

Adaptation and  
Performance of  
Forage Species

in  
North Carolina

## Contents

|  |    |
|--|----|
| Introduction .....                                   | 3  |
| General Procedure .....                              | 4  |
| Section I—Perennial Grasses .....                    | 5  |
| Section II—Perennial Legumes .....                   | 16 |
| Section III—Perennial Legume-Grass<br>Mixtures ..... | 23 |
| Section IV—Winter Annual Grasses .....               | 33 |
| Section V—Summer and Winter<br>Annual Legumes .....  | 36 |
| Section VI—Summer Annual Grasses .....               | 39 |
| Appendix .....                                       | 42 |
| Common and Scientific Names .....                    | 47 |
| Index .....  | 45 |

## Acknowledgments

*The author wishes to recognize the contributions of A. A. Hanson, M. A. Hein, Paul R. Henson and E. A. Hollowell located at Beltsville, Md. with the Field Crops Research Branch USDA. These men supplied much of the seed for the various strain tests and also assisted in the general planning.*

*The earlier tests reported in the publication were conducted largely by R. L. Lovvorn and W. W. Woodhouse, Jr. The first experiment described was conducted jointly with S. H. Dobson. Appreciation is also expressed to Scientific Aides, U. O. Highfill and J. D. Washburn.*

# Adaptation and Performance of Forage Species

## A 15-YEAR SUMMARY

By Douglas S. Chamblee, Associate Professor of Field Crops

This is a summary of certain variety and strain tests of forage crops in North Carolina conducted between 1943 and 1958. The yield performance of many species and varieties are presented in this manuscript; however, only those species and varieties which are of local (North Carolina) or general national interest are discussed. Varieties, for example, that have shown promise in adjoining or nearby states are discussed in detail regardless of their adaptability. This publication can and should be utilized as a reference manual. A complete index is presented. In several instances a new variety developed in another state will produce less than half as much forage per acre as a standard grown variety. In many such cases the exact cause for this relatively poor performance is not known. However, the data are available in the tables for examination by the reader.

Certain species or varieties are tested more extensively than others. Species or varieties which are very poorly adapted due to lack of winter hardiness, lack of drought resistance, or extreme susceptibility to disease or insects can be quickly eliminated in very simple tests.

Other species and varieties which are vigorous and apparently well adapted, such as Alta and Ky. 31 tall fescue, or common pearl and Starr millet, require extensive testing before any conclusion can be drawn as to the superior variety.

A species showing promise must also be tested under a wide range of conditions including combinations with other species and under different fertility and grazing conditions for several years before a final evaluation can be made. Frequently the plant breeder must improve characteristics such as the vigor, quality, and disease and insect resistance before a plant is deemed satisfactory for widespread use.

Even though many species and varieties are reported as inferior under the conditions tested, this report should not be considered a final evaluation. Under different conditions certain so-called inferior species mentioned in this publication may prove

useful as forage plants. In future years, such plants as smooth brome grass, big trefoil, reed canary grass, etc., may become very useful in this area through the efforts of the plant breeder and other research scientists. New methods of inoculation, fertilization or other cultural management procedures may enable us to grow forages now considered as unadapted.

Extensive strain and variety tests have been conducted in North Carolina with alfalfa and lespedeza by the various research workers. Since these data will be printed in another publication at a later date, only limited information on these species is presented in this report.

## General Procedure

All data reported herein represent weed-free forage. Weeds were removed by hand separation of a minimum 10 per cent sample. Individual plots, unless otherwise noted, were 5x25 feet in size, and a 2x23-foot sample was harvested with a cutter bar-type mower for yield. The entire sample was dried on slatted floor bins, utilizing forced hot air (approximately 140 degrees F.). Yields are reported in pounds dry matter per acre. Each experiment had either three or four replications.

Fertilization and general management are noted either on the tables or in the Appendix. F— numbers represent field number designations. Much of the data presented in the tables are self explanatory, and space does not permit individual and special discussions of all strains and varieties.

The fertilization procedures noted with the data do not represent necessarily our present recommendations for these crops. Fertilization procedures have changed greatly in the past ten to 15 years. In several instances slightly more fertilizer was applied on a per acre basis than is generally required for good production. In other instances the fertilizer practices utilized ten years ago may be considered inadequate for best growth of these forages today.

In many tables the data are summarized for the year and seasonal yields are not presented. These detailed data are available in the Forage Crops Management Annual Reports, Dept. of Field Crops, N. C. State College.

Analyses of variance are computed for many of the experiments and Least Significant Differences (LSD) at the 5 per cent level of significance and Coefficients of Variation (CV) are presented.

The common and scientific names (Latin names of genus and species) of the various species and varieties noted in the manuscript are presented on page 47.



Section 1—Tables 1-14

## Perennial Grasses

### Summary

Tall fescue, orchardgrass and Kentucky bluegrass are the best adapted cool season perennial grasses for use in North Carolina. Kentucky bluegrass is adapted in the Mountain area and Upper Piedmont; however, orchardgrass is more productive. On the more gentle slopes, orchardgrass is replacing Kentucky bluegrass. Orchardgrass and tall fescue are the two principal grasses utilized in mixture with Ladino clover in North Carolina. Potomac orchardgrass is the best variety of orchardgrass available, whereas Kentucky 31 and alta tall fescue are the better two varieties of tall fescue.

Coastal Bermuda grass is the best adapted perennial warm season grass for the drained soils of the Coastal Plain and Piedmont area. Suwannee Bermuda is subject to winter damage in North Carolina.

Coastal Bermuda grass is especially well adapted to deep sandy soils and high yields of forage may be obtained during midsummer if properly fertilized. Coastal is frequently grown in pure stand.

### Results and Discussion

#### Cool Season Perennials Emphasized

*(Tall fescue, orchardgrass, Kentucky bluegrass, redtop, etc. Tables 1-9)*

Seasonal and total yields of five perennial grasses grown at three locations are presented in Table 1. These grasses were seeded in March 1946, and the data for the first year are not presented in this report. These detailed data for the first year are presented in the Forage Crops Management Annual Report. However, in the first year, Dallisgrass was the most productive of all the grasses at all three locations, being most productive on the Bladen soil. The temperature in the Piedmont area reached 6 degrees F. on several days during the winter of 1946-47 and Dallisgrass suffered severe winter injury at the Piedmont and

Mountain locations. This injury was reflected in reduced yields in 1947 (Table 1). Dallisgrass usually winterkills in the Mountain area even during a normal year.

Kentucky bluegrass establishes itself slowly. During the first year it was the least productive of all grasses on all soils. Orchardgrass and tall fescue were more productive than Kentucky bluegrass in both years at all locations (Table 1).

The yields of orchardgrass and tall fescue were about the same in the Mountain and Piedmont areas. However, orchardgrass yielded more than tall fescue in the Tidewater area on a Bladen soil, which had been well-drained by artificial means. Other experiments indicate that tall fescue will yield more than orchardgrass in the Tidewater area on poorly drained soils.

Redtop was adapted at all locations, and was the most productive grass on the poorly-drained Bladen soil in the second year. However, tall fescue and orchardgrass have largely replaced red-

**Table 1. Seasonal growth of five perennial grasses grown in pure stands at three locations (second year following seeding).<sup>1</sup>**

| Grass                    | Mountains (Hiwassee clay loam) |               |                | Total 1947 |
|--------------------------|--------------------------------|---------------|----------------|------------|
|                          | May 16, 1947                   | July 24, 1947 | Sept. 13, 1947 |            |
|                          | (Pounds dry matter per acre)   |               |                |            |
| Tall fescue              | 2,605                          | 620           | 662            | 3,887      |
| Orchardgrass             | 2,837                          | 588           | 500            | 3,925      |
| Kentucky bluegrass       | 1,346                          | 158           | 284            | 1,788      |
| Redtop                   | 1,158                          | 376           | 218            | 1,752      |
| Dallisgrass <sup>2</sup> | 0                              | 144           | 1,408          | 1,552      |

| Grass              | Piedmont (Cecil clay loam)   |               |               | Total 1947 |
|--------------------|------------------------------|---------------|---------------|------------|
|                    | May 14, 1947                 | July 12, 1947 | Aug. 28, 1947 |            |
|                    | (Pounds dry matter per acre) |               |               |            |
| Tall fescue        | 962                          | 332           | 248           | 1,542      |
| Orchardgrass       | 1,052                        | 312           | 136           | 1,500      |
| Kentucky bluegrass | 136                          | 142           | 114           | 392        |
| Redtop             | 870                          | 338           | 96            | 1,304      |
| Dallisgrass        | 0                            | 126           | 886           | 1,012      |

| Grass              | Tidewater (Bladen silt loam) |               |               |               | Total 1947 |
|--------------------|------------------------------|---------------|---------------|---------------|------------|
|                    | May 17, 1947                 | June 24, 1947 | July 22, 1947 | Aug. 22, 1947 |            |
|                    | (Pounds dry matter per acre) |               |               |               |            |
| Tall fescue        | 490                          | 396           | 468           | 822           | 2,176      |
| Orchardgrass       | 1,276                        | 572           | 442           | 874           | 3,164      |
| Kentucky bluegrass | 78                           | 216           | 416           | 712           | 1,422      |
| Redtop             | 2,347                        | 1,362         | 538           | 438           | 4,685      |
| Dallisgrass        | 180                          | 986           | 812           | 1,258         | 3,236      |

<sup>1</sup> Plots were seeded in March 1946. Fertilized with 600 lbs./A. 0-12-12 at seeding and 96 lbs. elemental nitrogen in split application spring and summer. First year yields are not reported.

<sup>2</sup> Dallisgrass was severely damaged by cold during the previous winter.

**Table 2. Average per cent nitrogen analyses of five perennial grasses when grown on three soil types, 1947.<sup>1</sup>**

| Grass              | Mountains           | Piedmont        | Tidewater        |
|--------------------|---------------------|-----------------|------------------|
|                    | Hiwassee clay loam  | Cecil clay loam | Bladen silt loam |
|                    | (Per cent nitrogen) |                 |                  |
| Tall fescue        | 2.13                | 2.00            | 1.80             |
| Orchardgrass       | 2.24                | 2.00            | 1.68             |
| Kentucky bluegrass | 2.42                | 2.26            | 1.70             |
| Redtop             | 2.18                | 2.16            | 1.65             |
| Dallisgrass        | 1.66                | 1.42            | 1.40             |

<sup>1</sup> These analyses were made on same experiment noted on previous page, Table 1. Forage from Mountains was cut June 8, July 23 and September 13. Forage from Piedmont was cut May 14, July 12, Aug. 20, and forage from the Tidewater was cut and analyzed May 17, June 24, July 22. (Cut but not analyzed in August.) Fertilized as shown on previous tables with 96 lbs. elemental nitrogen in split application.

top as a pasture grass in this area. Redtop is very aggressive and competes too strongly with legumes. Even though redtop produces excellent total yields, the late summer yields of this plant are usually low compared with orchardgrass or tall fescue.

Dallisgrass was lower in per cent nitrogen than other grasses tested (Table 2). Orchardgrass and tall fescue had approximately the same percentage nitrogen on all soils.

In greenhouse experiments (Table 3) utilizing the same soils (from the Mountain, Piedmont and Tidewater areas) Dallisgrass was the most productive and Kentucky bluegrass the least productive of the grasses tested. The only exception occurred on the mountain soil where Kentucky bluegrass yielded as much as orchardgrass. Under field conditions, however, Dallisgrass grows during a much shorter season than orchard or tall fescue (Table 1).

Orchardgrass and redtop had a higher percentage of calcium (CaO) than did the other three grasses. Redtop had a higher

**Table 3. Average yield in grams dry weight per pot of five perennial grasses grown on three soil types under greenhouse conditions.<sup>1</sup>**

| Grass              | Mountain soil      |                   | Piedmont soil      |                   | Tidewater soil     |      | LSD .05 soils |
|--------------------|--------------------|-------------------|--------------------|-------------------|--------------------|------|---------------|
|                    | Hiwassee clay loam | Cecil clay loam   | Bladen silt loam   | Bladen silt loam  | Bladen silt loam   | Rank |               |
|                    | Yield <sup>2</sup> | Rank <sup>2</sup> | Yield <sup>2</sup> | Rank <sup>2</sup> | Yield <sup>2</sup> | Rank |               |
| Tall fescue        | 4.34               | 2                 | 4.96               | 2                 | 3.62               | 3    | .43           |
| Orchardgrass       | 3.90               | 3                 | 4.06               | 3                 | 2.65               | 4    | .53           |
| Kentucky bluegrass | 3.79               | 3                 | 3.42               | 5                 | 1.74               | 5    | 1.57          |
| Redtop             | 3.65               | 3                 | 3.95               | 3                 | 4.12               | 2    | N.S.          |
| Dallisgrass        | 7.46               | 1                 | 7.60               | 1                 | 6.79               | 1    | .45           |

LSD (.05) Between grasses on any one soil .46.

<sup>1</sup> Forage harvested every 30 days during 240-day period. First two harvests discarded. Above represents average of last six harvests. Two gallon pots were used. Average of two nitrogen levels, these being 16 and 48 lbs. of elemental nitrogen, applied every 60 days. Four replications.

<sup>2</sup> Average yield over a 240-day period.

percentage of phosphorus than did other grasses analyzed (Table 4).

In another series of experiments (Tables 5, 6, 7 and 8) several of the cool season grasses were tested under field conditions. Initial stands of 90 to 100 per cent were obtained in experiments F111, F331, and F146 with the exception of Iowa reed canary and meadow foxtail in experiment F146 (Table 7).

Potomac (Beltsville) orchardgrass proved to be a superior variety of orchardgrass (Tables 5, 6 and 7). Syn. IV, Wash. Hybr. 2, Str. 88, Oreg. 233 and No. 233 strains of orchardgrass produced less seed heads than Potomac, Virginia grown or Danish orchardgrass, and were generally later in maturing. Following a prolonged drought of ten weeks, Wash. Hybr. 2, Str. 88, Oreg. 233 and No. 233 strains of orchardgrass showed heat damage in the late summer of 1953. No data are recorded in this manuscript regarding heat damage; however, ratings were recorded in the field notebook. These particular plants turned brown and were slow in recovery. Prior to the drought, these Danish orchardgrass was inferior to Potomac in vigor and disease resistance, particularly in the Mountain area (Table 6). In the Mountain area at elevations of approximately 2,900 feet,

**Table 4. Chemical analyses of five perennial grasses grown on three soil types under greenhouse conditions.<sup>1</sup>**

| Grass                                  | Bladen silt loam  |                 |                  |
|--|-------------------|-----------------|------------------|
|  | Hiwasee clay loam | Cecil clay loam | Bladen silt loam |
| Tall fescue                            | 2.98              | 2.58            | 3.09             |
| Orchardgrass                           | 2.83              | 2.93            | 2.89             |
| Kentucky bluegrass                     | 3.19              | 2.86            | 3.58             |
| Redtop                                 | 3.38              | 3.39            | 3.34             |
| Dallisgrass                            | 1.71              | 1.70            | 1.76             |
| Per cent CaO                           |                   |                 |                  |
| Tall fescue                            | .68               | .58             | .54              |
| Orchardgrass                           | .86               | .78             | .70              |
| Kentucky bluegrass                     | .55               | .52             | .46              |
| Redtop                                 | .96               | .85             | .77              |
| Dallisgrass                            | .55               | .52             | .43              |
| Per cent P <sub>2</sub> O <sub>5</sub> |                   |                 |                  |
| Tall fescue                            | .64               | .72             | .42              |
| Orchardgrass                           | .66               | .99             | .46              |
| Kentucky bluegrass                     | .66               | .73             | .50              |
| Redtop                                 | .81               | 1.06            | .75              |
| Dallisgrass                            | .59               | .60             | .44              |

<sup>1</sup> Average of analyses made on six harvests. The analyses are averages from plots receiving 48 lbs. of N, every 60 days. This is the same experiment as reported in Table 3 and management is shown there.

