



CCA ADVANTAGE

*The Voice of the Certified Crop Adviser Program
American Society of Agronomy
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CCAs Important to New EPA Livestock Program

By Gordon Carlson

Certified Crop Advisers (CCA) should be preparing to help livestock producers implement nutrient management plans. Although the new concentrated animal feeding operation (CAFO) rule applies mostly to large animal feeding operations, any sized operation can come under the CAFO rule if it is designated a significant source of pollution.

Roberta Parry, who works in the EPA's Office of Water and who helped develop the regulations, says CCAs are going to play "a very important role in helping CAFO producers they work with develop and implement nutrient management plans." Most CAFO operators probably will not write their own plans, she adds, so CCAs, working with other professionals as needed, "will be vital to ensure the quality of the plans." CCAs also can educate producers to help them understand and conform to the requirements of the rule.

The CAFO rule, developed under the Clean Water Act (CWA), became effective April 14.

Categories Covered

Three categories of animal feeding operations are covered under the rule:

1. operations with 1,000 beef cows, heifers or veal calves; 700 dairy cows; 2,500 hogs over 55 pounds; 10,000 hogs under 55 pounds; 125,000 broilers,

2. medium-sized CAFOs that discharge directly into surface waters or through a manmade device

3. any size CAFO that is deemed a pollution source.

EPA expects that 15,000 CAFOs will be covered by the rules, or about 6 percent of all animal feeding operations.

Parry says most states implement their own water programs. In four states, EPA implements directly all CWA regulations. The states develop regulations that must be as stringent as the federal rules, although the state regulations can be and often are more stringent. EPA has an oversight role.

Since EPA published the CAFO rule in December 2002, EPA staff have made many presentations around the country on the rule. Also, EPA's Web site (<http://cfpub.epa.gov/npdes/afocafofinalrule.cfm>) has brochures in English and Spanish to help producers understand if they are covered by the rule.

State-Specific

Although the federal regulation requires that the nutrient management plans minimize movement of nitrogen and phosphorus to surface waters, the state-developed technical standards will vary depending on state-specific conditions.

"Some producers may not be affected by the new CAFO rule if their state has regulations that are already as stringent as the federal rules," says Parry.

Four agriculture organizations (American Farm Bureau Federation, National Chicken Council, National Turkey Federation, National Pork Producers Council) and four environmental organizations (Natural Resources Defense Council, Sierra Club, Waterkeeper Alliance, American Littoral Society) are suing EPA over various elements of the CAFO rule.

The CAFO rule does not require certified specialists to develop or review the nutrient management plan. The CAFO operator must meet the performance standards. "It is probably in the CAFO operators' best interest to make sure that they hire well-qualified personnel to help them meet the standards," Parry says.

Certification Encouraged

USDA's Natural Resources Conservation Service (NRCS) is playing a role in getting CAFO operators to implement nutrient management plans. The 2002 Farm Law expanded available assistance funds and introduced the technical service provider (TSP) as a source of technical assistance for producers. CCAs have been urged to become certified so they can be paid for their services by NRCS. For information on TSP certification, go to <http://techreg.usda.gov/>.

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State Focus: Texas

Texas Professionalism and Pride

By Gordon Carlson

In the six months that Donnie Dippel has been the Texas state agent for the Certified Crop Advisers (CCA) Program, he's become impressed with the dedication of the state's CCAs to their professional accomplishments and their pride in their work.

"I believe our members perceive their accomplishments with the same pride that I take in their work," he says. "Our members work hard to achieve certification and are dedicated enough to achieve recertification" when necessary.

As with other state CCA Programs, Texas requires CCAs to complete 40 Continuing Education Units (CEU) every two years. A CEU is defined as 50 minutes of quality contact time in training or other qualifying activity that meets the performance objectives.

The Texas CCA Program offers "as many CEU programs as possible," says Dippel. "We notify members where programs are being offered through our Web page (www.txcca.net) and try to approve programs as quickly as possible so they can be advertised as CCA approved."

CEUs are classified in four ways:

1. At least half (20) of the total CEUs must be board-approved prior to or within 30 days after the event is held.
2. Those Texas CCAs that also hold a valid Texas Department of Agriculture commercial or private applicator license automatically earn 10 CEUs in IPM for each two-year CEU cycle.
3. There are self-reported education opportunities that must meet similar qualifications as board-approved events but the only difference is that self-

reported have not been board-approved and are reported by the CCA.

