GREEN MANURING AND COVER PLANTS FOR COCO-NUTS.

By George H. Murray.

It has been proved, beyond question, by several Agricultural Departments and practical planters in tropical countries, that coco-nuts answer as readily to cultivation and fertilizing as any other crops in temperate or tropical regions.

In Ceylon, one of the most progressive tropical colonies of the British Colonial Empire, there are several firms which do a large business in the manufacture and sale of commercial fertilizers to coco-nut planters, competent managers, who would not commit themselves to the expenditure of money that did not result in increased profits. One gentleman with whom I discussed this matter locally, stated that cultivation and manuring of coco-nuts was "controversial", but there can be no gainsaying facts which have been repeatedly proved. Several planters, in the Territory, on the other hand have asked for the best kind of fertilizers to apply as top dressing in certain districts, but it would be almost useless to apply commercial fertilizers to a plantation covered with grass as the latter would be benefited at the expense of the coco-nuts.

Palms that have been circle-weeded could have suitable commercial fertilizers applied to them with benefit, and in many eastern plantations where it is still customary to graze cattle, and circle-weeding is practised, it is quite common to apply cattle manure or inorganic fertilizers. An estate known to me was, at one time, a decidedly poor yielder and the owners decided to carry out a systematic scheme for fertilizing with organic manure. All the cattle were penned at night and the manure scientifically composted each morning exactly as would be done on a well-managed farm in a temperate climate, even the poultry manure and other refuse being treated in the same way, and to-day that plantation is hardly recognizable as the same property that it was a few years ago. The crowns of the palms are all a healthy dark green bearing heavy crops of nuts, yet to use the words of the friend who accompanied me over the property, "ten years ago this was a poor estate". This improvement was only accomplished by carrying out a definite scheme of work over a period of years, but results proved that it was worth the labour, and if planters here would select a small portion of their plantation for experiment, using cover plants and circle-weeding for a radius of five or six feet, they could prove the question for themselves.

Naturally with slow-growing trees like coco-nut palms they could not expect immediate results, but there is not a shadow of doubt as to the ultimate benefit. The practice recommended by this Department for the use of cover plants is now becoming more general, but comparatively few planters are circle-weeding their palms, with the result that they complain that they cannot find their fallen nuts. Circle-weeding of sufficient radius enables the palms to obtain the full benefit of the application of both organic and inorganic manures, and most of the nuts will fall within the circle so weeded. In this connexion it might be stated that in a letter to me from the Government Chemist, Department of Agriculture, New South Wales, some years ago, he stated with reference to plantations in this Territory, "the practice of green manuring would be beneficial, but this necessitates the cleaning up of grass and weed growth, which I understand is not the general

practice". Recently I noticed on a small Mission plantation, that the ground had been hoed up, which was good as far as it went, and it was left in a fine condition for the sowing of cover plants, but such unfortunately had not been done. On a larger plantation a rotary hoe would be a very suitable implement for breaking up the ground prior to the sowing of cover plants, and if the planter would treat a portion of his property in this way annually, he would be able to deal with the whole arable portion of the plantation in the course of a few years.

It should not be forgotten that many of the plantations in this Territory, particularly in the Gazelle Peninsula, are 40, if not more, years old and that several are far from being in a healthy condition. Depreciation is rapidly going on and in a few cases it is rather doubtful if they can be brought into profit again. Rejuvenation is possible, provided the trees are not too far gone, but the more the growing point, or bud, becomes stunted the less likelihood there is of cultural methods being successful.

The soil on many of the older plantations, particularly in the neighbourhood of Rabaul, is lacking in organic matter, and the pulverised pumice of which it mainly consists is probably deficient in readily available phosphoric acid. Green manures (leguminous plants turned under) will supply the humus and the use of superphosphate would give beneficial results if applied in proximity to the tree, but the first consideration is to eradicate the kunai before manuring of any kind can be successful.

The value of green manure is not merely the supplying of elements lacking in the soil, but in improving the physical and mechanical condition of all classes of soil, heavy as well as light. The oxidation of humus resulting from the decomposition of green manures assists in rendering elements already in the soil more available as plant food, and has a stimulating effect on the activity of beneficial organisms present in the soil.

Green manures have one special property, organic matter, which they supply to soils and which is converted into humus, that essential without which no soil can be considered fertile. Artificial fertilizers can never replace organic manures (green or animal manure) because in order to be fertile soil must contain humus and be in a suitable mechanical condition essential for vigorous plant growth.

