Observations in Time of Maturity of Sweet Potato (Ipomoea Batatas (LAM.))

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ABSTRACT.

To observe development of a sweet potato crop, a technique using successive row by row harvesting of plots was used. Comparisons were made of various crop characters on the one soil type with varied pre-crop histories. It was found that as the soil tended to exhaustion low yields were obtained, resulting from reduction in both number and size of tubers, and that maxima in crop yield, number of tubers and flowers occurred earlier than in less depleted soil. It was shown that maximum flowering is a useful indicator of time of achievement of maximum yield.

The range of tuber size and its influence on crop maturity is also discussed.

INTRODUCTION.

ALTHOUGH sweet potato *Ipomoea batatas* (Lam.) is the staple food of much of the indigenous population of the Territory of Papua and New Guinea, little work has been done on its agronomy in this country.

A sweet potato crop is described as mature when it is considered ready for harvesting. This stage is usually judged subjectively by loss of vigour of the topgrowth, death of the lower leaves, and general yellowness of the vines. These criteria are normally employed in early estimations of when to harvest a particular sweet potato variety, but once experience has been gained, time of harvesting is usually judged by the length of time the crop has been in the ground. Varieties are often described as four, five or six-month varieties.

Hassell (1955) stated that the crop is mature when the cut surface of a typical tuber dries clear, according to the normal colour of the flesh. If immature, it will dry a dark or greenish colour.

In parts of the highlands of the Territory of Papua and New Guinea, sweet potato crops are allowed to grow for up to two or three years, while individual tubers are harvested from the soil as they mature, without removal of the topgrowth. Maturity of the individual tubers is decided by size.

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In those parts of the world where frosts occur, the practice is to harvest sweet potato immediately after the first killing frosts of winter.

A casual observation was made during conduct of the Soil Exhaustion Trial (Newton and Jamieson 1968) that sweet potato crops were maturing earlier as the trial progressed.

Logically, a sweet potato crop is best harvested at the stage of maximum yield, consistent with acceptable eating qualities. The following project, consisting of three main trials, was an attempt to study the development of a sweet potato crop, to link some easily discernible crop character with the stage of maximum yield, and also to investigate the hypothesis that as the soil tends towards exhaustion, so a sweet potato crop matures earlier.

EXPERIMENTAL METHODS.

Three field trials were carried out on pumice-derived soils at the Lowlands Agricultural Experiment Station, Keravat, where the annual rainfall of 110 in. is well distributed. The soils have a high sand content and are very low in clay. They are therefore strongly susceptible to leaching. The plots used in the trials were 30 feet square, and the sweet potato was planted in hilled rows. The ridges were built with hand hoes to a height of about one foot.

The name of the variety of sweet potato used is unknown, but it is numbered K3 in the Keravat collection. The variety has red-skinned

tubers with white flesh, and the leaves are palmate. It is reputed to mature in seven months.

The basic technique used in the trials was row by row harvesting. Consecutive rows were harvested with a determined time lapse between each row harvest. In this way, some indication of development of the crop with time was obtained. The first and last row records were ignored in Trials 1 and 2, and the last row records were ignored in Trial 3 because of possible edge effect. It was considered that there would not be any applicable edge effect on an inner row for the short period for which it was an edge row. Therefore, no arrangements were made to overcome this effect.

At each harvest, the following observations were made :—

1. Weight of tubers in each row ;
2. Number of tubers in each row ;
3. Number of rotted tubers in each row ;
4. Number of flowers in each row harvested ;
5. Vigour of the crop on each plot ;
6. The general colour of topgrowth on each plot ;
7. Colour of dried sap of the cut tuber ; and
8. Whether or not the sap formed beads or ran freely when the tuber was cut.

All fully formed tubers were harvested from each row. Tubers which weighed less than approximately one ounce were not considered, but were discarded from the harvest.

