Homeowner’s Guide to Eco-Friendly Lawncare

A video series on Techniques for reducing the amount of pesticides and fertilizers applied to the homelawn.

Summary

Every year in America millions of pounds of fertilizer and pesticides are applied to home lawns and it is a multi-billion dollar business, unfortunately they are often misused and misapplied. With a greater understanding of how these tools should be properly used and their impacts on the environment, homeowners and landscaping professionals can achieve their lawn goals safer, more efficiently, and often times cheaper. Through a series of educational videos titled “TurfTalk with Jesse & Jeff” we will provide the benefit of our educations in Turfgrass Management to the public.

Video Link

http://www.youtube.com/watch?v=tQ2JcqXpvbl
The Issue: The chemicals in question, what they do, and the problems they cause

MAJOR FUNGICIDES USED ON HOMELAWNS (JA)

1. Thiophanate-methyl

Use profile
Thiophanate-methyl (TM) is a systemic fungicide used on a variety of tree, vine, and root crops, as well as on canola and wheat. Residential homeowners may use TM on lawns and ornamentals. Methyl 2-benzimidazole carbamate (MBC) is registered as a systemic fungicide in paints in residential settings, but has no registered food uses in the US, nor import tolerances. TM formulations include dust, granular, wettable powder, water-dispersible granular, and flowable concentrate. TM may be applied with aerial, chemigation or ground equipment (broadcast, band, or soil drench); as a dip treatment for cut flowers, rose budwood, or nursery stock; and as a seed treatment for peanuts and potato pieces. Handheld equipment may be used on turf and ornamentals. The majority of the crops are treated with postemergent broadcast applications.

Source: [http://www.epa.gov/oppsrrd1/REDs/tm_red.pdf](http://www.epa.gov/oppsrrd1/REDs/tm_red.pdf)

Human health risk
TM generally has been shown to have low acute oral/dermal/inhalation toxicity (toxicity categories III/IV). TM is not an irritant to the skin and only a slight ocular irritant (toxicity category IV) and is a skin sensitizer. MBC generally has been shown to also have low acute oral/dermal/inhalation toxicity (toxicity categories III/IV). MBC is only a slight irritant to skin (toxicity category IV) and minimal to no irritation (toxicity category III) and is not a skin sensitizer. The liver and thyroid are the primary target organs of TM and MBC in several species following subchronic or chronic dietary exposure. The testes is also a known target organ of MBC. TM is classified as “likely to be carcinogenic to humans based on dose-dependent increases in liver tumors in male and female mice. MBC is classified as a possible human carcinogen based on hepatocellular tumors in female mice. Developmental toxicity based on decreased fetal body weight and increases in skeletal variations was observed in the fetuses of rabbits exposed to TM. MBC was associated with adverse reproductive effects in rats.

Source: [http://www.epa.gov/oppsrrd1/REDs/tm_red.pdf](http://www.epa.gov/oppsrrd1/REDs/tm_red.pdf)

Environmental fate
EPA’s ecological risk assessment suggests that TM dose not pose a high acute risk to terrestrial or aquatic organisms. Acute high risk levels of concern (LOCs) are not exceeded for any registered uses except for use on golf course, which may present acute risk to small animals. Golf course uses of TM also appear to generate acute concerns for endangered species.

TM is not stable or persistent in the environment, but transforms to MBC within a matter of days whether on foliage, in soil, or in water. Both photolysis and hydrolysis are important routes of degradation. MBC is persistent and mobile in the environment. Metabolism of MBC under aerobic and anaerobic conditions in both soil and water proceed at a very slow rate. Because of the rapid transformation of TM to MBC, MBC residue values were used in the TM chronic ecological risk assessment. EPA’s ecological risk assessment suggests that TM/MBC is expected to pose a chronic risk to endangered birds, mammals, aquatic animals, and aquatic plants under
most of the registered use scenarios. The acute risks to small mammals from golf course use and chronic risks to endangered species listed here are based on EPA’s screening level assessment do not constitute “may affect” findings under the ESA.

Source: http://www.epa.gov/oppsrrd1/REDs/factsheets/tm_red_fs.pdf

2. Myclobutanil

Use profile
Myclobutanil is a systemic, preventative and curative fungicide for the control of many diseases in established turf (including but not limited to residential and commercial lawns, turf, golf course fairways, greens and roughs), landscape ornamentals and nursery/greenhouse ornamentals. It is use on major turf varieties, landscape ornamentals, and backyard fruit trees and vines.

