EXPERIMENTS ON THE MANURING OF CIGARETTE TOBACCO IN CEYLON

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INTRODUCTION

IN the *maha* 1940 season a manurial trial was laid down at the Wariyapola Experiment Station to ascertain the effects of varying combinations of nitrogen and potash on the yield and quality of cigarette tobacco, the level of phosphoric acid being maintained constant.

The variety of tobacco experimented with was Harrison's Special, which has, up to now, been found most suited to the district. The soil of the area is a light sandy loam, extremely poor in nitrogen and organic matter and poor in mineral nutrients. It is of slightly acid reaction. The incidence of rainfall at the station during the period of the trial, *i.e.*, from October to early March and the average distribution are shown below :—

	1940–41. Inches.	Average. Inches.
October	18·40 ..	13·7
November	21·21 ..	11·7
December	5·20 ..	6·2
January	1·93 ..	5·4
February	0·56 ..	1·5
March (1–5th)	0·25 ...	0·5
	47·55	39·0

EXPERIMENTAL DETAILS

The manurial treatments, which consisted of combinations of nitrogen at three levels with potash at two levels, were six in number, and are detailed below.

(1) Single nitrogen (20 lb. per acre) and single potash (approx. 20 lb. per acre)—NK.
(2) Single nitrogen (20 lb. per acre) and double potash (40 lb. per acre)—N2K.
(3) Double nitrogen (40 lb. per acre) and single potash (20 lb. per acre)—2NK.
(4) Double nitrogen (40 lb. per acre) and double potash (40 lb. per acre)—2N2K.

(5) Treble nitrogen (60 lb. per acre) and single potash (20 lb. per acre)—3NK.

(6) Treble nitrogen (60 lb. per acre) and double potash (40 lb. per acre)—3N2K.

Nitrogen was applied as a mixture of nitrate of soda and blood meal, the quantities of these fertilizers per acre for the single dressing having been 100 lb. and 40 lb. respectively. These quantities were increased proportionately for the higher dressings. Potash was applied as sulphate of potash, the amount per acre for the single dressing having been 40 lb. The basal application of phosphoric acid was 30 lb. per acre in the form of superphosphate.

The experiment was laid out in six randomized blocks, each plot being of external dimensions 30 ft. by 30 ft. The net harvested area per plot was 24 ft. by 24 ft., comprising 81 plants in all. The plants were spaced 3 ft. by 3 ft. The fertilizers were applied at intervals as follows :—

One quarter, 5 days after planting.
One half, 14 days after planting.
One quarter, 21 days after planting.

The mixture was applied, suitably diluted with sand, around each plant separately.

OTHER PRACTICAL DETAILS

The area was originally planted out towards the end of October but had to be replanted on November 19 and 20 as a result of heavy rains. The first application of fertilizer was given on November 25, 1941, the second on December 3, 1941, and the last on December 11, 1941. It was noted that the plots receiving the highest dressing of nitrogen showed greatest vigour and rapidity of growth in the early stages of crop development. At each harvest, of which there were six, records of the green weight were kept so that information could be obtained relative to the conversion ratio of green to cured tobacco. The tobacco was flue-cured.

The high yield of crop per acre obtained in this trial as compared with the average for the station can be accounted for on the following grounds :—(1) the normal application of nitrogen on the station is 20 lb. per acre, corresponding to the lowest nitrogen level in the experiment; (2) in the trial all vacancies were filled, as far as was possible, with the best plants, and the best time of the season was selected for planting; (3) yields are based on the maximum number of plants per unit area, while on the farm the actual extent of land under crop is appreciably less than the surface area, owing to drains, bunds, &c.; (4) the area selected for the trial was the best available from the point of view of uniformity, good drainage, &c. On the farm certain areas are waterlogged in wet weather; (5)

the season was generally favourable in respect of total rainfall. The average yield of crop on the station for the season is much higher than that in previous years.