Score systems were used in the estimates of vigour and topgrowth colour :—

Vigor.	Score.	Topgrowth Colour.	Score.
Very good	4	all green	5
Good	3	¾ green	4
Fair	2	½ green	3
Poor	1	¼ green	2
Very poor	0	all yellow	1

There were slight variations in the observations made on each trial. These changes in procedure will be indicated where applicable.

TRIAL 1.

This trial was superimposed on part of a Three-Course Rotation Trial which is part of the project investigating farming systems (Newton and Jamieson 1968).

Basically, this trial compares four wide rotations involving an 18-month period of *Mimosa invisa* or *Pueraria phaseoloides* as cover crops and three rotations of virtually continuous food-cropping. Rotations in all treatments are on a three-year cycle.

Trial 1 was superimposed on Series A, Third Cycle, First Planting of the Three-Course Rotation Trial when all 21 plots of the series were planted to sweet potato.

The Rotation Trial had been in progress for over six years, and the wide rotations, particularly those involving a *Pueraria* cover crop, were yielding sweet potato significantly better than the narrow rotations. It was suspected that the yield differences were due to relative differences in the stage of soil deterioration. Thus it was hoped that by superimposing this trial on the sweet potato plots of the Rotation Trial, differences in behaviour between sweet potato on wide and narrow rotation plots could be observed.

There were ten rows of sweet potato on each plot. Harvesting commenced when the crop was six months old, and was continued at weekly intervals. At each harvest, observations were carried out as outlined above.

RESULTS.

The results are shown in *Table* 1. Those of the first and tenth harvests are excluded because of apparent edge effects.

In wide rotations, the sap exudate from cut tuber faces formed beads at and after the fourth harvest. This stage was not reached until the fifth harvest in the narrow rotations.

Statistical analysis indicated :—

1. No difference in time trend between the yield increases of wide and narrow rotations, and there was no significant difference between yields ;
2. Tuber size reached maximum during the period of the trial and wide rotations produced larger tubers than narrow rotations. There was no difference in the rate of increase in tuber size between wide and narrow rotations during the period of the trial ;
3. The slight increase in the number of tubers during the trial was not significant ; and

Table 1.—Trial 1 Means.

Harvest No.	Days After Planting.	Tuber Yields (lb./Row).		No. Tubers/Row.		Wt./Tuber (lb.).		No. Flowers/Row.	
		Wide Rotations.	Narrow Rotations.	Wide Rotations.	Narrow Rotations.	Wide Rotations.	Narrow Rotations.	Wide Rotations.	Narrow Rotations.
2	191	11.0	8.9	60	69	.18	.13	3	2
3	198	13.0	10.3	70	76	.19	.14	14	3
4	205	11.8	11.0	65	81	.19	.14	16	7
5	212	13.0	10.4	57	70	.24	.15	14	5
6	219	14.1	10.2	74	71	.19	.14	33	15
7	226	13.9	10.5	67	69	.21	.15	73	29
8	234	15.6	12.2	77	80	.21	.15	65	30
9	241	15.0	9.9	87	65	.18	.15	28	27
Mean Linear Coefficient		0.50 lb./week **		1.4/week		.002 lb./week *		——	
Mean Quadratic Coefficient						.003 lb./week *		——	

Mean Totals per Plot over the Eight Harvests.

	Wide Rotations.	Narrow Rotations.	
Tuber Yield (lb.)	107.0	83.4	NS
No. Tubers	552	580	NS
Wt./Tuber (lb.)	.20	.14	LSD .04(P<.01)

4. Flowering came to a peak at about the time that yields reached a maximum, but there was no difference in flowering time trend between wide and narrow rotations.

DISCUSSION.

The results of Trial 1 indicate that achievement of maximum flowering and maximum tuber yield are linked, and that narrow rotations produced smaller tubers.

The results also indicate that, at least in the later stages of development, yield increases may be largely due to increase in tuber weight, rather than to production of more tubers.

It was unfortunate that observations on this trial did not commence earlier. Only the later stages of development of the crop were observed and by this stage most of the development had occurred. Further, crop yields in all rotations were extremely low, probably due to seasonal factors.

