

Phosphate and Potash Fertilization of Flue-cured Tobacco in the Dry Zone Rice lands of Ceylon

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EXPERIMENTS to determine the optimum requirements of the three major elements N. P. & K. for Flue-cured tobacco grown as a yala crop in the Dry Zone ricelands of Ceylon have been carried out from 1962, with a view to a balanced use of these elements in the fertiliser formulations of tobacco. Investigations on nitrogen fertilisation have shown that 20 lb. nitrogen per acre gives best economic return. (1) Preliminary trials on phosphate and potash fertilisation in 1963-1965 gave no significant response in respect of the yield and quality of the leaf produced. (2) However, phosphate fertilisation was found to show some beneficial effect but consistent absence of response was observed for potash.

In yala 1966 and 1967 two experiments were conducted using varying levels of both phosphate and potash. The variety used in both experiments was White Gold. The results obtained in these investigations are presented in this paper.

EXPERIMENT No. 1

This experiment was sited at the Agricultural Station, Hingurakgoda in a well drained ricefield. The soil was a sandy loam.

EXPERIMENTAL TREATMENTS

A. Levels of Phosphate

P0—No Phosphate

P1—150 lb. Conc. Superphosphate per acre (43% P^2O^5).

P2—300 lb. Conc. Superphosphate per acre (43% P^2O^5).

B. LEVELS OF POTASH

K0—No Potash

K1—125 lb. Sulphate of Potash per acre (48% K^2O).

K2—250 lb. Sulphate of Potash per acre (48% K^2O).

Design : 3×3 factorial with 3 replicates

Block Size : $135' \times 30'$

Plot Size : $15' \times 30'$ (5 rows of 12 plants at a spacing of $3' \times 2\frac{1}{2}'$. The net harvested area was 30 plants leaving a border row of one plant all round—1/200 acre.)

All plots received a uniform application of ammonium sulphate (20%N) at 20 lb. nitrogen per acre rate. All the fertilisers were applied at the time of planting in bands on either side of the plants 4 inches away from the base of the plants and 5 inches deep.

Selected seedlings of uniform growth were planted on 17.5.66. Standard cultural practices were followed and the experiment was irrigated on 5.6.66, 14.6.66, 22.6.66 and 13.7.66. The harvest was taken in 7 primings and ripe leaves were taken in each pick. The leaf was cured and graded according to the buyers' grades by trained graders.

RESULTS

(1) *Rating of plots at 6 weeks' growth*

The experimental plots were visually rated on the basis of the growth and vigour of the plants 6 weeks after transplanting. Marks were recorded within a maximum score of 10. The data are presented in Table 1.

(2) *No. of leaves per plant at 6 weeks' growth*

The number of leaves on 3 random plants in each treatment 6 weeks after transplanting were recorded. Leaves up to the bud leaving out 3 in. and leaves at the bottom, were counted. The summarised data are in Table 2.

(3) *The number of curable leaves per plant*

The number of curable leaves in 3 random plants in each treatment at the time of topping was recorded and the data are presented in Table 3.

(4) *Green leaf yield*

The data on the effects of the treatments on the green leaf yield per acre are presented in Table 4.

(5) *Cured leaf yield*

The cured leaf yield for each treatment computed as lb. per acre are given in Table 5.

(6) *Acre value*

The cured leaf graded according to standard grades, valued on the basis of the prices fixed for the different grades in 1966 and computed as rupees per acre are summarised in Table 6.

EXPERIMENT No. 2

This experiment was also conducted at the Agricultural Station, Hingurakgoda during the 1967 yala season and was sited in another section of the farm having the same soil type. In view of the progressive response shown in Experiment No. 1 to increased phosphatic fertilisation up to 300 lb. of concentrated superphosphate per acre, the levels of phosphate tried in this experiment was increased to include a higher level, viz., 400 lb. of concentrated superphosphate per acre. On the other hand, the levels of potash were lowered in this experiment as no response had been obtained in the earlier trials.

EXPERIMENTAL TREATMENTS

A. Levels of Phosphate

- P0—No phosphate
 P1—100 lb. Conc. Superphosphate per acre
 P2—200 lb. Conc. Superphosphate per acre
 P3—400 lb. Conc. Superphosphate per acre

B. Levels of Potash

- K0—No Potash
 K1—75 lb. Sulphate of Potash per acre
 K2—150 lb. Sulphate of Potash per acre

Design : 4 × 3 factorial with 2 replicates

Block Size : 180 × 30'

Plot Size : 15' × 30' (5 rows of 12 plants at a spacing of 3' × 2½'. The net harvested area was 30 plants leaving a border row of one plant all round—1/200 acre.)

All plots received a uniform application of ammonium sulphate (20% N) at 20 lb. nitrogen per acre rate. All the fertilisers were applied at the time of planting in bands on either side of the plants 4 inches away from the base of the plants and 5 inches deep.

All cultural, curing and grading practices were carried out in accordance with those of experiment No. 1.

