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Effects of Interseeding Ladino Clover into Tall Fescue Pastures of Varying Endophyte Status on Grazing and Subsequent Finishing Performance of Stocker Steers

L.W. Lomas and J.L. Moyer

Summary
One hundred ninety-two yearling steers grazing tall fescue pastures were used to evaluate the effects of fescue cultivar and interseeding ladino clover on available forage, grazing gains, and subsequent finishing performance in 2016, 2017, and 2018. Fescue cultivars evaluated were high-endophyte ‘Kentucky 31,’ low-endophyte Kentucky 31, ‘HM4,’ and ‘MaxQ.’ In 2016 and 2018, steers that grazed pastures of low-endophyte Kentucky 31, HM4, or MaxQ gained significantly more ($P < 0.05$) and produced more ($P < 0.05$) gain/acre than those that grazed high-endophyte Kentucky 31 pastures. Gains of cattle that grazed low-endophyte Kentucky 31, HM4, or MaxQ were similar ($P > 0.05$). In 2017, steer gains were similar ($P > 0.05$) among all cultivars. High-endophyte Kentucky 31 pastures had more ($P < 0.05$) available forage than low-endophyte Kentucky 31, HM4, or MaxQ pastures during both 2016 and 2017. Steer gains and gain/acre were similar ($P > 0.05$) between pastures fertilized with nitrogen (N) in the spring and those interseeded with ladino clover during all three years. Fescue cultivar or legume treatment had little effect on finishing performance or carcass characteristics of steers grazed in 2016 or 2017. Steers that grazed high-endophyte Kentucky 31 in 2016 had lower ($P < 0.05$) final finishing weight and lower ($P < 0.05$) carcass weight than those that grazed low-endophyte Kentucky 31, HM4, or MaxQ. In 2017, steers that grazed pastures interseeded with ladino clover had lower ($P < 0.05$) finishing gains and greater ($P < 0.05$) feed:gain than those that grazed pastures with no legume.

Introduction
Tall fescue, the most widely adapted cool-season perennial grass in the United States, is grown on approximately 66 million acres. Although tall fescue is well adapted in the eastern half of the country between the temperate north and mild south, presence of a fungal endophyte results in poor performance of grazing livestock, especially during the summer. Until recently, producers with high-endophyte tall fescue pastures had two primary options for improving grazing livestock performance. One option was to destroy existing stands and replace them with endophyte-free fescue or other forages. Although it supports greater animal performance than endophyte-infected fescue, endophyte-free fescue has been shown to be less persistent under grazing pressure and
more susceptible to stand loss from drought stress. In locations where high-endophyte tall fescue must be grown, the other option was for producers to adopt management strategies that reduce the negative effects of the endophyte on grazing animals, such as diluting the effects of the endophyte by incorporating legumes into existing pastures or providing supplemental feed. In recent years, new tall fescue cultivars have been developed with a non-toxic endophyte that provides vigor to the fescue plant without negatively affecting performance of grazing livestock. Interseeding legumes into endophyte-free tall fescue cultivars and those with the non-toxic endophyte should be an effective way of increasing gains of cattle grazing tall fescue. However, these cultivars lack the vigor of high-endophyte Kentucky 31 and their competitiveness with legumes could be a potential problem. Objectives of this study were to evaluate forage availability, stand persistence, and performance of stocker steers grazing tall fescue cultivars with non-toxic endophyte and high- and low-endophyte Kentucky 31 with and without ladino clover.

**Experimental Procedures**

Sixty-four mixed black yearling steers were weighed on two consecutive days and allotted to sixteen 5-acre established pastures of high-endophyte Kentucky 31 or low-endophyte Kentucky 31, HM4, or MaxQ tall fescue (4 replications per cultivar) on March 30, 2016 (535 lb), March 28, 2017 (597 lb), and April 3, 2018 (581 lb). The HM4 and MaxQ are cultivars with a non-toxic endophyte. Two pastures of each cultivar had been interseeded with 5 lb/a of ‘Will’ ladino clover on February 22, 2016. Four steers were assigned to each pasture. Pastures without clover were fertilized with 80 lb/a N on February 10, 2016, February 16, 2017, and January 31, 2018. All pastures were fertilized with 40 lb/a N and P$_2$O$_5$ and K$_2$O as required by soil test on September 13, 2016, September 11, 2017, and September 25, 2018.

