FARM.

Rotation of Crops.

BY GEO. J. M'CORMAC.

In addition to tillage and fertilizers as means of increasing the products of the soil, a proper rotation of crops is also very necessary. On account of the variation in the character of soils and the slope of lands, it is seldom practicable to bring the entire farm under one and the same rotation. Modifications to suit existing conditions must be made, and the more judgment exercised in making these modifications to suit the conditions, the better will be the results.

On the ordinary farm of one hundred and fifty to two hundred acres there may be two or three slightly different rotations to suit the particular soils of individual fields. In determining upon a rotation for any farm, it is always well to introduce as much regularity as possible; that is, have about the same number of acres devoted each year to the respective crops. If this rule be followed, the farmer will from year to year have about the same amount of fodder for his stock. Break up each year the same amount of pasture land, and as far as possible be regular in the number of acres seeded for hay. A proper rotation of crops systemizes the several departments of the farm. It secures a regularity of fertility over the whole farm and furnishes the same income each year. Why is a rotation of crops necessary? Why is it necessary not to allow crops of the same kind or crops having the same habits of growth to be grown year after year upon the same land? There are several reasons: (1) Some plants, such as barley and wheat, must not have too much plant food. They require a soil in high condition, but not too much plant food. If too much plant food be present, the yield of straw will be far greater than that of grain. (2) Some kinds of plants require more food than others. (3) Plants differ greatly in their power of collecting food from the same soil. It is a well-known fact that oats can collect more than wheat or barley. (4) A variety is less expensive on a soil than the same crop grown year after year. It is not an easy matter to account for these differences in plants, but they do exist, and rotations enable the farmer to provide for the peculiar characters and habits of growth.

Example of a six years' rotation: 1st year, roots or fodder corn; 2nd, wheat or barley; 3rd, hay; 4th, hay; 5th, pasture; 6th, oats.

For the 1st year's crop—roots or fodder corn—the land must necessarily be thoroughly tilled and manured. After the crop is gathered, a deep and thorough plowing cleans the land; and in spring a shallow cultivation will render the soil suitable for the wheat or barley crop and the hay crop of the following year. Hay and pasture tend greatly to improve the mechanical condition of the soil and to increase its fertility. The humus of the soil is increased and the soil is opened up by the accumulation of roots. With clover, a full set of roots is developed the first year, just as if it were an annual plant; and every following spring, after the store of food contained in the roots of the previous year's growth has thrown out new plants, there is in addition to the old roots a similar development of another full set of roots. But when the clover is cut for hay, the root growth is somewhat modified. After the plant is cut, instead of the roots sending up a new plant, there begins an energetic growth of rootlets, and afterwards a new plant grows up and a full set of roots is produced. It will be seen that clover roots penetrate the soil in every direction, and every succeeding year new roots come in contact with new particles of soil. Food is therefore collected from a greater area and depth by clover roots than by the roots of the cereal plants. This extensive growth of roots and the disposition to store up food in them must greatly improve the fertility of the soil. The action of all plants in growing is to increase upward capillary movement of soil water, and therefore the upward movement of all kinds of plant food. As grasses and clovers are plants that grow during the whole summer, pasture and hay fields are having their surface soil constantly increased during the entire summer. If the grass were allowed to decay where it grew, the effect would be to speedily increase the soil's fertility; but when the grass is cut for hay a great quantity of plant food is removed. If this hay be fed to the stock, it may largely replace in the soil those food substances that are necessarily parted with in selling wheat, live stock, and dairy produce. The effect of pasture in a rotation is also to improve the fertility of the soil. The grass being pastured off, the soil only loses about 18% of the ash constituents and nitrates if the animals are growing; and if the animals are simply fattening, the fertility is greatly increased. The pasture land, being plowed late in the fall or early in the spring, may be worked into a suitable condition for oats by simply sowing the oats on the plowed land and following it by at least three harrowings. If the condition of the land is such that a good seed-bed cannot be secured by repeated harrowing, the spring-tooth cultivator or disk harrow should be used. This rotation may be increased to a seven-year rotation by sowing peas after pasture and following the peas by oats. The yield of oats would be greater after peas than after sod, and the pea crop will leave the land richer and in better tilth than it was before the peas were grown.

Cultivation of Sugar Beets.

BY A. E. SHUTTLEWORTH, B. A. SC., PH. D., PROFESSOR OF CHEMISTRY.

