

CONSIDERATIONS IN GREEN MANURING PROBLEMS

(1) On what soils should green manures be grown and under what climatic conditions? -

Provided there is sufficient rainfall, green manures can be grown on any type of soil. Poor sandy soils in particular will benefit most by green manuring, as their humus and nitrogen contents and water-holding capacities will eventually be increased by the practice.

It has already been stated that where the annual precipitation is less than twenty inches, green manuring is not practicable; but very few parts of Ceylon are as dry as this, and most districts get the benefit of at least one monsoon. It is only in certain parts of the Northern and North-Central Provinces that green manuring would appear to be impracticable. In the Puttalam and Chilaw districts the soils are of a light sandy type, the rainfall on the whole is low, and long periods of drought occur. The question then arises whether green manuring can successfully be practiced under these conditions. It is possible to do so, but under such conditions a quick-growing annual leguminous crop should be grown. It should be cut and left as a mulch during the drought and ploughed in during the next rainy season, a second crop being planted at the same time; or, where possible, the green manure should be forked in early enough for decomposition to set in before the rains cease. In districts with adequate rainfall green manuring will offer all the advantages already referred to.

(2) The optimum time for cutting and the best method of treatment of green manures -

Green manures should be cut at a stage when (1) they produce the maximum quality of easily-decomposable green material, (2) climatic consideration demand that they should not compete with the main crop for the moisture in the soil. On the first point it has already been stated that in general optimum time for cutting green manures for forking into the soil is just about the time of flowering. This applies to the

bush and cover types in particular. The tree types are best lopped when the branches are from three to four months old.

The loppings or cuttings of all green manures, particularly in drier districts should be ploughed in towards the end of the rains when showers alternate with dry weather. If ploughing is not possible the green material should be left as a mulch on the surface. In this case a certain amount of the carbon and nitrogen of the green material will be lost, as was found at Peradeniya but as in these dry districts moisture is the limiting factor of crop growth, the mulch will serve as a useful means of conserving soil moisture. It is preferable, however, to turn in the cuttings about three to four weeks before the drought sets in as by that time certain amount of decomposition will have taken place and the decomposed material will have been able to retain some moisture for the subsequent use of crop. In wet districts or in districts with an evenly distributed rainfall it is preferable that green manures should be turned into the soil immediately. The reason for this is that the drying of green manures delays as well as hinders nitrification, and loppings left on the surface are completely dried in a short time if dry weather prevails. If dry weather should alternate with wet weather then large losses of nitrogen and organic matter may result. Thus losses of over 43 percent of the nitrogen of *Gliricidia* and 37 percent of dadap leaves were found at Peradeniya, when alternate dry and wet weather occurred. When dry weather alone prevailed, decomposition of the leafy materials did not take place and no losses of nitrogen consequently occurred. The loss of nitrogen is also effected by the nature of the plant material such as *Gliricidia* than tea and *Grevillea* leaves. The forking in of green manures in the fresh state is therefore

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advocated whenever possible. On no condition should green manures be cut and forked into the soil during a drought, even at the beginning of it. This applies particularly to light sandy soils in dry districts where green manures are ploughed in. It may be necessary in some instances to compact the soil after green manuring in order to minimise losses of soil moisture and to establish capillarity in the soil. The loppings of tree and bush green manures should not be allowed to become too woody. If in this condition, they should not be ploughed into the soil.

(3) How can a good growth of green manures be obtained on poor soils?

- It may be found difficult to establish green manures for the first time both on medium and on poor soils. In this case the following methods may be tried:

(i) **Manuring the crop** - The green manure should be given a start by applying cattle manures to the seed bed. If this is not available, some nitrogenous manures, e.g. a mixture of nitrate of soda and blood meal incorporated with twice its weight of soil should be supplied at the rate of a handful or two per hole. Leguminous crops will be benefitted by the presence of nitrogen in the early stages of their growth till the formation of nodules has taken place. Potash and phosphoric acid should also be applied as the green manures have to compete with the main crops for these fertilising constituents. As a result of manuring, the nodule bacteria are reported to become more active and able to enter the plants readily and nodule formation increased. The root growth of leguminous plants in general is stimulated by manuring with phosphatic acid.

