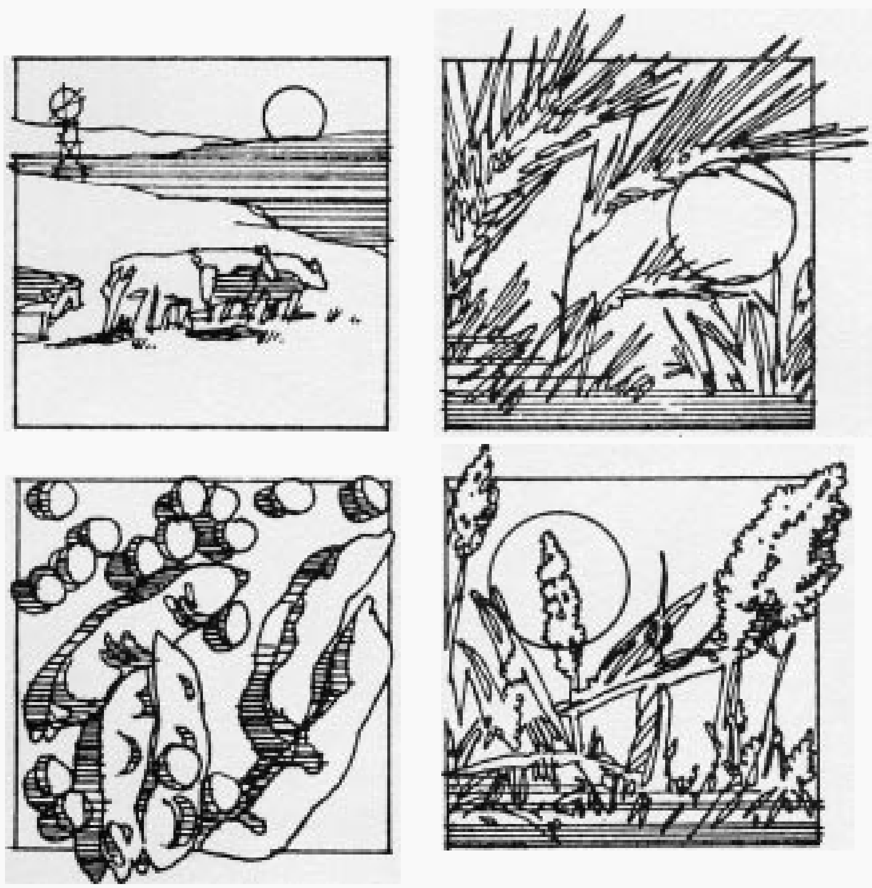
# 1994 AGRICULTURAL RESEARCH



Report of Progress 708

Agricultural Experiment Station

Kansas State University, Manhattan

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Contribution No. 94-444-S from the Kansas Agricultural Experiment Station.

# EFFECT OF LASALOCID, SHADE, AND LENGTH OF MORNING GRAZING ON WEIGHT AND SHRINK BY STEERS GRAZING SMOOTH BROMEGRASS PASTURES[1]

Kenneth P. Coffey, Frank K. Brazle[2], and Joseph L. Moyer

## Summary

A total of 72 mixed breed steers from two sources was used in an experiment to determine the effect of lasalocid, shade, cattle source, and length of morning grazing prior to weighing on weight and shrink of steers grazing smooth bromegrass pastures. Steers were divided into eight groups and weighed at either 6, 7, 8, or 9 a.m. on four separate days. Half of the steers received a control mineral mixture, and half received a mineral mixture containing lasalocid. Half of the assigned pastures had no shade, and half had natural shade on the entire east end. Purchased steers weighed less ($P < .10$) at the start of the study and gained more ($P < .10$) during the 119-d grazing study than those raised at the Southeast Kansas Branch Experiment Station (SEKES). Steers grazing pastures without shade gained more ($P < .10$) than those grazing pastures having shade, and lasalocid did not affect total gain by these steers. Purchased steers having an excitable disposition were not affected ($P > .10$) by length of morning grazing prior to weighing during the intensive weighing period. Weight of SEKES steers increased with length of morning grazing. Steers allowed to graze for 3 h before morning weighing had the lowest ($P < .05$) total % shrink and total % shrink/h by 3 p.m. Based on this research, cattlemen could add additional weight to cattle by simply allowing them to graze longer before gathering them for sale.

## Introduction

Cattle generally graze for 3- to 4-h periods beginning at daybreak and prior to sunset, and for 1- to 2-h periods scattered throughout the day. In a fall-grazing study on smooth bromegrass at SEKES, steers allowed to graze in the morning for 3 h before being gathered from pasture weighed 16 lb more than those gathered as the morning grazing period began. Other factors such as cattle disposition, shade, and supplemental ionophores also may have substantial effects on cattle performance and behavior. This study was conducted to determine 1) the effect of lasalocid, shade, and cattle source on performance by steers grazing smooth bromegrass pastures and 2) the effect of these factors along with length of morning grazing prior to weighing on weight and shrink of steers grazing smooth bromegrass pastures in the summer.

## Experimental Procedures

Forty purchased mixed breed steers and 32 Simmental × Angus crossbred steers from the SEKES herd were allotted in a random stratified manner to one of eight 10-acre smooth bromegrass pastures. Allotments were made such that steers from each origin were assigned to a block of four pastures. One steer from the purchased group was added to each SEKES group to equalize stocking rates across all

[1]Appreciation is expressed to Farmland Industries, Inc., Kansas City, KS, for providing lasalocid and mineral to conduct the study.

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pastures. Pastures were blocked such that two pastures grazed by each cattle source had natural shade consisting of a hedge row on the entire east end of the pasture, and two pastures grazed by each cattle source had no shade. Within each of those combinations, steers grazing two pastures were offered a control mineral mixture and steers grazing the two remaining pastures were offered a mineral mixture containing lasalocid. Steers were allotted to their respective pastures on June 3 and grazed the same pasture until October 1. All steers had previously grazed smooth bromegrass for at least 30 days prior to assignment to pasture treatments.

All steers were removed from pasture on the afternoon of June 24 and placed in pens without feed or water for a 16-h shrink. Steers were weighed upon removal from pasture and following the 16-h shrink to determine overnight shrink. Steers then were weighed full on June 28 and 30 and July 2 and 6 at either 6, 7, 8, or 9 a.m. according to a predetermined schedule to determine how length of grazing prior to weighing would affect steer weight. On each day of weighing, each group of steers was weighed only once, and each group of steers was weighed at a different time on each weigh day Following the weighing on July 6, steers were placed in pens without feed or water and weighed approximately at 2-h intervals until 3 pm. This was done to determine how lasalocid or length of morning grazing would affect rate of shrink. Because this was done on the last day of the morning weighings, the lasalocid effect was the only main effect represented at all four weighing times. Steers were shrunk overnight and weighed on July 13.

Steers were allowed free-choice access to a commercial loose mineral mixture throughout the study. Mineral containing lasalocid was formulated to provide 300 mg lasalocid/lb of mineral mixture during the initial 25 days of the study and 600 mg lasalocid/lb of mineral mixture during the remainder of the study.

## Results and Discussion

Purchased steers weighed less ($P < .10$) at the initiation of the study, but gained more ($P < .10$) during the 119-day study than SEKES steers (Table 1). The source of origin of the purchased steers was unknown. However, the steers appeared to be yearlings that had been wintered at a low rate of gain. Station steers were born during September and October, limit-creep fed, and weaned in mid-April. Compensatory gain on the part of the purchased steers probably accounted for the gain differential. Lasalocid had no apparent effect on animal performance. Lasalocid consumption averaged 119 mg/head/day but varied among groups of cattle from 96 up to 164 mg/head/day throughout the study. Cattle grazing pastures without shade gained more ($P < .10$) than those grazing pastures with shade. Although not measured in this experiment, cattle having access to shade appear to spend more time resting or standing in the shade rather than grazing. Cattle without shade were observed grazing more during the hot periods of the day. This may account for the difference in weight between the two groups.

A cattle source × grazing time interaction was detected ($P < .10$) for full weights measured between June 28 and July 6 and for weight change from the initial and final shrunk weights (Table 2). Weights of purchased cattle did not differ ($P < .10$) with length of morning grazing prior to weighing, and thus, their weight change from shrunk weights likewise did not differ ($P < .10$) with length of morning grazing prior to weighing. Conversely, SEKES steer weights increased with length of morning grazing prior to weighing, such that steers weighed at 9 a.m. were 14.3 lb heavier than those gathered and weighed at 6 a.m. Because steers started grazing at approximately 6 a.m., waiting until 9 a.m. gave them 3 h to graze and fill on forage. Weight changes from shrunk weight were greater ($P < .10$) for SEKES steers than for purchased steers at 7 and 9 a.m. and tended ($P > .10$) to be greater from SEKES steers at 6 and 8 a.m. This value represents fill and the ability of the cattle to regain fill following a shrink. The reason for the differential response between cattle sources probably can be attributed to cattle disposition. Purchased steers were difficult to manage and were excitable when weighed. The SEKES steers were calm and moved quietly through the weighing facilities. This ability to stay calm and return to their normal routine following a period of shrink and handling is the most probable reason for the increased fill acquired during the intensive weighing period.

The rate of cattle shrink throughout the day was affected by length of morning grazing prior to weighing (Table 3). Steers allowed to graze for 3 h prior to removal from pasture shrank at a rate of .86 %/hour less during the first 2.2-2.6 h following removal from pasture than those removed as grazing began. Steers allowed to graze for 3 h prior to removal from pasture shrank at a faster rate (%/hour) during the ensuing 1.9- to 2.7-h period, but cumulative rate of shrink at any length of time following pasture removal was lowest from steers allowed to graze for 3 h prior to being gathered from pasture. Total shrink at 3 p.m. was 2.9% less ($P < .10$) and rate of shrink was .19 %/h less ($P < .10$) for steers allowed to graze for 3 h prior removal from pasture compared with those removed at the time grazing began.

An example of the economic impact of this information is shown in Table 4. The first example is for 20 steers gathered at different times and sold at the local auction at 3 p.m. The second is for a group of steers loaded under different scenarios and sent to a feedlot in western Kansas. We realize that some price differential may be achieved from fluctuating cattle weights. However, we feel these would be minimal, because previous reports have indicated that little, if any, price differential is incurred unless the cattle are extremely full or shrunk. The results of this study indicate that, a cattleman selling a small number of head at the local auction could gain in excess of $26/head by delaying gathering the cattle until they have grazed for 3 h. Although this practice would probably not be feasible for larger producers, splitting the larger groups of cattle into smaller groups and allowing some of them time to graze prior to gathering them could result in over $11 additional value for those cattle.

Table 1. Performance by Steers Grazing Smooth Bromegrass Pastures and Offered Lasalocid in a Mineral Mixture

| | Cattle Source | | Treatment | | Shade | | |
|---|---|---|---|---|---|---|---|
| Item | Purch. | SEKES | Lasal. | Cont. | No Shade | Shade | SE |
| Initial wt., lb[a] | 647 | 661 | 655 | 653 | 651 | 657 | 2.7 |
| Final wt., lb | 779 | 776 | 777 | 778 | 782 | 772 | 5.8 |
| Total gain, lb[ab] | 132 | 115 | 122 | 125 | 132 | 115 | 5.1 |
| Daily gain, lb[ab] | 1.11 | .96 | 1.03 | 1.05 | 1.11 | .97 | .042 |

[a]Purchased steers differed ($P < .10$) from SEKES steers.
[b]Cattle grazing pastures with shade differed ($P < .10$) from those grazing pastures without shade.

Table 2. Average Full Weight (lb) and Weight Change from a 16-hour Shrunk Weight of Two Cattle Sources following Different Lengths of Morning Grazing on Smooth Bromegrass Pastures

| | | Gathering Time | | | | |
|---|---|---|---|---|---|---|
| Item | Source | 6 a.m. | 7 a.m. | 8 a.m. | 9 a.m. | SE |
| Average weight, lb | Purchased | 669.8[d] | 665.6[d] | 674.8[cd] | 666.6[d] | 3.49 |
| | SEKES | 680.7[bc] | 683.9[b] | 686.6[ab] | 695.0[a] | |
| Weight change, lb | Purchased | 25.5[c] | 21.3[c] | 30.5[bc] | 22.3[c] | 3.49 |
| | SEKES | 31.3[bc] | 34.5[b] | 37.2[ab] | 45.6[a] | |

[abcd]Means within an item without a common superscript letter differ (P < .10).

Table 3. Rate of Shrink (%/hour) by Steers Gathered from Pasture following Different Lengths of Morning Grazing on Smooth Bromegrass Pastures

| | | Gathering Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Item | Period[a] | 6 a.m. | 7 a.m. | 8 a.m. | 9 a.m. | SE | Lasal. | Cont. | SE |
| Shrink, %/h | 1[b] | 1.25[c] | 1.19[c] | 1.05[c] | .39[d] | .108 | .91 | 1.03 | .076 |
| Shrink, %/h | 2[f] | .61[d] | .96[c] | .17[e] | .94[c] | .070 | .68 | .66 | .049 |
| Shrink, %/h | 1-2 | .89[cd] | 1.08[c] | .71[de] | .64[e] | .042 | .81 | .85 | .029 |
| Shrink, %/h | 3[g] | .16[d] | .02[d] | .59[c] | .15[d] | .083 | .19 | .26 | .058 |
| Shrink, %/h | 1-3 | .67[c] | .72[c] | .67[c] | .49[d] | .042 | .62 | .67 | .019 |
| Tot. shrink, %[h] | to 1500 h | 6.2[c] | 5.9[cd] | 5.0[d] | 3.3[e] | .28 | 4.9 | 5.3 | .20 |
| Tot. shrink, %/h | to 1500 h | .69[c] | .71[c] | .67[c] | .50[d] | .033 | .62 | .67 | .023 |

[a]Periods are designations for times following removal from pasture.
[b]Period 1 is the first 2.2 - 2.6 h following removal from pasture, except steers removed at 8 a.m., for which period 1 was 3.4 h.
[cde]Means for gathering time within the same row without a common superscript letter differ (P < .05).
[f]Period 2 is the next 1.9 - 2.7 h following period 1.
[g]Period 3 is the next 1.9 - 2.2 h following period 2.
[h]Total % shrink is based on the weight measured immediately upon removal from pasture and water and a weight measured at approximately 3 p.m.

Table 4. Examples of the Effect of Different Lengths of Morning Grazing on Cattle Value

Example 1 - 20 steers gathered from pasture at different times and sold at the local auction at 3 p.m.

| | Gathering Time | | | |
|---|---|---|---|---|
| | 6 a.m. | 7 a.m. | 8 a.m. | 9 a.m. |
| # head | 20 | 20 | 20 | 20 |
| Off pasture weight, lb | 681 | 684 | 687 | 695 |
| Shrink, % | 6.2 | 5.9 | 5.0 | 3.3 |
| Sale wt., lb | 639 | 644 | 653 | 672 |
| Total value, $/hd[a] | $511.20 | $515.20 | $522.40 | $537.60 |

Example 2 - 432 steers loaded off of pasture. Group 1 has all steers in one group and removed from pasture starting at 6 a.m. and loaded at a rate of 1 truck every 30 min. Group 2 has 432 steers divided onto 3 pastures and gathered at either 6, 7:30, or 9 a.m., with half loaded immediately and half loaded 30 min later.

| | Group 1 432 head All in at 6 a.m. | | Group 2 432 head - 144 in at 6, 7:30, and 9 a.m. | |
|---|---|---|---|---|
| | Depart | Arrive[b] | Depart | Arrive |
| Truck 1 | 49032 | 46325 | 49032 | 46325 |
| Truck 2 | 48726 | 46036 | 48726 | 46036 |
| Truck 3 | 48421 | 45748 | 49320 | 46598 |
| Truck 4 | 48111 | 45462 | 49027 | 46320 |
| Truck 5 | 47818 | 45178 | 50040 | 48038 |
| Truck 6 | 47672 | 45040 | 49942 | 47945 |
| Total weight, lb | 289786 | 273790 | 296087 | 281262 |
| Average wt., lb/head | 671 | 634 | 685 | 651 |
| Total value, $[a] | $231,829 | | $236,869 | |

[a]Value is based on sale weight multiplied by $80/cwt.
[b]Weight upon arrival at a western Kansas feedlot after an 8 h transit time.

# PERFORMANCE BY STOCKER STEERS GRAZING RYE DRILLED INTO BERMUDAGRASS SOD AT DIFFERENT STOCKING RATES AND NITROGEN FERTILIZER RATES[1]

Kenneth P. Coffey and Joseph L. Moyer

## Summary

Two hundred forty mixed breed steers (510 lb avg BW) were grazed on rye-overseeded bermudagrass pastures at different stocking rates during the rye grazing periods of 3 consecutive yr. Rye/bermudagrass pastures were fertilized with either 45 or 135 lb N/a in February of each year. Animal performance was not affected ($P > .10$) by N rate. During the rye grazing period, individual animal gain declined ($P < .05$), but grazing days and gain per acre increased ($P < .05$) with increasing stocking rate. Rye-phase stocking rate did not affect ($P > .10$) subsequent bermudagrass performance. Cost of gain during the rye phase was not affected ($P > .10$) by N rate or stocking rate. Therefore, drilling rye into bermudagrass sod may economically extend the grazing season for bermudagrass pastures, but animal performance will be affected substantially by the chosen stocking rate.

## Introduction

Previous work at SEKES has shown the positive benefits of drilling cereal rye into bermudagrass pastures. However, a "put and take" grazing system was used to determine animal performance and pasture carrying capacity and an arbitrary N fertility level was chosen. This study was conducted to evaluate animal performance and pasture carrying capacity from bermudagrass pastures overseeded with cereal rye and fertilized with two N rates and stocked at different stocking rates.

## Experimental Procedures

A total of 240 mixed breed steers received routine vaccinations against IBR, BVD, $PI_3$, leptospirosis (5 strains), pinkeye, and seven clostridial strains and were implanted (Ralgro® or Synovex-S®), dewormed (oxfendazole), and deloused (Fenthion). Each year, 48 steers were allotted randomly by weight into eight groups of six head each, and the groups randomly assigned to one of eight 5-acre bermudagrass pastures that had been drilled with cereal rye in early September and fertilized in February with either 45 (low N) or 135 lb N/a (high N). The remaining 32 steers each year were allotted randomly to the different pastures to create stocking rates of 1.2, 1.6, 2.0 or 2.4 head/a on the low-N pastures and stocking rates of 1.6, 2.0, 2.4, and 2.8 head/a on the high-N pastures. Stocking rates and N rates were assigned to the pastures at random, and the same spring stocking rate and N rate was maintained on each pasture for each year of the study. Average grazing initiation date was March 20, and rye grazing continued for an average of 62 days. Excess rye forage production on pastures stocked at low stocking rates was removed by either clipping or mob-grazing immediately following the rye grazing period.

[1]Appreciation is expressed to Syntex Animal Health, West Des Moines, IA for providing oxfendazole and Synovex-S; to Pitman-Moore, Inc., Terre Haute, IN for providing Ralgro; and to Richard Porter for use of experimental animals.

Bermudagrass grazing began on June 3 (avg.) and continued for an average of 107 days. In 1991, a "put and take" grazing system was employed to maintain constant forage availability across pastures. In 1992 and 1993, all pastures were stocked at 2 head/a, and excess forage was mowed and baled monthly as weather permitted.

Bermudagrass pastures were fertilized annually with 150 lb N, 60 lb phosphate, and 80 lb potash/a in mid-May and additionally with 50 lb N/a after haying operations.

Costs of gain were calculated using the following assumptions. Estimated purchase price for steers was calculated each year based on local market prices. Charges for processing, fertilizer, seed, and cattle mineral were based on actual prices at the time of the study. Charges for seeding and haying operations were based on rates published in the Kansas Custom Rates Bulletin. An interest rate of 10% and a land cost of $20/ac were assumed.

## Results and Discussion

Gain/head during the rye grazing period decreased ($P < .05$) by 25 (high N) and 32 lb (low N) with each increase in stocking rate (Figure 1), but gain/a increased ($P < .05$) by 72 (high N) and 66 lb (low N) with each increase in stocking rate (Figure 2). Each additional animal added/a increased ($P < .05$) grazing days/a during the rye phase by 48 (high N) and 50 (low N) days but had little ($P > .10$) effect on rye-phase cost of gain.

Ending bermudagrass grazing weights declined ($P < .10$) with increasing rye-phase stocking rate (Table 1). However bermudagrass gain per head and per acre, grazing days, cost of gain, and return were not affected ($P > .10$) by previous rye-phase stocking rate.

A number of factors enter into the selection of a stocking rate for a pasture system. Obviously, overall economics should be among the top priorities. Although return/head and return/a during the separate phases were not substantially affected by either stocking rate or N rate, overall return/head and return/a were affected by stocking rate and N rate. On pastures fertilized with 135 lb N/a, maximum returns/head (Figure 3) and /a (Figure 4) were achieved at a stocking rate of approximately 2.2 to 2.3. On pastures fertilized with 45 lb N/a, the greatest return/head was from the lowest stocking rate (1.2 head/a), whereas the greatest return/acre was from the highest stocking rate used (2.4 head/a).

Other factors such as animal and forage management peculiarities related to N rate or stocking rate must be considered. At low stocking rates, forage production may exceed the animals' ability to consume it and allow the forage to mature. Because cattle do not readily consume rye seedheads or stems, the excess forage must be removed to avoid competition with the ensuing bermudagrass growth. Weather conditions may make it difficult to harvest the excess forage in a timely manner. Also, the quality of this forage would be low, because the grazing cattle would have removed much of the leaf material. At high stocking rates, the rye may be grazed out 2 to 3 wks before the bermudagrass starts growing. This necessitates having somewhere else to take the cattle to or to feed them until the bermudagrass forage is ready. In our economic analysis, the factors of pasture clipping to remove excess rye and costs of holding cattle between rye and bermudagrass grazing phases were not considered.

A stocking rate of 2 head/a on bermudagrass has worked well in past years and appears to match animal and forage resources well in summers of average to somewhat below average rainfall. In summers of excessive rainfall, haying the surplus forage has worked extremely well. Considering all factors mentioned, stocking rye drilled into bermudagrass at the same rate as the bermudagrass compromises economic returns somewhat but is much easier to manage. Additional N above approximately 50 lb/a is probably not beneficial for animal performance or overall economics.

Table 1. Performance and Economic Returns by Steers Grazing Rye Overseeded Bermudagrass Pastures at Different Stocking Rates and Nitrogen Fertilizer Rates

| Item | Stocking Rate on Rye with 45 lb N/a | | | | Stocking Rate on Rye with 135 lb N/a | | | |
|---|---|---|---|---|---|---|---|---|
| | 1.2 | 1.6 | 2.0 | 2.4 | 1.6 | 2.0 | 2.4 | 2.8 |
| Rye phase | | | | | | | | |
| Initial wt., lb | 510.4 | 508.7 | 509.2 | 511.2 | 509.7 | 509.8 | 508.1 | 509.9 |
| Final wt., lb[a] | 654.6 | 638.5 | 634.8 | 613.6 | 656.5 | 630.0 | 647.4 | 616.8 |
| Gain, lb[a] | 144.2 | 129.8 | 125.6 | 102.5 | 146.9 | 120.2 | 139.4 | 106.8 |
| Daily gain, lb[b] | 2.38 | 2.13 | 2.09 | 1.94 | 2.42 | 1.98 | 2.29 | 2.00 |
| Graz. days/a[a] | 74.0 | 98.67 | 123.3 | 132.8 | 98.67 | 123.3 | 148.0 | 154.9 |
| Gain/a, lb[a] | 173.0 | 207.6 | 251.2 | 245.9 | 235.0 | 240.4 | 334.5 | 299.1 |
| $/cwt. gain[c] | 24.37 | 24.15 | 31.48 | 23.82 | 39.92 | 30.05 | 29.07 | 33.16 |
| Return, $/head | 43.93 | 36.15 | 29.02 | 25.54 | 25.38 | 26.21 | 37.05 | 17.33 |
| Return, $/a | 52.72 | 57.83 | 58.04 | 61.29 | 40.60 | 52.42 | 88.92 | 48.52 |
| Bermudagrass phase | | | | | | | | |
| Initial wt., lb[a] | 638.4 | 620.9 | 618.9 | 608.1 | 642.9 | 616.0 | 629.5 | 616.3 |
| Final wt., lb[b] | 803.2 | 749.5 | 760.5 | 737.1 | 756.3 | 784.1 | 751.6 | 733.6 |
| Gain, lb | 152.9 | 137.0 | 139.4 | 136.1 | 120.9 | 170.9 | 122.3 | 126.9 |
| Daily gain, lb | 1.44 | 1.30 | 1.30 | 1.26 | 1.16 | 1.57 | 1.13 | 1.17 |
| Graz. days/a | 186.7 | 243.1 | 210.7 | 248.5 | 239.1 | 199.1 | 243.1 | 248.5 |
| Gain/a, lb | 262.7 | 309.6 | 275.6 | 305.3 | 270.0 | 321.1 | 264.6 | 280.7 |
| Cost of gain, $/cwt | 27.93 | 29.89 | 32.27 | 26.28 | 37.39 | 30.66 | 35.06 | 41.26 |
| Return, $/head | 42.23 | 31.23 | 28.18 | 35.65 | 14.96 | 39.15 | 21.77 | 20.97 |
| Return, $/a | 50.67 | 49.97 | 56.36 | 85.57 | 23.94 | 78.29 | 52.25 | 58.71 |
| Total | | | | | | | | |
| Graz. days/a[a] | 260.7 | 341.8 | 334.0 | 381.3 | 337.8 | 322.4 | 391.1 | 403.4 |
| Gain/a, lb[a] | 435.7 | 517.2 | 526.8 | 551.2 | 505.0 | 499.7 | 599.1 | 579.8 |
| $/cwt. gain | 26.02 | 25.92 | 31.75 | 25.01 | 37.86 | 30.05 | 31.03 | 33.96 |
| Return, $/head[d] | 86.16 | 67.38 | 57.20 | 61.19 | 40.34 | 65.36 | 58.82 | 38.30 |
| Return, $/a[d] | 103.38 | 107.80 | 114.40 | 146.86 | 64.54 | 130.71 | 141.17 | 107.23 |

[a]Linear effect of stocking rate ($P < .05$).
[b]Linear effect of stocking rate ($P < .10$).
[c]Costs included the following: $7.35 processing, $37.29/a for fertilizer and seed cost on low N, $48.60/a for fertilizer and seed cost on high N, $24.90/a for fertilizer on bermudagrass, $18.00/cwt for mineral, 10% interest on calf and fertilizer costs.
[d]Interaction between N level and the quadratic effect of stocking rate ($P < .05$).

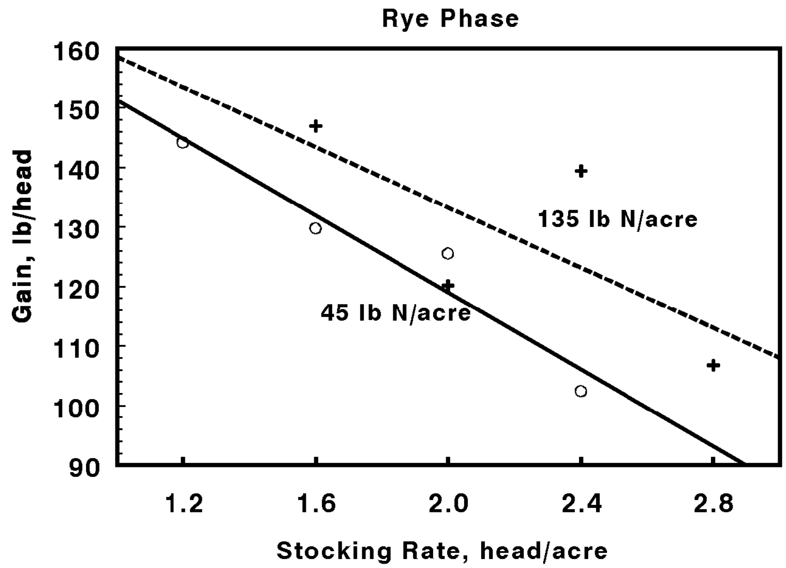


Figure 1. Gain/head from Steers Stocked on Rye Drilled into Bermudagrass at Different Stocking Rates and Fertilized with 45 or 135 Lb of N/A

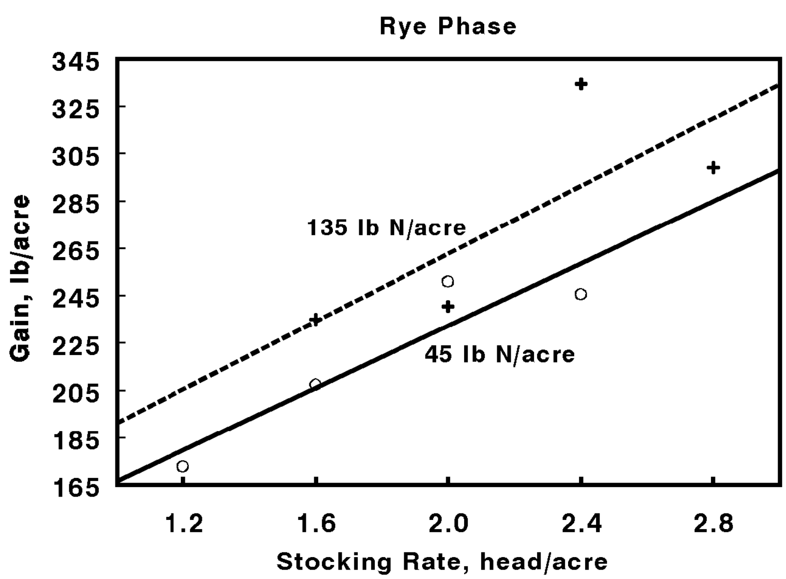


Figure 2. Gain/A from Steers Stocked on Rye Drilled into Bermudagrass at Different Stocking Rates and Fertilized with 45 or 135 Lb of N/A.

