Field Plot Technique for the Evaluation of Strawberry Cultivars[1]

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Size and number of plots is an important consideration for strawberry breeders and other researchers engaged in the evaluation of strawberry cultivars. Edgar (2) found at East Malling that plots of about 50 plants planted on the square were best, but Taylor (3) considered the variability in Edgar's plots to be abnormally low, and advocated plots of 24 plants arranged in a twin row. He considered that seven replicates were necessary to measure a 20 percent difference at the 5 percent level of probability. Baker and Voth (1) in California considered 3 plots of 50 plants or 8 of 25 plants necessary to reduce heterogeneity to an acceptable level for scoring clones for resistance to Verticillium wilt in a "wilt nursery." All of these researchers were working with strawberries on the hill system, whereas the matted row system is standard in Eastern North America.

The following experiment provides data on the variability of matted squares, and on the relative variability of plants within plots and between plots.

Three cultivars, Premier, Earlidawn and Sparkle, were chosen for the study. 32 matted hill plots were established from single plants of each variety with the plots being arranged into 4 replicates of 8 hills each. The 96 plots were allowed to develop to a 60 cm x 60 cm square, but were prevented by cultivation from growing larger. They were otherwise handled in a normal recommended manner.

During the autumn of the year of planting, records were taken of:

(1) Number of runners
(2) Number of daughter plants

During the fruiting year, records were taken of:

(1) Vigor rating out of 10
(2) Number of daughter plants
(3) Flower stalks per plot
(4) Flowers per stalk
(5) Number of berries
(6) Average weight per berry (g)
(7) Total yield (g)
(8) Average picking date (after June 30th in days).

[1]Contribution No. 1307.

Table 1. Variance components and means for 10 characters in the strawberry.

Character	σ^2_p	σ^2_R	$\bar{X}$
No. of runners (autumn)	26.30	7.19	16.25
No. of daughter plants (autumn)	109.4	99.3	37.65
Vigor rating (July, 2nd yr)	.835	.222	5.981
No. of daughter plants (2nd yr)	81.69	3.13	26.00
Flower stalks per plot	82.40	17.15	25.03
Flowers per stalk	3.501	0.344	8.995
No. of berries	3611.	838.	168.8
Average weight per berry (g)	1.090	.085	3.775
Total yield (g)	92,754.	27,466.	649.86
Picking date (days after June 30th)	2.058	.381	10.302

The analysis of variance of the data for each cultivar was set up as follows:

Source	d.f.	Composition of mean squares
Between replicates	(r-l)	$\sigma^2_p + p\,\sigma^2_R$
Plants within replicates	r(p-1)	σ^2_p

Where r = number of replicates (=4),
p = number of plants within replicates (=8)
σ^2_p = variance component due to plants within a replicate, and
σ^2_R = variance component due to replicates.

The variance components were then calculated from the algebraic composition of the two mean squares, and were averaged over the three cultivars. The averaged components are presented together with means in Table 1.

Having estimated values for the two components, the estimated variance of a mean can be determined for any combination of replicates and plants per replicate. The estimated variance of a mean can be expressed as

$$\text{var } \bar{X} = \frac{\sigma^2_R}{r} + \frac{\sigma^2_p}{rp}$$

where r and p are the number of replicates and plants within replicates respectively.

The standard errors of the mean for

each character ($S_{\bar{x}}$) were plotted against number of plants per plot for 2 and 6 replicates. The 10 characters were then ranked in the following order with respect to their standard errors expressed as a percentage of the mean:

Character	S.E. as percent of mean: 2 reps of 10 plants each	S.E. as percent of mean: 6 reps of 10 plants each
Average picking date	5.26	-
Vigor rating (2nd year)	6.54	-
Flowers per stalk	6.55	-
Average weight per berry	8.25	-
Daughter plants (2nd year)	9.14	-
No. of runners (1st autumn)	13.64	7.87
Flower stalks per plot	14.24	8.22
Number of berries	14.50	8.37
Daughter plants (1st autumn)	19.72	11.38
Total yield	20.86	12.04

Two replicates of 10 plants each was sufficient to measure five of the characters to within 10 percent of their mean, and six replicates of 10 plants each was adequate to measure three more characters to that degree of accuracy. However, number of daughter plants in the first autumn and total yield would require more replicates and/or more plants per replicate to achieve that degree of accuracy.

Literature Cited

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The Relationship Between Calcium, Magnesium, and Potassium Accumulation and Titratable Acidity in the Leaves of a Selected McIntosh Apple Clone[1]

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Abstract. Water extracts of dry leaf tissues from a selected McIntosh apple clone were analyzed by titration with sodium hydroxide and by atomic absorption spectrophotometry. It was shown that titratable acidity decreases during the period July 4 - August 1 and increases as the season advances beyond August 1. The data suggest that calcium and magnesium which accumulate may be the principal cations associated with bases involved in the buffer system to maintain a relatively constant pH in the leaf. It is theorized that changes in leaf pH may be a major factor in the damage characteristic of certain mineral deficiencies in apples.

Several workers have shown that the percentages of calcium and magnesium increase as the season advances (3,4). Even on a unit area basis, Rogers et.al. (16) showed that the amount of calcium at leaf fall was double that found at the beginning of the season. Potassium, on the other hand, decreases as the season advances (3,4,12). It has also been reported that magnesium deficiency symptoms usually appear late in the season after normal terminal growth is completed (2) unless the deficiency is excessive. Existing information on how calcium and magnesium function within plants (7,9,13) is difficult to reconcile with the accumulation of these cations at a time when terminal growth is almost completed. This investigation was conducted to determine if seasonal trends exist in titratable acidity which could be associated with the observed increase in calcium and magnesium content of leaves.

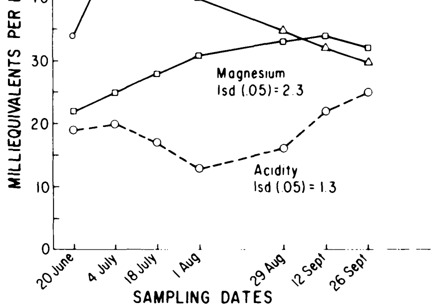

Fig. 1. Seasonal variation of titratable acidity, Ca, Mg and K in milliequivalents in the leaves of Rogers McIntosh apple.

Twelve bearing Rogers McIntosh apple trees on M. Robusta No. 5 clonally propagated rootstock were selected for this study. Samples of 100 leaves from the middle of growing shoots, at shoulder height, were collected at random from each tree. These samples were taken between 1:00 and 3:00 P.M. at 14 day intervals starting on June 20, 1966. The bagged leaves were stored at 0 C until they were washed on the day of collection. Each sample was washed in 2 liters of 0.1% Alconox detergent and rinsed with 2 liters of distilled water. The washed leaves were dried at 80 C for 72 hours, ground in a Wiley mill to pass through a 40 mesh stainless steel screen, and stored in glass bottles with plastic screw caps. Water extraction of organic acids was carried out according to a modified method of Palmer (14). Duplicate 1 g samples of ground material were placed in 50 ml centrifuge tubes, and 10 ml of

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[1]Published with the approval of the Director of the New Hampshire Agricultural Experiment Station as Scientific Contribution No. 436.

[2]The authors acknowledge the assistance of Dr. C.L. Grant of the Engineering Experiment Station and Miss Dorothy Josselyn of the Bio-chemistry Department in analyses for mineral elements.

[3]This indicator was developed for acid-base titration of leaf extracts during the course of the experiment. Its formula and characteristics will be published elsewhere.