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# The Importance of Liming to the Paddy Soils of South Kanara

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I. **Introduction:** Favoured with an annual rainfall of over 150 inches and made up largely of hills and valleys, the district of South Kanara is a land of rivers and abundant vegetation. While the rainfall provides an assured supply of water for one crop in normal seasons, its distribution over a short period of four months from June to September, with downpours lasting sometimes for days at a stretch, causes an appalling amount of erosion with all its attendent evils. Year after year, the best part of the soil is washed away into the sea and valuable plant foods are lost by leaching. Under natural conditions, it is probable that the greater part of this erosion would have been effectively checked by nature's own mechanism. When one sees the sudden emergence of green pasture after the first showers in May—June, one is tempted to think that the pre-monsoon showers followed by a short break are intended by nature to prepare the ground to face the rigours of the monsoon. But cultivation practices as adopted by the average ryot pay scant regard to soil conservation practices, so that a serious situation is created in the agriculture of the district.

The poor fertility of the soils of South Kanara is evident from the fact that the yields of important crops like paddy, sugarcane and sweet potato grown in this district are practically the lowest in the whole State of Madras. With the exception of small stretches of land near rivers where the effect of erosion is set off by the deposition of silt during floods, the soil is shallow and mostly sandy. It may indeed appear strange that in a land of such plentiful rainfall, the average cultivator often has an anxious time even during the main season, because even a few days' break in the monsoon causes the plots in the single-crop area (which constitutes the major portion under paddy) to dry up and seriously affect the yields. Compare this low retentivity with that of certain other parts like Nellore, where, despite the lower annual rainfall, it is stated that the paddy plots retain moisture for a period of over three weeks.

Chemical analysis reveals a decidedly acidic reaction and a low lime status in the soils of South Kanara; the pH in most cases ranging from 5·5 to 6. Here then may be the key to the entire problem of low fertility and poor retentivity associated with these soils. Crops like paddy and sugarcane prefer a neutral medium for their best growth and it is natural to presume that raising the pH of the soil cannot fail to exert a favourable effect on yields. Lime is a great binding material and the lack of it may be the factor responsible for the poor retentivity of the soils. The presence of lime in the soil promotes the oxidation of the organic matter and lime has an essential role in the conversion of ammoniacal nitrogen into nitrates. In the absence of sufficient lime in the soil, the soluble form of monocalcic phosphate is converted into phosphates of iron and alumina which are virtually unavailable to plants. When it is further realised that most of the bacteria, which are now definitely established to be essential for keeping the soil healthy and active, also prefer a neutral reaction, one can visualise the chain of ill-effects that can result from a lack of this important substance in the soil. Bacteria play a special role in paddy soils by helping in the aeration of roots. The direct manurial effect of lime has also to be considered. An example commonly cited to prove the inadequacy of lime in the soils of South Kanara is the poor build of the local cattle which apparently results from the lack of calcium in the feed. It may not be out of place to mention here that the inclusion of mineral mixture, as practised on the Paddy Breeding Station, Mangalore in the feed of cattle, was found to be very helpful in improving their growth and general condition.

D. N. Wadia in his "Soils of India" gives a critical account of the nature of the soils of West Coast. (6). "Laterite soils," says the author, "are composed of highly ferruginous and aluminous clay, poor in alkalies and alkaline earths, lime and magnesia being notably deficient. Laterite being largely a product of monsoonic regions with their alternate dry and moist conditions, leaching action in these soils is complete, with the result that they are denuded of exchangeable bases and other fertilizing constituents, giving to the soil a more or less marked acid reaction. Because of the intensive leaching and low base exchange capacity, typical laterite soils are lacking in fertility and are of little value for crop production."

**Materials and Methods:** With the conviction that liming may prove the solution to many of the ills of South Kanara soils, an experiment was started at the Paddy Breeding Station, Mangalore, in 1948, to assess the value of lime in increasing paddy yields. A split-plot technique was employed with leaf at 4,000 lb. per acre and no leaf as the main treatments. The second crop season was chosen for the trial as the application of lime during the first crop season is attended with certain practical difficulties on account of the heavy rains and the possibility of the lime getting washed out of the plots. A plot with an assured supply of water in the lower area of the station was selected for the trial. Four replications were used, the treatments being randomized in each replication. The size of the sub-plots was about one cent each and the strain used was PTB. 19, a selection from the standard local variety of *Athikraya*. Lime was applied and incorporated about ten days before planting. The soil from the field was analysed for pH value and lime content before starting the experiment. Lime being more an indirect than a direct manure, it was programmed to observe the residual effect of the application on the succeeding crop of first crop paddy and the experiment was conducted for a period of three seasons. The residual effect of the application in 1950—'51 is under observation in the field. The soil from each treatment was analysed after each year's trial.

The summary of the results of the experiments for the past three seasons is presented in the following tables.

