SUMMARY - PRESTEBAK

1. More than 2 ton hay increase with 150 lbs. nitrogen, 50 lbs. P_2O_5 and 50 lbs. K_2O.

2. 100 lbs. N per acre alone much less effective than complete fertilizer treatment.

3. 30 lbs. of nitrogen per acre in combination with 15 lbs. of P_2O_5 and 15 lbs. K_2O resulted in an average of .5 ton increase in hay yield.

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4) Location - Marshall County - Cooperator: Rantanen
Species - Quack, brome and bluegrass
Soil Type - Roliss
Soil Test - pH 7.7; phosphorus 18 lbs/A; potassium 230 lbs/A

	Tons Hay/Acre and Percent Protein						
	1st Cutting		2nd Cutting		3rd Cutting		Total
Treatment	hay	protein %	hay	protein %	hay	protein %	Tons Hay/A
1	.58	13.7	.47	13.4	.20	14.9	1.25
2	.52	12.3	.37	13.4	.17	15.0	1.06
3	.92		.50		.23		1.65
4	.81		.56		.17		1.54
5	1.51		.84		.37		2.72
6	1.65	17.3	.95	19.7	.40	19.8	3.00
7	1.07		.69		.23		1.99
8	.98		.65		.20		1.83

SUMMARY - RANTANEN

1. 30 lbs. of nitrogen plus 15 of P_2O_5 and K_2O per acre increased yields .4-.5 ton per acre. This treatment was effective on first cutting only.

2. 100 lbs. of nitrogen plus 50 P_2O_5 and K_2O increased yields approximately 1.5-2 tons of hay per acre.

3. The protein content of the 100-50-50 treated plots were 4 to 5 percent higher than the no-treated areas.

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5) Location - Mahnomen County - Cooperator: Slette
Species - Brome, quack, bluegrass
Soil Type - Flom
Soil Test - pH 7.4; phosphorus 24 lbs/A; potassium 260 lbs/A

Treatment	Tons Hay/Acre and Percent Protein hay	protein %
1	1.46	11.8
2	1.02	10.4
3	2.51	
4	1.46	
5	2.28	
6	2.35	16.6
7	1.69	
8	2.45	

SUMMARY - SLETTE

1. Only one cutting was made on this trial.

2. Nitrogen application in general increased yields .5 to 1 ton per acre.

3. 100 lbs. of nitrogen per acre plus 50 of P_2O_5 and K_2O increased the protein content of the forage 5-6 percent.

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6) Location - East Polk County - Cooperator: Calhoon
Species - Quackgrass
Soil Type - Cathro Muck
Soil Test - pH 6.6; phosphorus 7 lbs/A; potassium 90 lbs/A

	Tons Hay/Acre and Percent Protein				
	1st Cutting		2nd Cutting		Total
Treatment	hay	protein %	hay	protein %	Tons Hay/A
1	.36	15.4	1.30	12.6	1.66
2	.21	15.7	1.00	13.7	1.21
3	.67		1.40		2.07
4	.42		1.38		1.80
5	1.44		1.89		3.63
6	1.40	16.8	1.80	14.6	3.20
7	.39		.96		1.35
8	.32		1.51		1.83

SUMMARY - CALHOON

1. 30 lbs. N plus 25 of P_2O_5 and K_2O increased hay yields approximately .5 ton per acre.

2. 100 lbs. N plus 50 P_2O_5 and K_2O increased yields nearly 2 tons per acre.

3. Protein increase in the forage was approximately 1 percent when 100 lbs. of nitrogen and 50 lbs. of P_2O_5 and K_2O were applied.

7) Location - East Polk County - Cooperator: Wishard
Species - Bluegrass, brome, red top
Soil Type - Sioux
Soil Test - pH 6.7; phosphorus 2 lbs/A; potassium 90 lbs/A

	Tons Hay/Acre and Percent Protein				
	1st Cutting		2nd Cutting		Total
Treatment	hay	protein %	hay	protein %	Tons Hay/A
1	.48	12.2	.24	12.9	.72
2	.47		.27		.74
3	.81		.34		1.15
4	.88		.68		1.56
5	1.29		.56		1.85
6	1.33	15.0	.70	13.1	2.03
7	.67		.44		1.11
8	.73		.41		1.14

SUMMARY - WISHARD

1. 30 lbs. N plus 15 of P_2O_5 and 15 K_2O per acre increased yields .4-.8 tons of hay per acre.