Pasture was the experimental unit and weight gain was the primary measurement. No implants or feed additives were used. Cattle were weighed and forage availability was measured every 28 days in 2016 and 2017 with a disk meter calibrated for tall fescue. Cattle were treated for internal and external parasites before being turned out to pasture and later vaccinated for protection from pinkeye. Steers had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt. Four steers were removed from the study in 2016 for reasons unrelated to experimental treatment and replaced with grazers to maintain equal stocking rates. Pastures were grazed continuously until November 29, 2016 (244 days), December 6, 2017 (253 days), and November 7, 2018 (218 days) when steers were weighed on two consecutive days and grazing was terminated.

After the grazing period, cattle were moved to a finishing facility, implanted with Synovex-S (Zoetis, Madison, NJ), and fed a diet of 80% whole-shelled corn, 15% corn silage, and 5% supplement (dry matter basis) to determine the effect of grazing treatment on subsequent finishing performance. Cattle that grazed in 2016 and 2017 were fed a finishing diet for 98 days and were slaughtered in a commercial facility, and carcass data were collected on each steer. Cattle that were grazed during 2018 were being finished for slaughter at the time that this report was written.
Results and Discussion
Grazing and finishing performance is pooled across legume treatment and presented by tall fescue cultivar for 2016 and 2017 in Table 1 and Table 3, respectively; and pooled across fescue cultivar and presented by legume treatment for 2016 and 2017 in Table 2 and Table 4, respectively. There were significant interactions ($P < 0.05$) between fescue cultivar and legume treatment for average available forage DM in 2016 and average daily dry matter intake during the finishing phase in 2017. In 2016 and 2018, steers that grazed low-endophyte Kentucky 31, HM4, or MaxQ were heavier ($P < 0.05$) at the end of the grazing period, had greater ($P < 0.05$) grazing gain, greater ($P < 0.05$) daily gain, and produced greater ($P < 0.05$) gain/a than steers that grazed high-endophyte Kentucky 31. Average available forage DM of high-endophyte Kentucky 31 pasture was greater ($P < 0.05$) than that of low-endophyte Kentucky 31, HM4, or MaxQ. In 2016, MaxQ pasture had greater ($P < 0.05$) available forage DM than low-endophyte Kentucky 31. Average available forage DM of HM4 pasture was similar ($P > 0.05$) to that of low-endophyte Kentucky 31 and MaxQ pastures. In 2017, average available forage DM of low-endophyte Kentucky 31, HM4, or MaxQ pastures were similar ($P > 0.05$). Steer gains were similar ($P > 0.05$) between pastures fertilized with an additional 80 lb/a N and those interseeded with ladino clover in all three years. Pastures with clover had less ($P < 0.05$) available forage DM than those without clover for all cultivars except high-endophyte Kentucky 31 where available forage DM of pastures with and without clover were similar ($P > 0.05$).

In 2016, fescue cultivar had no effect ($P > 0.05$) on finishing gain, dry matter intake, or feed:gain ratio. However, steers that previously grazed high-endophyte Kentucky 31 had lower ($P < 0.05$) weight at the end of the finishing phase and lower ($P < 0.05$) hot carcass weight than those that previously grazed low-endophyte Kentucky 31, HM4, or MaxQ. The weight differential between cattle that grazed high-endophyte Kentucky 31 and those that grazed low-endophyte Kentucky 31, HM4, or MaxQ was similar at the end of the grazing phase (156 lb) and the end of the finishing phase (155 lb). Therefore, the weight advantage of cattle that grazed high-endophyte Kentucky 31, HM4, or MaxQ occurred during the grazing phase and was maintained during the finishing phase. Cattle that grazed high-endophyte Kentucky 31 did not exhibit any compensatory gain during the finishing phase. Backfat thickness of steers that grazed high-endophyte Kentucky 31 or HM4 were similar ($P > 0.05$) and lower ($P < 0.05$) than that of steers that grazed low-endophyte Kentucky 31 or MaxQ. Yield grade of steers that grazed high-endophyte Kentucky 31 was numerically lower ($P < 0.05$) than that of steers that grazed low-endophyte Kentucky 31 or MaxQ and similar ($P > 0.05$) to that of steers that grazed HM4. Fescue cultivar had no effect ($P > 0.05$) on ribeye area, marbling score, or percent of carcasses that graded USDA Choice. Overall gain of steers that grazed high-endophyte Kentucky 31 was lower ($P < 0.05$) than that of steers that grazed low-endophyte Kentucky 31, HM4, or MaxQ and overall gain of steers that grazed low-endophyte Kentucky 31, HM4, or MaxQ were similar ($P > 0.05$). Legume treatment had no effect ($P > 0.05$) on finishing performance or carcass traits.

