NOTES ON GREEN MANURING.

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Demonstration Plantation, Keravat.

Green manuring means the digging into the soil of growing crops so that the roots, stems and leaves can rot in the soil and so improve it. Sometimes the whole crop may be dug into the soil, such as cowpea when it flowers, or a crop may be pruned and the prunings dug into the soil such as the prunings from *Crotalaria* or *Tephrosia* when used as a temporary shade.

As a rule, legume crops are generally used for green manuring because they have the power of absorbing nitrogen and releasing it in the soil whilst the crop is growing. Nitrogen is very important for plant growth, and, without nitrogen, it is impossible for crops to grow and produce, and, the fact that a legume absorbs atmospheric nitrogen, makes it very valuable for green manuring.

Another plant food is humus which consists of decayed and decaying plant or vegetable material. For example, if we bury a leaf in the ground it very quickly rots or decays and becomes very small pieces of leaf which cannot be seen with the eye—the leaf is now said to have turned to humus. Thus, it will be seen that green manuring helps to keep up the humus supply in the soil, and, in addition, the plant food stored in the roots, stems, branches, leaves and flowers of the green-manure crop are returned to the soil, and food, such as nitrogen, is increased in the soil.

In the tropics, green-manure crops can be divided into two groups, namely:—

(1) Annual, and
(2) Non-annual.

Annual Green-manure Crops.—Cowpea, mungo bean, peanut, lima bean, velvet bean, annual *Crotalaria,* winged bean.

Non-annual Green-manure crops.—Crotalaria, Tephrosia, Indigofera arrecta, Leucaena, Erythrina, Mimosa, Pueraria, Centrosema, Desmodium, Calopogonium. The first five crops are erect and the last five are creepers.

Cultivation of Green Manure Crops.

Annual.

The cultivation of all the above annual green-manure crops, with the exception of annual *Crotalaria,* has already been given (*vide New Guinea Agricultural Gazette,* Vol. 7, No. 3). It is important to note that a green-manure crop must be dug into the soil when it is in full flower if the maximum benefit is to be obtained.

The chief annual *Crotalaria* variety used is "Sunn Hemp", a quick-growing *Crotalaria* which can be dug into the soil as green manure or harvested for making fibre. The crop grows about 6 feet high, has yellow flowers, grows best during the drier part of the year, will not stand constant wet weather and the seeds are larger than the usual *Crotalaria* seeds and are dark coloured. For green manure, the seed is sown broadcast or in rows 1 ft. 6 in. to 2 feet apart, the seed being spaced 1 foot apart in the rows.

NON-ANNUAL.

The "Giant" *Crotalaria* is the variety of *Crotalaria* most commonly used. It is a quick-growing shrub, 6 to 8 feet high, which lasts for about two to two and a half years. It gives a great deal of green material and can be pruned back three to four times a year.

Wet soils are totally unsuitable for *Crotalaria*; the soil must be well drained. The climate should be hot and moist, although *Crotalaria* grows very well in dry areas.

As a green manure to improve cultivated land, the seed may be broadcasted or planted in rows 4 feet apart, and the seed spaced 2 to 3 feet apart in the rows. When used as a combined temporary shade and green manure in young *cacao* or coffee it is planted between the rows of *cacao* or coffee.

The "Giant" *Crotalaria* is easily distinguished by the height to which it grows, the yellow flower, the fairly large yellowish-coloured seed which rattles in the pod, and the short, thick pod.

For green manure, the crop is pruned back to a height of about 4 feet, three or four times a year, and the prunings are either buried in trenches, dug into the soil, or allowed to remain on the surface of the land to rot. *Crotalaria* is a very good green manure and makes a lot of nitrogen available for the soil.

Tephrosia candida.—This is a legume, grows 6 to 8 feet high, is quick growing, has fairly long narrow leaves, white flowers, and long narrow pods containing a number of flat mottled-coloured seeds. It is used as a temporary shade for permanent crops, such as *cacao,* to control grass and weed growth in coco-nuts and rubber, and as a green manure.

As a green manure, *Tephrosia* is usually planted in rows 4 feet apart and the seed spaced 3 feet apart in the rows. As temporary shade, it is planted either in the same row as the *cacao* or between the rows. For green-manure purposes, *Tephrosia* is pruned back three to four times a year in the same manner as *Crotalaria,* and the prunings are buried, dug into the soil, or allowed to remain on the surface of the land to rot.

Tephrosia needs the same soil and climate as *Crotalaria,* but is deeper rooting, does not blow over so easily, produces a great deal of green material, and will last for about three years.

Indigofera arrecta.—This is a legume which grows to a height of 8 to 10 feet, the flowers are small, the seed pods small and clustered along the stems and branches, the seeds are very small and square in shape, and the leaves are short and fairly broad. *Indigofera* is not used so much as *Crotalaria* and *Tephrosia,* although it yields a large amount of green material and lasts about three years.

When planted as green manure, the seed can be sown broadcast or in rows 4 feet apart. The crop is pruned in the same manner and the prunings treated in the same way as *Crotalaria* and *Tephrosia* prunings.

