ity. We must broaden our horizons, expand our knowledge, apply our talents, and "seek and share" within the field of education.

MODERATOR HARAMAKI: Thank you, Larry, I heartily agree with your comments concerning the teaching of horticulture, particularly at the high school level. Many teachers at the high school level are not prepared to teach horticulture. Several years ago Penn State was involved in preparing materials to assist the teaching of horticultural subjects at the high school level. Several manuals have been prepared and these are available from Penn State University.

At this time I'll turn the microphone over to Mr. John Roller who will serve as moderator for the second half of this afternoon's program.

MODERATOR ROLLER: This portion of the program is known as "Propagation Potpourri" and as the name implies, it is a mixture of topics dealing with various aspects of nursery work. Our first speaker is James Aylsworth, whose topic is "Optimum Harvest Time for Woody Ornamentals".

ECONOMIC FACTORS DETERMINING THE OPTIMAL TIME TO HARVEST WOODY ORNAMENTAL PLANTS

J.Q. AYLSWORTH and J.T. SCOTT, JR.[1]

Woody ornamental plants generally represent a long term investment of land, labor, capitol and management inputs of production. Unlike orchard development costs which can be capitalized and depreciated over the productive life of the orchard, ornamental plants can be harvested but once and all development costs must be charged against current revenue.

Woody ornamental plants are harvested in many sizes corresponding roughly to the number of years of production. The revenue accruing to the crop at various ages of development provides the basis of determining the optimal time to harvest the crop to maximize income, over time, to the producer. Demands for current, over future expected income, cause the optimal harvest date to fluctuate among producers. A strong preference for current income reduces the profitability of holding long term appreciating

[1] Manager, Horton Nurseries, Inc., Madison, Ohio, and Professor of Farm Management, University of Illinois, Urbana, Illinois, respectively.

assets for additional time. Thus, the time to harvest the crop must be earlier than if there is no time preference for current income. To hold the crop for another year, the additional income associated with growing the crop for another time period must be quite large to compensate for the strong preference for current income. The problem is to find the optimal time to harvest woody ornamental plants to maximize profits in a continuing production sequence. Similar results were found for all five woody ornamental crops studied but only those for Hick's yew are presented here.

ECONOMIC MODEL

If a grower expects to produce only one short term crop, he would attempt to maximize income for that one crop and would continue growing the crop until t_n when net revenue is at a maximum (Fig. 1). However, if he expects to replace the present crop with another of the same kind, he would attempt to maximize his income over time, in which case he would replace the crop at t_o where average net revenue is greatest for each crop (Fig. 1).