There is rapid diminution of organic matter in the soil of tropical countries and a regular replenishment is necessary to keep the soil in good heart. Even in countries where there are large numbers of cattle as in Ceylon and Java, animal manures are not in sufficient quantity for this purpose and green manures are used regularly for the supply of organic matter.

A factor of the greatest importance is that outbreaks of disease and serious attacks of insect pests are largely due to lack of organic manure and it was stated recently in *Nature* in a review of a standard work on Plant Protection that, "properly fed plants, like properly fed animals, would be largely resistant to disease, and the road to health is through organic protective foods". The use of organic manures for most tropical soils is necessary on account of leaching from heavy rains. The continued use of artificial fertilizers is no remedy, but, on the contrary, is liable to lead to evil consequences if not accompanied by adequate organic matter. Further than that, the nutritive and economic value of a crop

is enhanced by the use of an organic manure. However rich, therefore, the planter may imagine his soil to be, he should see that all animal and vegetable waste products go back into the land by systematic organic manuring, if the value of the plantation is to be maintained.

There has been a steady deterioration of the soils in many parts of the Territory for many years, because of incorrect agricultural practice, due to various causes; in certain cases to the lack of soil nutriment, in a few cases by rainfall erosion, and, in some of the low sandy island plantations where there is insufficient ground cover, by exposure of the soil to a tropical sun. It is now appreciated that some of these conditions can be improved by adding to the humus content of the surface soil by cultivating cover and green manure plants after which applications of artificial fertilizers can be employed to accelerate improvement and maintain a satisfactory balance between the cover plants and the permanent crop. Manuring, therefore, with artificial fertilizers is complementary to the development of natural or other cover plants in soil improvements.

Many of our plantations are on land that can be no longer considered virgin, having deteriorated for the reason noted above, impoverishment by kunai (*Imperata arundinacea*) and other noxious plants. Such soils require regeneration, otherwise there will be a steady decline in yield as can be noticed on many plantations already on poor, or even ordinary soils which have suffered impoverishment for years past. Soil deterioration is a world-wide problem which is now receiving attention in many parts of the world owing to the increase of the world's population and the consequent rapid utilization of land for various crops. It would appear from frequent statements heard, that the areas of land suitable for European cultivation in this Territory are almost limitless, but such is by no means the case. This might apply to a certain extent to native agriculturists who require only relatively small individual areas, but it behoves the European planter, therefore, that he should put the land on his plantation to the best possible use.

Many quotations could be given from the most reliable authorities to support these statements, but I will merely give one extract from a lecture on "Land and Land Use" by P. E. Brown, Head of the Department of Agronomy, Iowa State University, U.S.A., who states as follows:—

> "It takes 400 to 500 years to produce an inch of top soil which may be lost in one year on a steep slope, in three years on a moderate slope poorly managed, or in one rainfall of the cloud burst type".

We had ample demonstrations of this fact during the heavy downfalls of rain on the north coast, New Britain, when gullies were simply scoured out and some thousands of coco-nut palms were torn up by the roots, also in Rabaul itself, flooded with torrents of water because the surface vegetation had been covered up with pumice during the recent volcanic eruption.

I have elsewhere pointed out that the disappearance of certain ancient civilizations was due to the conversion of what were once fertile lands carrying a dense and highly civilized population, into deserts produced not by a change of climate, but by man's ignorance and lack of foresight in his treatment of the soil.

Soil conservation is of more importance in the tropics where the oxidation of organic matter takes place most rapidly. Prof. J. C. Lipman writing in *Science* of 24th January, 1936, states:—

"Amongst the major constituents of the soil whose importance we have under-estimated is the organic matter. It is not enough that a soil contains the essential ingredients for the production of plants. The soil must be able to absorb and to store sufficient quantities of water. This texture and structure should be such as to provide optimum conditions for the vertical and horizontal movements of the water and air. A good soil must furnish a source of energy to various micro-organisms which are a positive factor in crop production. Soil organic matter is a source of food and energy for micro-organisms".

It has elsewhere been stated in this periodical that there is a likelihood of a decrease in our copra production on several of the older plantations, and this also applies to certain plantations not so old, one in particular, which formerly yielded 60 tons of copra per month and is now only producing 27 tons per month, owing to the fact that the nourishment in its comparatively shallow soil is becoming exhausted. It is far easier to maintain soil in good order than to regenerate it once impoverishment has set in, and in those cases where the surface soil has been eroded by bad cultivation and lack of vegetal covering it has been rendered useless for all time. Tens of thousands of acres of land in the north-western States of America and Australia have been rendered practically valueless for this reason, and even in a new country like New Guinea, it is not uncommon to find where soil deterioration has set in through bad cultural methods. In this case the natives are amongst the worst offenders, fond as they are of making their gardens on steep hill-sides with the result that soil, particularly when of a friable nature, is carried into the valleys or gorges below, the noxious grass, kunai, then being the only vegetation able to get a footing on such a terrain.

