CENTRAL HARDWOOD NOTES

Short-Rotation Plantations

Why Short Rotations?

Short-rotation plantations offer several advantages over longer, more traditional rotations. They enhance the natural productivity of better sites and of tree species with rapid juvenile growth. Returns on investment are realized in a shorter period and the risk of loss is reduced compared with long term investments. Production of wood and fiber can be maximized by intensifying cultural treatments near a processing site, lessening transportation costs.

Disadvantages of short-rotation plantations are similar to those of other intensive silvicultural systems. Costs of establishment are high because of the need for intensive site preparation, thorough weed control, and fertilization.

What exactly do we mean by short-rotation? Three possible short-rotation lengths for central hardwoods are:

- 5 to 10 years - Short-rotation intensive culture (biomass)
- 10 to 20 years - Short-rotation (for pulpwood)
- 20 to 40 years - Short-rotation (for sawtimber)

Material from short-rotation forests can be used for a variety of purposes including:

- Supplemental source of cellulose for the pulp and paper industry
- Reconstituted or solid core stock for furniture and paneling
- Chips and flakes for the fiberboard industry
- Feed stock for organic chemicals; cellulose for conversion to coke, ethylene glycol, ketones and alcohols; extractives, oils and gums
- Firewood
- Energy feed stocks for municipal and industry uses
- Fence posts
- Pallets

Species suitable for short-rotation intensive culture (biomass) plantings in the central hardwood region exhibit rapid, early growth on good sites and respond to fertilization-particularly nitrogen fertilizers. Short-rotation tree species are adaptable to a wide range of sites and reproduce by coppice or sprouting from the stump. This ability to sprout or coppice is critical for biomass plantations. Tree species that have these two characteristics in the central hardwood forest region include sycamore, eastern cottonwood, hybrid poplars of proven worth, bigtooth aspen, river birch, sweetgum, silver maple, black locust, willows, and European alder.

Site Selection

Soil Conservation Service drainage classes can be used as a general guide to site selection, but keep in mind that species will vary in their adaptability to poorly or excessively drained conditions:

Drainage class	Potential growth (Tons/acre/year)	Species favored'
Excessive	2-3.5	8
Somewhat excessive	2.5-4.5	1,2,8,10
Well	4.5-I 2.0	I-10
Somewhat poorly	4.5-I 2.0	I-10
Poorly	5.0-8.0	5,6,9
Very poorly	3.0-4.0	5,9

' 1 -Sycamore
2-Cottonwood
3-Bigtooth aspen
4-Hybrid poplar
5-River birch
6-Sweetgum
7-Silber maple
8-Black locust
9-Black willow
10-European alder

Sites most suitable for short-rotation plantations are fertile, moist but well drained, with soil pH ranging from 5.2 to 7.0 and an adequate rooting depth.

Site Preparation and Weed Control

Good site preparation improves soil aeration, helps control weed competition and some pests, and can improve accessibility. On old fields or cleared land, tillage is recommended. You should plow (including subsoiling if necessary) and disk before planting. In short-rotation forestry either mechanical or chemical weed control is necessary for 1 or 2 years to establish the original planting. Weed control for the coppice plantation may not be needed at all, or only needed for the first year. You can use a legume cover crop to control weeds and increase nitrogen fertility. If you do not till, either “broadcast” herbicides or apply them in bands or strips. However, more chances of rodent damage are likely to occur when herbicides are applied in strips.

On cut-over lands and in brushy areas, logging debris and existing vegetation should be chopped and burned or windrowed and burned. Afterwards you may find it necessary to use herbicides to control woody sprouts. Tillage is beneficial but may be omitted if impcactice

Planting Stock

Bareroot seedlings, containerized seedlings, and unrooted or rooted cuttings can be used depending on the tree species selected, the planting season, and the site quality. For example, unrooted cuttings of eastern cottonwood would be planted at

the start of the growing season when soils are likely to remain moist during root initiation. Plant only those selections, clones, or seedlings from sources appropriate to the locale and site. Plant either by hand using a planting bar or punch dibble, or by machine, but in all cases plant high quality stock.