The results of this trial gave little support to the hypothesis that sweet potato crops mature earlier as the soil tends to exhaustion. However, since yield differences between wide and narrow rotations were not significant, the effect of season, or the soil fertility difference between wide and narrow rotation plots may not have been sufficient to show differential crop behaviour.

TRIAL 2.

As work progressed on the first trial, it became evident that knowledge of what comprises a mature sweet potato crop was lacking. To investigate development of the crop further, a nine-plot trial was laid down on virgin soil. Each plot was 30 feet square, and contained ten hilled rows of sweet potato.

Essentially the same techniques were used and the same observations made as in the first trial. However, in an attempt to establish a criterion of maturity, samples of the harvested tubers were boiled, and eating qualities were assessed by a panel of New Guinean station field workers. Broken and rotted tubers and tubers smaller than approximately 2 oz. were rejected from the random sample collected for each palatability test.

Harvesting commenced when the crop was three months old, and continued at fortnightly intervals for ten harvests until the crop was eight months old.

RESULTS.

The results of Trial 2 are shown in *Table* 2. Those of the first and tenth harvests have been omitted because of possible edge effects.

The estimations of trends in crop behaviour in this trial may have been upset by the fact that at least minor pilfering of tubers was found to have occurred towards the end of the trial.

The rate of increase in yield of tubers appeared to diminish in the later stages of the trial. Yields increased only three lb. per row from the fifth to the ninth harvest, in contrast to twelve lb. per row from the second and the fifth harvest. There is a suggestion of maximum yield having been reached between the eighth and ninth harvests.

There is an indication of a maximum having been achieved in the number of tubers at about the fifth or sixth harvest, but probably the increase in number of tubers after the third harvest is not significant.

Individual tuber weights increased linearly over the period of the trial.

The linear increase in individual tuber weights, coupled with the suggested maximum yield between the eighth and ninth harvests, seems illogical, unless tubers were lost. As rotting was not evident, it appears certain that significant regular pilfering occurred towards the end of the trial. Since trends would have been greatly influenced by this loss of tubers, statements of significance have been omitted from *Table* 2.

Flowering had not reached its peak by the end of the trial.

From the fourth harvest onwards, sap exudate from the cut tubers formed beads. Eating quality, judged by absence of fibre from boiled tubers, was acceptable from the fifth harvest onwards.

Vine colour had yellowed appreciably by the sixth harvest, and by the eighth harvest, vigour was declining noticeably.

DISCUSSION.

The value of this trial was considerably marred by the apparent loss of tubers towards the end of the trial.

The suggested maximum in yield between the eighth and ninth harvests is inconclusive, and may have been an artefact of the model fitted in the statistical analysis. Allowing for the evidence of pilfering, there is a strong possibility that a true yield maximum was not achieved during the trial period.

The recorded figures for tuber numbers indicated that the maximum number of tubers had probably been produced by the third harvest, or

Table 2.—Trial 2 Means.

Harvest No.	2	3	4	5	6	7	8	9	* Linear Coefficient (per 2 weeks).	*Quadratic Coefficient (per 2 weeks).
Days After Planting	111	125	139	153	167	181	196	209		
Tuber Yields (lb./row)	12.6	16.2	19.5	24.2	26.8	27.8	25.6	29.7	2.31	0.71
No. Tubers/Row	128	150	163	195	182	162	145	154	1.97	†
Wt./Tuber (lb.)	.11	.12	.12	.14	.15	.18	.16	.21	.013	.002
No. Flowers/Row	0	0	0	0	1	4	12	11		
Vigour	4	4	4	4	4	4	3	3		
Leaf Colour	5	5	5	5	5	4	4	4		
No. Rotted Tubers	0	0	0	0	0	0	0	0		
Sap Bead or Run	Run	Sl B	B	B	B	B	B	B		
Appearance Boiled Tubers	Vitreous	Dry Floury	Dry Floury	Dry Floury	Dry Floury	Dry Floury	Dry Floury	Dry Floury		
Flavour Boiled Tubers	StSpSw	St	StSlSpTa	dry Ta	dry Ta	dry SlTa	dry SlTa	dry SlTa		
Dry Sap Colour	In all cases after ½ hour turned green-black and after a few hours turned red-brown									

* Unit varies with each line with the variable being considered

† Increase from 111 days to mean of 125 to 209 days = 34 tubers

Sl—Slightly B—Beaded St—Stringy (fibrous)

Sp—Spongy Sw—Sweet Ta—Tangy

at least by the fifth or sixth harvest. Pilfering, however, would have distorted this trend and its interpretation is of little value.