Human health risk
Myclobutanil has low acute toxicity with the exception for ocular irritation. In rat subchronic and chronic toxicity studies, the primary target organs are liver and testes. Liver effects, following subchronic exposure, include hypertrophy, hepatocellular necrosis and increased liver weight. Chronic exposure to the rat also results in hepatocellular vacuolization and additional testicular effects, which include bilateral aspermatogenesis, increased incidences of hypospermia and cellular debris in the epididymides and increased incidences of arteritis/periarteritis in the testes.

With the exception of testicular effects, subchronic and chronic exposures in the mouse result in a toxicity profile similar to the rat. The mouse, following chronic exposure, has, in addition, increased Kupffer cell pigmentation, periportal punctate vacuolation, and individual cell necrosis of the liver.

There is no evidence of carcinogenic potential in either the rat or mouse. In the subchronic dog study, there are hepatocellular hypertrophy, increased relative and absolute liver weight and increased alkaline phosphatase. In the chronic dog study, liver toxicity is similar with the addition of “ballooned” hepatocytes and increases in serum glutamic pyruvic transaminase (SGPT) and gamma glutamyl transferase (GGT).

Signs of toxicity observed in the rat 28-day dermal studies are limited to dermal irritation. There is no evidence of systemic toxicity in either study. There is no evidence of increased susceptibility in either of the developmental toxicity studies or the reproduction study. There is no concern for mutagenic activity. Myclobutanil was determined to be not carcinogenic in two acceptable animal studies. Specific information on the studies received and the nature of the
adverse effects caused by myclobutanil as well as the no-observed-adverse-effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL) from the toxicity studies are discussed in the final rule published in the Federal Register of May 10, 2000.

Source: http://www.federalregister.gov/articles/2008/03/26/E8-6205/myclobutanil-pesticide-tolerance#p-25

Environmental fate
Due to its persistence and mobility, the primary routes of dissipation are through leaching, runoff, and spray drift. There is also a potential for atmospheric transport. Myclobutanil is stable to hydrolysis and to photolysis. Myclobutanil degradation is controlled by microbial-mediated transformations. Myclobutanil was moderately persistent to persistent (DT50 > 70 days) in aerobic soils and persistent in anaerobic soils.

Myclobutanil photo-degrades with a half-life of approximately 143 days on soil, meaning, myclobutanil residues are fairly persistent. Leaching is not a significant dissipation pathway. The potential for accumulation in soil and sediment is possible due to the persistence, especially when there are multiple applications.

Source: http://nepis.epa.gov/Exe/ZyNET.exe/P10063TE.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2006+Thru+2010&Docs=&Query=734R09006%20or%20myclobutanil%20or%20environmental%20fate&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=pubnumber%22734R09006%22&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=pubnumber&IntQFieldOp=1&ExtQFieldOp=1&XmlQuery=&File=D%3A\zyfiles\Index%20Data\06thru10\Txt\00000013\P10063TE.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h|-&MaximumDocuments=10&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=pi&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

Myclobutanil Label
Myclobutanil 20EW T&O

Myclobutanil MSDS
Myclobutanil 20EW T&O

MAJOR HERBICIDES USED ON HOMELAWNS (JA)
1. 2,4-D
Use profile
2,4-D is an herbicide in the phenoxy or phenoxyacetic acid family that is used post-emergence for selective control of broadleaf weeds. 2,4-D is registered for use on a variety of food/feed sites including field, fruit, and vegetable crops. 2,4-D is also registered for use on turf, lawns, rights-of-way, aquatic sites, forestry applications, and is used as a plant growth regulator in citrus. Residents and professional applicators may use 2,4-D on home lawns.
Annual domestic 2,4-D usage is approximately 46 million pounds, with 30 million pounds (66%) used by agriculture and 16 million pounds (34%) used non-agriculture settings. In terms of pounds, total 2,4-D usage is allocated mainly to pasture/rangeland (24%), lawn by homeowners with fertilizer (12%), spring wheat (8%), winter wheat (7%), lawn/garden by lawn care operators/landscape maintenance contractors (7%), lawn by homeowners alone (without fertilizer) (6%), field corn (6%), soybeans (4%), summer fallow (3%), hay other than alfalfa (3%) and roadways (3%). Agricultural sites with at least 10% of U.S. acreage treated include spring wheat (51%), filberts (49%), sugarcane (36%), barley (36%), seed crops (29%), apples (20%), rye (16%), winter wheat (15%), cherries (15%), oats (15%), millet (15%), rice (13%), soybeans (12%) and pears (10%). For 2,4-D, rates per application and rates per year are generally less than 1.5 pounds acid equivalents per acre (lbs ae/A) and 2.0 pounds lbs ae/A, respectively. 2,4-D is used alone and is also commonly formulated with other herbicides such as dicamba, mecoprop, mecoprop-p, MCPA, and clopyralid, among many others to improve overall weed control.