Akaroa, No. 233, S143 and S-37 orchardgrass showed severe winter injury. In the Tidewater area (Table 7) orchardgrass produced approximately as much growth as tall fescue on a Bladen silt loam which had been well drained by canals and tile. Prairie bromegrass No. 25 (Rescue grass) and Harding grass produced excellent growth during the fall and spring of the first season in the Tidewater area. Rescue grass reached a height of six to eight inches by December and made excellent growth through July of the first year. After the first two years, how-

**Table 5. Performance of miscellaneous perennial grasses. Lower Piedmont, Cecil clay loam, F111.<sup>1</sup>**

| Percent stand | 1952                       |     | 1953 |                       | 1953 |      | 1955              |     | 1955 |                    | 1955 |     |                       |    |                            |    |    |
|---------------|----------------------------|-----|------|-----------------------|------|------|-------------------|-----|------|--------------------|------|-----|-----------------------|----|----------------------------|----|----|
|               | 11/24                      | 5/1 | 6/19 | 5/11                  | 6/5  | 11/3 | 6/2               | 6/2 | 6/2  | 6/2                | 6/2  | 6/2 |                       |    |                            |    |    |
|               | Vigor ratings <sup>4</sup> |     |      | Maturity <sup>5</sup> |      |      | Rust <sup>6</sup> |     |      | Vigor <sup>8</sup> |      |     | Maturity <sup>9</sup> |    | Leaf Disease <sup>10</sup> |    |    |
|               | 93                         | 93  | 93   | 93                    | 93   | 93   | 93                | 93  | 93   | 93                 | 93   | 93  | 93                    | 93 | 93                         | 93 | 93 |

| Treatment       | 1952                   |            | 1953 |      | 1953 |      | 1955 |     | 1955 |      | 1955 |     |
|-----------------|------------------------|------------|------|------|------|------|------|-----|------|------|------|-----|
|                 | 11/24                  | 5/1        | 6/19 | 5/11 | 6/5  | 11/3 | 6/2  | 6/2 | 6/2  | 6/2  | 6/2  | 6/2 |
| Orchardgrasses: | Trogdon                | 93         | 2.3  | 2.3  | 2.3  | 2.3  | 2.3  | 2.3 | 2.3  | 2.3  | 2.3  | 2.3 |
|                 | Syn. 1                 | 93         | 2.3  | 2.3  | 2.3  | 2.3  | 2.3  | 2.3 | 2.3  | 2.3  | 2.3  | 2.3 |
|                 | Syn. 11                | 95         | 2.3  | 2.3  | 2.3  | 2.3  | 2.3  | 2.3 | 2.3  | 2.3  | 2.3  | 2.3 |
|                 | Syn. 111               | 93         | 2.0  | 2.3  | 2.0  | 2.0  | 2.0  | 2.0 | 2.0  | 2.0  | 2.0  | 2.0 |
|                 | Syn. IV                | 93         | 2.3  | 2.0  | 2.0  | 2.5  | 3.3  | 6.5 | 1.0  | 2.5  | 1.5  | 1.5 |
|                 | Beltsville             | 95         | 2.0  | 2.3  | 2.7  | 8.0  | 3.5  | 3.5 | 6.0  | 4.0  | 4.0  | 4.0 |
|                 | No. 233                | 85         | 3.0  | 3.0  | 3.0  | 3.0  | 2.3  | 4.5 | 4.0  | 3.0  | 3.0  | 5.0 |
|                 | Palestine              | 50         | 6.7  | 5.0  | 9.0  | 8.0  | 6.3  | 3.5 | 9.5  | 8.0  | 8.0  | 8.0 |
|                 | Avon                   | 93         | 2.7  | 3.3  | 3.0  | 8.3  | 3.0  | 7.5 | 5.0  | 7.5  | 8.5  | 5.5 |
|                 | Akaroa                 | 93         | 2.3  | 1.7  | 2.3  | 8.0  | 8.7  | 6.0 | 2.0  | 7.5  | 4.0  | 4.0 |
|                 | M2-11142-49            | 93         | 1.7  | 2.3  | 2.7  | 6.0  | 7.3  | 4.5 | 3.5  | 8.5  | 5.0  | 5.0 |
|                 | No. 52                 | 95         | 2.3  | 2.7  | 7.5  | 2.7  | 7.5  | 4.5 | 6.0  | 6.0  | 6.0  | 6.0 |
| 2453            | 56                     | 7.7        | 5.3  | 7.3  | 4.0  | 4.3  | 5.5  | 8.0 | 3.0  | 5.0  | 5.0  |     |
| Tall Fescue:    | Commercial             | 95         | 2.0  | 2.0  | 2.0  | 3.0  | 10.0 | 9.7 | 5.0  | 4.0  | 9.5  | 5.5 |
|                 | Danish                 | 92         | 2.7  | 2.0  | 2.3  | 7.5  | 7.3  | 3.5 | 4.0  | 6.0  | 6.0  | 5.5 |
|                 | Oregon 233             | 87         | 2.7  | 2.0  | 2.3  | 2.0  | 2.3  | 3.5 | 4.0  | 6.0  | 6.0  | 5.5 |
|                 | Wash. Hyb. 2           | 82         | 3.0  | 2.3  | 2.3  | 2.0  | 2.0  | 5.5 | 4.5  | 1.5  | 7.0  | 7.0 |
|                 | Wash. Str. 88          | 88         | 3.0  | 2.0  | 2.7  | 2.5  | 3.0  | 6.0 | 3.0  | 3.0  | 2.5  | 5.0 |
|                 | Comm Va. Grown         | 95         | 2.0  | 2.0  | 2.0  | 10.0 | 9.7  | 5.5 | 4.0  | 9.0  | 6.0  | 6.0 |
|                 | Bromegrasses (smooth): | 4-36       | 87   | 2.7  | 2.3  | 2.7  | 8.0  | 6.3 | 4.0  | 9.0  | 5.5  | 5.5 |
|                 |                        | K-31       | 93   | 1.7  | 2.0  | 2.0  | 9.0  | 9.3 | 4.0  | 7.5  | 2.0  | 2.0 |
|                 |                        | 144        | 92   | 2.0  | 2.0  | 2.0  | 9.5  | 8.3 | 4.0  | 9.0  | 5.5  | 5.5 |
|                 |                        | 19 G1-25   | 93   | 1.7  | 2.0  | 2.0  | 9.5  | 8.3 | 4.0  | 7.0  | 2.0  | 2.0 |
|                 |                        | Goor       | 93   | 1.3  | 1.7  | 1.7  | 7.5  | 7.5 | 5.0  | 10.0 | 6.5  | 6.5 |
|                 |                        | Alta       | 93   | 1.7  | 2.0  | 2.0  | 2.0  | 2.0 | 4.0  | 8.0  | 5.0  | 5.0 |
| Tall fescue:    |                        | Lincoln    | 80   | 2.7  | 3.3  | 2.7  | 4.5  | 4.5 | 4.5  | 4.0  | 9.0  | 5.5 |
|                 |                        | Manchar    | 35   | 7.3  | 6.3  | 5.7  | 3.5  | 3.5 | 4.0  | 7.5  | 2.0  | 2.0 |
|                 |                        | Okla. #1   | 88   | 1.3  | 1.7  | 2.7  | 4.0  | 4.0 | 4.0  | 9.0  | 5.5  | 5.5 |
|                 |                        | Okla. Syn. | 77   | 2.7  | 3.0  | 3.0  | 4.0  | 4.0 | 4.0  | 9.0  | 5.5  | 5.5 |
|                 |                        | Achenbach  | 50   | 5.0  | 2.7  | 2.7  | 4.5  | 4.5 | 4.5  | 4.0  | 9.0  | 5.5 |
|                 |                        | LSD (.05)  |      |      |      |      |      |     |      |      |      |     |

<sup>1</sup> Seeded Oct. 5, 1951. See Appendix for fertilization.

<sup>2</sup> Initial stand=100 per cent.

<sup>3</sup> June 19 rating represents recovery vigor after clipping.

<sup>4</sup> 1=Most vigorous; 10=least vigorous.

<sup>5</sup> 1=Least mature; 10=full bloom.

<sup>6</sup> 1=No rust or no leaf disease; 10=Severe rust or severe leaf disease.

Table 6. Performance of miscellaneous perennial grasses. Upper Mountains, Watauga clay loam, Laurel Springs. F331.<sup>1</sup>

| Tr. Species No.            | 4/29/55 Vigor <sup>2</sup> | 4/29/55 Winter kill (per cent) | 7/29/55 Vigor <sup>2</sup> | 7/29/55 Leaf rust (per cent) | 10/4/55 Vigor <sup>2</sup> | 6/11/56 Vigor <sup>2</sup> |
|----------------------------|----------------------------|--------------------------------|----------------------------|------------------------------|----------------------------|----------------------------|
| <b>Bromegrass (smooth)</b> |                            |                                |                            |                              |                            |                            |
| 1. Lincoln                 | 2.0                        | 0                              |                            |                              | 2.0                        | 6.7                        |
| 2. Achenbach               | 2.0                        | 0                              |                            |                              | 2.0                        | 7.3                        |
| 3. Lancaster               | 2.0                        | 0                              |                            |                              | 2.0                        | 6.7                        |
| <b>Orchardgrass</b>        |                            |                                |                            |                              |                            |                            |
| 4. Danish                  | 3.0                        | 20.0                           | 3.0                        | 30                           | 1.7                        | 1.7                        |
| 5. Akarao                  | 10.0                       | 100.0                          |                            |                              |                            |                            |
| 6. M 2-11142-49            | 2.0                        | 2.0                            | 2.0                        | 10                           | 1.3                        | 1.3                        |
| 7. Ky. Sel.                | 1.0                        | 1.5                            | 2.0                        | 10                           | 1.0                        | 1.0                        |
| 8. No.233                  | 7.3                        | 55.0                           | 5.5                        | 10                           | 2.0                        | 2.0                        |
| 9. S-143                   | 9.3                        | 55.0                           | 3.5                        | 10                           | 2.7                        | 1.7                        |
| 10. S-37                   | 8.0                        | 55.0                           | 6.0                        | 10                           | 3.0                        | 1.7                        |
| 11. Beltsville             | 1.0                        | 1.5                            | 1.0                        | 10                           | 1.0                        | 1.0                        |
| <b>Rescue grass</b>        |                            |                                |                            |                              |                            |                            |
| 12. Chapel Hill brome      | 2.0                        | 1.0                            |                            |                              | 2.0                        | 2.5                        |
| <b>Perennial Ryegrass</b>  |                            |                                |                            |                              |                            |                            |
| 13. S-23                   | 4.7                        | 2.5                            |                            |                              | 2.0                        | 7.3                        |
| 14. Per. N.Z.              | 1.7                        | 2.5                            |                            |                              | 6.0                        | 8.3                        |
| 15. Oreg. Per.             | 1.0                        | 2.5                            |                            |                              | 2.0                        | 6.3                        |
| 16. H-1                    | 1.3                        | 2.5                            |                            |                              | 2.0                        | 8.3                        |
| 17. R.R. (Fla.)            | 9.0                        | 80.0                           |                            |                              | 10.0                       |                            |
| <b>Tall Fescue</b>         |                            |                                |                            |                              |                            |                            |
| 18. Alta                   | 1.0                        | 0.5                            |                            |                              | 2.0                        | 1.0                        |

<sup>1</sup> Seeded Aug. 12, 1954. See Appendix for fertilization.  
<sup>2</sup> 1=most vigor; 10=least vigor.

Table 7. Performance of miscellaneous perennial grasses. Tidewater, Bladen silt loam, Plymouth. F146.<sup>1</sup>

| Species                   | July 31, 1955 Vigor <sup>2</sup> | Leaf disease <sup>3</sup> | May 23, 1945 Stand <sup>4</sup> |
|---------------------------|----------------------------------|---------------------------|---------------------------------|
| <b>Orchardgrass:</b>      |                                  |                           |                                 |
| Wash. Hyb. 2              | 4.3                              | 3.3                       | 1.0                             |
| Wash. Str. 88             | 4.7                              | 2.7                       | 1.0                             |
| Va. Grown                 | 2.0                              | 2.0                       | 1.0                             |
| Danish                    | 2.3                              | 2.0                       | 2.3                             |
| Beltsville (Potomac)      | 1.3                              | 2.0                       | 1.0                             |
| <b>Tall fescue:</b>       |                                  |                           |                                 |
| Alta                      | 2.5                              | 2.5                       | 1.0                             |
| Goar                      | 2.0                              | 2.5                       | 1.0                             |
| <b>Miscellaneous:</b>     |                                  |                           |                                 |
| Prairie brome 25 (Rescue) | 1.5                              | 1.5                       | 2.3                             |
| Lolium perenne            | 2.5                              | 2.0                       | 6.7                             |
| Perm. ryegrass N.Z.       | 5.0                              | 2.0                       | 6.3                             |
| Harding grass             | 5.0                              | 5.5                       | 4.7                             |
| Meadow foxtail            | 6.0                              | 2.0                       | 9.0                             |
| Iowa reed canary          | 4.0                              | 1.5                       | 7.5                             |

<sup>1</sup> Seeded in Fall, 1954. See Appendix for fertilization.

<sup>2</sup> Vigor—1 = Best; 10 = Poor.

<sup>3</sup> Leaf Disease—1 = None; 10 = Severe.

<sup>4</sup> Stand—1 = Best; 10 = Poor.

ever, Rescue grass appeared greatly inferior to orchardgrass and tall fescue in general vigor at all locations. The smooth brome-grasses showed good vigor the first year, however, they were severely damaged during late summer each year by *Rhizoctonia solani*, and in general ranked greatly inferior to orchardgrass or tall fescue at both the Mountain and Piedmont locations.

Some strains of perennial ryegrass produced excellent yields the first year in both the Mountain and Tidewater areas (Tables 6 and 7). However, these ryegrasses were severely damaged by *Rhizoctonia* in subsequent years. Harding grass and meadow foxtail were essentially eliminated by *Rhizoctonia* in the Tidewater area. Reed canary grass established itself slowly and

Table 8. Forage and seed yield in pounds per acre of dry matter and chemical composition of various strains of tall fescue when grown in pure stands. Lower Piedmont, Cecil sandy clay loam, Raleigh.<sup>1</sup>

| Strain     | 1950 (wet year) |            |              | 1951 (dry year) |            |
|------------|-----------------|------------|--------------|-----------------|------------|
|            | Forage yield    | per cent N | per cent K,O | Forage yield    | Seed yield |
| Ky. 31     | 7,886           | 2.67       | 2.70         | 3,483           | 381        |
| Alta       | 7,700           | 2.67       | 2.73         | 3,466           | 359        |
| Alta (144) | 7,803           | 2.68       | 2.67         | 3,460           | 374        |
| NC 1       | 7,456           | 2.71       | 2.60         | 3,361           | 311        |
| LSD (.05)  | N.S.            | N.S.       | N.S.         | N.S.            | 28         |

<sup>1</sup> Total of five cuttings each year. Fertilized with 500 lbs. 0-9-27 plus 200 lbs. elemental nitrogen in four 50-lb. applications.

**Table 9. Yield of various strains of tall fescue. Lower Piedmont, Congaree silt loam, Raleigh.<sup>1</sup>**

| Strain                     | August 31, 1945              | (4 harvests), 1946 |
|----------------------------|------------------------------|--------------------|
|                            | (Pounds dry matter per acre) |                    |
| Alta                       | 2,555                        | 4,765              |
| Suiter (Ky. 31)            | 2,500                        | 4,940              |
| Rankin's <sup>2</sup>      | 3,165                        | 4,950              |
| S. Africa "A" <sup>3</sup> | 1,609                        | 3,143              |
| F. el. 6 Minnesota         | 1,532                        | 3,140              |
| LSD (.05)                  | 307                          | 280                |

<sup>1</sup> Seeded Sept. 1944. Plots harvested only once in 1945 and five times in 1946 from April through August. Fertilized annually with 50 lbs. N in April.

<sup>2</sup> Rankin's fescue later labeled NCS 511 and NC 1 was located by Mr. W. H. Rankin, N. C. State College, near Waynesville.

<sup>3</sup> S. Africa "A" was severely attacked by rust.

improved in general vigor over a period of years in the Tidewater area.

Kentucky 31 and Alta tall fescue are adapted to a wide range of soils and climate in North Carolina. These varieties appear approximately equal in vigor (Tables 8 and 9). Except in a few instances Kentucky 31 has shown slightly more vigor and fewer leaf diseases than Alta (Table 5, June 2, 1955).

NC 1, also called "Rankin's" tall fescue, yielded more forage than other varieties in one strain test in 1945 (Table 9). The NC 1 strain was approximately one week later in maturity than Kentucky 31 or Alta in the lower Piedmont area.

Goar, a coarse-leaved tall fescue, was equal to or more vigorous than Alta or Kentucky 31 (Tables 5 and 7). The extreme coarseness of Goar somewhat discounts it as a forage.

### Warm Season Grasses Emphasized

(*Bermuda, bahia, etc. Tables 10-14*).

Total and seasonal yields of certain warm season perennial grasses compared with a few cool season grasses, are presented in Tables 10, 11, 12 and 13.

Yields ranging from three to six tons were obtained from Coastal Bermuda grass on a Lakeland sand fertilized with 200 pounds of elemental nitrogen plus mineral fertilizer annually. Coastal Bermuda grass was damaged (approximately 20 per cent winter killed) by the severe winter of 1957-58 when the temperature reached 7 to 10 degrees F. for several days. Less winter damage was noted on common and Midland Bermuda following this particularly cold season. By midsummer the Coastal Bermuda had recovered from the winter injury. Suwannee Bermuda was 80 per cent killed during the winter of 1957-1958. Even though Midland produced excellent yields, severe leaf

**Table 10. Total yields of miscellaneous grasses. Sandhill area, Lakeland sand, Lee County. F13.<sup>1</sup>**

| Grass                               | July 29<br>1954              | 1955   | 1956   | 1957  | 1958  |
|-------------------------------------|------------------------------|--------|--------|-------|-------|
|                                     | (Pounds dry matter per acre) |        |        |       |       |
| Coastal Bermuda                     | 1,750                        | 11,994 | 7,605  | 8,447 | 6,034 |
| Midland Bermuda                     | 640                          | 10,225 | 6,077  | 6,818 | 6,913 |
| Suwannee Bermuda                    | 1,857                        | 6,961  | 2,546  | 5,866 | 267   |
| Common Bermuda (Raleigh)            | 125                          | 8,491  | 2,680  | 3,175 | 4,840 |
| Common Bermuda (Sandhills)          | 376                          | 4,548  | 3,022  | 2,863 | 3,119 |
| Narrowleaf Wilmington bahia         | 183                          | 5,728  | 5,567  | 5,944 | 4,726 |
| Pensacola bahia                     | 640                          | 3,508  | 6,255  | 7,004 | 2,358 |
| Pensacola Hybrid 14x108 bahia       | 442                          | 3,479  | 5,338  | 5,319 | —     |
| Pensacola X common<br>(28-61) bahia | 329                          | 0      | 0      | 0     | 0     |
| Argentine bahia                     | 301                          | 978    | 0      | 0     | 0     |
| Weeping lovegrass                   | 3,079                        | 10,336 | 10,878 | 9,392 | 6,586 |
| Caucasian bluestem                  | 788                          | 4,953  | 3,637  | 2,279 | ....  |
| Buffel grass                        | 348                          | 0      | 0      | 0     | 0     |
| Chapel Hill Rescue grass            | 254                          | 531    | 0      | 0     | 0     |
| Prairie brome 25<br>(Rescue grass)  | 225                          | 76     | 0      | 0     | 0     |
| Tall fescue                         | 0                            | 0      | 0      | 0     | 0     |
| LSD (.05)                           |                              |        | 1,699  | 1,339 |       |
| CV                                  |                              |        | 18     | 14    |       |

<sup>1</sup> Seeded or "sprigged" on March 20, 1954. At seeding one ton of dolomitic limestone and 1,000 lbs./A. of 2-12-12 was applied and 75 lbs. of elemental N was applied June 15, 1954. Each year thereafter, 600 lbs./A. 0-9-27, and 100 lbs. of elemental nitrogen May 1 and 100 lbs. of elemental N July 1 were applied. In 1955 the grasses were harvested four times June 8—Sept. 30, in 1956 three harvests, and three to four harvests were made in 1957 and 1958.

damage by *Helminthesporium* was noted several times during the various years.

