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# Nitrogen Fertilization of Rose Clover - Ryegrass Mixtures

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## Summary

A study of nitrogen (N) rate and time of application was conducted for 3 years on a mixture of 'Overton R-18' rose clover (*Trifolium hirtum* All.) and TAM 90 ryegrass (*Lolium multiflorum* Lam.) overseeded on Coastal bermudagrass (*Cynodon dactylon* (L) Pers.). This study was conducted at Texas A&M University Agricultural Research and Extension Center at Overton. Application of as much as 90 lb N/acre at planting or 1 month later did not affect leaves, nodules, or weight per clover seedling. The general trend was for ryegrass yields to increase and rose clover yields to decrease as total N fertilizer for the season increased. Rose clover alone or with ryegrass and without N fertilizer provided good spring forage production. Earlier forage production depended on N fertilization. Applying N in early winter had the greatest impact on improving early forage production. Ryegrass response to N applied at planting or 1 month after planting was poor because of slow seedling growth when overseeded in a warm-season perennial grass sod.

## Introduction

Clover-ryegrass mixtures are overseeded on warm-season perennial grasses such as bermudagrass, dallisgrass (*Paspalum dilatatum* Poir.), and bahiagrass (*Paspatum notatum* Flugge) to provide grazing in late winter and early spring, when the summer grass is dormant. Ryegrass provides early growth if fertilized with N and helps reduce bloat in cattle grazing a legume. Clover provides high-quality forage during spring months, and it can obtain N from the air through $N_2$-fixation. Nitrogen fertilizer is necessary for early ryegrass production, but clover growth and N-fixation may be hindered through competition with ryegrass for light. Whether to apply N to a legume at planting is controversial. Nitrogen can reduce nodulation (Evers 1980) and $N_2$-fixation (Hojjati et al. 1978) but has also enhanced growth (Schomberg and Weaver 1990) of some clover species.

Rose clover is new to Texas and the southeastern United States. It has been grown on the California rangelands since 1949 (Love 1985). Because rose clover is adapted to alkaline soils (Evers 1989) and produces a high percentage of hard seed (Smith 1993), it has great potential for the 20- to 30-in. rainfall belt of central Texas and Oklahoma. Overton R-18 rose clover, which was released in 1991 (Smith et al. 1992), is 3 to 4 weeks later maturing and twice as productive as other available varieties. A study examining N rates and application times on a rose clover - ryegrass mixture overseeded in a Coastal bermudagrass sod was conducted for 3 years at the Texas A&M University Agricultural Research and Extension Center at Overton.

**Keywords:** winter pasture / rose clover / nitrogen fertilization.

## Procedure

Study sites were overseeded in mid-October on a Keithville-Sawtown sandy loam in 1990 and 1991 and a Lilbert loamy fine sand in 1992. The bermudagrass sod was mowed to a 1-in. height before planting. Overton R-18 rose clover and TAM 90 ryegrass were drilled in 7-in. rows at 20 lb/acre separately and perpendicularly to each other. Phosphorus and potassium were each applied at 80 lb/acre and boron at 1 lb/acre at planting. Nitrogen fertilizer treatments are reported in Table 1. Experimental design was a complete randomized block with four replications. Plot size was 8 by 15 ft.

Ten rose clover seedlings were removed at random from each plot 2 months after planting in the 1990-91 study and 3 months after planting in the 1991-92 and 1992-93 studies. Leaves and nodules per clover seedling were counted. Seedlings were dried for 24 hr at 140 °F to determine dry weight. Plots were harvested in March, April, and May each year with a Hege sickle bar harvester at a 2-in. cutting height. Subsamples of the harvested forage were collected from each plot and were hand-separated to determine botanical composition and dry matter percentage. Statistical analysis was by PC-SAS, and treatment mean separation was by Waller-Duncan multiple range test.

## Results

Leaves, nodules, and weight of rose clover seedlings were not significantly different from the no-N fertilizer control when 30, 60, or 90 lb N/acre were applied at planting or 1 month later. Therefore, these results will not be reported. There were significant differences between years and year × treatment inter-

actions for the first harvest and total yield. These will be reported for each year.

