*Madras agric* J. 62 (4) : 171—174, April, 1975.

# Soil Test - Crop Response Studies with Ragi (*Eleusine coracana* Gaertn.)

By

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ABSTRACT

A trial was conducted at farmer's holding to study the soil test-crop response in CO 7 ragi using Mitscherlich-Bray equation and making use of Pimentel Gomes and Abreu equation for working out the optimum economic dose. The economic dose was found to be 58.6, 20.0 and 13.6 kg/ha of N, P and K respectively for black soil. It was found that the present soil test recommendation was alright with reference to N but a need for an upward revision for P and K for black soils was noticed. The causes for lower efficiencies of utilization of added nutrients are discussed.

## INTRODUCTION

The soil fertility management practices for successful maintenance of crop yields require the adequate amount of fertilizers. The availability concepts were successfully used in evaluating the manurial requirements of crops with short period of growth cycle (Anon, 1964). In evaluating crop responses in relation to the soil tests, Mitscherlich-Bray equation is used for P and K and for N it was largely based upon the results of experiments. The Canadian workers (Mackay *et al.*, 1963) reported the applicability of the Mitscherlich-Bray equation to N also, contrary to the original mobility concept of Bray. Similar observations were also made by Ranganathan *et al.* (1969) in various crops when N was estimated by alkaline permanganate method. Depressive effects of yield were strikingly noticed for N beyond optimum levels which mainly arise from the structural weakness of tissues to increased hydration and consequent lodging (Basak *et al.*, 1958). Pimentel Gomes and Abreu (1959) developed an equation for finding optimum economic doses for responses following Mitscherlich-Bray type. These methods are employed successfully for evaluating responses and fixing manurial doses in relation to soil tests.

As pointed out by Ramamoorthy (1966) that though there are large data on agronomic experimentation on the response of older varieties and limited information of new varieties, they are not sufficient as these agronomic experiments are not related to soil fertility. Therefore, an attempt is made in this paper to study the response of the high yielding variety of CO 7 ragi and to assess the efficiency of soil test recommendation.

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## MATERIALS AND METHODS

An experiment was conducted at the farmer's holding of a medium textured black calcareous soil of Peelamedu series at Kallapalayam, Coimbatore District with CO 7 ragi crop and graded doses of N, P and K, keeping two nutrients at sufficiency level and varying the dosage of the third at a time. The initial soil test was conducted for all the plots. Each plot was of one .cent in size. The treatments were randomized and replicated thrice. N was applied as ammonium sulphate, P as superphosphate and K as muriate of potash.

The soil test data for the various nutrients were recorded by the following methods:

Nitrogen - Alkaline permanganate method

Phosphorus - Olsen's extractant

Potassium - Normal neutral ammonium acetate extractant

The treatments were as given below:

| Nutrient element | Dose kg/ha* | | | | | Other nutrients kg/ha |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | |
| N | 0 | 25 | 50 | 75 | 100 | 5 P and 7 K |
| P | 0 | 20 | 40 | 60 | 75 | 67 N and 7 K |
| K | 0 | 12 | 24 | 36 | 48 | 67 N and 5 P |

*Nutrients expressed in elemental form in kg/ha

The yield data of grains containing 12 per cent moisture were collected.

The Baule percentage sufficiency concept, the Mitscherlich-Bray equation, Wilcox's Baule Unit (Wilcox, 1954) and fixation of maximum yields by extrapolation method (Ranganathan *et al.*, 1969) were used for studying crop responses. The economic doses were calculated using Pimentel Gomes and Abreu equation (1959). For N, Mitscherlich-Bray equation was applied to the ascending portion of the response curve.

## RESULTS AND DISCUSSION

The initial soil test and grain yield data are presented in Table 1. The efficiencies of soil test and added forms of nutrients are given in Table 2, 3 and 4.

It may be seen that the efficiency of N for CO 7 ragi is lower than that of CO 18 sorghum. Ranganathan *et al.* (1974) explained the reduction in efficiencies of added N in spite of greater uptake of N in high yielding varieties of sorghum due to the shifting of the response curve towards right which ultimately results in lower per cent yield at the dose of N at which maximum yields are reached for ordinary varieties. The efficiency of added nutrient for CO 7 ragi is better compared to Deccan maize and Hybrid sorghum CSH 1. Similar type of trend was observed by Balasundaram *et al.* (1971, 1972) in the same type of soils while studying the responses of Deccan maize and CSH 1 sorghum respectively. The lower efficiencies of N in the trial may be due to the calcareous nature of soil in which the activity of ammonia form is reduced and hence the availability is also lower.

