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WHITE CLOVER YEARS
In Cycles of Soil Changes

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WHY we don't have a good crop of white clover and the fine honey from it every year, or why this kind of clover comes seemingly in cycles of about the biblical seven years, are not new queries. The beliefs they imply have been more than just fancy in the minds of older observers of the volunteer white clover coming into the bluegrass pastures and lawns in periodic years. The inquirers have connected the intermittent appearance of white clover with certain kinds of soils. They have emphasized this cycle of dominance by this kind of clover especially on the glaciated, the windblown, and on the other more fertile soils where the growths of the bluegrass are also good. Some have believed that the "white clover year" is the "normal" one after a year or two of drought.

That we may expect white clover prominence in cycles of years is the suggestion from some soils studies in Missouri. Those studies suggest that this crop's periodic prevalence is related to the increasing degree of the soil's saturation by exchangeable calcium which favors the nutrition, and thereby the appearance and growth, of such a legume. So, theoretically then, we may well look to cycles of increase and de-

Fig. 1. White clover is a "periodic" legume in the bluegrass lawn only in certain spring seasons.

pletion of exchangeable calcium as possibly the cause of the white clover cycles. We may well expect this where the soil contains a reserve of weatherable calcium-bearing minerals in the surface or subsoil, as the glacier, for example, might have left it. Also, it would seem reasonable where unweathered floodplain deposits of silt, brought in from the arid West by the Missouri River for example, are constantly blowing from there and renewing the surface soil by these calcareous deposits on the soils of north Missouri. Then, too, when the clay of the soil, resulting from the weathering of the original minerals, is a partially reversible colloid which adsorbs the active fertility elements while moist (but may not take them up again when wetted after it lost them through severe drying), the very prominent white clover of the 1956 spring makes us give consideration to the suggestive data from some soil studies under continuous bluegrass sod.

Based on Soil Samples

Apropos of the belief that the "white clover year" is a sequel to one of drought, the studies included soil samples collected annually from 1931 to 1938 inclusive, the last of which was considered a "white clover year." The plots went out of cultivation and into the blue grass sod in 1930. While the 50-year average of the annual rainfall was 34.44 inches at Bethany, Missouri, the site of the Soil Conservation Research Station where the soils were studied, it was but 24.43 and 21.80 inches for the two years, 1936 and 1937 respectively, preceding the clover prominence. The former of these is well remembered for its disastrous heat and drought during June, July, and August. Also in 1934, there had been an almost equally serious drought. During the first half of the year 1938, the total rainfall was 16.06 inches with the amounts of 2.50, 4.39, and 3.07 inches for the months of April, May, and June respectively, to invite the white clover in what would seem nearly normal precipitation.

Starting with 1931, the soil samples were taken annually in a series of plots. But particular study was made of the changes in the soil under continuous bluegrass sod. This was given no soil treatment. It had no crops removed and was showing no more erosion than what would amount to carrying the surface seven inches of soil away in 4,545 years. The soil changes suggest themselves as theoretical reasons for the cycles of periodic prominence of white clover in continuous bluegrass. They suggest corresponding cycles of fluctuating growths in the sod crop too. These would go unnoticed since they do not call themselves to our attention by such flash of color as does the white clover.

The soil under sod was examined carefully by one-inch layers in order to measure the changes with time more accurately. This plot served as the basis for measuring the changes in the other plots undergoing fertility treatments, and surface soil losses. It was the check for the rates at which the other plot profiles were being truncated or whittled off at their tops. The sod plot was "the standard" in the study.

Soil samples for the alternate years 1931, 1933, 1935, and 1937 were considered sufficient numbers to show the changes in the soil fertility. Since legumes like white clover require calcium (and magnesium) generously, it is significant to note the increase in the exchangeable calcium during those seven years before the one of white clover prominence. For these four odd-numbered years the percentages saturation by calcium of the soil's exchange capacity stepped up in the following order, 56.96, 55.09, 69.70, and 70.96, respectively. Since for better crops of legumes, like alfalfa, the experiences with soil tests correlated with the crops suggested that the calcium saturation should be brought up to 75%, it seems highly probable that this increase in the soil's saturation by this dibasic nutrient

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ion might be enough to invite white clover when at the lower figure the deficient calcium was prohibiting it.

