Cooperative Extension
Colorado State University, Fort Collins, Colorado 80523

Colorado State University

AGRON-O-GRAM

Volume 11, Number 10 October 1991

TABLE OF CONTENTS

WATER QUALITY

The Role of Soil in Groundwater Protection

One key to protecting groundwater is understanding the role of soil in removing contaminants. Contaminants such as pesticides reach groundwater by moving with percolating water through soil pores. Daily human activities would rapidly pollute groundwater if the soil did not cleanse it of most contaminants. Some contaminants become adsorbed to soil particles, while others are broken down by soil microorganisms into harmless materials.

Different types of soils vary greatly in their ability to bind and break down contaminants. Likewise, contaminants differ in their ability to persist and leach in the soil environment. Other factors such as climate, irrigation, amount of potential contaminant, and soil and crop management also affect the soil's ability to remove contaminants.

Soil Properties Affecting Groundwater Protection

Soil Texture: Texture influences the porosity as well as the chemical activity of a soil. Silt and sand particles are not very active chemically and contribute little to the ability of the soil to adsorb contaminants, whereas clay is responsible for much of the chemical activity in soils. Sandy soils contain large pores, hold little water and allows excess water to drain rapidly. The combination of low chemical activity and rapid water movement through sandy soils makes them more vulnerable to leaching contaminants than finer-textured soils. Predominantly silt or clay soils have mostly small pores that do not readily allow water to drain. The risk of groundwater contamination is much less in these soils. They must be managed carefully, however, to prevent runoff and surface water contamination.

Structure: Structure is important because it increases the number of large pores in a soil. In fine-textured soils, structure is essential for infiltration of water. Good soil structure, soil cracks and animal burrows may lead to the deeper leaching of some contaminants, resulting in an increased risk to groundwater. In general, however, good soil structure is desirable because it increases soil aeration, improves productivity, and reduces runoff.

Organic Matter: Organic matter plays an important role by helping to bind soil particles into aggregates. Organic matter is similar to clay as it is chemically active. It is especially effective at binding many pesticides, and plays a key role in keeping contaminants out of groundwater. Increasing the amount of organic matter in a soil can reduce the risk of pesticide leaching.

Soil Depth: To protect groundwater, we need to know the depth of soil that provides contaminant removal. Once a contaminant leaches below the A-horizon, microbial activity is significantly reduced. Contaminants, therefore, tend to persist much longer in the subsoil, increasing the threat to groundwater. High water table also effectively limit soil depth. When shallow soils are underlain by loose sand or gravel, very little binding or microbial breakdown of contaminants occurs in the sand or gravel. In addition, leaching is rapid, making groundwater vulnerable to pollution.

Management Tools

Site-specific soil information is needed to make management decisions on selecting chemicals that will have the least impact on groundwater. Soil survey reports can be used to supplement site-specific information, and when broader information is needed over a larger land area. In general, avoid using highly leachable pesticides in areas made up of vulnerable soils. Choose and use pesticides carefully, and plan pest management to reduce overall pesticide use.

The Soil Conservation Service (SCS) has recently completed the development of a database called WATPEST which can be used to make management decisions on pesticide selection in Colorado. Watpest is an R:Base application that consults two data files to develop a soil-pesticide interaction rating. These ratings are relative, not absolute, but they should be useful for pesticide selection on vulnerable soils. Soil data for each county in Colorado and a database that ranks all labelled pesticides for surface loss potential and leaching potential are available on floppy disks for use with this program. SCS Area and District Conservationists throughout the state should now have this program and can provide further information for those who are interested.

In order to protect groundwater, we must take into account many environmental, site, and management factors. Soil is a key factor because different soil types have quite different abilities to remove contaminants. Also, soil is often the last line of defense against groundwater contamination. By fitting agricultural and waste management practices to the properties and limitations of soils, we can help protect our groundwater resources. □Waskom

(Adapted from Clean Water for Washington, by C.F. Engle, et al.)

