# Crested Wheatgrass and Nitrogen

Squaw Butte Experiment Station Field Day

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NITROGEN AND CRESTED WHEATGRASS 1/

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## FOREWORD

Crested wheatgrass seedings generally yield many more pounds of forage per acre than the same land in native sagebrush-bunchgrass cover. Those seedings provide a higher production base and economic increases through fertilizer management are sometimes possible.

At Squaw Butte we have looked long and hard at nitrogen fertilization for increasing spring, regrowth, and fall yields of crested wheatgrass. The results of those trials are summarized in this report. We cannot, at this time, recommend N fertilizer for use on crested wheatgrass seedings on former big sagebrush-bunchgrass sites.

This does not mean that N fertilizer studies are to be terminated. Nitrogen fertilization is about the only way we can increase the yield of an existing good stand of crested wheatgrass. We need to do further research to explore all possible combinations of fertilizer use and management techniques.

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SPRING YIELDS WITH AND WITHOUT NITROGEN

Crested wheatgrass, like other cool-season grasses, begins growth early in the spring. Nitrogen fertilization may cause plants to grow somewhat earlier, but more important, in crested wheatgrass it causes more stem per plant, growing at about the same rate, that results in the increased production from nitrogen fertilizer.

As we see in the table on this page, nitrogen did increase the spring yield. The response to N was greater on the old stand than on the new stand. BUT, WE MUST BE CAREFUL WITH PERCENTAGE RETURNS; CATTLE EAT POUNDS OF GRASS, NOT PERCENTAGES!

Herbage yield (lb/A) May 15

| Year | Old stand | | New stand | |
|---|---|---|---|---|
| | Zero N | 30 lb N | Zero N | 20 lb N |
| 1957 | 167 | 173 | 672 | 908 |
| 1958 | 269 | 657 | 631 | 856 |
| 1959 | 347 | 772 | 592 | 936 |
| 1960 | 326 | 712 | 518 | 857 |
| 1961 | 282 | 408 | 498 | 678 |
| 1962 | 346 | 533 | 487 | 755 |
| 1963 | 242 | 479 | 374 | 777 |
| 1964 | 346 | 472 | 358 | 620 |
| 1965 | 319 | 605 | 471 | 1016 |
| 1966 | 354 | 852 | 367 | 738 |
| 1967 | 192 | 400 | --- | --- |
| 1968 | 216 | 304 | --- | --- |
| 1969 | 438 | 759 | --- | --- |
| Mean | 296 | 548 | 497 | 814 |
| Increase due to N = | | 85% | | 64% |

Each pound of N applied to the new stand returned, on the average, 16 pounds of herbage as compared to 8 pounds return per pound of N applied to the old stand. If we place a cost value of 15¢ to each pound of N applied to these returns the total cost of producing an additional ton of early spring herbage lies somewhere between $19 and $28. Not only is the cost rather high for producing this additional spring forage but N fertilization increases year to year yield fluctuations. This is also undesirable.

Many ranchers are producing an additional ton of good quality meadow hay for $10 or less with fertilizer and in this way extending their hay feeding period. This appears to be more economical than fertilizing crested wheatgrass to provide more early spring grazing.

If we assume a life expectancy of a crested wheatgrass field of 25 years, an annual fertilization program of 20 lb/A (at a cost of 15¢ per pound of N) would cost $75, during the 25-year period. Where land for seeding is available the investment of more acres of seeded range also appears to merit greater consideration.

## REGROWTH YIELD WITH AND WITHOUT NITROGEN

The amount of regrowth that follows spring grazing is important in two ways. First, there must be sufficient regrowth to restore the root reserves depleted in making the spring growth. Secondly, we would like to have enough regrowth to provide a reserve for grazing in late summer or early fall.

Regrowth yield (lb/A) harvested Aug. 1

| | Old stand | | New stand | |
|---|---|---|---|---|
| Year | Zero N | 30 lb N | Zero N | 20 lb N |
| 1957 | 475 | 831 | 479 | 541 |
| 1958 | 259 | 440 | 452 | 426 |
| 1959 | 0 | 0 | 0 | 0 |
| 1960 | 197 | 210 | 213 | 188 |
| 1961 | 150 | 185 | 146 | 161 |
| 1962 | 129 | 110 | 77 | 55 |
| 1963 | 492 | 559 | 534 | 667 |
| 1964 | 420 | 623 | 318 | 631 |
| 1965 | 499 | 815 | 379 | 519 |
| 1966 | 232 | 335 | 199 | 254 |
| 1967 | 471 | 806 | --- | --- |
| 1968 | 39 | 25 | --- | --- |
| 1969 | 359 | 387 | --- | --- |
| Mean | 286 | 410 | 280 | 344 |
| Response to N | | 43% | | 23% |

The table to the left shows that regrowth from plots harvested on May 15 varied considerably. In some years there was no regrowth or so little that root reserve was probably not replenished and additional grazing not practical. Nitrogen changed this regrowth picture very little.