Rose clover yields at first harvest in 1990-91 were significantly higher in the treatment without N than in treatments with N fertilizer (Fig. 1). Applying 60 or 90 lb N at planting or 1 month later followed by 60 lb N in December reduced rose clover yields the most. Delaying any N fertilization until December resulted in the highest rose clover yields among the N fertilizer treatments. Ryegrass production was the greatest when 60 or 90 lb N were applied 1 month after planting followed by 60 lb N in December. The dependence of ryegrass for N fertilizer on the sandy soils of east Texas is illustrated by very low ryegrass yields from the clover-ryegrass mixture and from ryegrass yields alone where no N was applied.

Total yields of the rose clover - ryegrass mixtures ranged from 2,500 to 3,800 lb dry matter/acre (Fig. 1). Delaying the 60- and 90-lb N rate from planting until 1 month later enhanced ryegrass production and resulted in the highest total yields. The forage mixture without N produced 1,000 lb/acre more than did the ryegrass alone without N. Nitrogen fertilization of rose clover - ryegrass resulted in 5.6 lb/acre or less of forage produced per lb N applied. Applying only 60 lb N/acre 1 month after planting increased ryegrass but decreased clover production. This resulted in the same total yield as that of the treatment without N.

In the 1991-92 study, rose clover yields were very low at first harvest, ranging from 40 to 150 lb/acre (Fig. 2). There were significant differences among treatments, but there was no relationship to N rate or time of application. Ryegrass yields ranged from 700 to 1,100 lb/acre when fertilized with N except for the 60 lb N, 1 month after planting only. This treatment produced only 300 lb/acre. Best ryegrass production at the first harvest occurred when 90 lb N was applied at planting or when N fertilization was delayed until 1 month after planting followed by 60 lb N/acre in January. Ryegrass alone or mixed with rose clover without N produced only 100 lb/acre. Presence or absence of rose clover had no effect on ryegrass yields. Applying only 60 lb N in January resulted in the greatest yield response per lb N fertilizer.

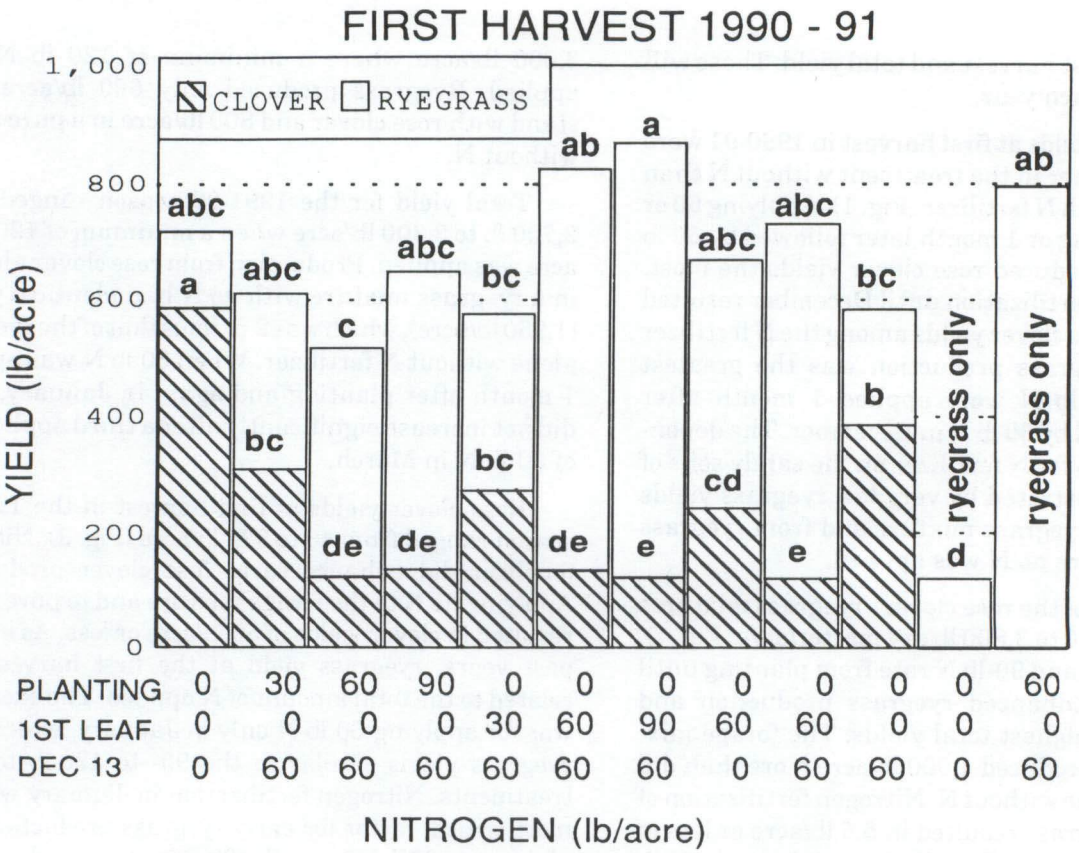
Total rose clover production of the 1991-92 season was greatest in the pure clover treatment followed by the no-N and with only 60-lb-N 1 month after planting treatments. Even in the absence of N fertilizer, ryegrass was competitive enough to reduce rose clover production. Lower clover yields when N was applied 1 month after planting instead of at planting were due to increased ryegrass competition. Ryegrass production in 1991-92 ranged from 2,000 to just over 3,000 lb/acre where a minimum of 120 lb N was applied. Ryegrass produced only 600 lb/acre in a stand with rose clover and 800 lb/acre in a pure stand without N.