Narrowleaf Wilmington bahiagrass was not damaged during any year by the cold weather. Pensacola bahiagrass showed more vigor the first growing season than Narrowleaf Wilmington

**Table 11. Seasonal yields of Coastal Bermuda, bahia, and weeping lovegrass. Sandhill area, Lakeland sand, Lee County. F13.<sup>1</sup>**

| Grass                       | June 8<br>1955               | July 8<br>1955 | July 21<br>1955 | Aug. 18<br>1955 | Sept. 30<br>1955 | Total<br>1955 |
|-----------------------------|------------------------------|----------------|-----------------|-----------------|------------------|---------------|
|                             | (Pounds dry matter per acre) |                |                 |                 |                  |               |
| Coastal Bermuda             | 2,386                        | ....           | 3,666           | 3,206           | 2,736            | 11,994        |
| Narrowleaf Wilm.<br>bahia   | 55                           | ....           | 1,337           | 2,058           | 2,278            | 5,228         |
| Weeping lovegrass           | 2,282                        | 1,192          | 1,861           | 2,855           | 2,176            | 10,366        |
| Grass                       | June 3<br>1957               | July 5<br>1957 | Aug. 28<br>1957 |                 | Oct. 12<br>1957  | Total<br>1957 |
| (Pound dry matter per acre) |                              |                |                 |                 |                  |               |
| Coastal Bermuda             | 3,303                        | 625            | 4,519           |                 | ....             | 8,447         |
| Narrowleaf Wilm.<br>bahia   | 843                          | 2,702          | 779             |                 | 1,620            | 5,944         |
| Weeping lovegrass           | 1,341                        | 3,438          | 2,907           |                 | 1,706            | 9,392         |

<sup>1</sup> Same experiment as in Table 10. See footnotes after that table.

**Table 12. Nitrogen content of different strains of Bermuda grass and weeping lovegrass. F13.<sup>1</sup>**

| Grass                     | Avg. 4 cuts<br>1955 | Avg. 3 cuts<br>1956 | Avg. 3 cuts<br>1957 |
|---------------------------|---------------------|---------------------|---------------------|
|                           |                     | (per cent)          |                     |
| Coastal Bermuda           | 1.83                | 1.73                | 1.30                |
| Suwannee Bermuda          | 1.87                | 2.36                | 1.43                |
| Common Bermuda (Sandhill) | 1.97                | 1.86                | 1.77                |
| Weeping lovegrass         | 1.73                | 1.30                | 1.31                |
| LSD (.05)                 | N.S.                | .26                 |                     |
| CV                        |                     | 8                   |                     |

<sup>1</sup> Same experiment as in Table 10. See footnotes after that table.

**Table 13. Seasonal yield of Coastal Bermuda grass when grown in pure stand. Lower Piedmont, Cecil clay loam, Raleigh.<sup>1</sup>**

| Grass           | July 25<br>1945              | August 27<br>1945 | Total<br>1945    |               |
|-----------------|------------------------------|-------------------|------------------|---------------|
|                 | (Pounds dry matter per acre) |                   |                  |               |
| Coastal Bermuda | 1,567                        | 3,200             | 4,767            |               |
| Grass           | June 12<br>1946              | July 11<br>1946   | Sept. 16<br>1946 | Total<br>1946 |
|                 | (Pounds dry matter per acre) |                   |                  |               |
| Coastal Bermuda | 3,171                        | 2,924             | 3,113            | 9,208         |

<sup>1</sup> Established May, 1944, Bermuda strain test. First year clipped and discarded. Fertilization: Total of 100 lbs. elemental nitrogen was applied in June each year and 400 lbs. 0-12-12 each spring.

**Table 14. Nitrogen content of Coastal Bermuda grass when grown in pure stand. Lower Piedmont, Cecil clay loam, Raleigh.<sup>1</sup>**

| Grass           | June 12<br>1946 | July 11<br>1946 | Sept. 16<br>1946 | Avg.<br>1946 |
|-----------------|-----------------|-----------------|------------------|--------------|
|                 | (per cent)      |                 |                  |              |
| Coastal Bermuda | 2.71            | 1.81            | .84              | 1.79         |

<sup>1</sup> 100 lbs. of elemental nitrogen per acre was applied June 1. This is the same experiment as in Table 13.

bahia, and also in two subsequent years. However, Pensacola bahia was 50 per cent killed by a late freeze (March 26, 1955), and 80 per cent killed by the severe winter of 1957-1958. The common and Argentine bahiagrasses were not winter hardy in this area. Pensacola hybrid 14 x 108 bahia (table 10) has been recently released in Georgia as Tifhi bahia. This hybrid was greatly damaged in the winter of 1957-58. Tall fescue and Rescue grass died out during the summer months and were reseeded twice but did not survive during the summer sufficiently to harvest.

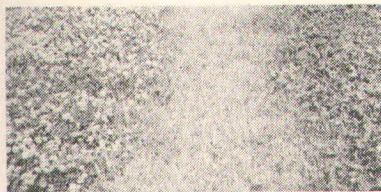
As noted in Tables 11 and 13, Coastal Bermuda produced large tonnages of forage during the summer months. Coastal is well

adapted to both the deep sands (Table 11) and the average clay loams of the Piedmont area (Table 13).

Weeping lovegrass proved to be well adapted to this area if seeded at the proper time. Fall seedings did not survive the winter; however, excellent establishment was obtained by early spring seedings.

Weeping lovegrass analyzed slightly lower in nitrogen content than Coastal Bermuda in one year out of three. During the other two the nitrogen content was the same (Table 12). These species analyzed less than 11.5 per cent protein each year on this Lakeland sand. On a Cecil clay loam (Table 13), Coastal Bermuda ranged in protein content from a high of 17.9 per cent (2.71 per cent nitrogen) about two weeks after being topdressed with 100 pounds per acre of elemental nitrogen, to a low of 5.25 per cent protein (.84 per cent nitrogen), 11 weeks after topdressing. Weeping lovegrass is extremely tough and coarse, and not readily eaten by livestock. In certain areas of Oklahoma, however, high total yields of beef have been obtained per acre even though the per animal daily production was low.





Section II—Tables 15-19

## Perennial Legumes

### Summary

Ladino clover is generally the most widely adapted and productive pasture-type legume for North Carolina. Ladino persists satisfactorily except on upland sandy loams and on the steeper slopes of several counties in Northwestern North Carolina. Ladino is more productive and persistent than the intermediate white clovers.

Birdsfoot trefoil shows promise as a pasture legume at elevations of 2,600 feet and above in the Mountain area of Northwestern North Carolina.

Extensive evaluations of various alfalfa strains and varieties have been conducted in North Carolina. These results are to be published in another publication in the near future.

Alfalfa is well adapted to most upland soils of the Mountain, Piedmont and Coastal Plain. On the sandy soils of the Coastal Plain, sericea lespedeza is generally used in preference to alfalfa as a hay or grazing plant. Sericea will produce  $1\frac{1}{2}$  to  $2\frac{1}{2}$  tons of hay annually.

Atlantic, Williamsburg and Oklahoma Common are widely adapted in North Carolina (see Forage Memo 16, N. C. State College, Extension Service). The varieties DuPuits and Narragansett have performed best in the Mountain area only. Buffalo is the highest producer on wilt infested soils.

Red clover is a short-lived perennial and is best adapted to well-drained soils of Upper Piedmont and Mountains.

### Results and Discussion

(Ladino and intermediate white clovers. Table 15)

These data show conclusively that the Louisiana white types of clover were inferior in North Carolina to the Ladino types. Certain foreign strains such as Kersey from England and New Zealand were poorly adapted in this area. Yields of individual cuttings for these tests are not reported in this manuscript; however, several cuttings were made (see Appendix). In experi-

**Table 15. Total yield in pounds per acre of dry matter, bloom count, and volunteer seedlings of various Ladino and intermediate white clover strains at several locations.<sup>1</sup>**

| Variety                          | F102 1951 |       | F110 1953 |       | F117 1953 |       | F117 Nov. 4 1953            |       | F143 1954 |       | F144 1954 |       | F109 1951 |       | Tidewater F155 1954 |       | Tidewater F155 1955 |       | Mtns. Ashe Co. F327 1956 |       |       |
|----------------------------------|-----------|-------|-----------|-------|-----------|-------|-----------------------------|-------|-----------|-------|-----------|-------|-----------|-------|---------------------|-------|---------------------|-------|--------------------------|-------|-------|
|                                  | Yield     | Bloom | Yield     | Bloom | Yield     | Bloom | Volunteer seedlings sq. yd. | Yield | Bloom     | Yield | Bloom     | Yield | Bloom     | Yield | Bloom               | Yield | Bloom               | Yield | Bloom                    |       |       |
| Ladino clovers                   | 412       |       | 823       |       | 823       |       |                             | 2,448 | 57        |       |           | 6,100 |           | 2,852 | 83                  | 2,050 |                     | 2,856 | 97                       | 1,807 |       |
| Breeders 23,851                  |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Pilgrim 24,669                   |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Western composite 24,818         |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Cert. composite 24,847           |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Cert. S. Calif. 24,128           |           | 3,693 | 794       | 216   | 547       |       | 23                          | 2,517 | 103       |       |           |       |           | 3,180 | 128                 | 1,357 |                     | 1,800 | 114                      | 1,481 |       |
| Cert. C. Calif. 24,127           |           | 3,615 | 250       | 218   |           |       | 75                          | 2,124 | 155       |       |           |       |           | 2,643 | 148                 | 1,142 |                     | 3,180 | 128                      | 1,357 |       |
| Cert. N. Calif. 24,126           |           | 3,955 | 643       | 328   |           |       | 99                          | 2,203 | 168       |       |           |       |           | 1,685 | 130                 | 1,205 |                     | 2,643 | 148                      | 1,142 |       |
| Non-cert. Oakdale, Calif. 24,129 |           | 3,603 | 537       | 264   |           |       | 72                          |       |           |       |           |       |           | 2,523 | 165                 | 1,604 |                     |       |                          |       | 1,469 |
| Breeders Calif. 24,075           |           | 3,461 |           | 244   |           |       |                             |       |           |       |           |       |           | 2,680 | 119                 | 675   |                     |       |                          |       |       |
| Madisons A51 (Calif. 24,031)     | 325       |       |           |       |           |       | 24                          | 2,335 | 96        |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| A51 23,638                       |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Lot 23-89 Cert. (Calif.)         |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Cert. Oreg. 24,543               |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Cert. Oreg. 23,596               | 1,604     |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Cert. Oreg. 24,849               |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Cert. Oreg. 24,531               |           |       |           |       |           |       |                             |       |           |       |           |       |           |       |                     |       |                     |       |                          |       |       |
| Cert. Oreg. 24,060               |           | 3,764 | 987       | 100   |           |       | 9                           | 2,442 | 42        |       |           |       |           | 2,788 | 73                  | 1,669 |                     | 2,788 | 73                       | 1,669 |       |
| Cert. Oreg. 24,081               |           | 4,143 | 188       | 66    |           |       | 24                          | 2,591 | 45        |       |           |       |           | 3,085 | 79                  | 1,647 |                     | 3,085 | 79                       | 1,647 |       |
| Cert. Oreg. 24,048               |           |       | 639       |       |           |       |                             |       |           |       |           |       |           | 2,870 | 83                  | 1,251 |                     | 2,870 | 83                       | 1,251 |       |

(Continued)

Table 15 (continued).

| Variety                                     | Lower Piedmont—Wake County |       |       |            |   |             |       | Tidewater |           |       | Mtns. Ashe Co. |           |       |
|---|----------------------------|-------|-------|------------|---|-------------|-------|-----------|-----------|-------|----------------|-----------|-------|
|   | F102                       | F110  |       | F117       |   | F117        | F143  | F144      | F109      | F155  | F155           | F327      |       |
|   | 1951                       | 1953  |       | 1953       |   | Nov. 4 1953 | 1954  |           | 1951      | 1954  |                | 1955      | 1956  |
|   | Yield                      | Bloom | Yield | Bloom      | Volun-<br>teer<br>seed-<br>lings<br>sq. yd. | Yield       | Bloom | Yield     | Bloom     | Yield | Yield          | Bloom     | Yield |
| <b>Ladino clovers</b>                       |                            |       |       |            |   |             |       |           |           |       |                |           |       |
| Minn. Syn.<br>Iowa Synth.<br>24,663         |                            |       |       |            |   |             |       |           |           |       |                |           | 988   |
| Recomb. Iowa<br>24,051                      |                            | 4,485 |       |            |   | 48          |       |           |           |       |                |           | 2,194 |
| Cert. Idaho<br>24,082                       |                            |       |       | 658        |   |             |       |           |           |       |                |           |       |
| Cert. Wisc.<br>23,642                       | 770                        |       |       |            |   |             |       |           |           |       |                |           |       |
| Non-Cert. Wisc.<br>24,151                   |                            | 3,324 |       |            |   |             |       |           |           |       |                |           |       |
| Cert. Montana<br>24,064                     |                            | 3,090 | 431   | <b>93</b>  |   | 15          |       |           |           |       |                |           |       |
| 24,074 F <sub>1</sub> of<br>23,608 (Wash.)  |                            | 3,845 | 203   | <b>491</b> |   | 6           |       |           |           |       |                |           |       |
| 24,363 F <sub>2</sub> of<br>23,608 (Wash.)  |                            |       | 804   | <b>106</b> |   | 12          |       |           |           |       |                |           |       |
| 24,075 F <sub>1</sub> of<br>23,608 (Calif.) |                            |       | 363   | <b>73</b>  |   | 6           |       |           |           |       |                |           |       |
| Ala-Lu 23, 735                              | 325                        |       |       |            |   |             |       |           |           |       |                |           |       |
| Italian Pl<br>208,567                       |                            |       |       |            |   |             |       | 3,322     | <b>51</b> |       | 3,607          | <b>73</b> | 1,414 |
| Italian Pl<br>208,730                       |                            |       |       |            |   |             |       | 2,973     | <b>48</b> |       | 3,592          | <b>73</b> | 1,282 |
| Italian 24,657                              |                            |       |       |            |   |             |       | 2,616     | <b>78</b> |       | 2,600          | <b>59</b> | 860   |
| Italian 24,901                              |                            |       |       |            |   |             |       | 3,262     | <b>56</b> |       | 3,372          | <b>77</b> | 1,155 |
| Italian 23,682                              | 684                        |       |       |            |   |             |       |           |           | 6,201 |                |           |       |

(Continued)

Table 15 (continued).

| Variety                           | Lower Piedmont—Wake County |       |           |       |   |             |                   | Tidewater |            |           | Mtns. Ashe Co. |           |           |
|-----------------------------------|----------------------------|-------|-----------|-------|---|-------------|-------------------|-----------|------------|-----------|----------------|-----------|-----------|
|                                   | F102                       | F110  |           | F117  |   | F117        | F143              | F144      | F109       | F155      | F155           | F327      |           |
|                                   | 1951                       | 1953  |           | 1953  |   | Nov. 4 1953 | 1954              |           | 1951       | 1954      |                | 1955      | 1956      |
|                                   | Yield                      | Bloom | Yield     | Bloom | Volun-<br>teer<br>seed-<br>lings<br>sq. yd. | Yield       | Bloom             | Yield     | Bloom      | Yield     | Yield          | Bloom     | Yield     |
| <b>Ladino clovers</b>             |                            |       |           |       |   |             |                   |           |            |           |                |           |           |
| Italian 23,985                    |                            |       |           |       | 499   | 33          |                   |           |            |           |                |           |           |
| Lodigiano Lot B<br>1566           |                            | 3,529 |           |       |   |             |                   | 3,459     | <b>72</b>  |           | 2,804          | <b>76</b> | 1,309     |
| Tofte Denmark                     |                            |       |           | 159   |   | 12          |                   | 2,109     | <b>184</b> |           |                |           |           |
| Cert. Kersey<br>24,301            |                            |       |           | 310   |   | 9           |                   |           |            |           |                |           |           |
| Cert. Kersey<br>24,186            |                            | 1,644 |           |       |   |             |                   |           |            |           |                |           |           |
| New Zealand white<br>23,959       | 358                        |       |           |       |   |             |                   |           |            |           |                |           |           |
| New Zealand white<br>24,565       |                            |       |           |       |   |             |                   |           |            |           |                |           | 948       |
| <b>Intermediate white clovers</b> |                            |       |           |       |   |             |                   |           |            |           |                |           |           |
| Louisiana mother<br>23,517        | 416                        |       |           |       |   |             |                   |           |            |           |                |           |           |
| La. Improved<br>23,952            |                            | 1,843 |           |       |   |             |                   |           |            |           |                |           |           |
| La. Syn. No. 1<br>23,928          | 279                        |       |           |       |   |             |                   |           |            | 3,964     |                |           |           |
| La. Syn. No. 1<br>24,539          |                            |       |           | 101   |   | 672         |                   |           |            |           |                |           | 1,079     |
| La. white 24,570                  |                            |       |           | 66    |   | 552         |                   |           |            |           |                |           | 752       |
| La. white 23,951                  | 306                        |       |           |       |   |             |                   |           |            | 4,615     |                |           |           |
| Green acres<br>23,810             | 759                        | 2,956 |           |       |   |             |                   |           |            |           |                |           |           |
| LSD (.05)                         |                            | 510   | <b>45</b> |       |   |             | N.S. <sup>1</sup> | <b>27</b> | 668        | <b>32</b> | 610            | 1,089     | <b>35</b> |
| CV                                |                            | 14    | <b>18</b> |       |   |             | 11                | <b>15</b> | 13         | <b>25</b> | 7              | 23        | <b>27</b> |

<sup>1</sup> See Appendix for planting dates and fertilization for the experiments in this table.

<sup>2</sup> Bloom count represents average blooms per square yard.

ments F110, F117 and F327 in Table 15 and the experiment described in Table 27, droughts of two to ten weeks were experienced and yields of individual cuttings and observations showed that Ladino clover was much more drought resistant than the intermediate white clovers. At the first harvest in the spring the Louisiana white types produced almost as much forage as the Ladino sources; however, Ladino recovered much faster following June or July droughts of two to four weeks in duration than the intermediate white clovers. In several instances the intermediate white clovers were eliminated following droughts of two to four weeks, whereas Ladino survived. Ladino clover strains were also largely eliminated by a drought of ten weeks (F117).