RESULTS

The summarised results of this experiment are presented in tables as follows :—

(1) Rating of plots at 6 weeks' growth	..	Table 7
(2) No. of leaves per plant at 6 weeks' growth	..	Table 8
(3) No. of curable leaves per plant	..	Table 9
(4) Green leaf yield as lb. per acre	..	Table 10
(5) Cured leaf yield as lb. per acre	..	Table 11
(6) Acre value in rupees	..	Table 12

DISCUSSION

Phosphorus

Phosphorus plays an important function in the growth and maturity of flue-cured tobacco as well as in the improvement of leaf colour. The quantity of phosphorus absorbed by a tobacco crop is, however, relatively small and in the initial stages the up-take of P2 O5 by a flue-cured tobacco crop is only about 10 lb. per acre. A portion of the incorporated phosphate would also get 'fixed' in the soil.

Though the P content of the soil in which the two experiments were laid down was medium (20-30 lb. of P2 O5 per acre) the effects of applied P2 O5 on the early growth of the plants was marked in both the experiments. The rating as well as leaf count taken at 6 weeks growth showed significant response to increased levels of phosphorus (Tables 1, 2, 7 and 8). These responses, however, evened out with the growth of the plants and there was no visible difference between the treatments at the time of harvesting. The number of curable leaves counted at the time of topping (Tables 3 and 9) also indicates this. This phenomenon has been generally observed in many reported experiments. Chai (3) recorded that in field tests on tobacco grown in sandstone and shale alluvial soils no correlation was observed between phosphate effect and available P content of the soil. The soil P content had no significant effect on the initial growth of the tobacco. However, an application of phosphate markedly improved it. Under the soil and climatic conditions of Andhra Pradesh too Patel (4) concluded that there were marked differences in the early stages when NP applied plots were compared with N applied plots, but as growth proceeded these differences narrowed down and finally at harvesting time visible differences were hardly observed.

Although there had been no significant response to applications of phosphate in the earlier trials in respect of the yield and quality of the crop, the 1966 and 1967 experiments showed marked effects to increased levels of applied phosphate (Table 5, 6, 11 and 12). This could probably be due to the build-up of this nutrient in the soil after repeated applications of phosphatic fertilisers for the tobacco and the rice crops in the rotation over the years. This is supported by the findings of Gopinath (5) in the fertile soils of Andhra Pradesh where he has found that response to P fertilisation was observed only after repeated applications.

The data from these experiments show that best results in respect of P application would be obtained at a level of 100 to 200 lb. of concentrated Superphosphate per acre.

Potassium

A liberal supply of potash is necessary for flue-cured tobacco for the production of good quality leaf. Its effects on the leaf burn, aroma, elasticity, colour and disease resistance are outstanding.

There was consistent absence of response to applications of potash in these trials. This is surprising as the K content of the soils in which the experiments were conducted were also found to be low. The available K₂O in these soils is of the order of 15 lb. per acre. Patel (4) has also, found that under the soil and climatic conditions of Andhra Pradesh in India no beneficial effect is observed to applications of potash either on cured leaf yield or bright leaf yield in any of the field experiments conducted this far. However, Hara, *et al* (6) has found in the soils of Japan that the content of potassium absorbed by the tobacco plant had a high correlation with the amount of exchangeable potassium in the soil. It may therefore be necessary to decide the amount of potassium fertiliser for tobacco in consideration of exchangeable potassium in the soil.

SUMMARY

Studies on the response of flue-cured tobacco to phosphate and potash fertilisation in the Dry Zone ricelands of Ceylon over a number of years are reported.

Response to P in respect of the yield and market value of the tobacco crop has been obtained after continuous applications of P₂O₅ in the soils over a number of years.

Successive increments of phosphate in the fertiliser resulted in progressively increasing the early growth and vigour of the plants.

Under the conditions of the experiment in the Dry Zone ricelands of Ceylon 150 lb. of concentrated superphosphate (43% P₂O₅) per acre would appear to be the optimum recommendation.

There has been consistently no response to potash in the experiments conducted so far.

In view of the low K content of the soils in which the experiments were laid down this phenomenon of non-responsiveness to fertiliser potash will have to be studied further in relation to exchangeable K in soil, irrigation water, environmental conditions and plant analysis. It is proposed to carry out further trials with very heavy doses of potash application on the same land over several years so as to enable a soil build up of this nutrient.

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REFERENCES

1. JAYANETTI, E. & SABANATHAN, P.—(1967). Flue-cured tobacco trials in the Dry Zone Ricelands of Ceylon. *Trop. Agric.* Vol. CXXIII, p. 111.
2. Unpublished data—Tobacco Division, Department of Agriculture, Ceylon.
3. CHAI, C.F.—(1963). Phosphorus Status of Tobacco Soils and Effect of Applied Phosphate. *Soils and Fert.* : 66.
4. PATEL, G. C. (1965) Phosphate and Potash Manuring of Flue-cured Tobacco Grown in the Black Cotton Soils of Andhra Pradesh—Problems and Progress—A review. *Ind. Tob.* Vol. XV No. 1.
5. GOPINATH, D. M.—(1965). Response to NPK Fertilisation in Flue-cured Tobacco. *Fert. News.* 10 (12), 131-6.
Coresta Infm. Bull. (3) ; No. 4297, 1967.
6. HARA, J., OKADA, M., MATSUYAMA, S.—(1967). Soil Survey of Tobacco Fields in Shikoku District. *Okayama Tob. Exp. Sta. Bull.* (28) : 35-50, Mar. 1967 graphs, maps, tables. (Jap.)