The most valuable of all organic manures is of course animal excreta, particularly when properly composted. In Ceylon it is customary to maintain cattle on plantations largely for this purpose. They should be penned at night and the ground well provided with litter all of which is placed into a large concrete lined pit. When the pit is full it is turned into a second and finally into a third and by the time the first is again filled the compost in the third is ready for application to the trees. On certain plantations of a well-managed company in the Solomon Islands, the land is sub-divided into comparatively small blocks in which cattle are grazed periodically and in this way the grasses are kept down so that grass cutting by hand labour, so commonly seen in this Territory, is quite unnecessary. Incidentally the use of cattle in this way has been responsible for the spread of the valuable low-growing indigenous cover plant, sometimes known as Japanese clover (*Desmodium triflorum*), a cosmopolitan leguminous plant very common in the Solomon Islands and this Territory. Cattle eat it readily and ripe seeds pass through the animal and germinate in the voided excreta.

In plantations in this Territory herds of cattle are sometimes to be seen, but they are not grazed systematically, as in the Solomon Islands, or penned for manurial purposes, as in Ceylon, and are of little use in keeping down the grass if allowed free range over the whole plantation.

Selective Weeding.

The first step to put the soil in a healthy condition is to eliminate noxious growths like kunai, encouraging the growth of indigenous leguminous weeds of which there are many species, such as *Cassias, Desmodiums,* &c., and by the introduction of cover plants.

There are many indigenous leguminous plants, considered as weeds, to be seen in New Guinea, all of which should be encouraged to establish themselves on plantations. Some are of comparatively weak growth, and are, therefore, of less value than others, but all are beneficial and labourers should be taught to distinguish them from noxious weeds, so that they are not destroyed when cleaning the plantation. This is not a difficult matter, as thousands of primitive natives in Papua to-day are able to recognize leguminous plants which have been explained to them in their own tongues, as "friends of the coco-nut tree", and distinguished from other plants by mostly bearing pea-like blossoms and legumes or bean-like pods.

Amongst the most common of such plants is that usually known as "Grilly Plant", botanically as *Herpetica alata,* easily recognized by its candelabra-like influorescence. Wherever a large clump of this plant is growing it will be found that noxious grasses have been smothered out, and the surface of the ground beneath is cool and usually covered with a leaf mulch. Incidentally the plant contains a considerable quantity of chrysophanic acid, which renders it of value as a remedy for the loathsome native skin disease known as "Grilly", hence its popular name.

Crotolaria spp., particularly *Crotolaria striata,* is not uncommon in some plantations, having probably been introduced during the German régime as a green manure, for which it is much used in agriculture in other tropical countries. It grows about 3 or 4 feet in height, bears yellow flowers striped with brown, and legumes with a silky surface, about 1½ inches in length. It is not as rampant a grower as *Herpetica* (formerly *Cassia*) *alata,* but like that plant bears many nitrate bacterial nodules on its roots. There are many other species of *Crotolaria* easily recognizable by their seed pods, which rattle when the seeds are ripe, hence its generic name, which means "rattle box". The above and many species of *Cassia* are all of shrubby growth, but there are also creeping leguminous plants which should also be encouraged. Amongst the best of these latter is *Vigna marina,* a common littoral creeper in many parts of the Territory, and it was seen growing prolifically near the beach areas of a plantation on the east coast of New Ireland, where labourers were cutting it with "sarifs", as if it were a noxious weed like kunai. It forms a fairly dense carpet with creeping stems 6 to 7 feet in length, bearing small yellow flowers and should be encouraged, as it is likely to thrive in positions less suited for many other leguminous creepers.

Cover Plants.

In agriculture of the temperate zone, weeds are kept down by tillage with hand or draught implements, but this method is quite out of the question in the humid tropics, for many weeds are no sooner turned under than they start to grow again. (Tillage of course is practised in the tropics, where agriculture is

advanced, for aeration of the soil and other cultural processes.) In the place of tillage, therefore, the best system of preventing the growth of noxious weeds, is the cultivation of leguminous cover plants, which are also of manurial value.

