Visual Reference Guide for Estimating Legume Content in Pastures

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Abstract
As the prices of nitrogen fertilizers rise, there is increased incentive to grow legumes for fixing nitrogen and improving forage quality in pastures and hay meadows. From a management perspective, it is important for managers to be able to estimate legume content in the stand. In research, clipping and hand separation is the standard method for measuring legume content. However, this method is impractical for farm managers. Another option is visual appraisal of the percentage surface covered by legumes. The objective of this photo reference guide is to provide a tool that pasture managers can use to assess legume content as it is related to legume cover. For each photo, the area within the quadrat was clipped and hand separated to determine the actual legume content. These photos represent a range of legume content across two ranges of forage mass. By using these photos to help estimate legume content, forage managers should be able to increase the accuracy of their visual estimate of legume content in pastures and aftermath meadows.

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INTRODUCTION

THERE are advantages to growing legumes with the grasses in pastures and hay fields. These include providing nitrogen for plant growth and increasing forage quality, thereby reducing fertilizer cost and enhancing animal performance (Blaser et al., 1969; Blaser and Colleagues, 1986; Rayburn et al., 2006).

Legume content in pastures is a dynamic characteristic that is dependent on weather, management, nitrogen accumulation in the soil, pests, and the legume and grass species present. During dry weather, pastures may be grazed closely, allowing white clover to increase and red clover seed to germinate and establish. Proper lime and fertilizer management is essential for legume production. Most clovers grow best when the soil pH is above 6.0 and soil-test phosphorous and potassium are high. When the soil-nitrogen supply is low, as for a newly planted forage stand in a crop

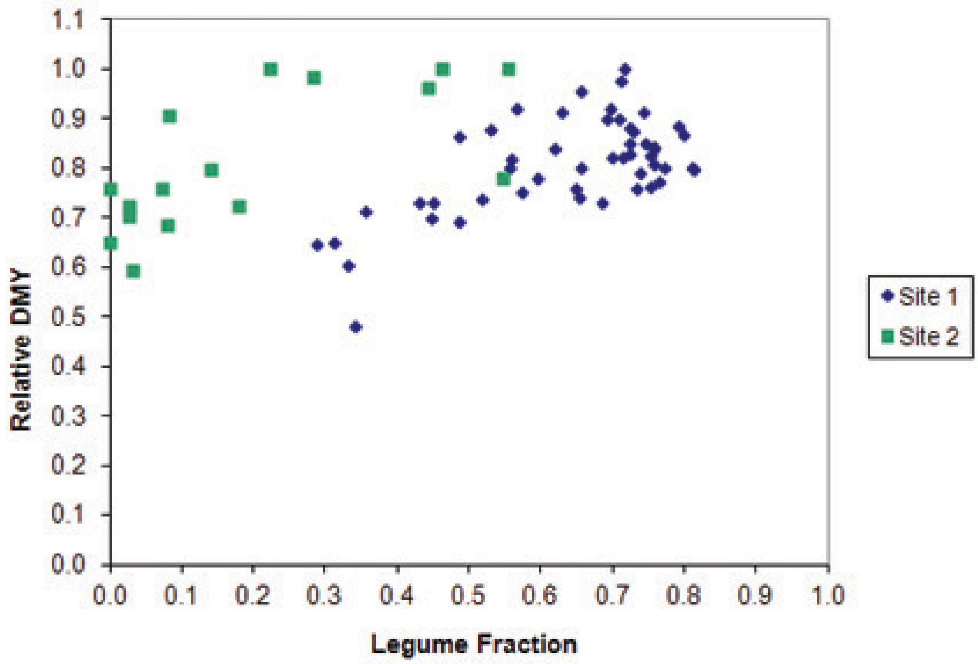

Figure 1. Relationship between legume fraction in the dry matter yield (DMY) and relative yield (1.0 is maximum yield) of total forage at two sites the year after no-till establishment. Site 1 was a grass-clover seeding after 3 years of corn followed 1 year of wheat. Site 2 was a grass–clover seeding on an old hay meadow sod.

rotation after several years of grain, legumes are more competitive (Fig. 1, Site 1). In this situation the legumes fix nitrogen from the air, provide nitrogen first for themselves and then to the grasses as root nodules slough off, dead leaves decompose, and livestock return manure and urine to the soil. In this situation, legumes dominate and yield is related to high legume content in the stand (60 to 80%). When the soil-nitrogen supply is high, such as in well-developed pasture or hay meadow soils, grasses will be more competitive (Fig. 1, Site 2) since they have access to adequate amounts of nitrogen from the soil. In these sites, relatively low levels of legume content (20 to 30%) are adequate for maximum production. The manager can use the pressure from livestock grazing to shift the balance of grasses and legumes. In general under rotational grazing, leaving a higher residual height encourages grasses, whereas grazing to a shorter height encourages legumes (Brown and Munsell, 1956; Blaser et al., 1969; Blaser and Colleagues, 1986; Belesky and Fedders, 1994). Providing adequate rest intervals between grazing events is a critical management requirement for legumes, especially tall legumes such as red clover and alfalfa.

When the cost of nitrogen fertilizer is high, managing for legumes in pastures becomes important. Being able to visually evaluate legume content is helpful when making management decisions. The objective of this photo reference guide is to provide a tool that pasture managers can use to assess legume content as it is related to legume cover in vegetative, cool-season, rotationally stocked pastures.