Source: http://www.epa.gov/oppsrrd1/REDs/factsheets/24d_fs.htm

Human health risk
In acute studies, 2,4-D generally has low acute toxicity (Toxicity Category III or IV) via the oral, dermal and inhalation routes of exposure. 2,4-D is not a skin irritant (Toxicity Category III or IV), nor a skin sensitizer. Although the 2,4-D ester forms are not eye irritants (Toxicity Category III or IV), the acid and salt forms are considered to be severe eye irritants (Toxicity Category I).

In longer-term studies, at dose levels above the threshold of saturation for renal clearance, 2,4-D is toxic to the eye, thyroid, kidney, adrenals, and ovaries/testes. Rat lowest observed adverse effect levels (LOAELs) are based on gait abnormalities in a neurotoxicity study, skeletal abnormalities in pups in a developmental study, and decreased weight gain in a chronic toxicity study. Dogs show a LOAEL based on decreased body weight gain and decreased food consumption, and rabbits show a LOAEL based on ataxia, decreased motor activity, and abortions.

Residential handlers may be exposed to 2,4-D during and after application to home lawns, or after applications at golf courses, parks, cemeteries, and other grassy areas. Exposure may also occur to recreational swimmers while swimming in waters treated with 2,4-D for aquatic weeds. 2,4-D products are marketed for homeowner use on residential lawns and turf. 2,4-D containing products are also marketed for use by professional applicators on residential turf, golf courses, and on other turf such as recreational or commercial areas.

http://www.epa.gov/oppsrrd1/REDs/factsheets/24d_fs.htm

Environmental fate
The 1988 2,4-D Registration Standard proposed an environmental fate strategy for bridging the degradation of 2,4-D esters and 2,4-D amine salts to 2,4-D acid. The bridging data indicate esters of 2,4-D are rapidly hydrolyzed in alkaline aquatic environments, soil/water slurries, and moist soils. The 2,4-D amine salts have been shown to dissociate rapidly in water. However, 2,4-D esters may persist under sterile acidic aquatic conditions and on dry soil. These bridging data
indicate under most environmental conditions 2,4-D esters and 2,4-D amines will degrade rapidly to form 2,4-D acid.

A complete database has been assembled for 2,4-D acid. The dissipation of 2,4-D appears to be dependent on oxidative microbial-mediated mineralization, photodegradation in water, and leaching. Data indicates that 2,4-D degrades rapidly in soils (half life = 6.2 days), degrades rapidly in aerobic aquatic environments (half life = 15 days), and is relatively persistent in anaerobic aquatic environments (half life ranges from 41 to 333 days). 2,4-D esters volatilize readily, particularly in conditions of high temperatures and low humidity.

2,4-D has a low binding affinity in mineral soils and sediment. 2,4-D has been detected in groundwater at approximately 15 ppb. This is below the DWLOCs determined to be protective in the human health risk assessment for 2,4-D and is also below the maximum contaminant level (MCL) for 2,4-D set at 70 ppb by the EPA Office of Water.

Non-human toxicity
2,4-D is considered to be moderately to practically non-toxic to birds on an acute basis. The avian chronic endpoint is based on the endpoints of eggs cracked and decreased number of eggs laid. 2,4-D is classified as slightly toxic to small mammals on an acute oral basis. The mammalian chronic endpoint is based on decreased maternal body weight gain and changes in hematology.

