ANNEXURE - B

LAWNS

Contrary to expectations, lawn installation and maintenance are among the more expensive and time-consuming horticultural activities, The individual grass plants are not only subject to many pests and diseases, but also are deliberately crowded 'and in intense competition for space, light, water, and nutrients. Nevertheless there is great personal desire and community pressure for a beautiful lawn to reduce dust and mud, to soften and enhance the landscape, and to sit and play on.

Table B-1
Grass Seed Mixtures

Situation	Hardiness zone	Composition
Sunny area	3-7	75% improved bluegrasses+25% improved red fescues
Shady area	3-7	75% improved red fescues+25% improved bluegrasses
Play area	4-8	80% improved tall fescues+20% perennial rye
Quick cover	3-9	75% annual rye+25% redtop
Rough lawn	3-8	33 1/3% ladino clover + 33 1/3% bluegrasses + 33 1/3 % tall fescues
Heavy traffic	4-8	60% fescues+ 20% bluegrasses +20% perennial rye
Over seeding	7-9	100% redtop

Establishing a good lawn demands quality seed, appropriate to the particular soil and climatic conditions. Many grass species have been selected and bred for particular characteristics (Table18-1). Within these, named cultivars have been developed that are generally superior to the unimproved species. The amid cultivars have the disadvantage of being almost isogenic (genetically uniform) To increase the lawn's survival under adverse conditions, most lawn grasses are sold as mixtures of two or more species. These mixtures are usually' keyed to hardiness zones, to environmental conditions in various lawn climatic regions, arid to the expected use of the lawn. In southern climates (Hardiness Zones 8 to 10) many lawns are established with a single species of grass, frequently as blends of several cultivars. Lawn grass seed should be labeled with the species and cultivars included, the germination percentage, the percentage weed seed (less than 1 percent is best), the percent of inert materials (less than 5 percent) and the percent of crop seed (less than 0.3 percent). Certified seed labels indicate that the plants were inspected in the field and were found to be true to type

SOWING

Sowing seed into a well prepared seed bed can be done by hand or with mechanical grass seeding machine. Since the seed is small, hand seeding, is made easier if the seed is thoroughly mixed with a carrier such as sand or topsoil. To ensure uniform distribution of seed, half the seed is sown in one direction and the other half at right angles to the first lot. After planting, the seed may be raked with a tooth rake to make sure that the seed is in direct contact with the ground. Rolling or treading the seeded area also ensures good contact. The seed should not be covered by more than 0.2 to 0.3 cm (1/8 in.) of soil for most cool-season grasses. Some varieties, such as the bluegrasses, germinate slowly, requiring over three weeks for full

germination. Mulching the sown area conserves moisture, prevents the seed from being washed away by heavy rains, and prevents wide swings in temperature. A weed-free straw or hay cover is excellent when used at the rate of 100 kg/100 m2 (100Ib/100 ft2). On steep slopes or banks, cheesecloth, sacking, or one of the commercially available mulching cloths can be used. The grass blades will grow through the mulch which usually rots away within a few months.

If the seedbed was properly prepared and adequately fertilized, additionalfertilizer may not be needed for the first months of lawn growth. If fall plantingwas done, a light fertilization in spring when the grass begins to grow may behelpful, particularly if the plants are pale green or yellowish. A phosphorus deficiency is recognized as dark green plants with red stems and reduced growth.

To avoid compaction of the soil, new lawns should not be walked on for the first month following appearance of the seedlings. Mowing can begin at this time with mower height set at 2 in. Chemical weed control is best deferred for another month or can be done the following spring.

SODDING

Sod is pre grown turf consisting of a weed-free mixture of grasses appropriate to the area. It should be purchased locally. Rectangles or strips of a mature turf 1 to 3 years old.are cut with special equipment-to a thickness of 2 to 3 cm (l in.), with little soil below the mat of roots. Laying sod is expensive, but it is an effective method on slopes subject to erosion or where a line, mature lawn is to be established in a short time. In many areas sodding provides an excellent turf, usually weed free, that is permanent with proper maintenance.