The table below presents the regrowth yields expressed as a percentage of the fall yields taken from other plots in this study. Regrowth on fertilized plots was less than from unfertilized plots when expressed in those terms. This difference can be explained by the greater stress placed on fertilized grasses and the more rapid depletion of available soil moisture for spring growth and consequently less available soil moisture for regrowth.

We have shown that this greater stress in fertilized crested wheatgrass is in part due to a greater depletion of root carbohydrate reserves. Therefore, a greater amount is needed from the regrowth to restore that depletion. It has been suggested from experimental data that regrowth equal to 20% or more of the total season's growth is needed to restore those depleted reserves. During the 13 years of this study, on the unfertilized plots, in only two years did regrowth fall below 20%, BUT WITH FERTILIZATION, DURING 5 YEARS REGROWTH WAS BELOW THIS VALUE AND JUST BARELY EXCEEDED IT IN ANOTHER 2 YEARS.

It appears that nitrogen fertilization has very little to offer in terms of increasing regrowth yields; and fertilization with spring grazing may leave crested wheatgrass stands extremely vulnerable because of reduced opportunity for adequate root reserve replenishment.

Regrowth yields expressed as a % of fall yields

| Year | Zero N | 30 lb N |
|---|---|---|
| | % | |
| 1957 | 40 | 40 |
| 1958 | 36 | 23 |
| 1959 | 0 | 0 |
| 1960 | 29 | 18 |
| 1961 | 33 | 33 |
| 1962 | 27 | 15 |
| 1963 | 76 | 59 |
| 1964 | 62 | 83 |
| 1965 | 57 | 48 |
| 1966 | 32 | 21 |
| 1967 | 59 | 39 |
| 1968 | 13 | 8 |
| 1969 | 32 | 19 |
| Mean | 38 | 31 |

## FALL YIELDS WITH AND WITHOUT NITROGEN

Crested wheatgrass has often been referred to as "broom straw" in late summer. At this time of the year it is coarse, stemmy, and not well accepted by cattle. The table to the left lists the crude protein concentrations of mature crested wheatgrass over a 13-year period. This is not the kind of forage growing animals should be grazing. Nitrogen fertilizer at 30 lb/A did increase the crude protein concentration after the second year. Yet, even with fertilization, only in 5 years were crude protein concentrations of the herbage above 7.0%. At Squaw Butte yearling cattle and suckling calves will gain 1 pound or less per day on crested wheatgrass having a crude protein concentration of less than 7%. In addition, the most efficient rate of N for yields is 20 lb/A; a rate which has not greatly influenced % crude protein.

Crude protein concentration of fall yields

| Year | Zero N | 30 lb N/A |
|---|---|---|
| | % | |
| 1957 | 2.7 | 3.6 |
| 1958 | 3.9 | 3.3 |
| 1959 | 3.9 | 5.2 |
| 1960 | 4.4 | 6.2 |
| 1961 | 6.1 | 9.4 |
| 1962 | 6.0 | 9.7 |
| 1963 | --- | --- |
| 1964 | 4.6 | 8.6 |
| 1965 | 5.0 | 6.4 |
| 1966 | 3.9 | 6.2 |
| 1967 | 4.1 | 5.9 |
| 1968 | 4.9 | 10.9 |
| 1969 | 4.3 | 7.7 |

Nitrogen increased the mean mature yield of crested wheatgrass from 708 to 1296 lb/A. This is approximately 16 pounds of additional herbage per pound of N applied. With N costing 15¢ a pound an additional ton of forage could be grown for approximately $19. Using 20 lb of N/A, the cost could be reduced to about $15.