A honey bee acute toxicity study indicated that 2,4-D is practically non-toxic to the honey bee. 2,4-D is toxic to terrestrial plants; it is more toxic to dicots than to monocots.

2,4-D acid and amine salts have been found to be practically non-toxic to freshwater or marine fish. The 2,4-D esters have been found to be highly toxic to fish. The chronic toxicity endpoint for the acid and amines salts is based on larval length and survival, and the chronic endpoint for the esters is based on fish survival.

Acute toxicity studies on 2,4-D acid and amine salts show these compounds to be slightly toxic to practically nontoxic to aquatic invertebrates. The 2,4-D esters have been found to be very highly toxic to slightly toxic to freshwater and marine invertebrates. The 2,4-D esters may be chronically toxic to freshwater and marine invertebrates. 2,4-D is toxic to aquatic plants; it is more toxic to vascular plants than to non-vascular plants.

Source: http://www.epa.gov/oppsrrd1/REDs/factsheets/24d_fs.htm

2,4-D Label
2,4-D Amine 4

2,4-D MSDS
2,4-D Amine 4

2. Glyphosate
Use profile
Glyphosate is a non-selective herbicide registered for use on many food and non-food field crops as well as non-crop areas where total vegetation control is desired. When applied at lower rates, glyphosate also is a plant growth regulator.

Glyphosate is among the most widely used pesticides by volume. It ranked eleventh among conventional pesticides used in the U.S. during 1990-91. In recent years, approximately 13 to 20 million acres were treated with 18.7 million pounds of glyphosate annually. The largest use sites include hay/pasture, soybeans and field corn.

Three salts of glyphosate are used as active ingredients in registered pesticide products. Two of these active ingredients, plus technical grade glyphosate, are contained in the 56 products that are subject to this RED.

The isopropylamine salt, an active ingredient in 53 registered products, is used as a herbicide to control broadleaf weeds and grasses in many food and non-food crops and a variety of other sites including ornamentals, lawns and turf, residential areas, greenhouses, forest plantings and industrial rights-of-way. It is formulated as a liquid, solid or pellet/tablet, and is applied using ground or aerial equipment.

Source: [http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf](http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf)

Human health risk
Exposure to workers and other applicators generally is not expected to pose undue risks, due to glyphosate's low acute toxicity. However, splashes during mixing and loading of some products can cause injury, primarily eye and skin irritation. EPA is continuing to recommend PPE, including protective eye wear, for workers using end-use products that are in Toxicity Categories I or II for eye and skin irritation. To mitigate potential risks associated with reentering treated agricultural areas, EPA is retaining the 12 hour REI set by the WPS.

Source: [http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf](http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf)

Environmental fate
Glyphosate adsorbs strongly to soil and is not expected to move vertically below the six inch soil layer; residues are expected to be immobile in soil. Glyphosate is readily degraded by soil microbes to AMPA, which is degraded to carbon dioxide. Glyphosate and AMPA are not likely to move to ground water due to their strong adsorptive characteristics. However, glyphosate does have the potential to contaminate surface waters due to its aquatic use patterns and through erosion, as it adsorbs to soil particles suspended in runoff. If glyphosate reached surface water, it would not be broken down readily by water or sunlight.

Source: [http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf](http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf)

Non-human toxicity
Glyphosate is no more than slightly toxic to birds and is practically nontoxic to fish, aquatic invertebrates and honeybees. Due to the presence of a toxic inert ingredient, some glyphosate
end-use products must be labeled, "Toxic to fish," if they may be applied directly to aquatic environments. Product labeling does not preclude off-target movement of glyphosate by drift. EPA therefore is requiring three additional terrestrial plant studies to assess potential risks to nontarget plants.

EPA does not expect that most endangered terrestrial or aquatic organisms will be affected by the registered uses of glyphosate. However, many endangered plants as well as the Houston toad (due to its habitat) may be at risk. EPA is deferring any use modifications or labeling amendments until it has published the Endangered Species Protection Plan and has given registrants guidance regarding endangered species precautionary labeling.

