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While the local cotton spins to 12 to 15 counts, X-20 spins to 20 counts, as certified by the Manager, All India Spinners Association, Andhra branch, Kandukur. After a test he opined that X-20 was very satisfactory and was in no way inferior to Kanigiri red cotton which he had been mainly purchasing for his business, and that its cultivation may be extended and would find a ready market with him.

It is obvious from the particulars furnished above that X-20 cotton, a strain evolved by the Madras Agricultural Department is a better yielder, fetching an enhanced price of Rs. 10-13-0 per acre more than the local variety in Kandukur taluk (Nellore district). The harvest of X-20 can be completed earlier than the local by about a fortnight, as it is early flowering and maturing. Saving of watchman's wages for a fortnight is an additional profit. Since X-20 is a red cotton, unlike the local variety which is a mixture of white and red, it has a better market.

Under these circumstances I may say that the public funds utilised for cotton research has been spent fruitfully to the advantage of the cultivator and it is left to my co-cultivators to make the best use of the fruits of research.

SELECTED ARTICLE

Cultivation as an aid to Soil Fertility

By E. BATCHELOR, *Sherborne, Dorset*

Geological and astronomical authorities place the age of our world at somewhere between two and three thousand million years, and that of the consolidation of its crust at about two thousand million years. Since then the agents of disintegration and denudation—water, atmosphere, heat, cold, and frost and for some hundreds of millions of years, the roots of vegetation, together with rabbits, moles and earthworms—have, mainly through the solvent action of rain water, transformed the solid rock into sand and clay and transported these products, together with minerals in solution, into the rivers, seas and oceans. The geological formations resulting therefrom after being raised above sea level, have repeatedly been subjected to the same processes of disintegration and denudation.

Observation in a railway cutting or quarry will frequently show slightly disintegrated rock at a depth of only a few feet below the surface. Above this the rock can be seen to be in progressive stages of disintegration until, at the surface, the solid formation has been transformed into fine sand or clay and is ready for erosion by rain and surface flow into adjoining streams. What is now soil on the land surface was but a short time ago, as measured by the geological clock, solid rock some feet below the surface. The rates of disintegration and denudation are clearly interdependent and vary with climatic conditions.

The use of tillage implements accelerates the rate of disintegration and denudation.

Soil fertility enhanced by tillage. The mineral constituents of a plant are taken up in solution in water, but their solubility varies greatly; for example, that of silica is very much less than that of calcium. In this country disintegration is effected mainly by solution in the surface flow of water and by solution in the rain water sinking into the soil to the ground-water. The solvent power

of rain water, over that of pure water, is due to the presence of carbonic, nitric and sulphuric acids, absorbed from the atmosphere. As rain water dissolves the mineral constituents of a solid mass of unweathered rock, or of the soil derived therefrom, a part of the mineral solutes is removed by surface and ground-water flow and is lost as plant food in the vicinity of that rock or soil. Part is re-precipitated elsewhere in the rock or soil. During intervals between rainfalls, water, impelled by the pressure of surface tension (capillarity), rises to the surface of the soil and evaporates leaving deposits of minerals in the surface soil. As each particle of mineral is dissolved, the surface area of the parent rock or soil exposed to the action of water becomes larger, and the mineral content of the water in a cubic foot of rock or soil thereby increases. The rate of solution of a mineral when re-precipitated from water moving in the soil, or when deposited by the evaporation of the water containing it, is greater, often far greater, than when the mineral is first exposed to the solvent action of water on the surface of the unweathered rock. *It follows, therefore, that the rate of mineral solution, and hence the fertility of a soil, is enhanced by exposure to the action of atmosphere and rain.* This is true even if the surface is untilled; by tillage the rate is increased. When, for example, land is bare or summer-fallowed, and there are no plants to assimilate the minerals precipitated in the soil by the process of disintegration described above, considerable quantities of these minerals are accumulated, and the land is described as 'regaining fertility'. The ensuing crop will then be larger than if the soil had been continuously cropped; but the fact that continuous cropping results in a smaller yield is no justification for regarding the soil as 'exhausted'.