Total yield for the 1991-92 season ranged from 2,700 lb to 3,300 lb/acre when a minimum of 120 lb N/acre was applied. Production from rose clover alone or in a ryegrass mixture with no N had identical yields (1,950 lb/acre), which was 2.5 times that of the ryegrass alone without N fertilizer. When 60 lb N was applied 1 month after planting and again in January, yield did not increase significantly after a third application of 60 lb N in March.

Rose clover yields at first harvest in the 1992-93 season ranged from 40 to 375 lb/acre (Fig. 3). Nitrogen fertilizer did enhance early rose clover production. Applying no N to the forage mixture and to pure clover resulted in clover yields of 50 lb/acre or less. As in the 2 past years, ryegrass yield at the first harvest was related to the total amount of N applied. The exception was for applying 60 lb N only in January, which gave ryegrass yields similar to the 90- to 120-lb total N treatments. Nitrogen fertilization in January was the most critical factor for early ryegrass production. Applying only 60 lb N 1 month after planting produced less than 200 lb/acre. Total yield at the first harvest was based on ryegrass response to N fertilizer.

Total rose clover production in the 1992-93 season was lowest whenever 60 lb N was applied in March. Clover yield in other treatments in decreasing order were clover alone, mixture with no N, mixture with 60 lb N 1 month after planting, mixture with 60 lb N in January, and mixture with 60 lb N 1 month after planting and in January. Rose clover yield in a mixture with no N was 4,000 lb/acre in 1992-93 compared with 1,400 lb/acre in 1990-91 and 1991-92. The high 1992-93 yield was due to mild winter temperatures, a wet spring, and a very low soil N level because the test site had not been fertilized the previous 2 years. Ryegrass plants turned yellow and died in the pure ryegrass plots with no N. Total ryegrass production in the 1992-93 season was directly related to the amount of N fertilizer applied.

Excluding the no-N treatment on pure ryegrass, total 1992-93 yields ranged from 3,750 lb/acre on pure ryegrass with 180 lb N to 5,300 lb/acre on a mixture with 90 lb N at planting followed by 60 lb N in January and again in March. The favorable clover growing season allowed total yields from no- or low-N treatments to be similar to high-N treatments. The treatment receiving 90 lb N at planting plus 60 lb N in January and March produced significantly more total forage than did the no-N-on-mixture treatment.



