problem. However, it has been effective job. (Elwell et al., 1950; chemical plant killers do a more the woods in the spring has been been to find ways to control the traditional way to solve this demonstrated that the new undesirable hardwood. Burning the woods in the spring has been the traditional way to solve this problem. However, it has been demonstrated that the new chemical plant killers do a more effective job. (Elwell et al., 1950; Elwell et al., 1954; Martin et al., 1954; Silker and Darrow, 1956; Koshi et al., 1954).

An opportunity arose in 1952 to evaluate the effect of both a typical spring burn and herbicides on herbage yield and composition when an accidental fire burned over part of a study area where herbicides were to be tested to control unwanted hardwoods.

The study was made in Dent County, about 10 miles east of Salem, Missouri, on rolling land with moderate slopes. The soil is a Clarksville stony loam with a surface that consists mainly of cherty stones covered by a light leaf litter.

Forest cover in the area is primarily blackjack (*Quercus marilandica*) and post oak (*Q. Stellata*) with some black oak (*Q. velutina*), hickory (*Carya*), sassafras (*Sassafras albidum*), and other hardwood species. The stand studied consisted almost entirely of sprouts about 6 to 10 feet high. A few sapling, pole-size and larger trees were on the area, and some shrubs such as sumac (*Rhus*) and blueberry (*Vaccinium*) occurred in the understory. Herbaceous vegetation consisted mostly of unpalatable species such as goatstrue (*Tephrosia virginiana*). Little bluestem (*Andropogon scoparius*), the predominant grass in the study area, was rather uniformly distributed, although the plants were in general spindly and of low vigor.

Periodic burning and grazing had long been common in this area except for several years just before the start of the study. The fire which occurred on May 11, 1955, burned an area of about 20 acres.

The herbicide was Estron 2,4,5-T applied in early June at a rate of 4 pounds acid per hundred gallons of an oil-water emulsion. It was sprayed on the smaller trees with hand equipment until the foliage was dripping. The larger trees on the study area had been girdled in June 1952.

Nine rod-square plots were randomly selected on each of the sprayed, burned, and control areas. Herbage yield (clipping to a height of 1 inch) and composition measurements were made on 4 randomly located 2.4 square-foot quadrats in each rod-square plot. Estimates of tree cover were based on 40 observations on each rod-square plot and used as a measure of hardwood competition.

**Results and Discussion**

Sprayed areas produced more herbage of quality than either spring burned on control areas. Spring burning in fact did not significantly increase total yield at all. Five years after treatment with 2,4,5-T, total herbage yield on sprayed areas was about 4.5 times greater than on burned areas and about 5.5 times greater than on control areas (Figure 1). Little bluestem and other perennial grasses accounted for prac-
Figure 1. A, plot sprayed in 1952 with 2,4,5-T. Average yield of sprayed plots in 1957 was 1210 pounds per acre (oven-dry). Predominant species was little bluestem. B, plot burned in 1952. Average yield of burned plots in 1957 was 270 pounds per acre (oven-dry). Predominant herbaceous species was goatsrue. Photographed summer of 1957.

Table 1. Yield of herbage in 1957.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Little bluestem (Pounds per acre, oven-dry)</th>
<th>Other perennial Grasses</th>
<th>Goatsrue</th>
<th>Other forbs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide</td>
<td>800</td>
<td>180</td>
<td>120</td>
<td>110</td>
<td>1,210</td>
</tr>
<tr>
<td>Burn</td>
<td>70</td>
<td>5</td>
<td>135</td>
<td>60</td>
<td>270</td>
</tr>
<tr>
<td>Control</td>
<td>50</td>
<td>10</td>
<td>120</td>
<td>40</td>
<td>220</td>
</tr>
</tbody>
</table>

Two other very palatable native grasses—Indiangrass (*sorghastrum nutans*) and switchgrass (*Panicum virgatum*)—yielded about 100 pounds per acre on the sprayed areas and nothing on burned or control areas.