In Hardiness Zones 4 to 8 sodding is most successful when done in the fall, although spring sodding may be done if adequate moisture and care are provided. In Hardiness Zones 8 to 10, where warm-season grasses are used, summer sodding is best. It is important that the sad is laid as soon as possible after delivery; a delay of even a few days will injure the turf since the root systems are exposed.

Soil preparation is identical to that used for seedbeds except that the soil is graded 2 to 3 cm (1 in.) lower near walkways to adjust for the thickness of sad. The bed must be well prepared and leveled to allow firm and close contact between the sod; and the soil. Rectangles or strips are planted as tightly together as possible, much as flooring tiles are laid: To minimize trampling or compaction of the soil, a board is laid over the soil surface to be sodded. After the sod is installed, the area is top-dressed with a thin layer of good topsoil and topsoil worked into the cracks between the pieces of sodding. The new lawn is light tamped or rolled to ensure good soil-sod contact and is watered immediately. Should be watered frequently for thefirst growing season to prevent root damage and to encourage good root penetration. A light application of superphosphate will accelerate root penetration.

Some grasses, particularly the warm-season species and the bent grasses, also be established from plugs or plantings (Table B-2). Plug sodding utilize small rectangles or discs of sodded grasses with adhering soil. These are plant 15 to 30 cm (6 to 12 in.) apart in well-prepared bed.

MAINTENANCE

If a fine, thrifty, weed-free lawn is desired, its maintenance becomes a significant part of management and cultivation. Unfortunately, lawns are neither work-free nor trouble-free. Fertilization. Liming, watering or irrigation, mowing. andcontrol of animal and plant pests are the basic constituents of lawn management.

FERTILIZING

If soil nutrients are brought to an adequate level during site preparation, additional fertilization will be unnecessary for the hulk of the first growing season. Indeed, over-fertilization is inadvisable since a young root system is less tolerant of high levels of inorganic salts than is the root system of an established lawn. Excessive nitrogen results in succulent, soft growth that is less disease and insect resistant.

Lawns should not be fertilized when the grass or the soil is wet. But it is good practice to water thoroughly after spreading fertilizer to wash any chemicals off the leaves, This prevents burning and ensures that the fertilizer reaches and enters the soil.

There is some confusion about the amount or rate of fertilizer application. While the phosphorus and potassium components in standard fertilizer formulations are necessary for grass development, lawn grass growth is primarily dependent upon the amount of nitrogen supplied, and it is the nitrogen component that is given primary consideration in determining fertilizer applications. For lawn applications, the amounts needed are usually given as pounds of nitrogen per thousand square feet or kilograms per hundred square meters, To provide 1 Ib N/ 1000 ft^2 (1kg N/100 m2) using a 10-10-10 fertilizer, 10 lb (4 kg) of fertilizer would be used.

Fertilizers may contain inorganic nitrogen as ammonium or nitrate ions, organically bound nitrogen, or a mixture of both, Inorganic nitrogen is immediately available to the plants, while organically bound forms release nitrogen slowly. When spring applications of fertilizer to cool-season lawns or summer applications to warm-season lawns are made, the combination formulations work well in spite of their high cost. For fall applications, where immediate uptake in cool weather is desired, only inorganic formulations are cost efficient.

'Fertilization schedules depend on the region and the grass type (figure18-3). Warm-season grasses put on most of their growth during the hot summer months and should be fertilized at the time of maximum growth. Bermuda grass, St. Augustine grass, zoysia, or Bahia grass benefit.from high fertilizer applications. Bermuda grass should receive 5 kg N/100 m2 (5 lb N/1000 ft2), St. Augustine grass and the zoysias 2 kg N/1OO m2,and Bahia grass 3 kg N/100 Sq.M.

LIMING

It should be obvious that correction of soil pH should be done only when it needs correcting as determined by a soil test. In general, established lawns on sandy soils require liming every two to three years, while those on clay soils need adjustment only every five to six years. The lime is usually supplied in a finely ground or granular form and can be spread at any time of the year, although late fall or very early spring are best. Amounts vary according to need, but are in the range of 10 to 30 kg/100 m2 (10 to 30 lb/1000 ft2).

