SOME EXPERIMENTS WITH POTATOES (SOLANUM TUBEROSUM) IN TRINIDAD 1963-4

— *by* —

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Imported foodstuffs have fulfilled an important role in the diet of the people of Trinidad and Tobago and considerable savings of currency could be made by utilising more effectively the natural resources of the country and producing more food locally.

One of the crops which has been increasing in its importance is the potato and the value of imports of this crop rose from $ WI 989,665 to $ WI 1,517,725 during the period 1953-59.

There are two possible ways of cutting this import bill either by producing alternative indigenous root crops more economically or by attempting to grow some part of the imported crop in Trinidad.

Thus Gooding imported seed tubers of various cultivars and tested them during the period 1959-61. His initial success (Gooding 1961; 1964) led to the belief that it would be possible to grow potatoes commercially, at least during the dry season when climatic conditions were as favourable as possible for the crop. Gooding also demonstrated the importance of adequate irrigation in the growth of the potato during the dry season.

However, before a proper assessment of the potato as a commercial proposition could be made, certain factors had to be examined. The spacing which Gooding had used in his experiments seemed too wide, a fertiliser application had to be pre-determined and the irrigation regime needed investigation. Only then could an assessment be made of the feasibility of growing the crop commercially.

EXPERIMENTAL (1963)

It had been hoped to investigate irrigation regimes for the crop as a matter of priority but unfortunately equipment was not available to allow the irrigation of small plots and so this was abandoned. It was decided therefore to investigate the effects of a closer spacing of the crop using three of Gooding's better cultivars, maintaining soil moisture as close to the optimum as could be achieved, and also to determine the optimum fertiliser dressing for the crop under Trinidad conditions.

Gooding in previous trials has used an inter-row spacing of 3 ft with an intra-row distance of 1ft between setts. It was considered that this was too wide and so this spacing was compared with the more normal 2.25 x 1ft. Three cultivars were used at each spacing making six treatments in all and these were arranged in a randomised block design with four replicates. The cultivars used were "Alpha", "Eigenheimer" and "Patrones"; the seed tubers being obtained from Holland.

The site of the experiment was cultivated and then ridged. Each plot had a distance of either 3ft or 2.25 ft between the crests of the ridges. Fertiliser was added to the furrows by hand at a rate of 100 lb/acre of each of N, P O and K_2O as sulphate of ammonia, super-phosphate (45% P_2O_5) and muriate of potash respectively. The plot size was 810 sq. ft.

The setts were planted 1ft apart in the furrows and were covered by splitting the ridges. Irrigation was applied at weekly intervals, the amount of water applied was varied to replenish the deficit between potential evapo-transpiration (calculated by the Thornthwaite method) and rainfall. Planting took place on 21.1.63 and harvesting approximately 90 days after. Routine sprays were used to combat *Alternaria solani* but disease incidence proved not to be a problem.

At intervals of 14 days throughout the trial two samples, each of five adjacent plants, were removed from each plot. These samples were separated into leaf, stem, root and tubers. The various plant parts were weighed and samples taken for dry matter determination. Net assimiliation rates (E^w) were calculated for the different varieties at the different spacings. Leaf weight was used as the basis for the calculation of E because no way of assessing leaf area was available.

Results

The total yields of tubers at harvest are given in Table 1.

Table 1 Total yield of tubers at harvest (tons/acre)

Spacing / *Cultivar*	3 x 1 ft	2.25 x 1 ft	Mean
	+0.400 (3)		+0.283 (1)
Patrones	8.084	9.762	8.923
Alpha	6.762	8.618	7.690
Eigenheimer	7.082	8.431	7.757
Mean	7.309	8.937	8.123
	+0.231 (2)		

It can be seen from Table I that yield per acre was increased by the closer spacing and also that "Patrones" out-yielded significantly both "Alpha" and "Eigenheimer".

The pattern of the build up and decline of leaf weight and tuber bulking is illustrated in figure 1 for the cultivar "Patrones". The other cultivars were similar and diagrams have therefore been omitted.

The E (E^w) for all cultivars at both spacings are presented in Table II.