In some countries, notably Ceylon, tall plants like *Tephrosia* are grown for this purpose and periodically lopped. The intensive methods of agriculture employed in Ceylon, however, would hardly be applicable on an extensive scale in a country like New Guinea, where cultivation is less advanced and labour less skilled. For that reason, the Department has recommended the use of leguminous creepers as cover plants, weeds in their own country, now commonly used on coco-nut and rubber estates in Malaya and elsewhere. The plants best suited for this purpose in New Guinea and which have already proved satisfactory, are the following:—

Calopogonium mucunoides.—This is one of the quickest-growing plants as a cover and forms a thick mat in about six months from sowing seed in the wet season. So rapid is its growth that one planter called it "galloping home", but it is apt to die back in a dry season, particularly if soil conditions are not altogether favorable. It forms a very dense, thick cover in good soil and the vines should be pulled back from the base of the palms for a radius of five or six feet.

Centrosema pubescens.—This has proved the best cover under most conditions. It does not form such a thick mat, as the above, but its tendrils pull down most noxious grasses and weeds when thoroughly established. It is not altogether successful with "Thurston grass" (*Paspalum conjugatum*) but, once established is permanent and does not require re-planting. It takes about twelve months to form a good cover from seed.

Pueraria javanica (*phaseoloides*).—This plant much resembles *Calopogonium mucunoides* in appearance, having hairy creeping stems, but the leaves are larger and even more vigorous in growth, so that it will even smother out "Thurston grass" and is equally effective in dealing with kunai. Its much ranker growth, however, requires more attention in keeping the circles round the palms clean. Like *Centrosema* it takes about twelve months to make a dense cover, but it is looked upon as one of the best cover plants for young coco-nuts at the Demonstration Plantation, Keravat. It does not seed freely and for a long time did not set seed at all at Keravat, consequently it is more expensive that other cover plant seeds. It is easily propagated by planting cuttings with adventitious roots at the nodes, or joints, so that once an area is thoroughly established it can be spread over the plantation. To economize the seed it would be well to plant it in a nursery first, to be planted in the field in clean ground, when sufficiently strong to hold its own. Planting cuttings should only be done in moist weather.

Method of Sowing Cover Crop Seed.

The best method of sowing cover crop seed is in mixture. The seed rate per acre depends entirely upon what the planter is prepared to spend. Up to 30 lb. per acre has been used in broadcasting on new land, but if the seed be sown in seed beds, much less will do. In a mixture of *Calopogonium* and *Centrosema*, 8 lb. of the former and 12 lb. of the latter has been recommended, but much less than that has produced a good cover on some New Guinea plantations, within twelve months.

In new plantations the cover plant seeds should be sown as soon as the land is cleared, before any grass or weeds can become established. On older plantations where grass and weeds are already in possession of the surface soil, clean beds, at least two feet in diameter, should be prepared about 6 feet apart each way. The seed should be dibbled or raked into the soil and given attention until the young plants start to send out climbing tendrils, when they can battle for themselves, and will eventually form a dense cover over the plantation.

Cover plants, being leguminous, are of value for green manure and when thoroughly established it is advisable, when possible, to turn them under every few years. The "cover" should be "sarifed" about twice a year, or it would be still better if it could be disced with a disc harrow or rotary hoe, which would have a beneficial effect in providing air for the roots, an essential for plant growth. It should also be remembered by those proposing to apply artificial or inorganic fertilizers that they are much more effective on soil comparatively rich in organic matter than on soils that are poor in such elements.

Grazing Value.

For those planters who carry stock on their properties, *Centrosema* in particular will be found very good grazing, but due care must be taken, otherwise there is danger of stock eating it out. For this and other reasons previously noted, all plantations carrying stock should be subdivided, and if worked systematically stock-raising could be made a valuable adjunct to the copra industry.

CORKS.

Various Household Purposes for which they may be Utilized.

An ordinary "wine" cork makes an excellent door-stop if a screw is driven through to secure it to the floor. The cork will not be conspicuous if coloured with household enamel to match the floor or walls of the room.

A cork screwed on to a kettle or pan lid serves as a convenient and non-conductive knob.

When a cork seems to be too big for a bottle it can be made to fit by soaking it in boiling water for a few minutes. To render a cork air-tight and water-tight, soak it in olive oil for five minutes before use.

To prevent the risk of a cork coming out of a bottle when travelling fix a strapping of adhesive plaster over the top, or tie over the cork the finger of an old glove.