VISUAL BASIC GROWTH-AND-YIELD MODELS WITH A MERCHANDISING OPTIMIZER FOR PLANTED SLASH AND LOBLOLLY PINE IN THE WEST GULF REGION

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Abstract—We developed two growth-and-yield models for thinned and unthinned plantations of slash pine (*Pinus elliottii* Engelm. var *elliottii*) and loblolly pine (*P. taeda* L.). The models, VB Merch-Slash and VB Merch-Lob, can be used to forecast product volumes and stand values for stands partitioned into 1-inch diameter-at-breast-height classes at any stage of plantation development from ages 10 through 50. Variables required to run the programs are age, density, site quality, minimum and maximum dimensions of products, and product prices. A merchandising optimizer converts predicted stand tables into an estimated optimum product mix by using a dynamic programming algorithm that maximizes the stand's selling value. The programs are written in Visual Basic and are available from the authors.

INTRODUCTION

The Nation's demand for timber products has been growing, increasing the pressure to harvest pine stands in the South. As a result, landowners increasingly are investing in pine plantation management. Because establishment and management of plantation pine stands are major investments, landowners need to have a sense of the value of future harvests if they are to justify their investments. Two computer models, VB Merch-Slash and VB Merch-Lob, allow landowners to model the development of slash pine (*Pinus elliottii* Engelm. var. *elliottii*) and loblolly pine (*P. taeda* L.) plantations. The models provide information on product mix and harvest value of both thinned and unthinned pine plantation harvests.

PROGRAM DESCRIPTION

VB Merch-Slash builds upon a planted slash pine growth-and-yield model (Zarnoch and others 1991). A computer program for this system, called COMPUTE_P-SLASH, was released (Baldwin and Ferguson 2003). The growth-and-yield subroutines are based on measurement data taken from study plots in unthinned and thinned slash pine plantations in the South's west gulf region. The data pool was composed of 543 thinned-stand growth-period observations on 0.10- to 0.25-acre plots. Generally, the growth period was 5 years but ranged from 3 to 11 years. The plots were not located in areas where survival was poor or where heavy damage from insects, disease, or other agents was present. For the most part, thinning was from below, but at later ages a good distribution of tree diameters across the plot was also a criterion. In addition, there were 530 residual-stand observations of postthinning conditions (Zarnoch and others 1991). VB Merch-Slash adds merchandising routines that divide up the stand-stock table of the model into product classes, which allow calculation of total stand value and total stand volume by product classes. VB Merch-Slash is written in Visual Basic, which allows for easy input and output.

VB Merch-Lob is an updated version of COMPUTE_MERCHLOB (Busby and others 1990). The growth-and-yield calculations are based on measurement data taken from study plots in unthinned and thinned loblolly plantations located in east Texas, north and central Louisiana, and eastern Mississippi. Plot age (from the time of planting) ranged from 10 through 45 years, site index (base age 25) from 40 to 90 feet, and initial planting density from 109 to 2,700 trees per acre. The thinning interval for stands in the long-term studies was 5 years, and residual densities after thinning ranged from 50 to 130 square feet of basal area per acre. The program is also written in Visual Basic, rather than the original Fortran, making it more flexible and user-friendly.

Both VB Merch-Slash and VB Merch-Lob can be used to forecast product volume and stand values for stands partitioned into 1-inch diameter-at-breast-height classes at any stage of plantation development from ages 10 through 50. The minimum initial variables required to run the program are age, density, site quality, minimum and maximum dimensions of products, and product prices. The merchandising optimizer converts predicted stand tables into an estimated optimum product mix by using a dynamic programming algorithm that maximizes the selling value of the stand.

Six different products can be specified: poles, veneer bolts, saw logs, chip-n-saw logs, pulpwood bolts, and chips. Residual wood is an additional product to account for any available wood in the bole of the tree not accounted for in the other six products. The model allocated the entire bole of each tree to one or more of the six product categories or to residual wood. The units of measurement for products are cords, tons, and board feet (in Doyle, Scribner, or International 1/4-inch rule), which can be set for each product.

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Product dimensions are the minimum and maximum top-end diameters, minimum and maximum piece length, piece-length increment, and an allowance for trim. For example, the user can say that poles must have a top-end diameter between 4 and 10 inches and be between 40 and 70 feet in length. Unit prices by product also must be specified. The user specifies an array of possible product sizes, and the model calculates the optimal cutting pattern to maximize the harvest value of the stand.

Two problems arise when attempting to estimate the best product mix based upon information given in the growth-and-yield model: (1) form and disease product defect information are not provided, and (2) small quantities of high-value products may be too expensive to sort out and sell. Poor form and disease are modeled by including a variable that allows the user to specify the percentage of properly sized trees from which a particular product cannot be made. For example, not all trees 40 feet tall to a 6-inch top are suitable for pole production, because some may have poor form or some defect that precludes the use of that log as a pole. If 60 percent of all properly sized trees have defects, then the variable would be set to 60 percent. The second problem that of small quantities of high-value products being too expensive to sort and sell is solved by inclusion of a minimum harvest variable. The user sets the minimum harvest volume required in a stand to make production economically viable. For example, the user may specify that a minimum of 1,000 board feet per acre of sawtimber logs must be produced if sawtimber is to be produced at all.

VB Merch-Lob and VB Merch-Slash provide two tables of output, a product-yield table with the specified product possibilities and a value table providing dollar amounts for the products. These tables represent the highest-value solutions, subject to constraints imposed by users. The information then can be used to make decisions critical to managing plantation loblolly and pine plantations.

DISCUSSION AND CONCLUSION

The Nation's demand for timber production is growing, and landowners are increasingly investing in southern pine plantations to meet the demand. Plantations must be profitable to landowners if required investments are going to be made. We offer the VB Merch-Slash and VB Merch-Lob models to help landowners make good investment decisions by providing estimates of harvest values of thinned and unthinned slash and loblolly pine stands. Landowners can predict the economic return of management options, using these models to develop harvest values and make better informed decisions about their plantation investments.

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