Other observations would not have been greatly affected by pilfering, and are worth discussing.

It is obvious that crop development had not run its full course by the conclusion of the trial, seven months after planting. Flowering was in its early stages, and tuber weights were still increasing linearly, although the variety used in the trial is reputed to mature in seven months. By the unrecorded tenth harvest (223 days after planting) flowering increased to 36 per row.

The late maturity of the crop in Trial 2 may have been due to seasonal factors. It is also possible that it may have been due to the fact that the crop was growing on a virgin soil. The decline of vigour and the tendency for leaves to yellow recorded towards the end of the trial would suggest that the crop was nearing maturity.

Palatability tests conducted on tubers at each harvest indicated that the tubers would be acceptable by the fifth harvest, when the crop was five months old. This was approximately the same time that the sap exudate from cut tubers formed beads, rather than running freely over the cut surface. Acceptable eating quality was attained somewhat earlier than maximum yield as determined by statistical analysis of the recorded yield trend. Palatability testing is discussed in more detail in the appendix.

The appearance of the boiled tubers did not show great promise as a determinant of tuber maturity.

TRIAL 3.

This trial can be considered as a repeat of Trials 1 and 2, as well as a comparison of sweet potato crop development in essentially the same soil at three stages of exhaustion.

The trial was carried out on two sites :—

The 21 plots of Series B, Third Planting Third Cycle of the Three Course Rotation Trial on which Trial 1 was superimposed ; and

Twelve plots, each 30 feet square, on a site adjacent to the Three Course Rotation Trial, which had been under a cover of the legume *Pueraria phaseoloides* for several years. It was anticipated that these plots would be higher yielding than those of the Three Course Rotation Trial. Of the twelve plots, the *Pueraria* topgrowth was removed from three prior to commencement of the trial, while it was dug into the plots on the remaining nine.

All plots contained eight hilled rows of sweet potato.

The first harvest was carried out 106 days after planting, and subsequent harvests were at three-week intervals, except that harvests 3 and 4 were each four weeks after the previous harvests. Essentially the same observations as in the two previous trials were made. It was hoped that differences in crop behaviour could be observed between sweet potato growing on wide and narrow rotation plots, and on plots which had supported *Pueraria phaseoloides* for a long period.

RESULTS.

Results of the trial are shown in *Table* 3. No distinction is drawn between the two treatments superimposed on the *Pueraria* plots, as there was no difference in crop behaviour. The results of palatability tests and beading of sap exudate are not included as they were variable and inconclusive.

These results were not analysed statistically, but it is clear that *Pueraria* plots out-yielded the wide rotation plots which, in turn, out-yielded the narrow rotation plots. Narrow rotation plots produced fewer and smaller tubers and fewer flowers, were less vigorous, and contained a higher proportion of yellow leaves than wide rotation and *Pueraria* plots.

Sampling variation within replicates precluded the posibility of defining maxima in the crop development. A comparative index was obtained by weighting the time of observation by the measure at this time and dividing the sum of these figures by the sum of the measure over the first seven harvests. A measure which increased sharply over the last harvests would give a high index. Results of the eighth harvest were excluded from the analyses because of suspected edge effects. Results of the analyses are shown in *Table* 4.

The clearest difference between treatments was in respect of flowering trends. The differences between the time indices may be due to prolonged flowering on the *Pueraria* plots, and an early brief peak on the narrow rotation plots.

Table 3.—Trial 3 Means.