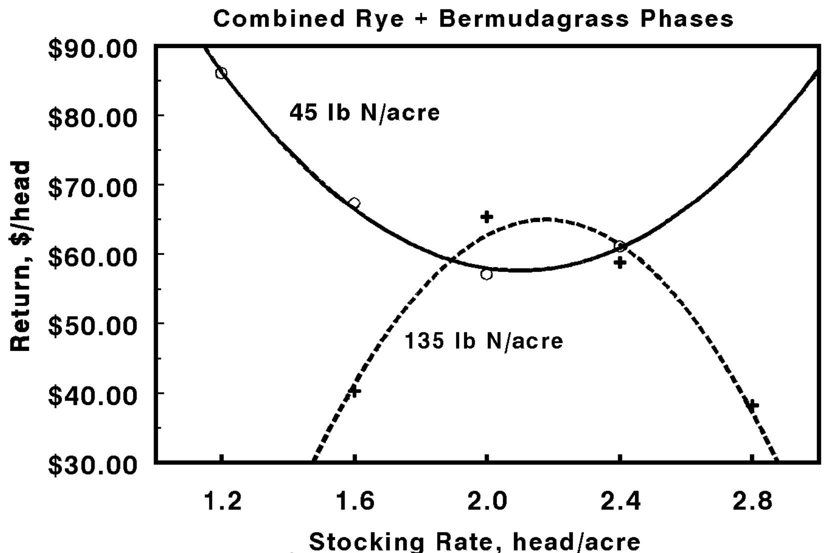


Figure 3. Combined Return/head from Steers Stocked on Rye Drilled into Bermudagrass at Different Stocking Rates and Fertilized with 45 or 135 Lb of N/A.

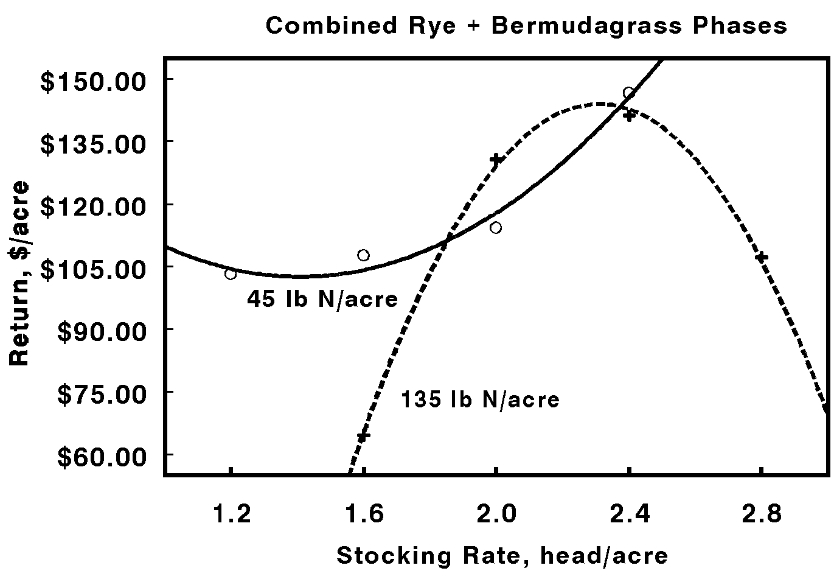


Figure 4. Combined Return/A from Steers Stocked on Rye Drilled into Bermudagrass at Different Stocking Rates and Fertilized with 45 or 135 Lb of N/A.

# GRAZING AND SUBSEQUENT FEEDLOT PERFORMANCE BY STEERS GRAZING FESCUE AND FESCUE - LADINO CLOVER PASTURES AT DIFFERENT STOCKING RATES[1]

Kenneth P. Coffey and Joseph L. Moyer

## Summary

Two hundred forty-three mixed-breed steers (631 lb avg BW) were grazed at different stocking rates on pastures of *Acremonium coenophialum*-infected tall fescue (IF) or IF overseeded with 'Regal' ladino clover (IFL) for an average of 72 d in the spring. Gains by steers grazing IF declined by 62% as stocking rate was increased from 1.2 to 3.2 head/a. Gains by steers grazing IFL declined by 47% as stocking rate was increased from 1.0 to 2.8 head/a. At similar stocking rates, steers grazing IF gained more ($P < .05$) than steers grazing IFL. Gain/a was maximized at 2.2 head/a on both forage types. Grazing cost of gain increased with increasing stocking rate on both forage types but increased at a much faster rate on IF pastures. Subsequent feedlot performance was not affected by previous stocking rate. Therefore, grazing IF and IFL pastures at heavier stocking rates in the spring to increase forage utilization can result in substantial reductions in animal gain and reduced available forage. Producers should not expect the reduced grazing-phase animal gains to be compensated for in the feedlot

## Introduction

Two-thirds to three-fourths of the total seasonal dry matter production from tall fescue generally occurs by early June. Gains by steers stocked at 1 head/a have typically exceeded 2 lb/d during the period between early April and early June. Therefore, one should be able to stock fescue pastures at a higher rate and better utilize the forage during a time of high production and quality and achieve acceptable gains. However, in previous studies in which stocker cattle were grazed at 2 head/a between early April and early June, gains have consistently been half of what was expected. This study was conducted to determine the effects of spring stocking rate on gain by stocker cattle grazing IF or IFL pastures and their subsequent feedlot performance.

## Experimental Procedures

A total of 243 mixed-breed stocker steers was weighed on March 28 and 29, 1991; April 21 and 22, 1992; and April 5 and 6, 1993 and divided into light- and heavy-weight groups. Following routine vaccinations against IBR, BVD, $PI_3$, leptospirosis (5 strains), and seven clostridial strains and deworming (oxfendazole), heavier steers were allotted randomly by weight into eight groups of five head each. These groups then were assigned randomly to graze either IF or IFL pastures at one of four stocking rates. Stocking rates were randomly allotted to four 5-acre pastures of each forage type, and the same stocking rate was applied to the same pasture in each year. Steers from the light-weight block were used as needed to create the different stocking rates. Steers were stocked continuously on the respective pastures until June 18 and 19, 1991 and June 22 and 23, 1992 and 1993. Steers were weighed on those days, then the five-head groups were transported to Mound

[1]Appreciation is expressed to Syntex Animal Health, West Des Moines, IA for providing oxfendazole; and to Steve Clark for use of experimental animals.

Valley, KS and placed in the SEKES feedlot facility. Feedlot processing included deworming (oxfendazole), implanting (Synovex-S®), and vaccinating against seven clostridial strains and *Hemophilus somnus*. Steers were offered a finishing ration for 149 (1991), 153 (1992), or 147 (1993) d, and original pasture allotment was maintained so that feed efficiency data could be collected. Following the feedlot period, steers were transported to Emporia, KS and slaughtered at a commercial slaughter facility. Carcass data were collected following a 24-h chill. Lighter weight steers were placed on bermudagrass pastures during the summer, then re-allotted and grazed on the IF or IFL pastures during a fall-grazing experiment.

Pastures were fertilized each fall with 40 lb each of N, phosphate, and potash. During the spring, IF pastures received an additional 80 lb of N, but IFL pastures were not fertilized.

Costs of gain and economic return were calculated using the following assumptions. Estimated purchase price for steers was calculated each year based on local market prices. Charges for processing, fertilizer, seed, mineral, and feed were based on actual prices at the time of the study. Charges for seeding and fertilization were based on rates published in the Kansas Custom Rates Bulletin. An interest rate of 10% and a land cost of $20/a were assumed. Seed and seeding charges as well as charges for phosphate and potash fertilization were assessed at half price, with the remaining half being assessed to the fall grazing period.

## Results and Discussion

Increasing the stocking rate substantially reduced ($P < .05$) animal performance on both IF and IFL pastures (Figure 1). Gain by steers grazing IF at 3.2 head/a was only 37.9% of gain by steers grazing at 1.2 head/a. Stocking rate increases had a smaller effect on gain by steers grazing IFL pastures than by those grazing IF pastures. Although gain by steers grazing at 2.8 head/a on IFL was only 53.3% of that by steers grazing at 1.0 head/a, overall reduction in gain was 25.3 lb for each increase in stocking rate on IFL compared with 42.3 lb for each increase in stocking rate on IF pastures. Gains by steer grazing IF at 1.2 head/a were only slightly lower than expected, based on observations of gains during similar grazing periods from previous studies.

Because of rapidly declining individual animal gain as stocking rate was increased, gain/a ranged from 166 to 200 lb/a on IF and from 100 to 173 lb/a on IFL, reaching a maximum at a stocking rate of approximately 2.2 head/a on both forages (Figure 2).

Cost of gain increased by $16.47/cwt gain for each additional head/a on IF, but by only $3.72/cwt gain for each additional head on IFL (Figure 3). Grazing return ($/head) from IF declined quadratically with increasing stocking rate throughout the levels measured in this study, but a maximum return was achieved from IFL pastures at a stocking rate of approximately 1.8 head/a.

Feedlot gain and feed efficiency were not affected ($P > .10$) by previous stocking rate or forage (Table 1). Feedlot dry matter intake increased ($P < .10$) with increasing grazing-phase stocking rate at rates of .54 and 1.06 lb of dry matter per additional animal/a during the grazing phase on IF and IFL pastures, respectively. Although these increases resulted in increased ($P < .10$) total feed costs, cost of gain and feedlot phase returns were not affected ($P > .10$) by previous forage or stocking rate.

Considering the data in this study, one should seriously question the practice of increasing the stocking rate on fescue or fescue-clover pastures during the spring. This could lead to substantial reductions in performance of cattle grazing IF and would reduce forage availability of IFL pastures so that grazing would be limited during the time when ladino clover would exert its greatest benefit.

Table 1. Performance by Steers Grazing Fescue or Fescue-Ladino Clover Pastures at Different Spring Stocking Rates

| | Stocking Rate on Fescue | | | | Stocking Rate on Fescue - Ladino | | | |
|---|---|---|---|---|---|---|---|---|
| Item | 1.2 | 1.8 | 2.4 | 3.2 | 1.0 | 1.6 | 2.2 | 2.8 |
| Pasture phase | | | | | | | | |
| Initial wt., lb | 631.1 | 631.2 | 631.0 | 633.5 | 632.3 | 629.8 | 631.0 | 628.5 |
| Final wt., lb[a] | 769.1 | 738.1 | 714.3 | 705.1 | 732.8 | 719.5 | 732.2 | 708.9 |
| Gain, lb[ab] | 137.9 | 107.0 | 83.5 | 52.3 | 100.5 | 89.9 | 78.9 | 53.6 |
| Daily gain, lb[ac] | 1.89 | 1.45 | 1.13 | 0.83 | 1.38 | 1.22 | 1.30 | 0.87 |
| Graz. days/a[a] | 88.0 | 131.7 | 175.9 | 204.7 | 73.3 | 117.1 | 140.7 | 173.4 |
| Gain/a, lb[d] | 165.6 | 192.5 | 200.3 | 167.2 | 100.5 | 143.8 | 173.3 | 150.1 |
| $/cwt. gain[ae] | 39.98 | 45.11 | 51.76 | 73.24 | 50.75 | 45.85 | 44.39 | 58.68 |
| Return, $/head[f] | 34.01 | 19.61 | 9.83 | (1.57) | 6.28 | 15.95 | 18.01 | 1.33 |
| Feedlot phase | | | | | | | | |
| Final wt., lb | 1210 | 1193 | 1184 | 1175 | 1205 | 1237 | 1197 | 1204 |
| Gain, lb | 440.5 | 454.6 | 469.7 | 469.6 | 472.3 | 517.6 | 465.2 | 494.9 |
| Daily gain, lb | 2.94 | 3.03 | 3.14 | 3.14 | 3.16 | 3.46 | 3.11 | 3.31 |
| DM intake, lb/day[g] | 22.04 | 21.48 | 21.78 | 23.05 | 21.65 | 22.85 | 22.17 | 23.99 |
| Feed:gain | 7.55 | 7.18 | 7.01 | 7.44 | 6.87 | 6.63 | 7.19 | 7.33 |
| Feed cost, $[g] | 183.88 | 178.81 | 180.79 | 191.68 | 180.17 | 189.52 | 184.34 | 200.04 |
| $/cwt. gain | 52.25 | 49.73 | 48.39 | 50.92 | 48.01 | 45.57 | 49.70 | 49.87 |
| Return, $/hd | (56.86) | (30.90) | (30.28) | (31.86) | (35.04) | 8.42 | (20.28) | (32.95) |
| Overall Return, $/hd | (22.85) | (11.29) | (20.44) | (33.43) | (28.75) | 24.37 | (2.27) | (31.62) |

[a] Linear effect of stocking rate ($P < .05$).
[b] Interaction between forage type and the linear effect of stocking rate ($P < .05$).
[c] Interaction between forage type and the linear effect of stocking rate ($P < .10$).
[d] Quadratic effect of stocking rate ($P < .05$).
[e] Costs included the following: $5.08 processing, $10.69/a for fertilizer and seed cost on IFL, $25.25/a for fertilizer on fescue, $18.00/cwt for mineral, 10% interest on calf and fertilizer costs.
[f] Interaction between forage type and the quadratic effect of stocking rate ($P < .05$).
[g] Linear effect of stocking rate ($P < .05$).

Table 2. Carcass Characteristics of Steers Previously Grazed on Fescue or Fescue-Ladino Clover Pastures at Different Spring Stocking Rates

| | Stocking Rate on Fescue | | | | Stocking Rate on Fescue - Ladino | | | |
|---|---|---|---|---|---|---|---|---|
| Characteristic | 1.2 | 1.8 | 2.4 | 3.2 | 1.0 | 1.6 | 2.2 | 2. 8 |
| Hot carcass wt., lb | 719.7 | 703.2 | 695.5 | 691.2 | 703.7 | 735.6 | 712.5 | 708.7 |
| Back fat, in | 0.26 | 0.34 | 0.31 | 0.25 | 0.34 | 0.38 | 0.30 | 0.32 |
| Ribeye area, $in^2$ | 14.4 | 13.8 | 13.8 | 13.4 | 13.6 | 13.5 | 14.4 | 13.7 |
| Marbling score[a] | 474.7 | 497.3 | 479.0 | 472.7 | 484.5 | 586.7 | 480.7 | 456.7 |
| USDA Yield Grade | 1.47 | 1.87 | 1.78 | 1.53 | 1.75 | 2.12 | 1.47 | 1.73 |

[a]400-499 = Select°; 500-599 = Select$^+$; etc.

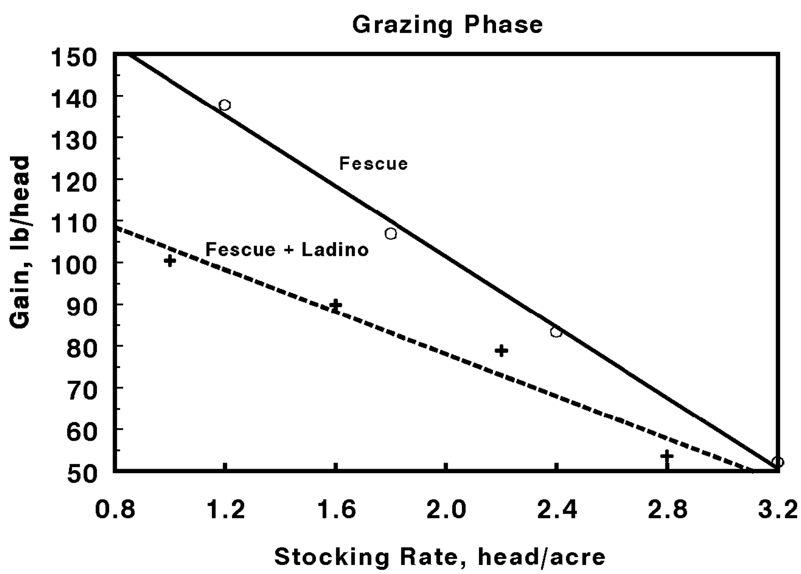


Figure 1. Gain/Head from Steers Grazed on Fescue or Fescue-Ladino Clover Pastures at Different Stocking Rates.

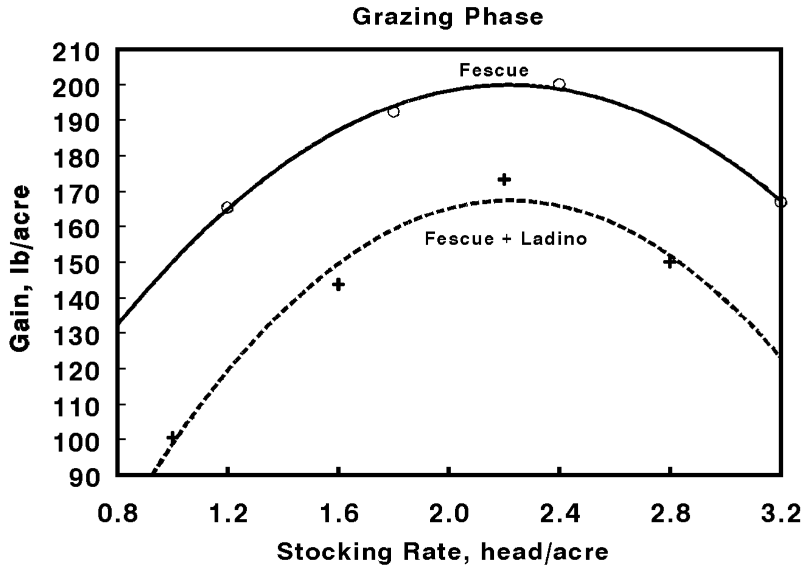


Figure 2. Gain/A from Steers Grazed on Fescue or Fescue-Ladino Clover Pastures at Different Stocking Rates.

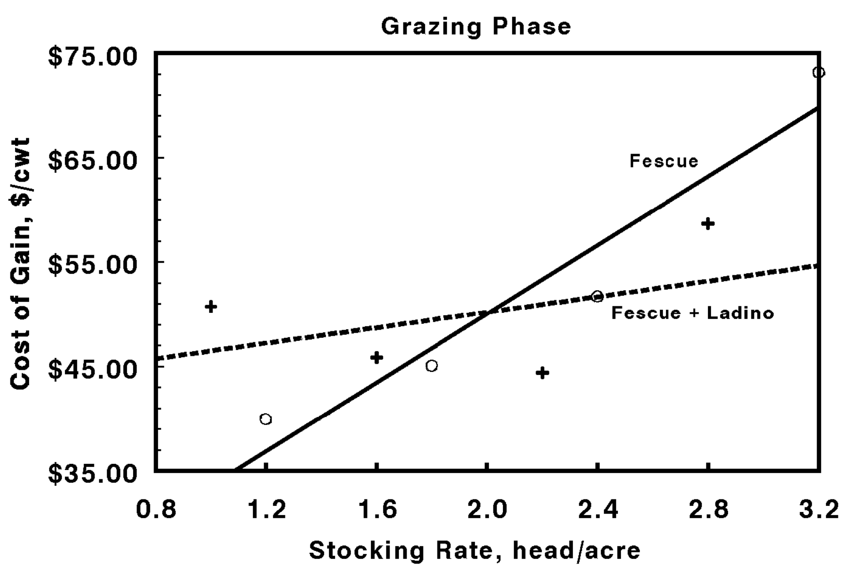


Figure 3. Grazing Cost of Gain from Steers Grazed on Fescue or Fescue-Ladino Clover Pastures at Different Stocking Rates.

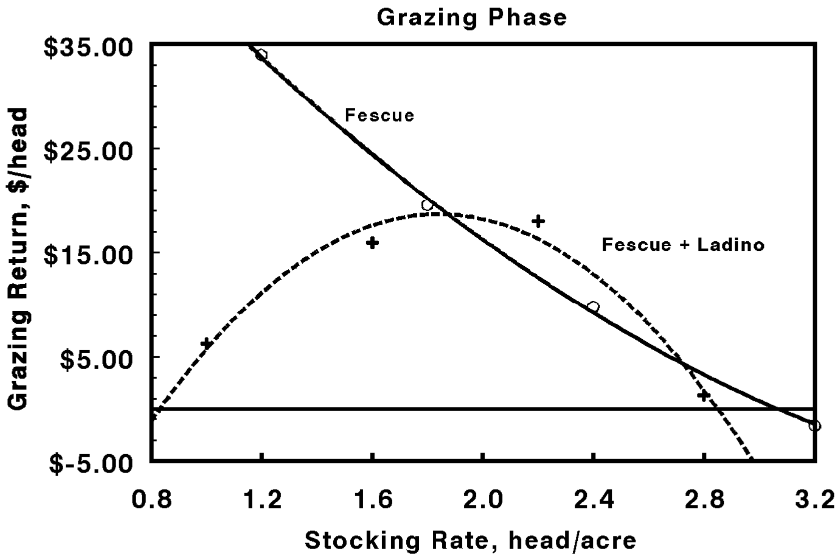


Figure 4. Grazing Phase Return/Head from Steers Grazed on Fescue or Fescue-Ladino Clover Pastures at Different Stocking Rates.

# EFFECT OF STRATEGIC SEEDHEAD REMOVAL ON PERFORMANCE BY STEERS GRAZING *ACREMONIUM COENOPHIALUM*-INFECTED TALL FESCUE PASTURES[1]

Kenneth P. Coffey, Joseph L. Moyer, and Frank K. Brazle[2]


## Summary

Forty-five mixed breed steers were used to compare the effects of time of seedhead clipping of *Acremonium coenophialum*-infected tall fescue pasture on steer performance. Steers were stocked at one steer/a on nine 5-a tall fescue pastures. Three pastures each were not mowed during the 204-day study (No clip), three pastures were mowed above the leaf canopy shortly after seedhead emergence (Early clip), and three pastures were mowed above the leaf canopy when the seeds were at the milk to soft-dough stage of maturity (Late clip). Pasture gains were .65, .65, and .66 lb/day for No clip, Early clip, and Late clip, respectively ($P = .98$). Therefore, clipping seedheads is not a viable management option to reduce the impact of grazing *A. coenophialum*-infected tall fescue pastures.


## Introduction

Cattle grazing *A. coenophialum*-infected tall fescue typically exhibit a number of toxicity symptoms including reduced weight gain and increased heat stress. Toxins causing this problem are distributed throughout the various plant parts, but concentrations in the seedheads may reach levels as high as 10 times the concentration in the leaf tissue. Therefore, preventing cattle from consuming fescue seedheads could substantially reduce toxin consumption, because cattle readily consume fescue seedheads when they are at the milk to soft-dough stage. This study was conducted to determine the effect of strategic clipping of tall fescue seedheads on performance by grazing cattle.

## Experimental Procedures

Forty-five mixed breed steers were weighed on May 3 and 4 while grazing a mixed grass pasture of fungus-free fescue and native grass and allotted by weight into nine groups of five head each. All cattle had been vaccinated against IBR, BVD, $PI_3$, leptospirosis (5 strains), pinkeye, and seven clostridial strains at arrival and dewormed (oxfendazole) immediately prior to starting the study. The nine groups were allotted randomly to nine 5-a tall fescue pastures of which approximately 70% of the plants were infected with *A. coenophialum* and grazed the pastures for 204 days.

Pastures were divided into three blocks of three pastures each. Within each block, one pasture was not mowed during the grazing period (No clip), one pasture was mowed with a rotary mower above the leaf canopy within 2

[1]Appreciation is expressed to Syntex Animal Health, West Des Moines, IA for providing oxfendazole.

[2]Southeast Kansas Area Extension Livestock Specialist, Chanute, KS.

days after seedhead emergence (Early clip), and one pasture was mowed with a rotary mower above the leaf canopy when the seeds were at the milk to soft-dough stage of maturity (Late clip). Following the clipping on the Early clip pastures, some fescue plants produced additional seedheads. These seedheads were removed by mowing the Early clip pastures a second time. The Late clip pastures needed to be clipped only once. Pastures were fertilized in February with 80 lb of N/a, 40 lb phosphate/a, and 40 lb potash/a as potassium chloride.

## Results and Discussion

Steer gains were equal (P = .98) across treatments. Clipping fescue seedheads is one of the recommendations currently proposed bymany to reduce the impact of grazing infected fescue pastures. In theory, this idea has merit. Because the toxins producing the adverse conditions in cattle are much more concentrated in the seedheads, and because cattle consume vast quantities of these seedheads when they are in the milk to soft-dough stage, preventing this excessive consumption of seedheads should substantially reduce the toxic effects of infected fescue. Because this did not translate into any performance advantage, we must conclude that the concentrations of toxins in the leaves is sufficient to maximize performance reductions associated with the presence of *A. coenophialum* in tall fescue.

Table 1. Effect of Strategic Seedhead Clipping on Performance by Steers Grazing *A. coenophialum*-infected Tall Fescue Pastures[a]

| Item | No clip | Early Clip | Late Clip |
|---|---|---|---|
| Initial wt., lb | 579 | 581 | 582 |
| Final wt., lb | 712 | 712 | 716 |
| Gain, lb | 132 | 131 | 134 |
| Daily gain, lb | .65 | .65 | .66 |

[a]No significant differences were detected (P < .10).

# EFFECT OF MAGNESIUM-MICA ON DIGESTIBILITY OF PRAIRIE HAY DIETS[1]

Kenneth P. Coffey, Frank K. Brazle[2], and Joseph L. Moyer


## Summary

Magnesium-mica, a mined phlogopite, was added to a 20% crude protein supplement to provide .1, .25, or .4 lb of magnesium-mica/ head daily in a digestion and nutrient balance study with cows. Cubic responses (P < .05) to magnesium-mica level were observed for dry matter (DM), organic matter (OM), neutral-detergent fiber (NDF), and acid-detergent fiber (ADF) digestion. The cubic response was characterized by a tendency for improved digestion over the control diet (no magnesium-mica) by the addition of .1 lb/day of magnesium-mica, followed by a suppressive effect on digestion by the .25 lb/day level, then a return to digestion levels approximating that of the control diet with the .4 lb/day level of magnesium-mica. Magnesium-mica level had no apparent effect on ruminal fill and passage rate or in situ rate of disappearance of prairie hay or soybean meal. Ruminal ammonia was greater (P < .05) from cows offered .1 and .4 lb/day of magnesium-mica than those offered the control supplement. Total volatile fatty acid (VFA) concentrations and molar percentages of individual VFA were not affected (P < .10) by magnesium-mica level. Nitrogen balance was not affected (P < .10) by magnesium-mica level in the supplement. Therefore, feeding magnesium-mica at the proper level to cows offered a prairie hay diet with a 20% protein supplement appeared to be beneficial for feed digestion. Furthermore, magnesium-mica apparently had no observable negative impact on intake or ruminal protein and fiber digestion. Excessive consumption of certain minerals did not apparently alter utilization of other nutrients.


## Introduction

Magnesium-mica is mined phlogopite used as a feed diluent and pellet binding agent. There is a reason to believe that magnesium-mica may have protein-sparing effects in a ruminant ration, either through chemically bonding with free ammonia in the rumen, through actions on rumen microorganisms, or some combination of the two. Increasing the efficiency of nitrogen usage by ruminants consuming poor quality forage diets may have a substantial effect on cow productivity through increased fiber digestion and greater forage intake. Furthermore, increasing nitrogen efficiency would help cows better utilize the non-protein nitrogen commonly found in most commercial range cubes. This study was conducted to evaluate the effect of magnesium-mica on digestibility and fermentation products of prairie hay diets.

[1]Appreciation is expressed to Micro-Lite, Inc. for providing magnesium-mica and partial financial assistance for the study, to Dr. T.G. Nagaraja for VFA and ammonia analyses, and to Gene Towne for protozoa analysis.

[2]Southeast Kansas Area Extension Livestock Specialist, Chanute, KS.

## Experimental Procedures

Four ruminally-fistulated, nonpregnant, nonlactating cows were used in an experiment designed such that each animal would receive each of four experimental diets. Cows were housed in a drylot pen with free-choice access to prairie hay for a 7-day preliminary adaptation. During this time cows were gathered daily and individually fed 4 lb/day of their assigned supplement. Supplements consisted primarily of wheat midds, grain sorghum, and soybean meal along with other minor ingredients. Either 2.5, 6.25, or 10% of the supplement was provided as magnesium-mica; whereas the control supplement contained none. Supplements were formulated to provide one-third of the supplemental crude protein from urea and balanced to provide similar quantities of crude protein, Ca, P, Mg, Fe, and K (Table 1). This is essential to ensure that results obtained are due to magnesium-mica and not simply an effect of the additional Mg, Fe, or K.

Following the preliminary adaptation to diet, cows were placed in individual stalls in a metabolism facility at the Mound Valley Unit of the Southeast Kansas Experiment Station (SEKES). Cows were individually offered a diet of ad libitum chopped (4 inch) prairie hay along with the previously described supplements at 7 a.m. daily. Nylon bags were placed in the rumen of each cow and incubated for specified time periods up to 96 h to determine the effect of dietary magnesium-mica level on rate of ruminal forage fiber (prairie hay) and protein (soybean meal) degradation. Total feces and urine were collected for 5 days beginning on day 13 of confinement. Rumen samples were collected immediately prior to supplement feeding on day 18 and every 2 h following feeding for 12 h. Daily intake and water consumption were monitored throughout the entire 19-day adaptation and collection period. Rumen evacuations were performed at 11 a.m. on day 19 of confinement to determine rumen fill and passage rate.

