system is considered essential to reduce water usage and increase efficiency of the system.

The possible leaching of nutrients from the bud tissue or an adverse influence on uptake of soil nutrients essential to adequate fruit set must also be investigated as potential causes of reduced fruit set. Excellent conditions for pollination during bloom in 1976 indicate that inadequate pollination probably was not a factor in reduced fruit set, although this possibility has not been dismissed at this time. The causal factor(s) for poor fruit set and reduced yields remain to be established. At present, inadequate fruit set is considered the primary limiting factor in adopting overhead sprinkling for bloom delay as a method for effective frost protection.

The disadvantages of reduced fruit set and fruit size along with potential tree losses due to excess soil moisture or phytotoxic materials in the water resulting from pre-bloom misting or sprinkling for bloom delay must be more thoroughly examined before adoption of the practice in commercial orchards in the Eastern U. S. Delayed fruit maturity might also be considered a disadvantage where early-season fruit marketing is emphasized or late fall weather conditions are unfavorable for harvesting.

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Field-plot Studies with Sweet Potato[1]

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Abstract. **The coefficient of variation on number of replications required for significance in field trials with sweet potato (*Ipomoea batatas* (L.) Lam decreased in most cases as the plot length and width increased. Using 12% as an arbitrary level of acceptability for the coefficient of variation, a single-row plot 15 to 20 hills, 30.5 cm apart in length and replicated 9 to 11 times appeared to be sufficient to conduct research on the total weight of sweet potatoes. A double-row plot of the same length would require 5 to 7 replications while a triple-row plot would require 3 to 6 replications to be precise enough for research on the total weight of sweet potatoes. For satisfactory research on the total number of roots, a plot 1 row wide and 20 to 25 hills long with 5 to 9 replications appeared to be adequate. A double-row plot the same length would require 3 to 7 replications, and a triple-row plot would require 2 to 6 replications for satisfactory results.**

Field plot technique for sweet potatoes grown under Louisiana conditions varies widely and is often arbitrary. Coefficients of variation (CV) range from 5 to 50% (L.G. Jones and T. P. Hernandez, unpublished). There is a need to reduce experimental error in field-plot work with sweet potatoes.

Thompson (5) found that square plots of sweet potatoes were superior to long narrow ones, unless the long narrow plots were set up as multiple row plots and concluded that a plot about 27.4 m long replicated 4 or 5 times should be satisfactory for field experiments. A greater reduction in variation in plot yields may be expected if the 27.4 m of row is divided into a no. of shorter rows. Conners (2) concluded that the "most efficient" size of plot for sweet potatoes was between 2 and 16 hills (hills spaced .53 m apart). When the size of plot was between 2 and 8 hills long, the best shape of a plot was 4 rows wide. Lana, Homeyer and Haber (4) found a decrease in the no. of replications required upon shifting from the unit sized plot to larger plots with sweet potatoes. This reduction corresponded to a decrease in the coefficient of variation.

The objective of this study was to study the effects of varying plot length and width on the size of the CV and no. of replications required for a given degree of precision in field plot studies of sweet potato.

Materials and Methods

Two uniformity trials with 'Centennial' sweet potatoes were conducted on an Olivier silt loam soil (Aquic Fraguidalf), in 1974 and 1975. This soil is commonly used for commercial sweet potato production and research in Louisiana. The test consisted of 12 rows 1.53 m wide and 42.66 m long. The soil at the site was considered to be fairly uniform.

Fertilizer was applied both years at 34 kg of N, 44 kg of P, and 56 kg of K per ha. The fertilizer was mixed and applied by hand in an effort to provide uniform distribution.

The test plots were planted by hand on May 22, 1974, and on May 28, 1975. The plants were spaced 30.5 cm apart and

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planted 12.7 cm deep. Missing hills were replaced as soon as they were discovered to insure a perfect stand. The cultural practices were essentially the same for both years.

The 1974 test was harvested on Oct. 9, 10, 11, and 12 with each hill harvested separately by hand. The total root wt and no. for each hill were determined. The 1975 test was harvested on Oct. 27, 28, and 29 using the same procedure as in 1974 except the data were taken from 5-hill instead of 1-hill plots.

By combining the 1-hill and the 5-hill basic units, plots of various lengths and widths were obtained as desired for the study. Plots of 5, 10, 15, 20, 25, 30, 35, and 40 plants in length were combined with widths of 1, 2, and 3 rows. The mean, sum of square, variance, standard deviation and CV for each plot size were obtained with CV used to measure experimental error in each plot.

The no. of replications required for each plot size and each category of yield studied to detect a 10% difference between treatments means at the 5% significance level was calculated by the method of Federer (3):

$$r = 2t_a{'}2s^2/d^2$$

where r is the no. of replications, s^2 equals the variance, $t_a{'}$ is the t value at the a' precentage level for the degrees of freedom associated with s^2, and d is the specified difference (10% of plot means).

Using the no. of replications calculated from this equation, a difference (type 2 error) will be detected about 50% of the time. Therefore, the no. of replications calculated by this method should only be used for rough estimates (3). Several techniques can be used that reduce this error (1, 3); however, these techniques take into account the no. of treatments being compared and did not fit the experimental design used in this test.

Results and Discussion

The wide range in the values for the total root wt and no. of roots for 1974 and 1975 indicates that soil heterogeneity, environmental conditions during the growing season, and the inherent nature of the crop played some part in affecting total production (Table 1). The total production of roots in 1975 was lower and somewhat more variable than in 1974.