Source: [http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf](http://www.epa.gov/oppsrrd1/REDs/factsheets/0178fact.pdf)

**Glyphosate label**

**Roundup Original Max**

**Glyphosate MSDS**

**Roundup Original Max**

3. **Dithiopyr**

**Use profile**

Dithiopyr is a mitotic inhibitor of normal cell division of susceptible plants. The formation and function of microtubulin is inhibited. Susceptible plant roots are stunted and fail to function in the presence of dithiopyr. Plants do not grow and develop through their normal cycle of vegetative growth followed by reproduction (flowering and seed setting). Susceptible plants react to dithiopyr in such a way as to be less competitive.

Dithiopyr is used for preemergence and early postemergence selective control of crabgrass and other susceptible annual grasses and broadleaf weeds in established lawns and ornamental turf.


**Human health risk**

Potential exposure to dithiopyr may occur through the drinking water, when handling and applying the product or when entering treated areas such as residential turf and golf courses. When assessing health risks, two key factors are considered: the levels at which no health effects occur in animal testing and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers). Only uses for which the exposure is well below levels that cause no effects in animal testing are considered acceptable for registration.

Toxicology studies in laboratory animals describe potential health effects from varying levels of exposure to a chemical and identify the dose where no effects are observed. The health effects noted in animals occur at doses more than 100-times higher (and often much higher) than levels
to which humans are normally exposed when dithiopyr products are used according to label directions.

Dithiopyr induced mild but transient eye and dermal irritation in rabbits and was not a sensitizer in guinea pigs. Consequently, no statements are required on the label of the technical product.

Dithiopyr did not cause cancer in animals, was not genotoxic or teratogenic and showed no signs of neurotoxicity. The liver and kidneys were the main targets of toxicity by the oral route in mice, rats and dogs. Effects on liver weights were also seen following exposure via the dermal route in rats. There is a low level of concern for potential prenatal and postnatal toxicity associated with dithiopyr.

The risk assessment protects against these effects by ensuring that the level of human exposure is well below the lowest dose at which these effects occurred in animal tests.


Environmental fate
When dithiopyr is released into the environment, some of it can be found in soil and surface water. However, dithiopyr readily volatilizes from turf grass, is broken down by soil microbes and undergoes phototransformation in water. Thus, dithiopyr is not expected to persist in the environment. Laboratory and field studies indicate that dithiopyr is not mobile in soil. There is limited potential for leaching and groundwater contamination and runoff can occur, although the concentrations are low.

When dithiopyr is used for weed control in turf grass, there is a potential that non-target plant species on land and in water may be exposed to the chemical as a result of spray drift or runoff. Some of plant species are sensitive to the chemical and would be adversely affected. To minimize the potential exposure, strips of land between the agricultural field and the nontarget terrestrial or aquatic areas must be left unsprayed. The width of these buffer zones will be specified on the product label. Dithiopyr presents negligible risk to wild birds and mammals, bees and other arthropods. Dithiopyr poses risk to terrestrial plants and aquatic organisms like fish, amphibians and algae. The concentrations are very low in runoff and do not pose a concern for aquatic environments.


Dithiopyr label
Dimension Ultra 40WP

Dithiopyr MSDS
Dimension Ultra 40WP
1. *Imidacloprid*

**Use profile**

Imidacloprid is a systemic, chloro-nicotinyl insecticide with soil, seed and foliar uses for the control of sucking insects including rice hoppers, aphids, thrips, whiteflies, termites, turf insects, soil insects and some beetles. It is most commonly used on rice, cereal, maize, potatoes, vegetables, sugar beets, fruit, cotton, hops and turf, and is especially systemic when used as a seed or soil treatment. The chemical works by interfering with the transmission of stimuli in the insect nervous system. Specifically, it causes a blockage in a type of neuronal pathway (nicotinergic) that is more abundant in insects than in warm-blooded animals (making the chemical selectively more toxic to insects than warm-blooded animals). This blockage leads to the accumulation of acetylcholine, an important neurotransmitter, resulting in the insect's paralysis, and eventually death. It is effective on contact and via stomach action.

Imidacloprid based insecticide formulations are available as dustable powder, granular, seed dressing (flowable slurry concentrate), soluble concentrate, suspension concentrate, and wettable powder. Typical application rates range from 0.05 - 0.125 pounds/acre. These application rates are considerably lower than older, traditionally used insecticides. It can be phytotoxic if it is not used according to manufacturer's specifications, and has been shown to be compatible with fungicides when used as a seed treatment to control insect pests.