Sugar beets for cattle feed can be grown probably in any part of Ontario; but owing to favorable climatic conditions, they can be grown for the production of sugar more profitably in certain portions or sections than in others. Experience in counties where the sugar beet is extensively grown shows that it attains its greatest perfection where the temperature for the months of May, June and July has a mean of 70° F.

A line running from Sarnia in a south-easterly direction to St. Thomas and then curving gradually in a north-easterly direction through the counties of Norfolk and Haldimand to the City of Hamilton would locate the northern boundary of the United States theoretical beet-sugar belt passing through Ontario. The section of Ontario to the south of this line, comprising Essex, Kent, Bothwell, Elgin, Welland, Lincoln and the southern portions of Lambton, Middlesex, Norfolk, Haldimand and Wentworth, possesses favorable climatic, and, for the most part, soil conditions for the highest development of the sugar beet. It is not to be understood, however, that there are no other sections in Ontario where sugar beets can be grown for sugar production. Temperature and length of season both north and east are more or less influenced by the lakes; consequently, in sections where land can be cultivated for planting by the 1st of May and where favorable beet-harvesting weather can be depended upon through October and the early part of November, beets may be produced as successfully as within the above named section.

To grow sugar beets with a high content of sugar and a paying tonnage, which are requisites of the beet-sugar industry, requires a high degree of agricultural skill. It is indeed a great mistake to suppose that because a farmer may be able to grow sugar beets for feed, he can also grow them for sugar production. The former means bulk, while the latter means quality and bulk. By a very little difference in the soil, in the cultivation, in the kinds and the quantity of manure, in the thinning, etc., a very great difference in the sugar content of the beets may result.

Past analyses of sugar beets grown in Ontario have shown that fully one-third of each year's crop contains less than 12 per cent. of sugar, a percentage too low for factory use. It would indeed be a serious matter to both the farmer and the factory should one-third of the total crop grown for a factory contain only 12 per cent. or less than 12 per cent. of sugar. To avoid such a misfortune, small plots of sugar beets should be grown according to definite instructions where a factory is likely to be established. Such an experiment would be an object lesson not alone to those growing the beets, but more or less to all farmers in the neighborhood, and by the analyses of the beets valuable data regarding the fertility and the requirements of the soil of different farms and sections would be collected. In this way the farmers would learn quickly and inexpensively to produce crops of beets of high tonnage and rich in sugar.

Restitution to the soil of the constituents removed has to be considered in good farming more or less for all crops, and especially for any root crop. The impression prevails that sugar beets are particularly hard upon soil and will in time impoverish land. This is not necessarily true with sugar beets any more than with other root crops.

Soil.—The kind of soil suitable for sugar beets is of less importance than cultivation. Almost any soil by proper cultivation in a suitable climate will grow sugar beets. This crop does not require a particular kind of soil. Good crops may be grown upon clay, loam, sand, or even prairie soil with proper cultivation. The beet does best in a warm moist soil having an open subsoil which is also naturally warm and moist. A soil capable of producing a good crop of potatoes will yield, with proper cultivation, paying crops of sugar beets.

Manure.—In proportion to a deficiency of nourishment in the soil and a consequent reduced growth, the quality of the sugar beet for factory purposes deteriorates; but in proportion to the degree to which proper and sufficient nourishment is available, the quantity and quality of the sugar beet improve. The best results, then, can be produced only when there are available to the plant in the right form and quantity, in the presence of other required conditions, the four most important constituents in the nourishment of beets, viz., nitrogen, phosphoric acid, potash, and lime.

It is only when all the other required elements of fertility are present that any manurial constituent or combination of constituents has any value; therefore, there can be no normal manure for sugar beets. An actual experiment alone will determine for a particular location or soil the constituent or combination of constituents that may be used to the best advantage in the cultivation of sugar beets.

In no case is it a safe practice to apply farmyard manure to sugar beets in the spring or early summer. If the early summer be dry, the manure will not decompose; consequently, the soil will remain too loose and open, and the young plants will suffer from drought. A wet period may follow the dry spell, which circumstance, owing to the late fermentation of the manure, develops leaf growth and produces a heavy crop, but of inferior quality. The later the second growth occurs the more the percentage of sugar is lowered. Unfermented manure further affords favorable conditions for the operation of insects that are enemies of the sugar beet, makes surface cultivation difficult, produces rooty beets, and predisposes the plants to disease. If a direct application of farmyard manure is to be made, early in the previous fall is the proper time, but even applied at that time the manure should be more or less decomposed. It is better, however, to apply farmyard manure to a preceding crop. The residue of this manure, supplemented by purchased fertilizers, will furnish the best fertility for the beets.