## Results and Discussion

Dry matter (16-d) intake did not differ ($P < .10$) among levels of magnesium-mica in the supplement (Table 2). Dry matter and organic matter digestibilities responded in a cubic ($P < .05$) manner to increasing level of magnesium-mica. Digestibilities of DM and OM of the control diet did not differ ($P < .10$) from those of diets containing magnesium-mica. Digestibility of DM from diets containing 2.5% magnesium-mica in the supplement was higher ($P < .05$) than that from diets containing 6.25 and 10% magnesium-mica in the supplement. Digestibility of neutral-detergent (NDF) and acid-detergent fiber (ADF) also responded in a cubic ($P < .05$) manner to increasing level of magnesium-mica. Water consumption was not affected ($P < .10$) by level of magnesium-mica in the supplement. Cubic responses are difficult to explain. Mathematically, the response curve had two inflection points. In the present data set, the lowest level of magnesium-mica inclusion in the supplement was somewhat beneficial. As the level of magnesium-mica was increased from 2.5 to 6.25% of the supplement, negative effects on digestibility were observed, which were apparently offset as the level of magnesium-mica was increased to 10% of the supplement.

Quantities and percentages of nitrogen digested and retained did not differ ($P < .10$) among levels of magnesium-mica (Table 3).

Adding magnesium-mica to constitute up to 10% of the supplements had no deleterious effect ($P < .10$) on fresh, DM, or OM fill; rumen turnover; or particulate passage rate (Table 4). Furthermore, ash fill did not differ ($P < .10$) with increasing level of magnesium-mica in the supplement. Because the ash content of the supplements increased with increasing level of magnesium-mica, this additional ash apparently was washed efficiently from the rumen and passed on to the other digestive organs.

Although rumen samples were collected at 2-h intervals throughout a 12-h period, no magnesium-mica level × sampling time interaction was detected (P < .05) for ruminal ammonia, pH, or volatile fatty acids (VFA). Therefore, data in Table 5 are presented as means across sampling times. Ruminal ammonia levels were greatest (P < .05) from cows offered the highest level of magnesium-mica and lowest (P < .05) from cows offered the control supplement. Ruminal pH of cows offered the highest level of magnesium-mica tended to be lower (P < .10) than that of cows on the other supplements. However, all ruminal pH measures were near neutral. Total VFA did not differ (P < .10) among levels of magnesium-mica offered but tended to follow the same trend as ruminal ammonia. Likewise, molar percentages of the individual VFA did not differ across different levels of magnesium-mica. Ruminal protozoa counts followed normal diurnal variations throughout the sampling days but were not affected (P < .10) by magnesium-mica level (Table 6).

A quadratic tendency (P < .10) across magnesium-mica levels was observed for in situ prairie hay DM and NDF disappearance at 72 h and for in situ prairie hay NDF disappearance at 96 h of ruminal incubation (Table 7). However, no differences were detected (P < .10) in digestion lag or rate or in the digestible or indigestible forage fractions.

Soybean meal in situ DM disappearance tended (P < .10) to decline linearly with increasing level of magnesium-mica at 24 hours of incubation (Table 8). However, in situ disappearance of DM and crude protein at the other incubation times did not differ (P < .10) across magnesium-mica levels. Soybean meal digestible DM fraction tended (P < .10) to decline linearly with increasing magnesium-mica level, but DM digestion lag and rate were not affected (P < .10) by magnesium-mica level. The digestible crude protein fraction of soybean meal tended (P < .10) to respond quadratically to increasing magnesium-mica level, and crude protein digestion lag responded (P < .05) cubically.

The primary benefit of including magnesium-mica in the diet of heifers consuming prairie hay appeared to be on the organic constituents of the diet. Although many of the measurements were not significant, a consistent beneficial pattern was apparent from the supplement containing 2.5% magnesium-mica. When compared with cows on the control diet, cows offered this supplement had slightly improved DM, OM, and ADF digestion; greater ruminal ammonia; slightly higher total VFA concentrations; and somewhat reduced acetic and increased propionic acid molar concentrations, resulting in an improved acetic to propionic acid ratio. These combined factors, although not statistically significant, are somewhat similar to those that might be achieved by using commercially available ionophores (monensin, lasalocid, etc.). The lowest inclusion rate of magnesium-mica also numerically improved the in situ digestible NDF fraction and the rate of in situ DM disappearance and reduced in situ crude protein lag time, while increasing the crude protein digestible fraction. Again, many of these differences were not statistically significant, and, therefore, from a scientific standpoint, cannot be emphasized. However, considering the combination of these factors, magnesium-mica appears to have beneficial effects on forage digestion that could translate into enhanced cattle performance.

Table 1. Composition of Supplements Offered to Cows

| Ingredient | Magnesium-Mica Level in Supplement, % | | | |
|---|---|---|---|---|
| | 0.0 | 2.5 | 6.25 | 10 |
| | % | | | |
| Grain sorghum | 26.5 | 24.02 | 21.70 | 17.13 |
| Wheat middlings | 62.5 | 62.5 | 62.5 | 62.5 |
| Soybean meal | 1.3 | 1.98 | 1.65 | 3.625 |
| Soybean oil | 1.0 | 1.0 | 1.0 | 1.0 |
| Urea | 2.25 | 2.25 | 2.25 | 2.25 |
| TM premix[a] | .2 | .163 | .12 | .075 |
| Limestone | 0.0 | .050 | .050 | 0.0 |
| Dicalcium phosphate | .5 | .5 | .40 | .375 |
| NaCl | 2.425 | 2.4 | 2.425 | 2.40 |
| Vit. A,D,E premix[b] | .625 | .625 | .625 | .625 |
| Magnesium-mica | 0.0 | 2.50 | 6.25 | 10.0 |
| $FeCO_3$ | .9 | .675 | .35 | 0.0 |
| $CuSO_4$ | .0275 | .0275 | .025 | .025 |
| $CoSO_4$ | .0225 | .0175 | .0075 | 0.0 |
| MgO | 1.375 | 1.025 | .50 | 0.0 |
| KCl | .375 | .275 | .150 | 0.0 |

[a]Contains 4% Zn, 2% Mn, 2% Fe, .16% Cu, .04% Co in 85% min. NaCl.
[b]Contains 1,000,000 IU/lb Vit. A, 500,000 IU/lb Vit. D, and 1,000 IU/lb Vit. E.

Table 2. Intake and Digestibility of Prairie Hay Diets by Cows Offered Supplements Containing Different Levels of Magnesium-Mica

| Item | Magnesium-Mica Level in Supplement, % | | | | SE |
|---|---|---|---|---|---|
| | 0.0 | 2.5 | 6.25 | 10 | |
| DM intake, lb/d | 21.8 | 22.1 | 22.0 | 22.2 | .26 |
| DM intake, % BW | 2.0 | 2.0 | 1.9 | 2.0 | .03 |
| DM digestion, %[†‡] | 52.9[ab] | 53.7[a] | 51.9[b] | 52.4[b] | .31 |
| OM digestion, %[§] | 56.0[ab] | 56.9[a] | 55.3[b] | 56.2[ab] | .28 |
| NDF digestion, %[‡] | 53.5 | 53.9 | 52.4 | 53.8 | .40 |
| ADF digestion, %[‡] | 50.6 | 51.3 | 50.0 | 51.5 | .40 |
| Hemicellulose digest, % | 56.4 | 56.6 | 54.7 | 56.0 | .59 |
| Water consumption, gal. | 8.4 | 8.2 | 8.1 | 8.4 | .23 |

[†]Linear effect of increasing magnesium-mica levels ($P < .10$).
[‡]Cubic effect of increasing magnesium-mica levels ($P < .05$).
[§]Cubic effect of increasing magnesium-mica levels ($P < .01$).
[ab]Means within the same row without a common superscript letter differ ($P < .05$).

Table 3. Nitrogen Balance of Cows Offered Prairie Hay Diets Supplemented with Different Levels of Magnesium-Mica[†]

| | Magnesium-Mica Level in Supplement, % | | | | |
|---|---|---|---|---|---|
| Item | 0.0 | 2.5 | 6.25 | 10 | SE |
| N intake, g/d | 146.4 | 145.3 | 139.6 | 144.3 | 1.96 |
| N digested, g/d | 71.4 | 69.9 | 66.8 | 69.2 | 1.58 |
| N digested, % | 48.8 | 48.0 | 47.8 | 48.0 | .70 |
| N retained, g/d | 21.0 | 17.2 | 16.8 | 16.8 | 3.11 |
| N retained, % of N intake | 14.3 | 11.7 | 11.6 | 11.7 | 1.99 |
| N retained, % of digested N | 29.3 | 24.1 | 23.6 | 23.8 | 3.88 |

[†]No significant (P < .10) differences were detected.

Table 4. Rumen Fill and Passage Rate of Cows Offered Prairie Hay Diets Supplemented with Different Levels of Magnesium-Mica[†]

| | Magnesium-Mica Level in Supplement, % | | | | |
|---|---|---|---|---|---|
| Item | 0.0 | 2.5 | 6.25 | 10 | SE |
| Fresh fill, lb | 141.8 | 142.4 | 141.2 | 140.7 | 4.65 |
| DM fill, lb | 21.9 | 21.1 | 21.7 | 21.6 | 1.01 |
| DM fill, % BW | 2.0 | 1.9 | 1.9 | 1.9 | .09 |
| OM fill, lb | 19.8 | 18.9 | 19.4 | 19.2 | .90 |
| OM fill, % BW | 1.8 | 1.7 | 1.7 | 1.7 | .08 |
| Ash fill, lb | 2.1 | 2.2 | 2.2 | 2.4 | .12 |
| Indigest. ADF fill, lb | 6.0 | 5.9 | 6.1 | 6.0 | .30 |
| Rumen turnover, h | 37.5 | 36.3 | 36.8 | 35.7 | 1.44 |
| Passage rate, %/h | 2.8 | 2.9 | 2.7 | 2.9 | .12 |

[†]No significant differences were detected (P < .05).

Table 5. Ruminal Ammonia, pH, and Volatile Fatty Acid (VFA) Concentrations from Cows Offered Prairie Hay Diets Supplemented with Different Levels of Magnesium-Mica

| | Magnesium-Mica Level in Supplement, % | | | | |
|---|---|---|---|---|---|
| Item | 0.0 | 2.5 | 6.25 | 10 | SE |
| Ruminal ammonia, mg/dl | 6.5[c] | 7.1[b] | 6.9[bc] | 7.8[a] | .14 |
| Ruminal pH | 7.1[d] | 7.1[d] | 7.1[d] | 7.0[e] | .02 |
| Total VFA, µmole | 60.2 | 64.9 | 61.0 | 65.9 | 2.19 |
| | ---------------------- mole/ 100 mole ---------------------- | | | | |
| Acetic | 71.9 | 70.2 | 69.6 | 72.4 | 1.66 |
| Propionic | 14.6 | 16.5 | 15.4 | 15.6 | .74 |
| Isobutyric | .6 | 1.0 | .7 | .7 | .19 |
| Butyric | 11.6 | 10.7 | 12.9 | 10.1 | 1.09 |
| Isovaleric | .6 | .7 | .7 | .4 | .12 |
| Valeric | .6 | .9 | .8 | .7 | .15 |
| Acetic:propionic | 5.4 | 4.7 | 5.0 | 4.9 | .33 |

[a,b,c]Means within the same row without a common superscript letter differ ($P < .05$).
[d,e]Means within the same row without a common superscript letter differ ($P < .10$).

Table 6. Ruminal Protozoa Counts ($10^3$/g) from Cows Offered Prairie Hay Diets Supplemented with Different Levels of Magnesium-Mica[†]

| | Magnesium-Mica Level in Supplement, % | | | | |
|---|---|---|---|---|---|
| Item | 0.0 | 2.5 | 6.25 | 10 | SE |
| | ------------------------- $10^3$/g ------------------------- | | | | |
| *Isotricha* | 6.7 | 5.8 | 5.5 | 6.6 | .56 |
| *Dasytricha* | 8.2 | 8.2 | 8.6 | 9.0 | .86 |
| *Charon* | 16.7 | 16.6 | 16.3 | 11.4 | 3.24 |
| *Microcetus* | 3.0 | 1.5 | .8 | 1.8 | .71 |
| *Entodinia* | 109.6 | 114.4 | 146.4 | 121.0 | 18.11 |
| *Diplodinium* | 11.0 | 8.3 | 9.5 | 11.7 | 3.55 |
| *Eudipoldinium* | 5.3 | 4.0 | 5.2 | 4.0 | 1.55 |
| *Metadinium* | 2.3 | 13.3 | 3.6 | 2.2 | 4.89 |
| *Ostracodinium* | 8.3 | 7.7 | 10.4 | 11.3 | 1.11 |
| *Epidinium* | .3 | 1.5 | 1.4 | 5.5 | 1.71 |
| *Polyplastron* | 1.1 | 1.1 | .5 | 1.0 | .25 |
| *Holotrichia* | 14.9 | 14.0 | 14.1 | 15.5 | 1.16 |
| Total | 172.6 | 172.8 | 208.3 | 185.4 | 20.25 |

[†]No significant ($P < .10$) differences were detected.

Table 7. Disappearance of Prairie Hay Dry Matter and Neutral Detergent Fiber from Nylon Bags Suspended in the Rumen of Cows Offered Prairie Hay Diets Supplemented with Different Levels of Magnesium-Mica

| | Magnesium-Mica Level in Supplement, % | | | | |
|---|---|---|---|---|---|
| Item | 0.0 | 2.5 | 6.25 | 10 | SE |
| Incubation time | --------------- DM disappearance, % --------------- | | | | |
| 6 | 8.6 | 7.4 | 6.4 | 7.4 | 1.12 |
| 12 | 17.9 | 18.3 | 21.3 | 18.0 | 1.63 |
| 18 | 29.7 | 30.7 | 32.5 | 28.3 | 2.02 |
| 24 | 39.8 | 39.8 | 42.7 | 37.3 | 2.84 |
| 48 | 61.1 | 62.1 | 61.6 | 58.7 | 1.10 |
| 72† | 67.6 | 69.2 | 68.3 | 66.6 | .73 |
| 96 | 71.4 | 71.4 | 71.8 | 70.8 | .32 |
| | --------------- NDF disappearance, % --------------- | | | | |
| 6 | 6.3 | 6.7 | 6.5 | 5.7 | .66 |
| 12 | 16.2 | 18.0 | 20.7 | 17.0 | 1.70 |
| 18 | 28.6 | 30.8 | 32.8 | 27.8 | 2.20 |
| 24 | 39.9 | 40.1 | 43.5 | 37.6 | 3.19 |
| 48 | 61.9 | 62.6 | 62.7 | 60.1 | 1.53 |
| 72† | 68.9 | 70.7 | 69.8 | 68.2 | . 7 8 |
| 96† | 72.6 | 73.4 | 73.0 | 72.4 | .36 |
| DM | | | | | |
| $f_d$, %‡ | 51.4 | 51.6 | 50.8 | 52.0 | .97 |
| $f_i$, %§ | 18.5 | 18.1 | 18.9 | 17.4 | .90 |
| $f_s$, %¶ | 30.2 | 30.3 | 30.3 | 30.6 | .19 |
| $k_d$, $h^{-1}$ # | .042 | .053 | .042 | .034 | .0081 |
| lag, h†† | 4.6 | 6.2 | 3.5 | 4.3 | 1.00 |
| NDF | | | | | |
| $f_d$, %‡ | 69.4 | 72.7 | 69.8 | 72.0 | 1.39 |
| $f_i$, %§ | 24.4 | 21.5 | 24.3 | 21.8 | 1.20 |
| $f_s$, %¶ | 6.2 | 5.8 | 5.9 | 6.2 | .39 |
| $k_d$, $h^{-1}$ # | .046 | .038 | .043 | .034 | .0050 |
| lag, h†† | 6.5 | 4.6 | 3.8 | 4.9 | .66 |

†Quadratic effect of level of magnesium-mica ($P < .10$).
‡Potentially digestible fraction.
§Indigestible fraction.
¶Soluble fraction.
#Fractional digestion rate constant.
††Digestion lag time.

Table 8. Disappearance of Soybean Meal Dry Matter and Crude Protein from Nylon Bags Suspended in the Rumen of Cows Offered Prairie Hay Diets Supplemented with Different Levels of Magnesium-Mica

| | Magnesium-Mica Level in Supplement, % | | | | |
|---|---|---|---|---|---|
| Item | 0.0 | 2.5 | 6.25 | 10 | SE |
| Incubation time | --------------- DM disappearance, % --------------- | | | | |
| 2 | 9.9 | 9.5 | 9.2 | 10.1 | 1.14 |
| 4 | 22.7 | 23.1 | 23.0 | 24.2 | .81 |
| 8 | 53.3 | 55.3 | 52.3 | 50.8 | 2.03 |
| 12 | 77.5 | 73.1 | 75.9 | 74.4 | 2.05 |
| 24† | 95.8 | 95.3 | 95.5 | 94.6 | .35 |
| | --------------- CP disappearance, % --------------- | | | | |
| 2 | 16.8 | 18.5 | 16.0 | 17.7 | 1.92 |
| 4 | 31.2 | 32.8 | 33.5 | 33.6 | 2.09 |
| 8 | 61.4 | 65.7 | 62.9 | 62.4 | 3.45 |
| 12 | 86.5 | 81.8 | 85.3 | 83.5 | 2.10 |
| 24 | 99.2 | 98.7 | 99.1 | 98.8 | .49 |
| DM | | | | | |
| $f_d$, %†‡ | 62.6 | 62.4 | 62.5 | 61.7 | .26 |
| $k_d$, $h^{-1}$ § | .12 | .11 | .12 | .11 | .013 |
| lag, h ¶ | 1.7 | 1.3 | 1.7 | 1.4 | .30 |
| Crude protein | | | | | |
| $f_d$, %‡# | 79.9 | 81.6 | 80.8 | 80.2 | .55 |
| $k_d$, $h^{-1}$ § | .14 | .13 | .16 | .13 | .013 |
| lag, h¶†† | 1.3 | .7 | 1.4 | .7 | .24 |

†Linear effect of level of magnesium-mica (P < .10).
‡Potentially digestible fraction.
§Fractional digestion rate constant.
¶Digestion lag time.
#Quadratic effect of level of magnesium-mica (P < .05).
††Cubic effect of level of magnesium-mica (P < .10).

# ALFALFA VARIETY PERFORMANCE IN SOUTHEASTERN KANSAS

Joseph L. Moyer

## Summary

Alfalfa yields for 1993 included five cuttings. For the year, DK 135 yielded less than nine other cultivars. Over the 3-year period, Garst 636 has tended to produce more than 'Riley'.

## Introduction

The importance of alfalfa as a feed crop and/or cash crop has increased in recent years. The worth of a particular variety is determined by many factors, including its pest resistance, adaptability, longevity under specific conditions, and productivity.

## Experimental Procedures

The 15-line test was seeded (12 lb/a) in April, 1990 at the Mound Valley Unit. Plots were fertilized with 20-50-200 lb/a of $N$-$P_2O_5$-$K_2O$ on 11 March, 1993. Five harvests were obtained this year. Growing conditions were generally favorable (see weather summary): a bit wet in May and early June and somewhat dry by the fourth cutting for optimum growth. No particular insect or disease problems were noted.

## Results and Discussion

Forage yields of each of the five cuttings, total 1993 production, and 4-year totals are shown in Table 1.

Cut 1 yield was higher from 630 than from DK 135, Riley, or WL-320. Cut 4 yield of WL-320 was higher than that of six other cultivars, including 636. 'Apollo Supreme' was most consistent in 1993, ranking among the top five entries in yield for four of the five cuttings and first in total production. Riley and DK 135 yielded less in 1993 than all other cultivars. After 4 years of testing, yields of the highest and lowest ranking cultivars were separated by more than 11 percentage points (2.4 tons).

Table 1. Forage Yields of the Alfalfa Variety Test in 1992, Mound Valley Unit, Southeast Kansas Branch Experiment Station

| Source | Variety | 1993 | | | | | 4-Yr | |
|---|---|---|---|---|---|---|---|---|
| | | 5/21 | 6/17 | 7/20 | 8/20 | 11/2 | Total | Total |
| | | - - - - - - - - - - - - - - - - - - - - tons/a @ 12% moisture - - - - - - - - - - - - - - - - - - - - | | | | | | |
| ICI (Garst) | 636 | 1.82ab[a] | 1.57a | 1.42a | 0.78bcd | 1.16abcd | 6.76a | 23.51a |
| Dairyland | Magnum III | 1.89ab | 1.56a | 1.44a | 0.87ab | 1.15bcd | 6.92a | 23.43a |
| Cargill | Trident II | 1.80ab | 1.62a | 1.48a | 0.78bcd | 1.26abc | 6.94a | 23.41a |
| Garst | 630 | 1.92a | 1.62a | 1.43a | 0.82abc | 1.14bcd | 6.94a | 23.23a |
| America's Alfalfa | Apollo Supreme | 1.85ab | 1.60a | 1.42a | 0.87ab | 1.21abc | 6.94a | 23.18a |
| Pioneer | 5364 | 1.88ab | 1.54ab | 1.44a | 0.81abc | 1.12bcd | 6.79a | 23.18a |
| Pioneer | 5472 | 1.82ab | 1.62a | 1.30ab | 0.89ab | 1.09cd | 6.72a | 22.92a |
| W-L Research | WL 317 | 1.82ab | 1.48abc | 1.46a | 0.86ab | 1.18abcd | 6.81a | 22.88a |
| Agripro | Dart | 1.76abc | 1.56ab | 1.33ab | 0.80abc | 1.21abc | 6.65a | 22.82a |
| Agripro | Ultra | 1.73abcd | 1.41abcd | 1.30ab | 0.70cde | 1.29ab | 6.42a | 22.79a |
| W-L Research | WL 320 | 1.64bcd | 1.45abcd | 1.38a | 0.93a | 1.20abc | 6.60a | 22.48ab |
| Pioneer | 5432 | 1.72abcd | 1.56a | 1.39a | 0.80abc | 1.02d | 6.49a | 22.30abc |
| Great Plains Res. | Cimarron VR | 1.65abcd | 1.31bcd | 1.33ab | 0.70cde | 1.33a | 6.32a | 22.10abc |
| DeKalb | DK 135 | 1.48d | 1.26cd | 1.13bc | 0.63e | 1.16abcd | 5.66b | 21.38bc |
| KS AES & USDA | Riley | 1.53cd | 1.22d | 1.07c | 0.66de | 1.02d | 5.49b | 21.11c |
| | Average | 1.75 | 1.49 | 1.36 | 0.79 | 1.17 | 6.56 | 22.71 |
| | LSD(.05) | 0.23 | 0.22 | 0.20 | 0.12 | 0.15 | 0.54 | 1.21 |

[a]Means within a column followed by the same letter do not differ (P = .05) according to Duncan's test.

# FORAGE PRODUCTION OF TALL FESCUE VARIETIES IN SOUTHEASTERN KANSAS

Joseph L. Moyer

## Summary

In the seventh harvest year of the test, Ky 31, Mo-96, and 'Phyter' yielded more first-cut forage than 'Stef', 'AU Triumph', and 'Kenhy'. For the year, Ky 31 and Mo-96 again produced more forage than Stef, AU Triumph, and Kenhy under hay management. Under a six-clipping system, Stef and Kenhy produced less than seven other cultivars. Over the 7 years of the test, Phyter averaged more forage production than Stef, 'Johnstone', and AU Triumph.

## Introduction

Tall fescue is the most widely grown forage grass in southeastern Kansas. New and old cultivars were compared for agronomic adaptation and forage quality, because effects of a variety chosen for a new seeding will be apparent for as long as the stand exists.

## Experimental Procedures

Plots were seeded on 4 September, 1986 at 20 lb/a at the Mound Valley Unit, ostensibly with seed free of *Acremonium coenophialum* endophyte. Plots were 30 x 7.5 ft each, in four randomized complete blocks. Application of 160-50-57 lb/a of N-$P_2O_5$-$K_2O$ was made on 9 March, 1993, followed by fertilization with 60 lb/a of N on 28 September, 1993. Plots 15'x 3' were cut on 26 May, 28 September, and 25 October, 1993. Subsamples from the first cutting were collected for determinations of moisture, fiber, and crude protein. Forage crude protein and neutral-detergent fiber (NDF) data from three cuttings taken in 1992 are reported. A 10'x 7.5' subplot of each plot was measured with a disk meter for yield estimation before those harvests, plus an additional five clippings.

## Results and Discussion

AU Triumph and 'Fawn', headed significantly earlier than seven other cultivars in 1993 (Table 1). Mo-96, 'Festorina', Kenhy, Ky 31, and Johnstone headed significantly later than six other cultivars.

Ky 31, Mo-96, and Phyter yielded significantly more in cut 1 than Stef, AU Triumph, and Kenhy (Table 1). Weeds tended to encroach during the summer of 1993, so the September cutting was disregarded. The October harvest produced little forage with no significant differences between cultivars (data not shown). Relative values for total 1993 production were similar to Cut 1 yields. Ky 31, Mo-96, and Phyter produced more forage than Stef, AU Triumph, and Kenhy under hay management. Seven-year average production was significantly higher from Phyter than from Stef, Johnstone, and AU Triumph.

Intensive clipping in 1993 caused few differences in relative productivity among the cultivars (Table 1). Stef and Kenhy produced less than seven other cultivars.

Forage crude protein contents for the three cuttings in 1992 are listed in Table 2. In Cut 1, Stef forage was higher in crude protein than forage of Festorina and Fawn. However, in the second and third cuttings, Stef forage ranked lowest in crude protein, mostly because of weed invasion. Other relative trends among cultivar protein content appeared minor and inconsistent across cuttings.

Neutral-detergent fiber contents also are shown in Table 2. Eight cultivars had lower first-cut NDF contents than Mozark. Generally, later-heading cultivars were lower in NDF than earlier cultivars. In subsequent cuttings, Festorina, Phyter, and Mo-96 forage had lowest NDF's, whereas Kenhy and Fawn tended to have higher NDF contents.

Table 1. Heading date and Forage Yield of Tall Fescue Varieties, Mound Valley Unit, Southeast Kansas Branch Experiment Station

| Variety | Heading Date[a] | 1993 Yield Clip[b] | 1993 Yield Cut 1(5/26) | 1993 Yield Total | 6-Year Average |
|---|---|---|---|---|---|
| | - - - - - - - - - - - - - - - - - tons/a @ 12% moisture - - - - - - - - - - - - - - - - - | | | | |
| Phyter | 127.0bc[c] | 5.34a | 4.28ab | 4.79ab | 6.78a |
| Festorina | 129.5ab | 5.40a | 4.19abc | 4.82ab | 6.63ab |
| Mozark | 124.8cd | 5.01ab | 3.73bcd | 4.40abc | 6.47abc |
| Mo-96 | 130.8a | 5.32a | 4.28ab | 4.90a | 6.54ab |
| Martin | 124.5cd | 5.18a | 3.92abcd | 4.55abc | 6.48abc |
| Ky-31 | 129.0ab | 5.27a | 4.42a | 4.94a | 6.50abc |
| Kenhy | 129.2ab | 4.50b | 3.65cd | 4.21bc | 6.39abc |
| Forager | 123.8d | 5.01ab | 3.97abcd | 4.52abc | 6.33abc |
| Fawn | 124.5cd | 5.42a | 4.12abc | 4.82ab | 6.31abc |
| Cajun | 124.5cd | 5.35a | 3.87abcd | 4.60abc | 6.23abc |
| AU Triumph | 123.8d | 5.00ab | 3.51de | 4.15c | 6.05bc |
| Johnstone | 128.8ab | 4.84ab | 3.94abcd | 4.44abc | 5.94c |
| Stef | 127.0bc | 3.73c | 3.03e | 3.48d | 5.30d |
| Average | 126.7 | 5.03 | 3.92 | 4.51 | 6.30 |
| LSD(.05) | 2.4 | 0.55 | 0.53 | 0.53 | 0.50 |

[a]Julian day when heads first appeared. (Day 120 = 30 April).
[b]Sum of disk meter yield estimates taken prior to each of five clippings.
[c]Means within a column followed by the same letter are not significantly ($P \leq .05$) different, according to Duncan's test.

**Table 2. Crude Protein and Neutral-Detergent Fiber Concentrations of 1992 Forage for Tall Fescue Varieties at the Mound Valley Unit, Southeast Kansas Branch Experiment Station**

| Variety | Crude Protein Cut 1 | Crude Protein Cut 2 | Crude Protein Cut 3 | Neutral-Detergent Fiber Cut 1 | Neutral-Detergent Fiber Cut 2 | Neutral-Detergent Fiber Cut 3 |
|---|---|---|---|---|---|---|
| | % | | | | | |
| Kenhy | 10.5ab[a] | 8.7cd | 7.5cdef | 64.7b | 67.6ab | 62.8ab |
| Johnstone | 10.0ab | 9.7abcd | 8.3a | 66.4ab | 66.3ab | 62.1abc |
| Stef | 10.9a | 8.5d | 7.2f | 63.6b | 66.6ab | 64.4a |
| Mo-96 | 9.7ab | 10.5a | 7.6bcdef | 63.3b | 65.0b | 59.6bc |
| Phyter | 9.4ab | 9.8abcd | 7.9abcde | 65.2b | 64.8b | 59.2bc |
| Ky-31 | 9.5ab | 8.8bc | 7.7abcdef | 65.3b | 67.0ab | 61.5abc |
| Festorina | 9.1b | 10.6a | 7.6bcdef | 65.3b | 64.3b | 58.5c |
| Cajun | 9.5ab | 10.0abc | 7.4ef | 67.8ab | 65.7ab | 60.4bc |
| AU Triumph | 9.8ab | 9.6abcd | 7.4def | 64.5b | 69.6a | 60.4bc |
| Mozark | 9.6ab | 9.6abcd | 7.7abcdef | 71.6a | 67.0ab | 60.9abc |
| Fawn | 9.1b | 9.8abcd | 8.1abc | 66.1ab | 67.2ab | 62.6ab |
| Martin | 9.7ab | 10.2ab | 8.2ab | 67.3ab | 65.6ab | 63.0ab |
| Forager | 9.4ab | 9.8abcd | 8.1abcd | 65.4b | 67.6ab | 59.9bc |
| Average | 9.7 | 9.7 | 7.7 | 65.9 | 66.5 | 61.2 |
| LSD(.05) | NS | 1.2 | 0.6 | NS | NS | 3.2 |

[a]Means within a column followed by the same letter are not significantly ($P \leq .05$) different, according to Duncan's test.