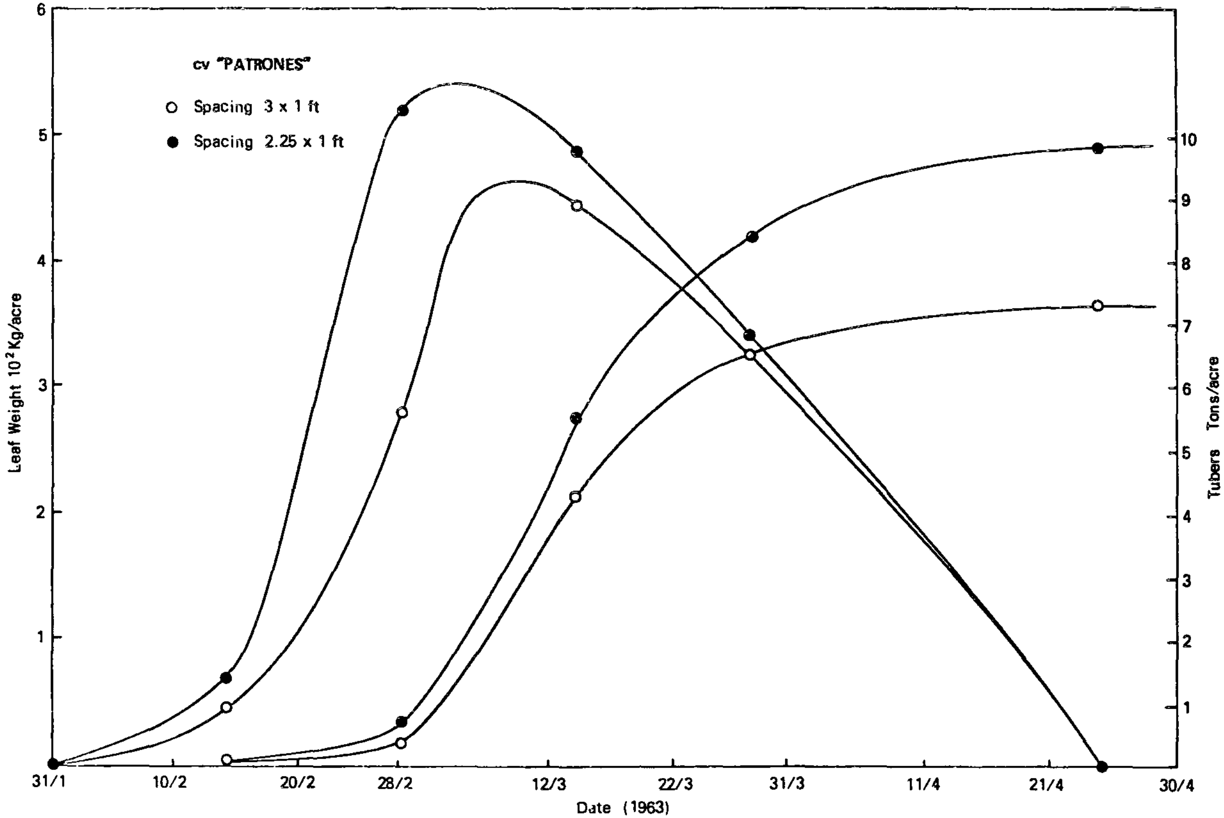

Fig 1 TUBER BULKING AND LEAF WEIGHT DEVELOPMENT

Table II NAR's (E_w) g/g/week

Period	14.2/28.2		28.2/14.3		14.3/28.3	
Spacing	3x1 ft	2x1 ft	3x1 ft	2x1 ft	3x1 ft	2x1 ft
Cultivar						
Patrones	1.80	1.89	1.44	0.98	0.53	0.61
Alpha	1.84	2.18	1.46	1.06	0.89	0.91
Eigenheimer	1.74	2.21	1.26	0.75	0.68	0.69
Mean	1.79	2.09	1.39	0.93	0.70	0.73
Coefficient of variation %	32.2		30.9		66.9	

The data presented in Table II show that there was an overall decline in E^w throughout the six week period. This was not altogether unexpected because during the period leaf weight was increasing rapidly and this must have led to increased shading of the lower leaves of the crop. The only significant differences found were during the period of 28.2/14.3.63 when the spacings showed significant effects (P—0.01). However it is clear from the final yields that the extra leaf area per unit plot area was more than enough to compensate for this and so highest yields resulted from the plots with the closer spacing.

During the same season a small plot experiment was laid down to obtain data on the fertiliser requirement of the crop. Small plots were used because seed tubers were in short supply and maximum information had to be obtained with the material available.

The plot size used was 36 sq. ft and the trial was a 3 factorial with 2 replications having the following treatments:

N at 0, 200 or 400 lb/acre as calcium ammonium nitrate
P_2O_5 at 0, 200 or 400 lb/acre as super-phosphate (45% P_2O_5)

K_2O at 0, 150 or 300 lb/acre as muriate of potash

Due to the shortage of seed tubers "Eigenheimer" was utilised for one replicate and "Patrones" for the other and guard rows were planted with "Alpha". The method of planting, fertiliser application and irrigation was exactly the same as for the first trial.

The yields in tons per acre are shown in Table III.

