

Increased Soil Fertility and Aeration to Reduce Buttercup in Pastures

Some weed species are more easily managed in livestock pastures than others. Many annual and perennial weeds, if offered to cattle in the vegetative stage, are nutritious and readily consumed before they mature and reproduce. Periodic clipping of pastures to remove over-mature and refused forage and weeds will also help to control weed seed production. However, several perennial weeds are unpalatable to livestock and/or are able to set seed on low-growing nodes or creeping stems that are too low to be clipped. The buttercups (*Ranunculus* spp.) are such weeds. Once established they become a problem because they produce many seeds and the herbage is often unpalatable and can be toxic to livestock if eaten in large quantities. Increasing populations of these weeds will seasonally foul areas of pasture by producing enough unpalatable stems that livestock will cease trying to select forage from the weeds and refuse all herbage. Pasture managers constantly seek to identify management practices that can provide some level of control of these weeds. The goal of this project was to use fertility and soil aeration to improve the competitiveness of the various forage species over the buttercup by increasing forage plant growth vigor.

Objective

To determine if the growing environment in a moist pasture can be manipulated through enhanced soil fertility and/or surface aeration to improve the competitive advantage of forages over weeds. Measurements included:

- Density of weeds and forage
- Biomass of weeds and forage
- Shifts in pasture composition (i.e. forage grasses vs. legumes vs. weeds)

Cooperators:

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Location:

Liberty, Tioga County, Pennsylvania

Soil Type:

Moderately heavy, somewhat well-drained

Previous crop:

Dairy pasture

Fertilizer:

Lime/poultry manure

Variety:

NA

Planting date:

NA

Seeding rate:

NA

Tillage:

Periodic aeration of some plots

Harvest date:

By cows, as conditions allowed

Methods

This trial was conducted from 2002 through 2005, using a permanent dairy pasture. In April 2002 a soil test was collected and analyzed to determine current soil fertility levels. Treatments for this trial were then developed in May 2002 to consider if enhanced soil fertility and/or surface aeration could improve the competitive advantage of forages over weeds. Three treatments for soil fertility were considered; 1). no amendments (control), 2). 2-3 t/ac poultry manure, 3). 2-3 t/ac poultry manure plus lime (according to soil test recommendations). Two aeration treatment methods were also considered; 1). no aeration, 2). aeration using an AerWay implement during the first 2 years, followed by subsoiling with a three-shank ripper during 2004 and 2005. The AerWay tool has knives that can penetrate from 5 to 8 inches, while the subsoiler is normally operated at depths of 10 to 14 inches. The experiment was a factorial design where all three fertility treatments were subjected to both the aerated and non-aerated treatment. This split block design was replicated 4 times. See Table 1 for dates and treatments.

Table 1. Soil fertility and aeration dates of treatments

| Date | Procedure |
|------|-----------|
|------|-----------|

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|----------|--------------------------|
| May 2002 | Apply lime at 4420 lb/ac |
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|-----------|--------------|
| June 2002 | 1st aeration |
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|-----------|--------------|
| Sept 2002 | 2nd aeration |
|-----------|--------------|

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|----------|-----------|
| May 2003 | Soil test |
|----------|-----------|

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|-----------|---|
| July 2003 | Apply lime at 3300 lb/ac plus apply 2-3 t/ac poultry manure |
|-----------|---|

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|----------|---------------------------|
| Aug 2003 | Only aeration during 2003 |
|----------|---------------------------|

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|-----------|--|
| Sept 2003 | Transect method of botanical composition |
|-----------|--|

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|-----------|--|
| July 2004 | More transects, hand-separated botanicals and yields |
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|-----------|-----------------------|
| Sept 2004 | Subsoil aerated plots |
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|----------|-----------------------|
| Aug 2005 | Subsoil aerated plots |
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|------------|-------------------------------------|
| April 2006 | Visual observations of weed density |
|------------|-------------------------------------|

Results

The first fertility amendment (poultry manure) was not applied until the second year. The aeration treatments were conducted twice during 2002, a dry year, but only once during 2003 because of excessively wet soils. A soil test taken in April 2004 revealed no measurable difference in phosphorus (P) or potassium (K) levels between the two treatments that received poultry manure and the control. Manured plots averaged 16 and 86 parts per million (ppm), while controls averaged 15 and 85 ppm for P and K, respectively. Nearly four tons of lime over two years greatly improved soil pH and calcium (Ca) levels. Compared to non-limed plots, pH increased from 6.0 to 6.8 and Ca increased from 1275 to 2224 ppm. No significant interactions between soil fertility and aeration were detected for species composition or growth measurements. However, several main effect

differences were observed. Results of the transect method of determining percent cover for buttercup and white clover in pastures during September 2003 and July 2004 are shown in Tables 2 and 3. Hand-separated samples of total aboveground biomass revealed no differences between levels of fertility or aeration for the yield of any fraction (Table 4). However, the buttercup, legume, and grass plus legume expressed as a percentage of the total did differ between some of the treatments (Table 5).

Table 2. Transect method for % buttercup and legume in pastures in September 2003.

| | Buttercup | Legume | Buttercup | Legume |
|---------------|----------------------------|--------|-----------|--------|
| | -----percent of total----- | | | |
| No amendments | 3.8 | 38.7 | | |
| No aeration | | | 3.6 | 44.7 |
| Manure | 4.7 | 38.3 | | |
| Aeration | | | 4.7 | 38 |
| Manure/Lime | 4 | 47.1 | | |

Table 3. Transect method of % buttercup and legume in pastures in July 2004.

| | Buttercup | Legume | Buttercup | Legume |
|---------------|----------------------------|--------|-----------|--------|
| | -----percent of total----- | | | |
| No amendments | 12.8 | 22.8 | | |
| No aeration | | | 13 | 23.4 |
| Manure | 17.2 | 20.9 | | |
| Aeration | | | 15.5 | 23.7 |
| Manure/Lime | 12.7 | 27 | | |

Table 4. Hand clipped and separate % buttercup and legumes in pastures, July 2004.

| | Buttercup | Legume | Buttercup | Legume |
|-------------|----------------------------|--------|-----------|--------|
| | -----percent of total----- | | | |
| Manure | 3.3 | 6.4 | | |
| Aeration | | | 1.9 | 4.5 |
| Manure/Lime | 2.7 | 12 | | |

Table 5. Living, senesced and total forage and weeds in pastures in July 2004.

| | No amendments | Manure | Manure/Lime | No aeration | Aeration |
|----------|------------------------------------|--------|-------------|-------------|----------|
| | -----dry matter yield (kg/ha)----- | | | | |
| Living | 1244 | 1082 | 1252 | 1221 | 1164 |
| Senesced | 624 | 434 | 317 | 300 | 619 |

Summary

The difficulties in obtaining organically certified soil fertility amendments at a reasonable cost was a factor in how often and how many nutrients were applied during the first two years of the study. Excessively wet soils caused by seemingly endless rains also limited how often the farmer was able to put equipment on the pasture. This hampered not only manure spreading, but aeration and routine clipping of refused herbage. The potential for fertility to improve the competition between the forages and the weeds was inconclusive; the N, P, and K applications from manure were insufficient to noticeably elevate soil fertility levels. Although the response of legumes to liming has been well documented, the response of forage legumes (white clover) to liming when soil P and K levels are low was encouraging. Finally, the potential for soil aeration to aid in drying wet soils, in which buttercup seemingly does well, is also inconclusive.