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Legumes and Increased Crop Production

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It is well realized that nitrogen is one of the essential elements required for plant growth. The necessity of replacing the loss of this element from the soil due to removal by crops or by leaching is, therefore, well understood in all systems of agriculture. No doubt, nitrogen is also the most expensive of plant food elements. The lack of sufficient available nitrogen in the soil to meet the needs of the growing crop is therefore, the most common limiting factor in crop production.

By raising crops, however, all soil nitrogen is not lost. A large part of it is replaced in the form of cattle manure, compost, oil-cakes etc. The application of inorganic fertilizers with a view to increasing crop yields is also resorted to. This idea of applying inorganic fertilizers, especially nitrogenous, with a view to increasing crop yields may be said to have originated from India. It may be interesting to note that India was for centuries the sole source of nitrates both in times of peace and in times of war. Potassium nitrate was obtained from the nitre beds of Bihar, Bengal and the Punjab, long before the nitre deposits of Chile were discovered and exploited in 1830.

As has been pointed out by Karunakar P. D. and Rajagopalan T. "Manuring in relation to maintenance of soil fertility and increased crop production", M. A. J. Vol. No. XXXV Sept. 1948, the amount of organic manures, such as oil-cakes, farm manure, compost etc., are not sufficient for all the cultivated areas of our province. The need for manuring the area under paddy alone is great and is not adequately met to achieve the target production of 3,000 pounds. Even supposing the 10·9 million acres under paddy is properly manured, we have still to think of maintaining the fertility of the soil of the rest of the 25·5 million acres out of the total 36·4 million acres under cultivation at present. Hence, the present need for nitrogenous manure is really great.

It is gratifying to note that proposals are under way to build factories to manufacture nitrogenous fertilizers in our country and already factories have been established at Sindhri in Bihar, and Alwaye in Travancore State. But nitrogen is available from the inexhaustible supply of nitrogen in the atmosphere, as 4/5ths of the air contains it. But it is in utilising this nitrogen as a fertilizer that we are concerned within this paper. Here come the bacteria with their role in maintaining soil fertility. There are two classes of bacteria that toil incessantly in maintaining soil fertility. They are (1) the non-symbiotic nitrogen fixers of the Azoto-bacter type and (2) the symbiotic nitrogen fixing bacteria as are found in legumes.

The non-symbiotic nitrogen-fixing bacteria are certainly more important, but since the subject chosen is legumes for increased crop production, only the role of the symbiotic nitrogen fixers is presented in this paper.

Nature has established a relationship between legumes and the nodule-forming bacteria. The ability of this partnership between the two to fix the atmospheric nitrogen is important to us and warrants unlimited efforts for the harnessing of this natural source of nitrogen for the improvement of crop yields. In fact, in growing legumes, nitrogen can be said to be actually "home grown." It may not be out of place to remark here, that the legumes are so numerous upon the earth that of the total number of flowering plants of 1,30,000 species known to-day 10,782 species in some 487 genera are legumes.

The ability of these plants to enrich the soil and its nitrogen was known to the early Chinese, Greek and Roman farmers who knew that they could go on cropping the same piece of land, if they rotated the crops with legumes.

The legumes with the aid of certain bacteria which live on the roots and cause small nodules to form thereon are capable of fixing the atmospheric nitrogen, thereby converting the nitrogen into a form in which it can be utilized by the leguminous plants upon which they are growing. If the nitrogen thus fixed is later converted into soluble compounds by the decay of legumes in the soil, it can be utilized by non-legumes as well. The amount of nitrogen fixed by the legumes are naturally dependent on moisture, temperature, reaction of the soil, the presence of lime and phosphorus etc. It can be modestly put at from 50 to 200 lbs. per acre.

If a legume crop is returned to the land there will be an actual increase of soil nitrogen. Not only is the total amount of nitrogen important but the form in which that occurs is even more so. The nitrogen of legumes is in a form which is very readily available to other plants.