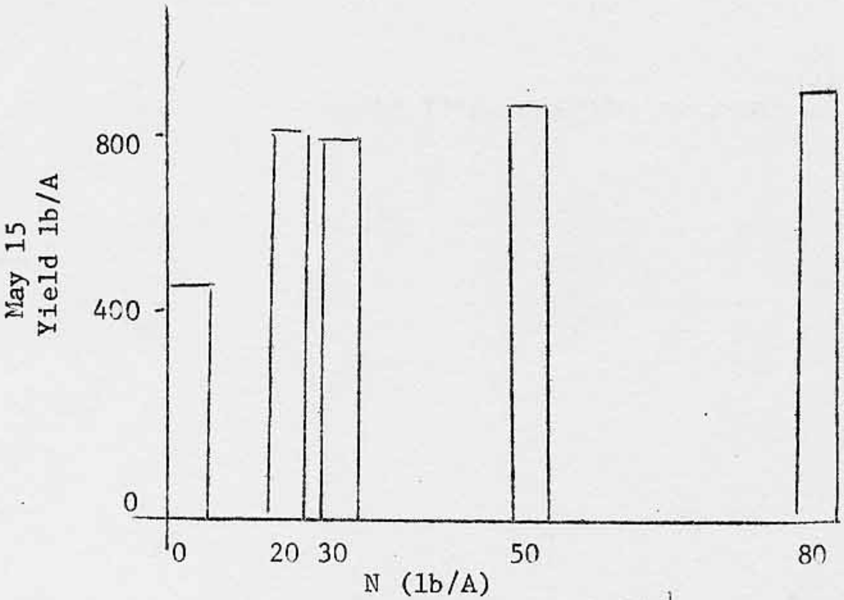
Nineteen dollars per ton, or even $15, for low quality, stemmy, and unpalatable forage is not a good buy in most years. In addition, the greatest response to N occurs in the more favorable moisture years, when the rancher is not hard pressed for a greater forage supply.

The alternatives of (1) increasing native forage production through brush control (2) seeding more acres, where available, to crested wheatgrass or some other adapted grass, or (3) increasing meadow hay production with fertilizer and rake-bunching for fall grazing, all appear to be a more economical means of achieving increased production for alleviating late summer and early fall forage shortages.

August 1
Herbage yield (lb/A)

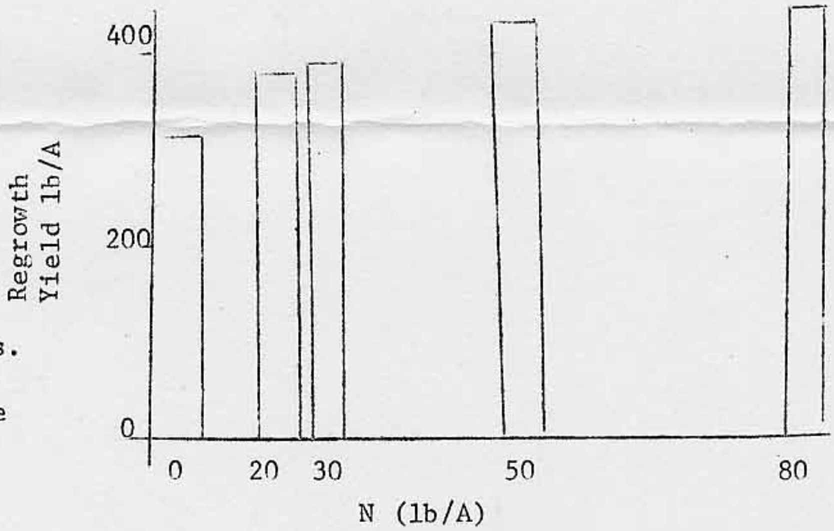
| Year | Zero N | 30 lb/N |
|---|---|---|
| 1957 | 1201 | 2099 |
| 1958 | 728 | 1940 |
| 1959 | 574 | 956 |
| 1960 | 674 | 1179 |
| 1961 | 449 | 554 |
| 1962 | 478 | 718 |
| 1963 | 644 | 944 |
| 1964 | 678 | 750 |
| 1965 | 873 | 1713 |
| 1966 | 721 | 1586 |
| 1967 | 792 | 2089 |
| 1968 | 288 | 321 |
| 1969 | 1105 | 1999 |
| Mean | 708 | 1296 |
| Response to N | | 83% |