WATERING

Watering or irrigation of lawns is, for most areas of North America, a necessity. An acre (0.4 ha)of lawn can transpire 2400 gallons (9600 liters) of water per day in midsummer. Considerable damage will occur if soils dry to their permanent wilting point (-15 bars) for any length of time. Many lawn grass roots grow to 30 cm (1 ft) or more into the subsoil and moisture levels at this depth should not fall below -8 bars during the period when the grasses arc actively growing. It

requires 2 to 5 cm (I to 2 in.) of water to bring the upper 30 cm (12 in.) of a sandy or silty loam soil from near wilting point to field capacity. This amount of water will be transpired or lost by evaporation in a week under summer conditions. To replace this water, regular wateringis required. In midsummer, when cool-season grasses stop growth and become summer- dormant, less, water is needed. if it is desirable to maintain growth during this time watering must be continued at somewhat higher rates than the 2 to 5 cm per week.

A light sprinkling of water several times a week is poor management practice. A good deal of this wafer is merely evaporated from leaf and soil surfaces and does-not enter the soil at all. The water that does enter the soil remains in the upper few centimeters and the grass roots become concentrated in this superficial horizon. The danger of massive root kill by even light droughts or a short period of hot weather is great. Watering should provide the amount needed to bring the upper 30 cm (12 in.) to field capacity and should be repeated when this layer is sti1l above the permanent wilting point-usually once a week or more frequently in very hot, dry weather with moderate to high winds.

MOWING

The fundamental rule on lawn mowing is to use only well-designed, well- maintained, and well-sharpened equipment. A dull blade, whether on it reel or a rotary mower, will shatter rather than cut grass blades cleanly and will increase the number of plants that die or become susceptible to infection. Although reel mowers involve more human effort, they preferable to rotary mowers because they cut cleaner and are less dangerous to use.

Cool-season grasses should not, except under special circumstances, be mowed closer than 5 cm (2 in.). Close mowing removes too much of the photosynthetic leaf blade tissue and depresses the growth of-root systems. It also exposes previously shaded stems to direct sunlight which may result in sun scald. Cool-season grasses should be mowed at frequent intervals during the growing period. It is a good general rule that lawns should be mowed when the grass length has exceeded the recommended height by no more than 1.0 to 1.5 cm (1/2 in.) where mowing shock is minimal. The warm-season grasses are generally cut shorter than the cool-season grasses, Bermuda grass is maintained at heights of 1.5 to 2.0 cm (5/8 in.) and the others at 2.0 to 2.5cm (3/4 to 1 in).

WEEDS

A bright green, well-trimmed, and weed-free lawn is not only an esthetic pleasure, but adds financial value to a property. Weed control is a necessary' cultural practice for most areas. Close to 50 species of weed plants invade lawns and require control if clean turf is to be maintained (Figure 18-4). Weed control starts with the turf itself. A healthy lawn, provided with adequate fertilizer, water, and lime and properly mowed, resists the invasion of the seeds of many lawn particularly if the turfis mowed to at least 3.5 to 5.0 cm (1.5 to 2.0 in.), a cuttingheight that is also best for lawn development.

Weedy species in lawns are separated into persistent (perennial) non persistent (annual) types and each type includes monocots and dicots. Two of the more troublesome weedy plants are the crabgrass and the nimble-wills. Both are monocots related to the lawn grasses. The crab-grasses are annuals, and nimble-will is a persistent perennial. The crab-grasses are vigorous C4. Photosynthetic plants and are particularly difficult to eliminate once they have become

established. Other grass species that are problems for lawns are the creeping bent-grasses foxtails, Dallies-grass and quack grass.

Since the desired lawn grasses are usually as sensitive to herbicides as are the weedy species, special control measures are required in an established lawn. When lawns contain few weeds, hand removal is the least damaging method of control. Removal is best done after a rain or thorough irrigation since many weeds have relatively superficial root systems and it is easier to pluck out the entire plant when the soil is damp. Many weeds reproduce easily from rootstocks and failure to remove the entire plant results in spread of the weed. This is particularly true for dandelion (Taraxacum), cinquefoil (Potentillacanadensis)and the plantains (Plantago spp.).