In 2017, fescue cultivar had no effect ($P > 0.05$) on finishing performance or overall performance. Steers that grazed pastures interseeded with ladino clover had lower
(P < 0.05) finishing gains and greater (P < 0.05) feed:gain than those that grazed pastures with no legume.

Grazing performance for 2018 is pooled across legume treatment and presented by tall fescue cultivar in Table 5, and pooled across fescue cultivar and presented by legume treatment in Table 6. Steers that grazed low-endophyte Kentucky 31, HM4, or MaxQ were heavier (P < 0.05) at the end of the grazing period, had greater (P < 0.05) grazing gain, greater (P < 0.05) daily gain, and produced greater (P < 0.05) gain/a than steers that grazed high-endophyte Kentucky 31. Legume treatment had no effect (P > 0.05) on grazing performance.
Table 1. Effects of cultivar on grazing and subsequent finishing performance of steers grazing tall fescue pastures, Southeast Research and Extension Center, 2016

| Item                                      | High-endophyte Kentucky 31 | Low-endophyte Kentucky 31 | HM4 | MaxQ |
|-------------------------------------------|-----------------------------|---------------------------|-----|------|
| Grazing phase (244 days)                  |                             |                           |     |      |
| Number of head                            | 13                          | 16                        | 16  | 15   |
| Initial weight, lb                        | 533                         | 535                       | 535 | 537  |
| Ending weight, lb                         | 770a                        | 920b                      | 931b| 924b |
| Gain, lb                                  | 238a                        | 385b                      | 396b| 387b |
| Daily gain, lb                            | 0.97a                       | 1.58b                     | 1.62b| 1.59b|
| Gain/a, lb                                | 190a                        | 308b                      | 310b| 310b |
| Average available forage dry matter, lb/a*| 7,365a                      | 5,944b                    | 6,139bc| 6,300c|
| Finishing phase (98 days)                 |                             |                           |     |      |
| Beginning weight, lb                      | 770a                        | 920b                      | 931b| 924b |
| Ending weight, lb                         | 1219a                      | 1374b                     | 1366b| 1386b|
| Gain, lb                                  | 449                         | 454                       | 435 | 462  |
| Daily gain, lb                            | 4.58                        | 4.63                      | 4.44| 4.71 |
| Daily dry matter intake, lb               | 26.2                        | 27.4                      | 28.3| 28.3 |
| Feed:gain                                 | 5.74                        | 5.91                      | 6.41| 6.05 |
| Hot carcass weight, lb                    | 756a                        | 852b                      | 847b| 859b |
| Backfat, in.                              | 0.47a                       | 0.60b                     | 0.55a| 0.60b|
| Ribeye area, sq. in.                      | 12.7                        | 12.8                      | 12.7| 12.9 |
| Yield grade                               | 2.3a                        | 3.0b                      | 2.9ab| 3.0b |
| Marbling score¹                           | 627                         | 669                       | 623 | 616  |
| Percentage USDA grade Choice              | 100                         | 100                       | 100 | 100  |
| Overall performance (grazing plus finishing; 342 days) | | | | |
| Gain, lb                                  | 687a                        | 839b                      | 831b| 849b |
| Daily gain, lb                            | 2.01a                       | 2.45b                     | 2.43b| 2.48b|

¹600 = modest, 700 = moderate.