4. **Discussion:** (Tables I-A, I-B and II). It is seen from the tables that application of lime at doses of 1,000 to 3,000 lb. per acre results in increased grain yields of 10 to 20 per cent during the second and third years of application. There was also a residual effect of lime on the subsequent crop, though this was less conspicuous. Table II shows a rapid rise in the pH of the soil with each years' application, the treated plots being nearly neutral or on the alkaline side at the end of the third year as against the untreated plots where the pH had more or less remained constant. The effect of lime in altering the pH is more perceptible in the leaf series than in the 'no leaf' series, but statistical significance of interaction is, however, observed only during the second year of application. The lime status of the soil has increased correspondingly with increased dosage of lime. The progressive fall in N content perceptible with increased dosage of lime is attributable to the greater utilisation of this plant food resulting from higher yields. This is supported by the fact that in treatment 7 (leaf 2,000 lb.) where the average acre yield has been slightly lowered by vitiating factors, the N content has registered a sudden rise. In other words, the fall in N content is the direct result of increase in yields.

The analysis of the first year shows a more or less progressive increase in the amount of available $P_2O_5$ with increased doses of lime. No phosphatic fertiliser had been applied directly to the crop but super phosphate had been applied to the plot at rates varying from 100 to 150 lb. per acre during the three seasons preceding the experiment. This aspect of the action of lime in the soil gains added importance from the fact that "ninety per cent of the soils of the district are deficient in phosphoric acid" (5). It may be questioned, however, why, as in the case of N content the available $P_2O_5$ also does not progressively fall with increases in yields. While one has to admit that soil reactions are complex and often baffling, the explanation may lie in the fact that the available $P_2O_5$ found in the analysis may represent the portion rendered available during the period between the harvest of of the crop in January and the taking of soil samples in April. A more remote possibility is that the $P_2O_5$ rendered available is in excess of the requirements of the crop.

Unlike in the case of most other manures including green leaf, residual effects of liming are observed even after the very first application. This aspect of the question deserves further study as it is possible that the effects may continue for a few years.

The economic aspect of the application of lime is a point which, may be mentioned in passing. The cost of 2,000 lb. of lime at the local rate works out to about Rs. 80/- and the average ryot may rightly be unwilling to invest this amount, considering that it is out of proportion to the advantage gained. The sale of lime at a subsidised rate for manurial purposes in South Kanara is a subject that may be fruitfully considered. It may also be possible for well-to-do landlords to invest some capital for two or three years in the shape of liming and make them fertile in the long run.

**Conclusion:** The trials conducted so far indicate the decisive role played by lime in increasing paddy yields. Several aspects of the application of lime require fuller investigation. The trial was conducted in the double crop area and effect of application to single crop areas remains to be seen. Even in single crop areas, it is worth considering whether lime is best applied directly to the paddy crop or indirectly by being applied to the pulse crop preceding paddy. The effect of liming on soil retentivity and the effect on cattle of straw and grass grown over limed plots are worth investigation. An experiment has been started at the station to investigate the deleterious effects, if any, of the continuous application of ammonium sulphate to the soils of South Kanara. Since the chief argument against the use of ammonium sulphate is that it depletes the soil of its lime content, it would be worth investigating how far using ammonium sulphate (indirectly) in conjunction with lime would set off the bad effects.

It may be of interest to know that in an experiment conducted on similar lines at Woburn, the application of ammonium sulphate at the rate of 2 cwts. per acre for several years in succession made the soil absolutely barren, the result being attributed to the acidification of the soil. With the same treatment, excellent crops were obtained throughout the period on adjoining plots to which lime was added. Despite the fact that the soils of South Kanara are highly deficient in phosphoric acid, the use of superphosphate on these soils does not ordinarily produce marked improvements in yields, the poor response being attributed to the low lime status of the soils which results in the conversion of the soluble phosphates into phosphates of iron and alumina. An experiment to assess the value of lime in increasing the effectiveness of phosphatic manures would therefore be useful. The above two problems assume special importance today since the use of artificial manures offers one of the quickest methods of increasing food production.

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TABLE I

*Summary of Residual Effects of Lime*

(i)—DOSES OF LIME.

| Particulars. | | 0 | 1000 lb. | 2000 lb. | 3000 lb. | General Mean | 'Z' Test Satisfied or not | Critical Difference. |
|---|---|---|---|---|---|---|---|---|
| Acre Yield in lbs. | 1949–'50 | 1974 | 2024 | 2138 | 2143 | 2070 | Yes. | 112·6 |
| do. | 1950–'51 | 2428 | 2496 | 2571 | 2620 | 2529 | Yes. | 106·0 |
| Percentage on Control | 1949–'50 | 100 | 102·5 | 109·6 | 110·2 | 105·6 | Yes. | |
| do. | 1950–'51 | 100 | 102·8 | 106·0 | 108·0 | 104·2 | Yes. | |

(ii) INTERACTIONS.