# FORAGE PRODUCTION OF BERMUDAGRASS CULTIVARS IN SOUTHEASTERN KANSAS

Joseph L. Moyer and Charles M. Taliaferro[1]

## Summary

In the second harvest year of the test, experimental LCB84 X 9-45 yielded more first-cut forage than 13 other cultivars, including all four named varieties. Total 1993 production was higher from that same experimental and LCB84 X 16-66 than from 10 other cultivars.

## Introduction

Bermudagrass can be a high-producing warm-season perennial forage for southeastern Kansas. Producers have profitted considerably from the replacement of the common bermudas with the variety 'Midland'. Developments in bermudagrass breeding should be monitored closely to speed adoption of improved types.

## Experimental Procedures

Plots were sprigged with plants in peat pots on 28 June, 1991 at the Mound Valley Unit. Plots were 15'x 20' each, in four randomized complete blocks. Application of 161-54-61 lb/a of N-$P_2O_5$-$K_2O$ was made on 17 June, 1993, followed by fertilization with 58 lb/a of N on 23 July. Plots 20'x 3' were cut on 17 June, 23 July, and 20 August, 1993. Subsamples were collected for determination of moisture.

## Results and Discussion

In the first cutting, Experimental LCB84 X 9-45 yielded more forage than 13 other cultivars, including Midland, 'Greenfield', 'Tifton 44', and 'Hardie' (Table 1). Six experimentals produced more first-cut forage than seven other cultivars, including all named cultivars except Hardie.

In the second cutting, LCB84 X 9-45, two other experimentals, and Hardie produced more forage than eight other cultivars, including Midland and Greenfield. One experimental that yielded well in the second cutting, 74 X 12-12, also ranked highest in cut 3 forage yield. It and LCB84 X 15-49 produced more in the third cutting than 16 other cultivars.

Total 1993 production was higher from LCB84 X 9-45 and LCB84 X 16-66 than from 10 other cultivars. Those two highest-yielding experimentals ranked in the top four in Cut 1 and in the top three in Cut 2 but finished no better than sixth in Cut 3. Conversely, 74 X 12-12, the third-ranked overall forage-producing cultivar, yielded relatively poorly in Cut 1, but ranked second in Cut 2 and first in Cut 3 as conditions became warmer and drier.

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[1]Department of Agronomy, Oklahoma State University, Stillwater.

Table 1. Bermudagrass 1993 Forage Yield, Mound Valley Unit, Southeast Kansas Branch Experiment Station

| Cultivar | Cut 1 | Cut 2 | Cut 3 | Total |
|---|---|---|---|---|
| | - - - - - - - - - - tons/a @ 12% moisture - - - - - - - - - - | | | |
| LCB84 X 9-45 | 3.35a[a] | 1.26abc | 1.76bcd | 6.38a |
| LCB84 X 16-66 | 3.09ab | 1.44a | 1.78bcd | 6.31a |
| 74 X 12-12 | 2.61def | 1.34ab | 2.18a | 6.12ab |
| LCB84 X 19-16 | 2.98abcd | 1.05cde | 2.02ab | 6.04ab |
| LCB84 X 15-49 | 3.00abc | 0.95def | 2.09a | 6.04ab |
| Hardie | 2.93bcd | 1.26abc | 1.78bcd | 5.96ab |
| LCB84 X 12-28 | 3.07ab | 1.12cd | 1.75cd | 5.94ab |
| 74 X 11-2 | 2.88bcde | 1.22bc | 1.80bcd | 5.90ab |
| LCB84 X 14-31 | 3.14ab | 1.15bcd | 1.60def | 5.88abc |
| LCB84 X 19-31 | 2.63cdef | 1.15bcd | 1.96abc | 5.74abcd |
| LCB84 X 19-23 | 2.84bcde | 1.05cde | 1.65de | 5.54bcd |
| LCB84 X 21-57 | 2.79bcde | 1.11cd | 1.34gh | 5.24cde |
| Tifton 44 | 2.29fg | 1.23bc | 1.71cde | 5.22cde |
| LCB84 X 15-26 | 3.09ab | 0.96def | 1.06i | 5.10def |
| LCB84 X 18-62 | 2.27fg | 0.97def | 1.38fg | 4.62efg |
| 74 X 12-6 | 2.02g | 0.89efg | 1.70cde | 4.60efg |
| Greenfield | 2.51ef | 0.90efg | 1.13hi | 4.54fg |
| Midland | 2.14g | 0.78fg | 1.48efg | 4.40g |
| LCB84 X 16-55 | 2.61cdef | 0.70g | 0.97i | 4.28g |
| World Feeder | 2.43efg | 0.75fg | 0.94i | 4.11g |
| Average | 2.75 | 1.08 | 1.64 | 5.47 |
| LSD(.05) | 0.33 | 0.19 | 0.23 | 0.59 |

[a]Means within a column followed by the same letter are not significantly ($P \leq .05$) different, according to Duncan's test.

# HAY PRODUCTION OF WARM-SEASON ANNUAL GRASSES

Joseph L. Moyer

## Summary

Sudan-type grasses were evaluated from three cuttings for hay production and quality. Twenty-five entries, including five millets, were evaluated for yield, crude protein content, leaf:stem ratio, and fiber contents. Millets yielded about 67% as much as sorghum-sudans, but first-cut forage had 173% greater leaf:stem ratio and more than 3 percentage points higher crude protein content. Differences for each trait were found within each species group.

## Introduction

A hay test of warm-season annuals, which included yield and quality evaluations, was offered in 1993 for commercial entrants on a fee basis. Check and/or public lines were added to the 16 commercial entries to make 25 entries, five of them millets.

## Experimental Procedures

The test was seeded in 30' by 5' (six 10-in rows) plots at the rate of 450,000 live seeds/a, replicated four times in a randomized complete block, on 2 June, 1993 at the Mound Valley Unit. Plots were fertilized preplant with 150-60-80 lb/a of N-$P_2O_5$-$K_2O$, and with 60 lb/a of N after the first cut. Three harvests were obtained, on 22 July, 19 August, and 11 October. The first harvest was delayed to the head emergence stage because of wet conditions. Growing conditions (see weather summary) were wet in May and early June and somewhat dry by late August-early September. No particular insect or disease problems were noted.

## Results and Discussion

Forage yields of each of the three cuttings and total 1993 production are shown in Table 1. In Cut 1, Regro H-22B and 'Grazex' produced more forage than ten other sorghum types. H-100 millet yielded more than all other millets and not significantly less than the top producers.

Regrowth (Cut 2) was significantly better for the sudangrasses, HS 35 and 'Piper', and for EX 4 than for the five millets, Greenleaf sudangrass, and seven sorghum crosses. In Cut 3, Piper and five sorghum crosses yielded more than the five millets, Greenleaf, and two sorghum crosses.

Annual yield was significantly higher for Tx623A X Ga337, 'Grazex', H-22B, and X 9293 than for the five millets, two sudangrasses, and two sorghum-sudan crosses.

Table 2 shows leaf:stem ratios of Cut 1. Three of the millet cultivars had significantly greater leaf:stem ratio than all but one sudan-sorghum cultivar. However, the millet with the highest leaf:stem ratio yielded significantly less than all other cultivars except 'Greenleaf'.

Table 2 also shows crude protein contents of Cut 1. Whole-plant protein of 'Tifleaf 2' millet was significantly higher than that of all other entries. As a group, the millets averaged 13.1% protein content for first-cut forage, whereas all sorghum types averaged 9.6%. Cultivars of the sorghum types ranged from 11.0 to 8.8% crude protein, but none of the differences were statistically significant.

Table 1. Production of Summer Annual Grasses Grown for Hay in 1993, Mound Valley Unit, Southeast Branch Experiment Station

| Source/Brand | Entry | Type | Cut 1[a] | Cut 2 | Cut 3[a] | Total[a] |
|---|---|---|---|---|---|---|
| | | | - - tons/a @ 12% moisture - - | | | |
| Agri-Genetics/Growers' | Feast | SX | 4.08 | 1.98 | 1.91 | 7.97 |
| | Total | SX | 4.07 | 1.36 | 1.58 | 7.01 |
| /Oro Hybrids | Kow Kandy | SX | 4.16 | 2.04 | 1.81 | 8.00 |
| Cargill | HS 35 | S | 3.19 | 2.30 | 1.89 | 7.38 |
| | Sweet Sioux V | SX | 4.69 | 1.70 | 2.06 | 8.45 |
| Dekalb Plant Genetics | ST-6E | SX | 4.10 | 1.80 | 1.97 | 7.88 |
| | X-0086 | SX | 4.56 | 1.66 | 2.12 | 8.36 |
| | SX-15 | SX | 4.52 | 1.58 | 2.42 | 8.45 |
| J. C. Robinson/Golden Harvest | H-100 | M | 4.35 | 0.56 | 1.33 | 6.24 |
| | Regro EX 4 | SX | 4.08 | 2.15 | 1.83 | 8.06 |
| | Regro H-22B | SX | 4.96 | 1.90 | 1.80 | 8.67 |
| | Si-gro H-1 | SX | 3.87 | 1.19 | 1.42 | 6.47 |
| Northrup-King/N-K | X 9293 | SX | 4.76 | 1.97 | 1.89 | 8.62 |
| Sharp Bros./Buffalo Brand | Grazex | SX | 4.83 | 2.04 | 1.82 | 8.68 |
| | Grazex II | SX | 4.25 | 1.90 | 2.13 | 8.28 |
| Taylor-Evans/T-E | Haygrazer II | SX | 4.33 | 1.81 | 1.92 | 8.07 |
| USDA - ARS, GA | Exp. #1 | M | 2.86 | 0.72 | 1.33 | 4.90 |
| | Exp. #2 | M | 3.42 | 0.99 | 1.57 | 5.99 |
| | Tifleaf 1 | M | 3.18 | 0.80 | 1.35 | 5.33 |
| | Tifleaf 2 | M | 2.48 | 0.72 | 1.24 | 4.44 |
| | Tx623A X Ga337 | SX | 4.62 | 1.93 | 2.28 | 8.96 |
| | Tx623A XDwGa337 | SX | 3.81 | 1.91 | 2.21 | 7.86 |
| Richardson's Seed | Greenleaf | S | 2.85 | 1.78 | 1.61 | 6.23 |
| Timken Seed Co. | NB 280-S | SX | 4.14 | 2.06 | 1.96 | 8.16 |
| | Piper | S | 4.02 | 2.21 | 2.30 | 8.53 |
| | Average | | 3.99 | 1.64 | 1.82 | 7.44 |
| | $LSD_{.05}$ | | 0.69 | 0.31 | 0.47 | 1.24 |

[a]Least-square means calculated because of missing plots.

Table 2. Forage Quality of the First Cutting of Summer Annual Grasses Grown for Hay in 1993, Mound Valley Unit, Southeast Branch Experiment Station

| Source/Brand | Entry | Leaf:Stem[a] | Forage Crude Protein Leaf | Forage Crude Protein Stem | Forage Crude Protein Whole-Plant |
|---|---|---|---|---|---|
| | | | --------- % --------- | | |
| Agri-Genetics/Growers' | Feast | 0.53 | 17.4 | 5.8 | 9.7 |
| | Total | 0.57 | 15.5 | 6.1 | 9.5 |
| /Oro Hybrids | Kow Kandy | 0.54 | 17.6 | 6.7 | 10.4 |
| Cargill | HS 35 | 0.44 | 17.8 | 6.7 | 10.0 |
| | Sweet Sioux V | 0.58 | 16.0 | 5.6 | 9.4 |
| Dekalb Plant Genetics | ST-6E | 0.65 | 15.9 | 5.8 | 9.7 |
| | X-0086 | 0.58 | 15.0 | 5.2 | 8.8 |
| | SX-15 | 0.47 | 15.2 | 5.2 | 8.9 |
| J. C. Robinson/Golden Harvest | H-100 | 0.83 | 15.7 | 7.1 | 11.0 |
| | Regro EX 4 | 0.53 | 16.8 | 5.8 | 9.6 |
| | Regro H-22B | 0.52 | 16.2 | 5.1 | 8.9 |
| | Si-gro H-1 | 0.51 | 16.9 | 6.2 | 9.7 |
| Northrup-King/N-K | X 9293 | 0.57 | 16.1 | 5.3 | 9.1 |
| Sharp Bros./Buffalo Brand | Grazex | 0.46 | 16.9 | 5.9 | 9.3 |
| | Grazex II | 0.50 | 17.0 | 5.1 | 9.1 |
| Taylor-Evans/T-E | Haygrazer II | 0.46 | 16.4 | 5.4 | 9.9 |
| USDA - ARS, GA | Exp. #1 | 1.81 | 17.6 | 9.0 | 13.9 |
| | Exp. #2 | 0.90 | 16.4 | 7.0 | 11.6 |
| | Tifleaf 1 | 1.32 | 16.4 | 12.3 | 12.4 |
| | Tifleaf 2 | 2.66 | 18.2 | 8.2 | 16.4 |
| | Tx623A X Ga337 | 0.68 | 15.2 | 5.5 | 9.4 |
| | Tx623A XDwGa337 | 0.91 | 15.8 | 6.1 | 10.5 |
| Richardson's Seed | Greenleaf | 0.64 | 17.6 | 6.9 | 10.9 |
| Timken Seed Co. | NB 280-S | 0.48 | 16.2 | 6.2 | 9.4 |
| | Piper | 0.51 | 16.7 | 5.4 | 9.2 |
| | Average | 0.74 | 16.5 | 6.4 | 10.3 |
| | $LSD_{.05}$ | 0.48 | NS | 2.2 | 2.4 |

[a]All entries were between the boot and head emergence stages of growth.

**(Addendum to http://www.oznet.ksu.edu/library/crpsl2/srp708.pdf)**

**Table 3. Neutral-detergent and acid-detergent fiber contents of first-cut *Sorghum* spp. forage in 1993, Mound Valley Unit, KSU - Southeast Agricultural Research Center.**

| | Neutral-detergent Fiber | | | Acid-detergent Fiber | | |
|---|---|---|---|---|---|---|
| Entry | Leaf | Stem | Total | Leaf | Stem | Total |
| | - - - - - - - - - - | - - - - - - - - - - | - - - - % | - - - - - - - - - - | - - - - - - - - - - | - - - - - - |
| Feast | 62.6 | 68.2 | 66.4 | 36.3 | 47.5 | 43.7 |
| Grazex | 65.4 | 71.7 | 69.8 | 38.1 | 50.3 | 46.5 |
| Grazex II | 64.4 | 72.0 | 69.5 | 35.7 | 51.3 | 46.1 |
| Greenleaf | 63.2 | 66.9 | 65.5 | 37.7 | 46.9 | 43.5 |
| Haygrazer II | 62.6 | 68.9 | 67.0 | 36.8 | 48.3 | 45.0 |
| HS 35 | 64.6 | 70.8 | 69.0 | 35.8 | 47.6 | 44.0 |
| Kow Kandy | 63.0 | 68.1 | 66.3 | 36.3 | 46.9 | 43.2 |
| NB 280-S | 64.7 | 69.6 | 68.1 | 38.1 | 49.2 | 45.8 |
| Piper | 62.0 | 71.2 | 68.2 | 34.5 | 49.8 | 44.8 |
| Regro EX 4 | 66.5 | 67.8 | 67.4 | 38.4 | 48.1 | 44.7 |
| Regro H-22B | 64.1 | 68.8 | 67.2 | 35.9 | 47.4 | 43.4 |
| Si-gro H-1 | 64.6 | 66.5 | 66.0 | 37.6 | 47.0 | 43.8 |
| ST-6E | 67.0 | 69.0 | 68.3 | 38.9 | 47.6 | 44.2 |
| Sweet Sioux V | 66.0 | 67.4 | 66.9 | 38.1 | 46.9 | 43.7 |
| SX-15 | 64.7 | 66.4 | 65.2 | 37.7 | 46.9 | 43.5 |
| Total | 66.7 | 68.9 | 68.2 | 38.6 | 47.8 | 44.4 |
| Tx623A x Dw Ga 337 | 67.3 | 68.0 | 67.7 | 37.8 | 49.0 | 43.8 |
| Tx623A x Ga 337 | 67.4 | 68.9 | 68.3 | 38.8 | 48.0 | 44.2 |
| Mean | 64.8 | 68.8 | 67.6 | 37.3 | 48.1 | 44.4 |
| $LSD_{0.05}$ | NS | 2.6 | NS | 2.2 | 2.3 | 2.0 |

# ENSILAGE-TYPE SORGHUM PERFORMANCE TEST

Joseph L. Moyer

## Summary

Sorghums were evaluated for ensilage production and agronomic characteristics. Fourteen entries were evaluated for yield (ensilage and grain), maturity, height, and lodging. Yields (30% D.M.) ranged from about 11 to 28 tons/acre. Grain in the ensilage ranged from 3 to over 30 bu/a. Generally, the later maturing cultivars produced the most ensilage.

## Introduction

A statewide test of forage sorghums was offered until 1989. Since that time, some new hybrids have entered the market. This evaluation was offered in 1993 for commercial entrants on a fee basis to provide an unbiased comparison among commercial entries and some older cultivars. Check and/or public lines were added to the 10 commercial entries to make 14 entries.

## Experimental Procedures

The test was seeded in four 30-inch rows at the rate of about 100,000 live seeds/acre, replicated four times in a randomized complete block on 7 June, 1993 at the Mound Valley Unit. Plots were fertilized preplant with 150-60-80 lb/a of N-$P_2O_5$-$K_2O$. Hard rains and wet soil prevented thinning, but also reduced emergence such that populations were as listed (Table 1). We used 1 lb/a of atrazine and cultivated once. The two center rows were harvested on 7 October. Heads were harvested from one border row for determination of grain yield. Growing conditions (see weather summary) were wet in May and early June and somewhat dry by late August-early September. No particular insect or disease problems were noted.

## Results and Discussion

Ensilage yields and moisture content are shown in Table 1. FS 466, 'Red Top Candy', and FS 25-E produced more forage than seven other sorghums. However, dry matter content and grain yield were both relatively low for those three hybrids. Grain yields were higher for 'Milk-A-Lot', 'Grain-N-Graze', and 'Total' than for eight other cultivars.

There were notable exceptions to the general rule that taller hybrids tended to yield more, but also lodge more than short types. Two cultivars with the most serious lodging problem were less than 100 inches in height, whereas the highest-yielding hybrid ranked fourth in height but was average in lodging percentage. Two of the shortest hybrids, Grain-N-Graze and Milk-A-Lot, showed no lodging but produced practically as much ensilage with more grain than the leading ensilage- producing hybrids.

Table 1. Yield and Agronomic Characters of Sorghums Grown for Ensilage in 1993, Mound Valley Unit, Southeast Kansas Branch Experiment Station

| Source/Brand | Entry | Ensilage Yield | Grain D.M. | Half-Yield | Days to Bloom[c] | Plant Popul. | Plant Ht | Lodging |
|---|---|---|---|---|---|---|---|---|
| | | tons/a[a] | % | bu/a[b] | | No./a | in | % |
| Agri-Genetics/Growers' /Oro Hybrids | Total | 16.6 | 33 | 29 | 62 | 47,800 | 80 | 7 |
| | Grain-N-Graze | 25.3 | 31 | 33 | 86 | 37,500 | 74 | 0 |
| | Red Top Kandy | 27.4 | 28 | 9 | 87 | 43,300 | 118 | 14 |
| Cargill | FS 455 | 24.6 | 28 | 6 | 102 | 35,600 | 85 | 0 |
| | FS 466 | 27.7 | 28 | 9 | 103 | 41,600 | 102 | 8 |
| Dekalb Plant Genetics | FS 25-E | 26.4 | 27 | 3 | 105 | 30,400 | 109 | 10 |
| Taylor-Evans/ T-E | Milk-A-Lot | 23.5 | 30 | 34 | 85 | 35,500 | 75 | 1 |
| | Silomaker | 25.4 | 29 | 12 | 98 | 37,400 | 94 | 6 |
| Triumph | Super Sile 20 | 25.4 | 30 | 31 | 83 | 41,600 | 109 | 15 |
| Sharp Bros. | Canex | 13.6 | 33 | 24 | 60 | 26,000 | 82 | 4 |
| Timken Seed | Atlas | 16.0 | 32 | 11 | 66 | 35,500 | 93 | 22 |
| | Rox Orange | 13.2 | 33 | 19 | 62 | 38,300 | 70 | 11 |
| | Early Sumac | 11.2 | 32 | 10 | 66 | 19,500 | 85 | 33 |
| | Sugar Drip | 14.7 | 33 | 16 | 67 | 33,300 | 99 | 17 |
| | LSD | 2.6 | 2 | 11 | 4 | 10,000 | 5 | 11 |

[a]Ensilage yields expressed on the basis of 30% dry matter.
[b]Grain yields expressed on the basis of 12.5% moisture, 56 lb/bu test weight.
[c]Days after planting on June 7.

# EFFECT OF PREVIOUS RESIDUE MANAGEMENT AND N RATE ON YIELDS IN A CONTINUOUS SMALL GRAIN - DOUBLE-CROP SOYBEAN ROTATION

Daniel W. Sweeney

## Summary

In general, double-crop soybean yields were low from 1983 to 1992, with a poorly defined trend for disc-only residue management to result in higher yields. However, wheat (or oat) yields often were lower where the previous double-crop soybeans were planted no-till as compared to burn and disc or disc only. Increased N rates for wheat had minimal effect on wheat or soybean yields.

## Introduction

Double-cropping of soybeans after wheat or other small grains, such as oats, is practiced by many producers in southeastern Kansas. Several options exist for dealing with straw residue from the previous small grain crop. The method of managing the residue may affect not only the double-crop soybeans but also the following small grain crop. Wheat (or oat) residue that is not removed by burning or is not incorporated before planting soybeans may result in immobilization of N applied for the following small grain crop (usually wheat). Therefore, an additional objective of this study was to observe whether an increase in N rate, especially where double-crop soybeans were grown with no tillage, could increase small grain yields.

## Experimental Procedures

Three wheat residue management systems for double-crop soybeans with three replications were established in spring 1983: no tillage, disc only, and burn then disc. After the 1983 soybean harvest, the entire area was disced, field cultivated, fertilized, and planted to wheat. In spring, urea was broadcast as a topdressing to all plots, so that the total N rate was 83 lb N/a. Wheat yield was determined in areas where the three residue management systems had been imposed previously. In spring 1985, residue management plots were split, and two topdress N rates were applied for wheat. These two rates were added to give total yearly N applications of 83 and 129 lb N/a. These residue management and total N rate treatments were continued through 1993, except in 1986 and 1987, when oats were planted in the spring because of wet conditions in the fall.

## Results and Discussion

In general, yields of double-crop soybeans were low during the 11 crop-years of this study and were nearly always less than 20 bu/a (Table 1). The disc-only treatment tended to give higher yields in years where residue management resulted in significant differences. No tillage tended to result in lower yields, partly because of weed pressure. In 1987, 1989, and 1993, the residual N that was applied to the previous wheat crop resulted in higher soybean yields in the burn-then-disc and in the disc-only treatments. However, yield was not increased by residual N in the no-tillage plots in 1987 and 1989 (interaction data not shown).

In general, the previous residue management used for double-crop soybeans affected the subsequent wheat or oat crops (Table 2). Small grain yields were up to 20 bu/a less where soybeans were double-cropped no-till in the previous year. Often, yield differences were small between the burn-then-disc treatment and the disc-only treatment. Averaged across residue management systems, increasing the N rate resulted in an increase in small grain yield only in 1990. However, oat yields in 1987 and wheat yields in 1991 were affected by an interaction between residue management system and N rate. In 1987, increasing N rate lowered oat yields in areas where double-crop soybeans had been planted no-till, whereas increasing N rate increased oat yields where the residue management had been either burn then disc or disc only. In 1991, increasing N rate increased wheat yields only in the disc-only system.

Table 1. Soybean Yield as Influenced by Straw Residue Management and Residual N Rates

| | Soybean Yield | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| | ------------------ bu/a ------------------ | | | | | | | | | | |
| Residue mgmt. | | | | | | | | | | | |
| Burn then disc | 7 | - | 15 | 10 | 13 | 1 | 11 | 8 | 5 | 17 | 5 |
| Disc only | 4 | - | 21 | 12 | 17 | 3 | 10 | 12 | 14 | 16 | 7 |
| No tillage | 6 | - | 0 | 9 | 13 | 6 | 0 | 3 | 5 | 10 | 6 |
| LSD 0.05 | NS | - | 2 | NS | 3 | 2 | 6 | 4 | 5 | 2 | 1 |
| N Rate (lb/a) | | | | | | | | | | | |
| 83 | - | - | 12 | 10 | 13 | 3 | 5 | 7 | 9 | 13 | 5 |
| 129 | - | - | 13 | 12 | 15 | 4 | 10 | 9 | 8 | 15 | 7 |
| LSD 0.05 | - | - | NS | NS | 1 | NS | 2 | NS | NS | NS | 1 |
| Interaction | - | - | NS | NS | * | NS | ** | NS | NS | NS | NS |

Table 2. Wheat Yield in 1984, 1985, 1988, 1989, 1990, 1991, and 1992 and Oat Yield in 1986 and 1987 as Influenced by Previous Straw Grain Residue Management and N Rates

| | Small Grain Yield | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
| | ------------------ bu/a ------------------ | | | | | | | | | |
| Previous residue mgmt. | | | | | | | | | | |
| Burn, then disc | 63 | 59 | 79 | 51 | 58 | 40 | 18 | 23 | 35 | 37 |
| Disc only | 59 | 55 | 85 | 49 | 53 | 45 | 12 | 17 | 38 | 32 |
| No-tillage | 43 | 48 | 64 | 42 | 50 | 33 | 7 | 15 | 26 | 17 |
| LSD 0.05 | 13 | 8 | 6 | NS | 5 | NS | 6 | 3 | 6 | 10 |
| N Rate (lb/a) | | | | | | | | | | |
| 83 | - | 53 | 77 | 47 | 56 | 38 | 10 | 19 | 34 | 30 |
| 129 | - | 55 | 75 | 47 | 51 | 40 | 14 | 18 | 32 | 27 |
| LSD 0.05 | - | NS | NS | NS | 5 | NS | 3 | NS | NS | NS |
| Interaction | - | NS | NS | * | NS | NS | NS | ** | NS | NS |

# TILLAGE AND NITROGEN FERTILIZATION EFFECTS ON YIELDS IN A GRAIN SORGHUM - SOYBEAN ROTATION

Daniel W. Sweeney

## Summary

In general, conventional and reduced tillage have resulted in higher grain sorghum yields than no tillage. Applying N resulted in large increases in grain sorghum yield, with anhydrous ammonia often resulting in highest yields, especially with no tillage. In contrast, soybean yields have been little affected by tillage or the residual from N fertilization.

## Introduction

Many kinds of rotational systems are employed in southeastern Kansas. This experiment was designed to determine the long-term effect of selected tillage and nitrogen (N) fertilization options on the yields of grain sorghum and soybeans in rotation.

## Experimental Procedures

A split-plot design with four replications was initiated in 1983, with tillage systems as whole plots and N treatments as subplots. The three tillage systems were conventional, reduced, and no tillage. The conventional system consisted of chiseling, discing, and field cultivation. The reduced-tillage system consisted of discing and field cultivation. Glyphosate (Roundup) was applied each year at 1.5 qt/a to the no-till areas. The four N treatments for the 1983, 1985, 1987, 1989, 1991, and 1993 grain sorghum were a) no N (check), b) anhydrous ammonia knifed to a depth of 6 inches, c) broadcast urea-ammonium nitrate (UAN - 28% N) solution, and d) broadcast solid urea. N rate was 125 lb/a.

## Results and Discussion

Averaged across the 6 crop-years of grain sorghum, conventional tillage has tended to result in higher yields than no tillage, even though the difference was not significant in 1983 or 1991 (Table 1). Small fluctuations occurred, but conventional and reduced tillage generally resulted in similar yields. As evidenced by the values obtained in the checks, N supplied by soybeans grown in alternate years was not sufficient to maintain yields. In general, any of the N fertilization systems resulted in large increases in yield as compared to the check. Except for 1983, which was dry, and 1991, when wet conditions resulted in poor soil closure behind the knives, anhydrous ammonia tended to result in highest yields. However, overall, the use of either urea or UAN for surface N fertilization has not resulted in large decreases in grain sorghum yield. Yield was affected by interactions between tillage and the N fertilization system in 1985 and 1993. These interactions were mainly because of larger yield increases obtained with anhydrous ammonia in no-tillage plots as compared to smaller or nonsignificant increases with anhydrous ammonia over urea or UAN in conventional or reduced-tillage plots.