Harvest	1	2	3	4	5	6	7	Means
Days after Planting	106	127	156	183	204	225	246	
				Weight Tubers per Row (lb.)				
Wide Rotations	18.0	21.7	23.5	27.4	28.2	27.3	26.0	24.6
Narrow Rotations	5.7	8.1	10.7	8.6	9.2	7.2	5.8	7.9
Pueraria Plots	22.9	23.7	32.7	36.3	40.6	39.9	35.0	33.0
				Number Tubers per Row				
Wide Rotations	121	120	109	117	134	124	142	124
Narrow Rotations	76	70	67	66	64	56	41	63
Pueraria Plots	126	99	106	146	143	153	164	134
				Weight per Tuber (lb.)				
Wide Rotations	0.15	0.18	0.22	0.24	0.22	0.22	0.19	0.20
Narrow Rotations	0.07	0.10	0.14	0.12	0.13	0.11	0.12	0.11
Pueraria Plots	0.19	0.24	0.31	0.26	0.29	0.27	0.21	0.25
				Number Rotted Tubers per Row				
Wide Rotations	0.1	0.1	0.1	2.4	1.7	2.0	5.2	1.7
Narrow Rotations	0.2	0.0	0.1	0.3	1.0	2.8	3.1	1.1
Pueraria Plots	0.1	0.2	0.1	1.2	1.2	1.7	4.2	1.2
				Number Flowers per Row				
Wide Rotations	20.8	51.2	55.0	82.2	49.3	25.0	9.4	56.6
Narrow Rotations	17.8	33.1	31.4	16.3	17.4	4.9	4.0	41.8
Pueraria Plots	3.0	36.2	105.7	90.6	47.7	64.2	49.1	17.8
				Vigour Rating				
Wide Rotations	2.6	2.5	2.2	1.9	2.2	2.9	1.8	2.3
Narrow Rotations	2.3	2.7	1.7	1.3	1.7	2.0	1.3	1.9
Pueraria Plots	4.0	4.0	4.0	4.0	3.8	3.9	2.6	3.8
				Leaf Colour Rating				
Wide Rotations	4.6	4.4	4.0	3.9	3.7	3.6	2.6	3.8
Narrow Rotations	3.3	3.1	3.1	3.0	2.6	1.4	1.6	2.6
Pueraria Plots	5.0	4.9	5.0	5.0	4.7	3.8	3.3	4.5

Narrow rotation plots produced maximum yield and maximum number of tubers earlier than the *Pueraria* and wide rotation plots. From *Table* 3 it seems that for narrow rotations the number of tubers had reached maximum by the first harvest, while the weight per tuber reached maximum some time between the second and third harvests. This supports the suggestion from *Table* 3 that maximum yield was achieved between the second and third harvests. The flowering data for narrow rotations indicate a maximum between the second and third harvests, which coincides with maximum yield.

Table 3 data from *Pueraria* and wide rotation plots indicate maxima in yield, tuber number and tuber size by the fourth or fifth harvest, coinciding fairly closely with flowering maxima.

Table 4 shows that the leaf colour rating dropped earlier on the narrow rotation plots than on plots of the other treatments. Data from *Table* 3 suggest that this drop may have been by the sixth harvest on narrow rotation plots, and by the seventh harvest or later on plots of the other treatments.

DISCUSSION.

Trial 3 showed that, at least within a given soil, as crop producing capacity diminished, so various aspects of behaviour of the sweet potato crop tended to occur earlier. Thus, soil deterioration caused earlier development of the crop. Assuming the crop was mature at the stage of maximum yield, it can be stated that soil deterioration caused earlier crop maturity. Under the

conditions of the trial the overcropped soil produced a sweet potato crop which matured at least one month earlier than the crop grown on fresh soil. However, the advantage of earlier maturity was offset by a considerably reduced yield.

The crop grown on the *Pueraria* plots was better than the wide rotation crop. However, the trend differences as the crops developed was not sufficiently wide to be distinguishable, except in the case of flowering. Flowering maxima for the two treatments were achieved at approximately the same time, but flower buildup and decline on the wide rotation plots was gradual, while on the *Pueraria* plots the buildup was sharp and the decline protracted. The protracted decline on the *Pueraria* plots was reflected in the time index (*Table* 4). Thus the difference between the flowering time indices between wide rotation and *Pueraria* plots probably does not refer to maxima.