Leucaena glauca.—This is a legume which grows to a height of 25 to 30 feet, the leaves are long and narrow, the flowers look like a small white ball, and the pods are long, flat, about $\frac{3}{4}$ inch wide and contain many shiny, flat, dark-brown seeds. *Leucaena,* in addition to being one of the most valuable green-manure crops in cultivation, is also used as a permanent-shade tree in the cultivation of coffee and *cacao.*

For green-manure purposes, the seed is planted in rows 4 feet apart and 3 feet apart in the rows, and when the plants are about 5 to 6 feet high, they are cut back to about 1 foot high and allowed to grow up again. *Leucaena glauca* can be cut back continuously and is a permanent tree. The prunings are treated in the same manner as the other green-manure crops.

Erythrina lithosperma.—This is a legume which grows to a height of 25 to 50 feet, the leaves are large and somewhat heart-shaped, the flowers are red, the seed is fairly large, most varieties have thorns on the stem, and the leaves, branches and stems are a light-green colour.

Erythrina is generally grown from cuttings, i.e., pieces of branches, about 3 ft. 6 in. to 4 feet long, are placed in the ground about 2 feet deep and at an angle. One variety of *Erythrina* is used a great deal in some countries as shade for coffee and *cacao*.

Erythrina is not a strong-rooting tree and hence is liable to be blown over by wind. The large leaves provide a great deal of green manures, but the tree is not very popular because it is very subject to attack by caterpillars and other insects.

Mimosa invisa.—This is a creeper which is easily recognized by thorns on the stems and branches and leaves which close up when touched.

Mimosa is also known as "sensitive plant", but the variety which is of such importance as a green manure is different from the one which grows in the Solomon Islands.

Mimosa flowers look like small light-purple coloured balls, the seed is small, flat, light-brown in colour and has a point at one end. In planting, either seed, seedlings or cuttings can be used, seed being best and most reliable. When planting small hills are made about 15 to 20 feet apart and a few seeds planted in the top of each hill. It is advisable to soak *Mimosa* seed in water for twelve hours before planting.

The *Mimosa* spreads over the ground, eventually covering it, killing grass and weeds. Being a legume, the roots are covered with nodules, hence, *Mimosa* makes available a lot of nitrogen and is, therefore, one of the best creeping green-manure crops that can be grown. It can be grown and allowed to remain on the land for many years, although after one or two years, if the land is needed for cultivation, the *Mimosa* can be dug into the soil.

Pueraria javanica.—This is a creeping legume which is easily recognized by its large leaves, and thick stems covered with very fine hairs. The flowers are small, light-purple to white in colour and boat-shaped; the seed-pod is long, narrow, round, black or dark-brown in colour and the seed is small, hard and dark coloured.

Pueraria can be used as a green-manure crop or as a cover crop in coco-nut plantations. It is grown from seed or cuttings, but if the latter are used, care must be taken that they are planted lengthways and not more than 1 inch deep, and that dull, cloudy, wet weather prevails during and after planting. *Pueraria* grows quickly and one plant can spread more than 30 feet in one year, thus is *Pueraria* a valuable crop for covering the ground and killing grass and weed growth. It will grow in almost any type of soil, and at Keravat does well on wet soil and on nicely drained soil. *Pueraria* will also withstand a fairly long period of dry weather.

The large leaves and stems provide a great deal of green material which makes valuable humus for the soil, and if grown on land that has been cropped many times or for a number of years, the top is cut off twice a year and the crop allowed to re-establish again. By cutting back, more green material is made available for humus.

Pueraria and *Mimosa* are the two best non-annual, creeping green-manure crops and soil improvers that can be grown.

Centrosema pubescens.—This is a creeping legume with small, dark-green leaves, thin wire-like stems, large boat-shaped purplish flowers, and long, slender, narrow, flat seed-pods containing fairly large, roundish seeds, which are a dark, streaky colour.

Centrosema can be grown from seed or cuttings, and if cuttings are used then the same care must be taken when planting as with *Pueraria*. *Centrosema* is also used as a cover crop in coco-nuts. It will not grow on such a variety of soils as *Pueraria,* and needs a soil that is well drained and fairly fertile. It will, however, withstand long dry periods.

Desmodium scorpiurus.—This is a creeping legume which is a native of New Guinea. The leaves are roundish and light-green in colour, the stems are soft and fairly hairy, the flowers very small, and seed is rarely produced. *Desmodium* is generally grown from cuttings, and it grows quickly and easily. It is not as good as *Mimosa* or *Pueraria* as a green manure or for the control of grass and weeds, but is excellent ground cover for crops such as *cacao* and coffee which require a low, ground-cover crop.

Calopogonium mucunoides.—This is a creeping legume, which, on first appearance, looks like *Pueraria,* but the leaves are only half as large, the stems are much smaller, the flowers are very small, the seed-pod is short, flat and covered with tiny hairs, and the seed is square-shaped and yellow in colour.

Calopogonium seeds freely and is grown from seeds or cuttings. It grows quickly, but will not stand dry weather and every year or eighteen months dies off.

Often *Calopogonium* is planted with *Pueraria* or *Centrosema,* the *Calopogonium* growing quicker than these two crops, forms a quick cover. By the time the *Calopogonium* has died back the *Pueraria* or *Centrosema* has become established and provides the ground cover and green manure.

METHOD AND TIME OF APPLICATION OF FERTILIZERS.

The value of fertilizers for promoting vigorous and abundant crops is largely determined by the time and method of their application. Applied at the right time and in the proper manner, fertilizers stimulate the growth of the crop from the start and result in heavy yields. On the other hand, premature, late or faulty distribution all militate against good results, because, thereby, the fertilizer is prevented from exerting its full influence and consequently its effects are uncertain.