(ii) **Inoculation** - Leguminous crops at times do not come up well in new areas. This is because the soil does not contain the specific type of bacteria needed by the particular legume for the formation of the root nodules. In this case inoculation of the soil or of the seed becomes necessary. There are three methods of soil inoculation, of which the soil method is alone suitable under Ceylon conditions at the present time. It consists of broadcasting over the area to be planted 300-400 lb of soil per acre which has been taken from an area on which the green manure, it is desired to establish, has been grown with success.

(4) Other practical points on green manuring - As regards the period of retention of green manures it may be stated that in general,

perennial cover crops should not be allowed to grow for more than two or three years without being ploughed in. The reasons for this are that the soils on which these covers grown (1) need periodical cultivation and aeration (2) get "stick" as the result of growing one particular crop. For the latter reason it is advisable to have a rotation of green manure crops. Bush green manures depending on the particular species will need replanting once in two to four years. Tree green manures can be left to grow for several years, but they should be rooted out if attacked by disease.

Cover crops should be ploughed under in alternate rows across the slope of the land once every year or so.; Where the green manure crop is a heavy one, it should be cut up with a disc-harrow or rolled before ploughing in. Bush green manures should preferably be planted in contour belts. When planting out green manures for the first time a heavier seed rate than is normally required, especially if seed is plentiful and comparatively cheap, is recommended. By this means a cover will be more quickly established and weeds more effectively suppressed. Generally speaking it is preferable to plant green manure seed in rows. A mixture of seed generally gives better results than seed of one variety. The seed bed should receive careful preparation. Planting should be done in the early stages in order to give the green manures a start.

When using a green manure as the main source of nitrogen, the inclusion of an organic manure such as groundnut cake or blood meal in the artificial mixture is not recommended; but the application of a small quantity of a concentrated nitrogenous fertiliser such as cyanamide along with the green manure is advised. The reason for this is that as the carbon/nitrogen ratio of the soil has been found to retain constant at about 10 to 1, and as green manures have a much higher carbon/nitrogen ratio, some concentrated nitrogenous fertiliser would appear necessary if a permanent improvement in the nitrogen content of the soil is to be effected. Further, only about half the nitrogen contained in green manures is available in a short time. It is also advisable to plough in some cattle manure along with the green manure as the large number of bacteria present in the former will hasten the decomposition of the latter.

(5) Some limiting factors in green manuring -
As with all other farm practices, green manuring has its limitations, and these are governed by crop and climatic conditions, cost of seed and of application, insect pests and fungus diseases of both the green manure crop and the main crop, and inadequate monetary returns. Climatic conditions essential for green manuring have already been dealt with. As regards crop conditions it is known that some green manures will not grow under the heavy shade of the main crop, such as rubber, others in the open, as in young clearings. Again, certain green manures of the tree type will be unsuitable for young plantations. Others again have a climbing tendency and, therefore, should not generally be grown in new plantations, or if they are, they should be kept away from the young plants. In Ceylon, suitable green manures for all crops under all conditions are available and there is no crop which will not benefit by green manuring, judiciously carried out. The cost of seed is a factor of importance at the start. Once green manuring has been adopted, however, this difficulty may be overcome as seed becomes available. The initial expenditure on green manuring may be fairly high, but this will more than be compensated for by a saving on the fertilisers purchased. Seed of all kinds can be obtained comparatively easily and cheaply in Ceylon. Though the cost of application, in which is included the cost of cutting and forking in, if the latter is carried out, will be found to vary in the different districts, it is not prohibitive.

The question of fungus diseases and insect pests both of the green manure crop and of the main crops in which they are grown in Ceylon will be dealt with in separate chapters.

Green manuring will not be an economic proposition if adequate monetary returns are not secured. The net result should not be measured by the returns of produce obtained after one or two years, because the residual and cumulative effects of green manuring are considerable, and apart from directly benefiting the crop, soil conditions will also be greatly improved. As far as the main Ceylon crops are concerned, the satisfactory returns obtained by the judicious use of green manures in tea, cocoa, and paddy cultivation are recognised. Evidence to prove that green manuring benefits rubber and coconuts is also being obtained, and the practice with reference to these crops will be considered in detail in the chapters to follow.