Although soybean yields in even years generally have tended to be less with no tillage, the differences have not been significant (data not shown). Residual N affected soybean yield only in 1984, but because of low yield levels, the differences between N treatments were less than 1.5 bu/a (data not shown).

Table 1. Effect of Tillage and N Fertilization on Yield of Grain Sorghum Grown in Rotation with Soybeans, Southeast KS Branch Experiment Station, 1993

| Treatment | Yield | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1983 | 1985 | 1987 | 1989 | 1991 | 1993 | Avg. |
| | bu/a | | | | | | |
| Tillage | | | | | | | |
| Conventional | 46.8 | 95.4 | 69.8 | 52.3 | 80.2 | 54.7 | 66.5 |
| Reduced | 45.9 | 95.0 | 75.5 | 43.3 | 80.7 | 56.6 | 66.2 |
| No tillage | 42.8 | 58.8 | 52.0 | 30.1 | 76.8 | 42.5 | 50.5 |
| LSD (0.05) | NS | 7.3 | 11.6 | 15.8 | NS | 11.4 | |
| N Fertilization | | | | | | | |
| Check | 45.0 | 65.6 | 30.4 | 18.9 | 56.5 | 23.6 | 40.0 |
| Anhy. $NH_3$ | 45.2 | 92.3 | 92.0 | 55.0 | 73.2 | 69.1 | 71.1 |
| UAN broadcast | 43.9 | 85.6 | 60.4 | 47.1 | 87.7 | 61.1 | 64.3 |
| Urea broadcast | 46.4 | 88.9 | 80.3 | 46.7 | 97.5 | 51.2 | 68.5 |
| LSD (0.05) | NS | 5.5 | 9.2 | 7.6 | 6.4 | 7.0 | |
| T x N | NS | * | NS | NS | NS | * | |

# TIMING OF LIMITED-AMOUNT IRRIGATION TO IMPROVE EARLY-MATURING SOYBEAN YIELD AND QUALITY

Daniel W. Sweeney, James H. Long, and Mary Beth Kirkham[1]

## Summary

Even though above-average rainfall resulted in yields above 30 bu/a, limited-amount irrigation resulted in increases in soybean yield and oil content. Protein content was not affected by irrigation treatments.

## Introduction

Production of early-maturing soybeans may spread economic risk by crop diversification. Previous research has shown that early-maturing soybeans often can have yields comparable to those of full-season soybeans. However, one disadvantage of early-maturing soybeans has been reduced quality. This potential for poor quality may be due to late reproductive growth that generally occurs in July when rainfall is typically low. Irrigation may improve not only yield of early-maturing soybeans, but also quality. Even though large irrigation sources such as aquifers are lacking in southeastern Kansas, supplemental irrigation could be supplied from the substantial number of ponds in the area. Thus, the objective of this study is to determine the effect of timing and quantity of limited-amount irrigation for improving yield and quality of early-maturing soybeans.

## Experimental Procedures

The study was established in 1991 on a Parsons silt loam soil. The experiment was a split plot arrangement of a randomized complete block design. The main plots comprised a 3x2 factorial arrangement of irrigation timing and amount. The three timings were irrigation at the R4, R5, and R6 soybean growth stages. The two amounts were 1 and 2 inches. Also included was a nonirrigated check plot. The subplots were two Maturity Group I soybean cultivars, 'Hodgson 78' and 'Weber 84'. Cultivars were drilled at 200,000 seeds/a on May 26.

## Results and Discussion

Above average rainfall from May through July resulted in nonirrigated Group I soybean yields from 30 to 35 bu/a (Table 1). Even so, irrigation increased average yields of Weber 84 by 6 bu/a and those of Hodgson 78 by nearly 8 bu/a. Yield was not significantly affected by the timing of irrigation, even though R4 irrigations tended to result in lower yields than irrigations at R5 and R6 growth stages. Increasing the irrigation amount from 1" to 2" increased soybean yield by nearly 5 bu/a.

Protein content of seeds was slightly higher for Hodgson 78 than Weber 84, but did not appear to be affected by irrigation treatment (Table 1). In contrast, irrigation significantly improved average oil content by nearly 0.5 percentage unit as compared to no irrigation. An interaction between growth stage irrigation timing and cultivar suggested that the oil content of Weber 84 was less influenced by irrigation applied at the R5 stage.

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[1] Department of Agronomy, KSU.

Table 1. Effect of Timing of Limited-Amount Irrigation on Early-Maturing Soybean Seed Yield and Quality

| Growth Stage | Amount | Cultivar | Yield | Protein | Oil |
|---|---|---|---|---|---|
| | inches | | bu/a | -------- % | --------- |
| R4 | 1 | Hodgson 78 | 37.5 | 34.0 | 19.7 |
| | | Weber 84 | 28.4 | 34.3 | 19.0 |
| | 2 | Hodgson 78 | 44.5 | 34.2 | 20.2 |
| | | Weber 84 | 39.1 | 33.9 | 19.0 |
| R5 | 1 | Hodgson 78 | 41.8 | 33.6 | 20.2 |
| | | Weber 84 | 36.2 | 34.7 | 18.5 |
| | 2 | Hodgson 78 | 45.7 | 34.2 | 20.2 |
| | | Weber 84 | 41.1 | 35.8 | 18.0 |
| R6 | 1 | Hodgson 78 | 42.1 | 34.1 | 20.4 |
| | | Weber 84 | 37.7 | 34.8 | 18.7 |
| | 2 | Hodgson 78 | 42.8 | 34.0 | 20.7 |
| | | Weber 84 | 39.0 | 34.6 | 18.7 |
| Check | None | Hodgson 78 | 34.7 | 34.3 | 19.7 |
| | | Weber 84 | 30.9 | 34.7 | 18.3 |
| | LSD (0.05) | | 7.2 | 0.8 | 0.7 |
| Treatment Means: | | | | | |
| Growth Stage | | | | | |
| R4 | | | 37.4 | 34.1 | 19.5 |
| R5 | | | 41.2 | 34.6 | 19.2 |
| R6 | | | 40.4 | 34.4 | 19.6 |
| | LSD (0.05) | | NS | NS | NS |
| Amount (inches) | | | | | |
| 1 | | | 37.3 | 34.3 | 19.4 |
| 2 | | | 42.0 | 34.4 | 19.5 |
| | LSD (0.05) | | 4.1 | NS | NS |
| Cultivar | | | | | |
| Hodgson 78 | | | 42.4 | 34.0 | 20.2 |
| Weber 84 | | | 36.9 | 34.7 | 18.7 |
| | LSD (0.05) | | 2.1 | 0.3 | 0.3 |
| Interaction(s) | | | NS | GxA,GxV | GxV |
| Contrasts: | | | | | |
| None vs. all irrigation | | | ** | NS | * |
| None vs. 1" | | | ** | NS | * |
| None vs. 2" | | | ** | NS | * |

# PHOSPHORUS, POTASSIUM, AND CHLORIDE EFFECTS ON ALFALFA AND BIRDSFOOT TREFOIL[1]

Daniel W. Sweeney, Joseph L. Moyer, and David A. Whitney[2]

## Summary

Both legumes yielded 1 to 1.5 ton/a more with 40 lb $P_2O_5$ than with no fertilizer; however, neither responded to higher P fertilization. Alfalfa yield increased by 0.7 ton/a with 125 lb $K_2O$/a compared with no K fertilization, but birdsfoot trefoil was not responsive to K fertilization. Chloride fertilization increased alfalfa yields by more than 1 ton/a, but did not appear to influence disease or plant stands.

## Introduction

With the attention recently given to sustainable agriculture, interest has been renewed in the use of legumes in cropping systems. Because sustainability of our agricultural resources needs to coincide with profitability, achieving and maintaining adequate soil fertility levels are essential. The importance of initial soil test levels and maintaining those levels has not been shown clearly for alfalfa and birdsfoot trefoil production in southeastern Kansas. Thus, the objective of this study was to determine the effect of soil and fertilizer phosphorus, potassium, and chloride levels on the emergence, stand persistence, yield, and quality of alfalfa and birdsfoot trefoil.

## Experimental Procedures

The experiment was established on a Parsons silt loam in spring 1991. Since 1983, different soil test levels have been maintained in whole plots by fertilizer applications. Phosphorus levels at the start of this study ranged from below 10 to more than 60 lb/a and K levels from approximately 120 to more than 200 lb/a. The experimental design was a split-plot. The whole plots comprised a factorial arrangement of P and K rates, in addition to selected chloride comparison treatments. Phosphorus rates were 0, 40, and 80 lb $P_2O_5$/a, and K rates were 0, 125, and 250 lb $K_2O$/a. Split plots were alfalfa and birdsfoot trefoil. Cuttings were taken from a 3x40' area of each plot.

## Results and Discussion

Total yield of both legumes increased 1 to 1.5 ton/a with the first 40 lb $P_2O_5$/a (Figure 1), but yield of either legume was not increased further with additional P. The yield response of both legumes to K was less (Figure 2) than that to P additions (Figure 1). However, total alfalfa yield was 0.7 ton/a more with 125 lb $K_2O$/a than with no K, but birdsfoot trefoil was affected little by any rate of K fertilization (Figure 2).

Alfalfa was responsive to the first 40 lb $P_2O_5$/a at each cutting, but was affected by K

[1] Research partially supported by grant funding from the Kansas Fertilizer Research Fund.

[2] Department of Agronomy, KSU.

only in the second cutting in 1993 (Table 1). Applying P at the highest rate did not increase alfalfa yield in any cutting. Birdsfoot trefoil forage yield was increased in only the first and last cuttings by P fertilization (Table 2). The highest K application rate appeared to reduce the yield of the first cutting, but increase the last cutting yield.

Chloride application increased total alfalfa yield by more than 1 ton/a, but had little effect on birdsfoot trefoil (data not shown). However, chloride additions as KCl or $CaCl_2$ did not decrease spring black stem or lessen stand decline as compared to no Cl.

Table 1. Effect of P and K Applications on Yield of Individual Cuttings of Alfalfa in 1993

| | Cutting | | | |
|---|---|---|---|---|
| Treatment | 1 | 2 | 3 | 4 |
| | ---------------------- ton/a ---------------------- | | | |
| $P_2O_5$ Rate (lb/a) | | | | |
| 0 | 1.05 | 1.11 | 0.90 | 0.46 |
| 40 | 1.49 | 1.70 | 1.24 | 0.74 |
| 80 | 1.53 | 1.58 | 1.28 | 0.82 |
| LSD (0.05) | 0.10 | 0.33 | 0.24 | 0.13 |
| $K_2O$ Rate (lb/a) | | | | |
| 0 | 1.30 | 1.21 | 0.97 | 0.61 |
| 125 | 1.41 | 1.51 | 1.23 | 0.68 |
| 250 | 1.36 | 1.67 | 1.23 | 0.73 |
| LSD (0.05) | NS | 0.33 | NS | NS |

Table 2. Effect of P and K Applications on Cutting Yields of Birdsfoot Trefoil in 1993

| | Cutting | | | |
|---|---|---|---|---|
| Treatment | 1 | 2 | 3 | 4 |
| | --------------------- ton/a ---------------------- | | | |
| $P_2O_5$ Rate (lb/a) | | | | |
| 0 | 1.09 | 1.71 | 0.99 | 0.33 |
| 40 | 1.38 | 1.96 | 1.33 | 0.46 |
| 80 | 1.28 | 1.81 | 1.29 | 0.73 |
| LSD (0.05) | 0.10 | NS | NS | 0.12 |
| $K_2O$ Rate (lb/a) | | | | |
| 0 | 1.27 | 1.81 | 1.17 | 0.45 |
| 125 | 1.34 | 1.75 | 1.24 | 0.43 |
| 250 | 1.15 | 1.92 | 1.21 | 0.63 |
| LSD (0.05) | 0.10 | NS | NS | 0.12 |

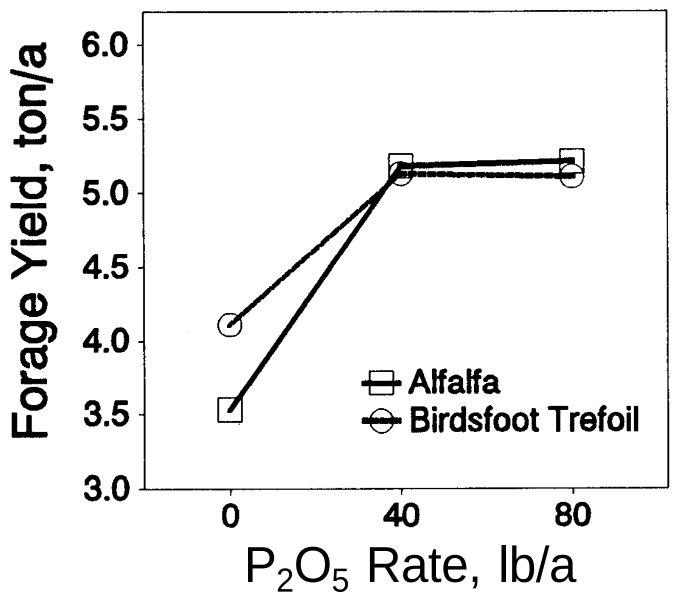


Figure 1. Effect of P Fertilization Rate on Total Forage Yield of Alfalfa and Birdsfoot Trefoil in 1993.

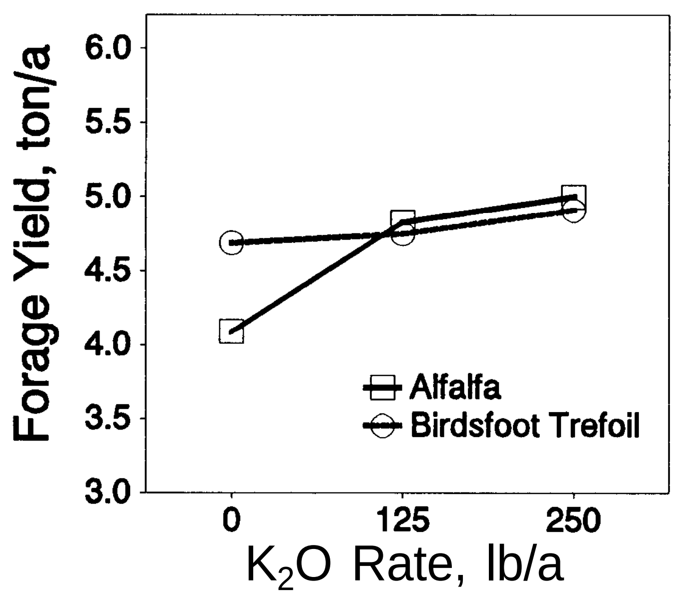


Figure 2. Effect of K Fertilization Rate on Total Forage Yield of Alfalfa and Birdsfoot Trefoil in 1993.

# LAND APPLICATION OF COMPOSTED MUNICIPAL SOLID WASTE FOR GRAIN SORGHUM PRODUCTION[1]

Daniel W. Sweeney and Gary Pierzynski[2]

## Summary

Municipal solid waste compost had little effect on grain sorghum growth or yield in 1993. Cow manure or fertilizer increased growth and yield, but the response was smaller when the other also was applied.

## Introduction

One of the most pressing environmental issues that will face communities in the near future is solid waste disposal. In recent years, news media coverage of landfill problems has become common. With diminishing capacity of existing landfills and the reluctance of the general populace to create new landfills at their own "back door", other alternatives to straight landfilling of municipal solid waste (MSW) need to be explored. Incineration may reduce waste volume, but likely raises as many environmental concerns as landfilling. However, composting of MSW may be more environmentally acceptable and should substantially reduce waste volume. Landfill longevity could be further extended by finding alternatives to landfilling the composted MSW. Composted MSW has potential uses in agriculture, horticulture, silviculture, and reclamation. Thus, the objective of this study was to determine the effect of application rate of composted MSW, with or without cow manure and with or without commercial fertilizer, on the growth, composition, and yield of grain sorghum and on selected soil chemical properties.

## Experimental Procedures

A field study was established in 1992 on a Zaar silty clay soil at an off-station site in Montgomery County. The experimental design was a split plot arrangement of a randomized complete block with three replications. The whole plots comprised a 4 x 2 factorial arrangement of four rates of MSW compost with or without cow manure. The four rates of MSW compost were 0 or 4.5, 9, and 13.5 ton/a applied each year. These rates were selected to be more in line with a "utilization-" rather than a "disposal-mentality". The cow manure rates were 0 or 4.5 ton/a applied yearly. The subplots were with or without commercial fertilizer, 100-60-30 lb N-$P_2O_5$-$K_2O$/a. Compost, cow manure, and fertilizer were applied on June 15, and grain sorghum was planted on June 16.

## Results and Discussion

Adding MSW compost increased dry matter accumulation at the 9-leaf stage as compared with no compost. However, this effect was not significant at the boot or soft dough stages or in grain yield. Adding cow manure or fertilizer generally increased growth and yield of grain sorghum. Several cow manure by fertilizer

[1] With the cooperation of Resource Recovery, Inc.

[2] Department of Agronomy, KSU.

interactions suggested that responses are smaller to either cow manure or fertilizer when the other also is applied.

Table 1. Effect of Composted Municipal Solid Waste (MSW), Cow Manure (CM), and Fertilizer on Grain Sorghum Growth and Yield

| Treatment | Dry Matter Production 9-Leaf | Boot | Soft Dough | Yield |
|---|---|---|---|---|
| | ------- lb/a | ------- lb/a | ------- lb/a | bu/a |
| MSW (t/a) | | | | |
| 0.0 | 390 | 3220 | 6910 | 36.8 |
| 4.5 | 490 | 3260 | 6760 | 33.3 |
| 9.0 | 460 | 3230 | 6980 | 29.0 |
| 13.0 | 520 | 3730 | 7090 | 42.0 |
| LSD 0.05 | 50 | NS | NS | NS |
| CM (t/a) | | | | |
| 0.0 | 390 | 2880 | 6620 | 31.0 |
| 4.5 | 540 | 3840 | 7250 | 39.5 |
| LSD 0.05 | 40 | 400 | 610 | NS |
| Fertilizer (lb/a) | | | | |
| 0 | 430 | 3100 | 6540 | 30.0 |
| 100-60-30 | 500 | 3620 | 7330 | 40.7 |
| LSD 0.05 | 60 | 300 | 660 | 4.2 |
| Interaction(s) | CxF | CxF | NS | CxF |

# EFFECT OF PREVIOUS CROP ON NITROGEN REQUIREMENT FOR WHEAT

Kenneth W. Kelley

## Summary

Wheat following soybeans produced significantly higher grain yield compared to wheat following corn or grain sorghum. Wheat yield was essentially the same following corn or grain sorghum. Yields increased with increasing levels of fertilizer N, regardless of previous crop. Grain yields were generally higher when liquid N fertilizer was knifed below crop residues compared to broadcast or dribble application methods.

## Introduction

In southeastern Kansas, wheat is rotated with other crops (corn, grain sorghum, and soybeans) to diversify cropping systems; however, the quantity of stalk residue varies with previous crops, which affects N fertilizer efficiency. This research seeks to evaluate different rates of N as well as N placement within three different cropping systems.

## Experimental Procedures

The experiment was a split-plot design, in which the main plots were the previous crops (corn, grain sorghum, or soybeans) and subplots included a factorial arrangement of three N rates (40, 80, and 120 lb N/a) with four placement methods - 1) broadcast UAN (urea-ammonium nitrate solution), 2) broadcast urea, 3) dribble UAN on 15" centers, and 4) knife UAN on 15" centers at a depth of 4" to 6". All N treatments were fall-applied and incorporated by shallow discing prior to wheat planting. Soil type was a Parsons silt loam with 2.8% O.M. All plots also received 60 lbs/a of $P_20_5$ and $K_20$.

## Results and Discussion

In 1993, the previous crop had a significant effect on wheat yield (Table 1). Wheat following soybeans produced significantly higher yield compared to wheat following corn or grain sorghum. Wheat yield was essentially the same following corn or grain sorghum. Yields increased with each increasing level of N, regardless of previous crop, although test weights declined with increasing levels of N. Previous research has shown that soybeans provide very little residual N to the following wheat crop, which this research also substantiates. Both corn and grain sorghum crops produce considerable quantities of crop residues, which evidently immobilize significant amounts of applied N fertilizer and thus make it unavailable for the growing wheat plant.

Placement of N fertilizer also significantly affected wheat yield in 1993. Liquid UAN knifed in a band below the soil surface was superior to the broadcast or dribble methods of application; however, broadcast urea was equal to the knifed UAN treatment, except for wheat following grain sorghum.

Denitrification, which is a loss of N to the atmosphere under water-logged soil conditions, was significant in many fields of southeastern Kansas in 1993; however, at this test site, denitrification evidently was not a problem.

**Table 1. Effect of Previous Crop on Nitrogen Requirement for Winter Wheat, Southeast KS Branch Experiment Station, 1993**

| N Rate | N Method | Grain Yield of Wheat after Corn | Sorg | Soy | Test Weight of Wheat after Corn | Sorg | Soy |
|---|---|---|---|---|---|---|---|
| lb/a | | ------ | bu/a | ------- | -------- | lb/bu | -------- |
| 0 | --- | 17.9 | 15.4 | 27.3 | 57.0 | 57.1 | 57.2 |
| 40 | BC-UAN | 26.4 | 24.3 | 32.5 | 56.8 | 57.4 | 57.2 |
| 80 | BC-UAN | 31.9 | 31.7 | 42.2 | 56.7 | 57.3 | 57.3 |
| 120 | BC-UAN | 35.2 | 35.7 | 47.3 | 56.3 | 57.1 | 57.0 |
| 40 | BC-Urea | 27.1 | 25.7 | 39.2 | 56.9 | 57.2 | 57.1 |
| 80 | BC-Urea | 38.1 | 33.5 | 47.0 | 55.8 | 57.3 | 57.0 |
| 120 | BC-Urea | 44.3 | 40.5 | 49.1 | 56.1 | 56.7 | 55.9 |
| 40 | DRIB-UAN | 24.6 | 23.1 | 35.7 | 56.6 | 57.4 | 57.2 |
| 80 | DRIB-UAN | 32.2 | 35.7 | 42.4 | 56.5 | 57.1 | 56.9 |
| 120 | DRIB-UAN | 38.6 | 39.3 | 45.0 | 55.8 | 56.8 | 56.8 |
| 40 | KN-UAN | 27.2 | 27.6 | 37.8 | 56.8 | 57.0 | 57.1 |
| 80 | KN-UAN | 39.4 | 36.8 | 42.4 | 55.8 | 56.9 | 56.7 |
| 120 | KN-UAN | 41.7 | 42.2 | 47.4 | 55.9 | 56.5 | 56.2 |
| Avg | | 32.7 | 31.7 | 41.2 | 56.4 | 57.1 | 56.9 |
| LSD (0.05): (Comparison of N treatments) | | | | | | | |
| Within same previous crop: | | | 2.6 | | | 0.5 | |
| Between different previous crop: | | | 3.9 | | | 1.2 | |
| Means: | | | | | | | |
| N Rate | | | | | | | |
| 40 lb N/a | | 26.3 | 25.1 | 36.3 | 56.8 | 57.2 | 57.1 |
| 80 lb N/a | | 35.4 | 34.4 | 43.5 | 56.2 | 57.1 | 57.0 |
| 120 lb N/a | | 39.9 | 39.4 | 47.2 | 56.0 | 56.8 | 56.5 |
| LSD (0.05): | | 0.7 | 0.7 | 0.7 | 0.1 | 0.1 | 0.1 |
| N Method | | | | | | | |
| BC-UAN | | 31.2 | 30.6 | 40.7 | 56.6 | 57.3 | 57.2 |
| BC-Urea | | 36.5 | 33.2 | 45.1 | 56.3 | 57.1 | 56.6 |
| DRIB-UAN | | 31.8 | 32.7 | 41.0 | 56.3 | 57.1 | 57.0 |
| KN-UAN | | 36.1 | 35.5 | 42.5 | 56.2 | 56.8 | 56.7 |
| LSD (0.05): | | 0.9 | 0.9 | 0.9 | 0.2 | 0.2 | 0.2 |

All N treatments were fall-applied and incorporated with tillage prior to wheat planting.
UAN = urea ammonium nitrate 28% N solution.
Planting date was Oct. 14, 1992; variety was Karl.

# EFFECTS OF PREVIOUS CROP, TILLAGE METHOD, N RATE, AND N PLACEMENT ON WINTER WHEAT YIELD

Kenneth W. Kelley and Daniel W. Sweeney

## Summary

Conventional tillage resulted in higher grain yields than no tillage when wheat followed soybeans, but the difference was small for wheat following grain sorghum. Knifing liquid N below crop residue produced higher grain yields than surface broadcast N treatments.

## Introduction

Cropping with no tillage may reduce the erosion potential of conventionally tilled soil in southeastern Kansas. This research seeks to compare wheat following soybeans or grain sorghum in no-tillage and conventional-tillage systems. Nitrogen rates and method of placement also were evaluted within each previous crop and tillage method.

## Experimental Procedures

The experiment was a split-plot design with previous crop (soybeans and grain sorghum) and tillage method (no-till and conventional) as main plots, and subplots were a factorial arrangement of N rates (60 and 120 lbs N/a) and N placement method (broadcast and knifed). All N treatments were fall-applied and, in conventional tillage, were incorporated with a disc prior to wheat planting. A no-till wheat drill was used to plant both no-tillage and conventional-tilled plots. Urea ammonium nitrate 28% N solution (UAN) was the N source, except for one comparison treatment where urea was applied as split applications (fall and late-winter). Knifed N treatments were banded on 15" centers at a depth of 4".

## Results and Discussion

Wheat yields were significantly influenced by previous crop, N rate, and N placement (Table 1). Tillage method did not have a significant effect on yield, but significant interactions occurred between previous crop and tillage method. Conventional tillage resulted in higher yields than no tillage when wheat followed soybeans, but the difference was small when wheat followed grain sorghum.

Wheat following soybeans produced significantly higher yield than wheat following grain sorghum. Previous research also has shown this same trend. Grain sorghum residue evidently immobilizes considerable amounts of fertilizer N. Knifing liquid N below crop residues was more efficient than broadcast N applications. More data are needed in southeastern Kansas under variable climatic conditions to evaluate conservation tillage systems for wheat.

**Table 1. Effects of Previous Crop, Tillage Method, N Bate, and N Placement on Winter Wheat Yield, Southeast KS Branch Experiment Station, 1993**

| N Rate | N Method | N Source | Wheat Yield: Gr Sorghum NT | Gr Sorghum CT | Soybean NT | Soybean CT |
|---|---|---|---|---|---|---|
| | | | bu/a | | | |
| 0 | ---- | ---- | 11.7 | 10.8 | 25.7 | 35.7 |
| 60 | BC | UAN | 23.2 | 27.3 | 36.8 | 46.4 |
| 120 | BC | UAN | 43.2 | 45.7 | 51.1 | 55.9 |
| 60 | KN | UAN | 37.7 | 30.3 | 48.0 | 51.6 |
| 120 | KN | UAN | 51.7 | 47.7 | 53.9 | 62.4 |
| 120[1] | BC | UREA | 40.2 | 51.5 | 51.1 | 60.9 |
| Avg | | | 34.6 | 35.5 | 44.4 | 52.1 |

| | |
|---|---|
| LSD (0.05): | |
| Same previous crop & tillage: | 3.4 |
| Different previous crop & tillage: | 5.1 |
| Means: (Control omitted and the 120 lb N/a urea treatment) | |
| Grain sorghum | 38.3 |
| Soybean | 50.8 |
| LSD (0.05): | 2.9 |
| No tillage | 43.2 |
| Conventional tillage | 45.9 |
| LSD (0.05): | NS |
| 60 lb N/a | 37.6 |
| 120 lb N/a | 51.4 |
| LSD (0.05): | 1.2 |
| Broadcast N | 41.2 |
| Knife N | 47.9 |
| LSD (0.05): | 1.2 |

[1] 60 lb N/a applied in fall and 60 lb N/a topdressed in Feb.
Wheat planted on Oct. 14, 1992; variety was Karl.
All plots received 60 lbs/a of $P_20_5$ and $K_20$.
NT = no tillage, CT = conventional tillage (disc)

# EFFECTS OF PLANTING DATE AND FOLIAR FUNGICIDE ON WINTER WHEAT YIELD

Kenneth W. Kelley

## Summary

October-planted wheat produced higher grain yields than that planted in late September, with no difference between early and late October plantings. Foliar fungicide application increased grain yields 5 to nearly 50%) depending upon cultivar disease resistance.

## Introduction

Wheat often is planted over a wide range of dates in southeastern Kansas because of the varied cropping rotations. Wheat following early corn, early grain sorghum, or wheat is planted in late September and early October, whereas wheat following soybeans is typically planted from early October through early November. This research seeks to determine how planting date affects grain yield of selected hard and soft winter wheat cultivars with variable disease resistance.

## Experimental Procedures

In 1993, six winter wheat cultivars were planted on three different dates at the Parsons and Columbus Units. Wet soil conditions prevented the November planting. Cultivars were selected for various foliar disease resistances: 1) moderately resistant soft wheat cultivars ('Caldwell' and Pioneer 2551), 2) susceptible hard wheat cultivars ('Chisholm' and 'TAM 107'), and 3) resistant hard wheat cultivars ('Karl' and 2163). Cultivars were seeded at the recommended rate for each planting date (850,000 seeds/a for late Sept. and 1,050,000 seeds/a for Oct. plantings). Tilt, a systemic foliar fungicide, was applied at 4 oz/a to half of the plot area for each planting date when the wheat was at Feekes' growth stage 8 (flag leaf just visible from the boot).