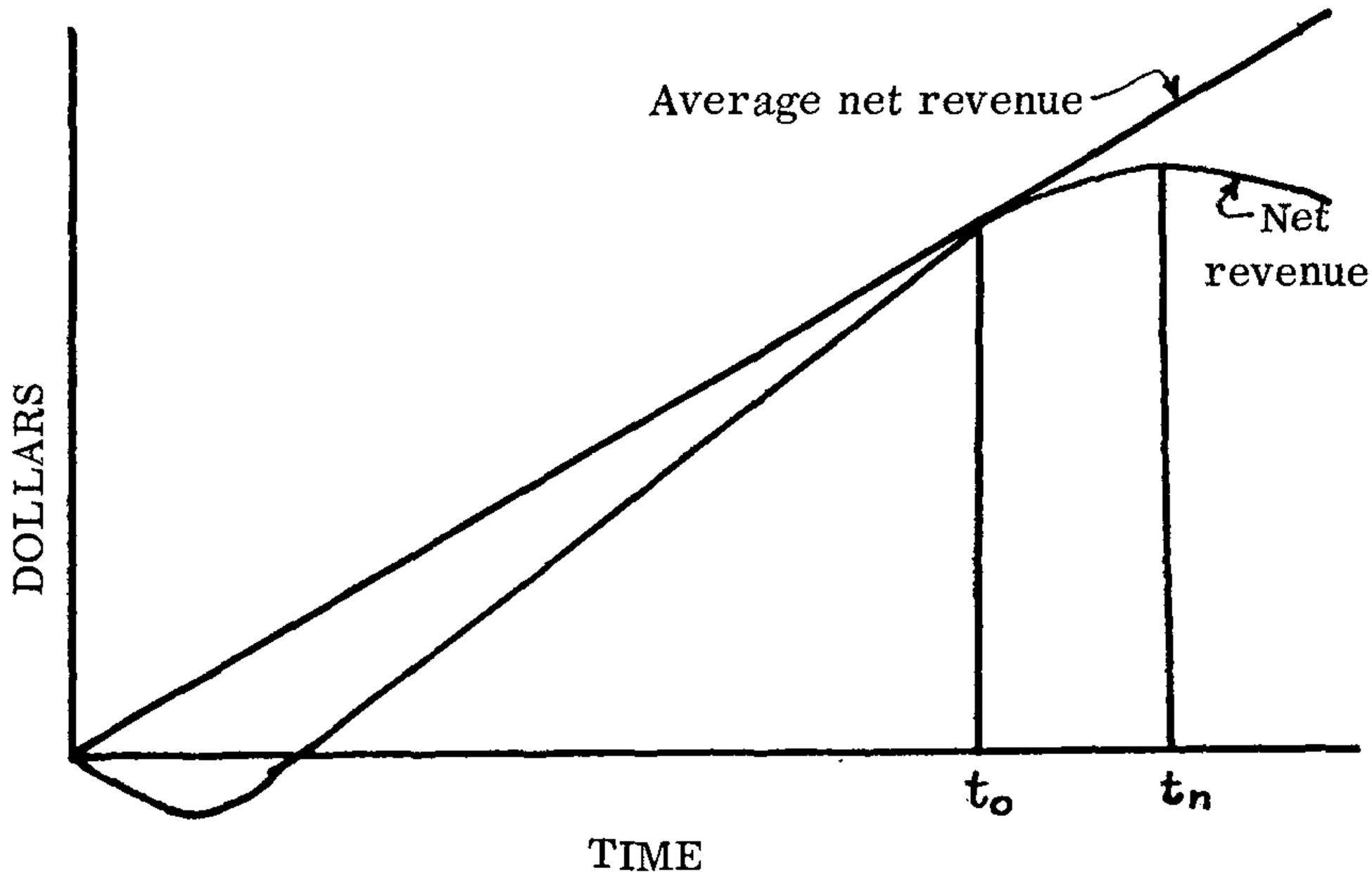

Figure 1. Theoretical determination of the optimal time to replace short term assets to maximize net revenue over time.

To maximize income over time for a series of identical crops he would replace the present crop when the average income is the largest and would produce a second crop even though the maximum net revenue for that crop had not been reached. Maximum net revenue or income over time would be achieved in this manner. The amount of time between t_o and t_n depends on the

shape of the net revenue curve which is determined by the particular crop ane the rate at which it increases in net value.

A long term asset such as woody ornamentals, which appreciates in value over time, must be analyzed somewhat differently than a short term crop due to the length of time before income is realized from the sale of the crop. The optimal time to replace assets of this type is when the marginal net revenue (income) from the present crop is equal to the amortized present value of the succeeding crop. Theoretically this can be depicted as in Fig. 2 where the expected income from the succeeding crop in year seven (y_7) is converted to the present value of net revenue in year zero (y_0), by the formula NR (insert formula) and is amortized over the 7 years of production by the formula PVNR (insert formula).

$$\left[\frac{1}{(1+i)^n}\right]^*$$

$$\left[\frac{i\,(1+i)}{(1+i)^n - 1}\right]^*$$

In Fig. 2 the expected income of the succeeding crop is depicted as the bar graph at year seven (y^7). The present value of this expected future income in year zero (y^0). is depicted as the bar graph to the left side of Fig. 2. The present value is always less than the future expected revenue because of time preference for the alternative uses of the expected future net revenues. This present value of net revenue (PVNR) is amortized or averaged over the expected life of the asset and is the average discounted net revenue expected over the life of the succeeding asset.

