.2	0.16	0.13	1.05	1.2	0.94	0.031	0.02	0.08	0.15	0.16	0.18
French broom	0.6	0.57	0.57	0.22	0.12	0.12	1.45	1.08	0.92	0.03	0.01	0.01	0.18	0.16	0.2
Bull thistle	2.06	1.42	1.52	0.23	0.4	0.2	3.97	4.38	2.38	0.03	0.02	0.01	0.3	0.31	0.25
Canada thistle	1.22	1.27	1.53	0.26	0.29	0.16	2.82	3.29	3.44	0.02	0.01	0.02	0.48	0.2	0.23
Yellow starthistle	0.95	0.54	0.98	0.28	0.26	0.29	2.47	2.02	1.57	0.032	0.01	0.05	0.53	0.43	0.5
Meadow knapweed	0.7	0.6	1.4	0.35	0.31	0.24	4.6	3.5	2.1	0.08	0.03	0.08	0.35	0.43	0.33
Gorse	0.45	0.36	0.3	0.2	0.17	0.1	1.18	1.21	0.71	0.36	0.37	0.39	0.27	0.29	0.21
Himalaya blackberry	0.5	0.54	0.67	0.26	0.29	0.18	1.53	1.7	1.39	0.02	3	0.009	0.14	0.36	0.36
Portuguese broom	0.45	0.33	0.27	0.21	0.21	0.13	1.34	1.28	0.99	0.171	0.02	0.02	0.14	0.13	0.09
Italian thistle	1.92	1.11	0.78	0.31	0.24	0.12	4.69	1.83	2.12	0.17	0.22	0.04	0.31	0.31	0.24

Eleven of the fourteen weeds studied met CP and TDN requirements of a 1000 lb. cow for the first 5 months of gestation (summer, for spring calving herds). The brooms did not meet cow energy (TDN) requirements during summer. Most weed species analyzed in this study did not meet TDN and CP requirements of cows in the last 4 months of gestation. Requirements for the cow at lactation were met by the knapweeds, French broom, Italian thistle, and Himalaya blackberry.

Sheep and goats are selective eaters, preferring shrubs, forbs and other broadleaf plants to grasses. Nutrient requirements throughout the year for spring lambing and kidding sheep and goats are presented in (Table 1). Sheep requirements for a 154 lb ewe bred in the fall to lamb in spring were compared to weed nutrient contents throughout the year (NRC, 1985). A ewe at maintenance (August- September) could meet its nutrient requirements for CP and TDN by grazing spotted knapweed. However, spotted knapweed in summer is low in zinc as is Spanish broom in spring and summer.

Zinc would, therefore, need to be made available to the animal from other sources such as forages, supplemental feed, or a mineral mix. For the first 15 weeks of gestation (October-January), the CP and TDN requirements of a ewe could be met by grazing yellow starthistle. However, yellow starthistle is low in zinc, copper, and manganese; therefore, ewes would need to be supplemented with minerals.

For 110 lb meat goats kidding in spring, CP and TDN requirements for maintenance can be met by consuming fall growth of Himalaya blackberry, yellow starthistle, and meadow knapweed. Requirements at gestation, fall through spring, can be met with several species analyzed including: Himalaya blackberry, yellow starthistle, and

Table 3. Average micromineral content in parts per million for common pasture weeds sampled for 3 years in spring, summer, and fall.