4. There are also self-study CEU opportunities that are similar to distance education events and these are all board approved. A CCA can earn up to 20 in a two-year cycle. An exam is required for all self-study CEUs.

Getting Industry Involved

Dippel hopes to get industry more involved in the program. "We also are working with the Texas Extension Service to try to get more of their agents doing CCA programs and getting more of their agents to become certified agents," he says.

The Texas CCA Program in the past worked with chemical and fertilizer companies to get their personnel certified, and now that effort has to be undertaken again, Dippel says. "We need to interest them again in getting this done," he says. "It makes them look good, when their salespeople can go to a



Donnie Dippel, CCA
Texas CCA Agent

farmer with a certification" from the CCA Program.

The Texas CCA Program also offers education programs at seminars, independently and at conventions, and crop inspection tours are held to provide education about new or innovative inputs.

New Web Site

"At this time, the Texas program is similar to most programs in other states," Dippel says, "but we hope that in the future, CCAs will be kept more informed through further development of our Web page."

He keeps in touch with the 427 Texas CCAs through written correspondence and the Web page, which has just been launched and still is in the development stages.

Donnie Dippel, CCA, comes to his position as Texas CCA agent with an impressive background in related careers. He was the assistant commissioner for pesticide programs for the state from 1996, before which he was the deputy assistant commissioner. As assistant commissioner, he became intimately involved with the U.S. EPA. The Texas Department of Agriculture has a cooperative agreement with EPA to enforce the rules under the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA). He worked with pesticide registration, endangered species and risk assessment and toxicology.

On Jan. 1 he started CHB Consulting, Inc., and now manages the Texas Ag Industries Association in addition to his CCA duties. He also runs a small cattle operation.

He earned his bachelor's degree in agriculture education in 1973 from Sam Houston State University in Huntsville, TX, and an associate degree from Blinn College in Brenham, TX, prior to that. From 1973 to 1988 he managed a farm service center and was a licensed commercial pesticide applicator.



ICCA Board Comments

Local CCAs — Do You Consider Them to Be Friends or Foes?

By John Harapiak, Canadian Regional Representative to the ICCA Board

If there are a number of Certified Crop Advisers (CCAs) working in your area, either advising growers or involved in crop scouting, how do you view their presence? Do you see them as a threat or as competitors that should be shunned? Or do you see them as fellow professionals with whom you can associate for mutual benefit, as well as for your growers' benefit?

I'd suggest you stand to gain a lot more in terms of potential agronomic benefits if you select the second alternative.

The agronomic support landscape has been changing quite rapidly. As a result, the researchers that conduct practical, agronomic field trials are becoming less available to help solve problems that arise in fields. As well, the well-seasoned government extension agronomists who were usually readily available to help interpret the new research information are becoming fewer and less accessible.

Under these circumstances, it has been my observation that your fellow CCA professionals can be powerful allies in helping keep each other informed about new developments and for helping you sharpen your agronomic skill sets. For example, if you are on the lookout for an annual outbreak of a given pest, as part of a larger group of eyes and ears, you are likely to become aware of developing problems at a much earlier stage.

The key is getting everyone in your network of agronomists committed to alerting each other about such potential developments. As a result, you can be much better informed networking than if you work on your own.

The Network

I have personally observed the effectiveness of CCAs working in a network of fellow agronomists. Usually such a group is composed of a diverse set of people, with important background differences. Invariably some of these individuals are more informed about some aspect of potential soil or cropping problems than you are, and, your particular skill sets also help to make them more effective in their respective jobs.

Ideas for Success

These are some of the practical initiatives that can be undertaken with your fellow agronomists:

1. Organize a half-day or full-day field tour in which as many members of the group as possible demonstrate how they have dealt with, or have been unable to solve, a weed, insect, disease or fertility problem. You may be surprised by the ideas that are put forward by group members.
2. Organize a tour of some of the top growers that members of your group are dealing with. You may be surprised at how much you can learn by discussing farming practices with top producers.
3. Consider organizing a mini-tour with your local herbicide rep so that, as a CCA group, you can offer opinions on the performance of the herbicides. It will also give the rep an opportunity to discuss new products. Chemical companies like to get feedback on arising pest control issues, particularly from experienced field agronomists.

