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Basic Weed Control

Russell Mathison, Senior Scientist, Agronomy

Most of us at some time in our lives have encountered a plant growing in a place where we didn't want it. By definition, this unwanted plant is a weed. We view weeds as problems for various reasons; they spoil the beauty of lawns and ornamental plantings; they reduce the enjoyment of outdoor recreation; they lower crop yields and product quality. The list can go on and on. It would be difficult to assess how much time and energy are expended annually to control weeds, but recent estimates are that over $5 billion are spent each year! In spite of the cost in time, energy or dollars, our human nature frequently compels us to remove these pests. The information in the remainder of this article may be helpful to landowners, whether homeowners or agricultural producers, in deciding precisely how to manage specific weed problems.

There are generally considered to be four principles to be used as guidelines in selecting a weed control method. The first principle is that the type of weed control used depends on the life cycle of the specific weed. Correct identification of the problem weed gives access to information about its life cycle. Plant keys, county agents and county weed inspectors are excellent resources for identifying weeds. Based on the length of their life cycle, weeds are of three types. Annuals grow from seed, mature and produce seed for the next generation in one year or less. Examples of annual weeds are crabgrass, lambsquarter and redroot pigweed. Biennials require two years to complete their life cycle. These plants grow from seed that germinates in the spring and develop heavy roots and compact rosettes or clusters of leaves the first summer. Biennials remain dormant through the winter, then in the second summer they mature, produce seed and die. Burdock and bull thistle are common biennials. Annuals and biennials should be controlled early in the growing season, not only to destroy plants of the current generation, but to prevent seed formation for the next. Plants that live more than two years and may live indefinitely are perennials. These plants may grow from seed, but many also produce underground storage structures such as bulbs, tubers, rhizomes (belowground stems) and stolons (aboveground stems) from which new plants can develop. Dandelions and quackgrass are common perennials. Weed control practices on perennials must deal with belowground storage structures as well as the aboveground portions of the plant.

The second general principle in selecting a weed control practice is to choose one suitable for the habitat of the weed and which will not harm desirable plants in the same area. For example, it would not be practical to mow quackgrass in a rock garden or to flood a lawn to kill dandelions.

Thirdly, the weed control practice chosen will depend on the size, density and age of the weed infestation. For example, a single redroot pigweed would be easily removed from a garden, but removing several thousand such weeds might require mechanical tillage, the use of a selective herbicide or both.

Lastly, the weed control practice chosed will depend on the type of equipment available and the personal preferences of the property owner. We tend to use the equipment we have and use the methods with which we are familiar, and that agree with our personal values. This is not to say that we should never consider trying a weed control method with which we are unfamiliar. Sometimes an unfamiliar method may be the most attractive alternative.

Armed with these general priniciples, we are better able to select a method to battle our specific weed problem. There are four types of weed control, which are (1) physical destruction, (2) competition, (3) biological, and (4) chemical.

Physical destruction includes such familiar methods as hand pulling, hoeing, rototilling, chopping and burning, as well as some less familiar methods like mulching, electrocution, heat sterilization and microwaving. Competition involves the selection of desirable plants that compete well with weeds for water, nutrients and light and the employment of management practices which will enable the desirable plants to crowd out the undesirable weeds. Management practices would include proper soil pH, adequate nutrients and water, correct seeding dates, seeds which germinate and grow rapidly, and selection of plants with vigorous root systems that not only compete well underground but enable rapid regrowth after cutting as well.

Biological weed control is the use of a biological agent (insect, plant disease, or animal) to control weeds. This method of weed control is currently receiving a lot of attention from agricultural researchers, both public and private, because of the increasing concern over the effects of herbicides on the environment and because of advancement in biotechnology and gene transfer. As a weed control method, biological control has some attractive advantages. It is inexpensive and control persists once established. It is selective, does not require the use of fossil fuel, and no harmful substances are introduced into the environment. There are, however, some limitations associated with biological weed control. It is a single species approach, and we have hundreds of weed species to be controlled. Biological weed control is a slow process, not an immediate control method. There is also the danger that a biological agent designed to control all plants of a given species will not differentiate between situations when a plant is considered to be a weed and when it is not.

A fourth method of weed control is the use of a herbicide, defined as a phytotoxic chemical used for killing or inhibiting the growth of a plant. Herbicides can be classified based on the time they are applied and on the way in which they act. Preplant, preemergence and postemergence herbicides are applied before desirable plants are seeded, after seeding but before emergence, and after desirable plants have emerged from the soil surface, respectively. Contact herbicides kill foliage

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Oxeye daisy can be a problem weed.

they come in contact with, systemic herbicides are absorbed through roots or foliage and translocated via the plant vascular system to attack the plant from several places (because of this feature, translocated herbicides are more effective on perennial weeds than contact herbicides). Selective herbicides kill only certain plants, where non-selective herbicides kill all plants. Soil sterilants prevent the growth of any plant when present in the soil for a period of 48 hours for some sterilants and up to two years for others.