Maximum flowering appeared to be related to the time of maximum yield. On the *Pueraria* plots maximum flowering appeared to pre-date maximum yield by as much as one month. Since these maxima were fairly ill-defined, the difference may have been less. On the wide and narrow rotation plots the two factors appeared to be virtually concurrent.

Appreciable changes in vigour and leaf colour ratings occurred two or three months after maximum yield.

CONCLUSIONS.

The results of Trial 3 substantiate the original hypothesis that as the soil tends towards exhaustion, sweet potato crops mature earlier. Crops grown on wide rotation and *Pueraria* plots were ready for harvest about six-and-a-half months after planting, while crops on narrow rotation plots were ready about five months after planting.

In this respect, however, Trial 3 results are not in agreement with Trial 1, where there was no significant difference between any trends in crop development on wide and narrow rotation plots. However, in Trial 1 there was little difference in yield between the two group treatments. As the different series of the Three Course Rotation Trial on which Trial 1 and part of Trial 3 were superimposed are replications in time, differences in crop behaviour between series should be purely due to seasonal effects. The fact that there were ten rows of sweet potato per plot in Trial 1, and eight in Trial 3 should have little bearing on the outcome of the two trials. Thus the failure of Trial 1 to differentiate between crop development on wide and narrow rotation plots was probably due to seasonal factors upsetting crop responses to treatment.

There is strong evidence from both Trials 1 and 3 that achievement of maximum flowering is closely linked to the stage of maximum yield. Considering evidence of pilfering of tubers, Trial 2 indications are not contrary. It is not possible to determine the time of maximum flowering until after the event, but there is scope for considerable flexibility in the time of harvesting sweet potato, as loss of crop through tuber rotting is minor until at least two months after achievement of maximum yield.

Vigour and leaf colour rating systems of determining crop maturity do not appear to be

Table 4.—Mean Time Index—Trial 3.

	Tuber Yield	No. of Tubers	Wt. per Tuber	No. of Flowers	Vigour	Leaf Colour	No. of Rotted Tubers
Wide Rotations	11.04	10.38	10.75	9.34	9.90	9.28	15.88
Narrow Rotations	9.99	9.14	10.21	6.89	8.83	8.40	16.06
Pueraria Plots	11.45	10.94	10.47	11.52	9.71	9.37	16.31
Variance Ratio for grouped treatments	7.66**	8.89***	0.65	17.05***	2.45	6.49**	0.12
L.S.D. between treatments							
Wide v Pueraria 5%	0.59	0.69		1.24		0.45	
1%	0.80	0.93		1.68		0.62	
Pueraria or wide v narrow 5%	0.64	0.74		1.34		0.49	
1%	0.86	1.01		1.82		0.67	

satisfactory, as their changes are not sharply defined. Further, appreciable changes usually occur well after maximum yield.

Assessment of the time of crop maturity based on tuber characteristics such as palatability and sap beading are not satisfactory, as there is a range of tuber maturity at any harvest. This aspect is discussed more fully in the Appendix.

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REFERENCES.

HASSELL, O. L. (1955). Sweet Potato Growing in Queensland. *Queensland Agricultural Journal* 80 (1) : 3-16.

NEWTON, K. AND JAMIESON, G. I. (1968). Cropping and Soil Fertility Studies at Keravat, New Britain 1954-1962. *Papua and New Guinea agric. J.* (this issue).

APPENDIX.

Tuber Palatability.

After the tenth harvest of Trial 2, about 120 lb. of tubers from the trial were amassed and used to test tuber weight against palatability. Broken tubers were discarded, and the samples were sorted into weight categories. Sub-samples of each category were then diced so that their original sizes were not obvious, and boiled. Six New Guinean field workers then acted as a panel, and each independently judged the eating qualities of boiled tuber samples. The various components of palatability were ranked from 0 to 10 according to what was considered to be their position of importance in the palatability scale. The total score from this ranking for each weight classification is termed 'Palatability Index' (P.I.). Results of the trial are shown in *Table* 5.