Both pre-emergence and post emergence herbicides are used in any thorough weed control program. The pre-emergence herbicides inhibit weed seed germination and earlyseedling growth, but have virtually no effect beyond that stage. They are effective in treating established lawns to eliminate crab-grasses, goose- grass (Eleusineindica), and creeping bent-grass all of which are resistant to most other herbicides. They may also be effective against seedlings of broad-leaved weeds, although post emergence herbicides are usually used for these plants. Pre-emergence herbicides are available as granules that at spread in early spring. They should not be used on new lawns since they can kill lawn grass seedlings.

The postemergence herbicides include 2, 4-dichlorophenoxyacetic acid (2, 4-D) and its derivatives plus a variety of other chemicals that interfere with a numberof physiological activities including photosynthesis, respiration, and synthesis of various compounds. Many are available as spreadable granules or as liquid formulations used as sprays. With few exceptions, spray formulations are most effective against young plants: as many weeds age. their tolerance to herbicides increases.

Herbicides are human and animal toxins. and as with all chemicals, package directions should be followed exactly. They can injure or kill desirable plantings and should not be used in very hot weather where they volatilize or in wind conditions where they may be carried to other plantings. Spot applications can be made by tipping a stick with a paint brush or a piece of plastic foam and touching individual weeds with the herbicide. Although formulations of fertilizer plus herbicides are available for dual treatment of lawns, they are more expensive than purchasing and applying each separately, and the timing for optimum effectiveness of each may be different.

PESTS AND DISEASES

Three insect types are responsible for most lawn problems. Those that suck sap include the chinch bugs, some aphids, and scale insects. Plants of Augustine grass in the south are particularly plagued by chinch bugs. The webworms, occasionally called tobacco crambids, are larvae of moths that damage by feeding on grass leaves and stems. Armyworms, the larval stage .S. another moth, are leaf feeders. By far the most serious pests are grubs, the larval hatchlings of the Japanese beetle, Mayor June beetles, and the billbugs. Beetle grub damage is evidenced by death of patches of grass in June through early August and by observations of white grubs directly beneath the sod. These insect feed on the roots of grass plants just below the sod level and can destroy a large lawn area within a week.

The sap sucking insects and leaf feeders are controlled with appropriate insecticide sprays, usually applied in midsummer in the south and a few earlier in more northerly climates. Grubs

can be controlled by preventing through sound cultivation practices, trapping or killing adults, use of biological ,control and soil treatments with appropriate pesticides.

Other animal pests rarely present major problems. Termites damage the roots of some grass species in the Ohio River basin, wireworms occasionally attack grass rhizomes near potato fields, ants are more of a nuisance. Land crabs dig holes in southern lawns and arc controlled with a rotenone solution poured into each burrow. Mole burrows are unsightly and can result in uprooted plants. Moles feed on grubs, so that grub control almost invariably. Resolves the mole problem. No one has successfully dealt with neighborhood dogs, cats, and squirrels.

A well-managed lawn is the best disease control. Among the worst management practices in terms of disease development is over-fertilization with high nitrogen formulations. Hot, wet summers are unavoidable, but they should alter the gardener that special care must be exercised if serious fungal diseases are to be avoided. Among the most common diseases of lawn grasses are the mildews, rusts, and smuts. Mildew infections look as if the grass had been dusted with a white powder and are controlled with fungicides. Rusts and smuts rarely kill thrifty, deep-rooted grass plants and can usually be controlled by fungicides;Smuts attack tender leaves forming black, powdery spore masses on curled leaves. In northern regions snow molds are a recurrent problem. The snow mold fungi attack overwintering leaves, and the results of their activity, dead circles or patches of grass, are seen when the snow melts. Unless the disease is far advanced, fungicidal treatments are effective.

REPAIR, RESTORATION AND RENOVATION

Even with reasonable maintenance. lawn repair, restoration or renovation becomes necessary. Soil compaction in traveled areas, the growth of shade trees, diseases, and neglect can individually or collectively create problems that must be corrected. These operations should be distinguished from routine maintenance.