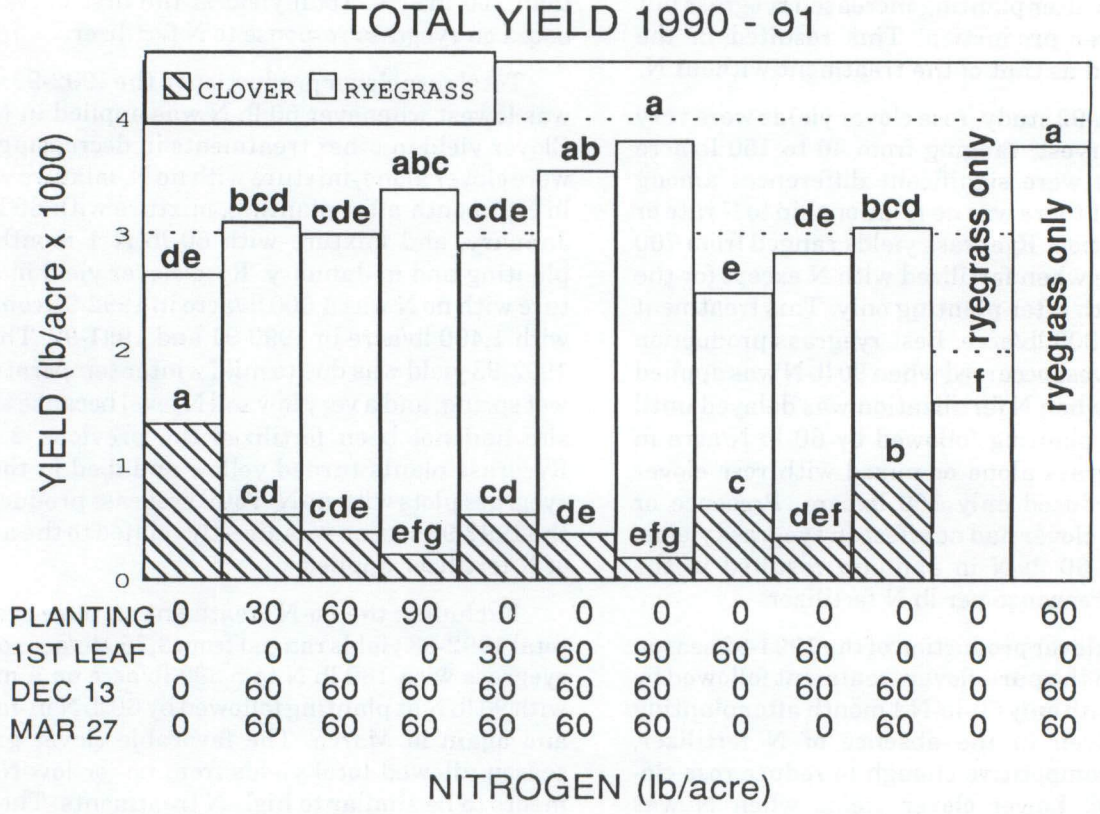




**Figure 1. Rose clover and rose clover - ryegrass yields in the first harvest and season of 1990-91. Bottom letters denote significant difference (0.05 level) in clover yields, and top letters indicate significant difference in rose clover plus ryegrass yields.**