One unpalatable legume—goatsrue—yielded more than all other forbs combined. There was no significant difference in yield of goatsrue among sprayed, burned, and control areas. However, this legume contributed only about 10 percent of the total herbage yield from sprayed areas, whereas it made up more than half the total yield from burned and control areas.

Only about 12 percent of the total yield on sprayed areas was made up of unpalatable plants, whereas about 65 percent of the total yield from burned and control areas consisted of unpalatable plants. Therefore, not only was total yield greater from sprayed areas, but quality of the forage was better.

From this study, then, it would appear that spraying wooded range with herbicides will result in a more complete and permanent release of herbaceous vegetation than can be obtained by spring burning.

**LITERATURE CITED**


Establishment of perennial grasses on abandoned fields of the Southern Great Plains is one of the most difficult tasks, and yet probably the major need, of the agriculture of that area. The low seedling vigor of some of the adapted grasses, the high temperature, eroding wind, and erratic rainfall of the area, coupled with low soil fertility of the usual seeding sites make establishment very difficult and uncertain.

The problem soils occupy areas that were cultivated one to three decades and then abandoned when soil erosion, depleted fertility, and economic conditions made further cropping unprofitable. The application of fertilizer as an aid to establishment of grass seedings has not received wide attention in this area. Investigations and demonstrations in the Southern Great Plains have shown that fertilizer additions to established stands of native grasses have usually given slight to nonsignificant increases in herbage production (Aldous, 1935; Frolik, 1941; Harper, 1957). Topdressings of phosphorus have usually been reported as increasing the phosphorous content of herbage but not the yield. Duncan and Ohlrogge (1958) showed that corn roots treated with a nitrogen-phosphorous fertilizer produced root proliferation and herbage yields that were not produced when only one fertilizer element was added. Walker, et al (1958), working in the Texas Panhandle, did not obtain a significant fertilizer response from band seeded native range grasses.

This investigation was made to evaluate band applications of fertilizer on initial growth and establishment of certain grasses. Adapted species, once established, are not difficult to maintain if proper grazing management is followed.

Procedure

Renfrow sandy clay loam was taken from the eroded surface of a field at the Noble Foundation's Lone Grove Farm and placed in a greenhouse bench. This field, used later for field experiments, had been out of cultivation for a decade or more. The experimental soil contained 1.4 percent organic matter, 140 pounds per acre of exchangeable K$_2$O, "very low" available phosphorous, and had a pH of 6.1.

King Ranch bluestem (Adropogon ischaemenum), weeping lovegrass (Eragrostis curvula), Caddo switchgrass (Panicum virgatum), and blue panicgrass (Panicum antidotale), were seeded in the soil in a greenhouse bench experiment. Quantities of fertilizer equivalent to 100 pounds per acre were banded with the seed in rows 14 inches apart. The rates of N, P$_2$O$_5$ and K-O applied are given in Table 1. A split plot design with two replications were employed. The grass was planted in late winter 1955, permitted to grow seven weeks, and harvested at soil level.

In the spring of 1955, 1956, and 1957 band seedings of grasses were made in the field. Fertilizer treatments and species planted varied from year to year. The 1955 planting was made in early June with a hand-pushed belt planter. The fertilizer and seed were mixed and planted in the same row. A 14-inch row width was used. This planting was irrigated once in mid-July. The 1955 planting was replicated five times. The 1956 and 1957 plantings were made in triplicate with a Servis Planter which placed the fertilizer two inches below the seed. These rows were 18 inches apart. Plantings were made on March 28, May 8, and June 11 in 1956; and on March 13, April 17, and June 8 in 1957 in prepared seedbeds. Yields were measured by harvesting the herbage at the end of the growing season.

Results

Weeping lovegrass was always the first to emerge. King Ranch bluestem was the slowest but continued to emerge over a period of several weeks.

Data from the greenhouse planting, summarized in Table 1, show that nitrogen alone was of no value. Phosphorous gave a