## Results and Discussion

Grain yields were higher with October plantings compared to late September, although no difference occurred between early and late October plantings (Table 1). Precipitation was significantly above average, especially during May when 10 inches of rain fell. Because of the cool climatic conditions, heading dates were nearly 10 days later than normal. In addition, foliar disease pressure (septoria, leaf rust, and scab) also was rather severe. All of these factors combined resulted in stressful conditions during the grain filling stage.

Grain yield response to foliar fungicide was more significant at the Columbus Unit than at Parsons. The reason evidently was related to differences in heading dates between the two locations. Wheat headed 3 to 7 days earlier at Columbus, which allowed for more disease protection with foliar fungicides during the ciritical grain filling period. Foliar fungicides typically provide only about 3 weeks of disease protection. Because fungicides were applied in late April and heading was delayed more at Parsons, foliar fungicide response was less pronounced at that site.

**Table 1. Effects of Planting Date and Foliar Fungicide on Wheat Yield and Test Weight of Selected Cultivars, Parsons and Columbus Units, 1993**

| Planting Date | Parsons Unit | | | Columbus Unit | | |
|---|---|---|---|---|---|---|
| | Fungicide | | Heading | Fungicide | | Heading |
| Cultivar | No | Yes | Date | No | Yes | Date |
| | --- bu/a --- | | | --- bu/a --- | | |
| Late September (Sept. 25) | | | | | | |
| 2163 | 29.6 | 31.8 | 5/13 | 29.7 | 30.5 | 5/9 |
| Caldwell (S) | 30.9 | 34.0 | 5/14 | 28.1 | 39.1 | 5/10 |
| Chisholm | 33.7 | 38.8 | 5/10 | 26.2 | 41.1 | 5/7 |
| Karl | 29.6 | 30.1 | 5/10 | 26.4 | 33.8 | 5/7 |
| Pioneer 2551 (S) | 33.9 | 39.3 | 5/14 | 26.1 | 38.7 | 5/10 |
| TAM 107 | 33.5 | 37.0 | 5/9 | 26.9 | 39.8 | 5/7 |
| Early October (Oct. 9) | | | | | | |
| 2163 | 40.2 | 42.4 | 5/14 | 39.4 | 45.0 | 5/10 |
| Caldwell (S) | 34.9 | 46.3 | 5/15 | 37.6 | 48.9 | 5/11 |
| Chisholm | 42.3 | 47.7 | 5/11 | 32.4 | 47.8 | 5/8 |
| Karl | 40.7 | 41.3 | 5/11 | 34.0 | 39.4 | 5/8 |
| Pioneer 2551 (S) | 37.3 | 45.3 | 5/15 | 32.2 | 51.4 | 5/11 |
| TAM 107 | 43.8 | 46.9 | 5/10 | 43.0 | 56.4 | 5/8 |
| Late October (Oct. 23) | | | | | | |
| 2163 | 40.8 | 43.1 | 5/18 | 42.3 | 51.0 | 5/12 |
| Caldwell (S) | 30.0 | 36.8 | 5/19 | 30.5 | 46.1 | 5/15 |
| Chisholm | 42.7 | 48.3 | 5/17 | 35.0 | 47.2 | 5/9 |
| Karl | 36.1 | 40.5 | 5/16 | 37.3 | 39.4 | 5/11 |
| Pioneer 2551 (S) | 37.3 | 46.1 | 5/19 | 33.4 | 49.5 | 5/16 |
| TAM 107 | 39.0 | 47.7 | 5/16 | 37.6 | 49.6 | 5/9 |
| LSD (0.05): | | | | | | |
| Cultivar within same (F) & (DOP) | | 3.8 | -- | | 4.9 | -- |
| Cultivar for different (F) & same (DOP) | | 4.2 | -- | | 4.9 | -- |

S = soft wheat cultivar.
Foliar fungicide = Tilt, applied at 4 oz/a at Feekes' GS 8 (early boot stage).

# WHEAT AND SOYBEAN ROTATIONS COMPARED

Kenneth W. Kelley

## Summary

Full-season soybeans have averaged 5 bu/a higher yields than double-crop soybeans over the 13-year period. Full-season soybean yield also has been highest where no double-cropping occurred in the previous year. Since 1988, wheat yield has been 10 bu/a higher following wheat compared to wheat following late-maturing soybeans (MG 4 and 5), whereas wheat yield following early-maturing soybeans (MG 1 and 3) has been nearly the same as wheat yield following wheat.

## Introduction

In southeastern Kansas, producers often rotate wheat after soybeans or plant double-crop soybeans following wheat harvest. Management practices of one crop, therefore, may affect the production of the subsequent crop. This research seeks to determine the long-term effects of wheat and soybean rotations on yield and soil properties.

## Experimental Procedures

Beginning in 1981, three different wheat and soybean rotations were established at the Parsons Unit: 1) [continuous wheat - double-crop soybeans, 2) [wheat - double-crop soybean] - soybean, and 3) full-season soybean following wheat with no double-cropping. Prior to 1988, full-season soybeans were maturity group (MG) V and double-crop, MG III or IV. Beginning in 1988, MG I, III, IV, and V were compared in both full-season and double-crop rotations (Rotation # 2). Group I maturity was planted in early May in 7-inch row spacing, whereas the other full-season maturity groups normally were planted in late June or early July after wheat. Prior to 1988, wheat was planted after all double-crop and full-season soybeans had matured, regardless of rotation. However, since 1988, wheat has been planted at different times with respect to individual crop rotations.

## Results and Discussion

Table 1 shows the yearly soybean yields for the different wheat and soybean rotations for the past 13 years. Double-crop soybean yields have averaged nearly 20 bu/a, with no difference in yield from continuous double-cropping versus double-cropping every other year. Full-season soybean yields following summer-fallowed wheat have averaged 2 bu/a higher than those following double-crop soybeans. Full-season soybean yields have averaged 5 to 7 bu/a higher than double-crop soybean yields, but the variation from year to year has been significant. During the years when wet weather conditions delayed full-season planting (1982, 1985, 1989, and 1992) until the same time as double-crop planting, no significant differences occurred in yields among rotations.

Since 1988, soybean maturity has significantly influenced full-season soybean yield, but when averaged over 6 years, grain yield differences between maturity groups were less than 2 bu/a (Table 2). In double-crop systems (Table 3), MG IV has consistently produced the highest yield.

Wheat yield as affected by the different crop rotations is shown in Table 4. Yield differences have been more pronounced since wheat has been planted at different dates according to the particular rotation scheme. Since 1988, wheat yields have averaged 10 bu/a higher following wheat compared to wheat following full-season soybeans. Wheat following 2 years of soybeans (double-crop and full-season) has yielded nearly the same as wheat following only 1 year of full-season soybeans. Wheat yields have been lowest in the continuous double-crop system. Wheat planted after early-maturing soybeans (MG I) has yielded nearly the same as wheat after wheat, whereas wheat yields have been lowest following late-maturing soybeans (MG V). In 1993, full-season soybeans were slow to mature because of cool climatic conditions, which delayed wheat planting until November. Thus, late-planted wheat lacked adequate fall growth for good tiller development, and grain yields were severely reduced.

**Table 1. Effects of Wheat and Soybean Cropping Systems on Soybean Yield, Southeast Branch Experiment Station, Parsons, KS**

| Crop Year | Rot. 1 Wh - DC Soy | Rot. 2 Wh - DC Soy FS Soy | Rot. 2 Wh - DC Soy FS Soy | Rot. 3 Wh-Wh FS Soy | **LSD (0.05)** |
|---|---|---|---|---|---|
| | - - - - - - - - - | - - - - bu/a | - - - - | - - - - - - - - - | |
| 1981 | 18.7 | 18.0 | 25.8 | 25.7 | 3.7 |
| 1982* | 23.6 | 23.0 | 24.3 | 24.9 | NS |
| 1983 | 17.9 | 16.9 | 15.5 | 14.5 | NS |
| 1984 | 2.1 | 2.0 | 11.1 | 12.8 | 2.9 |
| 1985* | 33.2 | 31.6 | 32.6 | 32.1 | NS |
| 1986 | 19.9 | 17.5 | 21.2 | 23.9 | 3.8 |
| 1987 | 19.5 | 19.3 | 35.4 | 42.6 | 2.5 |
| 1988 | 9.1 | 8.4 | 22.7 | 25.1 | 1.5 |
| 1989* | 27.6 | 28.0 | 28.3 | 29.8 | 1.7 |
| 1990 | 22.1 | 23.9 | 19.6 | 22.0 | 1.2 |
| 1991 | 18.6 | 15.2 | 24.9 | 27.3 | 0.8 |
| 1992* | 36.6 | 35.0 | 37.1 | 38.7 | 2.3 |
| 1993 | 22.1 | 22.5 | 28.9 | 35.3 | 1.3 |
| Avg. | 20.9 | 20.1 | 25.2 | 27.3 | |

(*) Full-season and double-crop soybeans were planted on the same date in 1982, 1985, 1989, and 1992.
DC = Double-crop soybeans; FS = full-season soybeans.
Cultivars planted: Double-crop (MG IV); Full-season (MG V).

**Table 2. Comparison of Soybean Maturity Groups in a Full-Season Soybean Crop Rotation, Southeast Branch Experiment Station, Parsons, KS**

| Mat. Group | Cultivar | Full-Season Soybean Yield 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | Avg. |
|---|---|---|---|---|---|---|---|---|
| | | bu/a | | | | | | |
| I | Weber 84 | 31.8 | 31.5 | 22.0 | 3.9 | 38.8 | 24.4 | 25.4 |
| III | Flyer | 24.0 | 30.8 | 14.5 | 23.8 | 36.4 | 28.9 | 26.4 |
| IV | Stafford | 26.9 | 28.8 | 16.0 | 24.0 | 36.5 | 30.0 | 27.0 |
| V | Hutcheson | 22.7 | 28.3 | 19.6 | 24.9 | 37.1 | 28.9 | 26.9 |
| LSD (0.05) | | 1.5 | 1.8 | 1.3 | 0.8 | 2.2 | 1.3 | |

Rotation is [Wheat - double-crop soybean] - full-season soybean.

**Table 3. Comparison of Soybean Maturity Groups in a Double-Crop Soybean Crop Rotation, Southeast Branch Experiment Station, Parsons, KS**

| Mat. Group | Cultivar | Double-Crop Soybean Yield 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | Avg. |
|---|---|---|---|---|---|---|---|---|
| | | bu/a | | | | | | |
| I | Weber 84 | 2.0 | 28.7 | 10.9 | 4.2 | 29.3 | 13.4 | 14.8 |
| III | Flyer | 2.2 | 28.9 | 16.6 | 14.7 | 31.6 | 19.4 | 18.9 |
| IV | Stafford | 8.4 | 28.0 | 23.9 | 15.1 | 35.0 | 22.5 | 22.2 |
| V | Essex | 6.5 | 22.8 | 20.7 | 12.1 | 32.7 | 19.6 | 19.1 |
| LSD (0.05) | | 1.5 | 1.8 | 1.3 | 0.8 | 2.2 | 1.3 | |

Rotation is [wheat - double-crop soybean] - full-season soybean.

**Table 4. Effect of Wheat and Soybean Cropping Rotations on Wheat Yield, Southeast KS Branch Experiment Station, Parsons, KS**

| Year | (Rot. 1) (Wh-DC Soy) | (Rot. 2) (Wh-DC Soy) FS Soy | (Rot. 3) Wheat Wheat FS Soy | (Rot. 3) Wheat Wheat FS Soy | LSD (0.05) |
|---|---|---|---|---|---|
| | -------------------------- | | bu/a | ------------------------ | |
| 1982 | 58.9 | 55.4 | 52.1 | 51.6 | 4.1 |
| 1983 | 48.4 | 53.4 | 51.6 | 51.9 | 1.4 |
| 1984 | 51.4 | 55.1 | 55.0 | 54.6 | 1.6 |
| 3-yr avg | 52.9 | 54.6 | 52.9 | 52.7 | |
| 1988 | 49.5 | 52.6 | 60.5 | 61.6 | 6.2 |
| 1989 | 50.3 | 64.8 | 64.3 | 68.6 | 6.5 |
| 1990 | 30.4 | 29.5 | 33.4 | 23.7 | 4.5 |
| 1991 | 39.4 | 46.1 | 39.5 | 60.0 | 6.6 |
| 1992 | 56.1 | 56.6 | 56.2 | 72.9 | 3.0 |
| 1993 | 10.2 | 14.2 | 13.9 | 39.8 | 2.4 |
| 6-yr avg | 39.3 | 44.1 | 44.8 | 54.4 | |

Wheat was not harvested from 1985 through 1987 because of wet soil conditions.
Spring oats were planted in 1986 and 1987 as a substitute crop for wheat.
Soybean maturity group:
Rotation 1: MG III or MG IV
Rotation 2,3,& 4: MG V
From 1982 - 1984, wheat was planted on the same date for all rotations, which was after the latest maturing soybeans.
Since 1988, wheat has been planted at different times according to the particular cropping system.

**Table 5. Effects of Soybean Maturity Group on Wheat Yield, Parsons Unit**

| Soybean Maturity | Wheat Yield | | | | | |
|---|---|---|---|---|---|---|
| | 1989 | 1990 | 1991 | 1992 | 1993 | Avg. |
| | bu/a | | | | | |
| MGI | 71.4 | 25.1 | 58.2 | 69.1 | 43.1 | 53.4 |
| MG III | 68.1 | 27.5 | 54.9 | 67.5 | 40.5 | 51.7 |
| MG IV | 71.9 | 36.0 | 48.3 | 65.7 | 17.9 | 48.0 |
| MGV | 64.8 | 29.5 | 46.1 | 57.6 | 14.2 | 42.4 |
| LSD (0.05) | 5.8 | 5.1 | 5.8 | 2.4 | 2.5 | --- |

Crop rotation: [wheat - double-crop soy] - full-season soybeans
Planting dates:
1989: Oct. 14, 1988 (MG I, III, & IV)
Oct. 25, 1988 (MG V)
1990: Oct. 16, 1989 (MG I & III)
Oct. 27, 1989 (MG IV & V)
1991: Oct. 5, 1990 (MG I & III)
Oct. 16, 1990 (MG IV & V)
1992: Oct. 7, 1991 (MG I, III, & IV)
Oct. 23, 1991 (MG V)
1993: Oct. 14, 1992 (MG I & III)
Nov. 2, 1992 (MG IV & V)

# ECONOMIC COMPARISONS OF WHEAT AND SOYBEAN CROPPING ROTATIONS[1]

Patrick T. Berends[2], Robert O. Burton, Jr.[2], and Kenneth W. Kelley

## Summary

Economic comparisons of three crop rotations were based on budgeting and on experimental data shown in the previous article of this report. Income above variable costs based on 1993 yields and prices favored a 2-year sequence of wheat followed by double-crop soybeans and full-season soybeans. Income above variable costs for average prices and yields favored a l-year sequence of wheat followed by double-crop soybeans. Four soybean maturity groups were considered in the two-year rotation containing wheat, double-crop soybeans, and full-season soybeans. A comparison of income above variable costs based on 1993 yields and prices or average yields and prices favored maturity group (MG) IV soybeans for double-crop use. This same comparison for full-season soybeans provided mixed results, with MGs IV and V soybeans favored over MGs I and III.

## Introduction

Farmers producing wheat and soybeans in southeastern Kansas select a cropping sequence that enables them to manage soil fertility, control weeds, and maximize income. An ongoing experiment at the Parsons Unit of the Southeast Kansas Branch Experiment Station provides biological data about alternative cropping sequences. The purpose of this study was to provide information about economic returns associated with these alternative sequences.

## Experimental Procedures

Budgeting was used to calculate income above variable costs for each crop in three rotations (Table 1): a l-year rotation of wheat and double-crop soybeans; a 2-year rotation of wheat, double-crop soybeans, and full-season soybeans; and a 3-year rotation of 2 years of wheat followed by full-season soybeans. Output prices were for the month of harvest: July for wheat; October for soybean MGs III, IV, V, and I when double- cropped; and August for full-season soybean MG I. Seed costs for MG I were actual costs plus a shipping charge in 1992. Other soybean seed costs were obtained from a seed distributor in southeastern Kansas. Fertilizer prices were the same for all wheat, and interest rate was the same for all crops. No fertilizer was applied on soybeans. Yields and machinery operations differed according to the crop sequence (Table 2). For purposes of this study, labor was included as a variable cost. Incomes above variable cost for each crop were added to provide total income for each sequence; these totals then were divided by the number of years required to complete a sequence to provide average annual incomes for

[1]This research was partially funded by the Kansas Soybean Commission.

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each sequence. Incomes above variable costs were calculated based on 1993 yields and prices for both wheat and soybeans and also based on average yields and prices over several years--1988-93 yields for wheat, 1981-93 yields for soybeans, and 1987-93 prices. The 1987-92 prices were converted to a 1993 price level before averaging.

## Results and Discussion

Results of a comparison of income above variable costs based on 1993 yields and prices favor a 2-year rotation of wheat followed by double-crop soybeans and full-season soybeans (Table 3). This result is different than in recent years, which have favored a l-year rotation of wheat followed by double-crop soybeans (see previous progress reports). When based on average prices and yields, income above variable costs comparison favored a l-year rotation of wheat followed by double-crop soybeans. However, double-cropping has not always been the most profitable strategy. For example, in a previous progress report, budgeting based on 1988 yields and projected prices showed double-cropping every year to be least profitable and no double-cropping to be most profitable. Moreover, some producers will not have adequate labor and machinery to double-crop every year, especially when weather limits the number of days when machinery operations can be performed during harvesting and planting periods.

One strategy for managing labor and machinery constraints during critical seasons is to use early-maturing soybeans. From 1988 to 1993, four MGs were considered in the 2-year rotation containing wheat, double-crop soybeans, and full-season soybeans (see previous article). In this experiment, MG I soybeans were drilled in 7-inch rows at 90 lb of seed/a. Budgeted costs of MG I soybean seeds were 30 ¢/lb plus a 2 ¢/lb shipping charge. MGs III, IV, and V soybeans were planted in 30-inch rows with seeding rates of 50 lb/a for MGs III and IV and 35 lb/a for V. Costs of MG III, IV, and V soybean seeds were 15.83 ¢/lb based on a price of $9.50/bu obtained from a seed distributor in Southeastern Kansas. Thus, budgeted seed costs were $7.92/a for MG III and IV soybeans, $5.54/a for MG V, and $28.80/a for MG I. Early harvest favors full-season MG I soybeans, because soybeans harvested prior to the traditional harvest season typically have a price advantage.

Early-maturing soybeans have shown promise by taking advantage of southeast Kansas's normally abundant spring rainfall. However, in this year's analysis, among full-season soybeans, MG IV had the highest returns above variable costs with 1993 yield data and MG V had the highest returns when 6-year average yield data were used (Table 4). For double-crop soybeans, MG IV had the highest returns above variable costs in 1993 and for the 6-year average (Table 5).

**Table 1. Sample Budgets for Two-Year Rotation of Wheat, Double-Crop Soybeans, and Full-Season Soybeans**

| | | Wheat | | | Double-Crop Soybeans Group IV | | |
|---|---|---|---|---|---|---|---|
| Item | Unit | Price[a] | Quantity per Acre[b] | Value or Cost | Price[a] | Quantity per Acre[b] | Value or Cost |
| 1. Gross Receipts from Production | bu | $2.72 | 14.20 | $ 38.62 | $5.85 | 22.50 | $131.63 |
| 2. Variable Costs | | | | | | | |
| Seed | lb | 0.12 | 75.00 | 9.00 | 0.16 | 50.00 | 7.92 |
| Nitrogen | lb | 0.24 | 70.00 | 16.80 | - | - | 0.00 |
| Phosphate | lb | 0.21 | 50.00 | 10.50 | - | - | 0.00 |
| Potash | lb | 0.13 | 50.00 | 6.50 | - | - | 0.00 |
| Herbicide | | - | - | 0.00 | - | - | 24.87 |
| Labor | hr | 8.00 | 1.11 | 8.86 | 8.00 | 1.35 | 10.81 |
| Machinery[c] | | | | 13.24 | | | 15.13 |
| Interest on ½ of variable cost | % | 9% | 32.45 | 2.92 | 9% | 29.36 | 2.64 |
| Total Variable Cost | | | | 67.82 | | | 61.37 |
| 3. Income above Variable Costs | | | | (29.20) | | | 70.26 |

**Table 1 (cont'd). Sample Budgets for Two-Year Rotation of Wheat, Double-Crop Soybeans, and Full-Season Soybeans**

| | | Full-Season Soybeans Group IV | | |
|---|---|---|---|---|
| Item | Unit | Price[a] | Quantity per Acre[b] | Value or Cost |
| 1. Gross Receipts from Production | bu | $5.85 | 30.00 | $175.50 |
| 2. Variable Costs | | | | |
| Seed | lb | 0.16 | 50.00 | 7.92 |
| Nitrogen | lb | - | - | 0.00 |
| Phosphate | lb | - | - | 0.00 |
| Potash | lb | - | - | 0.00 |
| Herbicide | | - | - | 24.87 |
| Labor | hr | 8.00 | 1.68 | 13.42 |
| Machinery | | | | 19.45 |
| Interest on ½ of variable cost | % | 9% | 32.83 | 2.95 |
| Total Variable Cost | | | | 68.62 |
| 3. Income above Variable Costs | | | | 106.88 |

[a]Wheat and soybean prices are for the 1993 month of harvest from Kansas Agricultural Statistics, Topeka, Kansas. Input costs other than machinery and soybean seed costs are projections from Fausett, Marvin, Soybean Production in Southeast Kansas and Continuous Cropped Winter Wheat in Southeast Kansas, KSU Farm Management Guides MF-994 (revised January 1994) and MF-992, revised August 1993. Machinery variable costs (fuel, lubrication, and repairs) and labor requirements are based on information from Fuller, Earl, Bill Lazarus, Lonnie Carrigan and Geoff Green, Minnesota Farm Machinery Economic Cost Estimates for 1992, Minnesota Extension Service, University of Minnesota, AG-FO-2308-C, revised 1991, with adjustments for Southeastern Kansas. Soybean seed costs are from a seed distributor in Southeastern Kansas.

[b]Yields, seed, and fertilizer are 1993 data from Kenneth Kelley at the Southeast Kansas Branch Experiment Station.

[c]Machinery costs are based on 1992 costs, with an adjustment made to reflect costs for 1993.

Table 2. **Typical Average Machinery Operations per Acre Used for Crops in Alternative Rotations**

| Machinery Operations | Wheat following Wheat | Wheat Following Double-Crop or Full-Season Soybeans | Double-Crop Soybeans following Wheat | Full-Season Soybeans following Wheat | Full-Season Soybeans following Double-Crop Soybeans |
|---|---|---|---|---|---|
| | ------- | ------- | Number of Times over the Field | ------- | ------- |
| Burn Wheat Straw | | | 1.00 | | |
| Moldboard Plow | 0.50 | | | | |
| Chisel Plow | | | | 1.00 | 1.00 |
| Disc | 2.50 | 1.00 | 1.00 | 3.00 | 2.00 |
| Fertilizer Buggy | 1.00 | 1.00 | | | |
| Field Cultivate | 1.25 | 1.00 | | | |
| Field Cultivate with Herbicide | | | 1.00 | 1.00 | 1.00 |
| Plant[a] | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Herbicide Application | | | 0.50 | 0.50 | 0.50 |
| Row Cultivate | | | | 0.50 | 0.50 |
| Combine | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | ------- | ------- | Acre/Truck Load | ------- | ------- |
| Medium Truck[b] | 10.05 | 39.22 | 18.10 | 13.84 | 17.78 |
| | ------- | ------- | Acre/Truck Load | ------- | ------- |
| Light Truck | 3.50 | 3.50 | 3.50 | 3.50 | 3.50 |
| | ------- | ------- | Acre/Truck Load | ------- | ------- |
| Machinery Variable Costs[c] | 19.30 | 13.24 | 15.13 | 21.03 | 19.45 |

[a]Group I soybeans are planted with a grain drill and, therefore, have machinery variable costs about $1.00 less than soybeans planted with a planter.
[b]Acres per truck load for a 400 bushel truck are based on yields of each crop in each rotation. Lower yields would increase acres per truckload and decrease costs per acre and vice versa. Thus, truck costs for the same crop in a different sequence will differ because of different yields.
[c]Variable costs include fuel, lubrication, and repairs and $2.50/a rental charge for the fertilizer buggy.

Table 3. Income above Variable Costs for Alternative Cropping Rotations Containing Wheat, Double-Crop Soybeans, and/or Full-Season Soybeans at Parson, Kansas[a]

| Crops and Crop Rotation[b] | Incomes above Variable Costs[d]: 1993 Yields and Output Prices[e] | Incomes above Variable Costs[d]: 1988-1993 Average Wheat and 1981-1993 Average Soybean Yields, 1987-1993 Average Output Prices[f] |
|---|---|---|
| | Dollars/Acre | |
| [W-DCSB] | | |
| W | (39.84) | 60.76 |
| DCSB | 68.29 | 72.49 |
| Annual Average[c] | 28.45 | 133.25 |
| IW-DCSB]-FSSB | | |
| W | (29.20) | 76.44 |
| DCSB | 70.26 | 67.55 |
| FSSB | 106.88 | 92.65 |
| Annual Average[c] | 73.97 | 118.32 |
| W-W-FSSB | | |
| W Year l | (29.99) | 78.76 |
| W Year 2 | 32.03 | 101.44 |
| FSSB | 137.83 | 103.44 |
| Annual Average[c] | 46.62 | 94.55 |

[a] Incomes are based on agronomic data shown in the previous article of this report.

[b] Abbreviations are as follows W = wheat; DCSB = double-crop soybeans, FSSB = full-season soybeans. Brackets indicate wheat and double-crop soybeans harvested the same year.

[c] Annual average income is the total income for the crop sequence divided by the number of years required to complete the sequence.

[d] Input costs are based on the same price level for all budgets. See Table 1 for sources.

[e] Source of 1993 wheat and soybean prices for the month of harvest is Kansas Agricultural Statistics, Topeka, KS.

[f] Source of average 1987-93 prices for the month of harvest is Kansas Agricultural Statistics. Prices were updated to a 1993 price level using the personal consumption expenditure (PCE) portion of the implicit GNP price deflator before averaging.

Table 4. Incomes above Variable Costs for Soybean Maturity Groups: Full-Season Soybeans in a 2-Year Rotation, Parsons, Kansas[a]

| Variety | Maturity Group | 1993 Soybean Price[b] | | 6-yr Avg Soybean Price[b] | |
|---|---|---|---|---|---|
| | | 1993 Yield[c] | 6-yr Avg Yield[c] | 1993 Yield[c] | 6-yr Avg Yield[c] |
| Weber 84 | I | 64.13 | 70.39 | 79.74 | 86.64 |
| Flyer | III | 100.46 | 85.83 | 114.62 | 98.77 |
| Stafford | IV | 106.88 | 89.34 | 121.59 | 102.57 |
| Hutcheson | V | 102.94 | 91.24 | 117.10 | 104.42 |

[a]Rotation is [wheat-doublecrop soybeans] - full-season soybeans

[b]Prices are for the 1993 month of harvest, August for MG I and October for MGs III, IV, and V. Prices for 1988-92 were updated to a 1993 price level to calculate a 6-year average. The personal consumption expenditure portion of the implicit GNP price deflator was used to update prices.

[c]Yields are shown in the previous article of this report.

Table 5. Incomes above Variable Costs for Soybean Maturity Groups: Double-Crop Soybeans in a 2-Year Rotation, Parson, Kansas[a]

| Variety | Maturity Group | 1993 Soybean Price[b] | | 6-yr Avg Soybean Price[b] | |
|---|---|---|---|---|---|
| | | 1993 Yield[c] | 6-yr Avg Yield[c] | 1993 Yield[c] | 6-yr Avg Yield[c] |
| Weber 84 | I | (1.16) | 7.03 | 5.40 | 14.28 |
| Flyer | III | 52.13 | 49.20 | 61.63 | 58.46 |
| Stafford | IV | 70.26 | 68.51 | 81.29 | 79.38 |
| Hutcheson | V | 55.78 | 52.85 | 65.38 | 62.21 |

[a]Rotation is [wheat-double-crop soybeans] - full-season soybeans

[b]Prices are for the 1993 month of harvest, October for MGs I, III, IV, and V. Prices for 1988-92 were updated to a 1993 price level to calculate a 6-year average. The personal consumption expenditure portion of the implicit GNP price deflator was used to update prices.

[c]Yields are shown in the previous article of this report.

# LONGTERM EFFECTS OF CROPPING SYSTEMS ON SOYBEAN YIELDS

Kenneth W. Kelley

## Summary

In the absence of soybean cyst nematode (SCN), continuous soybeans have yielded nearly 10% less than soybeans grown in a 2-yr rotation following double-crop soybeans, grain sorghum, or fallowed wheat. However, in the presence of SCN, soybean yield has declined nearly 25% in the monoculture soybean system.

## Introduction

Soybean is a major crop for farmers in southeastern Kansas. Typically, soybeans are grown in several cropping sequences with wheat, grain sorghum, and corn or in a double-cropping rotation with wheat. However, soybeans can follow soybeans, if a producer elects to enter the federal farm program and does not have a large enough wheat and feed-grain base to permit adequate crop rotation of available crop acreage. With the recent infection of soybean cyst nematode (SCN) into extreme southeastern Kansas, more information is needed to determine how crop rotations can be used to manage around the nematode problem.

