Hardinggrass and Annual Legume Production in the Sierra Foothills[1]

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Highlight

Seeding trials at the Sierra Foothill Range Field Station show that total forage production can be doubled by sowing annual clovers. Also increased were the quantity and quality of winter feed. Winter feed was increased further by planting hardinggrass with the legumes. Results were similar on the two soil types involved.

The recently acquired University of California Sierra Foothill Range Field Station will be the site of many range-livestock experiments. Many of the experiments will involve the grazing of forage plants introduced to increase the quantity and quality of livestock and game forages and improve the seasonal distribution of forage.

Jones (1967) showed that seeding the annual legume subclover (*Trifolium subterraneum* L.) was as effective as nitrogen fertilization in increasing winter forage. Jones and Winans (1967) showed that the protein content of forage in the dry season was increased more by seeding subclover than by nitrogen fertilization. Williams et al. (1957) discussed the general advantages of seeding annual clovers and fertilizing with phosphorus and sulfur, and showed forage increases of over 200%.

The ideal companion crop to be grown with winter annual legumes is hardinggrass (*Phalaris tuberosa* L. var. *stenoptera* (Hack.) Hitchc.). This perennial adds stability to the range feed by growing earlier in the winter, and helps provide a sod so livestock can graze the area during the rainy period (Love et al., 1953). It is one of the most durable dry-land grasses (Love and Jones, 1952).

Oram and Hoen (1967) report that cultivars of phalaris (*Phalaris tuberosa* L.) and cocksfoot (*Dactylis glomerata* L.) along with subclover are superior to annual grass species for long-term pastures in Australia. For short-term rotations (up to three years) the annuals are satisfactory with subclover. After three years, however, the pastures tend to become grass-dominant with such low-value species as barleygrass (*Hordeum leporinum* Link) and annual fescues (*Festuca* spp.). A similar succession has been observed many times in subclover stands in California. The presence of hardinggrass will help utilize the abundance of nitrogen produced by subclover and thus retard grass dominance. Hard-

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inggrass will also utilize late-season moisture to a greater degree than annual grass plus subclover, and combat the invasion of weedy summer annual plants such as tarweed (*Holocarpha virgata* (Gray) Keck.) (Green et al., 1957).

Although hardinggrass and annual clovers have been recognized for nearly 20 years as excellent promoters and stabilizers of forage production in California, they are still less widely grown than their high production would justify. Further demonstration of their merit seems warranted in an effort to stimulate their acceptance. With increasing land values and taxes this seems an obvious means of increasing and stabilizing a livestock enterprise.

Preliminary seeding trials were, therefore, established in the fall of 1962 at the Sierra Foothill Range Field Station to demonstrate the values of certain agronomic practices which might later be recommended for pasture-size grazing trials at the Station.

Procedure

The climate of the Field Station, at an elevation of 300 to 2,000 ft on the east side of the Sacramento Valley, is Mediterranean, with cold wet winters and hot dry summers. Rainfall, restricted to the period Oct. 15 to April 15, averages about 24 inches per annum.

The soils are a complex of the Argonaut and Auburn series. Each generally covers an area of less than 2.5 acres (as little as a few milacres) before changing to the other. They are found on both the north and south slopes, and are generally covered with a more or less open woodland. The dominant woody species is blue oak (*Quercus douglasii* H. & A.).

The Auburn series is described as a reddish-brown gravelly loam, slightly acid, which may or may not have a B_2 horizon of reddish-brown clay loam. Total soil depth is 10 to 20 inches.

The Argonaut series is a reddish-brown or brown loam, slightly acid, up to 15 inches deep in the A horizon. This is underlain by a cobbly clay loam of about 5 inches in the B_1 horizon and up to 20 inches of neutral reddish-brown clay in the B_2 horizon. Total soil depth may be as much as 40 inches, twice the depth of the Auburn series.

Both soils are underlain by fractured and decomposed metamorphosed basic igneous rock (greenstone). Plant roots penetrate this fractured lower profile of both soils, but are found in greater abundance in the Auburn series.