Planting Density

The spacing you should use depends on your (or the owner's) objectives, the tree species or clone, the rotation length, and the desired sizes and uses of the end product. Some examples of planting densities are listed below:

Management objectives	Spacing (Feet)	Approximate number of trees/acre	Remarks
Chips	3x3 to 6x6	4,800 to 1,200	5- to 1 O-year rotation
Cordwood (pulp and fuelwood)	6x9 to 9x12	800 to 400	10- to 20-year rotation. Will need thinning.
Cordwood and logs	10x10 to 12x12	435 to 300	Up to 40-year rotation for logs. Thin closer spacings for cordwood.
Intercrops and mixed plantings	9x24 to 18x36	200 to 67	Manage trees for cordwood or logs. Crops, including herbaceous legumes, nitrogen-fixing or other trees can be planted between rows.

Post-Establishment Management

After planting, weed control is *critical.* Use chemical or mechanical methods; periodically mow or till in older stands to help control vines and give a manicured look to the plantation. Cut vines on crop trees if necessary.

Thin after the canopy closes. Thin by taking out a row at a time; or thin based on the diameter of the potential crop trees (see preceding tabulation).

Fertilization requirements vary with sites and tree species. Fertilize any time from the second or third year up to 3 to 5 years before harvest. Ideally, fertilization rates should be based on chemical analyses of soil and plant foliage. In the central hardwood region, trees respond the most to nitrogen, followed by phosphorus and potassium. In some cases, thorough weed control increases early growth as much as nitrogen fertilization with or without weed control does. A wide variety of formulations, rates of application, and methods of application may be appropriate to a given site. The upper limit of nitrogen uptake by a rapidly-growing plantation of hardwoods may approach 80 pounds per acre per year in the central hardwood region. The more productive the site the longer fertilization can be delayed.

The use of nitrogen-fixing ground covers, shrubs or trees (such as black locust and European alder) may add enough nitrogen to the soil to eliminate the need for fertilization. Such species can also be used to increase the growth of trees planted with them and to diversify cropping. For example, alfalfa hay or black locust fenceposts can be produced along with a crop tree. Alternatively, Christmas trees or agronomic crops can be interplanted to provide income early in the forest rotation.

Generally, only one or two coppice rotations for biomass are feasible; production drops with more rotations. Coppice growth is not usually acceptable for sawtimber production. To obtain coppice you should harvest in the winter when the root system carbohydrate reserves, which support initial coppice growth, are at a high level. Stump heights of about 6 inches are often adequate to support coppice, and juvenile trees sprout more readily than mature trees. So you should use coppicing with the short-rotation biomass plantings.

Closely monitor plantations for insect and disease problems because dense plantings of single species are more susceptible then widely spaced, multi-species plantations.

Table 1 lists reported production of short-rotation plantations in the central hardwood region.

Table 1.-*Production of short-rotation plantations in the central hardwood region*

Common name	Location	Spacing	Rotation	Annual yield
		Feet	*Years*	*Tons/acre*
Hybrid poplar	Western Kentucky Ohio Valley	2 x 3	4	5.0
Sycamore	Western Kentucky Ohio Valley	2 x 3	4	3.8
European alder	Western Kentucky Ohio Valley	2 x 3	4	3.2
River birch	Western Kentucky Ohio Valley	2 x 3	4	3.8
Silver maple	Kansas	Variable	2	3.0
Black locust	Kansas	Variable	6	3.2
Sycamore	Mississippi Delta	6 x 4	2	3.2
Sycamore'	Mississippi Delta	6 x 4	4	10.7
Sycamore	Southern Illinois	0.7 x 0.7 to 1.8 x 2.3	2	3.6
Sycamore	Southern Illinois	0.7 x 0.7 to 1.8 x 2.3	4	4.5
Black locust	Southern Illinois	0.7 x 0.7 to 1.8 x 2.3	2	5.2
Black locust	Southern Illinois	0.7 x 0.7 to 1.8 x 2.3	3	5.2
Black locust	Indiana	6 x 3	3	10.9
Black locust	Indiana	6 x 3	5	10.3
Sycamore'	Mississippi	3.8 x 4.5	4	6.4
Populus	Lake States	6 x 6	5	7.1
Populus[1]	Lake States	6 x 6	5	8.2
Black locust	Central Great Plains	7.5 x 7.5	6	10.2
Black locust'	Central Great Plains	7.5 x 7.5	6	12.0
Eastern cottonwood	Mississippi River Floodplain	6 x 6	5	8.9
Eastern cottonwood	Mississippi River Floodplain	6 x 6	5	10.7

[1] **Coppice stands from sprouts**

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