Table III. Yields in tons/acre—fertiliser trial

		$P_2 O_5$ lbs per acre			$K_2 O$ lbs per acre			Mean
		0	200	400	0	150	300	
			+0.367 (3)					+0.213 (1)
N	0	6.923	2.617	8.904	7.346	8.454	7.644	7.815
lbs/acre	200	6.347	7.797	8.130	6.977	7.112	8.184	7.425
	400	5.339	6.968	7.572	6.095	7.031	6.752	6.626
$P_2 O_5$	0				6.113	6.446	6.050	6.203
					6.716	7.364	8.301	7.463
lbs/acre	200				7.590	8.787	8.229	8.202
lbs/acre	400					+0.213 (2)		
Mean					6.806	7.532	7.527	7.289

There was a very marked response to phosphate even at the highest rate of 400 lb $P_2 O_5$ per acre and the magnitude of this response was not in keeping with results of numerous fertiliser trials on other crops carried out on the University Farm over a period of years. For example Chapman (1957) found a good response to nitrogen on maize but little effect from phosphate or potash. However it is possible other factors were operative in that particular trial as it was carried out during the wet season as were most of the general fertiliser trials. It is possible that only when soil conditions are optimum the best response from fertilisers can be expected. However a more likely explanation is that the potato, being a very short term crop with little development of root, would be expected to respond markedly to fertiliser application. A longer term crop with a stronger root development would be better able to obtain its requirements from a limited soil nutrient supply. The response to nitrogen was surprising and it is suggested that the dosage was supraoptimal.

EXPERIMENTAL (1964)

It was decided in the following year both to investigate the effect of lower rates of nitrogen on the yield of potatoes and to attempt to grow one acre of potatoes commercially.

In the nitrogen trial, three rates 0, 75 or 150 lb/acre were used with calcium ammonium nitrate as the N source. An overall dressing was applied to all plots of 500 lb/acre $P_2 0_5$ as super-phosphate and 180 lb/acre of $K_2 0$ as muriate of potash. New seed tubers "Patrones" were imported and planted at a spacing of 2.25 x 1ft. The plot size was 607 sq. ft and the three treatments were arranged in a randomised block design with five replicates. Irrigation procedure followed that of the previous year.

Two samples each of five plants, were removed from each plot at intervals of fourteen days for the determination of leaf areas and net assimilation rates. The availability of a leaf area photometer enables E's to be expressed in terms of leaf area (EA). As in the previous year, the samples were divided into leaf, stem, root and tuber and sub samples were taken for the determination of dry matter. A sub sample of the leaves from each main sample was taken for the determination of leaf area.

Results

The yield of tubers expressed in tons/acre are given in Table 4.

Table 4. Yields tons/acre

Treatment N lb/acre	Yield tons/acre
Control	7.936
75	10.232
150	11.782
Mean	9.983
SE +	1.411
Coefficient of variation %	14.1

The yield of tubers and leaf area indices (L) at each of the sampling times are given — Table 5 and E for three 14 days periods are presented in Table 6.

Table V Yields of tubers in tons/acre and leaf area indices at each sampling

	Sampling date									
	13.2.64		25.2.64		10.3.64		24.3.64		7.4.64	
Treatment	Yield	LAI	Yield	LAI	Yield	LAI	Yield	LAI	Yield	LAI
Control	—	0.734	0.982	2.795	3.675	2.817	8.163	1.805	8.221	0.512
75 lb/acre, N	—	0.831	0.977	3.753	5.725	4.284	8.348	2.401	10.524	1.246
150 lb/acre, N	—	0.710	0.778	3.569	4.640	5.394	8.346	2.623	13.275	1.312
Mean	—	0.758	0.912	3.372	4.680	4.165	8.286	2.276	10.673	1.023

Table VI Net assimilation rates for the period shown as affected by treatments, g/m² per week

	Period		
Treatment	13.2 to 25.2.64	25.2 to 10.3.64	10.3 to 24.3.64
Control	0.49	0.40	0.55
75 lb/acre, N	0.53	0.35	0.17
150 lb/acre, N	0.46	0.36	0.12
Mean	0.49	0.37	0.28
SE+	0.06	0.08	0.11

It can be seen that nitrogen gave a positive result and increased yields thus confirming that the rates used in the previous year were excessive.

A comparison between yields of tubers obtained from the sampling on 7.4.64 (Table 5) and final yields (Table 4) reveals a discrepancy. However this is explicable in that irrigation was carried on too long and considerable rotting of tubers occurred before the final harvest. Jackson (1962) pointed out the damaging effects of excessive soil moisture to potatoes particularly at high soil temperatures. The effect was exacerbated in this trial because even at harvest the skins of the potatoes had not "set" and even limited storage after harvesting was a problem.