There is considerable variation between strains of Ladino clover. Plants grown from different certified sources of Ladino clover varied as widely as 100 per cent in yield (F155, Table 15).

In general, Oregon sources of Ladino clover bloomed less profusely than California types (Table 15, F110, F117, F143, F155). Observations and actual stand counts indicated that Oregon sources, however, produced enough volunteer seedlings for satisfactory re-establishment when re-establishment was necessary (F117). In experiment F117 between 70 and 100 per cent of the stands were eliminated by a severe ten-week drought. Volunteer seedling counts made in November showed that the Louisiana types produced five to ten times more seedlings than the Oregon or California sources of Ladino clover. One of the Oregon strains produced only nine seedlings per square yard. These nine seedlings eventually produced a complete cover, but not as rapidly as other Ladino strains which produced up to 100 seedlings per square yard. Apparently most Ladino clover strains will produce sufficient volunteer plants in this area to eventually re-establish themselves following elimination by drought although frequent fall or spring rains are necessary. Ladino usually produces at least 50 per cent more forage than the intermediate white clovers (Table 15) and in general Ladino is considered a superior forage in this area.

(*Birdsfoot trefoil, red clover, etc. Tables 16, 17, 18, 19*)

Birdsfoot trefoil became established quickly on both a Lakeland and Norfolk soil (Tables 16 and 17), and the various strains were well nodulated and appeared vigorous the first year or two on these sandy soils. By the end of the second season all strains of birdsfoot were largely eliminated by *Rhizoctonia solani* in the Coastal Plain area experiments. Neither Ladino clover, tall fescue, orchardgrass or Harding grass survived on the droughty Lakeland sand even for one year.

**Table 16. Yield of miscellaneous forage species. Sandhill area, Lakeland sand, Pinehurst.**

| Species                             | Total 1951 <sup>1</sup>      |
|-------------------------------------|------------------------------|
|                                     | (second year)                |
|                                     | (Pounds dry matter per acre) |
| Birdsfoot trefoil (New York)        | 924                          |
| Birdsfoot trefoil (Italian)         | 2,599                        |
| Birdsfoot trefoil (European)        | 1,935                        |
| Tall fescue and birdsfoot trefoil   | 2                            |
| Orchardgrass and birdsfoot trefoil  | 2                            |
| Harding grass and birdsfoot trefoil | 2                            |
| Ladino clover                       | 2                            |

<sup>1</sup> Plots were seeded Sept. 30, 1949 and were clipped in 1950; however, the forage was discarded. 1951, three cuttings, May 24, July 6, Aug. 15.

<sup>2</sup> The grasses noted above and Ladino clover died during the summer of the first year.

**Table 17. Total yield of miscellaneous forage species. Upper Coastal Plain, Norfolk sandy loam, Johnston County.<sup>1</sup>**

| Species                              | July 19, 1950                |
|--------------------------------------|------------------------------|
|                                      | (Pounds dry matter per acre) |
| Birdsfoot trefoil (New York)         | 1,426                        |
| Birdsfoot trefoil (Italian)          | 1,708                        |
| Birdsfoot trefoil plus Harding grass | 2                            |

<sup>1</sup> Seeded Aug. 31, 1949. Fertilization at seeding: one ton dolomitic limestone, 1,000 lbs. 2-12-12; annually, 800 lbs. 0-9-27.

<sup>2</sup> Birdsfoot trefoil and Harding grass were severely damaged in 1951 by *Rhizoctonia solani*.

Observational plantings of birdsfoot trefoil in several locations in the Piedmont area have been made, but in most cases Ladino clover will produce approximately twice as much forage as birdsfoot trefoil in this area of the state. Stands are weakened by *Rhizoctonia* also in the Piedmont area.

In general, birdsfoot trefoil appears well adapted in the Upper Mountain area. In several experiments (Table 18) and in observational plantings at approximately 2,800 feet elevation, birdsfoot has shown good vigor. No disease damage has been noted during three years at this location.

Empire showed less seedling vigor than other strains and also produced much less forage. The yields reported do not include the yield of the volunteer orchardgrass and Kentucky bluegrass which were present. Several strains of birdsfoot have been observed under grazing, at this location, for the past three years, and in general they have been vigorous. One lot of imported Italian birdsfoot trefoil was greatly reduced in stand and vigor by the end of the third year of grazing. The Douglas strain has shown the most uniform vigor in observations to date.

In the Upper Mountain area Ladino clover has not persisted. On the steeper slopes, stands often disappear in two to three years.

**Table 18. Yield of several strains of birdsfoot trefoil. Upper Mountains, Watauga clay loam, Laurel Springs.<sup>1</sup>**

| Variety          | F330                         | F350    |
|------------------|------------------------------|---------|
|                  | 1955-57                      | 1956-57 |
|                  | (Pounds dry matter per acre) |         |
| Imported Italian | 2,241                        | 2,161   |
| Granger          | 2,113                        | 2,384   |
| Empire           | 1,660                        | 1,168   |
| Iowa Empire      | ....                         | 1,678   |
| Viking           | 2,647                        | 1,952   |
| Douglas          | ....                         | 2,584   |
| Cascade          | 2,656                        | ....    |
| Mansfield        | 2,332                        | ....    |
| LSD (.05)        | 480                          | 530     |

<sup>1</sup> Both experiments were seeded first week in August. At seeding 1,500 lbs. calcitic lime and 800 lbs. 2-12-12 was applied. Top dressed annually with 800 lbs. 0-10-20. Experiments were harvested three times annually between May 10 and Aug. 1.

Kenland red clover has proven to be well adapted in North Carolina (Table 19). Kenland has resistance to Southern Anthracnose, and shows more vigor than the local grown lots tested. In recent limited tests over a two year period, Chesapeake red clover has outyielded all red clover varieties tested including Kenland.

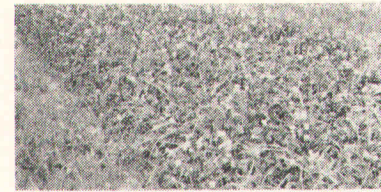
**Table 19. Yields of different varieties of red clovers seeded in different years. Piedmont Experiment Station, Statesville, and Lower Piedmont, Raleigh.**

| Variety                 | Test 1, Statesville <sup>1</sup> |             |              |            | Test 2, Statesville <sup>2</sup> |             | Test 3, Raleigh <sup>3</sup> |            |
|-------------------------|----------------------------------|-------------|--------------|------------|----------------------------------|-------------|------------------------------|------------|
|                         | Aug. 22 1950                     | May 25 1951 | Aug. 14 1951 | Total 1951 | May 13 1953                      | July 9 1953 | Total 1953                   | Total 1951 |
|                         | (Pounds dry matter per acre)     |             |              |            |                                  |             |                              |            |
| Kenland                 | 3,945                            | 1,639       | 976          | 2,615      | 5,121                            | 2,095       | 7,216                        | 3,000      |
| NC grown (commercial)   |                                  |             |              |            | 3,873                            | 1,953       | 5,826                        | 1,759      |
| NC grown (commercial)   |                                  |             |              |            | 4,597                            | 1,614       | 6,211                        |            |
| Cumberland              | 3,667                            | 1,817       | 559          | 2,376      |                                  |             |                              |            |
| Louisiana synthetic # 1 |                                  |             |              |            |                                  |             |                              | 1,500      |
| Louisiana red           |                                  |             |              |            | 4,180                            | 1,453       | 5,633                        | 2,516      |
| Midland                 | 3,666                            | 1,264       | 264          | 1,528      | 3,761                            | 1,406       | 5,167                        | 2,477      |
| Tenn. purple            |                                  |             |              |            | 4,652                            | 2,023       | 6,675                        | 1,750      |
| Wisconsin mildew res.   | 3,471                            | 637         | 126          | 763        |                                  |             |                              |            |
| Dollard                 | 3,370                            | 1,055       | 217          | 1,272      |                                  |             |                              |            |
| Oregon common           | 3,001                            | 331         | 46           | 377        |                                  |             |                              |            |
| LSD (.05)               | 460                              |             |              | 244        |                                  |             |                              | 700        |
| CV                      | 5                                |             |              | 9          |                                  |             |                              | 18         |

<sup>1</sup> Seeded March 3, 1950 in wheat (wheat 4-6 inches high). Soil had been limed within five years. Observation in October, 1950 showed Dollard, Oregon and Wisconsin very poor in recovery growth. Wisconsin showed resistance to mildew.

<sup>2</sup> Seeded March 10, 1952. This test clipped but no yields taken in 1952.

<sup>3</sup> Seeded Oct. 12, 1950. Total of three cuts, May 22, July 26, Aug. 24. Fertilization, one ton of limestone at seeding and 1,000 lbs. 2-12-12 per acre.



Section III—Tables 20-35

## Perennial Legume-Grass Mixtures

### Summary

For general pasture use Ladino-orchardgrass and Ladino-tall fescue are the most widely adapted and productive pasture mixtures for North Carolina. Alfalfa-orchardgrass is adapted to most drained soils of the Piedmont and Mountain areas, and this mixture is generally used alternately for hay, silage and grazing.

Mixtures such as Bermuda grass-annual lespedeza and Dallisgrass-lespedeza will provide extra grazing during the midsummer period. They are particularly useful on sandy loams.

Mixtures of birdsfoot trefoil-orchardgrass are being utilized successfully on an experimental basis (see Section II) in the Upper Mountain area.

### Results and Discussion

(Ladino-grass, big trefoil-grass, white clover-grass. Tables 20-29)

Ladino-orchardgrass and Ladino-tall fescue were compared under three different management systems with a check mixture of Louisiana white clover, Kobe lespedeza, orchardgrass and red-top. The Ladino clover-grass mixtures were far superior to the check mixture. The Ladino-orchard and Ladino-tall fescue yielded approximately the same. The Louisiana white clover did not recover as well as Ladino clover following the short droughts. Ladino-grass mixtures produced at least 60 per cent of their total seasonal yield by mid-June each year (Table 20). Frequently these mixtures are cut for silage in order to provide feed during the winter months or midsummer. Allowing the forage to accumulate during the spring may reduce the clover somewhat (Table 21); however, these reductions are not usually large.

Higher forage yields were obtained under a monthly defoliation schedule than under a two-week defoliation schedule (Table 20).

Comparisons of chemical composition under different management systems were made between Ladino-orchard and Ladino-tall fescue (Table 22). Grass cut on a monthly schedule generally

**Table 20. Seasonal yields second year after seeding and total yield for two years of Ladino-tall fescue, Ladino-orchardgrass, and other legume-grass mixtures under different systems of management. Lower Piedmont, Cecil clay loam, Raleigh. F28.<sup>1</sup>**

| Management <sup>2</sup>   | 4/11  | 4/25 | 5/9   | 5/23 | 6/6   | 6/20 | 7/4 | 7/18 | 8/1 | 8/15 | 8/19 | 9/12 | 9/26 | 10/10 | 10/24 | 11/7 | 11/21 | Total<br>1949 | Total<br>1950 |
|---|-------|------|-------|------|-------|------|-----|------|-----|------|------|------|------|-------|-------|------|-------|---------------|---------------|
| <b>Ladino-tall fescue 1949</b>                                  |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       |               |               |
| (Pounds dry matter per acre)                                    |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       |               |               |
| Continuous  | 1,372 | 498  | 614   | 753  | 263   | 66   | 114 | 501  | 204 | 92   | 192  | 206  | 73   | 46    | 29    | 29   | 2     | 5,054         | 2,306         |
| Rotational  | 1,553 |      | 1,346 |      | 1,196 |      | 376 |      | 766 |      | 493  |      | 338  |       | 157   |      | 40    | 6,265         | 3,112         |
| Delayed   | 1,369 |      |       |      | 2,802 |      | 425 |      | 700 |      | 460  |      | 359  |       | 180   |      | 44    | 6,339         | 3,434         |
| <b>Ladino-orchardgrass 1949</b>                                 |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       |               |               |
| (Pounds dry matter per acre)                                    |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       |               |               |
| Continuous  | 1,519 | 545  | 711   | 813  | 355   | 103  | 77  | 437  | 275 | 79   | 150  | 130  | 41   | 49    | 15    | 6    | 0     | 5,305         | 2,376         |
| Rotational  | 1,441 |      | 1,329 |      | 1,224 |      | 354 |      | 783 |      | 369  |      | 232  |       | 90    |      | 11    | 5,833         | 2,912         |
| Delayed   | 1,470 |      |       |      | 2,550 |      | 452 |      | 775 |      | 469  |      | 234  |       | 98    |      | 23    | 6,071         | 3,279         |
| <b>Louisiana white clover-Kobe lespedeza-orchard and redtop</b> |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       |               |               |
| (Pounds dry matter per acre)                                    |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       |               |               |
| Continuous  |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       | 3,748         | <sup>3</sup>  |
| LSD (.05)   |       |      |       |      |       |      |     |      |     |      |      |      |      |       |       |      |       | 460           | 510           |

<sup>1</sup> Plots seeded September 5, 1947. In 1948 all plots clipped monthly to permit establishment. Initial fertilization 1,000 pounds superphosphate (20 per cent) 500 lbs. 2-12-12 and 3,000 lbs. dolomitic limestone. Annual fertilization—500 lbs./A. 0-12-12 applied in April.

<sup>2</sup> Management: *Continuous*—(Harvest first harvest—and every two weeks thereafter). *Rotational*—Harvest first harvest—and every four weeks thereafter). *Delayed*—(Harvest first harvest—omit second four weeks harvest and harvest every four weeks thereafter).

<sup>3</sup> This mixture not harvested in 1950 due to infestation with Ladino clover.

**Table 21. Botanical analyses in second year after management treatment were indicated on Ladino-orchard and Ladino-tall fescue mixtures. Lower Piedmont, Cecil clay loam, Raleigh, F28.<sup>1</sup>**

| Management | April 24, 1950                         |       | July 17, 1950 |       |
|------------|--|-------|---------------|-------|
|            | Ladino                                 | Grass | Ladino        | Grass |
|            | (Percentage composition <sup>2</sup> ) |       |               |       |
| Continuous | 28                                     | 69    | 65            | 34    |
| Rotational | 23                                     | 73    | 66            | 33    |
| Delayed    | 26                                     | 71    | 57            | 41    |

<sup>1</sup> See previous table for management explanation. The above figures are averages for both mixtures. Botanical analyses represent percentage of each species present in a mixture of species. Determinations were made by hand separation of the mixture into its component parts.

<sup>2</sup> Unaccounted for percentage was weeds.

**Table 22. Chemical composition of individual species of Ladino-orchard and Ladino-tall fescue mixtures when grown under two different management systems. F28.<sup>1</sup>**

| Mixture Management                        | April 11, 1949 |       | July 4, 1949 |       | April 24, 1950 |       | July 17, 1950 |       |
|---|----------------|-------|--------------|-------|----------------|-------|---------------|-------|
|   | Clover         | Grass | Clover       | Grass | Clover         | Grass | Clover        | Grass |
| (Per Cent Nitrogen)                       |                |       |              |       |                |       |               |       |
| Ladino-fescue                             |                |       |              |       |                |       |               |       |
| Continuous <sup>2</sup>                   | 4.52           | 2.63  | 4.20         | 4.15  | 3.74           | 1.97  | 3.82          | 3.56  |
| Rotational <sup>2</sup>                   | 4.40           | 2.51  | 3.99         | 3.80  | 3.93           | 1.93  | 3.84          | 3.04  |
| Ladino-orchard                            |                |       |              |       |                |       |               |       |
| Continuous                                | 4.36           | 2.94  | 4.26         | 4.52  | 3.89           | 2.39  | 4.01          | 3.67  |
| Rotational                                | 4.47           | 2.78  | 4.11         | 3.96  | 3.75           | 2.49  | 3.79          | 3.13  |
| (Per Cent CaO)                            |                |       |              |       |                |       |               |       |
| Ladino-fescue                             |                |       |              |       |                |       |               |       |
| Continuous                                | 2.78           | .65   | 2.09         | .83   | 2.94           | .72   | 2.48          | .82   |
| Rotational                                | 2.74           | .61   | 2.39         | .78   | 3.04           | .75   | 3.05          | 1.16  |
| Ladino-orchard                            |                |       |              |       |                |       |               |       |
| Continuous                                | 2.90           | .66   | 2.04         | .91   | 2.87           | .76   | 2.60          | 1.24  |
| Rotational                                | 2.69           | .64   | 2.47         | .89   | 2.68           | .77   | 2.82          | 1.21  |
| (Per Cent P <sub>2</sub> O <sub>5</sub> ) |                |       |              |       |                |       |               |       |
| Ladino-fescue                             |                |       |              |       |                |       |               |       |
| Continuous                                | 1.09           | 1.23  | 1.18         | 1.39  | .51            | .70   | 1.28          | 2.49  |
| Rotational                                | 1.07           | 1.23  | 1.20         | 1.42  | .53            | .71   | 1.48          | 1.80  |
| Ladino-orchard                            |                |       |              |       |                |       |               |       |
| Continuous                                | 1.21           | 1.31  | 1.13         | 1.27  | .54            | .71   | 1.41          | 2.31  |
| Rotational                                | 1.11           | 1.31  | 1.22         | 1.41  | .57            | .70   | 1.28          | 1.82  |
| (Per Cent K <sub>2</sub> O)               |                |       |              |       |                |       |               |       |
| Ladino-fescue                             |                |       |              |       |                |       |               |       |
| Continuous                                | 3.25           | 4.19  | 2.66         | 3.48  | 1.17           | 2.40  | 3.80          | 3.94  |
| Rotational                                | 3.54           | 4.22  | 3.00         | 3.65  | .95            | 2.27  | 3.84          | 3.65  |
| Ladino-orchard                            |                |       |              |       |                |       |               |       |
| Continuous                                | 3.71           | 5.30  | 2.35         | 3.75  | .94            | 2.76  | 3.71          | 4.45  |
| Rotational                                | 3.33           | 5.34  | 2.66         | 3.69  | .92            | 2.66  | 3.73          | 3.98  |

<sup>1</sup> See previous two tables for fertilization and general management.