2. 150 lbs. N plus 50 P_2O_5 and 50 K_2O per acre increased yields 1 to 1.5 tons per acre.

3. Lack of moisture resulted in reduced yields at second cutting.

4. At the first cutting, 100 lbs. of nitrogen per acre increased the protein content nearly 3 percent.

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8) Location - Pennington County - Cooperator: Vigen
Species - Kentucky bluegrass
Soil Type - Garnes
Soil Test - pH 7.1; phosphorus 5 lbs/A; potassium 180 lbs/A

	Tons Hay/Acre and Percent Protein				
	1st Cutting		2nd Cutting		Total
Treatment	hay	protein %	hay	protein %	Tons Hay/A
1	.19	13.8	.48	13.7	.67
2	.11	12.9	.30	14.0	.41
3	.28		.48		.76
4	.33		.46		.79
5	.99		.69		1.68
6	1.02	15.9	1.38	15.8	2.40
7	.47		.85		1.32
8	.25		.44		.69

SUMMARY - VIGEN

1. Nitrogen applied at the rate of 30 lbs. of N per acre in combination with 15 lbs. of P_2O_5 and K_2O increased hay yields at the first cutting only.

2. 150 lbs. of N per acre in combination with 50 lbs. of P_2O_5 and 50 lbs. of K_2O increased yields 1 to 2 tons per acre.

3. Nitrogen alone at the 100 lb. per acre rate resulted in yield increases from .2 to .7 tons hay per acre.

4. Protein increases were 1 to 2 percent for the 100 lb. N rate.

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9) Location - Pennington County - Cooperator: Jennings
Species - Bluegrass, quack
Soil Type - Hamar
Soil Test - pH 8.1; phosphorus 6 lbs/A; potassium 70 lbs/A

	Tons Hay/Acre and Percent Protein				
	1st Cutting		2nd Cutting		Total
Treatment	hay	protein %	hay	protein %	Tons Hay/A
1	.17	7.8	.02	-	.19
2	.17	8.4	.04	11.3	.21
3	.27		.06		.33
4	.25		.10		.35
5	.43		.14		.57
6	.27	8.3	.12	10.3	.39
7	.27		.05		.32
8	.22		.12		.34

SUMMARY - JENNINGS

1. Hay yields on this very droughty soil were increased significantly at the first cutting. Yields in general were very low.

2. All fertilizer treatments more than doubled the yields of harvested hay.

3. The protein content of the forage was not increased by fertilizer application.

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10) Location - West Polk County - Cooperator: Wilkins
Species - Bluegrass and quack
Soil Type - Flaming
Soil Test - pH 7.4; phosphorus 5 lbs/A; potassium 100 lbs/A

	Tons Hay/Acre and Percent Protein						
	1st Cutting		2nd Cutting		3rd Cutting		Total
Treatment	hay	protein %	hay	protein %	hay	protein %	Tons Hay/A
1	.20	9.5	.31	11.9	.08	-	.59
2	.16	9.0	.19	9.7	.03	-	.38
3	.75		.14		.11		1.00
4	.61		.39		.03		1.03
5	1.60		.61		.30		2.51
6	1.51	14.0	.50	15.6	.28	14.4	2.29
7	.61		.55		.08		1.24
8	.53		.39		.08		1.00

SUMMARY - WILKINS

1. 30 lbs. of N plus 15 lbs. P_2O_5 and 15 lbs. K_2O increased yields .5 tons of hay per acre.

2. 150 lbs. of N per acre plus 50 lbs. P_2O_5 and 50 lbs. K_2O per acre resulted in yield increases of nearly 2 tons per acre.

3. Protein increases for the 100 lb. N rate were 4 to 5 percent.

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11) Location - East Polk County - Cooperator: Brunelle
Species - Brome, bluegrass, birdsfoot trefoil, orchard
Soil Type - Wheatville
Soil Test - pH 8.1; phosphorus 7 lbs/A; potassium 160 lbs/A

	Tons Hay/Acre and Percent Protein						
	1st Cutting		2nd Cutting		3rd Cutting		Total
Treatment	hay	protein %	hay	protein %	hay	protein %	Tons Hay/A
1	.82	12.5	.38	14.2	1.09	15.3	2.29
2	.56	10.1	.49	14.9	.55	14.6	1.60
3	1.79		.84		.99		3.62
4	1.07		.53		.72		2.32
5	2.00		.62		1.35		3.97
6	2.20	15.8	.89	18.5	.92	15.5	4.01
7	1.40		.40		.96		2.76
8	1.27		.47		.88		2.62

SUMMARY - BRUNELLE

1. 30 lbs. of N plus 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre increased yields nearly 1 ton per acre.