The data in Table 5 indicate that although nitrogen increased leaf area indices considerably, it was not until well after L had reached a maximum that substantial differences in tuber weights were found between treatments. Thus it appears that the increase in peak L due to nitrogen did not improve the efficiency of the plants but merely produced excessive foliage. The main beneficial result of nitrogen application was in maintaining leaf area prior to harvest. Indeed at the time of harvest the foliage on the control plots was dead but that of the plants treated with nitrogen was green. The haulms on treated plots were sprayed with Gramoxone prior to harvest. This was a mistake and the potatoes on these plots should have been allowed to mature naturally. It can be seen also from Table 6 that EA on control plots was maintained throughout the period under test but that it fell considerably on nitrogen treated plots as the crop grew.

DISCUSSION

Reasonable yields of potatoes can be obtained under the conditions experienced in Trinidad during the dry season provided irrigation is employed. To obtain good yields a suitable cultivar must be grown, at a specific plant spacing and using a fertiliser dressing of an approximately 6.20.6 composition. It is possible that a basal fertiliser dressing of phosphate and potash might be more benefical, followed by a side dressing of nitrogen at the time of peak L. The side dressing would be difficult to apply in practice however and a better alternative might be to give a small dressing at planting followed by foliar applications of urea after peak L. In this way the excessive production of foliage might be avoided and the maintenance of leaf area after peak L might be achieved.

The values for EA and EW are in themselves largely irrelevant. The rather tedious procedure of determination was used to explain some of the factors underlying the final yields. In this case the values did help explain some of the results and were comparable to those quoted by Thorne (1960).

Large scale trial 1964

Following the promising results obtained by Gooding and the indications found from work in 1963 it was decided to grow potatoes in a larger area and under commercial conditions. The final test had to be a large scale one.

An area of approximately one acre was cultivated and ridged by tractor. 300 lb. of calcium ammonium nitrate, 1100 lbs. of super-phosphate and 300 lbs. of muriate of potash per acre were applied in the furrows. A cultivation tine was drawn along each furrow to mix the fertiliser into the soil and prevent possible scorching of shoots after the tubers had sprouted. The furrows were 2.25 ft. apart. Seed tubers cv. "Patrones" were planted approximately 1 ft. apart in the furrows. Hand labour was used to cover the tubers because efficient mechanical means were not available.

Two interrow cultivations and a final moulding were carried out before the haulm growth covered the rows completely. Irrigation, amounting to one acre inch per week, was applied at 7 day intervals.

Some disease occurred but it was not serious. The disease was identified as *Alternaria solani* and periodic spraying of "Perenox" were carried out. However pests were a serious problem the main one being a species of Prodenia. It was difficult to obtain a good spray coverage and control was never really effective.

Yields were low and a total of 4.8 tons/acre only was achieved. This low yield was partly the result of losses due to rotting of tubers in the ground before harvest. It was not possible to estimate the amount lost by rotting. Chapman and Squire (1964) analysed the cost of production and showed that this particular crop realised a loss of $WI 532.60 per acre. This was the result of several factors, such as high costs of labour due to low productivity and inexperience, excessive irrigation costs etc. but even if these were corrected a loss of $WI 161.80 would have been realised.

To be profitable, yields would have to be raised to 7 or 8 tons/acre but this will be difficult under commercial conditions in Trinidad.

CONCLUSION

Good yields of potatoes can be obtained in small plot experiments in Trinidad but on a larger and more commercial scale, yields were lower and a loss was made. It is possible that on a more amenable soil with better irrigation control, economic yields might be obtained.

SUMMARY

A series of small plot trials with *Solanum tuberosum* was carried out in the dry season of 1963 and 1964 in Trinidad. These culminated in an attempt to grow a large area under commercial conditions in 1964.

As a result of these trials it was possible to confirm Gooding's (1961, 1964) findings concerning the possibility of producing good yields experimentally with some varieties under Trinidad conditions. It was also possible to gain some information concerning an optimum fertiliser regime and this was in the region of 2,000 lb/acre of a 6.20.6 mixture.

However the large scale trial failed to give economic yields.

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APPENDIX 1

Week	1963		1964	
	Max.	Min.	Max.	Min.
1	86.6	69.8	83.0	67.3
2	86.4	65.9	83.3	64.7
3	87.4	65.9	82.9	63.4
4	87.3	66.4	83.0	65.0
5	88.1	67.1	86.0	65.0
6	87.7	68.4	86.4	68.0
7	87.1	68.0	85.7	——
8	86.4	67.4	86.3	71.4
9	88.6	67.1	85.0	68.4
10	87.7	65.4	86.3	67.7
11	88.8	67.3	87.9	68.3
12	89.7	65.3	87.7	67.9
13	89.7	67.4	88.9	68.7
14	86.9	69.7	85.3	69.6
15	86.3	67.7	84.9	70.9

Week 1 : Week beginning 21.1.63 and 4.1.64.

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