HAWAII AGRICULTURAL EXPERIMENT STATION

Technical Note No. 33

ESTIMATING THE NUMBER OF PAPAW (CARICA PAPAYA) TREES REQUIRED FOR RELIABLE YIELD DATA

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SUMMARY

Statistics on twice-weekly harvesting of 4, 6, and 10 papaw trees in plots of 2, 3 and 4-year old trees in a continuous 4-year crop cycle showed that tree number and its interaction with treatments were nonsignificant. Harvesting of 4 trees only for yield data will save labor, and since plot size and attendant guard row trees can be correspondingly reduced, further savings in land, labor and materials can be realized.

I. INTRODUCTION

Agricultural scientists are repeatedly faced with the problem of plot and sample size to be used in research. Accuracy of results must be balanced against research costs and efficiency; therefore some conformity to best plot or sample size may be required for reasons of economy.

Many estimates of plot size requirements are based on Smith's (1938) equations and have been applied in crops such as tobacco (Crews, Jones, and Mason 1963), birdsfoot trefoil (Miller and Koch 1962) and orchardgrass (Rampton and Petersen 1962). Koch and Rigney (1951) described a method of estimating optimum plot size from experimental data.

Papaw is a favourite fruit in the tropics, where the palm-like tree grows readily from seed and attains production in one year. The trees are small, in Hawaii growing at the rapid rate of about 6 ft per year to a height of about 25 ft

in 4 years, at which time yields become uneconomic. The fruit, which is globose to ovoid, is borne on the hollow trunk below a cluster of long-stemmed leaves near the top. In commercial culture trees are planted in rows 6-10 ft apart, and occupy a space of 60-120 sq. ft, depending upon site conditions.

In recent years the papaw has developed from a local backyard crop for home use into an important export item, and its production is expanding in Hawaii. Despite its growing importance, however, little is known of the field scale culture of this crop.

II. METHODS

In 1961 a cover crop-papaw experiment was initiated at the Kauai Branch Station involving four main ground covers, two types of soil fumigation and four age groups of trees. A new planting was initiated each year in a continuous cycle, with trees being destroyed and replaced at the end of the fourth year of growth. The total number of plots was 76, comprising more than 4 acres, of which more than half was occupied by guard trees of no utility as experimental units. Mature fruit was harvested weekly on a year-round basis except for the first year of vegetative growth.

At first, in each test plot 10 trees were harvested weekly for yield data. Since fruit picking requires much labor and expense, it was desirable to reduce the number of harvested trees as much as reliability of the yield data would permit. To this end, an estimate of yield data precision was obtained by picking and weighing fruit from the same trees in series of 4, 6 and 10 trees over an 8-week period in December 1964 through January 1965. The yield data were adjusted to the standard 10-tree unit and statistically analysed as recorded in Table 1.

III. RESULTS

The analyses of variance of papaw fruit yields for the 2-month period show no significant differences on adjusted yields of harvests from 4, 6 and 10 trees in each plot. Also there were no significant interactions of the number of trees harvested with treatments, blocks, tree age or soil fumigation. This indicates that yields based on harvests from 4 trees are as reliable as those based on 6 or 10 trees. Considerable labor can be saved by harvesting only 4 trees for yield. Additionally, the results indicate that the size of papaw experimental plots and the number of attendant guard row trees can be correspondingly reduced, thereby effecting substantial savings in the total outlay for land, labour and materials. Recent experiments by Adlan and Plucknett (unpublished data) using small 4-tree plots have shown the utility of this approach. In their experiments, trees spaced 8 ft $\times$ 8 ft with a 12 ft guard spacing between trees of the adjacent plots have produced highly significant yield differences between fertilizer and soil amendment

TABLE 1

ANALYSES OF VARIANCE OF PAPAW FRUIT YIELDS (HAWAII NO. 1 GRADE) FROM 4, 6 AND 10 TREE UNITS HARVESTED OVER AN 8–WEEK PERIOD (DECEMBER AND JANUARY), KAUAI STATION*

Variance	Degrees of Freedom	Levels of significance for F values, 5% (*), 1% (**)
Total	143	
Treatments (cover crop)	3	27·64**
Trees (number of trees harvested)	2	1·24
Blocks	x1	13·27**
Age of trees (2, 3, 4 years)	2	64·39**
Fumigation (soil fumigation)	1	38·97**
Treatments x tree no.	6	n.s.
x blocks	3	n.s.
x tree age	6	4·69**
x soil fumigation	3	1·60
Tree number x blocks	2	n.s.
x tree age	4	n.s.
x soil fumigation	2	n.s.
Tree age x blocks	2	3·70*
x soil fumigation	2	34·76**
Soil fumigation x blocks	1	3·38
Treatment x tree age x blocks	6	3·54**
ERROR	97	

* Plot size was 56 ft x 48 ft, or 1/16·2 ac, containing 4 rows of 7 trees; only centre row trees entirely surrounded by guard trees were harvested for yield data. Yields on which this table is based are adjusted to 10-tree units.

Mean yield for 10 trees= 343 lb. Standard deviation = 45.

Fruit on 454 trees per ac = 101,280 lb/ac/year.

Coefficient of variation = 13·1%.

treatments. The experiment was conducted in an area one-third the size normally required for such an experiment. Labour and material savings for the experiment were also significantly reduced.

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