<sup>2</sup> Continuous—cut every two weeks; Rotational—cut every four weeks. April harvest was first harvest each year and forage was in approximately same stage of growth on both managements. Forage on continuous plot had been growing two weeks and on rotational plot four weeks when harvested in July each year. Fertilized annually in April with 500 lbs. 0-12-12 per acre.

**Table 23. Total yield of several legume-grass mixtures. Tidewater, Bladen silt loam, Plymouth. F26.<sup>1</sup>**

| Mixture                      | 1948 <sup>2</sup>            | 1949 <sup>2</sup> | 1950 <sup>2</sup> | Avg.  |
|------------------------------|------------------------------|-------------------|-------------------|-------|
|                              | (Pounds dry matter per acre) |                   |                   |       |
| Ladino clover plus:          |                              |                   |                   |       |
| Alta tall fescue             | 6,880                        | 6,103             | 6,850             | 6,611 |
| Ky. 31 tall fescue           | 6,500                        | 6,395             | 7,390             | 6,762 |
| Orchardgrass (Va.)           | 7,160                        | 5,915             | 7,511             | 6,862 |
| Redtop                       | 7,070                        | 6,080             | 6,600             | 6,583 |
| Big trefoil (Columbia) plus: |                              |                   |                   |       |
| Alta tall fescue             | 4,205                        | 3,980             | 4,880             | 4,355 |
| Ky. 31 tall fescue           | 4,020                        | 3,945             | 4,950             | 4,305 |
| Orchardgrass                 | 4,275                        | 4,161             | 4,510             | 4,315 |
| Redtop                       | 4,255                        | 3,680             | 5,200             | 4,378 |
| Big Trefoil (hairy) plus:    |                              |                   |                   |       |
| Alta tall fescue             | 3,230                        | 3,770             | —                 | 3,500 |
| Orchardgrass                 | 2,850                        | 3,720             | —                 | 3,285 |
| Forage mixture <sup>3</sup>  | 3,750                        | 3,650             | —                 | 3,700 |
| LSD (.05)                    | 540                          | 495               | 510               |       |

<sup>1</sup> Plots were seeded Sept. 23, 1947. Initial fertilization—500 lbs. 2-12-12, plus 1,000 lbs. superphosphate (20 per cent), and three tons dolomitic limestone per acre. Annual application of 500 pounds of 0-9-27 per acre in March.

<sup>2</sup> A total of five to six cuttings were made each year.

<sup>3</sup> Forage mixture consisted of 15 lbs. Kobe lespedeza, two lbs. La. white clover, five lbs./A. each of orchardgrass, alta fescue, redtop and Dallisgrass.

had a lower nitrogen content than if cut at two-week intervals. No large effects were noted between managements in the CaO, P<sub>2</sub>O<sub>5</sub> or K<sub>2</sub>O content of the clover or grass. One exception occurred in the phosphorous content. At one harvest date in 1950 the phosphorous content was lower on the monthly cut than in the two-week cut.

Orchardgrass had a slightly higher K<sub>2</sub>O content than tall fes-

**Table 24. Botanical analyses of several legume-grass mixtures at spring harvest. Tidewater Station, Bladen silt loam, Plymouth. F26.<sup>1</sup>**

| Mixture                    | May 18, 1948                                     |       | May 3, 1949 |       |
|----------------------------|--|-------|-------------|-------|
|                            | Legume   | Grass | Legume      | Grass |
|                            | (Average grams dry matter per four replications) |       |             |       |
| Ladino plus:               |  |       |             |       |
| Alta fescue                | 797  | 48    | 369         | 151   |
| Ky. 31 fescue              | 687  | 97    | 410         | 149   |
| Orchardgrass               | 782  | 90    | 262         | 234   |
| Redtop                     | 691  | 247   | 480         | 106   |
| Big trefoil (smooth) plus: |  |       |             |       |
| Alta fescue                | 204  | 126   | 94          | 186   |
| Ky. 31 fescue              | 124  | 144   | 91          | 194   |
| Orchardgrass               | 229  | 146   | 100         | 292   |
| Redtop                     | 210  | 413   | 104         | 175   |

<sup>1</sup> Botanical analyses represents grams of each species present in a mixture of species. Determinations were made by hand separation of the mixture into its component parts. See Table 23 for fertilization and management details.

**Table 25. Seasonal yields of three legume-grass mixtures. Tidewater station, Bladen silt loam, Plymouth. F26.<sup>1</sup>**

| Mixture                    | April 20                     | May 18 | June 16 | July 12 | Aug. 11 | Total |
|----------------------------|------------------------------|--------|---------|---------|---------|-------|
|                            | 1948                         | 1948   | 1948    | 1948    | 1948    |       |
|                            | (Pounds dry matter per acre) |        |         |         |         |       |
| Ladino plus:               |                              |        |         |         |         |       |
| Ky. 31 fescue              | 1,248                        | 1,648  | 2,229   | 1,061   | 312     | 6,498 |
| Orchardgrass               | 1,617                        | 1,825  | 2,100   | 1,252   | 364     | 7,158 |
| Big trefoil (smooth) plus: |                              |        |         |         |         |       |
| Ky. 31 fescue              | 0                            | 656    | 2,018   | 262     | 1,085   | 4,021 |
|                            | April 13                     | May 3  | May 26  | June 23 | July 25 | Total |
|                            | 1949                         | 1949   | 1949    | 1949    | 1949    | 1949  |
|                            | (Pounds dry matter per acre) |        |         |         |         |       |
| Ladino plus:               |                              |        |         |         |         |       |
| Ky. 31 fescue              | 957                          | 1,276  | 1,411   | 1,523   | 1,227   | 6,394 |
| Orchardgrass               | 931                          | 1,180  | 1,345   | 1,422   | 1,038   | 5,916 |
| Big trefoil (smooth) plus: |                              |        |         |         |         |       |
| Ky. 31 fescue              | 434                          | 656    | 1,153   | 1,700   | 0       | 3,943 |

<sup>1</sup> Seeded Sept. 23, 1947. See Table 23 for fertilization and management details.

cue. Both orchard and tall fescue were higher than Ladino clover in K<sub>2</sub>O content (Table 22).

In the Tidewater area (Tables 23-27), Ladino-grass mixtures yielded at least 50 per cent more forage than Big trefoil, Louisiana white clover, or New Zealand white clover-grass mixtures. Columbia big trefoil, which is a variety of Smooth big trefoil, was more productive than hairy big trefoil (Table 23). Columbia big trefoil is fairly well adapted to the Tidewater area, however, *Rhizoctonia solani* reduces the stands each year. Columbia big trefoil begins growth later in the spring than Ladino, however, it will produce as much or sometimes more forage in midsummer than Ladino. A more disease resistant variety, particularly resistant to *Rhizoctonia*, is needed prior to extensive use of this species. The Louisiana white clovers made excellent spring growth, however, they failed to recover after a three-week drought, and yielded much less than Ladino (Table 27).

Meadow foxtail and Harding grass were grown with Ladino clover in the Tidewater area, however, both grass species were essentially eliminated by *Rhizoctonia* (Table 28).

In practically all experiments at all locations similar total yields of Ladino-orchardgrass, and Ladino-tall fescue have been obtained (Tables 20, 23, 25, 29).

Big trefoil analyzed an average of 5.01 per cent nitrogen (equals 31.3 per cent protein), whereas Ladino clover analyzed 4.01 per cent nitrogen (25.1 per cent protein) in the same test (Table 26). Ladino analyzed considerably higher in CaO than

**Table 26. Chemical analyses of individual species of legumes and grasses when grown in mixture. Tidewater station, Bladen silt loam, Plymouth, F26.<sup>1</sup>**

| Mixture                       | Legume component |      |                               |                  | Grass components |     |                               |                  |
|-------------------------------|------------------|------|-------------------------------|------------------|------------------|-----|-------------------------------|------------------|
|                               | N                | CaO  | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O | N                | CaO | P <sub>2</sub> O <sub>5</sub> | K <sub>2</sub> O |
| <b>Harvested May 18, 1948</b> |                  |      |                               |                  |                  |     |                               |                  |
| (Per cent)                    |                  |      |                               |                  |                  |     |                               |                  |
| Ladino plus:                  |                  |      |                               |                  |                  |     |                               |                  |
| Alta fescue                   | 3.62             | 1.88 | .65                           | 3.14             | 2.21             | .45 | .72                           | 3.58             |
| Ky. 31 fescue                 | 3.78             | 1.90 | .67                           | 2.94             | 2.28             | .59 | .75                           | 3.72             |
| Orchardgrass                  | 3.26             | 1.94 | .67                           | 3.19             | 2.44             | .57 | .75                           | 4.29             |
| Redtop                        | 3.56             | 1.87 | .60                           | 3.00             | 2.16             | .54 | .68                           | 3.31             |
| Average                       | 3.55             | 1.90 | .65                           | 3.07             | 2.27             | .54 | .72                           | 3.72             |
| Big trefoil (smooth) plus:    |                  |      |                               |                  |                  |     |                               |                  |
| Alta fescue                   | 4.49             | 1.44 | .82                           | 3.18             | 1.74             | .39 | .64                           | 2.71             |
| Ky. 31 fescue                 | 4.51             | 1.41 | .81                           | 3.06             | 1.66             | .41 | .67                           | 2.96             |
| Orchardgrass                  | 4.54             | 1.51 | .87                           | 3.42             | 1.96             | .38 | .68                           | 3.44             |
| Redtop                        | 4.39             | 1.54 | .80                           | 3.61             | 1.75             | .43 | .59                           | 2.70             |
| Average                       | 4.48             | 1.47 | .82                           | 3.32             | 1.78             | .40 | .64                           | 2.95             |
| <b>Harvested May 3, 1949</b>  |                  |      |                               |                  |                  |     |                               |                  |
| (Per cent)                    |                  |      |                               |                  |                  |     |                               |                  |
| Ladino plus:                  |                  |      |                               |                  |                  |     |                               |                  |
| Alta fescue                   | 4.45             | 2.07 | .99                           | 3.07             | 3.08             | .51 | 1.22                          | 4.11             |
| Ky. 31 fescue                 | 4.46             | 2.17 | 1.01                          | 2.72             | 3.00             | .57 | 1.29                          | 4.01             |
| Orchardgrass                  | 4.65             | 2.19 | .99                           | 2.72             | 2.70             | .44 | 1.18                          | 4.36             |
| Redtop                        | 4.35             | 2.22 | 1.21                          | 3.96             | 3.89             | .61 | 1.20                          | 4.37             |
| Average                       | 4.48             | 2.16 | 1.05                          | 3.12             | 3.17             | .53 | 1.22                          | 4.21             |
| Big trefoil (smooth) plus:    |                  |      |                               |                  |                  |     |                               |                  |
| Alta fescue                   | 5.55             | 1.57 | 1.24                          | 3.60             | 2.61             | .48 | 1.07                          | 3.94             |
| Ky. 31 fescue                 | 5.71             | 1.58 | 1.18                          | 3.14             | 2.60             | .51 | 1.12                          | 3.27             |
| Orchardgrass                  | 5.26             | 1.36 | 1.35                          | 3.87             | 2.49             | .37 | 1.12                          | 4.03             |
| Redtop                        | 5.67             | 1.53 | 1.19                          | 3.37             | 3.37             | .55 | 1.00                          | 3.29             |
| Average                       | 5.55             | 1.51 | 1.24                          | 3.49             | 2.77             | .48 | 1.08                          | 3.63             |

<sup>1</sup> Seeded Sept. 23, 1947. See Table 23 for fertilization and management details.

big trefoil. In general the legumes were higher in nitrogen and calcium content than the grasses. As previously noted orchardgrass was higher in K<sub>2</sub>O than tall fescue. However, orchardgrass and tall fescue had approximately the same N, CaO and P<sub>2</sub>O<sub>5</sub> content.

(*Dallisgrass and Bermuda grass mixtures, Kobe lespedeza mixtures, alfalfa-grass mixtures. Tables 30-35*)

Mixtures of Dallisgrass-Kobe lespedeza and Coastal Bermuda-Kobe lespedeza are less productive on the average clay loams than Ladino-grass (Table 30). However, during dry summers Coastal Bermuda-lespedeza will produce more forage than La-

**Table 27. Yield of various grass-legume mixtures. Tidewater area, Bladen silt loam, Plymouth.<sup>1</sup>**

| Mixture  | Total 1951 | Total 1952 |
|--|------------|------------|
| (Pounds dry matter per acre)                         |            |            |
| Orchardgrass plus:                                   |            |            |
| Columbia big trefoil                                 | 2,579      | 1,752      |
| Breeders Ladino (F. C. 23,851)                       | 6,100      | 1,281      |
| Italian Ladino (F. C. 23,682)                        | 6,201      | 1,406      |
| Oregon cert. Ladino (F. C. 23,596)                   | 6,195      | 1,985      |
| Louisiana white clover (F. C. 23,951)                | 4,615      | 622        |
| Louisiana synthetic (F. C. 23,928)<br>(white clover) | 3,964      | 621        |
| New Zealand mixture <sup>2</sup>                     | 3,629      | 1,594      |
| LSD (.05)  | 610        | 683        |
| CV   | 7          | 28         |

<sup>1</sup> Plots seeded Sept. 27, 1950. Fertilization: 1½ tons dolomitic limestone, 1,000 lbs. 2-12-12 at seeding. Annually, 500 lbs. 0-9-27 per acre. Plots harvested six times May 14-Oct. 29, 1951, and three cuttings, May 2-July 17, 1952.

<sup>2</sup> N. Z. Mixture—Perennial ryegrass, short rotation, ryegrass, cocksfoot (orchardgrass), red clover and white clover.

**Table 28. Miscellaneous mixture adaptation study. Tidewater area, Bladen silt loam, Plymouth.<sup>1</sup>**

| Mixture  | 1950 | 1951 | N    | K <sub>2</sub> O |
|--|------|------|------|------------------|
| (Grams of grass per plot at second spring harvest) |      |      |      |                  |
| (Per cent)   |      |      |      |                  |
| Ladino plus:                                       |      |      |      |                  |
| Meadow foxtail                                     | 81   | 18   | 3.09 | 3.46             |
| "Beltsville" orchardgrass                          | 147  | 77   | 3.36 | 4.27             |
| "Massachusetts"<br>orchardgrass                    | 90   | 36   | 3.26 | 3.61             |
| N. C. 1 tall fescue                                | 132  | 56   | 3.04 | 3.35             |
| lo-reed canary                                     | 131  | 13   | 3.36 | 3.35             |
| Harding grass                                      | 22   | 1    | —    | —                |

<sup>1</sup> Seeded Sept. 2, 1949 in mixture with Ladino clover; two tons dolomitic limestone, and 1,200 lbs. 2-12-12 applied per acre at seeding, 500 lbs. 0-9-27 annually.

**Table 29. Yield of several legume-grass mixtures. Mountain Station, Hiwassee clay loam, Waynesville.<sup>1</sup>**

| Mixture                      | Total 1949 | Total 1950 | Total 1951 |
|------------------------------|------------|------------|------------|
| (Pounds dry matter per acre) |            |            |            |
| Ladino plus:                 |            |            |            |
| Alta fescue                  | 5,906      | 3,635      | 3,025      |
| Ky. 31 fescue                | 5,822      | 3,483      | 2,601      |
| NC 1 fescue <sup>2</sup>     | 5,675      | 2,898      | 2,308      |
| Orchardgrass                 | 6,075      | 4,337      | 3,542      |
| Lincoln bromegrass           | 5,800      | 3,270      | 2,834      |
| Alfalfa plus:                |            |            |            |
| Alta fescue                  | 6,126      | 4,001      | 3,337      |
| Orchardgrass                 | 6,653      | 4,865      | 3,637      |
| LSD (.05)                    | N.S.       | 601        | 614        |

<sup>1</sup> Plots cut three to four times annually. Applied one ton dolomitic limestone per acre at seeding and 800 lbs. 2-12-12. Fertilized annually with 500 lbs. 0-9-27.

<sup>2</sup> NC 1 fescue has shown better performance at other locations. This strain was tested but never increased and released.



dino-grass mixtures for a period of several weeks. As noted in Table 16, Ladino will not survive the summer on the deep sands, whereas Coastal Bermuda is well adapted to these conditions (Table 10). Many observations have confirmed the fact that both annual or perennial (sericea) lespedeza are better adapted to sands or dry sandy loams than Ladino clover.

**Table 30. Seasonal yield of three grass-legume mixtures over a two-year period. Lower Piedmont, Cecil sandy clay loam, Raleigh.<sup>1</sup>**

| Mixture                            | 3/27<br>1945                 | 4/23<br>1945 | 5/19<br>1945 | 6/5<br>1945  | 7/11<br>1945 | 7/30<br>1945 | 8/22<br>1945 | 9/10<br>1945 | 10/4<br>1945  | Total<br>1945 |
|------------------------------------|------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|---------------|---------------|
|                                    | (Pounds dry matter per acre) |              |              |              |              |              |              |              |               |               |
| Orchard-Ladino                     | 511                          | 781          | 438          | 384          | 140          | 896          | 571          | 477          | 297           | 4,495         |
| Orchard-Kobe<br>lespedeza          | —                            | —            | —            | 244          | 215          | 606          | 545          | 259          | 572           | 2,441         |
|                                    | 4/9<br>1946                  | 5/2<br>1946  | 5/30<br>1946 | 6/24<br>1946 | 7/17<br>1946 | 8/6<br>1946  | 8/26<br>1946 | 9/17<br>1946 | 10/14<br>1946 | Total<br>1946 |
|                                    | (Pounds dry matter per acre) |              |              |              |              |              |              |              |               |               |
| Orchard-Ladino                     | 618                          | 414          | 349          | 596          | 1,337        | 360          | 156          | 167          | 168           | 4,165         |
| Orchard-Kobe<br>lespedeza          | 212                          | 194          | —            | 476          | 686          | 437          | 519          | 333          | 129           | 3,036         |
| Coastal Bermuda-<br>Kobe lespedeza | —                            | —            | —            | 543          | 805          | 516          | 485          | 553          | 149           | 3,056         |

<sup>1</sup> Fertilization—500 lbs. 0-14-14 annually; one ton lime at seeding and 800 lbs. 0-14-14.