Older lawns that show minor wear and tear can be repaired by relatively simple procedures. Chemical and hand removal of weeds is best done prior to mowing the lawn to 2.5 cm (1.0 in.). Clippings should not be added to a compose the heap, but collected and discarded. Fertilization to correct nutrient deficiencies, liming as indicated by soil tests, and accelerated maintenance techniques should be included. Repair work can be done at any time of year, but spring and fall are best.

Much has been written about the horrors of thatch buildup as a factor in lawn decline and waste of it is probably overstated. The stolon’s of lawn grasses such as the bents and Bermuda grass are horizontal stems that extend along the ground and become intertwined. As stolon’s die, they can form a thick layer of organic material that decomposes slowly, sheds water, causes soils to dry out, and harbors earwigs and other pests. True thatch is a fluffy, matted blanket of these stolon’s above the soil.

GROUND COVERS

In many situations grass lawns are neither practical nor desirable. Heavily shaded areas including those on the north sides of structures, under mature trees, and behind hedges and tall fences rarely receive enough light to allow a good lawn to develop; Areas immediately adjacent to woodlots also rarely form good lawn. Steep banks are difficult to mow, are frequently dry and infertile, and rarely can be successfully seeded because of runoff and erosion, All of these

situations are being handled by planting ground cover plants. These should not be considered as second choices or compromise plantings, many ground covers are handsome and colorful additions to the landscape (Table B-3). Contrasting textures, foliage colors, and splashes of flower color add greatly to the total view of a garden.

Most effective ground covers are herbaceous perennials or small woodyshrubs. They may trail along the ground or spread by rhizomes so that bare areas are quickly covered. Some ground covers are essentially care-free, requiring only minimal fertilizing and watering, while others need as much or more attention as lawn grasses. Because of the large number of possible ground covers, selection is based not only on prevailing environmental conditions, but also on considerations of hardiness, foliage and flower interest, and the landscaping plan.

Many low-growing perennial flowering plants can be used as ground covers, Baby's breath (Gypsophila repens) turfing daisy (Matricariatchihatchewe), some saxifrages, lily of the valley (Convaltariamajolis), and others can fill in shaded areas .For southern areas (Hardiness Zones 9 to 10), gopher apple (Geobalanusspp.), peperomia, creeping charley (Pileahummulariaefolia) inch plant (Zebrinapendula), and several species of veronica are excellent shade-tolerant ground covers. Although not usually considered as ground covers, there are herbs to suit most conditionsand locations. Included among those that are often used as ground covers are catnip, tarragon, mint, pennyroyal, burnet, germander, lovage.

Table B-2

Seeding of Planting of Lawn Areas

Latin Name	Common Name	Seeds		Plugs or Plant		Mowing Height (in)	Remarks
		Time	Rate ($lb/1000ft^2$)	Time	Rate ($lb/1000ft^2$)		
	Cool Season Grasses						
Agropyroncrictatium	Crested Wheetgrass	F	1-2	-	-	2	Dry, cool areas
Agrostiscanina	Velvet bentgrass	F	1-2	-	-	1	Humid, cool areas
A.gigantea	Redtop	F	1-2	-	-	1.5	Quick cover, short-lived.
A.stolonfera	Creeping bentgrass	F	1-2	F	1000	1	Humid, cool areas
A.tenuis	Colonial bentgrass	F/S	1-2	-	-	1	Humid, cool areas, finest lawns
Boutelouagrevilis	Blue gramagrass	S	1-2	-	-	1.5	Dry, cool areas drought resistant
Festucarubre	Red fescue	F	3-5	-	-	2	Dry, cool areas shade resistant
F.ruba	Fescue improved	F	2-4	-	-	2	Water resistant, shade tolerant
.rubahetrophylla	Chewing Fescue	F	3-5	-	-	1.5	Cool areas, shade resistant
Loliummulslorum	Annual ryegrass	F/S	4-6	-	-	2	Quick cover, short lived.
L.perenne	Perennial ryegrass	F/S	3-5	-	-	1.5	Used in mixtures with other grasses.
Poapratense	Common blue grass	F	2-3	-	-	2	Drought resistant, rough use
P. pratense	Bluegrass improved	F	1-2	F	1000	2	Most common component in mixtures.
Trifoliumrepens	White Clover	F/S	2-4	-	-	1.5	Cool areas, nitrogen fixing legume.
T.r. forma lodigense	Ladino clover	F/S	2-4	-	-	-	-
	Warm season grasses						
Buchloedactylsides	Buffalo grass	S	1-2	S	50	1.5	Drought resistant, rough use
CynodonDactylon	Bermuda grass	S	2-3	S/S	10	0.75	Southern areas, in acidic area
Emerocholaoptiroides	Centipede grass	S	2-3	S/S	10	1	Low maintenance invasive
Paspalumnotaum	Bahia grass	S	2-3	-	-	1	Humid Warm areas, coarse textures
Stenotaphrumcondatum	St. Augustine grass	-	-	S/S	30	1	Shade tolerant heat resistant
ZoysiaMatrella	Japanese zoysia	S/S	1-2	S/S	30	1	Wear resistant, yellows in summer
Z.tenuifolia	Velvet Zoysia	S/S	1-2	S/S	30	1	Fine texture, yellows in summers