RESULTS

The data obtained from the trial is presented in a series of six tables, each of which deals with a separate aspect of the trial. In table I. below the yields of cured tobacco in pounds per plot are shown. No correction has been made in plot yield for the number of vacancies. In tables IA and IB, the results of the satistical analysis of the data are presented.

TABLE I
Yields of Cured Tobacco in Lbs.

Treatments	Blocks. A	B	C	D	E	F	Total	Mean
I NK	11·9	7·9	7·5	8·7	6·7	10·8	53·5	8·92
II N2K	10·8	6·8	9·4	5·3	7·2	7·4	46·9	7·81
III 2NK	16·3	10·4	12·8	6·0	11·2	9·1	65·8	10·97
IV 2N2K	16·1	9·0	10·6	16·1	9·0	9·8	70·6	11·77
V 3NK	13·2	7·8	14·3	17·6	12·4	14·1	79·4	13·23
VI 3N2K	17·7	10·5	10·3	17·1	11·5	14·6	90·7	15·12
	86·0	52·4	73·9	70·8	58·0	65·8	406·9	

General mean : 11·3 lb.

TABLE IA
Analysis of Variance of Yields

	Degrees of freedom	Sum of sq.	Mean sq.	F
Treatments	5	218·7	43·74	7·2
Blocks	5	119·1		
Error	25	152·1	6·08	
	35	489·9		

For P = ·05, F = 2·60
„ P = ·01, F = 3·86

Results are very definitely significant.

TABLE IB
Yields in Lbs.

	Single nitrogen	Double nitrogen	Treble nitrogen	Total	Mean per plot	Per acre
Single potash	53·5	65·8	79·4	198·7	11·04	662·4
Double potash	46·9	70·6	90·7	208·2	11·57	694·2
Total	100·4	136·4	170·1	406·9		
Mean per plot	8·37	11·37	14·17	—	11·3	—
Mean per acre	502·0	682·0	850·5	—	—	678
Per cent. of mean	74·0	100·5	125·4	—	—	100

Significant differences :—

For comparisons of nitrogen treatments: 2·07 lb. or 1·83 per cent. (P = ·05), 2·84 lb. or 2·51 per cent. (P = ·01).

For comparisons of potash treatments : 1·69 lb. or 1·49 per cent. (P = ·05), 2·29 lb. or 2·03 per cent. (P = ·01).

An examination of the data of tables IA and IB will indicate that very significant increased yields are obtained as a result of nitrogenous manuring, the increases being almost proportional to the additional amounts of nitrogen applied. The yields of cured tobacco at the second and third levels of nitrogen, expressed as percentages of the mean, are over 25 and 50 per cent. higher than that at the first level. Expressed in pounds per acre, the average yield varies from 502 lb. for the single nitrogen to 850 lb. for the treble nitrogen dressing. The additional application of potash over the basal dressing of 20 lb. per acre is without effect on yield. Interactions between the nitrogen and potash treatments are not significant.

TABLE II

Yields of Tobacco according to Grades

Grades	Treatments.					
	NK	N2K	2NK	2N2K	3NK	3N2K
I	9·2	6·3	6·7	10·9	4·9	3·4
	17·2	*15·5*	*10·2*	*15·4*	*6·2*	*3·8*
II	8·2	7·2	9·5	13·7	8·3	7·2
	15·2	*17·5*	*14·5*	*19·3*	*10·4*	*7·9*
III	3·0	4·5	4·9	5·8	1·3	2·8
	5·6	*11·1*	*7·4*	*8·2*	*1·7*	*3·1*
IV	11·7	7·0	12·3	11·5	11·4	14·1
	21·7	*17·2*	*18·6*	*16·3*	*14·3*	*15·9*
V	10·8	7·0	14·0	14·7	21·7	26·2
	20·2	*17·2*	*21·3*	*20·8*	*27·2*	*28·8*
VI	6·0	4·1	6·8	4·3	8·2	10·3
	11·2	*10·1*	*10·3*	*6·0*	*10·4*	*11·3*
VII	4·8	4·7	11·5	9·9	23·4	26·8
	8·9	*11·3*	*17·5*	*14·0*	*29·5*	*29·6*

Figures in italics indicate percentages of the grade on total yield of crop for the particular treatment.