| Particulars. | | No Leaf Series Lime at (lb./acre) | | | | Leaf Series Lime at (lb./acre) | | | | General Mean. | 'Z' Test Satisfied or not. | Critical Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1000 | 2000 | 3000 | 0 | 1000 | 2000 | 3000 | | | |
| Acre yield in lb. | 1949–'50 | 1929 | 1985 | 2175 | 2161 | 2020 | 2063 | 2154 | 2189 | 2085 | No | ... |
| do. | 1950–'51 | 2344 | 2450 | 2541 | 2564 | 2511 | 2541 | 2602 | 2677 | ... | ... | ... |
| Percentage on General Mean. | 1949–'50 | 92·6 | 95·3 | 104·4 | 103·8 | 97·0 | 99·0 | 103·5 | 105·0 | 100·0 | No | ... |
| do. | 1950–'51 | 92·7 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |

TABLE I-(a.)

(i)—DOSES OF LIME.

| Particulars. | | 0 | 1000 lb. per acre | 2000 lb. per acre | 3000 lb. per acre | General Mean. | 'Z' Test Satisfied or not | Critical Difference |
|---|---|---|---|---|---|---|---|---|
| Acre yield in lb. | 1948–'49 | 1833 | 1895 | 1955 | 1980 | 1916 | Yes. | 75·23 |
| do. | 1949–'50 | 1878 | 2091 | 2171 | 2279 | 2105 | Yes. | 110·7 |
| do. | 1950–'51 | 1485·4 | 1621 | 1652 | 1755 | 1628 | Yes. | 113·63 |
| Percentage on Control | 1948–'49 | 1007 | 103·4 | 106·7 | 108·1 | 104·6 | Yes. | ... |
| do. | 1949–'50 | 100 | 111·4 | 115·6 | 121·4 | 112·4 | Yes. | ... |
| do. | 1950–'51 | 100 | 109·1 | 111·2 | 118·2 | 109·6 | Yes. | ... |

(ii) INTERACTIONS.

| Particulars. | | *No Leaf Series.* Lime at (lb./acre) | | | | *Leaf Series.* Lime at (lb./acre) | | | | General Mean | 'Z' Test Satisfied or not | Critical Difference. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1000 | 2000 | 3000 | 0 | 1000 | 2000 | 3000 | | | |
| Acre Yield in lb. | 1948–'49 | 1697 | 1832 | 1874 | 1887 | 1968 | 1958 | 2035 | 2074 | 1916 | No | |
| do. | 1949–'50 | 1681 | 1966 | 2069 | 2274 | 2074 | 2217 | 2274 | 2285 | 2105 | Yes. | 156. |
| do. | 1950–'51 | 1281 | 1408 | 1519 | 1549 | 1690 | 1835 | 1789 | 1962 | 1629·1 | No | |
| Percentage on General Mean. | 1948–'49 | 88·6 | 95·6 | 97·8 | 98·5 | 102·7 | 102·2 | 106·3 | 108·3 | 100·0 | No | |
| do. | 1949–'49 | 79·9 | 93·4 | 98·3 | 108·0 | 98·6 | 105·3 | 108·0 | 108·6 | 100·0 | Yes. | 7·43 |
| do. | 1950–'51 | 78·6 | 86·4 | 93·2 | 95·1 | 103·7 | 112·6 | 109·0 | 120·4 | 100·0 | No | |

TABLE II.

*Chemical analysis of soil samples taken from different treatments during the period—1948 to 1951.*

| Heads of Analysis | No Leaf Series. Lime at (lb /acre) 0 | 1000 | 2000 | 3000 | Leaf Series. Lime at (lb./acre) 0 | 1000 | 2000 | 3000 | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| pH—Before Trial | 6·21 | | | | | | | | |
| pH—After first application | 5·61 | 5·54 | 5·47 | 5·64 | 5·64 | 5·57 | 5·40 | 5·74 | Samples taken after Harvest; April '49 |
| pH—After second application | 5·97 | 6·48 | 6·75 | 7·01 | 6·88 | 6·71 | 6·94 | 7·11 | do. March '50 |
| pH—After third application | 6·14 | 6·92 | 8·08 | 8·16 | 5·88 | 6·94 | 7·98 | 8·18 | do. March '51 |
| Total lime before trial | 0·066% | | | | | | | | |
| do. After third application, | 0·101 | 0·1563 | 0·2867 | 0·3133 | 0·0652 | 0·165 | 0·2179 | 0·3987 | Samples taken after Harvest. |
| Available $P_2O_5$ after first application | 0·0075 | 0·0069 | 0·0080 | 0·0096 | 0·0070 | 0·0081 | 0·0088 | 0·0095 | do. |
| Nitrogen % after third application | 0·1812 | 0·1525 | 0·1427 | 0·1313 | 0·1626 | 0·1542 | 0·1584 | 0·1584 | do. |