GREEN MANURES AND PHOSPHATE

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There are three principal lines of improvement which may be used to aid beet production, or to grow more sugar per unit of labor. They are earlier planting, better fertility, and mechanization. All of these factors are favored by summer fallowing under green-manure.

EARLY PLANTING

The advantage of early planting is well known but even with modern equipment planting in the spring is always held up for the preparation of the seed bed. Very often, some of the best days for seeding are lost because the land is not ready. With a summer fallowed field, the very best seed bed is ready when the time comes. The surface moisture is not worked out of the land and the texture is perfect. Planting on the earliest allowable date can be done. It will, of course, be contended that late plantings have done the best on some years, and this is admitted, but why play a game by following the exceptions. Why not operate according to the rules of long experience which favor the earlier dates of planting. It takes days of sunlight to produce tons of beets. When the first days of the season are lost by late planting, there is no possible way of catching up on the time lost. The growing season only comes once each year. Those not ready to take advantage of the first part of it will pay the penalty in tons of beets not produced.

FERTILITY

After the beets are planted early, in the best seed bed that is possible to prepare, they must have fertility. Green-manure on summer fallowed land provides the greatest fertility at the least cost. In the summer fallow process, bacteria release nitrogen and the other plant nutrients from the inert materials in the soil. When a green-manure crop is plowed under, there is an abundance of material for them to work on. The table below gives the value of the materials in one acre of sweet clover.

Value of one acre of sweet clover as a fertilizer

One Acre of Sweet Clover	Pounds Tops	Pounds Roots	Pounds Total	Value of Minerals
	3,000	2,800	5,800	
Nitrogen as (N)	90	70	160 =	800 pounds ammonium sulphate @ $2.50 = $20.00
Phosphorus as (P_2O_5)	12	8.4	20.4 =	47 pounds of treble superphosphate @ $2.74 = $1.29
Potassium as (K O)	42	16.8	58.8 =	100 lbs. of potassium muriate @ $2.60 = $3.01
				$24.30

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The total value of $24.30 represents only the minerals in the sweet clover if they were purchased as fertilizers at prevailing prices. About two-thirds of the nitrogen in a legume comes from the atmosphere. In this example, showing the nitrogen to have a value of $20.00 in an acre of sweet clover, two-thirds, or $13.33, would be the value of the new material brought into the soil from the air.

ORGANIC MATTER IN GREEN MANURE

In addition to the mineral elements made available in one acre of sweet clover, there is over 5,000 pounds of organic matter, the value of which is difficult to estimate, but it is safe to say that the value of the organic material is equal to that of the minerals.

Organic matter is truly the life of the soil. The carbohydrates it contains furnish energy for the bacteria that make plant foods available. Also, it does so much for the soil in a physical way by preventing cohesion or the close packing of the soil particles. A packed soil is not productive, as we well know, whereas a soil held apart by organic matter will allow for the movement of the gases and soil solutions; in other words, it breathes and oxygen moves in for the support of the bacteria.

There is little purpose in rehearsing the value of organic matter as this is the best known lesson in all agriculture. No doubt savages had this information before the dawn of history and applied manures to encourage plant growth. It is interesting to note, however, that certain modern teachers propose the use of organic matter as though it was a new discovery.

TIME TO TURN UNDER GREEN-MANURE

There is one principle in the use of green manure and other organic materials that is often overlooked. The operator, in attempting to save time in the use of his land, turns under organic matter so that it will decompose at a time when the crop that follows is growing most rapidly. Very often the results from this practice are unsatisfactory.

When organic matter decomposes, great numbers of bacteria develop. Their bodies are like the bodies of other living things, containing nitrogen and the materials that plants use. When there is a big job of decomposing a green-manure crop, the bacteria develop in great numbers and take possession of most of the available plant foods in the soil. If a crop happens to be making a rapid growth at the same time, the crop suffers, competition is too great, bacteria hold the food supply. A little later, when the decomposition job is finished, the bacteria run out of food and die, returning to the soil the plant nutrients they held; but perhaps it is too late for the crop.

It is thus apparent that the plowing under of green-manures must be arranged so as to get the decomposition over early or before the following crop makes its great demand on the soil. In the case of summer fallow there is, of course, plenty of time for decomposition to take place before the crop comes on. In the illustration that follows, this principle is shown graphically.

