West Virginia University Extension Service

Forage Management

Nutrient Management for Low Cost Production

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Strategic nutrient management

1. Soil sample and fertilize strategically:
    a) Soil test management units in fields,
    b) Sample 50 ft away from tree lines and water tanks,
    c) Apply only the nutrients that are needed where they are needed.
2. Feed hay on meadows where the hay was harvested.
3. Collect and apply manure back on fields where hay or silage was grown.
4. Feed minerals where more fertility is needed, animals will place more manure in these areas.
5. Control shade and watering areas to help control nutrient cycling in pastures and meadows.
6. Feeds produced on the farm are a store of "paid-for" nutrients.
7. Feeds and supplements brought onto the farm are a source of new nutrients.
8. Feeds and animal products moved off the farm are a loss of nutrients.
9. Mass balance of nutrient movement applies for the farm, the field, and within each paddock.

Soil test to find out how little fertilizer is needed

Divide each field based on previous management and soil type. Take representative soil samples from each area and send them to the lab. The soil testing lab measures available phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), soil pH, and the soil's lime requirement (tons of 100% ENV lime required to raise the soil pH to 6.6).

Table 1. Soil test description, index value for phosphorus (P) and potassium (K) based on WVU Soil Testing methods and the associated plant nutrient status and recommended management.

Soil Test Description	Soil Test Index Range		Plant Nutrient Status	Recommended Management
	P	K		
Low	0-25	0-60	Deficient	apply fertilizer
Medium	25-50	60-120	Some response	apply maintenance fertilizer
High	50-80	120-240	Sufficient	apply no or maintenance fertilizer
Very High	80+	240+	Excessive	no fertilizer needed

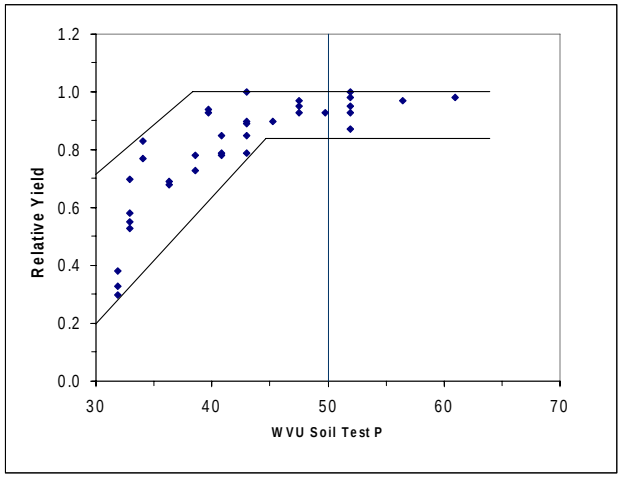
Apply only the plant nutrients to each part of a field that will give an economic return.

A plant nutrient is a mineral needed by plants for life, growth and reproduction.
A fertilizer is a mineral or organic source of plant nutrients.

On soils testing high in a nutrient, crops grow at their maximum even if the nutrient is not applied. On soils testing low in a nutrient, if the nutrient is not applied the crop will not produce at its maximum because lack of that nutrient limits growth.

Critical value - the soil test index number for a nutrient indicating the minimum level that allows maximum crop production with out added plant nutrient.

A. Soil Test Phosphorus (P)



B. Soil Test Potassium (K)

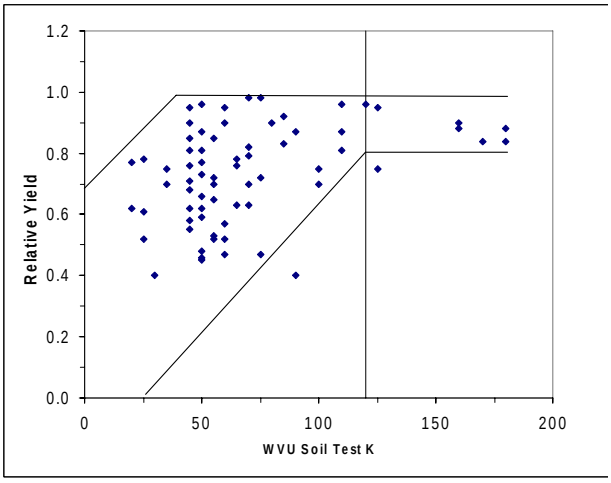


Figure 1. Effect of soil test phosphorus (A) and potassium (B) on forage crop yield without supplemental fertilizer as a fraction of the yield when adequate fertilizer is applied.

Apply maintenance P and K based on crop nutrient removal

A ton of hay removes about 10 lbs of P_2O_5 and 40-50 lbs of K_2O from the soil. Replacement P and K can be applied during the summer or fall based on tons of hay harvested per acre.

Management of nitrogen (N) for forage production

If no legumes are present in a grass hayfield applying nitrogen (N) using commercial mineral N or manure will increase hay yield (Fig. 2). When N is needed, apply 50-60 lbs/acre in the spring 6-weeks before first cut and again 6-weeks before each subsequent harvest.