The efficiencies of added P and K were higher while the efficiencies of

TABLE 1. Soil analysis and grain yields of CO 7 ragi

| Grading element | Location | Soil Analysis | | | | | Recommended dose (kg/ha) | | | Grain yield * (kg/ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | pH | E.C. | N | P | K | N | P | K | 0 | 1 | 2 | 3 | 4 |
| N | Kallapalayam Black, clayey | 8.2 | 1.0 | 230 | 34 | 520 | 67 | 5 | 7 | 3637 | 4481 | 4604 | 4760 | 3903 |
| P | loam, calcareous well-drained soil, | 8.1 | 0.9 | 230 | 34 | 525 | 67 | 5 | 7 | 4296 | 4424 | 4523 | 4702 | 4794 |
| K | irrigated by well | 8.2 | 1.1 | 230 | 33 | 520 | 67 | 5 | 7 | 4244 | 4319 | 4528 | 4713 | 4806 |

N. B.: Nutrients expressed in elemental form kg/ha

* Average of three replications

TABLE 2. Comparative efficiency of nitrogen with CO 7 ragi and other cereals

| Crop | Efficiencies of N | |
|---|---|---|
| | Soil form | Added form |
| Sorghum CO 18 | 0.0070 | 0.081 |
| Hybrid sorghum CSH 1 | 0.0059 | 0.0115 |
| Deccan maize | 0.0059 | 0.010 |
| Ragi CO 7 | 0.0027 | 0.025 |

TABLE 3. The coefficients of efficiencies for phosphorus and potassium with CO 7 ragi

| Nutrient | Crop | Soil form | Added form |
|---|---|---|---|
| P | Deccan maize | 0.120 | 0.042 |
| | Ragi CO 7 | 0.026 | 0.415 |
| K | Deccan maize | 0.0022 | 0.018 |
| | Ragi CO 7 | 0.0015 | 0.578 |

TABLE 4. Percentage yield, efficiency factors and Baule equivalents

| Grading element | Percentage yield | | | | | Maximum yield | Efficiency factor | | Baule equivalent (kg/ha) | | Economic dose (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | | $C_1$ | $C_2$ | Soil form | Added form | |
| N | 76.0 | 94.0 | 98.0 | 99.8 | 91.0 | 4780 | 0.0027 | 0.025 | 111.70 | 12.00 | 58.6 |
| P | 87.1 | 90.2 | 92.3 | 96.0 | 97.9 | 4898 | 0.026 | 0.415 | 11.51 | 0.73 | 20.0 |
| K | 86.3 | 87.8 | 92.0 | 95.8 | 97.7 | 4920 | 0.0015 | 0.578 | 199.50 | 0.521 | 13.6 |

soil test P and K were somewhat lower. This may be due to the calcareous nature of the soil where calcium phosphates have limited availability due to common ion effect (Aslyng, 1954).

The economic doses were also calculated using the methods developed by Ranganathan *et al.* (1969) for N, P and K. The optimum Baule requirements for N, P and K were calculated for CO 7 ragi using soil test values and economic doses obtained in this trial and are presented in Table 5. For ragi the optimum economic dose of N was found to be 58·6 kg/ha corresponding to 4·88 Baules. The soil test value corresponds to 2·06 Baules.

TABLE 5. Total Baules for optimum yields

| Nitrogen | | | Phosphorus | | | Potassium | | |
|---|---|---|---|---|---|---|---|---|
| Soil | Added | Total | Soil | Added | Total | Soil | Added | Total |
| 2.06 | 4.88 | 6.94 | 2.95 | 27.39 | 30.34 | 2.87 | 26.11 | 28.98 |

Hence, the optimum yields in the trial conducted was reached at a total N equivalent of 6·94 Baules. Such a lower Baule equivalent for N compared to P and K was also noticed to occur in the case of crops like sorghum, rice and cotton (Anon, 1966). It may be noted that ragi requires about the same N as previously recommended but needs more P and K. Even in rice the soil test-crop correlations have indicated the need for an upward revision of the recommendation (Ranganathan *et al.*, 1972). This is conspicuous in this particular case as the trial was conducted on a calcareous soil.

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