4. Is a particular crop production issue plaguing your group? Why not organize a training session, in the field or the classroom, to deal with it? It will be much easier to attract specialists to your meeting if they know they will be sharing their skills and knowledge with a larger group.
5. Do you feel that some of the CEU-granting events are not providing the agronomic information you need? As a group, consider inviting an expert to speak on the specific issue that is locally important. And don't forget to apply for CEU credits for this event.
6. Alert your fellow agronomists when you see the first signs of an outbreak of disease or insects. Out of professional courtesy, they should return the favor.
7. Never publicly criticize the work of your fellow CCA. It will only serve to damage your profession. If you have questions or concerns, offer to meet for coffee to discuss this issue.

Growing Your Skills

By networking with your local fellow CCA members, you can help gain greater awareness and respect from within your local region. Furthermore, you will find that sharing agronomic problems and challenges can be an effective means of growing your agronomic skill sets.

It has been my experience that agronomic knowledge and expertise progresses much more rapidly when it is shared and discussed with like-minded professional agronomists. Any attempts to keep new agronomic information secret only stifle its advancement.



Continuing Education Self-Study Course

Soil & Water Management



Effect of Roundup Ultra on Microbial Activity and Biomass from Selected Soils

Earn one CEU!

All CCAs may earn up to 20 Continuing Education Units (CEUs) per two-year cycle as board-approved self-study articles which will include CCA Advantage articles. The CCA CEU logo (above) marks all pre-approved material, with the CEU value indicated by the number in the middle. To receive one CEU in soil and water management, read this article, fill out the attached exam and mail the tear-out form, along with \$10, to the American Society of Agronomy.

By R. L. Haney, S. A. Senseman,
and F. M. Hons

The escalating increasing use of Roundup-tolerant crops has increased concerns regarding the potential environmental impact of glyphosate. Roundup Ultra (RU) is a nonselective, foliar-applied herbicide used to control weeds preplant or postemergence in tolerant crops or by using shielded sprayers in nontolerant crops. The active ingredient of RU is glyphosate, or more accurately the isopropylamine salt of glyphosate, which inhibits production of 5-enolpyruvylshikimate-3-phosphate synthase, resulting in death of susceptible plants by depleting essential aromatic amino acids needed for plant survival.

Glyphosate is readily adsorbed by clay minerals and hydrous oxides. The K_d values have been reported to range from 33 to 660 L kg⁻¹. Glyphosate adsorption correlates with the amount of vacant phosphate sorption sites and may occur through binding of the phosphonic acid moiety. Glyphosate is microbially degrad-

ed in soil and water and has a reported field half-life of 47 days and a laboratory half-life of <25 days. However, it is not known what effect the product-grade RU (which includes surfactant and other inert products) has on indigenous microbial populations and activities across a range of soils varying in fertility.

Although glyphosate is not intentionally soil applied, a significant concentration of material may reach the soil surface during broadcasted preplant or early-season applications. The amount of herbicide available to soil microorganisms depends on various factors, including available nutrients, pH, temperature, and moisture, though they differ in importance depending on the pesticide involved. Soil water and temperature directly affect many biological processes, including plant metabolism and microbial degradation, and thereby influence bioactivity and persistence of the chemicals.

In our previous work, we found that increasing rates of RU resulted in linear responses of C and N mineralization while no response was observed in soil microbial biomass (SMB) C and N when incubated at 25°C. Soil microbial biomass C and N were determined 14 days after addition of RU instead of 3 days, allowing more time for RU-derived C and N to be incorporated into microbial cells.

Since heterotrophic soil microorganisms acquire C and N for maintenance and growth by decomposing plant residues and other organic materials in soils, herbicides with low C to N ratios (<15) may potentially be readily mineralized, with N that is in excess of microbial demand being released in the inorganic form. A study in 1999 showed evidence of unculturable microorganisms when

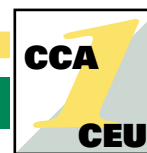
exposed to glyphosate. We chose C and N mineralization and soil microbial biomass C and N as indicators of microbial activity since these methods are usually sensitive to low C to N ratio substrates and allow for a more realistic study of the effect of RU on field soils since most laboratory studies use analytical glyphosate, which farmers do not use.

The objective of this study was to determine whether RU application that reaches the soil has a detrimental or favorable effect on the microbial biomass and activities as measured by C and N mineralization or SMB from soils covering a wide array of soil characteristics.