In table II. above are shown the yields of each of the seven commercial grades of tobacco for the different treatments. The data are yields of crop from six replicated plots. The figures in italics are percentages of the grades of tobacco on total yield of crop for each treatment.

It will be observed that the highest dressing of nitrogen results in a large outturn of poor quality tobacco. Thus, the percentages of grades V., VI., and VII. tobacco from the treble nitrogen (60 lb. per acre) treatments are 67·1 and 69·7 per cent. respectively, while the corresponding figures for the single nitrogen treatment are 40·3 and 38·6 per cent. respectively. On the other hand, the single and double nitrogen treatments give much the same outturns of good quality tobacco, *viz.*, 38·0 and 34·1 per cent. and 34·1 and 32·9 per cent. respectively

The higher application of potash does not appear to offset any ill-effects of the high nitrogen applications on quality, nor does it improve the quality of tobacco at the lower levels of nitrogen. From the points of view of both quality and yield, the double nitrogen treatments are, therefore, preferable to the single nitrogen treatments.

TABLE III

Average Value in Cents per Lb.

Treatments					
NK	N2K	2NK	2N2K	3NK	3N2K
64·7	67·0	60·7	64·8	54·1	51·1

Average for nitrogen treatments : N = 65·8, 2N = 62·7, 3N = 52·6.
Average for potash treatments : K = 59·7, 2K = 60·6

Significant differences :—

	P = ·05	P = ·01
	cts.	cts.
for nitrogen comparisons is	4·2	5·7
for potash comparisons is	3·4	4·6
for means of treatments is	5·9	8·0

The average price per pound of tobacco obtained for each of the separate treatments and for each level of nitrogen and potash, has been calculated from the yields per plot obtained of each grade of tobacco and the price per pound of the grade on the following scale :—

	Rs.	c.	
Grade I.	1	0	per lb.
,, II.	0	90	,,
,, III.	0	80	,,
,, IV.	0	60	,,
,, V.	0	50	,,
,, VI.	0	40	,,
,, VII.	0	30	,,

These figures are shown in table III. above. The data were subjected to statistical analysis and found to be significant. The significant value differences for the various comparisons are also shown in the table.

It will be noted that (1) there is, on the average, no statistical difference in value per lb. between that of the single and double nitrogen treatments ; (2) there is a very marked and statistically significant falling off in price, viz., from 66 to 53 cts. as the quantity of nitrogen is increased from the first and second to the third level (60 lb. per acre) ; (3) increasing the potash has not led to a statistically significant improvement in the value of the tobacco produced. At the lower levels of nitrogen an increase of potash does, however, appear to have some effect on the value of tobacco ; (4) the average price per lb. of tobacco in the case of treatment III. (double nitrogen, single potash) is significantly less than that of treatment II. (single nitrogen, double potash).

TABLE IV

Gross Returns Per Acre

Treatments	NK	N2K	2NK	2N2K	3NK	3N2K
Rs. ..	346	317	398	450	420	458

The data in table IV. above show that the highest gross returns are obtained from the double nitrogen and potash, and treble nitrogen and double potash treatments. In view, however, of the quality and price of tobacco at the third level of nitrogen being appreciably less than that of the product at the lower nitrogen levels, the double nitrogen, double potash treatment could be considered to be the optimum under the soil and climatic conditions at Wariyapola.

