FERTILIZER RESPONSES IN LOW-GROWN CLONAL TEA

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Clonal tea with a mean yield of 2442 lb in the first year and 4285 lb in the second year of three pruning cycles, each of two years, responded to 150 lb nitrogen in the first year and 225 lb nitrogen in the second year of each cycle. A mean yield of 3195 lb made tea per acre per year was maintained over a period of six years with only 75 lb nitrogen per acre per year. Increasing potash above 50 lb K_2O per acre per year failed to increase yields in the first four years of the experiment ; in two subsequent years, a five per cent increase in yield was obtained when potash was increased from 50 to 100 lb K_2O per acre per year ; increasing K_2O from 100 to 150 lb per acre per year depressed yields. Applications of magnesium sulphate failed to improve yields.

The first fertilizer experiment on low-grown clonal tea was initiated by Joachim in 1960 on four-year-old, vegetatively-propagated tea of the TRI Clone 2023, grown at the Karapincha Division of Palmgarden Group, Ratnapura.

Joachim (1964) examined the results of the first experimental cycle, May 1961 to May 1963. Of the fertilizers applied, only nitrogen increased yields. Potassium and magnesium, though supplied with nitrogen, each at three levels and in all combinations, did not increase yields. Phosphorus was applied uniformly to all plots at 60 lb P_2O_5 per acre per year. The response to nitrogen was significantly linear with a 10 per cent increase in yield over the range 75, 150 and 225 lb nitrogen per acre per year, the overall return being 2.2 lb of manufactured tea per lb of nitrogen applied. The yield of 3124 lb made tea with 75 lb nitrogen, per acre per year, was considered remarkable. The nine applications of nitrogen per cycle were significantly better than seven and five applications respectively.

The experiment was continued over the period 1963 to 1968, with no change in the fertilizer levels. The number of applications were increased from five, seven and nine per cycle to seven, nine and eleven respectively. The 81 plots, arranged in nine blocks of nine plots each, continued to accommodate the 81 treatment combinations of three levels each of nitrogen, potassium and magnesium, along with the three frequencies of fertilizer application.

The results of the second experimental year cycle, June 1963 to May 1965, are presented in Table 1. Again, responses to potassium and magnesium failed to reach significance. The nitrogen response was similar to that of the first cycle : an increase in yield of nine per cent over the cycle when nitrogen was increased from 75 to 225 lb per acre per year. The return per pound of nitrogen was two lb made tea. Over the duration of the cycle, the nitrogen response improved : in the first six months the application of nitrogen did not appear to increase yields ; in the second six months the response did not extend beyond the 150 lb nitrogen per acre level ; in the third six months 225 lb nitrogen per acre was beginning to show some effect, though not significant, and in the last six months of the two-year cycle 225 lb nitrogen was significantly the best. The decline in yield in the last six months was a result of adverse weather. Over the two-year period, 75 lb nitrogen continued to maintain a yield of 3222 lb made tea, per acre per year, and this conforms closely to a similar finding in the first cycle.

None of the interactions were significant in the second cycle, 1963 to 1965.

TABLE 1—*Yield of made tea in pounds per acre in successive six-months periods in the 1963 to 1965 cycle at Karapincha*

Treatments	First six months		Second six months		Third six months		Fourth six months		Cycle	
	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor
Nitrogen										
75 (lb N per acre per year)	618	100	1968	100	2161	100	1598	100	6445	100
150	619	100	2174	110	2319	107	1741	109	6753	105
225	610	98	2094	106	2431	112	1913	120	7048	109
Potassium										
50 (lb K_2O per acre per year)	617	100	2015	100	2264	100	1784	100	6680	100
100	612	99	2078	103	2363	104	1778	100	6831	101
150	618	100	2043	101	2285	101	1789	100	6735	101
Magnesium										
0 (lb MgO per acre per year)	628	100	2045	100	2319	100	1947	100	6839	100
24	610	97	2053	100	2288	98	1710	88	6661	97
48	609	97	2038	100	2305	99	1793	92	6745	99
Frequency										
7 (applications per cycle)	604	100	2015	100	2263	100	1681	100	6563	100
9	623	103	2069	103	2297	101	1835	109	6819	104
11	624	103	2073	103	2352	103	1825	109	6864	105
LSD ($P = 0.05$)	29	5	119	6	151	7	49	3	246	4