**Human health risk**

In mammals, the primary effects following acute high-dose oral exposure to imidacloprid are mortality, transient cholinergic effects (dizziness, apathy, locomotor effects, labored breathing) and transient growth retardation. Exposure to high doses may be associated with degenerative changes in the testes, thymus, bone marrow and pancreas. Cardiovascular and hematological effects have also been observed at higher doses. The primary effects of longer term, lower-dose exposure to imidacloprid are on the liver, thyroid, and body weight (reduction). Low- to mid-dose oral exposures have been associated with reproductive toxicity, developmental retardation and neurobehavioral deficits in rats and rabbits. Imidacloprid is neither carcinogenic in laboratory animals nor mutagenic in standard laboratory assays.


**Environmental Fate**

The half-life of imidacloprid in soil is 48-190 days, depending on the amount of ground cover (it breaks down faster in soils with plant ground cover than in fallow soils). Organic material aging may also affect the breakdown rate of imidacloprid. Plots treated with cow manure and allowed to age before sowing showed longer persistence of imidacloprid in soils than in plots where the manure was more recently applied, and not allowed to age. Imidacloprid is degraded stepwise to the primary metabolite 6-chloronicotinic acid, which eventually breaks down into carbon dioxide. There is generally not a high risk of groundwater contamination with imidacloprid if
used as directed. The chemical is moderately soluble, and has moderate binding affinity to organic materials in soils. However, there is a potential for the compound to move through sensitive soil types including porous, gravelly, or cobbly soils, depending on irrigation practices.

Source: http://pmep.cce.cornell.edu/profiles/extoxnet/haloxyfop-methylparathion/imidacloprid-ext.html

Imidacloprid label
Merit 2.5G

Imidacloprid MSDS
Merit 2.5G

COMMON FERTILIZERS (JS)

1. Nitrogen

Nitrogen is the most required mineral nutrient for all plants, grass being no exception. Nitrogen is required by several biological molecules required for both photosynthesis and growth. These two prior facts can be extremely dangerous when not properly understood. One of the most common mistakes made when maintaining a home lawn is the over application of nitrogen with the assumption more is better. The traditional rule of thumb inside the turf management community has been, keep you grass on the hungry side, it’s much easier to simply apply a little more nitrogen when needed than to deal with the consequences of applying too much. When over applied nitrogen can cause:

- The grass to grow too quickly, requiring more mowing,
- Roots to develop improperly, making maintain the grass more difficult
- Increased disease and pest incidence, requiring more pesticides
- Poor tolerance to environmental stress such as heat, cold, rain, drought, or traffic, causing the overall quality to decline
- And chemical burns, which can permanently kill the grass

One of the most important factors concerning nitrogen in relation to plant availability is the soil. Nitrogen can only be taken up by plants in two forms nitrate NO3-, and ammonium NH4+, these vary in availability depending upon characteristics of the soil. Cation exchange capacity or CEC is the overall ability of the soil to hold the mineral nutrients required by plants. The acidity of the soil or pH also affects the availability of the nutrients to the roots of the plant; nitrogen is more available at low pH. Clay like soils tend to have a very high CEC but a very low pH, sandy soils on the other hand have a very low CEC but high pH. Knowing your soil greatly aids maintaining a healthy well balanced lawn. The CEC of soils can be improved by adding organic matter such as manure. Grass has an added advantage here because it produces thatch, or a buildup of old decaying grass leaves, over time grass will naturally increase the organic matter in a soil. Acidity fluctuates more than CEC but can be controlled with lime CaCO3 and sulfur containing compounds such as ammonium sulfate which is a good source of nitrogen for basic soils. Lime raises the pH of soils and sulfur reduces it. Soils be tested every few years in order to refine a fertility regiment for a lawn. Home tests can be purchased or a more in depth analysis
can be provided by sending a soils sample to a testing facility. These tests can be worth their weight in gold.

Another factor affecting nitrogen requirement is the species of grass growing. Some species require very high fertility while other require none at all. It is extremely important to know your grass before applying an fertilizer. Along with the type of grass grown, the amount of sunlight which it receives can affect the need for nitrogen. In general grass in a shaded area needs half the amount of all inputs because there is half the amount of grass growing there. Shaded areas are even more sensitive to over fertilization and should always be kept on the lean side.

