CULTURAL MANIPULATION OF COASTAL BERMUDAGRASS TO AVOID LOSSES FROM THE FALL ARMYWORM

R. E. Lynch, P. B. Martin, and J. W. Garner

Abstract

The effects of fertilization, harvest frequency, and insect control on yield of coastal bermudagrass, Cynodon dactylon (L.) Pers., were evaluated to develop means for the cultural manipulation of the fall armyworm, Spodoptera frugiperda (J. E. Smith). A split application of nitrogen, applied by 1 June, allowed production of > 80% of the annual yield by 1 August. In most years, fall armyworm larval populations peaked after 1 August. Therefore, most of the bermudagrass yield can be produced prior to the occurrence of critical fall armyworm densities.

Coastal bermudagrass, Cynodon dactylon (L.) Pers., is the most widely grown forage grass in the southern United States, occupying over 6 million acres (Burton 1964). In Georgia alone, ca. 1.6 million acres of bermudagrasses, primarily coastal, are grown as perennial pastures. These bermudagrass pastures serve as hosts to a wide variety of insects, many of which can drastically reduce the yield of these pastures (Byers 1967, Hawkins et al. 1979, Osborn 1912). Cultural methods, such as spring burning for the twolined spittlebug, Prosapia bicincta (Say) (Beck 1963), and frequent mowing for leafhoppers and plant hoppers (Hawkins et al. 1979), have been developed to aid in the control of some of these insects. However, cultural methods have not been developed to reduce yield losses from 1 of the major pests of bermudagrass, the fall armyworm, Spodoptera frugiperda (J. E. Smith). Bermudagrasses are some of the preferred hosts of this insect (Luginbill 1928), and populations often exceed 10 larvae/sq ft (Lynch et al. 1980) or 20 larvae/sweep (Martin and McCormick 1979).

Several possible alternatives are available for cultural manipulation of the fall armyworm. These include: (1) the use of fertilization and/or harvest frequency to stimulate bermudagrass growth before damaging populations of the fall armyworm occur; (2) harvest of bermudagrass when fall armyworm larval populations exceed the economic injury level rather than control the insects with an insecticide; (3) delay harvest before peak fall armyworm moth flight so that the bermudagrass is not attractive for oviposition (1st-instar larvae are most prevalent in new growth of bermudagrass (Byers 1967), an indication that the new growth is probably most attractive for oviposition); and (4) harvest bermudagrass following the peak moth flight to destroy heavy infestations of 1st- or 2nd-instar larvae, if the grass is in an attractive stage of regrowth during the moth flight.

1Lepidoptera: Noctuidae.
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Although present in other crops at a much earlier date, damaging populations of the fall armyworm in coastal bermudagrass generally do not occur in south Georgia before late July to early August (Martin unpublished data). Furthermore, evaluation of previous research on the influence of nitrogen rate and harvest frequency (Burton et al. 1963, Prine and Burton 1956) indicated that these factors may be utilized to stimulate bermudagrass growth and subsequent yield prior to 1 August, thus avoiding major damage by the fall armyworm. We report here results of research conducted to test his hypothesis.

METHODS AND MATERIALS

An established coastal bermudagrass hay pasture that contained small amounts of bahiagrass (*Paspalum notatum* Flügge), goosegrass (*Eleusine indica* (L.) Gaertn.), and common bermudagrass was utilized for the research. Since the pasture had not been managed for several years, the entire area was fertilized with 39:31:62 lbs/A (N:P:K) prior to initiation of the experiment. A split-split plot arrangement of treatments with 4 replications was employed with fertilization as the whole plot, cutting frequency as the subplot, and insect control as the sub-subplot. Whole plots were: 1) initial fertilization with no subsequent fertilization; 2) 200 lbs N/A applied in a split application, i.e., an initial fertilization in the spring before cutting and the remainder applied in 2 applications before 1 June; 3) 200 lbs N/A in a continuous application, i.e., an initial fertilization in the spring before cutting followed by an application after each 5-week cutting for 5 applications; 4) 400 lbs N/A applied in a split application as in 2; and 5) 400 lbs N/A applied continuously as in 3. All fertilizer regimes were maintained in a 4:1:2 ratio of N, P₂O₅, and K₂O. Two cutting frequencies, 2-1/2- and 5-week intervals, were used as the subplots. The sub-subplots were 9 ft x 9 ft, separated from other sub-subplots by a 3-ft border, and consisted of fall armyworm control with methomyl, S-methyl N-[((methylcarbamoyl)oxy]thioacetimidate, versus no insect control. Methomyl (0.45 lb AI/A) was applied with a CO₂-powered backpack sprayer at 7 gal/A, 30 psi, and with 8001E even flat-spray tips. Plots for insect control were treated on 18 August and 8 and 26 September in 1978 and at weekly intervals from 10 July through 16 October in 1979.