The time to harvest the present crop is when the marginal net revenue (MNR) or the additional value increase each year is equal to the amortized or "average" net revenue of the succeeding crop. A positive discount rate for the use of current revenues (MNR_0) indicates an earlier harvest date than a zero discount rate (MNR_+). This helps explain, theoretically at least, why a firm short of available capital for current expenses would harvest and sell a crop earlier than would a firm which was not strapped for working capital.

BASIC ASSUMPTIONS AND CONSTRAINTS

Although the model allows for replacing the present crop with any other crop, simplicity of the calculations and experience

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* Where NR is the expected net revenue of the succeeding crop, i is the interest rate, n is the number of years of production, and PVNR is the present value of the net revenue.

with the industry indicates that most nurserymen would replace a crop with the same or similar crop if it were profitable. It was assumed in this example that a crop requiring similar costs and expected revenues would replace the present crop. The same analysis would hold if an entirely different crop were used to replace the present one.

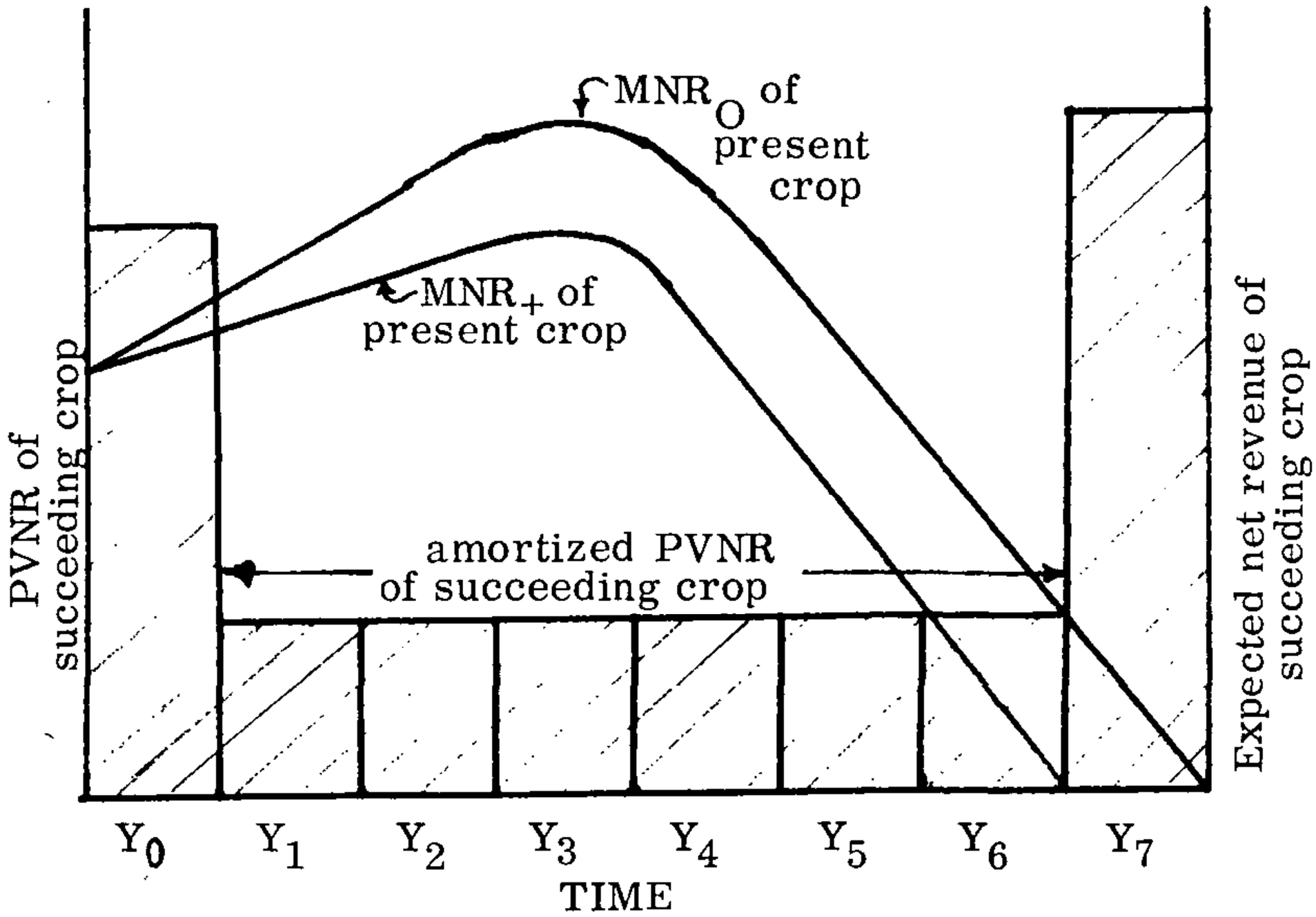

Figure 2. Theoretical determination of time to harvest a long term appreciating asset.

RESULTS AND DISCUSSION

A cost of production study was initiated to collect the variable costs of production for five woody ornamental plants. These costs were budgeted to cover 10 years of production expenses and anticipated revenues. The figures presented in Table 1 represent net values above variable costs only; fixed costs were not determined. Similar data are available for Canaert juniper, crabapple, pin oak, and Austrian pine.

The economic principle to be followed is that the time to harvest a crop of woody ornamental plants is when the marginal net revenue of the present crop, at the appropriate discount rate, is approximately equal to the amortized present value of the net revenue of the succeeding crop. For all discount rates studied, Hick's yew should be harvested and sold at the end of the fifth year of production since at this time, the marginal net revenue of the present crop is greater than the amortized present value of the net revenue of the succeeding crop. Waiting another year to har-

