LAND SHAPING DURING NURSERY SITE PREPARATION OR RENOVATION

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Abstract.--A new method for computer-assisted design for land shaping in the nursery is described. Various restrictions may be imposed regarding slope, row direction, etc. The computer print-out includes five possible solutions and indicates cuts and fills needed, total soil to be moved, and cost for each of the five solutions.

Additional keywords: Computer-assisted design, slope and drainage, hardwoods, seed orchard.

There is a relatively new technique available for assisting the nurseryman either to shape a new field for use or to renovate an existing field. Experience has taught us two lessons. First, we cannot tolerate a lack of surface drainage in the nursery. This leads to the formation of wet spots which are adverse to both the growth of seedlings and the operation of equipment. The second lesson is that in an attempt to provide adequate surface drainage, we must not push valuable topsoil into the low spots, if in so doing we expose subsoil on the high spots. This operation may overcome the drainage problem but create new problems in nutrition, soil moisture-holding capacity, soil texture (especially if the subsoil is clayey) and structure, and inoculum of mycorrhizal fungi. The new land shaping method can solve the drainage problem without creating the secondary problems and at minimum cost.

The Department of Biological and Agricultural Engineering at N. C. State University has developed a computer program for land foiming (Shih, et al., 1975). This program was developed for agricultural fields but it is equally useful in the nursery. We have made only one significant modification in order to make it most useful for the nursery.

METHODS

The computer program requires certain data and decisions from the user. In the order in which they are needed, they are discussed below.

First, a decision is made on the location and shape of each field since the computer handles each field separately. The field need not be rectangular as far as the computer is concerned. Field shape is only confined by nursery management considerations.

Once the field boundaries are determined, bed direction in the field is decided. If there is any question as to which is the best way to run the beds, it is fairly simple and inexpensive to run the field twice through the computer with different bed directions. Several additional decisions must be made re-

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garding the field design. They are the maximum and minimum slope you will tolerate both in the row (in the bed direction) and across the row (across the bed direction) and the cut to fill ratio. Excellent results have been obtained with slope limits of 0.2% to 1.0% in the row and 0% to 3.0% across the row. The required cut to fill ratio results from the fact that there is soil compaction during the actual land forming operation and thus you must cut more than one cubic yard of soil for each yard of fill required. A value of 1.2 has worked quite well for most soils.

Next grade stakes are established in the field on .a 100-foot grid parallel to the bed direction and the elevation of each station to the nearest 0.01 foot is determined. The thickness of the topsoil at each station is also determined. This information is not needed until after the computer program has been run and is discussed later.

All the decisions and data for each field are punched on computer cards and the program is run.

RESULTS

The computer print-out includes all of your original decisions regarding field design, all the original elevations on the 100-foot grid, and five possible solutions to the grading problem. The computer generates new elevations for each station (grid point) for each of the five solutions; it calculates the required cuts and fills and the total amount of soil which will need to be moved; and it provides a summary table showing the important facts from each solution, including total cost (if an estimate is available of what it will cost to move one cubic yard of soil).

The five solutions obtained have the following design characteristics:

I. Uniform slope both in row (in the bed direction) and cross row (across the bed direction).
II. Variable slope both in row and cross row but with drainage in both directions.
III. Uniform slope in row and variable slope cross row with drainage.
IV. Uniform slope in row and variable slope cross row without drainage.
V. Variable slope in row with drainage and variable slope cross row without drainage.

From the standpoint of nursery management it is required to have drainage in the row and it is better if it is on a uniform slope. Cross row drainage is much less important because of the effect that raised beds have on drainage. If a nurseryman is using flat beds, however, then cross row drainage is important. With these ideas in mind, it becomes apparent that solutions I, III, and IV are the most useful for designing nursery fields. Usually final selection among these three solutions is made on the least amount of soil to be moved.

Comparison of the required cuts with the topsoil depth previously measured at each station assists with one additional decision. In areas where required cuts would reduce topsoil thickness to less than ten inches, especially if the subsoil is quite clayey, it is better to remove a uniform thickness of the topsoil and stockpile it temporarily. Then the required cuts and fills in that area can be conducted in the subsoil. Finally, the topsoil is returned to the area in a uniform thickness. This is a fairly expensive operation but it pays dividends for a long time.

Finally, because of the unavoidable soil compaction resulting from the operation of heavy grading equipment, it is usually necessary to subsoil the field. A subsoiler foot or mole pulled through the soil at 18 to 24 inches deep on four foot centers in two directions has been adequate to re-establish good internal drainage and reduce soil compaction.

CONCLUSIONS

The computer-assisted method for the design of new or renovated nursery fields has been used in forest nurseries from Virginia to Mississippi. It has proven to be flexible and adaptable to a range of soil conditions. It is relatively quick and inexpensive to conduct. The soil movement may be expensive, depending upon the amount to be moved. However, the results will yield benefits in both ease of operation and uniformity of stock produced in the nursery for a long time. Any subsequent minor soil settling which may occur can be easily corrected with some light work with a land plane.

The method is usable for either conifer or hardwood nurseries. Also, it is potentially useful for seed orchard site preparation. As far as is known, however, it has not yet been used for that purpose. The development of the vacuum seed harvester, which requires a smooth, uniform surface for most efficient operation, should enhance the attractiveness of the method for seed orchard management.

LITERATURE CITED

Shih, S. F., Sowell, R. S., and Kriz, G. J. 1975. Computer program for land forming design of a nonrectangular field. Tech. Bul. 231, No. Carolina Agr. Exp. Sta. 85pp.