Technical Notes

USDA-Soil Conservation Service
Boise, Idaho

Needs Revision - Transfer to Agroforestry

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WATER NEEDS OF WINDBREAKS FOR TRICKLE IRRIGATION SYSTEM DESIGN

Optimum plant growth and survival of windbreaks during establishment is necessary to provide the planned level of protection. The majority of windbreaks in the State of Idaho occur in an arid to semi-arid environment. Water needs for temporary or permanent irrigation must be considered for optimum plant growth and survival in most areas. The accompanying procedure aids in determining the degree of irrigation development needed taking into consideration the climatic conditions, soil, and plant species.

The objective of the Soil Conservation Service is to ensure optimum plant growth and deep root establishment for windbreaks. This is accomplished by providing adequate water during critical growth periods in a timely manner and with proper placement of lines and emitters to ensure balanced root growth. The amount of water supplied depends on the annual moisture received and the capacity of the soil to retain sufficient moisture for the desired plant species response.

Species suited to various soils and their expected growth under irrigation are contained in Section II of the Field Office Technical Guide, Windbreak Suitability Groups. To achieve the expected growth indicated in Section II, four system design levels must be considered for optimum and sustained plant growth and vigor. Based upon well drained, non-saline soils and species suitability, they are:

Level 1: Permanent full irrigation designed for peak use.

Level 2: Permanent irrigation to the tenth year of growth with capacity to supply supplemental water during drought years and during warm spells.

Level 3: Temporary irrigation installation to the third year of establishment (the system removed thereafter);

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however, it is recommended that the system be retained for growing HIGH water use group species and in locations that have a history of drought or long, warm spells.

Level 4: No system is needed unless the area exhibits a history of drought or extensive warm spells, or the landowner desires accelerated tree and shrub growth.

Table 1 below, used with the peak "alfalfa grass" daily use factor (daily use graphs, Section ID687), from the Idaho Irrigation Guide and the potential plant rooting width from Table 2 by plant species, can be used to complete the Water Needs Worksheet, Attachment 1. The results of the worksheet will establish the water need and system life requirement for the planned or existing windbreak being evaluated.

Table 1: Water Use Factors

Mean Annual Precip. (in.)	AWC Total to 60 in.	Design Level Needed	Use Factor* Plant Species Use Group (Table 2) LOW	MED.	HIGH
<12	All	1	31	53	84
12-18	<7.5	1	31	53	84
	>7.5	2	19	32	51
18-35	<3.75	2	13	32	51
	3.75-7.5	3	9	16	25
	>7.5	4	0	0	0
>35	<3.75	3	9	16	25
	>3.75	4	0	0	0

*If drought conditions or extensive warm spells in the local area are expected, use the next highest use factor and design level.

Table 2: Windbreak Species Rooting Widths

WATER USE CONSUMPTIVE GROUPS	Typical Between Tree Spacings		Typical Root Width at 20 Yrs.
	Mult. Row (ft)	Single Row (ft)	(ft.)
HIGH USE GROUP:			
Lombardy poplar	6-8	4-6	30
hybrid poplar	10	8	30
golden, black or weeping willow	12	8	30
MEDIUM USE GROUP:			
black locust, Siberian elm, green ash	12	8	30
Austrian pine, ponderosa pine	12	8	30
eastern redcedar	8	6	15
Scotch pine	12	8	20
blue spruce, Norway spruce, Douglas-fir	12	8	25
northern white-cedar	8	6	20
LOW USE GROUP:			
Siberian peashrub, common Lilac	5	3-4	10
Amur honeysuckle, common privet	5	3-4	8
Nanking cherry, Peking cotoneaster	5	3-4	4
Russian-olive	10	8	20
Rocky Mountain juniper	8	6	15

NOTES:

1. Match consumptive use and root zone width for a species not listed with one that is.
2. "Typical Between-Tree Spacings" for trees can aid in the early placement of emitters.
3. The "Typical Root Width" at 20 years is not to be used for actual row-to-row spacing (the width indicates a root density factor for irrigation computations only).