Nine soils from Georgia and Texas were used in this study. The soils varied in soil pH (4.7 to 8.2), soil organic C (4.1 to 52.3 g C kg⁻¹ soil) and clay content (6 percent to 45 percent) (Table 1). Land management of these soils ranged from row crop production to permanent pasture. The isopropylamine salt of Roundup as RU (480 g active ingredient L⁻¹) was added to soil at a rate of 234 mg kg⁻¹. This amount was based on the recommended rate of RU being 0.84 kg ha⁻¹ and a shallow 2-mm soil interaction depth due to glyphosate's high adsorptivity and low leachability. A control treatment with no RU was included for each soil; therefore, comparison with RU additions to each soil would measure the positive or negative influences on microbial biomass and activity for each soil.

Carbon Mineralization

Soil samples were initially dried at 40°C for 24 hours to ensure homogeneity of soil moisture content. Samples were subsequently wetted and preincubated for 7 days and incubated at 30°C prior to RU



addition. Wetting amounts are calculated using the 90% of clay content technique. For example, if a soil contains 10% clay then $10\% \times 0.9 = 9$ mL water per 100 g soil; if only 50 g are used, then 4.5 mL water is added to the soil sample. The 7-day incubation period before RU addition allowed microbial respiration to reach a baseline level after the initial flush of activity from soil drying and rewetting.

A study in 1996 showed that dried and rewetted soils exhibited similar microbial biomass and activities as continuously moist samples after an incubation period of 5 to 10 days. RU was added in 5 mL of distilled water to soil samples, increasing the final moisture content to 20% w/w (approximately 60% water filled pore space). Soils were placed in gas-tight 1-L glass containers along with a vial containing 10 mL of 1 M KOH to trap evolved CO_2 and a vial of water to maintain humidity. Soils were incubated at 30°C with KOH traps replaced daily until 7 days and then at days 14, 24, 28 and 50. Unreacted alkali in the KOH traps was titrated with 1 M HCl to determine $\text{CO}_2\text{-C}$.

Nitrogen Mineralization

Nitrogen mineralization was determined by subtracting the initial inorganic N con-

centration of nonincubated soil samples from soil N extracted after 50 days of incubation. Inorganic N was extracted from 7-g soil subsamples using 28 mL of 2 M KCl. Samples were shaken for 30 minutes on a reciprocating shaker and filtered, and the extracts were analyzed for $\text{NH}_4\text{-N}$ and $\text{NO}_2\text{-}$ plus $\text{NO}_3\text{-N}$ using an autoanalyzer. The sum of the above N forms was designated inorganic N.

Soil Microbial Biomass Carbon and Nitrogen

Soil microbial biomass C (SMBC) and N (SMBN) were determined 14 days after RU addition for each soil. SMB C was determined by fumigation-incubation by exposing 40 g of soil to alcohol-free CHCl_3 vapor for 24 hours. Following evacuation and vapor removal, soil was incubated in 1-L gas-tight glass containers for 10 days at 30°C. Carbon dioxide evolved during the 10-day incubation period following fumigation was trapped in 1 M KOH and determined as described previously. The quantity of evolved $\text{CO}_2\text{-C}$ was divided by an efficiency factor of 0.41 to estimate microbial biomass C.

SMB N was determined by analyzing soil $\text{NH}_4\text{-N}$ concentrations of fumigated samples following the 10-day incubation

period minus initial $\text{NH}_4\text{-N}$ prior to fumigation, divided by an efficiency factor of 0.41.

Clay Content, Soil Organic Carbon, and pH

Soil pH was estimated with 2:1 water to soil. Clay content was determined by the hydrometer method and soil organic C from the modified Mebius method.

Statistical Analysis

All treatments were replicated three times. Analysis of variance was used for generation of means and for determination of standard error terms. Linear regression was used to assess relationships among variables. Model adequacy was based on residual plot analysis. Treatment means within each incubation interval were separated using Tukey's test at the 5 percent level of significance.

Results and Discussion

The first day after RU addition, C mineralization for all soils was significantly different from the control. The 30°C incubation temperature appeared to enhance microbial activity and resulted in no apparent lag phase after RU addition when compared with a similar study using Weswood soil, and conducted at 25°C.

TABLE 1. CHARACTERISTICS OF SOILS.