The results of the third experimental cycle, 1965 to 1967, are presented in Table 2. The nitrogen response again resembled what was observed in the first and second cycles. The cycle-yield was increased by 11 per cent when nitrogen was increased from 75 to 225 lb per acre per year ; the return per lb of nitrogen was 2.5 lb made tea. Beyond 150 lb nitrogen per acre per year, however, there was no increase in yield. When the yields over each six-months period were examined, it was found that the response to nitrogen improved over the cycle. Nitrogen failed to increase yield in the first six months ; 150 lb nitrogen increased yield, but 225 lb made no further contribution to yield in the second and third six-months periods ; and eventually in the fourth six months there was an impressive yield increase of 14 per cent with 150 lb nitrogen with a further five per cent increase in yield with 225 lb nitrogen. Again, over the two year period 75 lb nitrogen supported a yield of 3293 lb made tea, per acre per year. At this level of nitrogen there was no benefit from frequent applications. At 150 lb nitrogen, nine applications per cycle gave the highest yield. At 225 lb nitrogen, however, the most frequent application, 11 times per cycle, gave the highest yield. On the mean of all nitrogen levels, there was no significant difference between eleven and nine applications per cycle, but both these were better than seven applications. For the first time, the response to potash was significant, 100 lb K_2O per acre per year yielding five per cent more than 50 lb K_2O. Increasing potash to 150 lb K_2O per acre year gave no further increase in yield ; in fact there was a decline in yield, the response being significantly quadratic.

The interaction between the level of potassium and the frequency of application was also significant (Figure 1). At 100 lb K_2O per acre per cycle, there was a linear increase in yield, when the number of application was increased from seven to eleven per cycle. At 200 lb K_2O per acre per cycle, there appeared to be no advantage in increasing the applications from nine to eleven per cycle. At 300 lb K_2O per acre per cycle, increasing the frequency of application did not increase yield. Further investigation of this effect is necessary. In respect of applications of magnesium, there was no response, confirming observations of previous cycles.

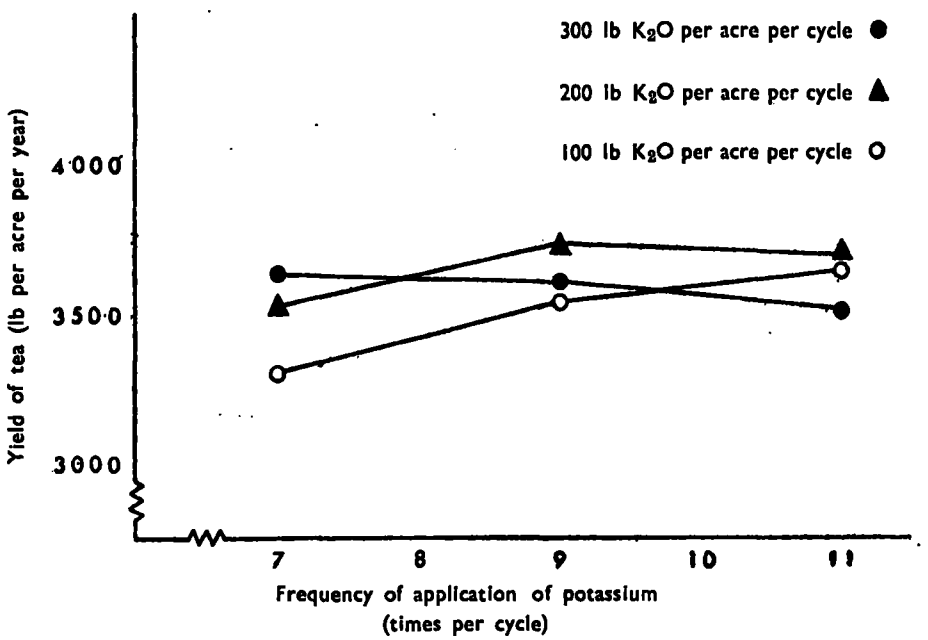

FIGURE 1—*Interaction between the level of potassium and the frequency of application on yield at Karapincha Division, Palmgarden Group.*

TABLE 2—*Yield of made tea in pounds per acre in successive six-months periods in the 1965 to 1967 cycle at Karapincha*

Treatments	First six months		Second six months		Third six months		Fourth six months		Cycle	
	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor	Yield (lb per acre)	% of lowest level in each factor
Nitrogen										
75 (lb N per acre per year)	523	100	1942	100	2230	100	1935	100	6587	100
150	540	103	2084	107	2354	106	2205	114	7228	110
225	526	101	2079	107	2418	108	2312	119	7335	111
Potassium										
50	519	100	1967	100	2306	100	2088	100	6880	100
100	542	104	2091	106	2377	103	2194	105	7204	105
150	528	102	2047	104	2318	98	2170	104	7966	103
Magnesium										
0	530	100	2022	100	2321	100	2108	100	6985	100
24	527	99	2062	100	2326	100	2179	103	7091	102
48	532	100	2021	100	2358	102	2122	101	7074	101
Frequency										
7 (applications per cycle)	578	100	1988	100	2291	100	1991	100	6789	100
9	543	105	2042	103	2331	102	2277	114	7196	106
11	528	102	2075	104	2380	104	2182	110	7165	106
LSD ($P = 0.05$)	23	4	146	7	133	6	97	5	220	3