Plots for grass yields were cut and harvested during 1978 and 1979 with a Sensation® plot harvester with a rear grass catcher. The bermudagrass was cut to 2-3 in. and weighed for wet yields. A subsample was taken from each plot, immediately sealed in a plastic bag, stored in an ice chest, and later weighed, dried in an oven at ca. 22°C, and reweighed for dry-matter determinations.

At weekly intervals, 10 samples of all sub-subplots were obtained with a 15-in. diam sweep net. Data were recorded on the abundance of *S. frugiperda* (J. E. Smith), *Mocia latipes* (Guéneé), *Antiela infecta* (Ochenheimer), leafhoppers, grasshoppers, and entomophages. In addition, 3 coastal bermudagrass hay pastures in 1977 and 1978 and 4 in 1979 were sampled at ca. weekly intervals during the fall armyworm moth flight to follow larval pop-

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ulations in these fields. These pastures were sampled in 1977 and 1978 with a 15-in. diam sweep net (4-6 series of 25 sweeps) in a diagonal path across the field and alternating the diagonal on each sampling date. In 1979, each field was divided into 4 quadrants, and 10 series of 25 sweeps with a 15-in. diam sweep net were taken in each quadrant.

Results and Discussion

Annual dry-matter yields were highly significant between years. In 1978, the average yield for all treatments was 6.94 tons per acre as compared with only 4.79 tons per acre in 1979. These differences corresponded primarily to higher rainfall in 1978 during May and June (4.69 and 4.65 in., respectively) than in 1979 (2.89 and 2.93 in., respectively). Similar differences between years, as influenced by moisture, were reported by Prine and Burton (1956).

As might be expected, fertilization rates had the greatest effect on annual dry-matter yields (Table 1). An initial fertilization with ca. 40 lbs N/A produced an average yield of only 2.97 tons per acre as compared with 5.58 and 7.60 tons/acre with the addition of 200 and 400 lbs of N/acre, respectively. Furthermore, a split application of 400 lbs of N/A significantly increased the annual yield as compared with a continuous application of the same rate. However, this difference due to application regimes was not present at the lower fertilization rate. These response differences led to a significant year x fertilizer interaction, since in 1978, a split application of either 200 or 400 lbs/acre produced a higher annual yield (significantly so at 400 lbs/acre) than the continuous application of equal rates. The reverse was observed in 1979 in that the annual yield for the continuous fertilization regime was slightly greater, though not significantly, than the yield for the split regime.

Dry-matter annual yields were significantly greater when bermudagrass was harvested every 5 weeks than when it was harvested every 2-1/2 weeks. These results were similar to those reported by Burton et al. (1963) with a fertilization rate of 600 lbs N/acre. A significant year x harvest frequency interaction was also noted as a result of the magnitude of the yields between the 2 harvest frequencies. In 1978, annual yields of 6.49 and 7.38 tons/acre were produced by the 2-1/2- and 5-week cutting frequencies, respectively; while only 4.71 and 4.84 tons/acre, respectively, were produced in 1979.

Insect control also significantly increased the annual yield of coastal bermudagrass. Plots treated with methomyl averaged 5.96 tons/acre while untreated plots averaged only 5.77. However, sweep-net samples of the plots, taken at weekly intervals, showed that fall armyworms failed to reach economic levels and that leafhoppers were the most abundant phytophagous insects present, especially during the latter part of the growing season. Hawkins et al. (1979) and Byers (1967) previously reported increased yields after control of leafhoppers.