TABLE V

Percentage Yields of Crop at each Harvest

Treatments	Harvets					
	1st	2nd	3rd	4th	5th	6th
NK ..	15·4	24·6	26·2	4·6	22·3	6·3
N2K ..	16·4	24·8	25·9	4·3	21·7	6·9
2 NK ..	13·1	22·2	27·5	2·9	26·0	7·6
2 N2K ..	15·5	26·3	27·7	4·2	20·4	7·6
3 NK ..	12·9	24·5	23·9	2·2	28·3	7·9
3 N2K ..	13·5	23·1	25·2	2·6	28·0	7·7

In table V. above, the calculated percentages of cured tobacco on total crop obtained at each harvest for each treatment are furnished. The data indicate that the treatments have not exerted any appreciable differential effect in respect of rate of maturity, as gauged from the total crop harvested at each harvest. The low percentage yield of crop at the fourth harvest is noteworthy.

TABLE VI

Percentage of Cured to Green Tobacco

Treatments	Harvests						
	1st Per Cent.	2nd Per Cent.	3rd Per Cent.	4th Per Cent.	5th Per Cent.	6th Per Cent.	Average Per Cent.
NK ..	10·7	15·0	15·7	14·6	18·2	19·7	15·6
N2K ..	11·1	15·1	17·6	13·1	18·2	18·7	15·6
2 NK ..	10·0	13·6	17·0	13·6	18·0	18·2	15·1
2 N2K ..	10·0	14·0	16·6	14·4	18·8	18·0	15·3
3 NK ..	9·4	14·6	16·0	14·0	17·8	19·3	15·2
3 N2K ..	9·5	13·4	16·0	13·3	18·1	19·7	15·0
Average ..	10·1	14·3	16·5	13·8	18·2	18·9	15·3
Date of harvest	23/1	3/2	10/2	18/2	25/2	5/3	
Rainfall for period between harvests ..	1·93	—	·56	—	—	·02	

The percentages of cured to green tobacco at each harvest for each treatment are set out in table VI. The interesting point which emerges from the data is that the percentages, except in one instance, increase from 10·1 to 18·9 as the season advances. In the case of the exception referred to, the fourth harvest the yields of crop harvested were so very low as compared with those of the harvest immediately before and after, that any figures obtained therefrom cannot be considered truly representative. These results need no explanation and are as to be expected. The percentage figures are not in any way correlated to the rainfall prior to or between harvests.

GENERAL

These results, in respect of yield and quality of crop as affected by fertilizer treatment, generally confirm those obtained in Rhodesia (1). The quantities of nitrogen applied in our trial are, however, appreciably higher than those in the Rhodesian experiments. The reverse is the case with potash. Further trials on similar lines to the one under discussion are contemplated at two centres next *yala* season.

SUMMARY AND CONCLUSIONS

A manurial trial conducted at the Wariyapola Experiment Station during the *maha* 1941–42 season to determine the effects of combinations of nitrogen and potash at different levels on the yield and quality of cigarette tobacco have indicated that :—

(1) Yields increase proportionately with the additional amounts of nitrogen applied, the rate of increase being about 25 per cent. of the mean yield for each unit of nitrogen (20 lb. per acre) given.

(2) An additional application of potash (20 lb. per acre) over the basal dressing (20 lb. per acre) is without effect on yield.

(3) The highest dressing of nitrogen (60 lb. per acre) reduces the percentage outturn of the higher grades and increases appreciably the percentage of the lower grades of tobacco.

(4) There is a marked falling off in the average value per pound of the cured tobacco as the quantity of nitrogen is increased from the first and second to the third level. Increasing the potash, has not affected any improvement in quality of tobacco.

(5) The highest gross returns are obtained from the treble nitrogen, double potash and the double potash, double nitrogen treatments.

(6) From the point of view of both yield and quality of tobacco at Wariyapola, the optimum manurial dressing would appear to be 40 lb. nitrogen and 40 lb. potash per acre.

(7) Manurial treatments do not appear to affect to any appreciable degree, the percentage yields of crop at each harvest on total crop harvested.

(8) The outturns of cured to green tobacco increase with advancing season.

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LITERATURE

1. Report of the Tobacco Research Board, 1937. *Rhodesia Agl. Jour.*, Vol. XXV., May, 1938.