THE NEW LEAD STANDARD

On June 7, 1991, the Federal Register reported a new lead standard of 0.015 mg/l for public water supplies. This is a reduction from the current standards of lead not to exceed 0.05 mg/l. The new lead level will go into effect on December 7, 1992. If lead levels exceed .015 mg/l more than 10% of the time, public suppliers are required to treat the water, reducing lead to safe levels prior to delivery. There is still the possibility that lead could contaminate water through household plumbing either by lead pipes or lead solder. The Environmental Protection Agency (EPA) hopes that individuals using private wells for domestic water adhere to the new regulations; however, the water quality from private wells is difficult to regulate. The decision to assess water quality of private wells will have to be determined by the owner. The goal of the EPA is to achieve lead levels of zero. Further investigations must be done, however, to assess whether water suppliers can effectively remove lead economically to achieve zero lead levels. □Self

FALL AND WINTER FERTILIZER APPLICATION

Fall and winter fertilization is an important management tool in many production programs. Fall and winter fertilization programs should be based on sound agronomic, economic, and environmental considerations. Fertilization during this time makes agronomic, economic, and environmental sense.

Advantages of a Fall-Winter Fertilization Program

Beat the weather: Take advantage of warm, clear fall days. Fall weather is more predictable than spring weather.

Reduce soil compaction: In fall and winter, soils are usually dry enough to withstand field equipment weight without compacting soils. When soil is compacted, moisture infiltration, aeration, and nutrient uptake is reduced resulting in less plant growth.

Nutrient storage: Fall or plowdown applications of fertilizer place nutrients in a moist, active root zone. Surface broadcast applications in spring then incorporated tend to concentrate nutrients in the top few inches of soil. This may lead to reduced uptake in summer, when topsoil moisture is usually short. Nutrients concentrated in the soil surface encourage shallow rooting of plants, increasing the chances for drought stress.

Availability of fertilizer supplies: Fertilizer supplies are more readily available because of off-season schedules. This allows extra time for soil sampling and consulting with company personnel.

There is a concern that fall nitrogen fertilization increases nitrate nitrogen leaching and denitrification in high rainfall areas. Other nutrients such as phosphorous (P), potassium (K) or zinc (Zn) do not move significantly by leaching. Nitrogen fertilizer application on very sandy soils must be delayed to avoid leaching. Spring applied nitrogen on winter wheat is still advised on sandy soils. A nitrogen sidedress or through-the-irrigation system application coupled with spring applied nitrogen is possibly the most efficient method of applying nitrogen to row crops such as corn.

Excessive rainfall or irrigation on fine textured soils can lead to denitrification. When this occurs, nitrate is converted to gaseous forms of nitrogen and is lost to the atmosphere. The odds of significant N leaching through the soil profile in dryland winter areas with water are small. Anhydrous ammonia is recommended for preplant fall application, since all N in the ammonia form is resistant to leaching.

Nutrients such as P, K, and Zn are relatively immobile in soils and uptake efficiency and response is highest when these nutrients are placed in the root zone. By applying fertilizer P and K before any fall tillage, through incorporation into the root zone is assured. If the primary tillage operation is performed in the fall and fertilizer application delayed until the spring, shallower secondary spring tillage operations may leave much of the applied P and K in the surface layer of the soils. Fertilizer remaining in the dry surface soil during the growing season will not be taken up by plants.

Phosphorous and K can be safely applied on fields without incorporation. Phosphorous and potassium bond tightly to soil particles and will move only if soil erosion occurs. Avoid surface applications on fields with steep and/or long slopes where little or no crop residue is present.

Fall Forage Fertilization

Fall P and K applications are well suited to alfalfa production. Fall applications help

ensure better winter survival and longer-lasting stands. Also, since the first and second cuttings are generally the best in terms of quality and tonnage, fall P and K applications ensure that the nutrients are in place during the critical early season growth period. Alfalfa places a heavy demand on the soil for adequate P and K. About 10 lb of P_2O_5 and 50 lb of K_2O are removed in each ton of production. □Follett

QUICK TEST KITS FOR NITRATES - PITFALLS

Recently, we evaluated Hach and Spectrum Technologies' quick test kits for nitrates.