In conclusion, the choice of a weed control method, either physical destruction, competition, biological, chemical, or a combination of any of these types, should be based on four general principles: the life cycle of the weed; where it is located; the number, size and age of the infestation; and the available equipment and personal preference of the individual land owner.

Some information for this article was taken from the "Pesticide Application Manual" developed by the Minnesota Extension Service, Bulletin 428 and from the lecture materials for the class "Principles of Weed Control" offered by the University of Minnesota, Department of Agronomy and Plant Genetics, course number 5030.

Managing Competition During Forage Establishment

David L. Rabas

Successful establishment of highly productive perennial legume or grass stands for forage involves a number of critical management decisions. The species selected must be adapted to the soil drainage, pH and fertility conditions as well as to the harvest management system. Consideration may have to be given to modifying the existing soil conditions to fit the requirements of the species selected for a given site. Seedbed preparation techniques must be selected to provide a firm uniform seedbed to insure optimum conditions for seed germination and early seedling growth. Seeding rates and seeding mixtures must be adjusted to insure adequate stands and optimum species composition are established under existing soil and climatic conditions.

Even if all the correct seeding time management decisions are made, many perennial forage stands do not establish well enough to reach maximum forage production potential. Farmers are often faced with the prospect of maintaining unproductive stands for several forage production seasons or plowing under poorly established new seedings and hoping for more success the following year. Either choice can be expensive. Reestablishment costs money and time. Poor stands result in reduced yields and are often invaded by quackgrass and other weed species.

Failure of forage seedlings to establish successfully is often associated with excessive competition from weeds and/or the companion crop during the establishment year. The slower growing forage seedling is often not able to compete successfully with faster growing weed species or small grain companion crops for light, moisture or nutrients during the critical establishment period.

Efforts to reduce seeding year competition should greatly improve the chances of successfully establishing a productive forage stand. The following management practices are suggested as methods of reducing competition to forage seedlings under various establishment situations.

Situation 1 ***The small grain companion crop is used for mature grain and straw.***

It is not practical to expect to produce maximum small grain yields and successfully establish forage seedings with small grain crops. If mature grain and straw are desired, companion crop competition can be reduced by reducing seeding rates to one half the normal rate for small grains not used as a companion crop. Planting short, stiff-strawed, earlier maturing varieties will reduce competition, avoid lodging problems and allow earlier removal of the mature grain crop.

Even if all the suggestions for reducing competition from the mature grain companion crop are followed, in many years this system of establishing perennial forages is less than successful. Competition from the small grain crop for light and moisture can be most damaging to seedling establishment when the grain crop is in the heading to mature grain stages.

Situation 2 ***Establishment of perennial forages without a companion crop.***

The main function of the companion crop during legume establishment is to control weeds. It may also be useful in reducing erosion on erodible sites. If perennial forages are established without a companion crop some other method of weed control must be provided.

Clipping or mowing is sometimes used as a method to control weeds in new forage seedings. Our experience has been that clipping is not very successful in dense fast-growing weed populations. It is not always possible to clip low enough or frequently enough to prevent excessive weed competition without injuring the forage seedling. Clipping can work well for controlling most annual broadleaf weeds if done in a timely manner and weed populations are not too dense.

Summer seedings will avoid some of the weed competition common to spring seeding dates. Summer seeding allows more time for cultivation for weed control prior to seeding. However, moisture conditions in summer are often not favorable for germination and seedling growth. Winter annual weeds can also be a problem in summer seedings.

Herbicides can be used to effectively control weeds in perennial forage crops seeded without a companion crop. Glyphosate (Roundup) at 1 to 1-1/2 pounds per acre can be used to control quackgrass in the fall prior to tillage. Preplant incorporated applications of EPTC (Eptam) at 2 to 3 pounds per acre or benefin (Balan) at 1-1/8 to 1-1/2 pounds per acre, can be used to control many broadleaf and grass weeds in forage legumes such as alfalfa, trefoil and clover species during establishment. Eptam has worked better in northern Minnesota because it provides some control of quackgrass. However, Balan does a better job of controlling pigweed. Balan and Eptam cannot be used when legumes are grown with a grass or grain companion crop. Postemergence treatment of bromoxynil (Buctril 2E) at 1/4 to 3/8 pounds per acre (alfalfa only) or 2,4-DB (Butyrac) at 1/2 to 1-1/2 pounds per acre can be used to control broad-leaved weeds in seedling alfalfa, trefoil or clover species. Sethoxydim (Poast) can be applied postemergence at 1 to 2-1/2 pints per acre with 2 pints per acre oil concentrate for annual grass control and perennial grass suppression in alfalfa.