**Table 31. Seasonal yields of various forages. Lower Coastal Plain, Lynchburg fine sandy loam, Pender County.<sup>1</sup>**

| Forage                                     | March <sup>2</sup>           | April <sup>2</sup> | May <sup>2</sup> | June <sup>2</sup> | July <sup>2</sup> | Aug. <sup>2</sup> | Sept. <sup>2</sup> | Total <sup>2</sup> |
|--|------------------------------|--------------------|------------------|-------------------|-------------------|-------------------|--------------------|--------------------|
|  | (Pounds dry matter per acre) |                    |                  |                   |                   |                   |                    |                    |
| Dallisgrass—Kobe<br>lespedeza <sup>2</sup> | 58                           | 105                | 220              | 389               | 891               | 649               | 476                | 2,787              |
| Dallisgrass-white<br>clover <sup>2</sup>   | 229                          | 254                | 445              | 261               | 773               | 663               | 467                | 3,091              |
| Dallisgrass <sup>2</sup>                   | 102                          | 118                | 140              | 144               | 421               | 430               | 351                | 1,707              |

<sup>1</sup> Fertilization—500 lbs. 0-14-14 annually; one ton lime at seeding and 800 lbs. 0-14-14. in third year; 100 lbs. K<sub>2</sub>O at planting; 200 lbs. K<sub>2</sub>O in third year.

<sup>2</sup> Usually there was a larger percentage of volunteer carpetgrass than Dallisgrass present on all plots.

<sup>3</sup> Average of 1941-45.

**Table 32. Yield of two alfalfa-grass mixtures. Lower Piedmont, Cecil sandy clay loam, Raleigh. F62.<sup>1</sup>**

| Mixture              | Total<br>1947                | Total<br>1948 | Total<br>1949 | Total<br>1950 | Four-year<br>average |
|----------------------|------------------------------|---------------|---------------|---------------|----------------------|
|                      | (Pounds dry matter per acre) |               |               |               |                      |
| Alfalfa-orchardgrass | 7,452                        | 6,078         | 7,879         | 4,788         | 6,549                |
| Alfalfa-tall fescue  | 7,210                        | 5,981         | 7,348         | 1,893         | 5,608                |
| LSD (.05)            | N.S.                         | N.S.          | N.S.          | 1,316         | —                    |

<sup>1</sup> Seeded September 1946. Fertilized at seeding with one ton lime, 200 lbs. P<sub>2</sub>O<sub>5</sub>, 100 lbs. K<sub>2</sub>O, 20 lbs. N, and 30 lbs. agricultural borax. Fertilized annually with 60 lbs. P<sub>2</sub>O<sub>5</sub>, 120 lbs. K<sub>2</sub>O and 20 lbs. agricultural borax. Total of four cuttings made annually.

**Table 33. Average botanical composition for the season of two alfalfa-grass mixtures in first and fourth year after seeding. Lower Piedmont, Cecil sandy clay loam, Raleigh. F62.<sup>1</sup>**

| Mixture              | 1947                        |       | 1950    |       |
|----------------------|-----------------------------|-------|---------|-------|
|                      | Alfalfa                     | Grass | Alfalfa | Grass |
|                      | (Grams dry matter per plot) |       |         |       |
| Alfalfa-orchardgrass | 416                         | 125   | 267     | 141   |
| Alfalfa-tall fescue  | 404                         | 126   | 81      | 77    |

<sup>1</sup> Represents average of four harvests. See previous table for total yield, management, fertilization, etc. Botanical analyses represent grams of each species present in a mixture of species. Determinations were made by hand separation of the mixture into its component parts.

The data presented in Table 31 typify the total and seasonal production obtained from Dallisgrass and two Dallisgrass-legume mixtures. Since both Dallisgrass and Kobe lespedeza make very little growth in cool weather, their production of forage is low in March, April and May. Due to the early spring growth of intermediate white clover, the Dallisgrass-white clover mixture was more productive than the Dallisgrass-Kobe lespedeza during March, April and May. In general tall fescue has appeared too aggressive with alfalfa in the Piedmont area (Tables 32 and 33). As noted in one test in the Piedmont area (Table 33), only one-third as much alfalfa was present in the alfalfa-tall fescue planting as in the alfalfa-orchardgrass in the fourth year after seeding.

Studies on methods of planting demonstrated that either broadcast or drilled was preferable to alternate row seeding (rows spaced 6 inches) of alfalfa-orchardgrass. Average yields of 6,377, 6,664 and 6,607 pounds of dry matter per acre were obtained over a period of 4 years in the lower Piedmont from alter-

**Table 34. Total yield and yield of individual species of two alfalfa-grass mixtures when grown in alternate rows of different spacing. Lower Piedmont, Cecil sandy clay loam, Raleigh.<sup>1</sup>**

| Management<br>and Mixture | 1948                         |       |       | 1949    |       |       |
|---------------------------|------------------------------|-------|-------|---------|-------|-------|
|                           | Alfalfa                      | Grass | Total | Alfalfa | Grass | Total |
|                           | (Pounds dry matter per acre) |       |       |         |       |       |
| Wide spacing:             |                              |       |       |         |       |       |
| Alfalfa-orchard           | 3,453                        | 927   | 4,380 | 4,129   | 831   | 4,960 |
| Alfalfa-tall fescue       | 3,251                        | 1,742 | 4,993 | 3,881   | 1,135 | 5,016 |
| Narrow spacing:           |                              |       |       |         |       |       |
| Alfalfa-orchard           | 4,309                        | 1,608 | 5,917 | 5,066   | 1,234 | 6,300 |
| Alfalfa-tall fescue       | 3,423                        | 1,373 | 4,796 | 4,143   | 1,086 | 5,229 |

<sup>1</sup> Plots were seeded in fall of 1946. Clipped and discarded in 1947 due to weed infestation. Good stands were present on all plots. Rate of seeding: 20 lbs. Alfalfa and 10 lbs. grass per acre on all plots. Wide spacing, alternate rows spaced 12 inches. Narrow spacing, alternate rows spaced six inches.

**Table 35. Chemical composition of individual components of an alfalfa-orchardgrass mixture. Norfolk fine sandy loam, Johnston County.<sup>1</sup>**

| Mixture                                | June 20<br>1944 | July 15<br>1944 | May 8<br>1946 | June 6<br>1946 |
|--|-----------------|-----------------|---------------|----------------|
| Per cent N                             |                 |                 |               |                |
| Alfalfa                                | 2.39            | 3.60            | 3.23          | 3.56           |
| Orchardgrass                           | 3.42            | 3.84            | 1.86          | 2.97           |
| Per cent CaO                           |                 |                 |               |                |
| Alfalfa                                | .98             | 1.28            | 2.93          | 1.73           |
| Orchardgrass                           | .48             | .56             | .38           | .58            |
| Per cent P <sub>2</sub> O <sub>5</sub> |                 |                 |               |                |
| Alfalfa                                | .46             | .63             | —             | —              |
| Orchardgrass                           | .89             | .83             | —             | —              |
| Per cent K <sub>2</sub> O              |                 |                 |               |                |
| Alfalfa                                | —               | 3.01            | 2.53          | 3.10           |
| Orchardgrass                           | —               | 3.86            | 3.55          | 4.52           |

<sup>1</sup> The above mixture was seeded in September 1942 and harvested regularly. Chemical composition is shown for only two harvests in two years. Two tons dolomitic limestone was applied per acre at seeding. Approximately 50 lbs. P<sub>2</sub>O<sub>5</sub> and 50 lbs. K<sub>2</sub>O applied annually.

nate row, broadcast and drilled mixed, respectively (no data reported).

Wide row spacing (12-inch rows) was definitely inferior to narrow row spacing (6-inch rows) particularly as regards alfalfa-orchardgrass (Table 34).

In legume-grass mixture studies orchardgrass was higher than alfalfa in K<sub>2</sub>O content (Table 35).

In the experiment described in Table 32, potash deficiency symptoms were noted on alfalfa growing with tall fescue, but not with orchardgrass during 1948 although orchardgrass analyzed higher in K<sub>2</sub>O content than tall fescue. The proportion of total production of the individual grass species would affect the degree of per cent K<sub>2</sub>O competition. The possibility also exists that the root system of tall fescue is more heavily concentrated in the surface layers than is orchardgrass, and consequently tall fescue is more competitive for the applied potash.



Section IV—Tables 36-41

## Winter Annual Grasses

### Summary

The main winter annual grasses utilized for forage in North Carolina are the small grains and Italian ryegrass. No data are reported herein on Italian ryegrass; however, this grass is widely adapted to a wide range of soil and climatic conditions throughout the state. Italian ryegrass volunteers readily and grows vigorously in the seedling stage; consequently, it is considered a pest in small grain fields and new seedings of permanent pastures and alfalfa.

Small grains are utilized to advantage for grazing and silage. Generally abruzzi rye is considered superior for early fall and early winter grazing, whereas barley and oats usually furnish more grazing in the spring of the year.

### Results and Discussion

North Carolina abruzzi rye yielded as well or better than other ryes. Balbo, Tetra Petkus and winter rye yielded much less forage prior to March 15 than N.C. abruzzi. After March 15 these ryes yielded more forage than N.C. abruzzi. Abruzzi 200-96 (Tables 36 and 37) was released in 1955 as N.C. abruzzi. Miss.

**Table 36. Seasonal yield of small grain. Upper Coastal Plain, Norfolk sandy loam, McCullers. F83.<sup>1</sup>**

| Grain                           | Jan. 29<br>1953 | March 11<br>1953 | April 13<br>1953 | May 16<br>1953 | Total<br>1953 |
|---------------------------------|-----------------|------------------|------------------|----------------|---------------|
| (Pounds dry matter per acre)    |                 |                  |                  |                |               |
| Arlington oats                  | 1,050           | 935              | 2,608            | 645            | 5,238         |
| Balbo rye                       | 348             | 444              | 2,474            | 26             | 3,292         |
| Winter rye                      | 327             | 908              | 2,809            | 17             | 4,061         |
| Colonial barley                 | 839             | 1,346            | 2,913            | 188            | 5,286         |
| Abruzzi rye 200-96 <sup>2</sup> | 1,679           | 1,130            | 948              | 110            | 3,867         |
| Tetra petkus                    | 855             | 782              | 2,453            | 141            | 4,231         |
| Atlas 66 wheat                  | 1,037           | 1,022            | 1,454            | 317            | 3,830         |
| Abruzzi rye 200-97              | 990             | 1,317            | 1,217            | 72             | 3,596         |
| Taylor's rye                    | 1,077           | 1,583            | 1,344            | 47             | 4,051         |
| Abruzzi rye 200-98              | 1,086           | 1,507            | 1,326            | 177            | 4,096         |
| LSD (.05)                       |                 |                  |                  |                | 520           |

<sup>1</sup> Seeded Sept. 15. Fertilization: Applied 400 lbs. per acre 5-10-10 at seeding. Topdressed with 50 lbs. N Feb. 15.

<sup>2</sup> Later named and released as NC abruzzi rye.

**Table 37. Seasonal yields of small grains. Lower Piedmont, Cecil clay loam. F(83A).<sup>1</sup>**

| Grain                       | Jan. 1<br>1954 | March 6<br>1954 | March 29<br>1954 | April 17<br>1954 | Total<br>1954 |
|-----------------------------|----------------|-----------------|------------------|------------------|---------------|
|                             |                |                 |                  |                  |               |
| Arlington oats              | 471            | 342             | 1,099            | 1,220            | 3,132         |
| Balbo rye                   | 107            | 0               | 767              | 1,755            | 2,629         |
| Winter rye                  | 114            | 27              | 1,314            | 1,244            | 2,699         |
| Colonial barley             | 478            | 98              | 1,436            | 1,176            | 3,188         |
| Abruzzi 200-96 <sup>2</sup> | 700            | 929             | 631              | 1,550            | 3,810         |
| Tetra petkus                | 360            | 0               | 991              | 1,697            | 3,048         |
| Atlas 66 wheat              | 412            | 817             | 830              | 1,124            | 3,183         |
| Abruzzi 200-97              | 476            | 1,167           | 718              | 1,270            | 3,631         |
| Taylor's rye                | 658            | 727             | 927              | 1,264            | 3,576         |
| Abruzzi 200-98              | 221            | 598             | 901              | 1,032            | 2,752         |
| LSD (.05)                   | 316            | 215             | 286              | 327              | 562           |
| (.01)                       | 432            | 295             | 392              | 447              | N.S.          |
| CV (per cent)               |                |                 |                  |                  | 19            |

<sup>1</sup> Seeded Sept. 8, 1953. Fertilization: Followed renovated Ladino-orchardgrass pasture. No fertilization at seeding. Topdressed with 50 lbs. N March 1.

<sup>2</sup> Later named and released as NC abruzzo rye.

Syn. 3 rye was released by Mississippi as "explorer rye" in 1958. This rye has yielded approximately the same as N.C. abruzzo. Gator rye appeared inferior to most ryes in the test (Table 41). Abruzzi rye usually produced more forage in fall and early winter than did the various varieties of oats, barley and wheat.

Arlington oats and colonial barley produced high yields of forage in several tests, particularly in late March and April. These small grains usually yielded considerably more than abruzzo rye during late March and April (Tables 36, 38, 40). In limited tests Atlas 66 wheat produced yields of dry forage ranging from 2,800 to 3,800 pounds per acre.

**Table 38. Seasonal yields of small grain. Upper Coastal Plain, Norfolk sandy loam, Clayton. F344.<sup>1</sup>**

| Grain                       | March 3<br>1955 | March 16<br>1955 | April 6<br>1955 | April 26<br>1955 | June 2<br>1955 | Total<br>1955 |
|-----------------------------|-----------------|------------------|-----------------|------------------|----------------|---------------|
|                             |                 |                  |                 |                  |                |               |
| Arlington oats              | 109             | 403              | 587             | 1,971            | 868            | 3,938         |
| Balbo, Tenn.                | 810             | 1,215            | 658             | 1,043            | 130            | 3,856         |
| Colonial 2 barley           | 141             | 458              | 692             | 1,440            | 214            | 2,945         |
| Georgia 821                 | 1,294           | 731              | 591             | 1,141            | 161            | 3,918         |
| Ga. Cert. (abruzzo) Kitrell | 958             | 733              | 444             | 692              | 68             | 2,895         |
| Ga. Foundation abruzzo      | 853             | 718              | 298             | 834              | 99             | 2,802         |
| NC abruzzo                  | 1,253           | 880              | 484             | 802              | 84             | 3,503         |
| Atlas 66 wheat              | 399             | 731              | 384             | 1,042            | 300            | 2,856         |
| LSD                         |                 |                  |                 |                  |                |               |
| Total: .05                  |                 |                  |                 |                  |                | 722           |
| .01                         |                 |                  |                 |                  |                | 1,002         |
| Cutting: .05                |                 |                  |                 |                  |                | 93            |
| .01                         |                 |                  |                 |                  |                | 126           |
| Cutting x Treat.: .05       |                 |                  |                 |                  | 264            |               |
| .01                         |                 |                  |                 |                  | 352            |               |
| CV (per cent)               |                 | 24               |                 |                  |                |               |

<sup>1</sup> Seeded Sept. 29, 1954. Fertilization: Applied 400 lbs. per acre 5-10-10 at seeding. Topdressed 50 lbs. N Nov. 15.

**Table 39. Seasonal yields of small grain (rye). Upper Coastal Plain, Norfolk sandy loam, Clayton. F367.<sup>1</sup>**

| Rye             | Nov. 16<br>1955 | Feb. 15<br>1956 | March 19<br>1956 | April 18<br>1956 | Total<br>1955-56 |
|-----------------|-----------------|-----------------|------------------|------------------|------------------|
|                 |                 |                 |                  |                  |                  |
| Balbo           | 179             | 8               | 1,841            | 630              | 2,658            |
| Florida black   | 559             | 715             | 856              | 215              | 2,345            |
| Wren's abruzzo  | 341             | 1,034           | 1,008            | 291              | 2,674            |
| Wood's abruzzo  | 291             | 955             | 1,722            | 243              | 3,211            |
| Georgia 8-21    | 219             | 815             | 1,226            | 326              | 2,586            |
| Miss. Selection |                 |                 |                  |                  |                  |
| of abruzzo      | 77              | 308             | 1,724            | 402              | 2,511            |
| Miss. Syn. 1    | 354             | 511             | 1,983            | 438              | 3,286            |
| Miss. Syn. 3    | 259             | 600             | 1,685            | 400              | 2,944            |
| Miss. Syn. 5    | 247             | 229             | 2,054            | 367              | 2,897            |
| NC abruzzo      | 227             | 429             | 1,612            | 266              | 2,534            |
| LSD (.05)       |                 |                 |                  |                  | NS               |
| (.01)           |                 |                 |                  |                  | NS               |

Note: There was a cutting by treatment interaction.

<sup>1</sup> Seeded Sept. 21, 1955. Fertilization: None at seeding. Topdressed with 30 lbs. N Oct. 5, 30 lbs. N Nov. 20 and 20 lbs. N Feb. 1.

**Table 40. Seasonal yields of small grain (rye). Lower Piedmont, Cecil clay loam, Raleigh. F384.<sup>1</sup>**

| Rye                | Nov. 12<br>1956 | Jan. 14<br>1957 | Mar. 30<br>1957 | May 7<br>1957 | Total<br>1956-57 |
|--------------------|-----------------|-----------------|-----------------|---------------|------------------|
|                    |                 |                 |                 |               |                  |
| Balbo              | 259             | 0               | 1,761           | 551           | 2,571            |
| Florida black      | 269             | 672             | 913             | 455           | 2,309            |
| Wren's abruzzo     | 191             | 240             | 1,935           | 340           | 2,706            |
| Wood's abruzzo     | 209             | 15              | 2,066           | 418           | 2,708            |
| Georgia 8-21       | 86              | 55              | 2,054           | 455           | 2,650            |
| Miss. Sel. abruzzo | 291             | 15              | 2,467           | 498           | 3,271            |
| Miss. Syn. 3       | 303             | 91              | 2,396           | 447           | 3,237            |
| Miss. Syn. 4       | 235             | 17              | 2,006           | 433           | 2,691            |
| Miss. Syn. 5       | 148             | 0               | 2,083           | 654           | 2,885            |
| NC abruzzo         | 345             | 29              | 2,542           | 379           | 3,295            |
| LSD (.05)          |                 |                 |                 |               | 336              |
| (.01)              |                 |                 |                 |               | 460              |

<sup>1</sup> Seeded Sept. 19, 1956. Fertilization: Applied 300 lbs./A. 5-10-10 at seeding. Topdressed with 20 lbs. N Jan. 2.