Weight vs Volume

Both kits determine nitrates on a soil volume basis: one volume of soil and one volume of extracting solution are mixed and filtered and results are reported in mg per liter of soil (ppm). Some kits determine nitrates on a soil weight basis and report results in mg per kilogram of soil (ppm). Colorado State University Soil Testing Laboratory (CSUSTL) reports results on a weight basis and results are reported as ppm. In order to compare test kit results with those of the CSUSTL, make sure the results are on the same basis. To change the mg of nitrate nitrogen per liter of soil (ppm on a volume basis) to mg per kg (ppm on a weight basis), divide mg/L by the soil bulk density:

$$\frac{(mg\ NO_3\text{-}N/L)}{kg/L(soil\ bulk\ density)} = mg\ NO_3\text{-}N/kg$$

The soil bulk density can be determined by dividing the weight of soil (grams) in the soil scoop by its volume in cubic centimeters (cc). Bulk density expressed in g/cc has the same numerical value as in kg/L.

Calcareous vs Acid Soils

The Spectrum Technologies' kit uses a nitrate electrode (Cardy meter) for the NO_3-N test. This kit was developed for the eastern United States having acid soils. Use of the acid extracting solution for calcareous soils resulted in dissolution of calcium carbonates and excessive interference from bicarbonate ions. This kit overestimated the nitrate nitrogen values in calcareous soils of Colorado. We are in the process of modifying the procedures so that valid nitrate nitrogen values can be obtained with this kit.

For water samples with significant amounts of bicarbonate, a drop of an acid with appropriate strength will cause change of bicarbonate to carbon dioxide and will eliminate bicarbonate interference.

Use of strong acids (pH 0-2) or strong bases (pH 12-14) will damage the sensor on the meter.

Conclusion

Make sure the results are expressed on a weight basis before you compare results of a test kit with those of the CSU Soil Testing Laboratory. For soil samples with a bulk density of one, the results are the same for weight or volume basis. For sandy soils, the differences could be significant.

Before using a kit, make sure the procedure is valid for soil and water samples taken from western states. □Soltanpour

SEED GROWERS NEWS

The Colorado Seed Growers and the Colorado Seedsmens Associations will hold their joint convention on December 5-7 at the Estes Park Holiday Inn Convention Center. The convention consists of committee meetings, annual business meetings and an educational program. The educational session, held Friday, December 6, will be presented by scientists from Colorado State University and others. Some topics are discussions on Russian Wheat Aphids, jointed goatgrass, Colorado weather & solar cells. An attorney will talk on important points to consider when owning your own business.

The main assemblies of the two organizations will deliberate points such as field standards for jointed goatgrass, approved conditioner status for out of state processors, the proposed state seed law, a change in the bulk sales certificates and revision of the Seed Growers Association by-laws.

All members of the two organizations are urged to attend. Extension Agents, potential seed growers and other interested parties are welcome. Registration forms will be sent in late October, or they can be obtained from the Colorado Seed Growers Association office at 303/491-6202.

After the convention, activities for the 1992 certification season will begin. In early January, you will receive the "Declaration of Certifiable Fields" form. This yellow form is sent to all 1990 and 1991 growers of fall planted crops and to buyers of fall planted foundation seed. It is used to get preliminary information about potential certified fields. Any potential grower who does not receive a copy can call the Colorado Seed Growers office. Copies of this form have been sent to most county extension offices. Additional forms are available from the Colorado Seed Growers' office.

During January, the 1992 applications for approved conditioner status will be sent. All conditioners considering cleaning certifiable seed in the next year should apply. Seed is not certifiable if it is cleaned by a conditioner who has not been approved. These applications are available at our office. □Stanelle

TRITICALE HAS REAL POTENTIAL AS A FEEDGRAIN IN COLORADO

Triticale, a cross of wheat and rye originated in Sweden prior to 1900. Triticale remained little known until about 20 years ago when plant breeders developed spring-type triticales. Planted in the spring, triticale matured during the summer heat and yields were poor because of low seed set and seed shriveling. The spring-types had enough winter hardiness to perform as a fall-planted grain some years in Colorado. Unfortunately, some seed was sold on the basis of yields obtained in the favorable years but those marketing the seed failed to mention poor yields when winter injury is severe. This gave triticale a bad name. Recently research conducted in Poland, Nebraska, Kansas, and Texas resulted in improved varieties having high yield potential and improved winter hardiness. Universities and private breeders developed many new acceptable varieties.