2. 150 lbs. of N plus 50 lbs. of P_2O_5 and 50 lbs. of K_2O per acre increased yields nearly 2 tons per acre.

3. Nitrogen alone produced yield increases of .5 to 1 ton per acre.

4. Protein increases for 150 lbs. of nitrogen ranged from 1 to 4 percent.

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12) Location - Red Lake County - Cooperator: Shirrick
Species - Bluegrass
Soil Type - Viking
Soil Test - pH 7.3; phosphorus 8 lbs/A; potassium 600 lbs/A

Treatment	Tons Hay/Acre and Percent Protein	
	hay	protein %
1	.21	8.4
2	.14	10.0
3	.42	
4	.49	
5	1.09	
6	1.02	14.7
7	.31	
8	.26	

SUMMARY - SHIRRICK

1. Only one cutting was obtainable from this trial due to cattle grazing.

2. The 30 lb. N rate plus 15 lbs. P_2O_5 and 15 lbs. K_2O per acre doubled hay yields.

3. 100 lbs. of N plus 50 lbs. P_2O_5 and 50 lbs. K_2O per acre increased yields nearly 1 ton per acre.

4. 100 lbs. of nitrogen alone produced approximately .15 ton increase in hay yield.

5. The protein content of the forage was increased more than 4 percent by the 100 lb. nitrogen application.

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13) Location - Roseau County - Cooperator: Paulson
Species - Bluegrass, quackgrass
Soil Type - Percy
Soil Test - pH 8.1; phosphorus 4 lbs/A; potassium 120 lbs/A

	Tons Hay/Acre and Percent Protein						
	1st Cutting		2nd Cutting		3rd Cutting		Total
Treatment	hay	protein %	hay	protein %	hay	protein %	Tons Hay/A
1	.32	10.9	.32	14.0	.10	12.7	.74
2	.33	13.9	.49	14.2	.10	13.5	.92
3	.73		.53		.10		1.36
4	.87		.49		.16		1.52
5	1.31		.71		.13		2.15
6	1.16	14.6	1.03	15.7	.13	14.6	2.32
7	.49		.43		.08		1.00
8	.58		.79		.05		1.42

SUMMARY - PAULSON

1. An application of 30 lbs. N plus 15 lbs. P_2O_5 and 15 lbs. K_2O per acre resulted in an increase of approximately .5 tons per acre of hay.

2. 150 lbs. of N plus 50 lbs. of P_2O_5 and 50 lbs. K_2O resulted in yield increases of approximately 1.4 tons of hay per acre.

3. An application of 1 lb. of 2-4-D per acre produced increases in yield for all treatments. Increases were from .2 to .4 tons per acre.

4. Protein increases ranged from 1 to 4 percent for 100 lb. N applications.

GENERAL SUMMARY

1. An application of 30 lbs. of nitrogen in combination with 15 lbs. of P_2O_5 and 15 lbs. of K_2O resulted in a yield increase of approximately 0.5 tons hay per acre. This increase is consistent with the nitrogen requirement of most grasses - i.e., 1 ton of grass hay contains approximately 40 lbs. of nitrogen. Considering a nitrogen efficiency of 60 percent, 30 lbs. of nitrogen per acre should produce an increased yield of .5 tons per acre.

2. The ability of the 30 lb. nitrogen rate to increase yields diminished rapidly after the first cutting. In several trials, there was little, if any, increase in yield in the second cutting as a result of the treatment containing 30 lbs. of nitrogen per acre in combination with 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre.

3. The application of 100 lbs. of nitrogen in the spring plus an additional 50 lbs. of nitrogen after the first cutting increased yields approximately 2 tons per acre when 50 lbs. of P_2O_5 and 50 lbs. of K_2O were applied.

4. Weed control measures were effective in increasing yields of forage where broadleaf weeds were a problem-Gill Bros., Prestebak, Wishard and Paulson.

5. The protein content of the forage was increased as a result of nitrogen applications. The average increase for 100 lbs. of nitrogen was 1 percent.

