A PRACTICAL RESEARCH DIGEST FOR TURF MANAGERS

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WEED CONTROL

Weeds
Shedding Light on an Old Foe

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Weeds are opportunistic plant species that possess the ability to colonize open or thinned areas of turf quickly. Human activities and disturbances are the major means for introducing weeds. It should be no secret then, that the great majority of the 2,000 plant species considered weeds are not native to the United States.

Weeds are often grouped into broad groups according to life cycle (winter or summer annual, biennial or perennial), and morphological characteristics (monocot, dicot). Recognizing other ways of grouping weeds can help turfgrass managers devise effective management control programs.

Classification based on Carbon Fixation

Classification of weeds can also be based on their photosynthetic pathway. All plants carry on photosynthesis, the process whereby a plant captures radiant energy (light) from the sun and converts it into a usable form.

Photosynthesis is comprised of two main steps. The first is the light-dependent reaction where radiant energy is converted into biologically useful energy called ATP (adenosine triphosphate). The second, or dark (light independent), step is the storage of this energy into the chemical bonds of sugars and carbohydrates. Central to the light-independent reaction is the fixation of carbon dioxide (CO_2) known as the Calvin cycle. The cycle is a series of reactions where CO_2 is fixed. The initial step is the attachment of CO_2 to a 5-carbon compound, ribulose bisphosphate (RuBP) that quickly divides into two 3-carbon compounds. The term C3 cycle comes from the catalyzation of the 3-carbon compounds. Cool-season turfgrasses are often referred to as C3 plants.

Some plants however fix CO_2 differently. In many tropical plants, CO_2 is initially fixed to phosphoenolpyruvate (PEP) prior to entering the Calvin cycle. This additional reaction step is known as the C4 Dicarboxlic Acid Pathway. Most C4 plants are warm-season grasses. Generally speaking, C4 plants capture CO_2 more efficiently under increasing light and temperature conditions. Conversely, C3 plants capture CO_2 more efficiently under more moderate light and temperature conditions.

In 1969, Black proposed that plant-weed competition could be based on photosynthetic efficiency. Based on the efficiency of capturing CO_2, the competitive outcome between a C3 and a C4 plant is predictable. Under increasing temperature and light intensity, the more efficient capture of CO_2 (C4) would provide a competitive advantage over

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the less efficient C3 plants. The competitive outcome between C3 and C4 plants will not always result in a C4 advantage. In turf, this generalization will hold true under many high light and temperature situations.

For example, Kentucky bluegrass has a distinct disadvantage against C4 weeds like crabgrass, goosegrass and foxtail during the summertime. Under high temperatures and light intensities, Kentucky bluegrass does not capture CO_2 efficiently. The end result is less energy is produced reducing carbohydrate formation in the plant. The C4 weeds, on the other hand, are capturing CO_2 at an increasing rate under increasing temperatures and light conditions. Thus, during the summer, the C4 weeds are accumulating energy (carbohydrates) while the Kentucky bluegrass is losing energy. The opposite situation occurs in shaded environments. Kentucky bluegrass will capture CO_2 more efficiently under cooler temperatures and lower light levels than C4 weeds. Crabgrass and goosegrass are not found in high populations in shaded environments.

Control measures can be adjusted to account in the different carbon fixing mechanisms of plants. Pre-emergent herbi-

COMMON MONOCOT WEEDS OF TURF

Table 1. Description and characterization of common monocot weeds found in turf.

Common Name	Botanical Name	Photo-synthetic Apparatus	Origin
Quackgrass	*Elytrigia repens* L. Nevski	C3	Europe
Alexandergrass	*Brachiaria plantaginea* Hitchc.	C4	Central America
Smallflowered Alexandergrass	*Brachiaria subquandripara* Hitchc.	C4	Asia
Sandbur	*Cenchrus longispinusp* Fern.	C4	Central America
Yellow Nutsedge	*Cyperus esculentus* L.	C4	Europe/Native
Purple Nutsedge	*Cyperus rotundus* L.	C4	Asia
Smooth crabgrass	*Digitaria ischaemum* Schreb.	C4	Europe
Large crabgrass	*Digitaria sanguinalis* L.	C4	Europe
Blanket crabgrass	*Digitaria serotina* Mitch.	C4	Europe
Barnyardgrass	*Echinochloa crusgalli* L.	C4	Europe
Goosegrass	*Eleusine indica* L.	C4	Asia
Tall fescue	*Festuca arundinacea* Schreb.	C3	Europe
Bearded sprangletop	*Leptochloa fascicularis* Lam.	C4	Central America
Nimblewill	*Muhlenbergia schreberi* Gmel.	C4	Native
Carpetweed	*Mullugo verticillata* L.	C3 - C4	Central America
Witchgrass	*Panicum capillare* L.	C4	Native
Fall panicum	*Panicum dichotomiflorum* Michx.	C4	Native
Torpedograss	*Panicum repens* L.	C4	Europe
Dallisgrass	*Paspalum dilatatum* Pior	C4	Europe
Kikuyugrass	*Pennisetum clandestinum* Hochst.	C4	Europe
Annual bluegrass	*Poa annua* L.	C3	Europe
Giant foxtail	*Setaria faberi* Hevrm.	C4	Europe
Green foxtail	*Setaria virdis* (L.) Beauv.	C4	Europe
Smutgrass	*Sporobolus indicus* L.	C4	Central America