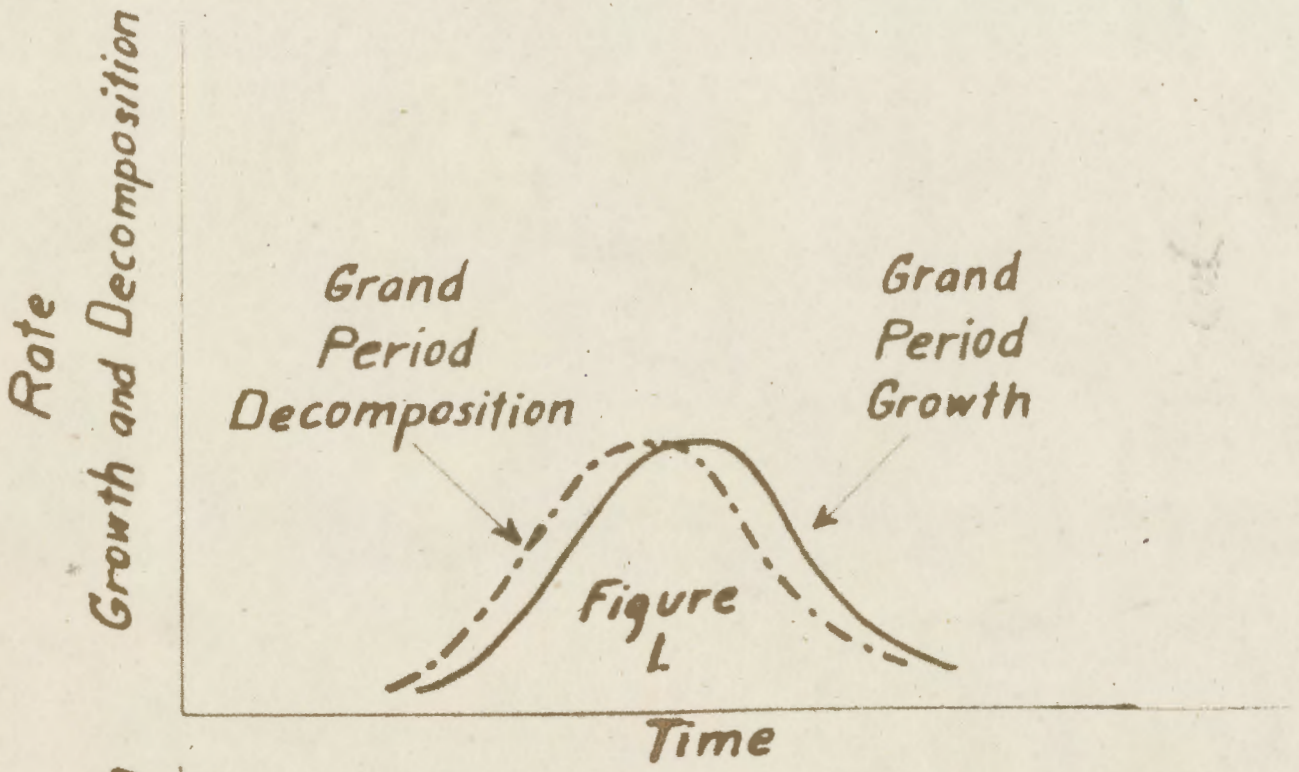

Figure 1.