Table 1. Comparison of amortized present value of net revenue above variable costs with the discounted marginal net revenue of Hick's yew.

Year of production	Net revenue of succeeding crop	Present value of net revenue of succeeding crop	Amortized present value of net revenue of succeeding crop	Marginal Net Revenue of Present Crop			
				0% discount	3% discount	6% discount	12% discount
1	$ 17.98	$ 16.96	$ 17.98	—	—	—	—
2	227.49	202.47	107.53	$ 209.51	$ 202.69	$ 195.86	$ 182.21
3	70.59	59.27	22.17	156.90	—	—	—
4	1160.58	919.30	265.31	1089.99	1055.17	1020.36	950.72
5	3239.79	2421.10	574.77	2079.21	1982.02	1884.82	1690.44
6	3628.70	2558.23	520.34	388.91	280.05	171.19	-46.53
7	3987.74	2652.25	475.02	359.04	239.41	119.78	-119.49
8	4268.97	2678.35	431.21	281.23	153.16	25.09	-231.05
9	569.94	337.35	49.49	3699.03	—	—	—
10	915.86	422.58	71.02	365.92	337.84	309.77	253.62

vest and sell would reduce the marginal net revenue of the present crop below that which could be earned by beginning another crop. Since most woody ornamental crops are sold in the spring or fall of the year, this crop should be sold in the fall of the fifth year or the following spring to maximize net revenue to the producer.

Although net revenue increases through 8 years of production, maximum profit in a continuing operation occurs at the end of the fifth year — before net profits for each crop are at a maximum. This has important implications for producers in timing the sale of their crops. However, if the producer was not going to replace the crop, it would be most profitable to continue production until the eighth year when net profits for that crop would be at a maximum. Generally it is easier to find a market at existing prices for smaller plant material. Because of plant losses during production, producers might have a greater percentage of sales to destroyed plants if sold at the smaller size which could also improve net profits.

CONCLUSIONS

Financial analyses of this type will improve the profitability of nursery enterprises more quickly than if the only criterion were one of net profits from each crop of plants. Generally greater profitability over time will occur several years prior to the usual nursery practice of time to sell woody ornamental plants.

MODERATOR ROLLER: Thank you, James. Our next speaker is Glen Lumis who will tell us about using organic composts in container production.