6. Yields of forage were highest on those sites where the pasture had formerly been cultivated and mixtures of brome, quack, orchard grass or timothy were the predominant species.

EFFECTS OF FERTILIZER AND CHEMICAL WEED CONTROL ON YIELD OF GRASS PASTURES ON SEVERAL SOIL TYPES OF THE RED RIVER BASIN-1973

Charles Simkins, Oliver Strand, Robert Schoper and Marlin Johnson

THE SITUATION

Minnesota has more than 2 million acres of unimproved grasslands. It includes areas of open, treeless grasslands, as well as areas of grass-woodland bush which are used primarily for grazing. There are also several hundred thousand acres of peat land which are used for hay and graze land. Little of this land has been fertilized, although it is grazed each year from May to October. Present forage is composed primarily of cool season grasses including: bluegrass, timothy brome, orchard, quackgrass and reed canary grass. In some areas, the native warm season grasses such as the bluestem, side oats, grama and switchgrass are present. White clover is the predominant legume species in these pastures and haylands. On the peat soils, reed canary, quackgrass and timothy are the main species.

June Production - The growth of feed is limited largely by the existing fertility levels as well as the rainfall during the growing season. Normally the grasslands with a predominance of cool season grasses, (bluegrass, quack, timothy, brome, etc.) produce a flush of forage during the month of June and early July when the soil and air temperature have increased and moisture is adequate. As the growing season progresses, the cool season grasses become mature, moisture becomes limiting and many of the forage species become dormant.

Levels of Forage Production - Low soil fertility limits the growth of forage on many of these grasslands, even when moisture is favorable. Soils are often very low in phosphorus (P). Potassium (K) can also be limiting. Nitrogen (N) however, is the most limiting nutrient in grass forage production. The ability of various soil types to release available nitrogen accounts for a great deal of the differences in grass production from soil to soil. It must be stressed, however, that on most soils of the Red River Basin, phosphorus fertilizer used in combination with nitrogen produces the most striking increases in yield.

Without fertilizer use, the dry matter production per acre varies from 200 to 2,000 pounds per acre. Average yields without fertilizer approximates 1,100 pounds dry matter per acre.

Quality of Forage - The early spring growth of the grasses generally results in good feed. Later, as the grasses mature, many of the species are low in nutritive quality and quite unpalatable. Grasses growing on soils of low fertility are often unable to compete with perennial and annual weeds. Weeds such as ragweed, goldenrod, dandelion and thistles greatly reduce the quantity and quality of forage produced.

PREVIOUS STUDIES

Clipping trials conducted during the 1971 and 1972 growing season showed that hay yields on predominantly bluegrass pastures can be increased approximately .5 ton per acre by the application of 30 lbs. of nitrogen plus 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre. The average hay yield on 8 predominantly bluegrass sites where no fertilizer was applied was 0.8 ton per acre. Thirty pounds of nitrogen and 15 lbs. of P_2O_5 and K_2O applied to 4 sites which contained predominantly quackgrass increased hay yields .9 ton per acre. One hundred pounds of nitrogen applied without the use of phosphorus or potassium fertilizer increased yields less than 30 lbs. of nitrogen applied in combination with 15 lbs. of phosphorus and 15 lbs. of potassium.

One hundred-fifty pounds of nitrogen applied in combination with 50 lbs. of P_2O_5 and 50 lbs. of K_2O increased yields on the predominantly 8 bluegrass sites 1.8 tons of hay per acre (.8 tons vs. 2.6 tons). Yields of sites which were predominantly quackgrass were also increased approximately 1.8 tons per acre by the application of 150 lbs. of nitrogen and 50 lbs. each of P_2O_5 and K_2O (2.0 tons vs. 3.8 tons).

The protein content of grass which received 150 lbs. of nitrogen during the growing season was increased approximately 2 percent when compared to the non-fertilized plots (11.7 to 13.5 on bluegrass sites) (13.8 to 16.1 on quackgrass sites).

The application of 2-4-D at the rate of 1 lb. per acre was effective in increasing yields on those sites where broadleaf weeds were a problem. The increase of harvested forage on some sites were as much as .6 tons of hay per acre.