(6) Green manuring practices in Ceylon estates and suggestions for their improvement where desirable - It may be well briefly to outline some of the practices followed by estates, and to indicate in which ways, if any, they may advantageously be modified. Tree green manures, e.g., dadap and *Gliricidia*, are lopped on early all estates from once to two or three times a year, and even more often. More frequent lopping is certainly preferable for the reasons that firstly a greater amount of easily decomposable green material and much less decomposable woody material is obtained and secondly, as the direct effects of green manures do not last for more than five or six months under Ceylon conditions, a continuous supply of nitrate nitrogen will be available to the plant if lopping is frequently carried out. On one estate as many as six loppings are done, the method adopted being to slash the green manure trees across as is now done to tea in the low-country. The loppings are left as a mulch on the surface either across the slope of the land or down the rows of the crop. Some estates envelope-fork all loppings into the soil each time the trees are lopped either in every row or in alternate rows. Others fork in the loppings from certain cuttings e.g. along with artificial manures; at other times the loppings are left as a surface mulch. Others again fork in the leaves and more tender branches only, the more woody branches being used either for supplying vacancies or as firewood. Many estates use the tender leaves and stems for filling into supply holes. The loppings are either cut into small pieces or left as they are; or again they are buried in deep trenches or holes between the rows of the main crop. Whenever this is done a layer of soil should be placed over a layer of the green material. The practice of burying in trenches is not one to be generally recommended, as it is likely that only the trees or bushes immediately adjacent to the trenches would profit most by it. Loppings may however be buried in large shallow trenches between the rows of the main crops as in the case of coconuts. The practice of forking in the loppings above each bush has distinct merits. Some estates plant out green manures on the manured areas between rows of the main crops, e.g., coconuts. This is a mistake, for as pointed out already, if a leguminous crop is given a source of available nitrogen it will make no effort to obtain the nitrogen it requires for its use from the air. Further, the green manure crop will even temporarily compete with

Coconut Research Institute, Lunuwila to evaluate different cover crops, 'Waduru Me' (*Mucuna utilis*) produced 130 tonnes of wet leaf litter in six months per hectare during the first year the cover was planted.

Integrating animal husbandry with crop cultivation where applicable is appropriate for the small-holders: raising cattle, goats and chicken without over-stocking. The animal dung will provide nitrogen in fair quantities, phosphate and potassium in smaller amounts. Hence the last two minerals have to be supplemented with artificial fertilizers depending on the crop and soil type.

The tendency today is to control an outbreak of a pest by spraying insecticides. These are not selective, both beneficial and destructive insects are killed in the process of spraying, disrupting the eco-system.

These disadvantages could be overcome by adapting an integrated programme of pest control: minimal use of insecticides combined with the introduction of selected parasites that attack the pest. A good example is the control of the Philippine coconut beetle inadvertently introduced into Sri Lanka in 1970 and controlled within two years by the Coconut Research Institute, Lunuwila.

The earth worms by their constant burrowing, mixing and digesting, keep the soil loose giving it a better capacity to retain air and water, increasing water absorption by about 350 percent. Earthworm excreta contains twice the

amount of phosphate and eleven times potassium than present in the surrounding soil.

Bio-farming creates a living soil teeming with bacteria, fungi and earth worms that help the plants to absorb nutrients. If the small grower could be encouraged to follow bio-farming, costs on application of fertilizer and cultural practices could be reduced considerably. For coconuts the saving on these two items will be about 70 percent. Further, the fertility of the soil maintained for successive generations to grow crops successfully.

With this system of farming, the smallholder could provide most of the inputs necessary for increasing coconut production from the farm itself at a low cost and also receive an additional income by selling the produce from the animals. The cost on application of fertilizer and cultural practices per hectare could be reduced from 70 per cent to about 30 per cent.

It is essential that the animals should be raised on the small-holdings for bio-farming to succeed. This is a field where more research has to be done, and different models developed to meet the requirements of crops, environmental factors and the socio-economic conditions of the growers.

The objectives to develop small-holdings should be to produce more with low cost management practices, not necessarily to maximize production with high inputs. As the small-holders are rational and efficient operators they are likely to accept a simple technology of this nature to develop their holdings.

(The contents of this article, written by Vidya Nidhi Dr D V Liyanage in 1985 and published in the *Daily News*, are still appropriate.)