The legumes occupy nearly 7 million acres or 19·4% of the cultivated area under crops in our Province. The total amount of nitrogen fixed may be reckoned at 350 million pounds or 1·50 lakhs of tons on the presumption that the bacteria associated with the legumes are efficient in fixing nitrogen. But in actual practice this may not be obtained in most cases due to various causes such as the soil condition and the nature of the organism in association with the legumes. Naturally the question resolves itself to two factors namely (1) selection of suitable types suited to the variety of plants and favourable to soil and other environmental conditions and (2) the maintenance of a proper culture medium, that is the soil, for the organism to fix nitrogen efficiently.

It has been well established that although the bacteria associated with the various types of leguminous plants are all very closely related and cannot be definitely distinguished by ordinary laboratory procedure yet through the course of time different varieties or strains have become so adapted to certain legumes or groups of legumes that they are unable to cause nodules on plants outside their particular group. The lucerne nodule bacteria for example is not capable of producing nodules on groundnut. The cowpea organism cannot infect Dhaincha. The soya bean organism is capable of nodulating soya bean roots only. Thus, one more factor is introduced in the problem and that is the specificity of the bacteria to inoculate or cross-inoculate other legumes other than the one on which they normally grow.

Granting that in the 10 million and odd acres under paddy, green manure crops are raised, which will, not only add soil nitrogen but also the much needed organic matter, still there is the problem of adequately manuring the 19 million acres of land out of the total cultivated area of 36 and odd million acres. This can be solved to a great extent by growing a legume crop in rotation, wherever possible. The importance of rotating cereals with legumes can be seen from the method adopted in Italy where in a seven-year rotation, wheat is followed by two years meadow land and four years rice, only a portion of the land is occupied by rice at a time, the rest of the area being devoted to legumes, invariably a dual purpose crop, which enables the farmer to maintain work animals and milch cows. This practice certainly enriches the soil fertility and increases the crop yield to nearly double of what could be had by continuous cultivation of rice alone. This is only an illustration. This may not be suited to our condition. (The present need is for more grains for food.)

The legumes being so important from the point of view of the nitrogen economy of our agriculture, the proper rotation for every crop may have to be studied in relation to them. Here, it may be observed, that in parts of Tiruchirappalli District groundnut is cropped before a crop of paddy. So also, in all most all delta areas a pulse crop is sometimes raised after the first crop of paddy. Such a rotation may be beneficial to the succeeding crop of paddy as the legume enriches the soil both in organic matter and nitrogen.

In our effort to encourage cultivation of legumes on a large scale it must not be forgotten that they are voracious feeders of lime and phosphorus. It is essential from the point of view of nitrogen fixation and soil fertility that a dressing of phosphate in the form of super be given to the legume crop.

Apart from the nitrogen fixation, there are also attendant benefits due to legume cultivation such as release of plant food in an available form from the soil, especially by the deep-rooted crop like lucerne.

In designing therefore our pattern of agriculture, it is evident from the facts presented in this paper that an all-out effort should be made ere long to encourage extensive and intensive cultivation of legumes to serve as a potent source of renovating our much depleted fertility of soils and thereby increasing our crop production to the maximum possible extent.

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LITTLE THINGS OF GREAT UTILITY.

1. Visiting card from palm leaf.
2. Plant labels from palm leaf for breeders' use in field studies.
3. Pith lengths for making fancy toys like houses, furniture and model implements.
4. Periderm of cholam internodes peeled and sized into convenient lengths or broomstick tips sterilized, as tooth pick.
5. Lengths of ripe flower stalks of *irungu* cholam (a variety of cholam grown for fodder in the black soils of Tinnevelly) as dissecting needles for use in biological laboratories.
6. Lengths of flower stalks and internodes of *irungu* as holders for steel nibs.
7. Pith of cholam internodes to hold plant material for sectioning in histological studies.
8. Thorns of Acacia and *odai* trees as substitutes for pins; carefully selected thorn tips can be used as substitutes for soft tone gramaphone needles in cinema theatres with pick up equipment.
9. Assorted bits of cholam piths as cork for test tubes and bottles.

— *Contributed by L. Neelakantan.*