The design level will ensure compliance with the purpose of farmstead and field windbreak standards: To protect the soil resources, control snow deposition, prevent wind damage, protect farmsteads, crops, livestock, orchards, and wildlife, or increase the natural beauty of the area.

The procedure followed by using the Water Needs Worksheet, Attachment 1, is intended for trickle irrigation supply systems. However, the determination of windbreak water needs is applicable to all forms of irrigation.

Much of the content of this technical note came from a 1985 technical note developed by former SCS State Technical Staff in the State of Washington. They are: Lyn Townsend, WNTC Forester; Bob Engle, Soil Scientist, MNTC: and Tom Spofford, Irrigation Specialist, WNTC.

ATTACHMENT 1

WINDBREAK DRIP IRRIGATION WATER NEEDS WORKSHEET

Step 1 - Select the peak daily consumptive use figure for the proper climatic zone and alfalfa grass: Alfalfa grass c.u. _____ (Step 1 value).

Step 2 - Record the selected species (from F.O.T.G. Section II) and their water use factor from Table 1).

	Species	Use Factor (Step 2 Value)		Species	Use Factor (Step 2 Value)
Row 1	_____	_____	Row 4	_____	_____
Row 2	_____	_____	Row 5	_____	_____
Row 3	_____	_____	Row 6	_____	_____

Step 3 - Record the species root width from Table 2, and the row length, to calculate the area to be wetted (Step 3 value):

	Species Root Width (ft.)		Row Length (ft.)	Area (Ft.)2		Species Root Width (ft.)		Row Length (ft.)	Area (ft.)2
Row 1	_____	x	_____	_____	Row 4	_____	x	_____	_____
Row 2	_____	x	_____	_____	Row 5	_____	x	_____	_____
Row 3	_____	x	_____	_____	Row 6	_____	x	_____	_____

Step 4 - Determine the gallons per day needed per windbreak row. The basic equation is: {(Step 1) X (Step 2) X (Step 3)} / (Efficiency %) = gallons/day/row.

						gal/day /row	gal/day/tree (gal/day/row)/ (#/trees/row)
Row 1	(____) X	(____) X	(____) /	(____) =		_____	_____
Row 2	(____) X	(____) X	(____) /	(____) =		_____	_____
Row 3	(____) X	(____) X	(____) /	(____) =		_____	_____
Row 4	(____) X	(____) X	(____) /	(____) =		_____	_____
Row 5	(____) X	(____) X	(____) /	(____) =		_____	_____
Row 6	(____) X	(____) X	(____) /	(____) =		_____	_____

Efficiencies: Point Source on Ground = 90% Spray Emitters = 80%
Point Source Suspended = 80% Bubbler = 85%

Step 5 - Determine the gallons per day needed from ages one to twenty by the following equation: {(Species age) / 20 yrs X gal/day/tree value determined from Step 4}

EXAMPLE:
A row of Rocky Mtn. Juniper needed 8 gal/day/tree at age 20 as determined by Step 4. How much will the juniper need at age 5?
{(5/20 X 8 = 2 gals/day/tree (age 5)}

Gallons/day/tree/age*

Yrs.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(X Fac)	.25	.1	.015	.2	.25	.3	.35	.4	.45	.5	.55	.6	.65	.7	.75	.8	.85	.9	.95	1.0
Row 1																				
Row 2																				
Row 3																				
Row 4																				
Row 5																				
Row 6																				

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* For species with high-medium water use requirements using 2-3 emitters per species will reduce irrigation set and aid in better root development

Step 6 - The system will be (check one): Permanent ___ Temporary ___

Step 7 - The system will need to be designed and balanced to provide the necessary amounts of water above by a person with appropriate engineering authority or by a certified irrigation dealer.