Manuring: *Green manuring* When green manuring, particularly with legumes, is practised, some part of the elements essential to the following crop, especially nitrogen, are fixed in the plant and are not eroded as they might be were the land bare fallowed. The ploughing up of old pasture land may be regarded as a kind of green manuring. It is frequently asserted that the keeping of land under grass is a method of building up a reserve of fertility, and that the humus so obtained is indispensable for the maintenance of fertility. However, no satisfactory definition of what is meant by 'humus' has yet been framed; nor has the writer seen any estimation, in numbers, of this 'reserve', nor of the stores of so-called 'humus'. The presence of plant roots and the ploughing in of stalks improves the texture of some soils until the roots and stalks are disintegrated and the soil settles down; *drainage and aeration may be improved through their presence.* These effects will increase fertility without the supply of minerals.

Animal manuring The value of urine and dung for improving vegetation was obvious to primitive man. Elements present in organic form in animal excreta have to be retransformed into an inorganic form before they can be dissolved in water and assimilated by the plant. There is no proof, so far as the writer is aware, that animal excreta accelerate the disintegration of the soil by natural agents. In a self-supporting area where no cattle foods or fertilizers are brought in from outside, and where the most careful conservation and application of the dung to the soil is practised, if there were no disintegration of the soil the losses of minerals in the produce removed from the area, and by erosion in the surface flow and ground water must in a very few years leave the soil barren in so far as profitable cultivation is concerned.

Such were the conditions in this country until the introduction of artificial fertilizers about a century ago (potash much later). Yet the fertility of the soil had continued to improve from the earliest times. *It follows, therefore, that the creation and maintenance of the fertility of the soil must be sought basically, in the disintegration of soil and subjacent rock.*

Continous Corn growing From the above arguments it follows that a uniform crop can be grown continuously on the same soil without animal manure, green manure or mineral fertilizers, provided the soil contains the minerals indispensable to the crop, and the crop is suited to climatic conditions. It may be objected that this is mere theory and is contradicted by practical experience. It is probable, however, that experience generally outside these islands is in accordance with the theory, e. g. in Russia, the United States of America, Canada, Australia and India. In the Central Provinces of India, wheat is grown continuously without fallow and without manure, and the yield per acre has increased since it was first observed and recorded in the 'sixties of the nineteenth century. The facts are in accordance with theory in Great Britain also, as was proved by Tull two centuries ago, and by the experiments at Rothamsted in growing wheat without manure or fertilizer continuously for the past 100 years.

It may be objected that rotation gives a larger or more valuable yield per acre in this country than abroad. The average yield of wheat per acre for the last 10 years is stated to be 32 bushels (2000 lb.) in Britain and only 13 bushels (820 lb.) in the United States of America. If it is assumed that the rotation in Britain is one of 4 years, the average annual yield per acre is only 8 bushels of wheat; if that of the corn in one other course of the rotation is included, the average annual yield of corn is only some 1000 lb. Most of the land sown with wheat in the United States of America is not under rotation, hence the reality, where *bread* is the sole criterion, is very different from the impression given by these figures. So far as the writer is aware, experiments have not been made in this country since Tull's time to ascertain the maximum uniform wheat crop obtainable without manure or mineral fertilizers; the experiments at Rothamsted have not been conducted precisely to that end. (*J. Minist. Agric. December 1942*)

Abstracts

Soil cultivation and Increased production by J. H. Hofmeyr, *Fmg. S. Afr. Vol. 17, No. 200, Nov. 1942.* Where moisture is in any way a factor limiting production and that includes the extensive maize growing areas of the Orange Free State, as well as other parts of the country, it is absolutely essential that rigid weed control should be practised in order to increase production or even, in some cases, to produce a crop at all. *Weeds and drought have an identical effect on the growth of maize and other agricultural crops.* Hence, the drier and more unfavourable climatic conditions are, the more imperative it is that effective weed control should be practised—and the sooner the better.

The production of maize may be considerably increased, without extending the cultivated area, merely by practising more effective weed control. Even for the more economical production of maize, better weed control by hand and inter-row cultivations are essential.

Although the use of a ridging plough for the inter-row cultivations of maize often yields excellent results, this implement should be judiciously used. The use of an ordinary cultivator appears to give more constant and generally satisfactory results provided the weeds are subsequently hoed by hand in the rows. The ridging plough also requires more tractive power and greater effort in handling than the ordinary cultivator. An additional disadvantage is that it leaves the land uneven, making subsequent ploughing more difficult.

The maintenance of a mulch appears to be unnecessary but generally speaking, under dry land production the number of cultivations, as well as the time of cultivation should be determined primarily by the appearance of weeds.