Photos of Legume Cover to Help Calibrate the Eye

Vertical photos are good for evaluating plant surface cover as an estimate of botanical composition (Rayburn, 2014). However, the relation between the percentage cover and legume composition is dependent on grass species, legume species, and management (Rayburn et al., 2007). When visually estimating botanical composition, consider plant species, forage mass and age, and associated visible dead material. These sward characteristics will largely be determined by management and environmental conditions. Using photographs of known botanical composition and comparing them to areas in a pasture can help improve visual estimates of pasture botanical composition.

Measuring Legume Content in the Photographed Swards

These vertical aerial photos (Fig. 2–15) were taken of rotationally stocked, cool-season pastures in West Virginia and North Carolina. The predominant legumes in these photos are white clover (*Trifolium repens* L.) and red clover (*T. pratense* L.). The predominant grasses in these photos are orchardgrass (*Dactylis glomerata*, L.), tall fescue (*Festuca arundinacea* Schreb.), Kentucky bluegrass (*Poa pratensis* L.), and crabgrass (*Digitaria sanguinalis* L.).

The photos were taken at 5 to 6 ft above the ground. In West Virginia, a metal quadrate (1-ft square) on 8-inch legs was used to mark the area of interest. After the photo was taken, a quadrate without legs (1-ft square) was place on the ground, and the forage within the quadrate was cut at ground level. In North Carolina, a 1.5-ft square

Figure 2. Sward containing 6% legume, 52% grass, 43% weeds, 5.0-inch canopy height, and 1180 lbs dry matter acre^{-1} forage mass.

Figure 3. Sward containing 18% legume, 80% grass, 2% weeds, 7.5-inch canopy height, and 1775 lbs dry matter acre^{-1} forage mass.

quadrate was used. After the photo was taken, the forage within the quadrate was cut at 1.0 to 2.5 inches above ground level. At both locations, the forage was hand separated into grass, legume, broadleaf weed, and dead fractions. Botanical fractions were then oven dried. Botanical fractions are based on dry, live plant material.

Organization of Photo Reference Guide

Photos in the reference guide are presented in order of legume content from low to high (Table 1) within two ranges

Figure 4. Sward containing 25% legume, 75% grass, 0% weeds, 6.0-inch canopy height, and 1400 lbs dry matter acre^{-1} forage mass.

Figure 5. Sward containing 30% legume, 68% grass, 2% weeds, 9.5-inch canopy height, and 2000 lbs dry matter acre^{-1} forage mass.

of forage mass. Low forage mass was defined as less than or equal to 2000 lbs dry matter acre^{-1}. High forage mass was defined as greater than 2000 lbs dry matter acre^{-1}. Stand botanical composition of legume, grass, and broadleaf weeds, canopy ruler height (inches), and clipped forage mass (lbs dry matter acre^{-1}) are listed for each photo (Table 1).

CONCLUSION

Legumes in pastures and hay meadows provide the important ecological services of fixing nitrogen for plant growth and improving forage quality for animal nutrition. This series of photos can help managers train their eye for determining the botanical composition in rotationally stocked, cool-season pastures where the predominant legumes are white and red clover. A manager's skill at estimating legume content will enable them to improve their management of legumes and livestock on pasture.

Figure 6. Sward containing 40% legume, 27% grass, 33% weeds, 8.0-inch canopy height, and 1880 lbs dry matter acre^{-1} forage mass.

Figure 7. Sward containing 55% legume, 23% grass, 22% weeds, 7.0-inch canopy height, and 1677 lbs dry matter acre^{-1} forage mass.

Figure 8. Sward containing 61% legume, 24% grass, 15% weeds, 7.5-inch canopy height, and 1780 lbs dry matter acre^{-1} forage mass.

Figure 9. Sward containing 5% legume, 82% grass, 13% weeds, 13.0-inch canopy height, and 2950 lbs dry matter acre^{-1} forage mass.

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Figure 10. Sward containing 11% legume, 89% grass, 0% weeds, 12.0-inch canopy height, and 3600 lbs dry matter acre^{-1} forage mass.

Figure 11. Sward containing 16% legume, 74% grass, 10% weeds, 16.5-inch canopy height, and 3270 lbs dry matter acre^{-1} forage mass.

Figure 12. Sward containing 19% legume, 81% grass, 0% weeds, 9.0-inch canopy height, and 2150 lbs dry matter acre^{-1} forage mass.

Figure 13. Sward containing 25% legume, 73% grass, 2% weeds, 9.5-inch canopy height, and 3230 lbs dry matter acre^{-1} forage mass.

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Figure 14. Sward containing 34% legume, 66% grass, 0% weeds, 10.25-inch canopy height, and 3550 lbs dry matter acre^{-1} forage mass.

Figure 15. Sward containing 46% legume, 41% grass, 13% weeds, 8.0-inch canopy height, and 2150 lbs dry matter acre^{-1} forage mass.

Table 1. Figure numbers of photographs of pastures of low and high forage mass with their content of legume, grass, broad leaf weeds, canopy ruler height, and forage mass.

Figure	Legume	Grass	Weed	Height	Forage mass
		%		inches	lbs dry matter acre^{-1}
		Low forage mass ($\leq$2000 lbs dry matter acre^{-1})			
2	6	52	43	5.00	1180
3	18	80	2	7.50	1775
4	25	75	0	6.00	1400
5	30	68	2	9.50	2000
6	40	27	33	8.00	1880
7	55	23	22	7.00	1677
8	61	24	15	7.50	1780
		High forage mass (>2000 lbs dry matter acre^{-1})			
9	5	82	13	13.00	2950
10	11	89	0	12.00	3600
11	16	74	10	16.50	3270
12	19	81	0	9.00	2150
13	25	73	2	9.50	3230
14	34	66	0	10.25	3550
15	46	41	13	8.00	2150