Spring Cultivation and Planting.—Plant as early as climate and soil will allow. In that area, previously mentioned, where sugar beets may be expected to do well, plant not later than May 1st. Early planted beets, as experience in other countries has shown, uniformly give both a greater yield and a higher content of sugar than those which are planted later.

Spring cultivation for planting must be shallow, the object being to prepare a seed-bed whose soil is reduced to the highest degree of tilth, resembling the surface soil of a well-prepared onion bed. The exact method of working the land to attain this object will vary in different locations and soils as soils themselves and weather vary. For every soil, however, loosening the surface to a depth of three inches is an essential operation, after which, by the proper use at the right time of the roller and harrow, a seed-bed which is mellow, firm, moist and warm can with little difficulty be prepared. The seed should be planted upon the same day, or as early after as possible, as the final preparation of the seed-bed. Before planting and while preparing the seed-bed, commercial fertilizers containing the constituents phosphoric acid and potash should be sown broadcast and worked into the soil of the seed-bed in its preparation. Hardwood ashes and superphosphate of lime (water-soluble phosphate) may be used to furnish the above constituents. The quantities required, since soils vary in fertility and fertilizers in composition, may differ for every soil. Fifteen tons of beets with their tops require 300 lbs. potash, 60 lbs. phosphoric acid, and 155 lbs. of nitrogen. These figures may form the best basis for calculating the required quantities of fertilizers to be used in addition to the manure or residue of manure already in the soil. Nitrogen, which may be needed over and above that in the manure, can to advantage be applied in the form of a soluble salt as a top dressing after the plants are thinned. Lime, which may be obtained from sugar-beet factories as a by-product free, is essential in soils growing sugar beets.

Seed.—The choice of seed is a matter of very great importance. Under no consideration should an inferior variety or quality of seed be sown. Owing to the many good varieties of sugar beets, arising chiefly from selection and culture, it is not easy to name all. The Vilmorin Improved and the Kleinwanzlebener have been the most widely grown in America. When the soil of the seed-bed has been reduced to a finely divided condition, it should be compressed by rolling, and upon the same day the seeds may be planted to a depth of one inch. Planting, therefore, is *upon the flat*, done either by hand or by drill at the rate of 16 pounds of seed per acre. The best results in root and sugar content are obtained by a distance of 21 inches between the drills, and seven inches between the plants in the drill. At these distances the ground becomes completely covered with the foliage, a condition which is very essential to a paying percentage of sugar. After planting, the land should be harrowed once lengthwise with the planting with light seed harrows, for the purpose chiefly of preserving the soil moisture. In from ten to fourteen days, with favorable weather, the plants will have germinated.

Cultivation of Beets Before Thinning.—As soon as the plants can be traced in the row, surface cultivation of the soil between the drills should be commenced, to clean the land and preserve moisture, to admit air more freely into the soil, and in every way to hasten the most rapid growth of the young plants. This cultivation may be accomplished by hand, but more quickly by a horse hoe. It should be remembered that the young plants are easily injured, either by a covering of earth or by being loosened; therefore, a strip of 2 inches on each side of the plants in the drill should not be disturbed by this early cultivation.

Thinning.—After the first cultivation, the young plants grow rapidly, when upon the development of the 3rd or 4th leaf thinning must be commenced, and should be finished as soon after as possible. Thinning is done chiefly with a narrow hoe, but the hands must be also freely used in singling out, for the reason that the young selected plants, unlike turnips, must not be roughly handled.

Cultivation After Thinning.—During thinning the beet will have grown considerably, and the time having arrived for a second cultivation, the hand or horse hoe may be run deeper than in the first cultivation, in order to open thoroughly and loosen the soil for the free admission of air. A second hand hoeing soon after finishing the first thinning is advisable, for the reason that two or more plants growing together injure one another both in size and quality. It has also the advantage of cleaning and loosening the ground in the drills between the plants. Even a third and a fourth horse hoeing may be done, depending, of course, upon circumstances. Every cultivation promotes growth, improving the chances for a profitable crop, but must never be done when the ground is wet.