Nitrogen is present in many form in the environment, applying fertilizer alter the balance of nature. However, when applied properly fertilizers are taken up by plants and not leached into the environment. When fertilizers are over applied problems can develop. The greatest environmental risk with nitrogen is contamination of the water table. Build ups can interfere with natural flora and fauna altering the ecosystem.

http://webs.wichita.edu/mschneegurt/biol103/lecture07/soil_pyramid.gif
http://www.ncagr.gov/cyber/kidswrld/plant/soiltest.htm
http://www.extension.org/pages/13064/soil-ph-modification

2. Phosphorous
Phosphorous and potassium are the next most important nutrients, after nitrogen, for healthy grass. Most high quality fertilizers will contain these along with the nitrogen, on a fertilizer there should be three numbers in the for of xx-xx-xx, these numbers will represent the percentage of nitrogen, phosphorous, and potassium respectively.

Phosphorous is used by the plant in the same manner that it is used by all living organisms, as an energy carrier. The standard “energy currency” in all beings is ATP or adenosine triphosphate, this molecule is used to store and transfer energy throughout the organism and to power the biological mechanisms which make life possible. Symptoms of phosphorous deficiency include, narrowed leaf blades, stunted growth and the plants develop a reddish color. The minimal level of phosphorous needed is 30 pounds per acre. A soil test as mentioned before can provide you with an estimate of the amount of phosphorous in the soil, if it is below this rate fertilizer can be added, if it is above the necessary amount no action is needed. One way to maintain nitrogen levels within the soil is to leave clippings on the grass after it is cut. The clippings contain up to 0.5% phosphorous and can provide all the needed phosphorous after the initial fertilization.

Phosphorous is fairly stable in the soil and should not readily leach into the water table but if excess phosphorous is applied ecological problems can arise. The phosphorous cycle. Along with nitrogen phosphorus can be very damaging to water quality, algal blooms, depleted oxygen levels, and a decline in wildlife have all be observed as effects of phosphorus pollution. Eutrophication is the name given to the process when a body of water receives excess nutrients and a boom in the pollution of one plant species take place. These booms can further lower biodiversity by out competing other plants and animals and wiping out less aggressive species.
3. **Potassium**

Potassium is the second most necessary nutrient in the plant. It is used for regulation of osmotic pressure within cells along with regulating and catalyzing many other biological actions. Potassium will not improve growth but will improve overall health and the ability to recover from heat, cold, drought, and traffic stresses. Potassium does not cause any major ecological or environmental issues; it is a fairly safe and stable compound when compared to nitrogen or phosphorous. The biggest risk associated with over application is a decline the health of grass, for this reason potassium should be applied at low rates throughout the course of the year as opposed to a single heavy application.

II Reducing the Problem (JA)

1. **Integrated Pest Management**

IPM as defined by the EPA:

“Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.”

The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, organic food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-tiered approach. The four steps include:

1. **Set Action Thresholds**
   Before taking any pest control action, IPM first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. Sighting a single pest does not always mean control is needed. The level at which pests will either become an economic threat is critical to guide future pest control decisions.

2. **Monitor and Identify Pests**
   Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so
that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

3. Prevention
As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to prevent pests from becoming a threat. In an agricultural crop, this may mean using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

4. Control
Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk. Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.

With respect to Control, there are three components:

Cultural
Cultural control involves good turf management!! Sound irrigation, mowing, and fertilization practices increases turf vigor, pest tolerance, and recovering ability of the turf when damaged. Thatch management is key, as it is a prime habitat for many insect pests and fungi that cause foliar diseases. Choosing the right grass species for your lawn is also key. Many species are resistant to many of the important pests, so choose wisely. Information about resistant grass species can be found at The Turfgrass Information Center's website.