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TABLES FOR EXPERIMENT No. I

TABLE I—RATING OF PLOTS AT 6 WEEKS' GROWTH

<i>Levels of P2 05</i>		<i>Mean</i>		<i>Levels of K2 0</i>		<i>Mean</i>
P0	..	5.5	..	K0	..	6.5
P1	..	6.8	..	K1	..	6.7
P2	..	7.0	..	K2	..	6.1
LSD : 2.064						
CV : 23%						

TABLE II—No. OF LEAVES PER PLANT AT 6 WEEKS' GROWTH

<i>Levels of P2 05</i>		<i>Mean</i>		<i>Levels of K2 0</i>		<i>Mean</i>
P0	..	6.5	..	K0	..	8.5
P1	..	8.9	..	K1	..	9.0
P2	..	9.7	..	K2	..	8.6
LSD : 0.016						
CV : 6.28%						

TABLE III—No. OF CURABLE LEAVES PER PLANT

<i>Levels of P2 05</i>		<i>Mean</i>		<i>Levels of K2 0</i>		<i>Mean</i>
P0	..	18.7	..	K0	..	19.5
P1	..	19.0	..	K1	..	19.5
P2	..	20.5	..	K2	..	19.3
LSD : NS						
CV : 4.1%						

TABLE IV—GREEN LEAF YIELD AS LB. PER ACRE

<i>Levels of P2 05</i>		<i>Mean</i>		<i>Levels of K2 0</i>		<i>Mean</i>
P0	..	35.25	..	K0	..	37.00
P1	..	33.92	..	K1	..	32.22
P2	..	35.573	..	K2	..	35.44
LSD : NS						
CV : 15%						

TABLE V—CURED LEAF YIELD AS LB. PER ACRE

<i>Levels of P2 05</i>		<i>Mean</i>		<i>Levels of K2 0</i>		<i>Mean</i>
P0	..	807	..	K0	..	1,004
P1	..	940	..	K1	..	855
P2	..	1,008	..	K2	..	889
LSD : 604.12						
CV : 13%						

TABLE VI—ACRE VALUE AS RUPEES PER ACRE

<i>Levels of P2 05</i>		<i>Mean</i>		<i>Levels of K2 0</i>		<i>Mean</i>
P0	..	2,682	..	K0	..	3,379
P1	..	3,070	..	K1	..	2,785
P2	..	3,254	..	K2	..	2,842
LSD : 702						
CV : 13.5%						

TABLES FOR EXPERIMENT No. II

TABLE VII—RATING OF PLOTS AT 6 WEEKS' GROWTH

Levels of P2 05	Mean	Levels of K2 0	Mean
P0 ..	5.6	.. K0 ..	6.4
P1 ..	5.7	.. K1 ..	5.8
P2 ..	6.3	.. K2 ..	6.3
P3 ..	7.3	.. — ..	—

LSD: 1.3

CV: 7.31%

TABLE VIII—No. of LEAVES PER PLANT AT 6 WEEKS' GROWTH

Leaves of P 02 05	Mean	Levels of K2 0	Mean
P0 ..	7.2	.. K0 ..	7.8
P1 ..	7.4	.. K1 ..	7.6
P2 ..	7.8	.. K2 ..	7.9
P3 ..	8.3	.. — ..	—

LSD: NS

CV: 5.88

TABLE IX—No. of CURABLE LEAVES PER PLANT

Levels of P2 05	Mean	Levels of K2 0	Mean
P0 ..	16.3	.. K0 ..	17.2
P1 ..	16.7	.. K1 ..	17.4
P2 ..	16.8	.. K2 ..	16.2
P3 ..	17.9	.. — ..	—

LSD: NS

CV: 4.9%

TABLE X—GREEN LEAF YIELD AS LB. PER ACRE

Leaves of P2 05	Mean	Levels of K2 0	Mean
P0 ..	5,524	.. K0 ..	5,574
P1 ..	5,327	.. K1 ..	5,385
P2 ..	5,799	.. K2 ..	5,943
P3 ..	5,887	.. — ..	—

LSD: NS

CV: 11%

TABLE XI—CURED LEAF YIELD AS LB. PER ACRE

Levels of P2 05	Mean	Levels of K2 0	Mean
P0 ..	927	.. K0 ..	1,002
P1 ..	1,020	.. K1 ..	1,067
P2 ..	1,118	.. K2 ..	1,063
P3 ..	1,111	.. — ..	—

LSD: NS

CV: 7%

TABLE XII—ACRE VALUE AS RUPEES PER ACRE

Levels of P2 05	Mean	Levels of K2 0	Mean
P0 ..	2,460	.. K0 ..	2,655
P1 ..	2,853	.. K1 ..	2,861
P2 ..	2,893	.. K2 ..	2,849
P3 ..	2,947	.. — ..	—

LSD: 349.52

CV: 8.7%