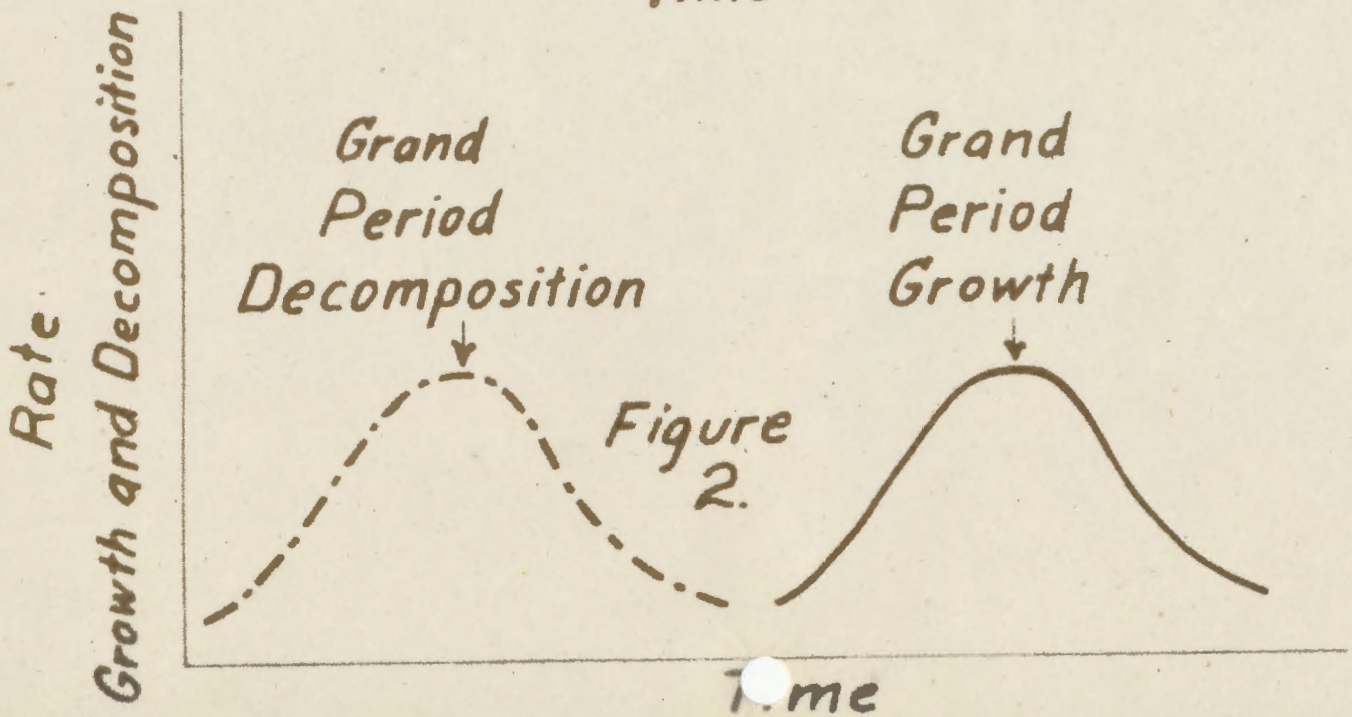

Figure 2.

In figure one above the grand period of growth takes place at the same time as the grand period of decomposition of the green-manure. Under these conditions, the crop may not have sufficient available plant food. In figure two, decomposition is complete before the crop makes its demands. This is a better plan.

STAGE OF GROWTH FOR GREEN-MANURES

The question is often debated, "How mature must a green-manure crop be?" If we consider our purpose, the answer can be given. The principal aim is to get organic matter, and with this in view the plowing should be done at the greatest growth consistent with other factors. If the crop is too young and succulent, decomposition takes place at once, leaving no trace of organic material. Under these conditions there is no finely divided inert plant material left to improve the physical composition of the soil.

On the other hand, a sweet clover crop may be left until the stems are dried and woody. At this time, the moisture is probably all gone from the soil and if the hardened plant material is plowed under, decomposition is too slow. Where water is on hand, the land can be irrigated either before or after plowing, and in that event a maximum crop growth can be obtained and also decomposition will take place. The best rule to follow is to plow under as large a crop as can be decomposed.

KIND OF GREEN-MANURES

White sweet clover is the leading green-manure crop. The seed is cheap, stands are easily obtained, and the growth is abundant. Also, it will grow on soils where some other crops will not, especially on those soils where some other crops will not, especially on those soils where the salt content is high.

Alfalfa is a good green-manure and has about the same composition as sweet clover. The value of one ton of the hay is shown below:

One ton of alfalfa contains the equivalent of	
2 1/3 bags of ammonium sulphate, worth	$5.83
1/4 bag of phosphate, worth	.68
1 bag of potash, worth	2.60
Total	$9.11

As in the example of one acre of sweet clover, the minerals in one ton of alfalfa are worth $9.11, which is only a part of its value. The organic matter cannot be estimated, but with the minerals, one ton of hay is worth as much for fertilizer as for feed.

The grains are often used for green-manures, but they have the disadvantage of decomposing too rapidly and too thoroughly. Furthermore, as the legumes take two-thirds of their nitrogen from the air, they make a distinct contribution of new materials to the soil.

Annual sweet clover (hubam) is a good green-manure crop. With proper management, hubam can be planted with an early grain crop. After the crop is removed, the land can be irrigated and will produce a good growth of sweet clover to be plowed under in the fall.

SUMMER FALLOWING UNDER GREEN MANURE CROPS AND MECHANIZATION

To grow the fertilizer materials on the land and to turn it under without handling it is an application of the principle of mechanization; that is, a purpose is accomplished with a minimum of human effort. But more important to the plan of mechanization is the fact that good weed control is attained by summer fallowing. If mechanical thinning of beets is to succeed, the land must be clean. The best way to prepare a clean field for seeding to beets is to grow a heavy crop of green-manure, plow it under in June, and keep it black the rest of the season.

PHOSPHATE FOR GREEN-MANURE

The greatest limiting factor to the growth of all legumes is the lack of phosphorus. These plants use more phosphorus than any others and the element must be supplied to get good crops. The photograph shows what phosphate fertilizer does in some fields for sweet clover. This field of sweet clover was phosphated except for one drill width where the little girl is standing.

In addition to promoting the growth of legumes, phosphate encourages nodulation, which is the means these plants use to fix atmospheric nitrogen. The photograph shows increased root growth and nodule development on phosphated sweet clover roots. The sweet clover root system was phosphated and shows a greater development and more nodules than the untreated plant.

In fertilizer experience, phosphate alone has often failed to improve crops. In most cases this is because of the lack of nitrogen, or because there is too little organic matter in the soil. When phosphate is used with green manure crops these two limiting factors nitrogen and organic matter are provided and the combination is ideal. In fact the answer to the soil fertility problem can be had in most cases by making heavy applications of phosphate to green manure crops.

Barnyard manure or manure and phosphate have been said to be the answer to the soil fertility problem, and they are as far as they go. The production of manure over the country as a whole has never been sufficient, and it can never be increased to meet the need for nitrogen and organic matter. The livestock and dairy industry will bear considerable expansion but cannot be increased to a point where their by-products will maintain soil fertility.

There is only one alternative, the growing of organic matter as green manure right on the land. This practice can be expanded to build the highest state of soil fertility.

Phosphate and green manure will fill in where barnyard manure leaves off.