The following commonly seeded varieties were compared: Mt. Barker subclover, Wilton rose clover (*T hirtum* All.), and a mixture of rose clover, subclover, and hardinggrass. These, in turn, were compared with unfertilized resident range species. The most abundant resident species were soft chess (*Bromus mollis* L.), silver hairgrass (*Aira caryophyllea* L.), bur clover (*Medicago hispida* Gaertn.), and broadleaf filaree (*Erodium botrys* Bertol.). The clovers were seeded at 10 lb/acre and hardinggrass at 4 lb/acre.

The three seeding treatments were applied to Auburn and Argonaut soils in four 15-ft rows spaced 22 inches apart in 4 to 6 replications on a NW slope at 650 ft elevation. Identical trials were also established on both soils on a SW slope at 1150 ft. Oak trees were first removed from each of the four experimental areas, and a strip about 50 ft wide was cleared around each plot to remove any shade influence.

All seedings were band-fertilized (beneath the seed) with single super-phosphate at 200 lb/acre at the time of planting. An additional broadcast application of single superphosphate at 300 lb/acre was made each fall during the study.

The sites were prepared by cultivation following the first rain in the fall of 1962, which resulted in excellent weed control. Frost heaving was a problem, particularly on the northwest exposure. Some reseeding of rose and subclover was necessary in the following year, but on the northwest sites only. Frost heaving was not a problem where hardinggrass was seeded with the clovers. No reason for this was apparent.

Forage yields were taken throughout the second and third growing seasons of the seeding. Forage was clipped to a 2-inch height periodically during the growing season. An area of 24 × 22 inches was clipped, the harvest was oven-dried, and the remainder of the plot was cut at 2 inches with a rotary lawnmower. At the end of each growing season the yields of all seeding treatments were measured by cutting to ground level. The remainder of the plot (not included in this final sample) was mowed at 2 inches and removed from the experimental area in the late summer.

Results and Discussion

Total forage production.—In both years all seeding treatments nearly doubled total seasonal forage production over that of the resident vegetation (Fig. 1). The increase is assumed to be due both to nitrogen fixation by the planted legumes and to the sulfur and phosphorus fertilizer. All seeded legumes were inoculated immediately before being planted into moist soil. Legume plants were well nodulated, with large pink nodules near the crown of the plant. This nitrogen stimulated the growth of both the clover and associated grass plants in following years.

Total production was increased further in 1964–65 by the presence of hardinggrass. The mixture of hardinggrass and clovers produced more forage than the clovers alone (significant at the .05 level) in 1964–65, but not in 1963–64. This difference between years may be due in part to the additional