Tall oat varieties make poor "companion crops."

2,4-D can be used to control broad-leaved weeds when grass species are seeded for forage, but not in legumes or legume-grass mixtures.

Chemical weed control for forage establishment has been very effective for many farmers. The inability to use chemicals in legume-grass forage mixture seedings and the cost of chemicals has kept many farmers from trying chemical weed control for forage establishment.

Situation 3 *Early removal of the smallgrain companion crop as hay or silage.*

Harvesting the small grain companion crop in the pre-boot to early dough stage of grain development has been an effective method of reducing companion crop competition and improving perennial forage establishment success for many farmers. Many studies have been conducted which show improved forage stands result from removing the companion crop in the heading to early dough stage. The data in the following table indicate that this system of early companion crop removal results in good hay or silage yields and fair forage quality. However, in some years even when the companion crop has been removed at the early heading stage, severe competition to the new forage seeding has already occurred and forage stands are less than optimum.

Yield and chemical composition of oat forage harvested at several stages of maturity.

Stage of maturity	Moisture at harvest, %	Protein %	Dry matter yield T/A
Boot	86.5	17.0	1.1
Headed	82.7	14.6	1.5
Early dough	72.3	12.3	2.2
Late dough	67.1	8.4	2.9
Mature seed	58.6	8.1	2.6

Research and personal observation would indicate that removing the companion crop prior to heading in the boot or pre-boot stage is more beneficial to the new forage seeding. Harvesting the companion crop prior to heading will produce a higher quality forage for livestock feed. This is especially important for the dairy producer. If the companion crop is harvested at the pre-boot stage a second harvest of quality forage consisting of regrowth from the companion crop and newly established forage plants can be taken by August 15. The combined yield of these two harvests should be nearly equal in yield to the yield of the late harvested companion crop. The higher quality of forage produced by the pre-boot and second harvest and the potential for improved forage stand establishment should make this system attractive to many farmers. Maximum yield should be achieved with early May planting dates. Late May and early June planting dates may make this system of early companion crop removal less practical.

Many farmers have a need for mature grain for livestock feed and straw for bedding. Early companion crop removal does not satisfy this need. From a management standpoint it may be more practical to raise small grain crops for mature grain and straw on a separate site and not use them as companion crops. This situation has several advantages. It allows a farmer to raise higher yielding, later maturing varieties not well suited as companion crops. Variety selection and fertilization practices can be designed to maximize grain yield without danger of injury to new forage seedings.

Weed control practices can be improved if small grains are grown in fields not underseeded to legumes. Chemicals to control problem weeds such as wild buckwheat, mustard, smartweed and thistle can be used without danger of injury to underseeded legumes. Many weed species are increasing in small grain fields where grain companion crops are used and chemical control options are limited.

Efforts to reduce companion crop competition during perennial forage establishment should provide continuing benefits in higher forage yield and quality, reduced weed problems in established forages and longer productive forage stand life.

Breeding for Shattering Resistance in Wild Rice

by Raymond A. Porter

Seed shattering is a characteristic of many wild grasses. When a plant loses its seed through shattering, it is carrying out a designed survival mechanism — the shattered seed is dispersed around the plant, producing new plants the following season. This is a disadvantage in species from which man might want seed. In domesticated cereals, non-shattering has been selected over centuries by harvesting only what remained on the plant.

Wild rice has been cultivated only since 1950. Plants expressing a "non-shattering" trait were first collected by U of M scientists in 1963. These became the source from which non-shattering varieties were later developed. The trait was found to be controlled by two complementary genes. Although seed stayed on the plant longer, permitting combine harvesting, a substantial amount of seed was still lost. In 1989 variety trials, 21 to 55% of the total amount of seed of cultivars grown in Minnesota was lost by shattering. M3, a variety known to have a high percentage of shattering, wild-type plants, lost 55% of its seed within one week after the optimal harvest date. One source of K2, the most widely grown cultivar, lost 37%. Meter, Netum, Voyager, and M1 lost 21, 27, 31, and 38% respectively. The "Bottlebrush" variety (recently developed by a Waskish grower and gaining in popularity), lost 37%.

Previous studies have indicated that the strength with which a seed is attached to a "non-shattering" plant can be increased by population improvement, using simple mass selection. By inference, one might expect improvement in this seed retention strength to result in reduced shattering. Improvements made in such a manner should be gradual but steady over a number of years while maintaining the agronomic performance of the variety and avoiding inbreeding.