TABLE 3—*Response to nitrogen at Karapincha during three cycles of two years each from 1961 to 1967*

Nitrogen (lb per acre per year)	First year of 3 cycles		Second year of 3 cycles		Mean of 1st and 2nd years in each cycle	
	Yield (lb per acre per year)	increase in yield (%)	Yield (lb per acre per year)	increase in yield (%)	Yield (lb per acre per year)	Increase in yield (%)
75	2337	0	4053	0	3195	0
150	2502	7	4306	6	3404	7
225	2488	6	4497	11	3503	10
LSD ($P = 0.05$)	63	3	128	3	167	4

When the results of the three cycles were analysed together, over the period 1961 to 1967 (Table 3), it was found that 75 lb nitrogen sustained a yield of 3195 lb made tea, per acre per year. This was increased by seven per cent when nitrogen was increased to 150 lb and by a further three per cent when nitrogen was increased to 225 lb. In the first year of the cycle the response did not extend beyond the 150 lb nitrogen level, but in the second year there was a significant response right up to 225 lb nitrogen. The best yield was obtained when the highest level of nitrogen was combined with the highest frequency of application, *viz* 450 lb nitrogen in eleven applications per cycle. Mean yields were nearly 2500 and 4500 lb made tea in the first and second years of the cycle respectively. At the end of the second year it was decided to extend the cycle to three years. The plucking table was eventually too high for the pluckers. Moreover, an unprecedented drought early in 1968 depressed the third year yield, which was nevertheless 3684 lb made tea per acre.

DISCUSSION

Of the nutrients tested in this experiment, only nitrogen gave a consistent response. Over the six-year period, 1961 to 1967, covering the three cycles, the response was of the order of ten per cent, when nitrogen was increased from 75 to 225 lb per acre per year. In the first year of each cycle the response did not proceed beyond the 150 lb level of nitrogen ; in the second year the response was significant at the 225 lb level of nitrogen, and increasing nitrogen from 75 to 150 lb gave a return of 2.2 lb made tea in the first year and 3.4 lb in the second year. From 150 to 225 lb nitrogen, the return was—0.2 in the first year and 2.6 in the second year. These results indicate that the nitrogen applied is more effective in the second year than in the first. While this may support the practice of applying nitrogen according to yield, the basis on which nitrogen is applied in relation to yield needs review. For instance, on a replacement basis of ten lb nitrogen to 100 lb made tea, which estates usually adopt, 250 lb nitrogen would be applied for the yield of 2500 lb tea in the first year ; similarly 450 lb nitrogen would be applied for the 4500 lb yield of tea in the second year. These quantities of nitrogen are in excess of requirements, as indicated by the results of this experiment. Moreover, when the so-called balanced NPK mixtures are used, excessive quantities of phosphate and potash are also supplied. For instance, using the mixture T 700 (which contains 500 parts sulphate of ammonia, 100 parts saphos phosphate and 100 parts of muriate of potash) 69 and 124 lb of P_2O_5, 150 and 270 lb K_2O would be applied along with 250 and 450 lb nitrogen in the first and second year respectively. The response to potash in this experiment, evident only after four years, did not extend beyond the 100 lb level of K_2O per acre per year. Although 60 lb of P_2O_5 per acre were applied uniformly to all plots, nine adjacent plots outside the main experiment carried 25, 50 and 75 lb P_2O_5 per acre per year, along with nitrogen and potash, and there was no gain in yield when phosphate was increased.

The results of this experiment, therefore, indicate that 225 lb nitrogen per acre per year are adequate for an average yield of 3503 lb made tea per acre per year, derived in this case from 2488 lb in the first year and 4497 lb in the second year. The yield of 3195 lb tea obtained with only 75 lb nitrogen, per acre per year, over a period of six years is hard to explain. In fact, two adjacent plots which had no nitrogen over this period yielded an average of 1921 lb made tea per acre per year. It should be mentioned that this field received liberal quantities of fertilizer from the time of planting, and it is possible that the effects of fertilizer in the early years is more important than was hitherto known. The results of the experiment at the TRI Substation, Kottawa, Talgampola (LA4) (Fernando 1968 ; 1969) support this view.

The increasing yields and the improvement of the response to nitrogen over the duration of the cycle, strongly suggest a benefit from a longer cycle, in place of the two-year cycle now commonly practised in low-grown tea.

Throughout the experiment there was no evidence of the influence of one nutrient on another, as indicated by the absence of any significant interaction between nutrients. The interaction of nitrogen and frequency of application was significant. There was no benefit from applying 150 lb nitrogen more often than five times per cycle ; but 450 lb nitrogen was best applied eleven times per cycle. In the last cycle, there was evidence of a significant potash-frequency interaction.

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