When the saturations of the soil by calcium combined with magnesium were considered, the values fluctuated between a low of 75.45% and a high of 90.85% during those years. The high value represents a soil well stocked with these two essentials for protein-producing crops like white clover and other legumes in general. Thus, we might expect the white clover to come back because the fertility improved so much in respect to calcium. Since none was applied, the incidence of the white clover suggests that either the reserve soil minerals or those recently blown in were weathered enough during the absence of the clover to bring the active fertility up again to meet the needs of the clover in this respect.

The total exchange capacity of the soil remained constant during those years. The figures for the four samplings within the seven-year period were 19.98, 19.06, 19.20, and 19.35 milligram equivalents, respectively.

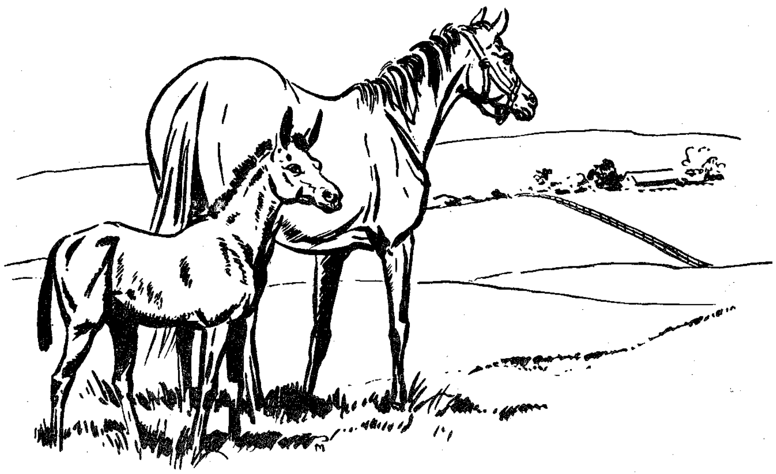
Of particular interest was the increase in the organic matter of the soil as a result of growing the bluegrass. As per cent of the dry soil, the figures for the four years cited were 3.53, 3.71, 4.07, and 4.29, respectively. The total nitrogen also increased according to the following per cents of the dry soil, 0.173, 0.185, 0.190, and 0.205, respectively.

One might have expected this increase in nitrogen to give it more activity in growing more bluegrass. But while this more stable organic matter of the soil was increasing, it was not becoming any the less woody or less carbonaceous to increase its rate of liberating its nitrogen, phosphorus, potassium, calcium, or any other of its nutrients. This was shown by the nearly constant carbon-nitrogen ratios of it. Those values during the four sampled years cited for the seven-year period were respectively 11.85, 11.63, 12.41, and 12.15. The organic matter seemed relatively too stable for any shift to speedy decomposition without tillage. Thus the bluegrass sod was building up the more permanent organic matter. It was increasing the percentages saturation of the soil with those inorganic essentials by which the white clover would be encouraged, since as a legume it needed little nitrogen from the soil and could build its own protein-rich organic matter from atmospheric nitrogen. This organic matter, dropped back to the soil on the death of the white clover, would provide extra and active nitrogen. It would invite subsequent lush growth of the bluegrass. This non-legume would compete with the next crop of clover for other fertility elements liberated because the added nitrogen would hasten the decomposition of the more carbonaceous soil organic matter to set them free or make them active again.

Thus we can visualize the bluegrass exhausting the soil's supply of active nitrogen and of other active fertility, and building these into more stable organic matter even with an increase in total nitrogen. This was happening while the decomposition of the reserve minerals was releasing extra calcium to saturate the soil's exchange capacity more highly with this active, essential cation. This would favor the advent and the growth of a legume crop, like white clover, which fixes atmospheric nitrogen. But this clover growth would reduce the calcium saturation to the hindrance of its own future growth. It would put extra and active nitrogen into the soil. So while eliminating itself by exhaustion of the active calcium, it would favor the bluegrass by providing the active nitrogen.

The time period required for building up the sufficiently increased calcium saturation needed for the white clover suggests itself as the time interval between the "white clover years." That interval may well include "drought" years for whatever changes in the soil or cycle they bring about.

Such are the theoretical suggestions for the number of inter-clover years on soils of the Kansan glaciation given loess deposits and located in the climatic setting of north Missouri. They are presented to be confirmed or refuted by further studies of soil fertility in relation to the periodic annual growths of white clover in our permanent pastures and lawns.



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