1973 TRIALS - METHODS AND MATERIALS

Trials were continued on sites established in 1971 and 1972. Eleven locations in 7 counties received fertilizer applications and chemical weed control. Soil samples were taken from the non-fertilized plots and each soil was classified as to soil series. In order to more closely assimilate grazing, the sites were harvested on a monthly basis as soon as the grass at each location reached a harvestable stage (6-7 inch height). The sites were harvested on a monthly basis as long as there was forage to be harvested. Chemical weed control was accomplished by using an application of 1 lb. of 2-4-D per acre. The following fertilizer and weed control treatments were used:

Treatment lbs/acre			
N	P_2O_5	K_2O	
0	0	0	
30	15	15	
100	50	50	plus 50 lbs. N after each cutting
100	0	0	

The above treatments were applied alone and in combination with 2-4-D. Each treatment was replicated twice.

DISCUSSION AND RESULTS

Location - East Polk County - Gully, Minnesota
Species - 95 percent quackgrass, 5 percent timothy
Soil Type - Cathro Muck - a relatively deep peat soil, relatively well-drained, formerly a timothy grass seed field
Soil Test - pH 6.4; phosphorus 3 lbs/A; potassium 70 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (5 cuttings) Lbs. Dry Matter Per Acre Total Wt.	Weed Wt.	Forage Wt.	Protein lbs/acre
0	0	0		2746	824	1992	
0	0	0	W C	2223	-	2223	415
30	15	15		4173	1221	2951	
30	15	15	W C	3424	-	3424	603
300	50	50		7584	2275	5309	
300	50	50	W C	6465	-	6465	1475
100	0	0		2869	830	2039	
100	0	0	W C	3191	-	3191	

This pasture and hayland on peat soil was the most productive of all sites in both terms of dry matter per acre as well as protein per acre.

The percent protein in the harvested forage for various treatments at the 5 cuttings was as follows:

Treatment lbs/acre N	P_2O_5	K_2O	Percent Protein Per Cutting 1	2	3	4	5
0 (weed control)	0	0	21.5	14.8	22.2	24.3	21.5
30 (weed control)	15	15	19.0	13.1	21.4	22.4	22.1
300 (weed control)	50	50	28.0	18.2	25.8	25.4	26.5

It is interesting to observe the relatively high protein content of the quackgrass without fertilizer applications. Quite certainly this is the result of tremendous nitrogen release from the peat soils and the early cutting of the grass. Except for the second cutting, the grass was less than 10 inches in height when harvested. There would appear to be a considerable potential to produce high protein feed on peat soils using cool season grasses. Based on a protein price of 20¢ per pound of protein, the non-fertilized plot produced more than $80.00 of protein per acre. With increasing nitrogen use, the protein per acre was increased by more than 1,000 pounds per acre. With present nitrogen costs of 20¢ per pound

of nitrogen, the 300 pound nitrogen treatment produced increased protein at an approximate cost of 6¢ per pound of protein.

The three years of chemical weed control treatment plus clipping had eliminated broadleaf weeds from those plots receiving the 2-4-D treatment. Dandelion was the chief weed on those areas not treated with 2-4-D.

Thirty pounds of nitrogen plus 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre increased yields by 1,200 lbs. dry matter per acre. It also increased the protein harvested per acre by nearly 200 pounds per acre.

Three hundred pounds of nitrogen per acre applied in four applications (100 plus 50 after each cutting) increased yields by 3,000 lbs. dry matter per acre. The protein was increased by more than 1,000 lbs. per acre.

Nitrogen applied alone was less effective in increasing yields than 30 lbs. of nitrogen in combination with 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre.

Controlling the dandelion and other weeds increased yields only slightly on the non-fertilized plots (approximately 200 lbs. dry matter per acre). On the fertilized plots, the increase due to weed control was more than 1,000 lbs. dry matter per acre.

Location - East Polk County - Trail, Minnesota
Species - Bluegrass, needle and thread, brome, quackgrass
Soil Type - Sioux loam - a droughty soil formed over sand and gravel. The site was nearly level with sand and gravel at 6-7 inches.
Soil Test - pH 6.5; phosphorus 2 lbs/A; potassium 130 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (4 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		725	
0	0	0	W C	746	97
30	15	15		890	
30	15	15	W C	1372	183
250	50	50		3531	
250	50	50	W C	3652	724
100	0	0		1225	
100	0	0	W C	1150	

As with other locations, the weed control areas contained little or no weeds. Weeds harvested in those plots not receiving chemical weed control were separated and not included in the dry matter determination. Chemical weed control was especially effective on those areas receiving 30 lbs. of nitrogen and 15 lbs. each of P_2O_5 and K_2O per acre. Thirty pounds of nitrogen and 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre in combination with chemical weed control increased yields of dry matter by 650 lbs. per acre. Dry matter yields were increased 1,900 lbs. per acre through the application of 250 lbs.

of nitrogen, 50 lbs. of P_2O_5 and 50 lbs. of K_2O and chemical weed control. One hundred pounds of nitrogen applied alone on this very phosphorus deficient soil resulted in smaller increases in yield than 30 lbs. of nitrogen applied in combination with phosphorus and potassium.