**Table 41. Seasonal yield of small grain (rye). Piedmont, Georgeville clay loam, Pittsboro. F390.<sup>1</sup>**

| Rye            | Nov. 11<br>1957 | April 4<br>1958 | May 19<br>1958 | Total<br>1957-58 |
|----------------|-----------------|-----------------|----------------|------------------|
|                |                 |                 |                |                  |
| Balbo          | 39              | 1,556           | 253            | 1,848            |
| Florida Black  | 637             | 278             | 333            | 1,248            |
| Wren's abruzzo | 123             | 1,050           | 114            | 1,288            |
| Wood's abruzzo | 62              | 1,367           | 171            | 1,600            |
| Miss. abruzzo  | 36              | 1,131           | 244            | 1,411            |
| Miss. Syn. 3   | 152             | 1,726           | 309            | 2,187            |
| Miss. Syn. 4   | 105             | 1,488           | 275            | 1,868            |
| Miss. Syn. 5   | 110             | 1,360           | 224            | 1,694            |
| Miss. Syn. 6   | 31              | 1,620           | —              | 1,651            |
| NC abruzzo     | 149             | 1,443           | 159            | 1,751            |
| Gator          | 35              | 709             | 142            | 886              |
| Elbon          | 189             | 911             | 39             | 1,139            |

<sup>1</sup> Seeded Sept. 11, 1957. Fertilization: 800 lbs. 2-12-12 at seeding. Top dressed with 30 lbs. N Oct. 15, and 30 lbs. N Feb. 6.



## Summer and Winter Annual Legumes

Section V—Tables 42-45

### Summary

The annual lespedezas and soybeans are the most widely adapted and utilized summer annual legumes for hay and grazing in North Carolina. No strain test performances are reported in this bulletin for the annual lespedezas (See Ext. Cir. No. 387, Jan. 1955). The annual lespedezas are adapted on most North Carolina soils except the dry sandy ones. Kobe is well adapted to upland loams and low-lying, poorly-drained soils of the Coastal Plain and Southern Piedmont, and generally produces more forage in the Coastal Plain than Korean. In the Mountain area Korean is more frequently utilized, since Kobe is often killed by frost before the seed mature. Two varieties of Korean, Rowan and Climax, are superior under certain conditions in North Carolina. Rowan is superior on root-knot nematode infested soils. The annual lespedezas are usually seeded in late winter in small grain, and about one to two tons of dry forage per acre may be expected in one year.

Soybeans are also widely adapted in North Carolina and are frequently seeded for silage, hay or grazing.

Crimson clover is usually superior to other winter annuals grown in North Carolina, except on the deeper sands where hairy vetch is better adapted. Hairy vetch will grow on most medium drained soils of the state; however, it frequently becomes a pest in small grain.

(*Summer Annual Legumes, Table 41*)

Yields of soybean-sorghum mixtures varied from 1½ to better than 5½ tons per acre, depending on the season. The data illustrate the type of production that can be obtained for silage purposes from pure stands of soybeans and soybean-grass mixtures. Higher yields could have been obtained from the grass and soybean-grass mixtures by topdressing with nitrogen fertilizer (Table 42).

(*Winter Annual Legumes, Tables 41-44*)

Yields ranging from less than one ton to approximately two tons of dry forage per acre was obtained from mixtures of crimson clover-small grain and hairy vetch-small grain (Table 42).

Comparisons of several winter annual legumes showed that crimson clover was usually superior to other winter annuals throughout North Carolina. In several tests button clover was successfully established and grew vigorously, but yields were usually lower than crimson clover (Tables 43 and 45). Subterranean clover was well inoculated in the test reported herein, however, difficulty with "inoculation" is frequently encountered. Tests between Bacchus March, Tallarook and Mt. Barker showed

**Table 42. Yield of summer and winter annuals grown at two locations.<sup>1</sup>**

| Annual                         | Norfolk fine sandy loam<br>Johnston County |         |         | Cecil clay loam<br>Wake County |         |         |
|--------------------------------|--|---------|---------|--------------------------------|---------|---------|
|                                | 1943                                       | 1945    | 1946    | 1943                           | 1944    | 1945    |
|                                | (Pounds dry matter per acre)               |         |         |                                |         |         |
| Soybeans                       | 2,580                                      | 4,915   | 6,160   | 2,619                          | 1,750   | 3,446   |
| Soybeans and orange<br>sorghum | 3,080                                      | 10,310  | 11,715  | 7,950                          | 8,660   | 9,030   |
| Soybeans and sudangrass        | 4,980                                      | 6,245   | 5,940   | 5,960                          | 6,600   | 5,480   |
| Sudan                          | 5,240                                      | 5,095   | 4,930   | 7,210                          | 7,860   | 5,490   |
| LSD (.05)                      | 990  | 927     | 910     | 1,212                          | 1,216   | 1,160   |
|                                | 1942-43                                    | 1943-44 | 1944-45 | 1942-43                        | 1943-44 | 1944-45 |
|                                | (Pounds dry matter per acre)               |         |         |                                |         |         |
| Oats-crimson clover            | 3,110                                      | 2,920   | 1,301   | 1,845                          | 2,580   | 2,042   |
| Oats-hairy vetch               | 2,235                                      | 3,400   | 1,200   | 1,545                          | 3,735   | 2,400   |
| Oats-barley-hairy vetch        | 2,935                                      | 4,650   | 1,265   | 1,890                          | 4,464   | 2,835   |
| LSD (.05)                      | 458  | 735     | 407     | 213                            | 635     | 263     |

<sup>1</sup> A total of seven winter annuals and seven summer annuals were treated. Only seven of the 14 are presented. All winter treatment mixtures contained a legume, either vetch, crimson or Austrian peas. With the exception of one treatment the same is true of summer treatments. Seeding dates: Summer annuals were seeded between May 20 and June 1. Winter annuals were seeded between Sept. 1 and Sept. 20. *Fertilization:* Land was fertilized with 300 lbs./A. 3-9-9 before seeding each spring and each fall. No topdressings were made. *Management:* The summer and winter annual experiments described above were conducted on the same area of land. The blocks were square and the summer annual plots were run crosswise the winter annual, etc.

**Table 43. Performance of various winter annual legumes compared with two perennials. Tidewater, Bladen silt loam, Plymouth. Experiment II.<sup>1</sup>**

| Legume                  | April 17<br>1947             | May 17<br>1947     | Total<br>to date |
|-------------------------|------------------------------|--------------------|------------------|
|                         | (Pounds dry matter per acre) |                    |                  |
| Manganese bur clover    | 287                          | 535                | 822              |
| Sub clover "Mt. Barker" | 160                          | 709                | 869              |
| Fla. black medic        | 175                          | 456                | 631              |
| Button clover           | 59                           | 506                | 565              |
| Dixie crimson clover    | 368                          | 1,325              | 1,693            |
| Ladino clover           | 186                          | 1,143 <sup>2</sup> | 1,229            |
| Big trefoil (smooth)    | —                            | 528                | 528              |

<sup>1</sup> Seeded Sept. 12, 1946. Fertilization at seeding: two tons dolomitic limestone, 120 lbs. P<sub>2</sub>O<sub>5</sub> and 120 lbs. K<sub>2</sub>O per acre.

<sup>2</sup> Summer harvests were made but not shown.

that Mt. Barker is the better adapted strain of subterranean clover (no data reported). In experiments to date subterranean clover has been too erratic to warrant its general use. In tests not reported here, hairy vetch was found to be more productive than crimson clover on a Lakeland sand.

Dixie crimson produced as much or more forage than other varieties of crimson clover tested in a preliminary test (Table 44).

Low hop clover has been widely tested in North Carolina and is adapted to a wide range of conditions (no data reported). It is relatively non-productive and is no longer recommended. Low hop volunteers throughout the state, particularly where stands of other forages have been lost. Low hop will not successfully volunteer in a good pasture of Ladino clover.

Although no data are reported, comparisons in tests between crimson clover and rose clover show crimson to be much more productive. Most strains of lupine, particularly the blue lupines, winter kill in North Carolina. There are some strains of white lupine which will survive and produce fair growth in the South-eastern area of the state.

**Table 44. Performance of four strains of Crimson clover. Lower Piedmont, Appling sandy clay loam, Wake County.<sup>1</sup>**

| Strain    | April 27<br>1950                |
|-----------|---------------------------------|
|           | (Pounds dry matter<br>per acre) |
| Dixie     | 4,733                           |
| Auburn    | 3,824                           |
| Autauga   | 4,605                           |
| Talladega | 4,274                           |
| LSD (.05) | 620                             |

<sup>1</sup> Seeded Sept. 30, 1949. Fertilized at seeding with one ton dolomitic limestone and 1,000 lbs. 2-12-12 per acre.

**Table 45. Growth and maturity ratings of several winter annual legumes. Tidewater, Bladen silt loam, Plymouth.**

| Legume                  | Experiment I <sup>1</sup> |        | Experiment II <sup>2</sup> |        |                |
|-------------------------|---------------------------|--------|----------------------------|--------|----------------|
|                         | April 16, 1946            |        | May 11, 1946               |        | April 17, 1947 |
|                         | Growth                    | Bloom  | Growth <sup>3</sup>        | Bloom  | Growth         |
|                         | (inches)                  |        | (inches)                   |        | (inches)       |
| Manganese Bur           | 1                         | None   | 1                          | Mature | 7              |
| Sub-clover (Mt. Barker) | 5                         | Early  | 6                          | Mature | 4              |
| Florida black medic     | 10                        | Full   | 10                         | Mature | 4              |
| Button clover           | 12                        | Early  | 12                         | Mature | 4              |
| Dixie crimson           | 18                        | Medium | 18                         | Mature | 7              |
| Tifton B-15-Bur         | 10                        | Full   | 10                         | Mature |                |
| Persian clover          | 9                         | Full   | 10                         | Mature |                |

<sup>1</sup> All had 100 per cent stand except Manganese Bur had 50 per cent stand and poor color. Seeded Sept. 10, 1945.

<sup>2</sup> Considerable lateral growth since last notes.

<sup>3</sup> Stand of all legumes was at least 90 per cent. Seeded September, 1946. Fertilization: Same as noted in Table 43.



Section VI—Tables 46-51

## Summer Annual Grasses

### Summary

Pearl millet (cattail millet) and sudangrass are quick growing summer annuals capable of producing two to four tons of dry forage per acre within an eight- to 12-week period during the summer. Pearl millet is much better adapted to the sandy soils of the Coastal Plain area of North Carolina than sudangrass. Starr millet is a more leafy variety which produces lower dry matter yield than common; however, in grazing studies Starr has been approximately equal to pearl in production of total digestible nutrients (Report No. FC-5, AI-28, DH-15, May 1957, N. C. State College). Ga-hi millet looks promising in initial tests.

### Results and Discussion

On sandy soils of the Coastal Plain area pearl millet strains have proven far superior to sudangrass, producing three to ten times more forage, Table 46. In limited tests in the Piedmont area sudangrass yielded approximately the same total forage as common pearl and Starr millet. Sudan produced the most forage early in the season prior to July 8, and millet the most after this date (Table 49). Starr millet did not produce as much total forage as common pearl, however, Starr appeared more leafy and offers promise under grazing. Georgia Hybrid #1 (Gahi-1) produced more total forage than other strains or varieties of pearl millet listed in two of the three years tested (Table 46). In experiment F405, common, Starr and Ga. Hybrid #1 produced similar yields.

Usually common pearl millet showed much more early season (four to eight weeks following seeding) vigor and growth than Starr or Georgia Hybrid #1 (Tables 47 and 49). In late summer Starr and Georgia Hybrid #1 were usually much more productive than common pearl, with the exception of Starr millet in one test (Table 47, F372).

In preliminary tests in the Coastal Plain (Table 48), very low yields were obtained from Brown top millet.

The perennial sweet sudan grasses and *Sorghum almum* pro-

**Table 46. Relative performance of various summer annual grasses when grown at several locations.<sup>1</sup>**

| Grass                    | Coastal Plain |              |              |              | Piedmont     |              | Leaf disease <sup>2</sup><br>F302<br>Oct. 1 |
|--------------------------|---------------|--------------|--------------|--------------|--------------|--------------|---|
|                          | Wallace       | Clayton      | Clayton      | Clayton      | Raleigh      | Pittsboro    |   |
|                          | F303<br>1953  | F380<br>1956 | F372<br>1957 | F405<br>1958 | F302<br>1952 | F407<br>1958 |   |
| Pearl millet:            |               |              |              |              |              |              |   |
| Common                   | 7,409         | 2,870        | 4,922        | 3,414        | 5,743        | 5,648        | 2.3   |
| Starr                    | 6,283         | 2,575        | 3,844        | 3,588        | 3,916        | 4,528        | 3.0   |
| Ga. Hybrid #1            |               | 3,002        | 5,382        | 3,357        |              |              |   |
| Cattail #7               |               |              | 4,544        | 3,143        |              |              |   |
| Hybrid cattail SJ        |               |              | 3,581        | 3,577        |              |              |   |
| Improved Starr           |               | 2,376        | 3,025        |              |              |              |   |
| Texas No. 7              | 7,096         | 2,541        |              |              | 7,091        |              | 2.0   |
| Hybrid C (Georgia)       | 8,934         |              |              |              | 8,816        |              | 1.3   |
| Hybrid D (Georgia)       | 10,015        |              |              |              | 7,823        |              | 1.7   |
| Sweet cattail            |               | 1,912        |              |              |              |              |   |
| Sudan:                   |               |              |              |              |              |              |   |
| Okla. 130                |               |              |              |              | 4,858        |              | 2.7   |
| Sweet (Texas Sta.)       |               |              |              |              | 3,674        |              | 5.7   |
| Common                   | 497           |              | 1,036        |              | 3,915        | 4,963        | 8.3   |
| Sweet common             | 484           | 1,572        | 865          | 557          | 4,642        |              | 4.3   |
| Sweet 372                | 604           |              | 1,018        |              |              | 2,764        |   |
| Sweet 372 (S-1)          |               |              | 642          |              |              | 3,283        |   |
| Piper                    | 852           | 1,584        | 1,371        |              | 3,347        | 4,447        | 6.3   |
| Greenleaf                |               | 1,187        | 884          |              |              | 4,360        |   |
| Lahoma                   |               | 768          | 865          |              |              | 3,651        |   |
| Ga. 337                  |               | 979          | 1,113        |              | 2,967        | 4,607        | 4.3   |
| Stoneville synthetic #1  |               |              | 1,636        |              |              | 4,619        |   |
| Stoneville selection     |               |              | 882          |              |              | 4,088        |   |
| Tift                     | 661           | 1,386        |              |              | 3,418        | 4,643        | 4.0   |
| Wheeler                  | 1,081         |              |              |              |              |              |   |
| Syn. #4                  | 358           |              |              |              | 3,928        |              | 2.7   |
| Sorghums:                |               |              |              |              |              |              |   |
| Miss. Persistent Johnson |               | 225          |              |              |              |              |   |
| Commercial Johnson       |               | 176          |              |              |              |              |   |
| Sorghum-Johnson hybrid   |               | 119          |              |              |              |              |   |
| LSD (.05)                |               | 433          |              |              | 1,503        |              |   |
| CV                       |               | 26           |              |              | 18           |              |   |

<sup>1</sup> See Appendix for planting dates and fertilizations.  
<sup>2</sup> 1=No leaf disease; 10=most severe.

**Table 47. Seasonal yields of various strains of pearl millet in two years. Coastal Plain, Norfolk sandy loam, Clayton. F380 and F372.<sup>1</sup>**

| Strain          | July 24<br>1956              |       | Aug. 27<br>1956 |       | Total<br>1956 |
|-----------------|------------------------------|-------|-----------------|-------|---------------|
|                 | (Pounds dry matter per acre) |       |                 |       |               |
| Common pearl    | 2,018                        |       | 852             |       | 2,870         |
| Starr           | 1,252                        |       | 1,353           |       | 2,575         |
| Georgia Hyb. #1 | 1,256                        |       | 1,746           |       | 3,002         |
| Strain          | July 17<br>1957              |       | Aug. 7<br>1957  |       | Total<br>1957 |
|                 | (Pounds dry matter per acre) |       |                 |       |               |
| Common pearl    | 2,471                        | 1,005 | 685             | 761   | 4,922         |
| Starr           | 1,255                        | 1,120 | 603             | 866   | 3,844         |
| Georgia Hyb. #1 | 1,804                        | 1,333 | 713             | 1,532 | 5,382         |

<sup>1</sup> See Appendix for planting dates and fertilization.

