# EFFECT OF NITROGEN INPUT ON PERFORMANCE OF A SODSEEDED TEMPERATE LEGUME-GRASS MIXTURE

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**ABSTRACT**
The objective of this study was to determine the effect of N application rate and timing on forage production when an annual ryegrass (*Lolium multiflorum* Lam.) and red clover (*Trifolium pratense* L.) mixture is overseeded on a warm-season grass sward. Nitrogen was applied soon after planting in the fall at rates of 0, 38, 76 and 114 kg $ha^{-1}$ and in late February at 0, 56 and 112 kg ha-$^{1}$. Fall and winter N rates were included in a 4 x 3 factorial arrangement. Forage production was measured monthly from February through June and botanical composition was determined for each treatment at each harvest. Application of N in either season reduced total production from the clover component but the effect was less severe if fall N did not exceed 76 kg $ha^{-1}$ and N was not applied in winter. Applied N from both seasons had to total at least 170 kg $ha^{-1}$ before forage production exceeded that from the treatment with no N applied. Early season ryegrass production was minimal unless fall N rate was 76 kg $ha^{-1}$ or greater. Results indicate application of 76 kg $ha^{-1}$ only in the fall would provide for early season production from ryegrass while maintaining relatively vigorous clover production.

**INTRODUCTION**
Red clover is a productive legume in the southeastern U.S. and can be sodseeded into warm-season grass based pastures. Clovers are often established by sodseeding in a mixture with annual ryegrass. A mixture of red clover and ryegrass can be quite productive when no nitrogen is applied but early season productivity is less than from ryegrass fertilized with N (Alison and Ashley, 1994). A survey of fertilizer recommendations in 45 states indicated considerable variability concerning N use when planting mixtures of cool-season grasses and legumes (Hojjati et al., 1978). For ryegrass to be productive on soils in the southeast U.S. fertilizer N needs to be applied.

It has been widely demonstrated over time that N fertilization of grass-legume mixtures enhances the grass component while adversely affecting the legume contribution to forage production (Maas et al., 1962; Nesheim and Oyen, 1994; and Templeton and Taylor, 1966). Craigmiles and Crowder (1963) reported crimson clover (*Trifolium incarnatum* L.) was eliminated from a mixture with oats and ryegrass when fertilizer N exceeded 54 kg $ha^{-1}$. Heichel and Henjum (1991) found red clover transferred minimal amounts of N to a companion grass in the seeding year. Results from these studies indicate annual grasses, such as ryegrass, will be dependent on fertilizer N when seeded with red clover but too high rate of N fertilization may adversely affect the clover.

The objective of this field study was to determine the impact of timing and rate of N fertilization on productivity from a sodseeded mixture of annual ryegrass and red clover.

**MATERIALS AND METHODS**
A field study was conducted for two years near Winnsboro, LA, U.S.A. on a Gigger silt loam soil (fine-silty, mixed, thermic Typic Fragiudalf). 'Kenland' red clover and 'Gulf' annual ryegrass were seeded in a mixture at rates of 10 and 34 kg $ha^{-1}$, respectively. The mixture was drill seeded into a closely clipped warm-season grass sod in a separate location in the fall of each year.

Soil test results were used to determine rates of P and K to apply each fall. Nitrogen fertilization treatments were applied in fall, approximately three weeks after planting, and in late February of each winter. Fall nitrogen rates were 0, 38, 76, and 114 kg $ha^{-1}$ while winter rates were 0, 56, and 112 kg ha-1. Fall and winter N treatments were combined in a 4 x 3 factorial arrangement.

Harvests began when growth in any treatment reached approximately 20 cm and continued on a monthly basis thereafter. All treatments were clipped at each harvest using a rotary disk mower that left approximately a 5 cm stubble height. Whole plot weights were recorded and a subsample was taken from each and weighed, dried and reweighed for dry matter determinations. A sample was collected from each plot at each harvest and hand separated and dried to determine botanical composition.

Treatments were arranged in a randomized complete block design. Data was analyzed using analysis of variance procedures. Treatment means of variables proving significantly different ($P < .05$) were compared using Fisher's protected least significant difference (LSD).

**RESULTS AND DISCUSSION**
Application of N to the sodseeded mixture of red clover and annual ryegrass reduced total dry forage production from the clover component (Table 1). When no N was applied in late winter and fall N did not exceed 76 kg $ha^{-1}$, total production from red clover was greater than from all treatments that received N in both fall and winter. The combination of the high N rate in either season with either of the two highest N rates in the other season reduced clover production below that of all other N treatments.

Red clover did not contribute significantly to forage production until March. When compared to treatments that received no applied N in the fall, clover production in March was not affected significantly by fall N rate of 38 kg $ha^{-1}$ but was reduced by higher fall N rates. Application of N in either season had an adverse effect on clover production in April but the detrimental effect was less if N was applied only in the fall at 76 kg $ha^{-1}$ or less. Treatments that received 170 or greater kg $ha^{-1}$ total N provided similar amounts of clover forage in April but the clover production was less than from all other N treatments. In May, clover production was greatest where no N had been added and least when N application had been highest in both fall and winter.