The use of legumes to provide N reduces production costs and improves hay and pasture quality. Legume-grass mixes provide hay yields equivalent to 150 lbs N on a grass stand. Clover-grass pastures provide animal gain/acre equivalent to 200 lbs N on a grass pasture. Legumes grow best when the soil test P and K are in the high range and the soil pH is 6.0 or above for clovers and 6.5 or above for alfalfa.

At $0.70/lb of N 150 lbs of N is worth $105. Red clover seed ($5/lbs) seeded at 8 lb/acre costs $40/acre which should last 2 years when using a good variety, providing $210 worth of N for a $40 seed investment plus other seeding expenses. When converting from a mineral-N to a grass-legume system seed clover on about 25-33% of the farm each year to make a gradual transition.

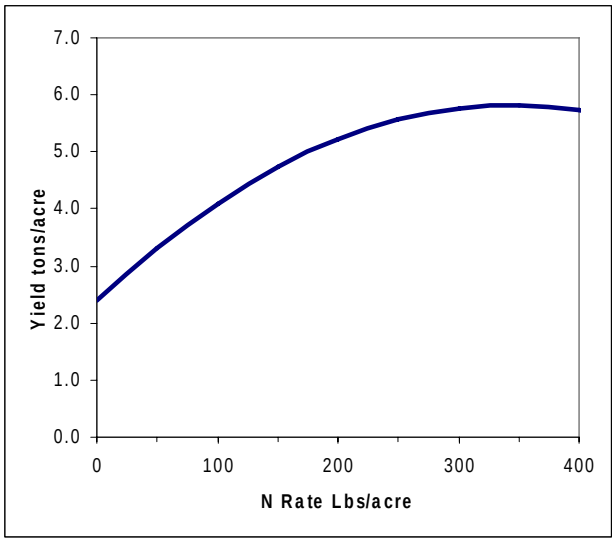


Figure 2. Orchardgrass growth response to nitrogen (N) when grown on well drained soils before accounting for harvesting losses; haylage dry yield will be 90% and dry hay yield 75% of these values after accounting for drying and harvesting losses.

Table 1. Value of nutrients in forages fed to livestock (Feb 2008 prices).

Forage	Percent of Dry Matter	Pounds/Ton at 90% Dry Matter					Nutrient Value / Ton Feed
	CP	N	P_2O_5	K_2O	$CaCO_3$	$MgCO_3$	Total
Pasture, grass	20	58	16	73	19	14	$83
Pasture, mm grass	22	63	16	60	34	16	$82
Pasture, mm legume	22	63	14	57	45	18	$80
Pasture, legume	24	69	14	67	54	19	$88
Hay, grass	11	30	9	38	23	12	$44
Hay, mm grass	12	35	9	40	31	13	$49
Hay, mm legume	17	48	11	47	49	16	$63
Hay, legume	19	56	10	51	62	17	$69

Table 2. Amount of nutrients cycled in a pasture versus removed in animal products.

Nutrient Movement	Lbs. Fertilizer			
	N	P_2O_5	K_2O	$CaCO_3$
Nutrient cycled by grazing 6 AUM (2.3 t DM)	161	40	152	86
Nutrients removed in a 500 lb. steer	16	7	1	14
Nutrients removed in 100 cwt. milk	51	23	17	30

Table 3. Value of nutrients in supplements fed to livestock (Feb 2008 prices).

Supplement	Percent on As Fed Basis					Value Of Nutrients / Ton or Bushel
	CP	P	K	Ca	Mg	Total
Livestock Mineral	0	7.0	1.00	15.0	4.00	$299
Corn, shell	10	0.30	0.47	0.03	0.12	$0.92
Wheat	14	0.41	0.50	0.13	0.16	$1.32
Oats	13	0.38	0.55	0.11	0.15	$0.67
Barley	13	0.39	0.54	0.08	0.14	$1.00
Soybeans	41	0.59	1.91	0.25	0.25	$3.36

Factors used to convert between plant and animal nutrient values.

$CP = 6.25\ N$ $P_2O_5 = 2.29\ P$ $K_2O = 1.21\ K$

$CaCO_3 = 2.50\ Ca$ $MgCO_3 = 3.47\ Mg$

Manage the Manure

There is $45-$70 of N, P, and K in a ton of hay (Feb 2008 prices). Feeding livestock mineral provides $300 worth of fertilizer per ton of mineral. When mineral is $15 a bag ($600/ton) about half of the cost comes back in the manure as fertilizer.

Manage manure through strategic winter feeding, mineral feeding, watering and shade control.

When confinement feeding, store manure under roof or in storage tanks. Test manure to know its nutrient content. Manure nutrient content is a reflection of the nutrients fed the animals and manure storage conditions.

Summary

Nutrient management using legumes and manures allows farmers to maintain high yields without the excessive purchase of commercial fertilizers, reducing production costs.