Tubers under 2 oz. in weight were unpalatable (P.I. = 6), and made up 12 per cent. of the weight of tubers. Tubers weighing between 2 oz. and 8 oz. accounted for 38 per cent. of the weight of the tubers, and were of acceptable palatability (P.I. = 22). Ignoring the anomalous index of 22 recorded for the 18-20 oz. tubers, 50 per cent. of the weight of tubers were very palatable (P.I. = >32). These tubers were all in excess of 8 oz. weight.

Assuming that palatability and maturity of a tuber are equivalent, it can be said that there is a range of maturity in any sweet potato harvest, and smaller tubers are less mature than larger tubers. This accounts for the fact that smaller tubers are normally discarded from a harvest prior to cooking.

Palatability tests as applied in Trials 2 and 3 were not soundly based, as tubers for the tests were selected at random, regardless of size. This probably accounts for inconsistencies encountered during the conduct of these tests.

Table 5.—Tuber Size Palatability.

Weight Classification (oz.)	No. Tubers	Percentage.	Weight (oz.)	Percentage by Weight.	Palatability.				
					T	S	F	Ta	P.I.
0-2	166	43	242	12	0	2	1	3	6
2-4	89	23	270	14	4	6	5	7	22
4-6	46	12	247	13	4	6	5	7	22
6-8	29	7	218	11	4	6	5	7	22
8-10	14	4	132	7	9	6	10	7	32
10-12	12	3	140	7	9	6	10	7	32
12-14	2	1	33	2	9	6	10	7	32
14-16	8	2	130	7	9	6	10	7	32
16-18	2	1	35	2	9	6	10	7	32
18-20	3	1	50	3	4	6	5	7	22
20-22	2	1	41	2	9	8	10	7	34
22-24	5	1	110	6	9	8	10	7	34
24+	9	2	310	16	9	8	10	7	34
TOTAL	387	101	1949	102					

Score Key :—

Toughness (T).		Fibre (F).	
Tough	0	Fibrous	1
Slightly tough	4	Slightly fibrous	5
Soft	9	Not fibrous	10

Sweetness (S).		Tang (Ta).	
Not sweet	2	No tang	3
Sweet	6	Tangy	7
Very sweet	8		

Tuber Size Distribution.

As an adjunct to Trial 3, data were recorded on the range of tuber sizes taken at each harvest. A sub-sample of approximately 50 tubers was taken from the yield of each plot at each harvest, and the tubers were classified by weight in 2 oz. classes up to 32 oz.

In *Tables* 6A and 6B, these data have been summarized in categories 0 to 2 oz., 2 to 8 oz. and over 8 oz. to correspond to the results of the trial on tuber palatability. The numerical and weight distribution data were calculated using the plot data in *Table* 3. Results were not analysed statistically.

Data from *Table* 6A suggest that there was no change in size distribution of tuber numbers on wide rotation or *Pueraria* plots as the crops developed. *Table* 6B data suggest that yield increases on *Pueraria* and wide rotation plots were due to increased weight of larger tubers, while contribution to the yields by smaller tubers remained static as the crops developed.

Table 6A.—Size Distribution of Tuber Numbers.