Means within a row followed by the same letter do not differ (P < 0.05).

*There was a significant (P < 0.05) fescue cultivar × legume interaction.
Table 2. Effects of interseeding ladino clover on grazing and subsequent finishing performance of steers grazing tall fescue pastures, Southeast Research and Extension Center, 2016

| Item                                | Legume treatment |           |           |
|-------------------------------------|------------------|-----------|-----------|
|                                     | No legume        | Ladino clover |
| Grazing phase (244 days)            |                  |           |           |
| Number of head                      | 30               | 30        |           |
| Initial weight, lb                 | 534              | 536       |           |
| Ending weight, lb                  | 868              | 905       |           |
| Gain, lb                           | 334              | 369       |           |
| Daily gain, lb                     | 1.37             | 1.51      |           |
| Gain/a, lb                         | 267              | 295       |           |
| Average available forage dry matter, lb/a* | 6,888a          | 5,986b    |           |
| Finishing phase (98 days)           |                  |           |           |
| Beginning weight, lb               | 868              | 905       |           |
| Ending weight, lb                  | 1320             | 1353      |           |
| Gain, lb                           | 453              | 448       |           |
| Daily gain, lb                     | 4.62             | 4.57      |           |
| Daily dry matter intake, lb        | 27.4             | 27.6      |           |
| Feed:gain                          | 5.97             | 6.09      |           |
| Hot carcass weight, lb             | 819              | 839       |           |
| Backfat, in.                       | 0.55             | 0.56      |           |
| Ribeye area, sq. in.               | 12.8             | 12.8      |           |
| Yield grade                        | 2.8              | 2.8       |           |
| Marbling score¹                    | 619              | 649       |           |
| Percentage USDA grade Choice       | 100              | 100       |           |
| Overall performance (grazing plus finishing; 342 days) | | | |
| Gain, lb                           | 786              | 817       |           |
| Daily gain, lb                     | 2.30             | 2.39      |           |

¹600 = modest, 700 = moderate.
Means within a row followed by the same letter do not differ (P < 0.05).
*There was a significant (P < 0.05) fescue cultivar × legume interaction.
Table 3. Effects of cultivar on grazing and subsequent finishing performance of steers grazing tall fescue pastures, Southeast Research and Extension Center, 2017

| Tall fescue cultivar | High-endophyte Kentucky 31 | Low-endophyte Kentucky 31 | HM4 | MaxQ |
|----------------------|----------------------------|---------------------------|-----|-----|
| **Grazing phase (253 days)** |                           |                           |     |     |
| Number of head       | 16                         | 16                        | 16  | 16  |
| Initial weight, lb   | 597                        | 597                       | 597 | 597 |
| Ending weight, lb    | 901                        | 1029                      | 986 | 1007|
| Gain, lb             | 304                        | 432                       | 389 | 411 |
| Daily gain, lb       | 1.20                       | 1.71                      | 1.54| 1.62|
| Gain/a, lb           | 244                        | 346                       | 311 | 328 |
| Average available forage dry matter, lb/a | 5,179a | 4,728b | 4,812b | 4,808b |
| **Finishing phase (98 days)** |                       |                           |     |     |
| Beginning weight, lb | 901                        | 1029                      | 986 | 1007|
| Ending weight, lb    | 1311                       | 1422                      | 1374| 1400|
| Gain, lb             | 410                        | 393                       | 389 | 393 |
| Daily gain, lb       | 4.18                       | 4.01                      | 3.97| 4.01|
| Daily dry matter intake, lb* | 28.5 | 28.4 | 28.7 | 27.6 |
| Feed:gain            | 6.82                       | 7.13                      | 7.25| 7.01|
| Hot carcass weight, lb | 813                      | 882                       | 852 | 868 |
| Backfat, in.         | 0.46                       | 0.58                      | 0.58| 0.52|
| Ribeye area, sq. in. | 13.1                       | 13.3                      | 13.1| 13.1|
| Yield grade          | 2.4                        | 2.8                       | 2.8 | 2.7 |
| Marbling score¹      | 659                        | 694                       | 754 | 701 |
| Percentage USDA grade Choice | 94 | 100 | 100 | 100 |
| **Overall performance (grazing plus finishing; 351 days)** | | | | |
| Gain, lb             | 715                        | 826                       | 778 | 803 |
| Daily gain, lb       | 2.04                       | 2.35                      | 2.22| 2.29|

¹600 = modest, 700 = moderate, 800 = slightly abundant.