Location - Mahnomen County - Mahnomen, Minnesota
Species - Quack, brome
Soil Type - Flom silty clay loam - a deep, somewhat poorly drained soil, but under conditions of this trial, drainage was no problem. Soil fertility levels were relatively high, a very productive soil.
Soil Test - pH 7.1; phosphorus 22 lbs/A; potassium 270 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (4 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		1957	
0	0	0	W C	1829	226
30	15	0		2460	
30	15	0	W C	2660	334
250	50	0		5954	
250	50	0	W C	6594	1235
100	0	0		3265	
100	0	0	W C	3584	

Yields on fertilized areas were increased from 200 to 600 lbs. per acre by application of chemical weed control. Dry matter yields were increased by 800 lbs. per acre with the application of 30 lbs. of nitrogen, 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre. Two hundred-fifty lbs. of nitrogen per acre applied in 3 applications increased dry matter yields by 4,700 lbs. per acre when used in combination with phosphorus, potassium and chemical weed control.

Protein yields were increased by more than 200 lbs. per acre by application of 30 lbs. of nitrogen, 15 lbs. of P_2O_5 and 15 lbs. of K_2O per acre. Two hundred-fifty lbs. of nitrogen per acre in combination with 50 lbs. of P_2O_5 and K_2O per acre increased protein yields approximately 1,000 lbs. per acre. Nitrogen applied alone was effective in increasing yields on these soils which are relatively high in phosphorus and potassium.

Location - Marshall County - Middle River, Minnesota
Species - Quack, brome, timothy
Soil Type - Kratka loamy sand - a relatively deep, poorly drained sandy soil overlying loamy glacial till. Pasture and hayland formerly seeded to brome and timothy.
Soil Test - pH 7.3; phosphorus 18 lbs/A; potassium 240 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		*Yield (3 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		1210	
0	0	0	W C	1037	118
30	15	15		1373	
30	15	15	W C	1261	188
200	50	50		3352	
200	50	50	W C	3318	629
100	0	0		2468	
100	0	0	W C	2408	

* one cutting was lost due to cattle grazing

Little increase in yield was realized from the 30 pound nitrogen, 15 lb. P_2O_5 and 15 lb. K_2O treatment. This was largely due to the fact that the first cutting was lost. Chemical weed control had little influence on forage production or protein production. The 200 lb. nitrogen and 50 lb. P_2O_5 and K_2O application increased dry matter yields more than 2,000 lbs. per acre. The same treatment increased protein yields approximately 500 lbs. per acre.

Location - West Polk County - Crookston, Minnesota
Species - Bluegrass, quackgrass, white clover
Soil Type - Flaming fine sandy loam - formed under tall prairie grass, but rather droughty. Site was a pasture and grazing area.
Soil Test - pH 7.2; phosphorus 3 lbs/A; potassium 110 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (3 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		496	
0	0	0	W C	299	19
30	15	15		666	
30	15	15	W C	595	45
200	50	50		2633	
200	50	50	W C	2320	390
100	0	0		691	
100	0	0	W C	590	

The application of chemical weed control resulted in slight decreases in yields of dry matter on this area. Broadleaf weeds were not abundant after the two previous years of mowing. In addition, the 2-4-D applications reduced the population of legumes. Dry matter yields were increased approximately 200-300 lbs. per acre by the 30 lb. nitrogen and 15 lb. P_2O_5 and K_2O treatments. Nitrogen at the rate of 100 lbs. per acre applied without phosphorus and potassium increased yields of dry matter also 200-300 lbs. per acre. The application of 200 lbs. of nitrogen in combination with 50 lbs. each of P_2O_5 and K_2O increased dry matter yields 2,000 lbs. per acre.

The increased protein per acre for the 30 and 200 lb. nitrogen rates was rather low compared to other trials, 26 and 371 lbs. of protein per acre, respectively.