The CV for total root wt and no. for any given size plot, obtained in 1975 was higher than that for the same plot size in 1974 (Tables 2 and 3). If an arbitrary value of about 12% is chosen as an acceptable level for the CV, it is apparent that most of the plot sizes studied are in the acceptable range. The CV in both categories for both years decreased as the plot length and width increased. The decrease in CV at all plot lengths due to increase in plot width was greatest when the plots were increased from 1 row to 2 rows.

Table 1. Sweet potato yields from a single-row, 5-hill basic unit in 1974 and 1975.

Variable	Year	Total root wt. (kg)	Total no. of roots
Total row yield[z]	1974	2,402	13,529
	1975	1,826	10,402
5-hill mean (range)	1974	8.0 (5.3–11.6)	45 (29–67)
	1975	6.1 (2.7–9.3)	35 (22–55)

[z]12 rows, 1.53 m wide and 42.66 m long.

Table 2. The CV for different plot sizes for the total wt of roots in 1974 and 1975.

Width of plot (No. of rows)	Year	CV (total root wt) Length of plot (no. of hills) 5	10	15	20	25	30	35	40
1	1974	15.0	12.8	11.7	11.3	10.9	10.8	10.1	10.2
	1975	17.0	13.3	11.5	10.8	10.6	9.8	9.6	9.6
2	1974	9.9	8.6	7.7	7.4	7.2	7.1	7.4	6.7
	1975	12.2	9.6	8.3	7.8	7.1	7.1	7.0	6.8
3	1975	8.1	6.9	6.0	5.6	5.7	5.5	4.9	4.7
	1975	10.8	8.6	8.2	7.7	7.2	7.2	7.3	6.9

This suggests that for the total root wt and no., a plot 2 rows wide would be sufficient to obtain acceptable information, but a single-row plot in most cases above the 5-10 hill plot length may be as practical as a double-row plot.

For both categories, CV tended to level off after a certain plot length was reached. Any increase in length beyond this cut-off point resulted in little reduction in CV (Tables 2 and 3). For the total root wt a plot 15 to 20 hills in length and 1 or 2 rows wide appears sufficient for a research plot. A plot 20 to 25 hills long and 1 to 2 rows wide appears to be adequate to conduct studies on the total no. of roots.

The relationship between the no. of replications required to detect a difference of 10% between treatment means with

Table 3. The CV for different plot sizes for the total no. of roots in 1974 and 1975.

Width of plot (No. of rows)	Year	CV (total root no.) Length of plot (No. of hills) 5	10	15	20	25	30	35	40
1	1974	15.1	11.8	10.5	9.2	7.9	7.9	7.4	7.0
	1975	17.5	13.3	11.7	10.7	10.2	9.8	9.4	9.2
2	1974	10.8	8.8	7.9	7.0	6.1	6.3	5.4	5.7
	1975	13.1	10.5	9.7	8.8	8.6	8.5	8.3	8.0
3	1974	8.5	7.0	6.3	5.7	4.3	4.5	4.2	3.6
	1975	11.1	9.6	8.9	8.4	8.2	8.0	7.8	7.4

Table 4. The no. of replications required to detect a difference of 10% between treatment means with a significance level of 5% for the total wt. of roots in 1974 and 1975.

Width of plot (No. of rows)	Year	No. replications required for total root wt. length of plot 5	10	15	20	25	30	35	40
1	1974	18	13	9	10	10	9	9	9
	1975	23	14	11	9	9	8	8	8
2	1974	8	6	5	5	4	4	4	4
	1975	12	7	6	5	4	4	4	4
3	1974	5	4	3	2	3	3	2	3
	1975	9	6	6	5	5	5	5	5

Table 5. The no. of replications required to detect a difference of 10% between treatment means with a significance level of 5% for the total no. of roots in 1974 and 1975.

Width of plot (No. of rows)	Year	No. replications required for total root no. — Length of plot 5	10	15	20	25	30	35	40
1	1974	18	11	9	7	5	5	5	4
	1975	24	14	11	9	8	8	7	7
2	1974	9	6	5	4	3	3	3	3
	1975	13	9	8	7	6	6	6	6
3	1974	6	4	3	3	2	2	2	2
	1975	10	7	7	6	6	6	6	5

a significance level of 5% for the total root wt and no. in 1974 and 1975 was determined (Tables 4 and 5). In both categories at most plot sizes, the no. of replications required in 1974 was somewhat less than that in 1975. Most of the no. of replications required appear to be in a reasonable and practical range for research with sweet potatoes, except for the 5-hill, 1 row, 2 row, and 3 row plots (Tables 4 and 5).

The no. of replications required decreased in most cases as plot length and width were increased. The sharpest decline in the no. of replications required due to an increase in plot width resulted from increasing the plot width from 1 to 2 rows. The no. of replications required decreased further as plot width was increased but not of the same magnitude as widening the plot from 1 row to 2 rows. The greatest decrease in the no. of replications required due to increasing plot length occurred as the length was increased from 5 to 10 hills. Further increases in plot length in most cases resulted in decreasing the no. of replications required but not as much as that caused by lengthening the plot from 5 to 10 hills. For both categories studied, the no. of replications required tended to level off after a certain point was reached in plot length. This point corresponds closely to the cut-off point for plot length in the coefficient of variation.

A comparison of table 4 and 5 indicates that the cut-off point for plot size and the level-off point for the no. of replications required were not the same for total wt and no. of roots. This may be due to the fact that each category measured the yield of sweet potatoes in a different way, has its own specific effect, and influences experimental error in its own special way. Other possible reasons for the variation in the cut-off and level-off points may be soil heterogeneity, the inherent nature of the crop, and environmental conditions during the growing season.

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