Photosynthetic apparatus refers to the carbon dioxide fixing pathway. Sources for some of the information in the table were obtained from: 1) Elmore, C.D. and R.N. Paul. 1983. Weed Science 31:686-692. 2) Muenscher, W.C. 1987. Weeds. Cornell University Press. Ithaca. 3) Murphy, T.R. Weeds of Southern Turfgrasses. Alabama Cooperative Extension Service, ANR 616.

COMMON DICOT WEEDS OF TURF

Table 2. Description and characterization of common dicot weeds found in turf.

Common Name	Botanical Name	Photo-Synthetic Apparatus	Origin
Common Yarrow	*Achillea millefolium* L.	C3	Native
Wild Onion	*Allium canadense* L.	C3	Native
Wild Garlic	*Allium vineale* L.	C3	Europe
Yellow Rocket	*Barbarea vulgaris* Br.	C3	Eurasia
Sheperdspurse	*Capsella bursa-pastoris* L.	C3	Europe
Mouse-ear Chickweed	*Cerastium vulgatum* L.	C3	Europe
Common Lambsquarters	*Chenopodium album* L.	C3	Eurasia
Prostrate Spurge	*Euphorbia supina* Raf.	C4	Native
Ground Ivy	*Glechoma hederacea* L.	C3	Eurasia
Hawkweed	*Hieracium pilosella* L.	C3	Europe
Pennywort	*Hydrocotyle sibthorpioides* Lam.	C3	Asia
Purple Deadnettle	*Lamium pupureum* L.	C3	Eurasia
Henbit	*Lamium amplexicaule* L.	C3	Eurasia
Mallow	*Malva neglecta* Wallr.	C3	Eurasia
Black Medic	Medicago lupulina L.	C3	Eurasia
Yellow Woodsorrel	*Oxalis stricta* L.	C3	Native
Cinquefoil	*Potentilla* spp. L.	C3	Native
Buckhorn Plantain	*Plantago lanceolata* L.	C3	Eurasia
Broadleaf Plantain	*Plantago major* L.	C3	Europe
Prostrate Knotweed	*Polygonum aviculare* L.	C3	Eurasia
Common Purslane	*Portulaca oleracea* L.	C4 - CAM*	Europe
Healall	*Prunella vulgaris* L.	C3	Native/Europe
Curly Dock	*Rumex crispus* L.	C3	Eurasia
Largeflower Pusley	*Richardia grandiflora* Steud.	C3	South America
Common Chickweed	*Stellaria media* L.	C3	Europe
Common Dandelion	*Taraxacum officinale* Weber	C3	Native/Eurasia
White Clover	*Trifolium repens* L.	C3	Europe
Puncturevine	Tribulus terresris L.	C4	Mediterranean
Speedwell	*Veronica* spp.	C3	Europe
Field Pansy	*Viola arvensis* Murr.	C3	Europe

* Crassulacean Acid Metabolic Pathway (CAM) which is often found in succulent desert plants.

cide applications targeted at C4 weeds might be reduced or eliminated in shaded conditions where the existing cool season turfgrass is well established. In hot, dry areas found along sidewalks and driveways, the rate of pre-emergent herbicide may need to be increased to account for the increased pressure of C4 weeds.

Conversely, the major weeds associated with shaded conditions are C3 weeds. If a warm season turfgrass is growing in shade, the major weed pressure will come from C3 carbon fixing weeds.

Major weeds are summarized according to their carbon fixing pathway in the accompanying tables. In determining management programs for weeds, consider the carbon-fixing pathway. Increased weed control and more efficient use of herbicides will be the outcome.

References

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