Dry Matter and Nitrogen Yields of Legume Tops and Roots in the Fall of the Seeding Year

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Although the use of legumes plowed under for green manure is one of our oldest agricultural practices, there is a surprising lack of information in the literature on the critical evaluation of legume species with respect to differences in yields of dry matter or nitrogen, and nitrogen percentages. Numerous investigators (1, 4, 9, 10, 11, 12) have recorded the pounds of dry matter and yield of nitrogen per acre for sweetclover at the end of the seeding year. A few investigations (2, 6, 7, 13) have been made to compare red clover and alfalfa, or to contrast these legumes with sweetclover, but no studies were found reporting on the comparative value of strains of alfalfa and Ladino clover.

With changes in seed production practices and greater availability of Ladino clover and Southern common alfalfa, it seemed desirable to evaluate these legumes in comparison with biennial and annual sweetclovers, medium red clover and Northern-grown alfalfa, which have been in more common use as sources of green manure crops planted with oats. The data to be presented in this report are limited to comparisons of the legumes in the fall of the seeding year. The effects of these legumes on the subsequent yields of corn in the rotation will be reported in a later paper.

MATERIALS AND METHODS

Seedings of Madrid and Hubam sweetclovers, Grimm and Southern-grown common alfalfas, and Ladino and medium red clovers were made at four locations in Iowa in the springs of 1951 and 1952. The experimental sites at Ames, Clarinda, Kanawha and Marcus, were located on Nicollet loam–Webster silty clay loam intergrade, Marshall silt loam, Nicollet–Webster intergrade, and Marcus silt loam–Primingar silt loam intergrade, respectively. The soils at each location either had been limed or had a pH value of 6.2 or above. The legumes were seeded at the rate of 70 viable seeds per square foot. At all locations, liberal applications of phosphorus and potassium fertilizers were broadcast in the spring and disked in. The oat companion crops were combined at maturity.

A randomized complete block design with four replications was used at all locations. Each plot measured 13 ft. by 4 in. by 23 ft., 4 in. Following a killing frost in the fall of the seeding year, samples were obtained from the legume seedings to determine yields of tops and roots. In 1951, 2 quadrats measuring 18 in. by 36 in. were taken in each legume plot; in 1952, 4 quadrats, 18 in. by 18 in., were used. The method followed for uplifting root samples from the soil, and the subsequent washing treatment, have been presented earlier (5). Roots were sampled to a maximum depth not exceeding 21/2 ft.

After washing, the tops and roots were dried in a 70°C C. oven, and weighed. The top and root samples from a particular plot were then composited separately and ground in a Wiley mill to pass a 40-mesh sieve in preparation for subsequent chemical analysis.

RESULTS AND DISCUSSION

In 1951, severe attacks of sweetclover were made, reduced stands of the sweetclovers, and seriously damaged the alfalfas. As a result, the yields of these four legumes were low (table 1). On the other hand, stands of medium red clover and Ladino clover were excellent and were favored by a moist season. Total (tops plus roots) dry matter yields of Madrid sweetclover and Ladino clovers were in general above 2 tons per acre and were over 11/2 tons in the case of Ladino clover in 2 locations. In 1952, good stands of alfalfa were obtained. Total dry matter yields of Madrid sweetclover varied between 2 and 3 tons per acre. Alfalfa yields were above 1 ton and attained as much as 2 tons per acre. The differences between Grimm and Southern common alfalfas were nonsignificant. The 1952 season was characterized by severe mid-summer and early fall drought conditions, Ladino clover yields compared favorably to those obtained the previous year, ranging between 1 and 11/2 tons per acre. Hubam sweetclover yields were probably lower than those of biennial sweetclover, but the legume probably were underestimates of the seasonal growth, since sampling was carried out at a time when most leaves and some stem branches of Hubam had already been removed from the plants. Medium red clover yielded from slightly over 1 ton dry matter per acre, and was competitive with Ladino clover at all locations in the fall of 1951.

The top-root ratios for dry matter yields are presented in table 2. Madrid sweetclover and the 2 alfalfas showed ratios varying between 1 and 3, with only 2 exceptions. 1951 ratios for these legumes were higher at all locations where yields also were larger. However, if these ratios were less than those for alfalfas, and were not as high as those of biennial sweetclover, this ratio was higher than the average of the experiment. The ratios for Hubam sweetclover emphasized the potential growth and development of this annual legume.

The nitrogen percentages of tops (table 3) of Madrid sweetclover and alfalfas, were higher than at the other 2 locations. This is illustrated by the fact that Madrid sweetclover contained more than double the nitrogen percentage of the other locations. Alfalfa, on the other hand, was less produc-