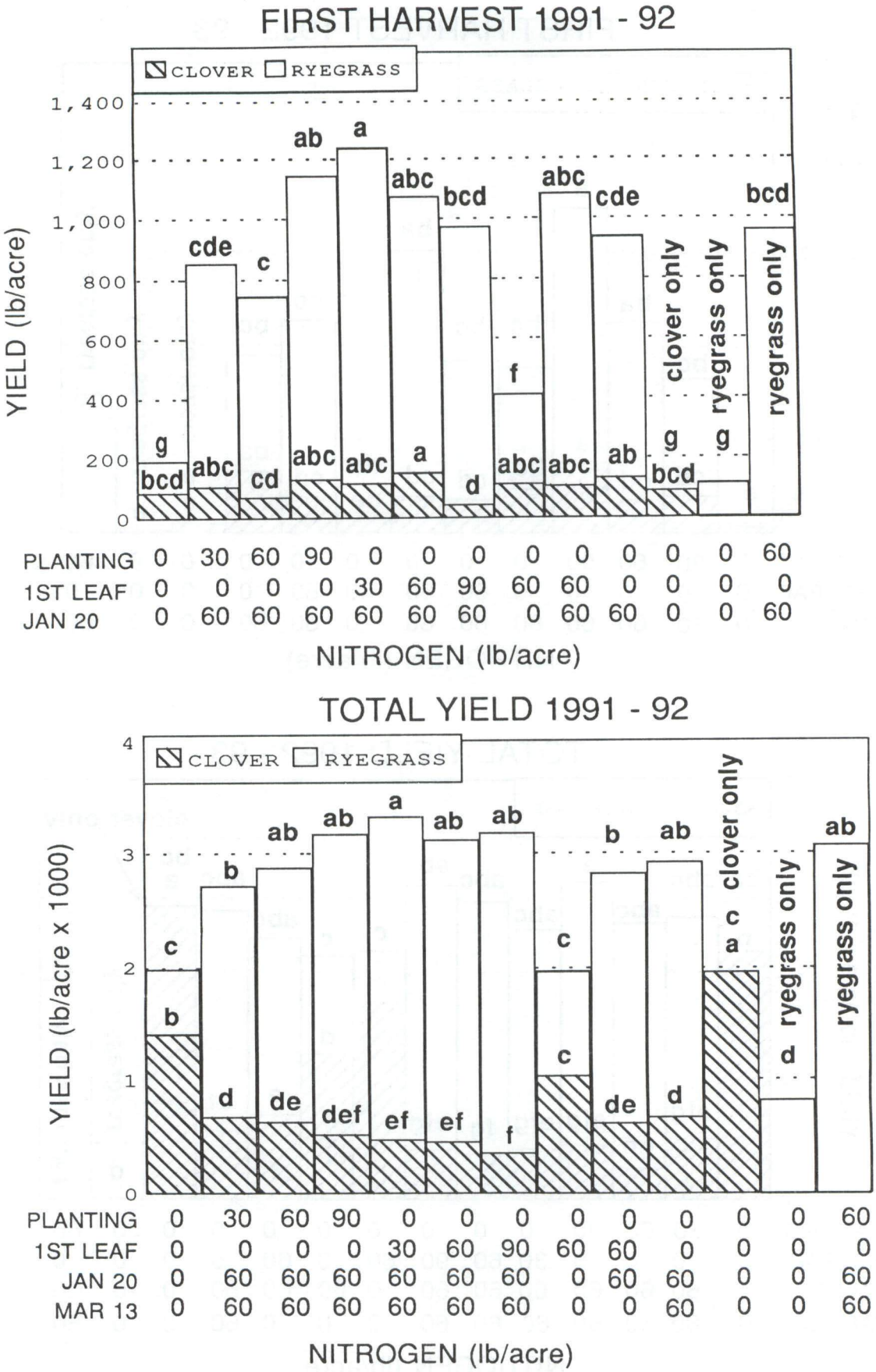