## Experimental Procedures

In 1979, four cropping systems were started at the Columbus Unit: 1) [wheat - double-crop soybean] - soybeans, 2) [wheat - summer fallow] - soybeans, 3) grain sorghum - soybeans, and 4) continuous soybeans. Full-season soybeans were compared across all rotations in even-numbered years. Beginning in 1984, an identical study was started adjacent to the initial site, so that full-season soybeans also could be compared in odd-numbered years. All rotations received the same amount of phosphorus and potassium fertilizer (80 lb/a each), which was applied to the crop preceeding full-season soybeans. Beginning in 1991, an SCN-susceptible and an SCN-resistant cultivar were compared within each of the four cropping systems. During alternate years, a susceptible cultivar is planted in full-season and double-crop rotations.

## Results and Discussion

Soybean yields from the initial study (no SCN) are shown in Table 1. Continuous soybeans have yielded 10% less than soybeans grown in rotation. However, in the continous soybeans, yield has not been depressed as much as anticipated, considering that soybeans have been grown continuously on that site for the past 14 years.

Soybeans yields from the adjacent study that was started in 1984 are shown in Table 2. At this site, SCN were detected in 1989, and soybean yield has been reduced nearly 25% in the continuous soybean rotation. Soybean yield differences between resistant (5292) and susceptible (Stafford) cultivars have not been as pronounced as in other SCN research sites in Cherokee County. It is unclear why the yield response has been different at this SCN site; however, beginning in 1994, additional cultivars of varying maturity will be compared across rotations.

Table 1. Effect of Long-Term Cropping Systems on Soybean Yield in the Absence of SCN, Southeast KS Branch Experiment Station, Columbus Unit

| Yr | Full-Season Soybean following | | | | LSD |
|---|---|---|---|---|---|
| | Wh - DC Soy | Gr Sorg | Wheat[1] | Soy | |
| | bu/a | | | | |
| 1980 | 12.6 | 13.3 | 12.8 | 10.3 | 1.0 |
| 1982 | 28.0 | 30.4 | 31.9 | 27.2 | 3.0 |
| 1984 | 11.8 | 10.8 | 12.0 | 12.1 | NS |
| 1986 | 21.9 | 23.6 | 23.9 | 21.8 | 1.8 |
| 1988 | 31.3 | 30.1 | 32.8 | 25.2 | 3.0 |
| 1990 | 22.4 | 23.4 | 24.9 | 22.4 | NS |
| 1992 | 44.1 | 42.8 | 43.8 | 35.6 | 3.8 |
| Avg. | 24.6 | 24.9 | 26.0 | 22.1 | |

[1] Lespedeza was grown in the summer fallow period from 1988 - 1992.

Table 2. Effects of Long-Term Cropping Systems on Soybean Yield in the Presence of Soybean Cyst Nematode, Columbus Unit

| Yr[1] | Full-Season Soybean following | | | | LSD |
|---|---|---|---|---|---|
| | Wh - DC Soy | Gr Sorg | Wheat | Soy | |
| | bu/a | | | | |
| 1985 | 31.9 | 30.9 | 29.5 | 27.9 | 3.2 |
| 1987 | 30.7 | 31.5 | 33.2 | 28.2 | 3.8 |
| 1989 | 27.0 | 27.5 | 33.4 | 20.7 | 4.5 |
| 1991-SCN-R | 32.3 | 35.8 | 38.3 | 33.2 | 3.2 |
| 1991-SCN-S | 33.4 | 39.1 | 39.4 | 30.6 | 7.1 |
| 199%SCN-R | 33.3 | 35.8 | 40.9 | 27.9 | 4.5 |
| 1993-SCN-S | 32.5 | 36.9 | 37.1 | 25.3 | 3.8 |
| Avg - SCN-S | 31.1 | 33.2 | 34.5 | 26.5 | |

[1] Beginning in 1991, plots were split to include an SCN-resistant cultivar (5292) and an SCN-susceptible cultivar (Stafford).

# SOYBEAN HERBICIDE RESEARCH[1]

Kenneth W. Kelley

## Summary

Various soybean herbicide treatments and application methods were compared for weed control in conventional-tillage and no-tillage conditions. Weed control generally was good to excellent in both tillage systems.

## Introduction

Soybeans occupy approximately 40% of the crop acreage in southeastern Kansas. Herbicide studies are conducted to compare herbicide performance and application methods for the control of annual broadleaf and grassy weeds in soybeans. Because of the interest in conservation tillage practices, several studies evaluated herbicide performance in no-till conditions.

## Experimental Procedures

Soybean herbicide trials were conducted at the Columbus Unit in 1993. Soybeans were grown in 30-inch row spacing. All treatments were applied with a tractor-mounted, compressed air sprayer, with a spray volume of 20 GPA. Plot size was 4 rows wide by 30' in length, with three replications. The center two rows of each plot were harvested for yield. Preplant treatments were incorporated with a field cultivator, equipped with a three-bar tine mulcher. Weed ratings were taken at 4 weeks after herbicide treatment.

## Results and Discussion

### Conventional Tillage

Herbicide results with conventional tillage are shown in Tables 1, 2, and 3. Because of wet soilconditions during May and early June, early preplant herbicide treatments were applied in mid-June, immediately ahead of soybean planting. Broadleaf and grass weed control was generally good to excellent for nearly all herbicide treatments. Preemergent herbicides were activated by timely rainfall within 10 days of application, which also provided ideal climatic conditions for postemergent herbicide treatments. Early postemergent treatments applied at reduced rates were as effective in controlling broadleaf weeds as later postemergent treatments applied at the full rate.

Soybean yields were reduced somewhat with certain herbicide treatments and application methods in 1993. Soybean plant height was reduced significantly with preplant tank-mixes of Canopy with Treflan or Prowl and with postemergent tank-mixes of Classic with Pinnacle. Because of the reduced plant height, soybeans evidently did not compensate by producing more branches. However, previous research has shown that reduced plant height from herbicide applications is not always associated with reduced yields.

[1]Products without label registration are presented for informational purposes only and are not recommendations for use.

No tillage

Herbicide results with no tillage are shown in Table 4. Soybeans were planted no-till into standing grain sorghum stubble. Weed control and soybean yields were generally good. Early preplant applications of Roundup gave good early burn-down weed control; however, split applications (early preplant and at planting) of Roundup gave better weed control than the single, early preplant treatment. Weed control, especially of annual grasses, was less effective where residual herbicides were applied too early. Results suggest that a postemergent grass herbicide application or mechancial cultivation may be necessary in no-till systems, especially where a heavy infestation of annual grass weeds exist. More data are needed on no-till weed control in soybean under various climatic conditions and weed infestations.

**Table 1. Comparison of Soybean Herbicides: Soybean Yield and Weed Control, Southeast Kansas Branch Experiment Station, Columbus Unit, 1993**

| | Herbicide Treatment | Product Rate | Time | Yield | BL | GR |
|---|---|---|---|---|---|---|
| | | | | bu/a | % | % |
| 1) | Treflan + Canopy | 1.5 pt + 6 oz | PPI | 22.8 | 98 | 97 |
| 2) | Pursuit (+) | 2.5 pt | PPI | 30.4 | 98 | 100 |
| 3) | Squadron + Command | 3 pt + 4 oz | PPI | 28.4 | 93 | 92 |
| 4) | Salute + Scepter | 2.25 pt + 1.4 oz | PPI | 29.5 | 94 | 97 |
| 5) | Treflan + Broadstrike (TM) | 1 qt | PPI | 31.0 | 95 | 95 |
| 6) | Freedom + Scepter | 2.5 qt + 1.4 oz + 4 oz | Shal. PPI | 33.0 | 87 | 90 |
| 7) | Lasso + Canopy | 1.5 qt + 6 oz | Shal. PPI | 25.3 | 100 | 94 |
| 8) | Lasso + Pursuit | 1.5 qt + 4 oz | Shal. PPI | 29.4 | 98 | 97 |
| 9) | Turbo + Scepter | 1 qt + 1.4 oz | PRE | 28.7 | 73 | 96 |
| 10) | Lasso + Canopy | 1.5 qt + 6 oz | PRE | 26.1 | 97 | 94 |
| 11) | Dual + Pursuit | 1.5 pt + 4 oz | PRE | 31.0 | 77 | 100 |
| 12) | Commence + Basagran | 1 qt + 1 pt | PPI + Post | 30.9 | 97 | 94 |
| 13) | Prowl + Pursuit | 1.5 pt + 4 oz | PPI + Post | 32.3 | 99 | 96 |
| 14) | Treflan + Basagran + Cobra | 1.5 pt + 1 pt + 8 oz | PPI + Post | 30.2 | 97 | 92 |
| 15) | Treflan + Classic + Pinnacle | 1.5 pt + 1/4 oz + 1/4 oz | PPI + Post | 27.6 | 85 | 88 |
| 16) | Cultivation Only | ---- | ---- | 32.9 | 73 | 75 |
| 17) | Control (No herbicide) | ---- | ---- | 17.8 | 0 | 0 |
| | LSD: (0.05) | | | 3.5 | 7 | 6 |

PPI = preplant incorporated (6/14), Shal. PPI = shallow preplant incorporated (6/14), PRE = preemergent (6/15), Post = postemergent (7/15).
BL = broadleaf (velvetleaf, smooth pigweed, and common cocklebur), GR = grass (crabgrass).

**Table 2. Comparison of Soybean Herbicides and Time and Method of Application : Soybean Yield and Cocklebur Control, Southeast KS Branch Expt. Station, Columbus Unit**

| Herbicide Treatment | Product Rate | Time | Yield | Coc |
|---|---|---|---|---|
| | | | bu/a | % |
| 1) Prowl + Canopy | 1.5 pt + 6 oz | PPI | 26.5 | 77 |
| 2) Prowl + Scepter | 1.5 pt + 2.8 oz | PPI | 31.4 | 85 |
| 3) Treflan + Broadstrike (TM) | 1 qt | PPI | 30.5 | 80 |
| 4) Lasso + Canopy | 1.5 qt + 6 oz | Shal. PPI | 29.7 | 85 |
| 5) Lasso + Scepter | 1.5 qt + 2.8 oz | Shal. PPI | 28.1 | 100 |
| 6) Dual + Canopy | 1.5 pt + 6 oz | PRE | 31.7 | 82 |
| 7) Dual + Scepter | 1.5 pt + 2.8 oz | PRE | 31.3 | 91 |
| 8) Treflan + Basagran | 1.5 pt + .5 pt | PPI + EP | 31.8 | 94 |
| 9) Treflan + Basagran | 1.5 pt + 1 pt | PPI + Post | 31.8 | 97 |
| 10) Treflan + Basagran + Cobra | 1.5 pt + .5 pt + .33 pt | PPI + EP | 33.4 | 98 |
| 11) Treflan + Basagran + Cobra | 1.5 pt + 1 pt + .66 pt | PPI + Post | 31.8 | 100 |
| 12) Treflan + Classic | 1.5 pt + .25 oz | PPI + EP | 31.4 | 93 |
| 13) Treflan + Classic | 1.5 pt + .5 oz | PPI + Post | 31.3 | 98 |
| 14) Prowl + Pursuit | 1.5 pt + 2 oz | PPI + EP | 32.6 | 88 |
| 15) Prowl + Pursuit | 1.5 pt + 4 oz | PPI + Post | 31.8 | 100 |
| 16) Prowl + Scepter | 1.5 pt + 0.7 oz | PPI + EP | 33.6 | 97 |
| 17) Prowl + Scepter | 1.5 pt + 1.4 oz | PPI + Post | 31.4 | 100 |
| 18) Control (No herbicide) | ---- | ---- | 19.9 | 47 |
| 19) Cultivation only | ---- | ---- | 24.2 | 57 |
| 20) Hand weeded | ---- | ---- | 32.1 | 100 |
| LSD: (0.05) | | | 3.0 | 7 |

All herbicide treatments cultivated 28 days after planting.
PPI = preplant incorporated (6/14), Shal. PPI = shallow preplant incorporated (6/14),
EP = early postemergent (7/9), Post = postemergent (7/16).
Nonionic surfactant (0.25% v/v) added to all postemergent treatments.

Table 3. **Comparison of Soybean Herbicides and Time of Application: Weed Control, Columbus Unit, 1993**

| | Herbicide Treatment | Product Rate | Yield | BL | GR |
|---|---|---|---|---|---|
| | | | bu/a | % | % |
| 1) | Treflan (PPI) + [Classic + Cobra] (EP) | 1.5 pt + 1/4 oz + 3 oz | 33.3 | 98 | 96 |
| 2) | Prowl (PPI) + [Pursuit + Cobra] (EP) | 1.5 pt + 2 oz + 3 oz | 33.2 | 100 | 95 |
| 3) | Squadron + Command (PPI) | 3 pt + 4 oz | 32.5 | 100 | 95 |
| 4) | Treflan + Canopy (PPI) | 1.5 pt + 6 oz | 25.4 | 100 | 95 |
| 5) | Treflan + Broadstrike (TM)(PPI) | 1 qt | 35.6 | 90 | 95 |
| 6) | Freedom (SPPI) + [Classic + Cobra] (EP) | 3 qt + 1/4 oz + 3 oz | 35.9 | 100 | 92 |
| 7) | Dual (SPPI) + [Pursuit + Cobra] (EP) | 1.5 pt + 2 oz + 3 oz | 33.9 | 97 | 97 |
| 8) | Lasso + Scepter + Command (SPPI) | 1.5 qt + 2.8 oz + 4 oz | 32.6 | 100 | 92 |
| 9) | Dual + Canopy (SPPI) | 1.5 pt + 6 oz | 31.4 | 97 | 96 |
| 10) | Lasso (PRE) + [Classic + Cobra] (EP) | 1.5 qt + 1/4 oz + 3 oz | 35.6 | 100 | 90 |
| 11) | Dual (PRE) + [Pursuit + Cobra] (EP) | 1.5 pt + 2 oz + 3 oz | 33.8 | 100 | 95 |
| 12) | Lasso + Scepter (PRE) | 1.5 qt + 2 oz | 34.6 | 95 | 90 |
| 13) | Dual + Canopy (PRE) | 1.5 pt + 5 oz | 34.6 | 100 | 95 |
| 14) | Classic + Cobra (EP) + Assure II (PO) | 1/4 oz + 3 oz + 8 oz | 36.3 | 100 | 90 |
| 15) | Pursuit + Cobra (EP) | 2 oz + 3 oz | 35.9 | 100 | 85 |
| 16) | Scepter + Cobra (EP) + Fusilade 2000 (PO) | 1.4 oz + 6 oz + 1.5 pt | 34.4 | 100 | 92 |
| 17) | Classic + Pinnacle (PO) + Assure II (PO) | 1/2 oz + 1/8 oz + 8 oz | 29.6 | 100 | 92 |
| 18) | Control | ---- | 32.0 | 75 | 80 |
| | LSD (0.05) | | 2.9 | 6 | 3 |

All plots were cultivated.
BL = broadleaf (smooth pigweed and cocklebur); GR = grass (crabgrass).
PPI = preplant incorporated (6/14), SPPI = shallow preplant incorporated (6/14), PRE = preemergent (6/15),
EP = early postemergent (7/9), PO = postemergent (7/16 & 7/23)

**Table 4. Comparison of Herbicides for Weed Control in Soybeans Planted No-Till following Grain Sorghum, Columbus Unit**

| | Herbicide Treatment | Product Rate | Yield | BL | GR |
|---|---|---|---|---|---|
| | | | bu/a | % | % |
| 1) | Roundup (EPP) + | 1 pt | 28.4 | 86 | 75 |
| | Squadron + 2,4-DE (EPP) | 3 pt + 1/2 pt | | | |
| 2) | Roundup (EPP) + | 1 pt | 28.9 | 80 | 77 |
| | Prowl + Canopy + 2,4-DE (EPP) | 1.5 pt + 6 oz + 1/2 pt | | | |
| 3) | Roundup (EPP) | 1 pt | 29.7 | 87 | 78 |
| | Squadron + 2,4-DE (EPP) | 2 pt + 1/2 pt | | | |
| | Scepter (EP) | 1.4 oz | | | |
| 4) | Roundup (EPP) | 1 pt | 29.2 | 91 | 75 |
| | Prowl + Canopy + 2,4-DE (EPP) | 1.5 pt + 4 oz + 1/2 pt | | | |
| | Classic (EP) | 1/4 oz | | | |
| 5) | Roundup + 2,4-DE (EPP) | 1 pt + 1/2 pt | 31.2 | 95 | 89 |
| | Roundup + Squadron (PP) | 1 pt + 3 pt | | | |
| 6) | Roundup + 2,4-DE (EPP) | 1 pt + 1/2 pt | 32.3 | 95 | 92 |
| | Roundup + Prowl + Canopy (PP) | 1 pt + 1.5 pt + 6 oz | | | |
| 7) | Roundup + Prowl (EPP) | 1 pt + 1.5 pt | 28.3 | 98 | 72 |
| | Scepter + 2,4-DE (PP) | 2.8 oz + 1/2 pt | | | |
| 8) | Roundup + Prowl (EPP) | 1 pt + 1.5 pt | 31.6 | 94 | 89 |
| | Canopy + 2,4-DE (PP) | 6 oz + 1/2 pt | | | |
| 9) | Roundup + Canopy + 2,4-DE (PP) | 1 qt + 6 oz + 1/2 pt | 24.0 | 95 | 73 |
| 10) | Roundup + Scepter + 2,4-DE (PP) | 1 qt + 2.8 oz + 1/2 pt | 27.8 | 98 | 78 |
| 11) | Poast Plus + 2,4-DE (PP) | 1 pt + 1/2 pt | 20.9 | 72 | 50 |
| | Basagran + Blazer (PO) | 1 pt + 1 pt | | | |
| 12) | Control | ---- | 3.6 | 0 | 0 |
| | LSD (0.05) | | 5.6 | 11 | 10 |

All plots, except the control, also received 8 oz/a of Select, applied postemergent for fall panicum control.
EPP = early preplant (5/28), PP = preplant (6/15), EP = early postemergent (7/9), PO = postemergent (7/16)
BL = broadleaf (cocklebur and smooth pigweed); GR = grass (crabgrass and fall panicum).

# SHORT-SEASON CORN COMPARED TO GRAIN SORGHUM

James H. Long and Gary L. Kilgore[1]

## Summary

Short-season corn has done as well as grain sorghum at two locations in Southeastern Kansas. The early-planted crop spreads the work load and allows early harvest so that wheat can be planted in a timely fashion after the corn. Total receipts from short-season corn compare to those from grain sorghum. However, higher variable costs of equipment and seed for corn should be considered.

## Introduction

Short-season corn, those hybrids of 105 or less days relative maturity, can be a viable alternative crop for use in rotations that are planted back to wheat in the fall or where corn is needed for animal consumption. However, little information is available on how it compares to other summer-planted crops such as grain sorghum. This study was started to compare short-season corn to grain sorghum as a summer-planted crop. Comparisons also were made between cash returns per acre for corn and grain sorghum.

## Experimental Procedures

Two corn hybrids, DK 535 and Pioneer 3737, were planted in late March or April. Grain sorghum, Oro G Xtra, was planted at two times to coincide as closely as possible to early May and early June target dates. The soil was a Parsons silt loam.

Both crops received 100 lb/a of N and 50 lb/a of $P_2O_5$ and $K_2O$ fertilizer applied before planting. Lasso and atrazine herbicides were applied for weed control after planting. Both crops were monitored for blooming dates and maturity. Crops were harvested with a plot combine when grain was determined to be field ready. Yields were adjusted to a dry weight at 15% moisture for corn and 14% moisture for grain sorghum and reported on a bushel basis appropriate for each crop. Test weight and grain moisture were measured with a Dickey-John analyzer.

## Results and Discussion

Short-season corn generally performed as well as grain sorghum. The short-season corn outperformed the grain sorghum at Parsons in 1991 (Figure 1) and yielded nearly the same as grain sorghum at Columbus (Figure 2). In the wet years of 1992 and 1993, grain yields of both corn and grain sorghum were good, with neither holding a distinct advantage. Cash returns for the crop, before costs, indicate that the short-season corn also compared favorably to the grain sorghum (Figures 3 and 4). However, variable costs for corn were greater than for grain sorghum, mainly because of higher costs for equipment and seed.

[1]Southeast Area Extension Office.

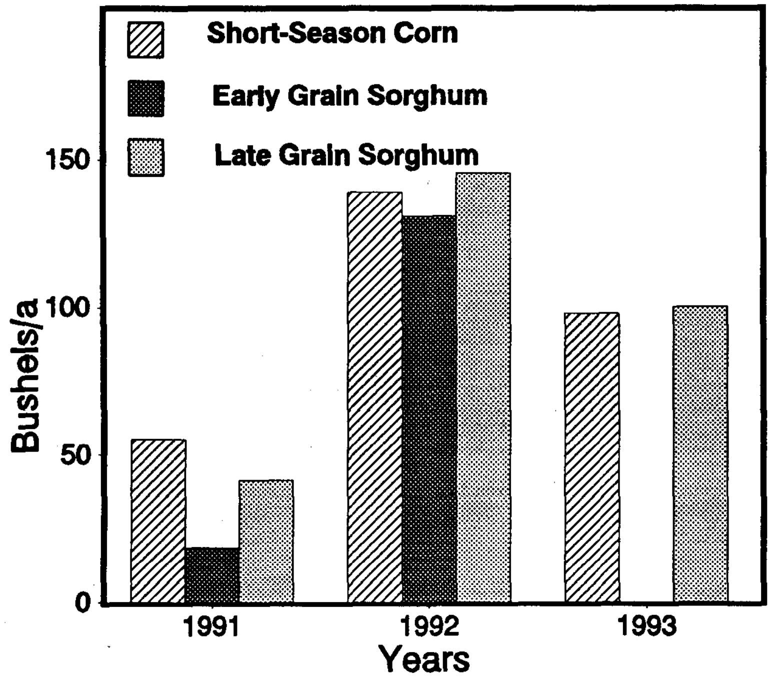


Figure 1. Grain Yield of Short-Season Corn and Grain Sorghum at Parsons.

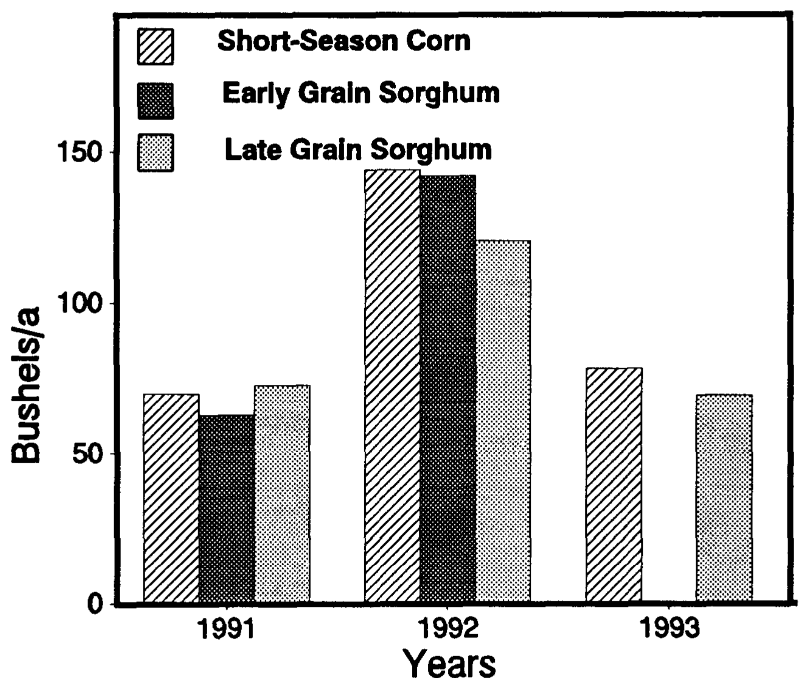


Figure 2. Grain Yield of Short-Season Corn and Grain Sorghum at Columbus.

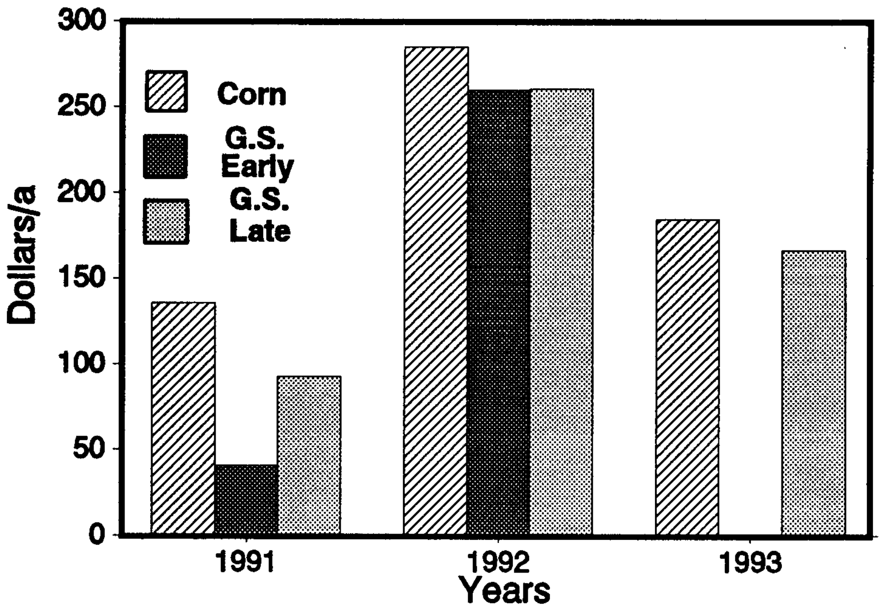


**Figure 3. Returns on Grain Sales of Short-Season Corn Compared to Grain Sorghum at Parsons.**

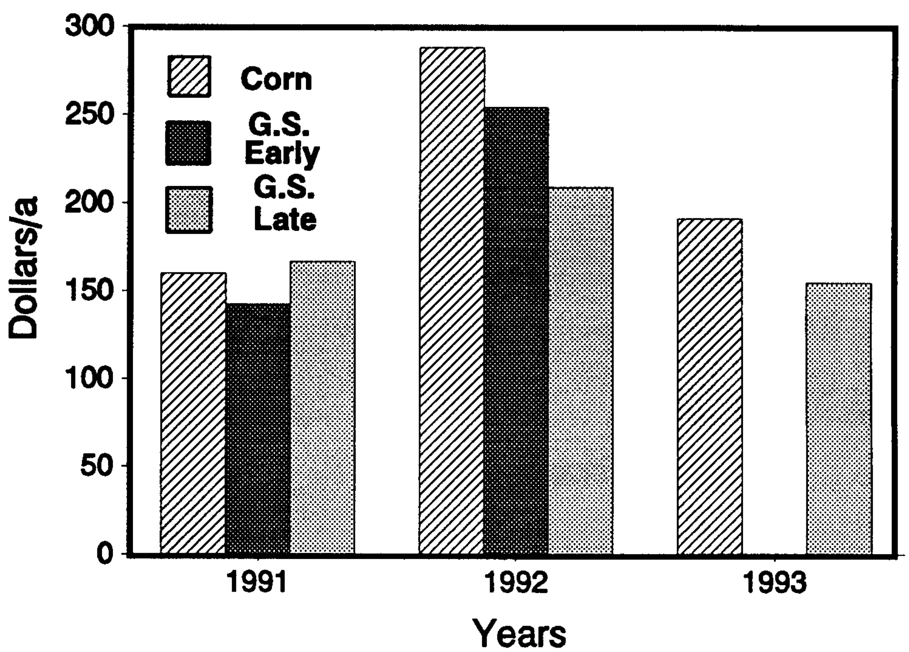


**Figure 4. Returns on Grain Sales of Short-Season Corn Compared to Grain Sorghum at Columbus.**

# SOYBEAN VARIETY TRIAL FOR CYST NEMATODE RESISTANCE

James H. Long, William T. Schapaugh[1], Ted Wary[2] and Timothy Todd[3]

## Summary

Soybeans varieties with resistance to cyst nematodes prevented as much as 50% grain yield loss over varieties without such resistance in Cherokee County, Kansas in 1991, 1992, and 1993. Severe drought occurred in 1991, whereas 1992 and 1993 were wet years. Several varieties in both Maturity Groups IV and V had very good yield potential and adequate soybean cyst nematode resistance. These could be used in suitable rotations to combat the pest.

## Introduction

The appearance of soybean cyst nematode in Southeastern Kansas has complicated the production of soybeans by requiring a definite plan to combat the pest. Part of this planning is to use varieties that are resistant to the nematode. Ongoing trials to identify adapted resistant varieties were established in an area of the southeast region, Cherokee County, known to have damaging populations of the pest.

## Experimental Procedures

Twenty three varieties of soybeans, some rated as resistant to cyst nematode, were planted on June 17, 1991, June 25, 1992, and June 16, 1993. The 1991 and 1992 tests were grown at the Soybean Cyst Nematode Research Area located on the Martin Farms in Columbus, Kansas. The 1993 test was grown on the Wilkinson Farm south of Pittsburg, Kansas. Both areas are dedicated to soybean cyst nematode research in southeastern Kansas. Seed were planted at 8 per row foot in 30-inch rows. Fertilizer application included 100 lb/a of 6-24-24 before planting in 1992. Maturities were rated in September and October, and plots were harvested with a plot combine on October 9, 1991; November 11, 1992; and November 4, 1993. Test weight and seed moisture were measured with a Dickey-John analyzer, and grain yields were adjusted to 13% moisture.

