Preliminary Comparison of the Effects of Leguminous and Non-Leguminous Green Manures on Sugar Beet Production

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The use of green manure crops has been a common practice in California agriculture since $1900 (2)^2$. However, information developed in controlled experiments relative to their value and the nature of their effects on soils and subsequent crops is limited. This is in large part due to the wide variation in soil conditions, climate and cropping sequences which limit the application of results determined under a particular set of circumstances.

The field experiment discussed in this paper is the first of a series of tests which are designed to evaluate the influence of various green manure crops on the growth, nutrition and yield of several field crops and accompanying physical and chemical changes in the soil, and disease and pest effects. The sugar beet was chosen as the test crop in this preliminary experiment because it is a crop which is very sensitive to the level of soil fertility and to soil structure. A winter legume and a non-legume were compared with fallow at two levels of nitrogen fertilization in a split plot design with fertilizer levels as the main plot treatments.

Procedure

The experiment was established on Yolo sandy loam near Santa Maria, California, following a crop of potatoes. Six replications of strips 20 feet wide of Hero barley, purple vetch (*Vicia atropurpurea* Desf.), and a mixture of barley and vetch were planted across a small field on September 14, 1951, and sprinkled up. The seeding rates in pounds per acre were barley 80, purple vetch 45, and barley and vetch 10 and 40 respectively. The barley and vetch crops were turned under to a depth of 10 inches with moldboard plows after being rolled down on January 29, 1952, and sugar beets were planted February 5, 1952. At thinning time, April 23, 600 pounds per acre of ammonium sulfate were applied to three of the replications. Petiole samples were collected from the plots periodically and analyzed for nitratenitrogen, phosphate-phosphorus, and potassium by the methods developed by Ulrich and Hills (4, 5).

The beets were harvested September 10, 1952, with two double row beds 100 feet long being taken from each plot for yield. The effects of the treatments on water penetration were measured by taking successive readings on the heads of water in six single ring infiltrometers placed in each plot.

Results and Discussion

Just prior to turning under the green manure crops, strips were cut to determine the amount of organic matter produced and its nutrient content.

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The shoot length of the vetch was about 30 inches, and it was in the vegetative stage with a nitrogen content of 3.9 percent (Table 1). The barley averaged 38 inches in height and was *in* the early milk stage with a nitrogen content of 1.2 percent. The barley produced the most green weight; the vetch produced a little more than half as much. The vetch, however, contributed almost twice as much nitrogen to the soil in the top growth as did the barley. The barley and vetch mixture was intermediate for both green manure and nitrogen production. It contained 31 percent vetch and 69 percent barley with an average nitrogen content of 2.2 percent.

Тгезирспі	Dry Matter Turned Under Lbs./Acre	Nitrogen Content %	Nitrogen Turned Under Lös./Acre
Fallow	0		0
Barley	4.950	1.2	62
Barley and vetch	3,690	2.2	87
Vetch	2,620	3.9	115
1S.D. 5%	, 870	0.9	23

Table 1.—Dry Matter Production, Nitrogen Content, and Amount of Nitrogen Turned Under in Green Manure.

Differences in the growth of the sugar beets were evident by thinning time. A growth sample taken April 30, 1952, indicated that the beets which followed vetch had made four times as much growth as those on the fallowed plots (Table 2). The growth following the barley and vetch mixture was about three times that following fallow, and the growth following barley was somewhat greater than that following fallow. These differences were correlated with the amount of nitrogen turned under in the green manures. Data from the analyses of petiole samples taken at thinning time showed that the growth differences were closely associated with the level of nitrate-nitrogen in the plants, further indicating that nitrogen nutrition was the primary limiting factor involved.

Table 2.—Effect of Green Manure Crops on Sugar Beet Seedling Growth and Concentration of Nitrate-Nitrogen in Beet Petioles.

Treatment	Fresh Weight gm./lop	Nitrate-N p.p.m. (dry basis)
Fallow	7.1	980
Barley	12.0	2,060
Barley and vetch	20.9	4.790
Vetch	27.9	8,150
L.S.D. 5%	4.7	1,260

The growth differences demonstrated by the growth measurements at thinning time were maintained up to the harvest on the unfertilized plots. The harvest data show that the vetch green manure increased the root yield by 8.5 tons per acre with no appreciable drop in sucrose concentration (Table 3). The barley and vetch mixture increased root yield by 5.4 tons and the barley 1.7 tons. Fertilization of fallow plots with 120 pounds of

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