

There Is No Substitute For Soil Fertility

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CROP growth depends on the usable stock of plant nutrients in the soil, or on that made available during the growing season. Crop rotations represent good soil management because they lessen the rate of plant nutrient depletion from the soil. Legume crops and grass sod covers are considered particularly effective in this respect because of the slower rate of soil nitrogen exhaustion in the former and because of the partial return of the nutrients to the field as animal droppings in the latter. Considered then purely from the crop-combination viewpoint, one can readily reason that any approach toward constant legumes or constant grass cover will approach satisfaction in terms of lessened soil depletion.

The short rotations of the cereals with newer legumes and the lessened soil tillage that have become popular in Missouri are built, in part, on this reasoning. A barley-lespedeza combination is 50 per cent legume, for example. Their satisfaction, however, is not in the crop combination without soil treatment. It must take into consideration the facts, (a) that a soil is being exhausted by any crop order or arrangement under soil management that disregards fertility return; (b) that legumes are ravenous consumers of calcium, magnesium, phosphorus, potassium, and others; (c) that they are nitrogen fixers rather than only soil nitrogen consumers when generously supplied with calcium and the other essential soil bases; and (d) that grass sod or non-leguminous crops, as well

as legumes, are becoming less effective for their own preservation, or for forage feed production under increasing soil acidity, or, rather, base deficiency. In our present desire for more sod cover and more legumes, especially those growing on less fertile soils where we are expecting them to demonstrate their soil-saving results, we may well recognize many soils too low in calcium, phosphorus, and other nutrients before these crops can get even a "toe hold" in rejuvenating effects on the land.

Rotation Is Not Enough

The short rotation combinations of the cereals, barley or wheat with the more popular legumes, such as soybeans, Korean lespedeza, or possibly sweet clover, have been recently adopted for their soil cover value and their pasture extension over the main portion of the calendar. Their provocation of discussion of the subject of rotations has brought with it a recognition of the need for fitting crops to the fertility of the soil as well as into a particular rotation, or crop sequence. Soil fertility depletion has brought us to wheat and barley, in the place of oats, as nurse crops for legumes. This is true because the former two draw much of their needed nutrient supply in their young growth in the fall of the preceding year and lessen competition with the young legume during its first and the cereal harvest year. The oats are the poorer nurse crop, because they "get there first," so far as fertility is concerned, in the same season as the



Fertilizer reflects its effects on barley by earlier maturity, better quality, and larger grain yields. The plot shown at the top was not fertilized, the plot at the bottom received applications of a 5-10-5 fertilizer.

legume. They stay on well into the summer and make it difficult for legumes to succeed in the soil already sapped before they get underway at their delayed and possibly dry season. This shift to nurse crops that get off the land early is acceptance of the evidence of crop competition for a fertility that is getting too low to support both crops at the same time. It commonly places the blame on factors other than the soil, such as the seed or the season. The same declining fertility that has been too low for two crops at the same

time has not only been obliterating the legume completely, but has also been lessening the productivity of the cereal, or non-legume, crop itself.

Fertilizers have been recognized as a serious need for the cereals. Superphosphate on wheat has been a safe investment in most parts of Missouri and has extended its effectiveness by establishing the legume nursed by the wheat. Now that drilling fine limestone with the wheat for clover the next spring shows liming beneficial on the wheat in the fall, as well as on the clover the

succeeding year, we may remind ourselves that superphosphate of the past contained so much calcium that this element was perhaps doing much of the benefit for which phosphorus was getting the entire credit.

The graminiae, or grass family, on many of our soils respond to the calcium in limestone more than anticipated. Oats reflect the effects of lime additions in their growth, and even corn demonstrates the influence. Limestone serves to mobilize the nutrients into the plant. Fertilizers alone on corn mobilized phosphorus into the crop only one-third as effectively as when used in conjunction with limestone, according to chemical studies of the crop.

Parallel with the increase of phosphorus went an increase of calcium in the fodder crop. Barley, used extensively in conjunction with lespedeza, also reflects the beneficial influence of the phosphate and limestone treatments. Its earliness makes it the best of all nurse crops to draw its fertility the preceding season and leave a liberal supply for the lespedeza after the barley harvest. These cereal crops reflect the effects, particularly in composition of their forage, of the lime and phosphates to remind us that, in arranging rotations, the fertility of the soil may be a factor to determine the crop efficiency as well as the crop choice. They tell us that we cannot escape the fertility shortage by offering substitute crops.

Legumes Need Fertilizers

Fertilizers for the legume in the rotation tell the same story as for the cereals, only with more emphasis. In our search for legumes which manage to grow on thinner soils, those so found must do so at a lower rate of fertility consumption by giving correspondingly lower yield rates, or smaller offering in the lower concentration of feed nutrients in the forage. Of course, lowered levels in all these are still better than complete crop failure.

Less calcium concentration in the legumes because of its depletion from the soil means less phosphorus mobilized into the plant. It means lowered concentration of protein in the forage, the tonnage yield of which means less protein yield per acre. So when these legumes make tons, it is well to appreciate the need for some test by which we can learn whether they are rich enough in such ash constituents as lime, phosphorus, potassium and others, or whether they are giving protein and items that do more than merely distend the consuming animals' paunch.

Maintaining Feeding Value

Declining soil fertility is reflected in natural vegetation by lowered yields within the same plant kind, or its disappearance and the incidence of such other kinds as can grow by using less nutrients from the soil. Such as make their advent into—and maintain themselves in—the ecological array at the lowest soil fertility level may be expected to be of low concentration in protein and ash. They must then be of low feed value as suggested by their refusal as forage by wild animals. The declining calcium, in particular, in conjunction with a moderately constant potassium level suggests the shift from the proteinaceous to woody plant composition even within the legumes. The same is indicated for the non-legumes to the point where wood production by trees may represent the extreme in calcium reduction in the calcium-potassium ratio. Naturally such also represents the lowest feed value as forage.

In disregarding soil fertility decline, represented by the large calcium depletion to give a narrowed calcium-potassium ratio, we are in danger of accepting forages of lower protein and lower mineral content irrespective of the crop combination into rotation schemes. Crops in short rotations, like any others, respond to soil treatments and are no escape from the facts that soil treatments can be beneficial to them.

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