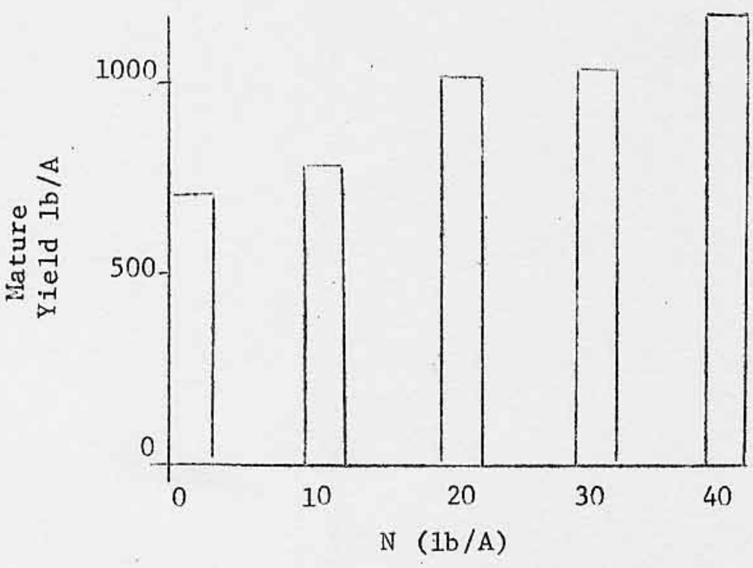
HOW ABOUT YIELD RESPONSE TO OTHER RATES OF N?




The results reported in the 3 previous pages have been those from rates of 20 or 30 lb/A. We have also measured the yield response to other levels of N applied annually as well as biennially.

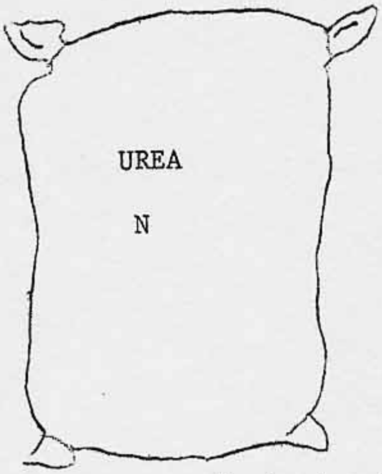
The figures presented on this page show that for spring, regorwth, and mature yields the response was similar. Nitrogen rates above 20 lb/A caused only small additional increases in yield. Twenty pounds of N was the most efficient rate in all harvests. In dry years rates above 30 lb of N per acre decreased the yield



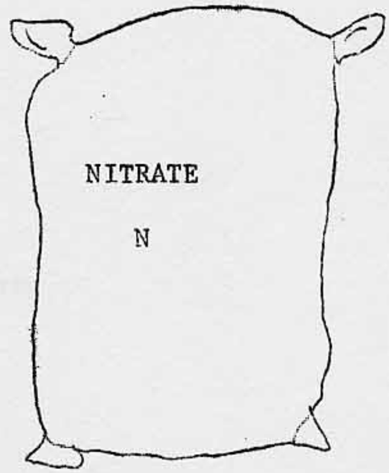




Forty pounds of N applied every other year produced 2-year mean yields that were no different from plots fertilized annually with 20 lb of N. Thus, one could save half the cost of application over fertilizing annually. But management would be increased as the response to biennial applications is greater the first than the second year.

FERTILIZER - WHAT KIND AND WHEN




Studies concluded at Squaw Butte have been with ammonium nitrate and nearly always this has been surface applied in the fall of the year. In recent years urea nitrogen has made inroads into the fertilizer market. Comparisons of the 2 fertilizers are lacking for this area. The time of application may also cause differences in the response of crested wheatgrass.




Beginning in the fall of 1968, 20 lb/A of N as ammonium nitrate or as urea was applied to crested wheatgrass on the 15th of September, November, January, February, March, April, and May. In 1969, the first yield year there were no differences in mature yields due to source of N or date of application. Treatments were repeated in the following year. In 1970 there was again no difference due to N source, but applications made in September or November produced higher yields than winter or spring applications.

The similarity in response between urea-N and nitrate-N obtained in these 2 years agrees with results of investigators in other areas. Further testing of application dates is needed before firm conclusions can be drawn.

There is a possibility that soil sulphur may become limiting rather quickly in these soils when subjected to continuous applications of N. A study to evaluate sulphur additions to the soil in the initial year of N fertilization and on stands under N fertilization for 13 years is underway.