Means within a row followed by the same letter do not differ (P < 0.05).

*There was a significant (P < 0.05) fescue cultivar × legume interaction.
Table 4. Effects of interseeding ladino clover on grazing and subsequent finishing performance of steers grazing tall fescue pastures, Southeast Research and Extension Center, 2017

| Item                                      | No legume | Ladino clover |
|-------------------------------------------|-----------|---------------|
| Grazing phase (253 days)                  |           |               |
| Number of head                            | 32        | 32            |
| Initial weight, lb                        | 597       | 597           |
| Ending weight, lb                         | 951       | 1011          |
| Gain, lb                                  | 354       | 414           |
| Daily gain, lb                            | 1.40      | 1.64          |
| Gain/a, lb                                | 283       | 331           |
| Average available forage dry matter, lb/a | 5,215a    | 4,548b        |
| Finishing phase (98 days)                 |           |               |
| Beginning weight, lb                      | 951       | 1011          |
| Ending weight, lb                         | 1363      | 1391          |
| Gain, lb                                  | 412a      | 380b          |
| Daily gain, lb                            | 4.20a     | 3.88b         |
| Daily dry matter intake, lb*              | 28.0      | 28.6          |
| Feed:gain                                 | 6.68a     | 7.42b         |
| Hot carcass weight, lb                    | 845       | 862           |
| Backfat, in.                              | 0.51      | 0.56          |
| Ribeye area, sq. in.                      | 13.0      | 13.3          |
| Yield grade                               | 2.7       | 2.7           |
| Marbling score¹                           | 693       | 711           |
| Percentage USDA grade Choice              | 97        | 100           |
| Overall performance (grazing plus finishing; 351 days) |           |               |
| Gain, lb                                  | 766       | 794           |
| Daily gain, lb                            | 2.18      | 2.26          |

¹600 = modest, 700 = moderate, 800 = slightly abundant.

Means within a row followed by the same letter do not differ (P < 0.05).

*There was a significant (P < 0.05) fescue cultivar × legume interaction.
### Table 5. Effects of cultivar on performance of steers grazing tall fescue pastures, Southeast Research and Extension Center, 2018

| Item                        | High-endophyte Kentucky 31 | Low-endophyte Kentucky 31 | HM4   | MaxQ   |
|-----------------------------|-----------------------------|---------------------------|-------|--------|
| Grazing phase (218 days)    |                             |                           |       |        |
| Number of head              | 16                          | 16                        | 16    | 16     |
| Initial weight, lb          | 581                         | 581                       | 581   | 581    |
| Ending weight, lb           | 815a                        | 954b                      | 940b  | 953b   |
| Gain, lb                    | 234a                        | 372b                      | 359b  | 372b   |
| Daily gain, lb              | 1.08a                       | 1.71b                     | 1.65b | 1.70b  |
| Gain/a, lb                  | 187a                        | 298b                      | 287b  | 297b   |

Means within a row followed by the same letter do not differ ($P < 0.05$).

### Table 6. Effects of interseeding ladino clover on performance of steers grazing tall fescue pastures, Southeast Research and Extension Center, 2018

| Item                        | No legume | Ladino clover |
|-----------------------------|-----------|---------------|
| Grazing phase (218 days)    |           |               |
| Number of head              | 32        | 32            |
| Initial weight, lb          | 581       | 581           |
| Ending weight, lb           | 914       | 917           |
| Gain, lb                    | 332       | 336           |
| Daily gain, lb              | 1.52      | 1.54          |
| Gain/a, lb                  | 266       | 269           |

Means within a row followed by the same letter do not differ ($P < 0.05$).