Location	Series	Texture†	USDA soil classification	Soil pH (water)	Clay content %	Organic C gkg^{-1}	Depth of sampling cm	Land management‡
Waynesboro, GA	Lakeland	S	thermic, coated Typic Quartzipsamment	4.7	10.1	5.9	30-60	cropped (cotton, soybean)
Watkinsville, GA	Cecil	SL	fine, kaolinitic, thermic Typic Kanhapludult	4.8	12.8	15.0	0-15	pasture (bermudagrass)
Amarillo, TX	Pullman	SCL	fine, mixed, superactive, thermic Torrertic Paleustoll	5.7	28.7	11.6	0-7.5	cropped (sorghum, wheat)
Overton, TX	Bowie	fSL	fine-loamy, siliceous, semiactive, thermic Plinthic Paleudult	6.3	6.0	4.1	0-7.5	pasture (bermudagrass)
Stephenville, TX	Windthorst	fSL	fine, mixed, thermic Udic Paleustalf	6.4	13.0	18.3	0-7.5	pasture (bermudagrass)
Watkinsville, GA	Pacolet	SCL	fine, kaolinitic, thermic Typic Kanhapludult	6.6	26.9	52.3	0-5	pasture (tall fescue)
Malone, TX	Houston Black	C	very-fine, smectitic, thermic Oxyaquic Hapludert	7.8	45.0	13.7	0-10	cropped (sorghum, wheat)
College Station, TX	Weswood	SiCL	fine-silty, mixed, superactive, thermic Udifluventic Ustochrept	8.0	28.4	23.7	0-7.5	pasture (bermudagrass)
Weslaco, TX	Hidalgo	SCL	fine-loamy, mixed, hyperthermic Typic Calcicustoll	8.2	22.3	9.8	0-7.5	cropped (cotton, corn)

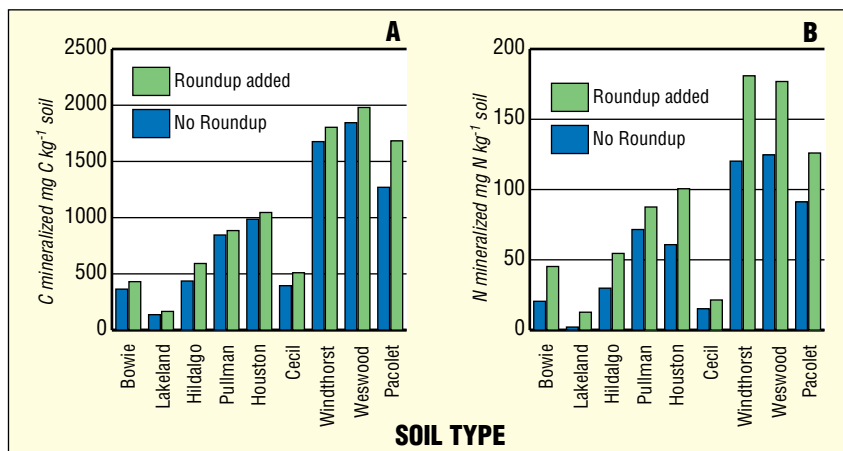
† S, sand; SL, sandy loam; SCL, sandy clay loam; fSL, fine sandy loam; C, clay; SiCL, silty clay loam.

‡ Cotton, *Gossypium hirsutum* L.; soybean, *Glycine max* (L.) Merr.; bermudagrass, *Cynodon dactylon* (L.) Pers.; sorghum, *Sorghum bicolor* (L.) Moench; wheat, *Triticum aestivum* L.; tall fescue, *Festuca arundinacea* Schreb.; corn, *Zea mays* L.

The stimulation of soil microbial activity appeared to be unique to each soil, as soils lower in clay content and soil organic C tended to reach their peak mineralization rate a few days later than the soils with higher clay and organic matter content. Carbon mineralization rates for the higher organic C soils tended to peak earlier and then dropped significantly in contrast to the lower organic C soils that may have first had to increase their microbial biomass in response to an easily mineralizable substrate. The flush of C mineralization was greater in the higher organic C soils possibly due to a greater population of microbial biomass, which mineralized the added substrate more quickly. Of the nine soils tested, two reached their peak on Day 2, five by Day 3, one on Day 4, and one on Day 5. By Day 7, only the Lakeland soil had yet to release more C as CO₂ than was added as RU. By the 14th day of incubation, however, all soils had evolved more C as CO₂ than was added as RU.

Soils differed greatly in organic C content (Table 1). Some soils responded similarly to RU addition at the end of 7 days while others did not. These data showed that generally as soil organic carbon (SOC) increased, C mineralization did also; however, when SOC, soil pH, and clay content are regressed with the flush in CO₂ (the difference between RU and no RU after 14 days) the relationships were poor. Therefore, SOC, soil pH, and clay content do not necessarily indicate how rapidly RU will be mineralized in a given soil.