Biological
There are three biological control methods: conservation, classical, and augmentative or inundative. Conservation involves using control agents that have a reduced impact on beneficial organisms. You should use pesticides only when necessary. Classical biological control is the introductions of natural enemies to suppress and accidentallyt introduced pest. It can be very effective, but there has been little success in the turfgrass niche. Augmentative control involves the application of large quantities of natural enemies to suppress unwanted organisms for quick control. It is analogous to a pesticide application. It is very safe, but at the same time can also be so specific of a control, that it may not be economically efficient to implement.
Chemical
Chemical control in an IPM program usually involves many of the same pesticides used in a conventional program, however the emphasis is on using the least toxic chemicals available, and this is only after it is deemed that cultural or biological control methods may not be feasible. There are two types of chemical control: preventative and curative. Preventative applications of a pesticide are made before an infestation is recognized, to help ensure that the problems will not get too large. In IPM programs, this should be restricted to high-risk areas only (areas where problems repeatedly occur). Curative control applications are made after a pest has been recognized in order to have timely control of the matter.

Useful links for additional information on homeowner IPM programs:

- EPA Integrated Pest Management Page
- The Concept of IPM
- Low-Maintenance Landscaping
- "Greenscaping for Homeowners"
- "Greenscaping: The easier way to a greener, healthier yard"
- "Citizen's Guide to Pest Control and Pesticide Safety"
- "Healthy Lawn, Healthy Environment"
- IPM Strategies for Important Turf Diseases

***There is however one flaw to a turfgrass/homelawn IPM program: in turfgrass there are no real action/economic thresholds; turfgrass is viewed aesthetically rather than economically. So it is difficult to develop such thresholds with respect to turfgrass and homelawns.***

III Alternative solutions (JS)

Full organic
Organic lawn care is an option for those willing to put in the time and effort who wish to do right by nature. Be forewarned that an organic lawn can be much more labor intensive than traditional methods. No pesticides are applied when under a full organic system. Weeds are controlled by hand picking which can be very time consuming based upon the size and composition of one's lawn. Fertilizers are limited to those produced by nature, usually animal and plant wastes. Manure is the standard for organic fertilizer however some commercial products such as milorganite which is produced from the solid wastes of Milwaukee are available.

Plant Selection
One of the most key aspects of reducing pollution and improving environmental friendliness of a lawn is the proper plant selection. Grasses fall into the main categories, cool season and warm season. Cool season grasses perform best in cooler climates and can tolerate cold winters. Warm season grasses thrive in the subtropics and warmer areas of the country, these grasses cannot survive cold winters. Different grasses will have varying fertility requirements, disease issues, color, heights and characteristics. Unfortunately there is no simple way to choose a grass for one's lawn, it depends on the situation but this decision can be aided by using the link above.
You should do a thorough investigation before seeding or sodding any lawn to make sure that an appropriate grass is selected.

**Zero Maintenance**

Zero maintenance lawns refer to those which need no maintaining besides occasional mowing. Buffalo grass, centipede grass, and Zoysia are the ideal choices for zero or low maintenance lawns. These grasses can persist under adverse conditions and may even be harmed by over maintenance. Another option is synthetic turf, which although has never matched natural grass in quality and appearance is available on the market. The only maintenance required for synthetic turf is the occasional cleaning.


**The Service Project: Education through Videos**

**Overview (JS)**

The average homeowner or landscape professional has limited knowledge of proper lawn maintenance. As a result of this chemical are often over applied to correct problems that did not exist or did not have to exist. As turf grass management majors at Rutgers we want to let the public benefit from our years of education. To do this we have created a series of videos to educate homeowners on some of the more common mistakes made when taking care of grass. The videos will cover the information provided in the classepedia above but in a more interactive format. To reach an audience the videos will be posted on the most popular lawn care forums on the web:


**Video links: (JA)**

- TurfTalk with Jesse and Jeff, Episode I: Pesticides
- TurfTalk with Jesse and Jeff, Episode II: Fertilizers
- TurfTalk with Jesse and Jeff, Episode III: IPM
- TurfTalk with Jesse and Jeff, Episode IV: Organics

These videos should provide the uninformed homeowner with the resources and understanding of how to reduce the amount of chemicals applied to their lawn while still increasing the quality and aesthetic appeal of the lawn. Pesticides and fertilizers applied to lawns interfere with the environment, the most effective way to convince people to reduce the amount of chemicals is to show how to maintain the same quality with less applications and therefore less expense. We hope that people will take this information and apply it to their lives to help improve the health of our environment. For those interested in further education in lawn care there are many lawn care classes available from the New Jersey Agricultural Extension service found here:

[http://www.cpe.rutgers.edu/](http://www.cpe.rutgers.edu/)