The mixture of annual ryegrass and red clover had to be fertilized with at least 170 kg $ha^{-1}$ total N before total dry forage production through June significantly exceeded production where no N was applied (Table 2). Amount of total dry forage from all other N treatments was similar to that produced when no N was applied.

Forage production in February came exclusively from ryegrass and reflects the dependence of ryegrass on N input. Fall N rate had to have been at least 76 kg $ha^{-1}$ before any significant amount of forage was produced in February and the highest fall N rate provided for the greatest amount of forage during this month. During March, forage production was least in treatments that received no N in winter and greatest where N had been applied in the fall and winter N rate was 112 kg $ha^{-1}$. Even though ryegrass was responding favorably in treatments that received 112 kg $ha^{-1}$ in winter the greater red clover production from treatments receiving no N in winter resulted in similar forage production among these treatments in April. In May and June,

ryegrass production was minimal and there was not enough residual N to boost warm-season grass growth so production differences among treatments could primarily be attributed to differences in red clover production.

These results indicate red clover can be sodseeded in a mixture with ryegrass and substitute for considerable amounts of N input without sacrificing overall forage production. Use of red clover as a complete substitute for N will greatly alter seasonal production, especially early. Use of relatively high rates of N in the fall with no winter N input appears to be a good strategy to provide for ryegrass production in the early season and maintain relatively high red clover production.

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**Table 1**
Dry forage production from red clover overseeded with ryegrass in a warm-season grass sward and fertilized with N at varying rates, Winnsboro, LA, two-years.

| Fall N | Winter N | Production Month | | | | |
|---|---|---|---|---|---|---|
| | | Mar. | April | May | June | Total |
| —kg ha$^{-1}$— | | ————Clover dry forage, Mg ha$^{-1}$———— | | | | |
| 0 | 0 | .7 | 3.4 | 2.1 | .6 | 6.8 |
| 76 | 0 | .3 | 2.4 | 1.8 | .6 | 5.2 |
| 38 | 0 | .5 | 2.4 | 1.7 | .5 | 5.1 |
| 0 | 56 | .7 | 1.8 | 1.6 | .6 | 4.6 |
| 0 | 112 | .7 | 1.6 | 1.8 | .4 | 4.4 |
| 114 | 0 | .3 | 1.8 | 1.8 | .5 | 4.3 |
| 38 | 56 | .5 | 1.7 | 1.6 | .4 | 4.2 |
| 76 | 56 | .3 | 1.6 | 1.7 | .4 | 4.0 |
| 38 | 112 | .5 | 1.3 | 1.7 | .4 | 3.8 |
| 114 | 56 | .2 | .8 | 1.5 | .3 | 2.9 |
| 76 | 112 | .3 | .7 | 1.5 | .2 | 2.7 |
| 114 | 112 | .2 | .8 | 1.1 | .3 | 2.4 |

LSD (.05) for comparisons among N treatments within a production month = .3.
LSD (.05) for comparisons within total yield = .7.

**Table 2**
Total dry forage production from a warm-season grass sward overseeded with ryegrass and red clover and fertilized with varying rates of N, Winnsboro, LA, two-years.

| Fall N | Winter N | | Production Month | | | | |
|---|---|---|---|---|---|---|---|
| | | Feb | Mar. | April | May | June | Total |
| —kg ha-1— | | ————Dry forage, Mg ha-1———— | | | | | |
| 114 | 112 | 1.2 | 2.4 | 4.3 | 1.4 | 1.5 | 10.7 |
| 76 | 112 | .7 | 2.2 | 4.0 | 2.0 | 1.7 | 10.6 |
| 114 | 56 | 1.1 | 2.0 | 3.9 | 2.0 | 1.6 | 10.5 |
| 76 | 56 | .6 | 1.9 | 4.0 | 2.1 | 1.6 | 10.2 |
| 114 | 0 | 1.2 | 1.1 | 3.7 | 2.2 | 1.9 | 10.1 |
| 38 | 112 | .2 | 2.1 | 4.2 | 2.1 | 1.6 | 10.1 |
| 76 | 0 | .6 | 1.0 | 4.2 | 2.3 | 2.0 | 10.0 |
| 0 | 112 | 0 | 1.9 | 4.1 | 2.3 | 1.6 | 9.7 |
| 0 | 0 | 0 | 1.1 | 4.3 | 2.4 | 1.8 | 9.6 |
| 0 | 56 | 0 | 1.7 | 4.0 | 2.0 | 1.7 | 9.3 |
| 38 | 56 | .1 | 1.8 | 3.9 | 1.9 | 1.6 | 9.3 |
| 38 | 0 | .2 | 1.0 | 4.0 | 2.2 | 1.8 | 9.2 |

LSD (.05) for comparisons among N treatments within a production month = .3.
LSD (.05) for comparisons within total yield = .9.