Days after Planting	Percentage Distribution.								Numerical Distribution.							
	106	127	156	183	204	225	246	268	106	127	156	183	204	225	246	268
Harvest	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Weight Class (oz.)	Wide Rotations (1, 2, 6, 7)															
0-2	54	49	40	36	38	39	51	42	65	59	44	42	51	48	72	47
2-8	43	48	52	56	53	53	44	48	52	58	57	66	71	66	62	54
>8	4	5	8	9	10	8	6	11	5	6	9	11	13	10	9	12
Total	101	102	100	101	101	101	101	101	121	120	109	117	134	124	142	112
	Narrow Rotations (3, 4, 5)															
0-2	87	76	70	70	60	67	60	41	66	53	47	46	38	38	25	14
2-8	13	24	28	29	37	31	37	53	11	17	19	19	24	17	15	19
>8	0	1	3	1	3	2	3	6	0	1	2	1	2	1	1	2
Total	100	101	101	100	100	100	100	100	76	70	67	66	64	56	41	35
	Pueraria Plots															
0-2	38	36	33	45	34	30	52	40	48	36	35	66	49	46	85	68
2-8	49	48	45	38	48	50	39	44	62	48	48	55	69	77	64	74
>8	13	15	22	17	19	19	10	17	16	15	23	25	27	29	16	29
Total	100	99	100	100	101	99	101	101	126	99	106	146	143	153	164	169

Table 6B.—Size Distribution of Tuber Weights.

Days after Planting	Percentage Distribution								Weight Distribution (lb.)							
	106	127	156	183	204	225	246	268	106	127	156	183	204	225	246	268
Harvest ...	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Weight Class (oz.)	Wide Rotations (1, 2, 6, 7)															
0-2	29	25	17	14	14	16	24	17	5.3	5.4	4.0	3.8	3.9	4.4	6.2	4.6
2-8	58	62	59	62	54	60	57	52	10.6	13.5	13.9	17.0	15.2	16.4	14.8	13.9
>8	13	14	24	25	32	25	19	32	2.3	3.0	5.6	6.9	9.0	6.8	4.9	8.6
Total	100	101	100	101	100	101	100	101	18.0	21.7	23.5	27.4	28.2	27.3	26.0	26.8
	Narrow Rotations (3, 4, 5)															
0-2	72	63	36	46	35	42	33	40	4.1	5.1	3.9	4.0	3.2	3.0	1.9	2.4
2-8	26	36	48	48	51	46	50	46	1.5	2.9	5.1	4.1	4.7	3.3	2.9	2.8
>8	2	1	16	6	13	13	16	14	0.1	0.1	1.7	0.5	1.2	0.9	0.9	0.9
Total	100	100	100	100	99	101	99	100	5.7	8.1	10.7	8.6	9.2	7.2	5.8	6.1
	Pueraria Plots															
0-2	13	12	9	14	10	8	21	12	3.9	2.8	2.9	5.1	4.1	3.2	7.4	4.9
2-8	52	47	37	34	39	40	45	34	11.9	11.1	12.1	12.3	15.8	16.0	15.8	14.0
>8	34	41	55	51	51	52	34	55	7.8	9.7	18.0	18.5	20.7	20.7	11.9	22.7
Total	99	100	101	99	100	100	100	101	22.9	23.7	32.7	36.3	40.6	39.9	35.0	41.2

By contrast, on narrow rotation plots (*Table* 6A), percentage and numerical distribution of small tuber numbers appeared to decline steadily as the crop developed, while the figures for large tubers rose steadily. *Table* 6B data indicate the percentage of the weight yield contributed by larger tubers increased until the third harvest, while the contribution by small tubers declined over the same period. There was a similar but weak indication from the tuber size distribution of yield. This supports the indication that maximum yield was achieved between the second and third harvests.

The indications are that the sweet potato crops in Trial 3 continued to initiate and develop tubers until production of new tubers was limited by the soil fertility level. Thus in low fertility soil tubers would tend to be more uniform in age, and maximum yield would be more sharply defined than in fertile soil. This appeared to be the case in comparison between narrow rotation crops and crops on *Pueraria* and wide rotation plots.

The trial commenced too late to study very early tuber development, and it is not clear whether the early rate of tuber initiation depended on soil fertility, or whether low fertility induced early decline in initiation rate.

A higher proportion of large tubers was produced in better soil than in less fertile soil in Trial 3. The rate of growth of tubers appeared to be higher in better soil, and the proportion of unpalatable tubers (under 2 oz.) was lower than in poorer soil. However, in poor soil the proportion of unpalatable tubers appeared to decline as the crop aged.

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