Table B-3
Some Ground Cover Plants

Latin name	Common name	Mature height (cm)	Light	Soil	Flowers	Hardiness zone
Acaenamicrophella	Sheepbur	0.5	FS	N	_	7
Achillea spp.	Yarrow	30	FS	N	_	3
Aegropodium spp.	Goutweed	35	FS	N	_	4
Ajugarepens	Bugleweed	20	FS	N	+	4
Akebiaquinata	Akebia	Vine	Sh	N	_	5
Aloe spp.	Aloe	10	FS	N	+	9
Andromeda polifolia	Bog roesmary	30	FS	Wet	+	3
Arabis alpine	Rock ress	20	FS	N	+	4
Arctostaphylosspp,	Bearberry	30	FS	Wet	_	3
Arenariaverna	sandwort	8	FS	N	+	3
Armeriamaritima	Thrift	30	FS	Wet	_	3
Cerastium spp.	Snow in summer	20	Sh	N	+	3
Chamaemelumnobile	Chamomile	15	FS	N	+	4
Convallariamajalis	Lily –of-the-valley	20	Sh	N	+	3
Cornus Canadensis	Bunchberry	18	FS	Wet	+	3
Coronillavaria	Crown vetch	60	FS	N	+	4
Dichondramicrantha	Dichondra	8	Sh	N	_	9
Duchesneaindica	Indian strawberry	5	Sh	Wet	_	6
Erica carnae	Heath	25	FS	Acid	+	6
Euonymus Fortunel	Winter creeper	15	FS	Wet	_	5
Fragariachiloensis	Wild strawberry	12	FS		+	5
Galax urcreolate	Wandflower	15	Sh		+	4
Gaultheria procumbens	Wintergreen	1	Sh		+	4
Glechomahederacea	Ground ivy	2	FS		_	4
Hadera helix	English ivy	Vine	Sh		_	6
Juniperiscvs	Creeping juniper	35	FS		_	4
Liriopespicata	Lilyturf	20	FS		+	7
Mitchellarepens	Partrideberry	3	Sh		+	4
Mazusreptans	Mazus	3	Sh		+	4
Ophiopogon japonicas	Dwarf lilyturf	15	Sh		+	6
Pachysandra spp.	Pachysandra	30	Sh		_	5
Phlox subulata	Moss pink	15	FS		+	4
Phylanodiflora	Lippie	10	FS		_	6
Potentilla spp.	Cinquefoil	10	FS		+	5
Prunella vulgaris	Self-heal	5	FS		+	3
Saginasubulata	Pearlwort	10	FS		+	5
Sedum spp.	Stonecrop	10	FS		+	4
Teucriumchamaedrys	Germander	30	Sh		+	6
Thymus spp.	Thyme	4	FS		+	4
Veronica spp.	Speedwell	10	FS		+	4
Vinca minor	Periwinkle	15	Sh		+	5
Vtola spp.	violet	10	Sh		+	3

FS = full sun;Sh = partial shade; N = normal soil ;wet=can withstand wet soil; acid= requires pH