**Table 48. Total yield of millets and sorghum. Coastal Plain, Norfolk sandy loam, Clayton. F374.<sup>1</sup>**

| Grain            | Total<br>1957                   |
|------------------|---------------------------------|
|                  | (Pounds dry matter<br>per acre) |
| Brown top millet | 245                             |
| Sorghum alnum    | 135                             |
| Starr millet     | 2,434                           |

<sup>1</sup> Fertilized similarly to F372. (See Appendix.)

duced more forage than sweet sudan in preliminary tests in the Piedmont (Table 50). About 50 percent or more of the plants of perennial sudangrass and *Sorghum alnum* were eliminated by winter killing in the first winter following seeding, sudan being somewhat more susceptible to damage than *S. alnum*. These species offer problems as a pest. Their performance has not been fully evaluated in this area. The perennial sorghums tested

**Table 49. Seasonal yields of sudangrass, pearl millet and sorghums. Piedmont, Georgeville clay loam, Pittsboro. F407.<sup>1</sup>**

| Grass          | July 8<br>1958  |                 |                              |  | Total<br>1958 |
|----------------|-----------------|-----------------|------------------------------|--|---------------|
|                | July 28<br>1958 | Sept. 2<br>1958 | (Pounds dry matter per acre) |  |               |
| Sudans:        |                 |                 |                              |  |               |
| Piper          | 1,745           | 2,258           | 444                          |  | 4,447         |
| Tift           | 2,139           | 1,838           | 666                          |  | 4,643         |
| Greenleaf      | 1,773           | 2,054           | 533                          |  | 4,360         |
| Ga. 337        | 1,542           | 2,283           | 782                          |  | 4,607         |
| Common sudan   | 1,931           | 2,377           | 655                          |  | 4,963         |
| Pearl millets: |                 |                 |                              |  |               |
| Starr millet   | 542             | 2,906           | 1,080                        |  | 4,528         |
| Common pearl   | 554             | 4,549           | 545                          |  | 5,648         |
| Sorghums:      |                 |                 |                              |  |               |
| Dekalb X 1     | 1,171           | 2,499           | 838                          |  | 4,508         |
| Dekalb X 2     | 899             | 2,954           | 758                          |  | 4,611         |

<sup>1</sup> See Appendix for seeding date and fertilization.

**Table 50. Seasonal yields of pearl millet, and annual and perennial sorghums. Piedmont, Georgeville clay loam, Pittsboro. F408.<sup>1</sup>**

| Grass                          | July 8<br>1958  |                 |                              |  | Total<br>1958 |
|--------------------------------|-----------------|-----------------|------------------------------|--|---------------|
|                                | July 29<br>1958 | Sept. 2<br>1958 | (Pounds dry matter per acre) |  |               |
| Perennial sweet (Harpool)      | 1,063           | 3,089           | 1,209                        |  | 5,361         |
| Perennial sweet (F. C. 34,050) | 1,188           | 2,792           | 1,152                        |  | 5,132         |
| Sweet sudan (commercial)       | 1,617           | 2,179           | 165                          |  | 3,961         |
| Sorghum alnum                  | 2,101           | 2,753           | 919                          |  | 5,773         |
| Starr millet                   | 644             | 3,663           | 1,039                        |  | 5,346         |
| Pearl millet                   | 1,015           | 4,761           | 307                          |  | 6,083         |

<sup>1</sup> Fertilization: 450 lbs./A 8-8-8 at planting, 60 lbs. N June 12 and 60 lbs. N July 9.

were not productive in the Coastal Plain area (Table 46, Experiment F380 and Table 48).

Potassium analyses (Table 51) show that millet and sudan remove relatively large quantities of potash.

**Table 51. The chemical composition of pearl millet and sudan-grass (N and K<sub>2</sub>O). Coastal Plain, Norfolk sandy loam, Clayton. F380 and F372.<sup>1</sup>**

| Grass               | July 24, 1956 |                  | Aug 27, 1956 |                  | Avg. four dates 1957 |                  |
|---------------------|---------------|------------------|--------------|------------------|----------------------|------------------|
|                     | N             | K <sub>2</sub> O | N            | K <sub>2</sub> O | N                    | K <sub>2</sub> O |
|                     | (Per cent)    |                  |              |                  |                      |                  |
| Common pearl millet | 2.25          | 5.03             | .90          | 2.95             | 1.90                 | 2.76             |
| Starr millet        | 2.35          | 4.41             | .90          | 2.81             | 2.13                 | 2.73             |
| Ga. Hybrid #1       | 2.48          | 4.82             | .76          | 2.92             | 1.99                 | 3.19             |
| Sweet common sudan  | 2.14          | 3.66             | .98          | 2.23             | 2.00                 | 1.71             |
| LSD (.05)           | N.S.          | .57              | N.S.         | .58              | 15                   | 9                |

<sup>1</sup> See Appendix for seeding dates and fertilization.

## Appendix

### Section I—Perennial Grasses

(Tables 1-7)

#### Fertilization and Management

The fertilization and management procedure for the experiments shown in Tables 1, 2, 3 and 4 are presented with the data.

Experiment F111 (Table 5) was fertilized at seeding with one ton of dolomitic limestone and 1200 pounds of 2-12-12. The plots were topdressed annually in March with 600 lbs. 0-9-27 and 60 lbs. of N per acre. Ladino clover was uniformly seeded over the area. The forage was harvested at 5 to 6 week intervals after reaching full bloom each spring. Each plot consisted of two rows spaced one inch apart, 25 feet in length.

Experiments F331 and F146 (Tables 6 and 7) were fertilized and managed similarly to F111 with the exception that four tons of dolomitic limestone per acre was applied at seeding on F146.

### Section II—Perennial Legumes

(Table 15, White clover and Ladino)

#### Fertilization and Management

All Ladino and intermediate white clover tests in the Lower Piedmont area received one ton of dolomitic limestone at seeding. In the Mountain and Tidewater areas two tons of dolomitic lime-

stone was applied. Plots at all locations received 1,000 lbs. per acre of 2-12-12 at seeding and 500 lbs. 0-9-27 annually.

Due to severe droughts which damaged the stands, only one to two years data were obtained from most experiments.

F102—Seeded September 1950 in pure stand. Two harvests were made in 1951, May 4 and July 30.

F110—Seeded in pure stand Oct. 5, 1951. No yields were taken in 1952 due to irregular stands and severe drought. Excellent stands were present in the spring of 1953 and four harvests were made between March 24 and July 1.

F117—Seeded to pure stand of clover Sept. 25, 1952. The plots were harvested in April and discarded due to heavy weed infestation. Yields were taken on July 10 only and bloom counts were made July 1.

F143 and F144—These two experiments were seeded Sept. 3, 1953 to a pure stand of clover. Four harvests for yield were made April 10 through Sept. 3. Bloom counts were made April 30, May 27 and June 28 and an average for the three dates is presented.

F109—Seeded September 1950 in mixture with orchardgrass. Five harvests were taken in 1951, May 14 through Oct. 29, and three harvests in 1952, May 2, June 18, and July 17. The experiment was discontinued due to severe drought in summer of 1952. Yield data in 1952 showed similar trends to 1951 and are not presented.

F155—Seeded Sept. 17, 1953 to a pure stand of clover. Harvested five times May 21 through Oct. 7 in 1954 and twice, June 10 and July 11, in 1955. An average of bloom counts taken on May 21 and Aug. 2 is presented.

F327—Seeded Aug. 4, 1955 in mixture with orchardgrass. The forage was harvested May 17, June 12 and July 25 in 1956.

Tables 16-19 (*Birdsfoot trefoil, red clover, etc.*)

#### Fertilization and Management

General fertilization and management procedure is noted with the data.

### Section III—Perennial Legume-Grass Mixtures

(Tables 20-35)

#### Fertilization and Management

General fertilization and management procedure is noted with the data.

## Section IV—Winter Annual Grasses

(Tables 36-41)

### Fertilization and Management

Fertilizer treatments are noted with the tables. The forage was harvested back to a height of 2 inches with a cutter-bar type mower.

## Section V—Summer and Winter Annual Legumes

(Tables 42-45)

### Fertilization and Management

The general management and fertilization schedules are presented with the data.

## Section VI—Summer Annual Grasses

(Tables 46-51)

### Fertilization and Management

*F303*—Coastal Plain, Norfolk sandy loam, Wallace. This experiment was seeded June 29, 1953. At seeding 500 lbs./A. of 6-8-6 was applied and 100 lbs./A of N was added three weeks later. The plots were seeded in rows spaced one foot apart. Plots were harvested twice, Aug. 17 and Sept. 30.

*F380*—Coastal Plain, Norfolk sandy loam, Clayton. This experiment was seeded June 20, 1956. At seeding 350 lbs. 8-8-8 was applied and 50 lbs./A of N on July 16. Plots were harvested twice, July 24 and Aug. 27, back to height of 6 inches.

*F372*—Coastal Plain, Norfolk sandy loam, Clayton. This experiment was seeded in rows 1 foot apart in 5-by 25-foot plots, on May 21, 1957. At seeding 350 lbs. of 5-10-10 was applied. All plots were topdressed with 50 lbs./A of N on June 15 and 50 lbs./A. of N on July 8. Plots were harvested back to a height of 6 inches on July 17, Aug. 7, Aug. 26 and Sept. 25. The total yields for the season are presented.

*F302*—Lower Piedmont, Cecil clay loam, Raleigh. The experiment was seeded July 14, 1952. At seeding applied 500 lbs. of 0-12-12 plus 60 lbs. N. Applied 50 lbs. N when 12 inches high. Plots were harvested Oct. 3.

*F405*—Upper Coastal Plain, Norfolk sandy loam, Clayton. Seeded May 16, 1958. At seeding 450 lbs. of 8-8-8 was applied. All plots were topdressed with 60 lbs. N June 4 and 60 lbs. N June 25. Forage was harvested back to a height of 6 inches on June 24, July 17 and Aug. 21.

*F407*—Piedmont, Georgeville clay loam, Pittsboro. Seed broadcast on May 19, 1958. At seeding 450 lbs. of 8-8-8 was applied. Plots were topdressed with 60 lbs. N June 12 and July 9. Forage was harvested July 8, July 28 and Sept. 2.

## INDEX

|  | Yield       | Page<br>Chemical<br>Analyses | Discussion  |
|--|-------------|------------------------------|-------------|
| Alfalfa  | 29,30       | 32                           | 16          |
| Bahiagrass (Pensacola, Tifhi, etc.)                        | 13          |                              | 13,14       |
| Barley ( <i>See</i> Smallgrains)                           |             |                              |             |
| Bermudagrass (Coastal Suwannee,<br>Midland, etc.)          | 13,14       | 14                           | 5,12,15,28  |
| Big trefoil  | 26,27,29,37 | 28                           | 27          |
| Birdsfoot trefoil  | 21,22       |                              | 16,20,21    |
| Black medic  | 37,38       |                              |             |
| Bluegrass ( <i>See</i> Kentucky bluegrass)                 |             |                              |             |
| Bromegrass (Smooth)  | 9,10,29     |                              |             |
| Browntop millet  | 41          |                              | 39          |
| Buffelgrass  | 13          |                              |             |
| Bur clover   | 37,38       |                              |             |
| Button clover  | 37,38       |                              | 37          |
| Caucasian bluestem   | 13          |                              |             |
| Chapel Hill brome ( <i>See</i> Rescue)                     |             |                              |             |
| Crimson clover   | 37,38       |                              | 36          |
| Dallisgrass  | 6,7         | 7,8                          | 5,6,7,28,31 |
| Fescue ( <i>See</i> Tall fescue)                           |             |                              |             |
| Hairy vetch  | 37          |                              | 36          |
| Hardinggrass   | 11,21,29    |                              | 9,11,27     |
| Italian ryegrass   |             |                              | 33          |
| Kentucky bluegrass   | 6,7         | 7,8                          | 5,6,7       |
| Kobe lespedeza   |             |                              | 28,31,36    |
| Korean lespedeza   |             |                              | 36          |
| Ladino clover strains<br>( <i>Also see</i> Ladino-General) | 17,18,19    |                              | 16,20       |
| Ladino-General   | 37          | 25,27,28                     | 16,20,21,30 |
| Lespedeza ( <i>See</i> Kobe, Korean, Sericea)              |             |                              |             |
| Lovegrass ( <i>See</i> Weeping lovegrass)                  |             |                              |             |
| Low hop clover   |             |                              | 38          |
| Lupine   |             |                              | 38          |



**INDEX (Continued)**

|  | Yield                    | Page<br>Chemical<br>Analyses | Discussion            |
|--|--------------------------|------------------------------|-----------------------|
| Manganese bur clover ( <i>See</i> Bur)                             |                          |                              |                       |
| Meadow foxtail   | 11,29                    |                              | 11,27                 |
| Medic ( <i>See</i> Black medic)                                    |                          |                              |                       |
| Millet ( <i>See</i> Pearl millet and Browntop)                     |                          |                              |                       |
| Orchardgrass (Potomac,<br>Danish, etc.)                            | 6,7,9,10,11,29           | 7,8,25,<br>28,29,32          | 5,6,7,8,9             |
| Pasture mixtures   |                          |                              |                       |
| Alfalfa-grass  | 29,30,31                 | 32                           | 31                    |
| Bermudagrass-legume  | 30                       |                              | 28                    |
| Dallisgrass-legume   | 30                       |                              | 28                    |
| Ladino clover-grass  | 24,26,27,29,30           | 25,26,27,28                  | 23,27                 |
| Trefoil-grass  | 26,27,29                 | 27,28                        | 27                    |
| Other mixtures   | 30                       |                              |                       |
| Pearl millet (Starr, Gahi-1, etc.)                                 | 40,41                    | 42                           | 39                    |
| Perennial ryegrass   | 10,11                    |                              | 11                    |
| Persian clover   | 38                       |                              |                       |
| Red clover (Kenland, Chesapeake, etc.)                             | 22                       |                              | 16,22                 |
| Redtop grass   | 6,7,26                   | 7,8,28                       | 6,7                   |
| Reed canarygrass   | 11,29                    | 29                           | 11,12                 |
| Rescuegrass  | 10,11,13                 |                              | 9,11,14               |
| Rose clover  |                          |                              | 38                    |
| Ryegrass ( <i>See</i> Italian and Perennial)                       |                          |                              |                       |
| Sericea  |                          |                              | 16,30                 |
| Smallgrains  | 33,34,35                 |                              | 33,34                 |
| Smooth bromegrass ( <i>See</i> Bromegrass)                         |                          |                              |                       |
| Sorghums-Annual  | 37,41                    | 42                           |                       |
| Sorghums-Perennial (Sorghum alnum,<br>perennial sweet sudan, etc.) | 40,41                    |                              | 39,41                 |
| Soybean  | 37                       |                              | 36                    |
| Subterranean clover  | 37,38                    |                              | 37                    |
| Sudan  | 37,40,41                 | 42                           | 39                    |
| Tall fescue  | 6,7,9,10,11,<br>12,13,29 | 7,8,25,<br>28,29             | 5,6,7,12,14,<br>20,31 |

**INDEX (Continued)**

|   | Yield | Page<br>Chemical<br>Analyses | Discussion  |
|---|-------|------------------------------|-------------|
| Trefoil ( <i>See</i> Big and Birdsfoot) |       |                              |             |
| Vetch ( <i>See</i> Hairy vetch)         |       |                              |             |
| Weeping lovegrass                       | 13,   | 14                           | 15          |
| Wheat ( <i>See</i> Smallgrains)         |       |                              |             |
| White clover (Intermediate types)       | 19,29 |                              | 16,20,23,27 |

**GRASSES**

| Common Name        | Scientific Name                                      |
|--------------------|--|
| Bahiagrass         | <i>Paspalum notatum</i>                              |
| Barley             | <i>Hordeum vulgare</i>                               |
| Bermudagrass       | <i>Cynodon dactylon</i>                              |
| Browntop millet    | <i>Panicum fasciculatum</i>                          |
| Buffelgrass        | <i>Pennisetum ciliare</i>                            |
| Carpentergrass     | <i>Axonopus affinis</i>                              |
| Caucasian bluestem | <i>Andropogon intermedius</i> var. <i>caucasicus</i> |
| Dallisgrass        | <i>Paspalum dilatatum</i>                            |
| Hardinggrass       | <i>Phalaris tuberosa</i> var. <i>stenoptera</i>      |
| Italian ryegrass   | <i>Lolium multiflorum</i>                            |
| Kentucky bluegrass | <i>Poa pratensis</i>                                 |
| Meadow foxtail     | <i>Alopecurus pratensis</i>                          |
| Orchardgrass       | <i>Dactylis glomerata</i>                            |
| Pearl millet       | <i>Pennisetum glaucum</i>                            |
| Perennial ryegrass | <i>Lolium perenne</i>                                |
| Redtop             | <i>Agrostis alba</i>                                 |
| Reed canarygrass   | <i>Phalaris arundinacea</i>                          |
| Rescuegrass        | <i>Bromus catharticus</i>                            |
| Rye                | <i>Secale cereale</i>                                |
| Smooth bromegrass  | <i>Bromus inermis</i>                                |
| Sudan              | <i>Sorghum vulgare</i> var. <i>sudanense</i>         |
| Tall fescue        | <i>Festuca arundinacea</i>                           |
| Timothy            | <i>Phleum pratense</i>                               |
| Weeping lovegrass  | <i>Eragrostis curvula</i>                            |

**LEGUMES**

| Common Name                 | Scientific Name                                |
|-----------------------------|--|
| Alfalfa (purple)            | <i>Medicago sativa</i>                         |
| Big trefoil                 | <i>Lotus uliginosus</i>                        |
| Black medic                 | <i>Medicago lupulina</i>                       |
| Blue lupine                 | <i>Lupinus angustifolius</i>                   |
| Broadleaf birdsfoot trefoil | <i>Lotus corniculatus</i> var. <i>arvensis</i> |
| Bur clover                  | <i>Medicago arabica</i>                        |
| Button clover               | <i>Medicago orbicularis</i>                    |
| Crimson clover              | <i>Trifolium incarnatum</i>                    |
| Hairy vetch                 | <i>Vicia villosa</i>                           |
| Kobe lespedeza              | <i>Lespedeza striata</i>                       |
| Korean lespedeza            | <i>Lespedeza stipulacea</i>                    |
| Low hop clover              | <i>Trifolium procumbens</i>                    |
| Manganese bur clover        | <i>Medicago arabica</i>                        |
| Persian clover              | <i>Trifolium resupinatum</i>                   |
| Red clover                  | <i>Trifolium pratense</i>                      |
| Rose clover                 | <i>Trifolium hirtum</i>                        |
| Sericea                     | <i>Lespedeza cuneata</i>                       |
| Soybean                     | <i>Glycine soja</i>                            |
| Subterranean clover         | <i>Trifolium subterranean</i>                  |
| White clover or Ladino      | <i>Trifolium repens</i>                        |
| Yellow lupine               | <i>Lupinus luteus</i>                          |



Bulletin 411

April, 1960

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## Agricultural Experiment Station

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