The result of the analyses for bermudagrass yield by 1 August was similar to that for the annual yield: yields were significantly different between years, fertilization had the greatest effect on yield, the 5-week harvest frequency outyielded the 2-1/2-week harvest frequency, and the interactions were similar. However, there were 2 important differences between the annual yield and the yields by 1 August. First, the yield by 1 August was significantly greater for both the 200 and 400 lbs N/acre fertilization rates when
<table>
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<th>Harvest frequency</th>
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<th>Tons of hay/acre with indicated lbs N/A/yr</th>
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<tr>
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<td>2-1/2 Wks</td>
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<td>2.89</td>
<td>5.64 b</td>
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<td>Methomyl (0.45 lb AI/A)</td>
<td>3.16</td>
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<td>5 Wks</td>
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<td>3.02</td>
<td>5.71</td>
</tr>
<tr>
<td>Mean #</td>
<td></td>
<td>2.97 d</td>
<td>5.53 c</td>
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*PLOTS treated with methomyl on VIII-18, IX-8, and IX-26 in 1978 and at weekly intervals from VII-10 through X-16 in 1979.
**Entire test area fertilized with 38.0:31.6 lbs of N:P:O:K before the test was initiated. Other treatments were maintained in a 4:1:2 ratio.
†Split appl. = an initial N application in the spring before cutting, with the remaining N applied in 2 applications before 1 June.
‡Cont. appl. = continuous application = an initial N application in the spring before cutting followed by an application after each 5-week cutting for 5 applications of N.
#Means within columns or within rows followed by the same letter do not differ significantly (P = 0.05) when using Duncan's multiple range test.
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<th>Harvest frequency</th>
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<th>Percentage</th>
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<td>Initial** fertilization</td>
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<td>200 lbs N Cont. appl.‡</td>
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<td>400 lbs N Cont. appl.‡</td>
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<td>81.9</td>
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<td>5 Wks</td>
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<td>Methomyl (0.45 lb Al/A)</td>
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<tr>
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<td></td>
<td>73.7</td>
<td>86.3</td>
<td>76.1</td>
<td>82.8</td>
<td>76.1</td>
</tr>
</tbody>
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**Entire test area fertilized with 8.9:31:0 lbs of N:P:O_5 before the test was initiated. Other treatments were maintained in a 4:1:2 ratio.
†Split appl. = an initial N application in the spring before cutting, with the remaining N applied in 2 applications before 1 June.
‡Cont. appl. = continuous application = an initial N application in the spring before cutting followed by an application after each 5-week cutting for 5 applications of N.
applied in a split application by June than were the same rates applied continuously, i.e., every 5 weeks. Secondly, differences in yield by 1 August due to insect control were not significant: the untreated and methomyl-treated plots yielded 4.66 and 4.73 tons/acre, respectively. These data suggest that the primary insect pressure to bermudagrass occurs after 1 August. Indeed, Genung and Mead (1969), Wilson et al. (1973), and Byers and Jung (1979) showed that leafhopper populations reached their peak in late summer, i.e., after 1 August.

Table 2 presents data on the percentage of coastal bermudagrass dry-matter yield produced by 1 August. Previous data (Hart et al. 1965, Burton et al. 1969) have indicated that ca. 65-75% of the total yield of coastal bermudagrass could be produced by 1 August. Furthermore, evaluation of temperature accumulations above 55°F, i.e., temperatures favorable for bermudagrass growth (Monson personal communication) from 1922-1967 indicated that 63% of the growing degree days from April to September are

![Graph showing seasonal abundance of fall armyworm larvae in coastal bermudagrass hay pastures. Berrien County, GA, 1977.](image)

Fig. 1. Seasonal abundance of fall armyworm larvae in coastal bermudagrass hay pastures. Berrien County, GA, 1977.
accumulated by the end of July. Indeed, yields in excess of 75-85% of the annual yield can be produced by 1 August. Considerable differences were also noted between the 2 procedures for fertilization; 86.3 and 82.8% of the total annual yield were produced by 1 August with a split application of 200 and 400 lbs N/acre, respectively; whereas only 76.1% of the annual yield was produced by 1 August with 200 or 400 lbs N/A applied in a continuous regime. Mowing schedules or insect control had little influence on the percentage of dry-matter yield produced by 1 August.

Figures 1, 2, and 3 present the seasonal abundance of fall armyworm larvae in coastal bermudagrass pastures in 1977, 1978, and 1979, respectively. 1977 was a year of epidemic fall armyworm population densities; in 1979, fall armyworm larval densities were only moderate until after 1 August. Only in 1978 did fall armyworm larval densities reach severe levels prior to 1 August. In this year, populations peaked ca. 15 July in 2 of the 3 fields sampled.

Fig. 2. Seasonal abundance of fall armyworm larvae in coastal bermudagrass hay pastures. Tift County, GA, 1978.
Fig. 3. Seasonal abundance of fall armyworm larvae in coastal bermudagrass hay pastures. Tift County, GA, 1979.

In conclusion, fertilization to stimulate coastal bermudagrass yields appears to be a viable method to evade fall armyworm damage. A split application of N, applied by 1 June, will produce > 80% of the annual yield by 1 August. In most years, fall armyworm larval populations reach a peak after this time. Thus, the major portion of the bermudagrass yield can be produced prior to critical fall armyworm densities.

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LITERATURE CITED

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