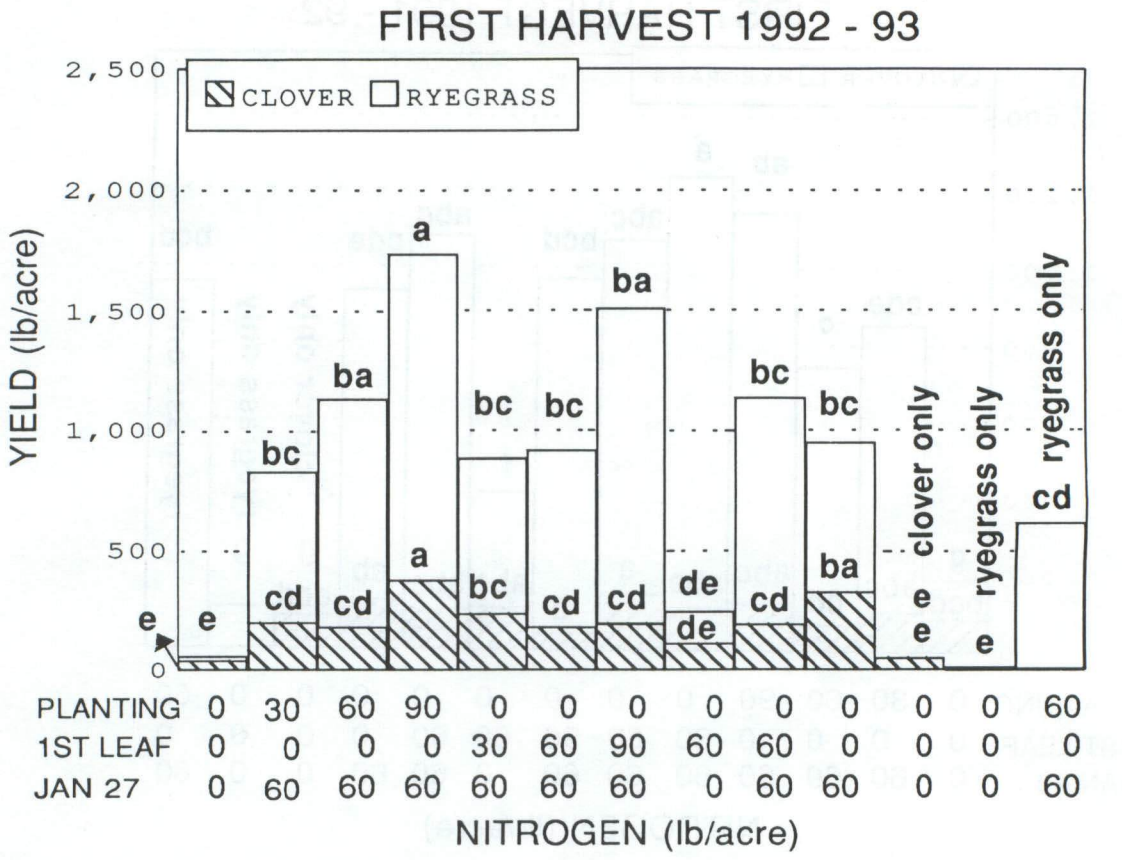