Location - West Polk County - Crookston, Minnesota
Species - Brome, orchard, birdsfoot trefoil
Soil Type - Wheatville sandy clay loam, well drained - a formerly cultivated land - seeded to orchard and birdsfoot trefoil. The available water in the soil is relatively high.
Soil Test - pH 7.5; phosphorus 7 lbs/A; potassium 250 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (4 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		2401	
0	0	0	W C	1221	210
30	15	15		2690	
30	15	15	W C	1302	210
250	50	50		5245	
250	50	50	W C	5093	1140
100	0	0		2204	
100	0	0	W C	2054	

Mowing during 1971 and 1972 had controlled rather effectively the predominant broadleaf weeds of Canadian thistle and ragweed. The use of chemical weed control reduced the population of birdsfoot trefoil, which resulted in less forage per acre. Dry matter yields were increased by 2,800 lbs. per acre by application of 250 lbs. of nitrogen and 50 lbs. each of P_2O_5 and K_2O per acre. The same treatment resulted in protein increase of 930 lbs. per acre when compared to no-treated areas. The protein percent of various treatments by cuttings is shown below:

Protein content of grass forage - Wheatville soil

Treatment lbs/acre N	P_2O_5	K_2O		Protein Percent Cutting 1	2	3	4
0	0	0	W C	13.4	18.1	18.4	18.0
30	15	15	W C	12.2	17.7	18.2	18.1
250	50	50	W C	19.1	22.3	25.6	23.2

Location - Roseau County - Greenbush, Minnesota
Species - Bluegrass, quackgrass, alfalfa, timothy, white clover
Soil Type - Percy sandy clay loam, poorly drained. This site used as a pasture, was formerly cultivated to alfalfa and timothy.
Soil Test - pH 7.7; phosphorus 5 lbs/A; potassium 150 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (4 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		692	
0	0	0	W C	774	92
30	15	15		1174	
30	15	15	W C	971	152
250	50	50		2887	
250	50	50	W C	2669	558
100	0	0		1422	
100	0	0	W C	1624	

Chemical weed control reduced the total dry matter yields slightly except where nitrogen fertilizer was applied alone. This is probably due to the reduction in the population of alfalfa and white clover species. The application of 30 lbs. of nitrogen in combination with 15 lbs. of P_2O_5 and 15 lbs. of K_2O resulted in an increased yield of approximately 500 lbs. dry matter per acre. Two hundred-fifty pounds of nitrogen in combination with 50 lbs. of P_2O_5 and K_2O per acre increased dry matter yields approximately 2,000 lbs. per acre.

Location - Marshall County - Grygla, Minnesota
Species - Quackgrass, bluegrass
Soil Type - Roliss fine sandy loam, poorly drained, surface runoff slow. This area used as a pasture. Perennial weeds were abundant.
Soil Test - pH 7.3; phosphorus 5 lbs/A; potassium 270 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (4 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		944	
0	0	0	W C	1222	135
30	15	15		1775	
30	15	15	W C	1902	263
250	50	50		4223	
250	50	50	W C	5137	899
100	0	0		1766	
100	0	0	W C	2044	

Chemical weed control produced increases in yield on this trial although all plots had been mowed in 1971 and 1972. Yield increase for chemical control of weeds was greatest on the heavily fertilized areas.

Application of 30 lbs. of nitrogen in combination with 15 lbs. of P_2O_5 and 15 lbs. of K_2O increased dry matter yields approximately 800 lbs. per acre and protein yields 130 lbs. per acre. Two hundred-fifty lbs. of nitrogen per acre in combination with 50 lbs. each of P_2O_5 and K_2O increased dry matter yields as much as 3,000 lbs. per acre and protein yields 750 lbs. per acre.

Location - Pennington County - Thief River Falls, Minnesota
Species - Bluegrass
Soil Type - Hamar loamy fine sand - a very droughty soil used primarily as permanent pasture land.
Soil Test - pH 7.8; phosphorus 8 lbs/A; potassium 70 lbs/A

Treatment lbs/acre N	P_2O_5	K_2O		Yield (3 cuttings) Dry Matter lbs/acre	Protein lbs/acre
0	0	0		246	
0	0	0	W C	269	22
30	15	15		434	
30	15	15	W C	598	51
200	50	50		3013	
200	50	50	W C	3172	427
100	0	0		792	
100	0	0	W C	916	