## Results and Discussion

Varieties with resistance to soybean cyst nematode prevented yield losses of 40% or more during the years 1991, 1992, and 1993 (Table 1). Resistant varieties such as ‘Manokin’, Pioneer 9521 and Delsoy 4900 averaged yields of more than 30 bu/a over the 3-year period. Susceptible varieties of similar maturity such as ‘Essex’ have average yields of only 18 bu/a during the same period. Soybean maturity grouping also may have played a role in grain yield. Over the 3 years, susceptible varieties such as maturity group V ‘Hutcheson’ averaged

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yields of 19.5 bu/a, whereas the earlier maturing, late Group IV 'Stafford' averaged yields of only 16.5 bu/a over the same period (Table 1). In 1993, Hutcheson yielded 23.4 bu/a, whereas an early Group IV variety, Flyer, yielded 18.8 bu/a.

Growing conditions in 1991 were poor, with extended drought all summer. Yields reflecting the hot dry conditions ranged from 7.5 bu/a to 20 bu/a. Growing conditions were very good in 1992, with above average rainfall for the summer and cooler than normal temperatures. A dry period in late July and early August hurt the cyst-susceptible soybean varieties because of a lack of root development. Test yields ranged from 16 bu/a to 39.5 bu/a. The year 1993 was very wet except for a short dry period during August. Yields were again generally good for those varieties that had cyst nematode resistance. Yields ranged from 18.8 bu/a to 39.2 bu/a.

More variety characteristics such as height, lodging, and maturity date can be found in 1993 Kansas Performance Tests with Soybean Varieties, Report of Progress 701, available at your local county extension office.

**Table 1. Grain Yield of Cyst-Nematode Resistant and Susceptible Soybean-Varieties at the Wilkinson and Martin Farms, 1993 and Summaries**

| | | | Race Resistance[1] | | Grain Yield | | | Average Yield | |
|---|---|---|---|---|---|---|---|---|---|
| Brand | Variety | MG[2] | 1 | 3 | 1991 | 1992 | 1993 | 2-yr | 3-yr |
| | | | | | ------------ bu/a ------------ | | | | |
| Asgrow | A4715 | IV | S | R | -- | 32.4 | 32.8 | 32.6 | -- |
| Asgrow | A5112 | V | S | R | -- | 39.5 | 32.4 | 36.0 | -- |
| Hyperformer | HY484 | IV | S | S | -- | -- | 23.2 | -- | -- |
| Hyperformer | HSC501 | V | S | R | -- | -- | 33.2 | -- | -- |
| Midland | XP471SCN | IV | -- | R | -- | -- | 36.4 | -- | -- |
| NC+ | 5A15 | V | -- | R | -- | -- | 32.5 | -- | -- |
| Pioneer | 9521 | V | -- | R | 15.7 | 38.0 | 39.2 | 38.6 | 31.0 |
| Stine | 5970 | V | -- | R | -- | -- | 33.0 | -- | |
| Terra | E4792 | IV | -- | R | -- | -- | 33.4 | | -- |
| Terra | TS499 | IV | -- | -- | -- | -- | 24.2 | -- | |
| Public | Flyer | IV | S | S | -- | 16.0 | 18.8 | 17.4 | -- |
| Public | Stafford | IV | S | S | 9.6 | 18.0 | 21.8 | 19.9 | 16.5 |
| Public | Essex | V | S | S | 7.5 | 22.4 | 22.9 | 22.7 | 17.6 |
| Public | Bay | V | S | S | 14.0 | 18.6 | 22.0 | 20.3 | 18.2 |
| Public | Hutcheson | V | S | S | 11.6 | 21.4 | 25.4 | 23.4 | 19.5 |
| Public | Avery | IV/V | S | R | 19.8 | 33.5 | 31.1 | 32.3 | 28.1 |
| Public | Delsoy 4710 | IV | S | R | | | 36.9 | -- | -- |
| Public | Delsoy 4900 | IV | R | R | 17.3 | 35.7 | 35.7 | 35.7 | 30.6 |
| Public | Manokin | IV/V | R | R | 19.9 | 37.7 | 36.2 | 37.0 | 31.3 |
| Public | Forrest | V | R | R | 20.0 | 34.5 | 34.7 | 34.6 | 29.7 |
| Public | Hartwig | V | R | R | -- | 37.9 | 34.5 | 36.2 | -- |
| Public | KS 5292 | V | S | R | 14.3 | 38.1 | 35.2 | 36.7 | 29.1 |
| Public | 1192 | IV | -- | -- | 10.7 | -- | 22.9 | | -- |
| | Average | | | | 14.2 | 31.6 | 29.5 | | |
| | L.S.D. (0.05) | | | | 2.9 | 5.5 | 2.3 | | |

[1]Resistance to either race 1 or race 3 of the soybean cyst nematode.
[2]Maturity grouping.

# PERFORMANCE TRIAL OF DOUBLE-CROP SOYBEAN VARIETIES

**James H. Long and Gary L. Kilgore**[1]

## Summary

Twenty double-crop soybean varieties were planted following winter wheat in Columbus, Kansas and evaluated for yield and other agronomic characteristics throughout the summer of 1993. Grain yields were good, and variety differences were seen under the favorable growing conditions. Yields ranged from near 18 bu/a to 30 bu/a. The short-season MG (maturity group) III and IV varieties matured during the second week of October, whereas long-season varieties in MG V matured as much as 2 weeks later. Generally, the longer the MG, the higher the pod set. 'Avery' matured in late October and set its first pods higher than other varieties maturing at the same time.

## Introduction

Double-cropped soybean is an opportunistic crop grown after winter wheat over a wide area of southeast Kansas. Because this crop is vulnerable to weather-related stress, such as drought and early frosts, it is important that the varieties have not only high yield potential under these conditions but also the plant structure to allow them to set pods high enough to allow harvest. They also should mature before a threat of frost.

## Experimental Procedures

Twenty soybean varieties were evaluated in a double-crop variety trial following winter wheat harvest at Columbus, Kansas on a Parsons silt loam soil. Wheat was harvested on July 8, 1993. The wheat stubble was burned, and the soil field cultivated twice prior to planting. Squadron was applied at 3.0 pt/a before the field cultivations. Soybeans then were planted on July 10, 1993 at seven seed per foot of row. The soybeans were harvested on October 28, 1993, with the exception of KS5292, which was harvested on November 22, 1993. The latter date was for the MG V soybean, which matured only after frost in late October.

## Results and Discussion

Yields ranged from 18 bu/a to 30.2 bu/a. The varieties Ohlde 4510, Golden Harvest H-1483, Pioneer 9491, Jacques 396, and NK 44-77 all yielded more than 27 bu/a. Careful consideration should be given to maturity and the height to the first pod. The height to the first pod ranged from 1 in to 4 in. The public variety 'Avery' had the first pods 4 in from the ground. Most varieties matured before October 20, yet one-third of those tested matured later. The lateness of most varieties was caused by the very late planting date in July.

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[1]Southeast Area Extension Office.

**Table 1. Yield of Double-Crop Variety Trial for Soybeans at Parsons, Kansas, 1993**

| Brand | Variety | MG | Yield 1992 | Yield 1993 | Yield 2yr | 1993 Characteristics Ht | Ht to 1st pod | Test wt | Mat |
|---|---|---|---|---|---|---|---|---|---|
| | | | --------bu/a---------- | | | ----------in--------- | | lb/bu | Oct |
| Golden Harvest | 1388 | III | -- | 18.7 | -- | 15.7 | 1.3 | 55.1 | 8.0 |
| Golden Harvest | 1483 | IV | 39.8 | 30.2 | 35.0 | 26.3 | 3.0 | 56.6 | 19.0 |
| Jacques | 396 | III | 36.8 | 27.1 | 32.0 | 18.0 | 1.7 | 55.6 | 14.3 |
| Jacques | 399 | III | -- | 24.5 | -- | 16.7 | 1.7 | 56.9 | 10.7 |
| Jacques | 467 | IV | 35.7 | 26.5 | 31.1 | 20.0 | 2.0 | 57.7 | 22.7 |
| Midland | 8393 | III | -- | 18.6 | -- | 17.7 | 1.3 | 56.7 | 10.7 |
| Midland | 8410 | IV | -- | 24.9 | -- | 17.0 | 1.0 | 55.8 | 12.0 |
| NK | S44-77 | IV | 35.6 | 27.1 | 31.3 | 20.7 | 1.7 | 56.4 | 13.3 |
| NK | S46-44 | IV | - - | 25.4 | - - | 17.7 | 2.3 | 55.6 | 17.7 |
| Ohlde | 4386 | IV | 41.2 | 25.1 | 33.2 | 22.0 | 2.0 | 56.2 | 19.3 |
| Ohlde | **4440** | IV | -- | 23.6 | - - | 19.7 | 2.0 | 55.6 | 19.7 |
| Ohlde | 4510 | IV | -- | 30.0 | -- | 23.3 | 2.7 | 56.6 | 21.7 |
| Pioneer | 9411 | IV | -- | 24.0 | -- | 19.7 | 1.3 | 56.1 | 10.0 |
| Pioneer | 9491 | IV | -- | 27.5 | -- | 15.7 | 3.0 | 56.1 | 23.3 |
| Stine | 4190 | IV | -- | 24.2 | -- | 25.3 | 2.0 | 56.6 | 20.7 |
| Terra | TS 402 | IV | 33.5 | 21.7 | 27.6 | 17.0 | 1.0 | 56.3 | 13.0 |
| Terra | E4292 | V | - - | 19.0 | -- | 14.0 | 1.3 | 55.9 | 17.0 |
| Public | Flyer | IV | 32.5 | 18.2 | 25.4 | 15.7 | 1.0 | 56.5 | 11.0 |
| Public | Avery | IV | 33.5 | 24.8 | 29.2 | 26.0 | 4.0 | 54.5 | 23.0 |
| Public | KS5292 | V | 38.3 | 23.6 | 31.0 | 20.8 | 3.3 | 55.1 | 11/l |
| (L.S.D. 0.05) | | | 5.1 | 7.0 | | 3.5 | 1.0 | 1.0 | 3.4 |

SOUTHEAST KANSAS BRANCH EXPERIMENT STATION
KANSAS STATE UNIVERSITY

## VARIETY RESISTANCE AND ROTATIONS FOR SOYBEAN CYST NEMATODE

**James H. Long and Timothy Todd**[1]

### Summary

The keys to reducing the effect of soybean cyst nematode include the use of resistant soybean varieties and rotation of crops to minimize its impact. Results from the cyst nematode management studies at the Martin Farms Research Area in Columbus indicate that the effect of using resistant' varieties is greater than previously thought. Rotation also reduces the impact of the cyst nematode. However, results from 3 years show that holding a field out of susceptible soybean varieties for 1 or 2 years may not be sufficient time to overcome the problem.

### Introduction

The soybean cyst nematode (SCN) is a serious problem in the eastern U.S. It is persistent in the soil and will continually rob soybean yield if good management practices are not used each year. Many cropping strategies, including resistant varieties, have been used to overcome this pest, yet it has now spread to Kansas.

Each region of the U.S. has had to develop locally adapted soybean varieties and cropping rotations suited for that area's agricultural soils and climate. Southeast Kansas is a region with shallow clay-pan soils that are drought prone and a climate that permits growth of long maturity crops such as MG (maturity group) V soybeans. Because of the need to develop cropping strategies and evaluate varietal resistance under southeast Kansas conditions, a study was started in 1991 at the Martin Farms Cyst Nematode Research Area in Columbus, Kansas.

### Experimental Procedures

Six cropping systems ranging from 0 to 3 years out of susceptible soybeans and with no soybeans were started in 1991. The systems include:

1. Continuous susceptible soybeans. (No crop rotation)
2. Grain sorghum followed by susceptible soybeans (1 year out).
3. Grain sorghum followed by a small grain that is followed by susceptible soybeans (2 years out).
4. Grain sorghum followed by resistant soybeans followed by grain sorghum then susceptible soybeans (3 years out).
5. Grain sorghum followed by a small grain that is double-cropped to resistant soybeans followed by grain sorghum then a small grain double-cropped to susceptible soybeans (3 years out).
6. Grain sorghum followed by a small grain (no rotation to soybeans).

The susceptible soybean variety was 'Bay' and the resistant variety was 'Pioneer 9531', both early to mid MG V soybeans. Two sister

[1] Department of Plant Pathology, KSU.

studies with the same rotations were run. One was on heavily infested soils at the Martin Farms Cyst Nematode Research Area, and the second was at the Southeast Branch Experiment Station - Columbus Field, an area that has no detectable levels of the cyst nematode.

## Results and Discussion

After 3 years, differences could be seen in 1993 (Figure 1). The continuous susceptible Bay soybeans at Martin Farms in 1993 yielded only two-thirds as much as the resistant variety, Pioneer 9531, that is being grown in rotation. The continuous Bay variety also ended 1993 with 10 times the eggs/100 $cm^3$ found for Pioneer 9531 in rotation (Figure 2). After 3 years, some rotations have been held out of soybeans for 2 years. Grain yield (Figure 1) and cyst nematode (Figure 2) differences among rotations, seen in 1992 when soybeans were grown after a nonsusceptible crop, were not evident in 1993. This is probably due to several factors, one of which is high rainfall that enabled continuous susceptible soybeans to grow relatively well. Grain yield of susceptible soybeans then is very dependent on rainfall during the growing season. In addition, yields of susceptible soybeans after 2 years out of soybeans still did not equal resistant soybeans yields. This may be due to egg and cyst levels developing rapidly during the growing season on susceptible soybeans, even when crop rotation gave relatively low early season levels of the pest. Indications are that holding fields out of susceptible soybeans for 2 years may not be enough time to completely overcome the cyst nematode and allow the planting of susceptible soybeans.

It is still too early to draw conclusions about individual rotations in the study, because some are not yet through a complete cycle of 4 years. However, results indicate that crop rotation can have an impact on grain yield and cyst numbers, depending on the year. Selection of a resistant variety has the most consistent and largest effect on grain yield.

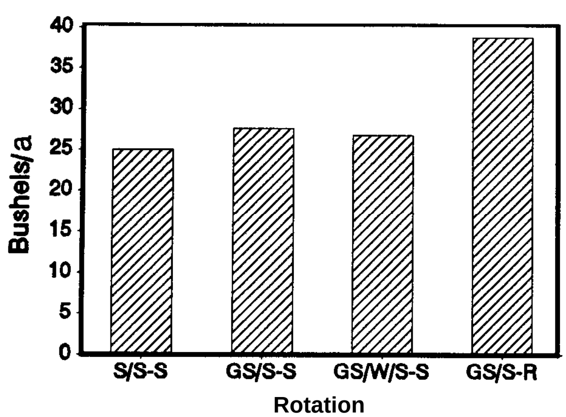



**Figure 1. Effect of Crop Rotation on Soybean Grain Yield on Cyst Nematode-Infected Soils in 1993.**

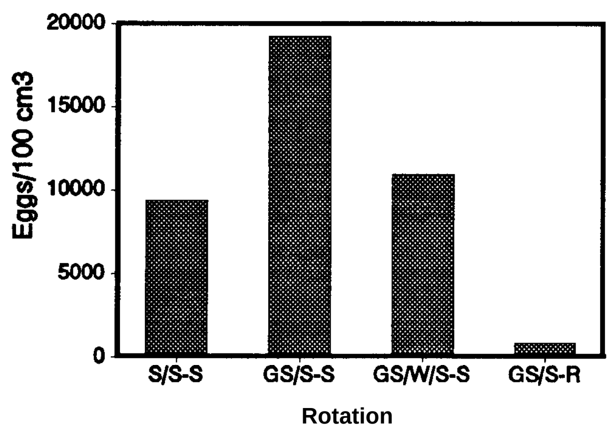



**Figure 2. Effect of Crop Rotation on Cyst Nematode Egg Numbers in Cyst Nematode-Infected Soils in 1993.**

# THE EFFECT OF CROP ROTATION ON CHARCOAL ROT AND SOYBEAN GRAIN YIELD

**James H. Long, Timothy Todd[1], Daniel Sweeney, and George Granade[2]**

## Summary

Rotating from corn to soybean benefits both crops, however, the positive effects on the soybean crop are not well understood. Levels of the plant disease, charcoal rot *(Macrophomina phaseolina)*, were followed on soybeans grown continuously and in rotation with corn. Soybean grain yield increased 12% and charcoal rot colonies decreased 50% when soybean was grown in rotation with corn. Crop rotation increased grain yield in soybeans by conserving pods on the plant and by increasing the total number of seed produced by the plant.

## Introduction

Charcoal rot, a plant disease widespread in Kansas, can reduce the yield of soybean and other crops. It rapidly infests the plant during early reproductive growth and adversely affects the plant's root system and lower stem. No genetic resistance is known, although longer maturity varieties may escape the most devastating effects of the disease by setting pods later in the summer when rainfall is more likely and temperatures are cooler.

Crop rotation is known to increase the yield of soybeans, although the reasons are uncertain. In an effort to better define the effect of crop rotation on soybean, a field study was begun in 1988 and run until 1992 to compare grain yield and plant disease levels of continuously grown soybean with soybean following corn. Feathery and restricted colonies of the disease, known to affect soybean, were counted.

## Experimental Procedures

Several cropping systems were established in 1988 at the Columbus unit of the Southeast Kansas Experiment Station to help determine the effect of crop rotation on soybean. Two of the systems will be reported on and include:

1. Continuous soybeans.
2. Soybeans for 1 year then corn.

The early MG (maturity group) IV variety Spencer was used from 1988 to 1990 during the first complete cycle of the rotation, whereas Flyer was used during the second cycle for 1991 and 1992. Data were recorded from 1989 to 1992 (the year 1988 was excluded, because it was the establishment year) and included grain yield, yield components, and charcoal rot colonies from the roots of the soybean plants. The soil was a Parsons silt Loam (Mollic Albaqualf). Rainfall averages 41 in/yr at the site.

## Results and Discussion

Charcoal rot developed rapidly on the lateral root system of soybeans after the plants reached the early reproductive stage (R2-3) around July

[1]Department of Plant Pathology, KSU.

[2]Former Crop Variety Development Agronomist at Southeast Kansas Experiment Station.

27 (Figure 1). An increase of 2000 colonies/g of root occurred during a 4-week period from July 27 to August 25. This was a period of intense flowering and early pod setting by the soybean plant. Continuous soybeans at plant maturity (R7) had double the colonies/g root of plants grown in rotation (Table 1).

This reduction of charcoal rot through crop rotation benefitted grain yield of the crop by conserving pods and by increasing the number of seed produced by each plant (Table 2).

**Table 1. Effect of Crop Rotation on Charcoal Rot Numbers and Grain Yield**

| Cropping System | Charcoal Rot | Grain Yield |
|---|---|---|
| | log colonies/g | bu/a |
| Soy-Soy | 3.29 | 20.8 |
| Soy-Corn | 3.07 | 23.6 |
| L.S.D.(.05) | 0.18 | 2.7 |

**Table 2. Effect of Crop Rotation on Grain Yield Components**

| Cropping System | Pods | Seed |
|---|---|---|
| | -----no/m of row------ | |
| Soy-Soy | 497 | 1030 |
| Soy-Corn | 590 | 1200 |
| L.S.D. (.05) | 74 | 135 |

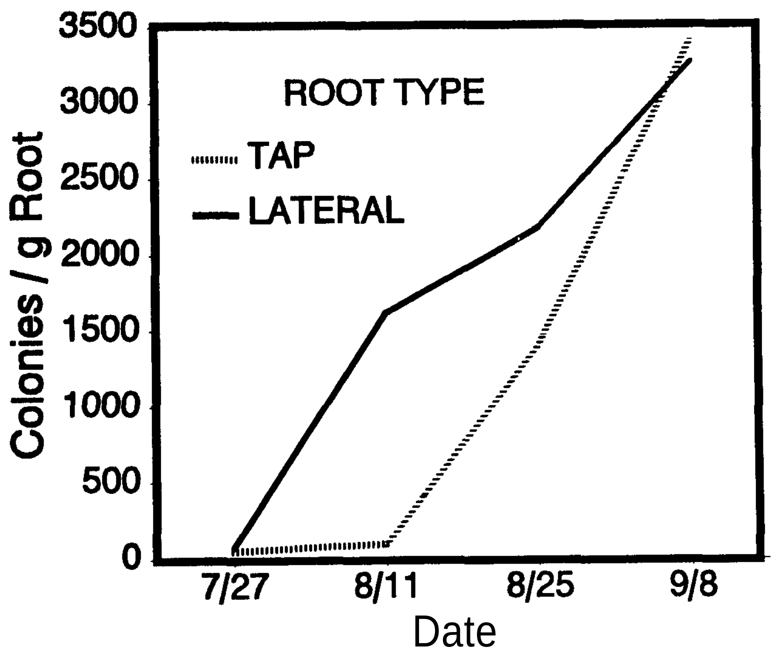



**Figure 1. Seasonal Colony Development of Charcoal Rot on Soybean Roots**

# ANNUAL WEATHER SUMMARY FOR PARSONS - 1993

**Mary Knapp**[1]

## 1993 DATA

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Avg. Max | 38.1 | 42.0 | 52.3 | 61.1 | 71.9 | 82.2 | 89.3 | 90.4 | 75.7 | 65.5 | 50.6 | 47.1 | 63.8 |
| Avg. Mm | 21.9 | 24.5 | 33.4 | 42.9 | 54.4 | 64.4 | 70.9 | 68.2 | 53.4 | 41.3 | 30.2 | 36.9 | 45.2 |
| Avg. Mean | 30.0 | 33.2 | 42.8 | 52.0 | 63.1 | 73.3 | 80.1 | 79.3 | 64.5 | 53.4 | 40.4 | 36.9 | 54.1 |
| Precip | 1.89 | 1.73 | 2.84 | 2.37 | 10.22 | 5.62 | 5.05 | 2.29 | 13.87 | 1.37 | 2.38 | 1.75 | 51.38 |
| Snow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2 | 7 |
| Heat DD* | 1088 | 820 | 598 | 261 | 88 | 0 | 0 | 0 | 31 | 220 | 561 | 939 | 4606 |
| Cool DD* | 0 | 0 | 0 | 21 | 125 | 294 | 474 | 412 | 190 | 46 | 0 | 0 | 1562 |
| Rain Days | 8 | 6 | 12 | 11 | 16 | 14 | 14 | 8 | 7 | 7 | 5 | 4 | 112 |
| Min < 10 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Max ≥ 90 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 20 | 0 | 0 | 0 | 0 | 30 |
| Min ≤ 32 | 30 | 22 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 15 | 25 | 107 |

## NORMAL (1961-1990 Average)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Avg. Max | 40.5 | 46.6 | 57.1 | 68.2 | 76.8 | 85.2 | 91.7 | 90.1 | 81.5 | 71.3 | 56.8 | 44.5 | 67.5 |
| Avg. Min | 19.3 | 24.8 | 34.2 | 45.8 | 55.5 | 64.1 | 69.0 | 66.4 | 59.1 | 47.3 | 35.7 | 24.8 | 45.5 |
| Avg. Mean | 29.9 | 35.7 | 45.7 | 57.0 | 66.2 | 74.7 | 80.3 | 78.3 | 70.3 | 59.4 | 46.3 | 34.7 | 56.5 |
| Precip | 1.32 | 1.46 | 3.40 | 3.80 | 5.26 | 4.61 | 3.15 | 3.63 | 4.80 | 3.92 | 2.91 | 1.76 | 40.02 |
| Snow | 2 | 3 | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 8.5 |
| Heat DD* | 1001 | 742 | 565 | 209 | 59 | 6 | 0 | 0 | 24 | 173 | 528 | 849 | 4156 |
| Cool DD* | 0 | 0 | 10 | 29 | 143 | 339 | 505 | 462 | 237 | 58 | 0 | 0 | 1783 |

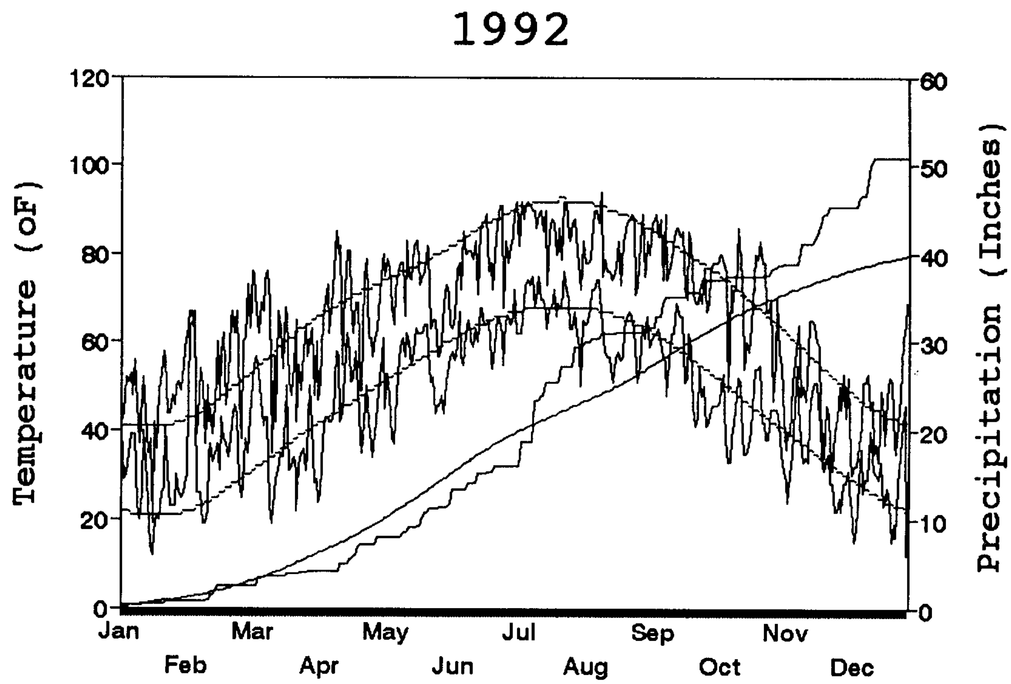
## DEPARTURE FROM NORMAL

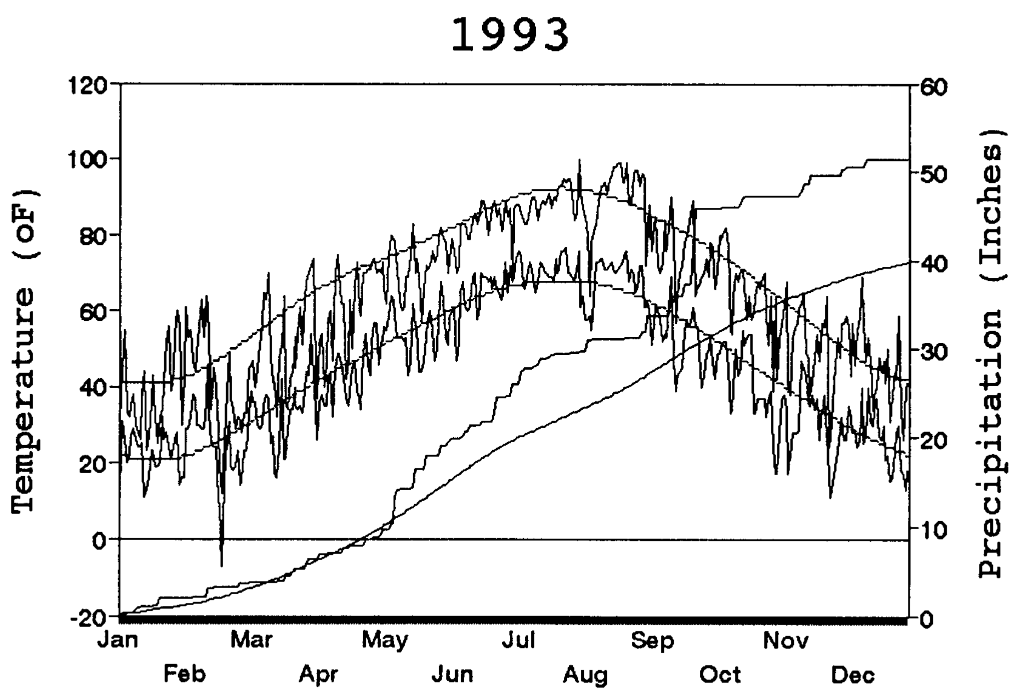
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Avg. Max | -2.4 | -4.6 | -4.8 | -7.1 | -4.9 | -3.0 | -2.4 | 0.3 | -5.8 | -5.8 | -6.2 | 2.6 | -3.7 |
| Avg. Min | 2.6 | -0.3 | -0.8 | -2.9 | -1.1 | 0.3 | 1.9 | 1.8 | -5.7 | -6.0 | -5.5 | 12.1 | -0.3 |
| Avg. Mean | 0.1 | -2.5 | -2.9 | -5.0 | -3.1 | -1.4 | -0.2 | 1.0 | -5.8 | -6.0 | -5.9 | 2.2 | -2.4 |
| Precip | 0.57 | 0.27 | -0.56 | -1.43 | 4.96 | 1.01 | 1.90 | -1.34 | 9.07 | -2.55 | -0.53 | -0.01 | 11.36 |
| Snow | -2 | -3 | -2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | -2 |
| Heat DD* | 87 | 78 | 33 | 52 | 29 | -6 | 0 | 0 | 7 | 47 | 33 | 90 | 450 |
| Cool DD* | 0 | 0 | -10 | -8 | -18 | -45 | -31 | -50 | -47 | -12 | 0 | 0 | -221 |

* Daily values were computed from mean temperatures. Each degree that a day's mean temperature is below (or above) 65" F is counted as one heating (or cooling) degree day.

[1]Weather Data Library, KSU.

# WEATHER SUMMARY FOR PARSONS



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Contribution No. 94-444-S from the Kansas Agricultural Experiment Station.

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