**Figure 2. Rose clover and rose clover - ryegrass yields in the first harvest and season of 1991-92. Bottom letters denote significant difference (0.05 level) in clover yields, and top letters indicate significant difference in rose clover plus ryegrass yields.**



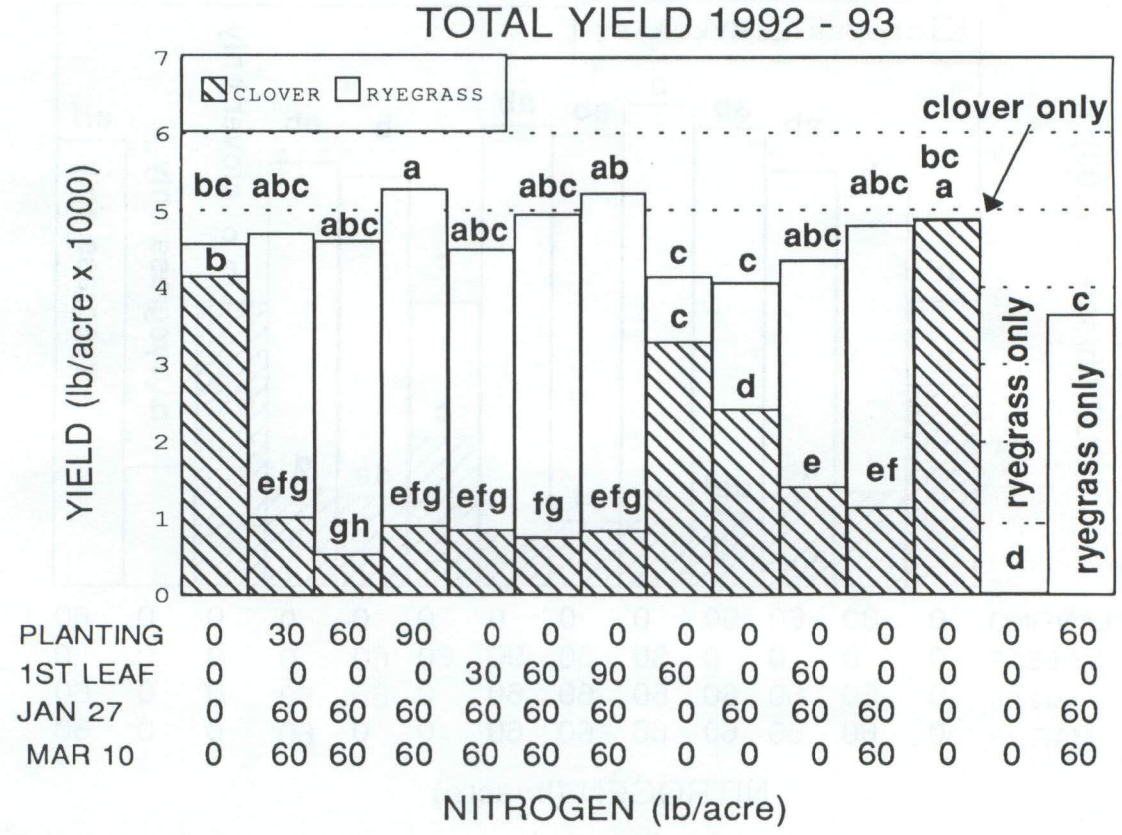




**Figure 3. Rose clover and rose clover - ryegrass yields in the first harvest and season of 1992-93 season. Bottom letters denote significant difference (0.05 level) in clover yields, and top letters indicate significant difference in rose clover plus ryegrass yields.**

**Table 1. Nitrogen fertilizer treatments imposed on an Overton R-18 rose clover - TAM 90 ryegrass mixture or pure stands.**

| Oct. (planting) | Nov. (1st clover leaf) | Dec. or Jan. | Mar. | Total |
|---|---|---|---|---|
| | | lb N/acre | | |
| Rose-ryegrass mixture | | | | |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 60 | 60 | 120 |
| 30 | 0 | 60 | 60 | 150 |
| 60 | 0 | 60 | 60 | 180 |
| 90 | 0 | 60 | 60 | 210 |
| 0 | 30 | 60 | 60 | 150 |
| 0 | 60 | 60 | 60 | 180 |
| 0 | 90 | 60 | 60 | 210 |
| 0 | 60 | 0 | 0 | 60 |
| 0 | 60 | 60 | 0 | 120 |
| 0† | 0 | 60 | 0 | 60 |
| 0† | 0 | 60 | 60 | 120 |
| Ryegrass | | | | |
| 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 60 | 60 | 180 |
| Rose clover | | | | |
| 0‡ | 0 | 0 | 0 | 0 |

†In 1992-93 only.
‡In 1991-92 and 1992-93 only.

## Discussion

Rose clover provided very little forage production early in the season. This agrees with previous work that showed rose clover seedling growth to be slow and inferior to other major cool-season clover species used in the southeastern United States (Evers 1993). Early forage production from a rose clover - ryegrass mixture depended on N fertilization of the ryegrass. Nitrogen rates as much as 90 lb/acre at planting or 1 month after planting did not influence leaves, nodules, or weight per clover seedling.

Soils on which these studies were conducted are sandy, low in fertility and organic matter, and subject to leaching, which results in low N utilization. On loam or clay soils, N rates of 60 lb/acre or more may reduce nodulation and growth of clover seedlings because of greater ryegrass competition. On sandy soils, the initial N application should be delayed until clover and ryegrass seedlings are established to increase greater N availability for ryegrass growth. Early production of ryegrass increased as N rate at planting or 1 month after planting increased. For the total season, rose clover yields decreased and ryegrass yields increased as the total N rate increased.

A balance between clover yield and N fertilizer rate must be reached to optimize forage production and distribution per lb N fertilizer applied. If forage is not needed before mid-March, a rose clover - ryegrass mixture or rose clover alone without N would be satisfactory. Nitrogen fertilization of the ryegrass is essential if earlier forage production is desired. The most critical N application time for enhanced early ryegrass production was December-January. Applying only 60 lb N/acre at this time produced first-harvest yields comparable to treatments receiving 90 to 120 lb N/acre. Sixty lb N/acre applied 1 month after planting and in early winter produced more forage than did the single winter application each year. However, these differences are not significantly different. With normal late autumn and winter rainfall in east Texas, most of the applied N fertilizer is taken up by the plant or lost within 5 to 6 weeks after application. Utilization of N applied at planting or early in the growing season is poor because ryegrass seedling growth is slow when overseeded on warm-season perennial grass pastures. Applying N in March increased ryegrass and decreased clover yields, which resulted in very little gain in total yield. Spring months are the peak clover-growing period. Nitrogen fertilization during this time does not benefit clover because clover can obtain N from the air through $N_2$-fixation.

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