	Iron (ppm)			Zinc (ppm)			Copper (ppm)			Manganese (ppm)			Molybdenum (ppm)		
Item	Sp	Su	F	Sp	Su	F	Sp	Su	F	Sp	Su	F	Sp	Su	F
Bog rush	98	102	72	36	45	39	6	6	4.5	549	695	717	<1	0.45	0.58
Sedge	570	162	148	20	25	20	5	8	5	462	549	452	<1	0.35	0.83
Spotted knapweed	2545	575	1395	27	27	21	15	10	9	94	33	64	<1	1	0.68
Diffuse knapweed	259	208	196	21	19	18	9	8	7	43	34	61	<1	1.3	1.7
Scotch broom	152	123	234	41	26	28	13	12	7	426	499	257	<1	0.65	0.53
French broom	210	130	332	48	48	53	5	5	6	304	221	236	2	1.05	1.2
Bull thistle	687	115	234	70	35	29	18	21	12	117	80	79	<1	0.7	<.1
Canada thistle	4922	120	156	63	86	66	26	15	8	57	89	67	0.87	0.7	<.1
Yellow starthistle	1327	141	164	63	38	50	19	10	11	57	14	16	0.87	0.7	0.7
Meadow knapweed	305	140	183	24	27	23	7	18	8	36	42	50	0.67	<1	0.53
Gorse	152	123	202	49	33	28	6	5	4	142	81	81	<1	<1	1.03
Himalaya blackberry	243	79	206	43	31	27	12	11	9	227	198	221	0.27	0.3	0.25
Portuguese broom	190	91	107	44	33	52	11	8	8	536	164	233	1.6	0.25	0.35
Italian thistle	3386	1	1934	35	31	29	18	17	11	202	39	101	0.77	0.57	0.4

meadow knapweed in fall and Himalaya blackberry, diffuse knapweed, Scotch broom, bull thistle, Portuguese broom, and meadow knapweed in early spring. Since goats browse, preferring shrubs to grasses, they may be the most effective at weed control for many of the species analyzed in this study.

Macro-minerals include calcium (Ca), phosphorous (P), potassium (K), sodium (Na), and magnesium (Mg). The macro-mineral content of the weeds studied were present in amounts that ranged from deficient to sufficient for grazing livestock. They would pose no problems for toxicity or deficiency if a well-formulated mineral mix were consumed by the grazing animal. However, ratios of potassium to calcium plus magnesium were high in some weed species analyzed, indicating possible grass tetany problems for ruminants consuming them. Bull thistle, Canada thistle and Italian thistle had ratios greater than 2.2 in all seasons, and the knapweeds had high ratios in summer and fall.

Micro-minerals include iron (Fe), zinc (Zn), copper (Cu), manganese (Mn), and molybdenum (Mo). They showed mixed results. The Fe content of the majority of the weeds in this study was sufficient to meet or exceed the nutrient requirements of livestock. Some weed species contained excessive, even toxic, levels of Fe. We speculated that high levels of Fe in some samples were due to contamination of the sample by soil. Therefore, when encountering weeds with high Fe, take precautionary steps. Most weeds examined had Zn and Mn concentrations sufficient to meet, but not exceed, maximum tolerable levels for grazing animals.

Copper levels in some weed species were often too high for sheep. Since Cu is known to accumulate in the sheep liver, grazing strictly on

these weeds may cause toxicity. The spring sample of Canada thistle, for example, contained 26 ppm Cu, exceeding the sheep maximum tolerable level. However, the cow and doe would need additional Cu if they were to consume the majority of their diet as Canada thistle. Molybdenum levels in some weeds were much lower than animal requirements and supplementation would be needed. None of the weed species exceeded maximum levels for Mo. Several weed species had mineral levels that could negatively affect ruminants. Some minerals are known to interact with others, causing possible mineral imbalances in livestock. Mineral interactions can be complicated and are beyond the scope of this paper. Animal managers need to carefully compare mineral requirements of livestock with weed mineral content (Tables 2 and 3). Sampling of pastures containing mostly weeds is recommended prior to turning livestock out, especially if the weeds will make up a majority of the grazing animal's diet. Mineral requirements of grazing livestock can be found in reference books or by contacting local county Extension Service offices.

Conclusions

Results from this experiment indicate that nutrient requirements of grazing animals can be met with some weed species. It will depend on animal species, its production cycle, weed species present, and growth stage of the weed. Management of grazing is important and will impact the success or failure of using livestock as a biological weed management tool. Producers will want to encourage livestock to graze the weed when it is most palatable and susceptible to defoliation. A sound weed management program that includes livestock grazing will require information such as nutrient value of weeds combined with a high degree of management, flexibility, and dedication by livestock producers.

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