But the success of any scheme for improving seed retention depends on how accurately and reliably the trait is measured, so that the true genetic potential for seed retention is used to compare plants or families of plants within a population. More specifically, the strength of seed retention decreases as the seed matures, so a fair comparison of the genetic potential for seed retention among a group of plants is only possible if the seeds are of the same maturity. If not, the later maturing plants — not necessarily the most shattering resistant ones — will be selected. Wild rice populations — even cultivars — are highly variable for many traits, including maturity. Therefore, in breeding for shattering resistance, the maturity of an individual panicle is determined according to heading date, and comparisons for seed retention are made within a given narrow range of maturity.

Under Dr. Robert Stucker, selection programs utilizing these principles were initiated in populations of several varieties and are being continued. Comparisons of these improved populations with the respective cultivars from which they came were made in variety trials discussed above. There is evidence from these comparisons that shattering is being reduced. In five improved K2 populations, shattering ranged from 20 to 25% (vs 38% in a check variety). After only one cycle of selection in an M3 population, shattering was down to 34% (vs 58% in the check).

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Wild rice breeding plots at NCES.

Quarterly Report

Robert F. Nyvall, Superintendent

The legislative session is about to begin as this is written. An issue that concerns the Station is a capital request for a combination machine storage/field laboratory to be built on the Hauser property. Currently there is no building on this property and one is sorely needed. We would hope that friends of the Experiment Station would support this request and express their support to their local legislator.

Work is scheduled to begin this spring on a greenhouse for the aspen larch project. We are also hoping to accomplish the purchase of land close to Grand Rapids that is suitable for a forest nursery.

We would like to thank Dave Rabas, Charlie Johnson, Malcolm Hanson, Tom and Jan Evensen, John Suffron, Max Fulton and Dave Radford for their generous donations to the North Central Experiment Station Research Fund.

The mild winter has been easy on our fuel bills and snow removal crew. This is very welcome, especially in days of tight budgets. Speaking of winter our beef and dairy herds are doing very well during the mild weather with less health problems than normal.

Our Dairymans Day and Beef Cow-Calf Day were well attended with good programs. Information was presented at Dairymans Day on bovine somatotropin (BST) and feeding protein to dairy cows by Dr. Brian Crooker and Dr. Donald Otterby from the Department of Animal Science in St. Paul. Beef Cow-Calf Day participants were informed on crossbreeding systems, fencing techniques, pelvic measurements and feeding the cow herd. Dr. Pete Anderson, Dr. Dale Haggard and Dr. Jay Meiske from the St. Paul Campus and Al Ringer from Brimson and Russ Boe from Duluth were the instructors.

We wish everyone a further mild winter and an early spring.

Breeding *continued from page 3*

Shattering in two Voyager populations were 20 and 30% (vs 35% for the check). M1 and Meter populations did not show much difference from their checks.

Selection in these populations is continuing, as well as improvements in methodology. Controlled crosses are being made to study the genetics of the trait(s) involved. The goal is to release a variety with minimal losses due to shattering, and one which will maintain its high level of shattering resistance. In order to achieve this goal, either cultural practices or genetic mechanisms must prevent plants growing from shattered seed from becoming prevalent in a field. As a field is allowed to reseed itself from shattered seed over several years, natural selection will erase the gains made in shattering resistance. Production practices which include fallowing may prevent this from happening. Alternatively, the possibility of incorporating a non-dormancy trait from a related species is under investigation. If dormancy were eliminated, shattered seed might be encouraged to germinate and die in the fall, permitting paddies to be sown in the spring with shattering resistant seed, thus maintaining the level of shattering resistance, or even increasing it.

Much research has been done in the past to achieve the current levels of shattering resistance, and as the research of present and future scientists builds on the foundation laid by others, more gains will be made.

NCSA Alumni News

Tom Carpenter

The North Central Alumni Association met on December 6. Tom Hopkins, Russell Lackner, Lonny Ross, Jim Dethloff, Vernon Strom and his wife and I were present.

There was discussion on the North Central Experiment Station Research Fund. We are going to try to get ten percent of the North Central School of Agriculture Alumni to pledge to Associates 1000 by July 1991 and also to obtain two $10,000 pledges from alumni. You will be hearing more from me on the Research Fund in the future.

We also started making plans for the next reunion to be held in 1991. We would like to plan a breakfast for alumni and their wives the morning after we all get partied out from the evening of fun. We are also planning bus tours of the Grand Rapids area during the tours of the farm and the college.

The Alumni Association purchased a yellow brick in the Yellow Brick Road at the Central School. We will be recognized by visitors to Grand Rapids. The inscription reads U of M, North Central School of Ag, 1925-65.

If you have any news of alumni, questions or comments, call or send them to me at the Station. I hope you all have a nice spring.

COMING EVENTS

Minnesota Wild Rice Convention .... **March 1, 2, Grand Rapids**

Visitors Day .... **Thursday, July 19**

Horticulture Night .... **Wednesday, August 29**

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DR. ROBERT F. NYVALL
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