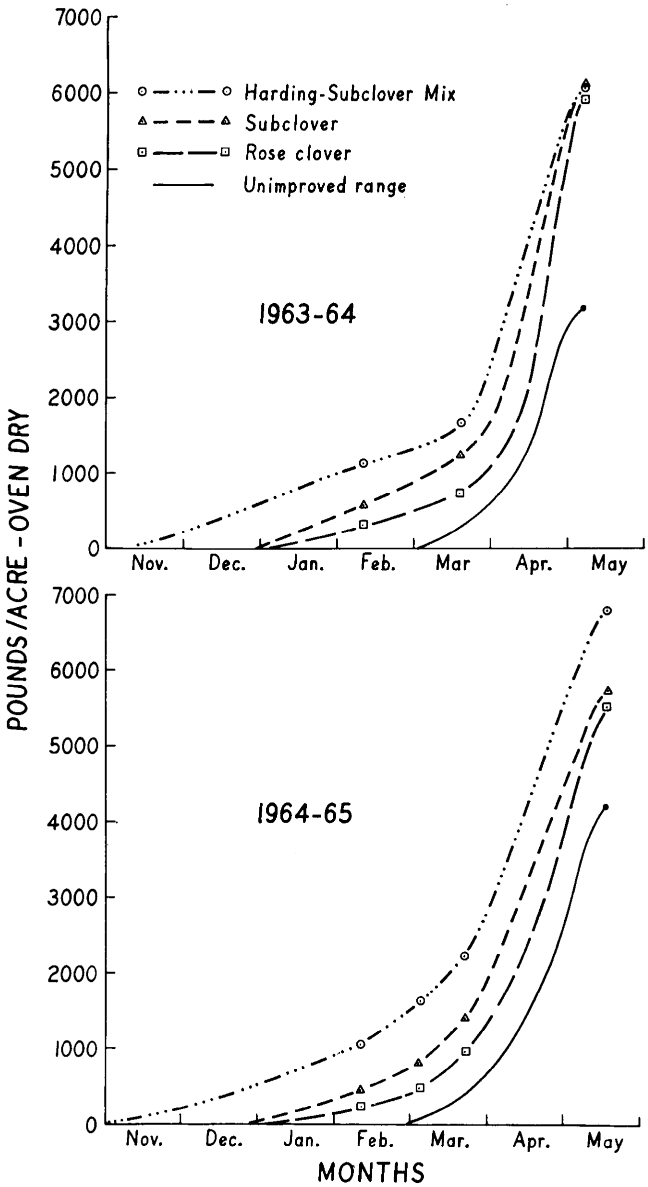

FIG. 1. Cumulative forage yields, 1963–1964, and 1964–1965.

age of the hardinggrass (3 yrs old in 1964–65). Miller et al. (1953) found that hardinggrass planted on a fall-prepared seedbed did not reach maturity until the fourth growing season.

In neither year was total yield affected by soil type or exposure.

Winter forage production.—Perhaps of greater importance than total forage production is production in winter, the most critical feed period in local livestock operations. Even though soil moisture is adequate, the lower temperatures permit only minimal plant growth.

In the winter, all seedings produced significantly more forage than did the resident range species. Again, the difference was due primarily to the nitrogen fixed by the legume bacteria. Much of the early growth harvested after legume seeding was not the legumes but the resident annual grasses, responding to nitrogen fixed by the legume crop of the previous season.

Subclover produced more winter feed than did rose clover (significant at the .01 level). This difference was more pronounced on the NW (colder) slopes. The SW slopes generally produced higher winter forage yields of all species than the NW slopes. The SW slopes also dried out earlier in the spring. These differences, though observed consistently, were not statistically significant.

It was during the winter that hardinggrass proved its worth. The mixture of hardinggrass and legumes consistently produced more winter feed on all soils and exposures than did the clovers plus the resident annual grasses. The difference can be attributed to the extensive well-established root system of the perennial grass. The resident annuals were hardly sprouted before winter temperatures restricted their growth.

There was a significant interaction between exposures and seeding treatments, but never a difference due to soil type. In designing the experiment it was thought that the clay layer beneath the Argonaut soil might serve as a moisture reservoir and result in higher forage production, particularly of hardinggrass. In fact, the weathered layer beneath the Auburn soil apparently serves this purpose equally well.

The hardinggrass was damaged severely by clipping at the end of the growing season, when the hardinggrass and clovers were still green but the soil moisture was nearly exhausted. Hardinggrass plants in these 24 × 22-inch areas were slower to recover in the following fall than the remainder of the plot, and the difference could be detected throughout the following growing season. It would appear that close grazing in the late season will severely reduce winter production. McKell et al. (1966) also found that frequent clipping during the most active growing period reduced yields and increased plant death. Miller et al. (1957) found that early-plus-late cutting (cut at the end of the green feed period) retained the vigor of hardinggrass. They recognized that other studies have shown reduced vigor, and suggest that annual application of ammonium phosphate plus a desirable percentage of subclover compensated for the effects of the harvesting method. Further studies appear desirable on correct management of hardinggrass and subclover grown together.

Conclusions

Under the conditions of this study the seeding of winter annual legumes can be expected to nearly double forage production and more important, winter forage production will be markedly increased. The addition of hardinggrass will further increase winter forage production over that of subclover plus the resident annual grasses.

Subclover may produce more winter feed than rose clover but there is no difference in total annual production. There is no difference in the forage production between Auburn and Argonaut soils with any of the species tested.

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