Data from variety trials comparing wheat, triticale and barley during the last five years indicate that triticale from the new varieties yield similar to winter wheat while some varieties are more winter hardy than others. Triticale is better than barley in winter hardiness and is damaged less by Russian Wheat Aphids than barley or wheat. During 1990, the Nebraska triticale variety Newcale showed excellent winter hardiness and yield. Presto proved to be superior to other varieties of triticale, wheat and barley where winter injury was less severe. The variety

Lasko having excellent yields declined in performance where winter injury was severe. During 1991, Presto triticale yielded highest of all grains when averages were calculated over four locations.

Table 1. Triticale, wheat and barley varieties from 4 locations in eastern Colorado during 1991.

	Yield Lb/A	Test Wt Lb	Plant Ht In	Winter Survival %
PRESTO	2639	52	37	74
LAMAR	2369	59	34	99
NEWCALE	2332	49	36	85
TAM 107	2230	57	27	99
WESKAN	1751	44	23	24
LASKO	1643	47	36	33
PERKINS	1474	46	25	14
SCHUYLER	1194	41	22	17

Yield, test weight, and plant height are average of 4 locations.
Winter survival is average of 3 locations.

Triticale seeds are somewhat shriveled when compared to wheat. The variety Presto had an average bushel weight of 52 pounds when compared to Lamar wheat having a bushel weight of 59 pounds. The crude protein content of triticale is better than wheat and much better than corn or barley. Because of the amino acid balance of triticale, it is an excellent feed for hogs or poultry.

Because triticale plants look more like rye than wheat, people become frightened and they immediately become concerned about a volunteer problem similar to rye. Fortunately, triticale will volunteer similar to wheat. Volunteer triticale is taller than wheat and mixtures are easy to see and identify. Triticale is popular as a forage in areas where winter wheat is pastured. Considerable triticale is grown for pasture in Texas.

It is estimated that Poland produces 1.2 million acres of triticale and 1.8 million acres are grown in the rest of the world. One hundred twenty thousand acres are grown in the U.S. annually. A limited acreage is grown in Colorado for pasture, silage, or green chop. At present, certified seed supplies are limited. Commercial forage-type varieties are available from private seed companies in Texas.

The certified variety Newcale, was released in 1989 by the University of Nebraska, and seed is available. Limited quantities of seed for the Polish variety Lasko, released by Colorado State University, is now available. Larger quantities of Lasko will be available after the 1992 harvest. The variety Presto has excellent performance. However, plans for an official release are not complete. This fall, feedgrain experiments of triticale, wheat and barley were again planted at Akron, Burlington, Ovid, Sheridan Lake, Strasburg, and Willard. At the Strasburg site, plots were split, half for grain harvest and the other half for forage. This site is sponsored Adams, Morgan, and Weld county Extension offices and they will request cooperation from CSU animal scientists.

Grain from triticale is superior to winter barley. The forage potential appears to be considerably better than wheat. Some varieties are awnless and could be superior for late season hay production. □Echols

Where trade names are used, no discrimination is intended, and no endorsement by the Cooperative Extension Service is implied.

CONTRIBUTING AUTHORS

Echols, James W.,
Extension Agronomist - Crops,
Colorado State University
Follett, R. Hunter,
Extension Agronomist - Soils,
Colorado State University
Self, James R., Manager, Colorado State University Soil Testing Laboratory,
Colorado State University
Stanelle, James R., Manager,
Colorado Seed Growers Association,
Colorado State University
Waskom, Reagan M.,
Extension Agronomist - Water Quality,
Colorado State University

Sincerely,

Robert L Croissant

Robert L. Croissant
Editor
Extension Agronomist - Crops