Fourteen days after RU addition, all soils returned to background CO₂ levels. SMB C and SMBN were determined at this time, as the added RU had apparently been completely mineralized. Five of the nine soils showed significant increases in SMBC with RU addition. However, all nine soils exhibited significantly increased SMBN with RU addition. RU addition to soil appeared to affect the microbial N content to a greater extent than microbial C, thereby effectively lowering the microbial biomass C to N ratio and releasing N to the soil. The average increase in SMBC due to the addition of RU was 17% compared with 76% for SMBN. This result may indicate an enhanced ability to min-



eralize N that is in excess of microbial demand from RU degradation.

After 50 days of incubation following RU addition, five of the nine soils tested had significantly greater C mineralization and eight showed significantly greater N mineralization (charts A and B). The average increase for all soils for C mineralization due to RU addition was 18% compared with 108% for N mineralization. After 50 days of incubation all soils had released more C above the control than was added by RU. RU appeared to be readily mineralized regardless of soil type, clay content, pH or soil organic C content.

The literature suggests that the methods for SMBC and SMBN usually do not separate differences between herbicide treatments. In our study, SMBC was highly correlated to SMBN with and without RU addition. Carbon and N mineralized were also highly correlated. The slopes of the regression were reduced by roughly three with the addition of RU. Since the C to N ratio of the isopropylamine of glyphosate is 3:1, these data support the hypothesis that the addition of isopropylamine of glyphosate in RU was directly responsible for the increase in SMBC, SMBN, and C and N mineralization. These results support earlier work done on Weswood soil.

SMBC was estimated on the 14th day after addition of RU and was highly related to the amount of C mineralized at both 7 and 14 days. The relationships were not as strong on Day 7 as on Day 14, which may indicate that soil microbial respiration is coupled to the size of the population when substrate is not limiting. In both

instances, RU addition increased C mineralized per unit of microbial biomass.

Summary

RU was readily mineralized by indigenous soil microbes and increased their population and activity. Soils with higher organic matter tended to mineralize RU more quickly initially than soils with lower organic C, possibly due to a greater microbial biomass. Soils with less organic C tended to mineralize RU at a slower rate, while their microbial biomass increased in response to the added substrate. Soil organic C, soil pH and clay content do not necessarily indicate a soil's ability to mineralize RU. Available N may have been more limiting than substrate C in the studied soils as RU application significantly increased SMBN in all soils, but increased SMBC in only five soils. The amount of C mineralized was more highly correlated to SMBC at 14 days after addition of RU than at 7 days. Since the method for SMBC was estimated at 14 days, it appeared that activity was coupled to microbial population when substrate was not limiting. These data suggest that RU actually enhances microbial activity and biomass and does not adversely affect the soil microbial community.

Editor's note: Content was adapted from the paper "Effect of Roundup Ultra on Microbial Activity and Biomass from Selected Soils," which was published in J. Environ. Qual. 2002 31, and is courtesy of the authors R. L. Haney, S. A. Senseman, and F. M. Hons.



Get a CEU!

This exam is worth 1 CEU in **Soil and Water management**. An exam score of 70% or higher will earn CEU credit. The International CCA program has approved self-study CEUs for 20 of the 40 CEUs required in the two-year cycle.

DIRECTIONS

1. Read the self-study article on pages 44-46 carefully.
2. Answer the questions by clearly marking an "X" in the box next to the best answer for each question.
3. Complete the self-study exam registration form on the back of this page.
4. Clip out this self-study examination page, fold and place in envelope.
5. Enclose a check for \$10.00 made payable to the American Society of Agronomy, for processing fees. Payment in U.S. funds only.
6. **Mail your self-study exam and fee to:**
ASA c/o CCA Self-Study Exam, 677 S. Segoe Road, Madison, WI 53711 *Please allow 60 days for processing.*
7. An electronic version of this test is also available at www.AgProfessional.com. Go to the Certified Crop Advisers section (lefthand column) and access the "CCA Advantage" link.

Effect of Roundup Ultra on Microbial Activity and Biomass from Selected Soils

September Self-Study Examination

1. Roundup Ultra is a herbicide that is:
 - a. selective and subsoil-applied.
 - b. nonselective and subsoil-applied.
 - c. selective and foliar-applied.
 - d. nonselective and applied postemergence.
2. Glyphosphate has a reported field half-life of:
 - a. 27 days.
 - b. 37 days.
 - c. 47 days.
 - d. 57 days.
3. Many biological processes are directly affected by water and:
 - a. soil pH.
 - b. nutrients.
 - c. temperature.
 - d. all of the above.
4. As indicators of microbial activity, this study chose to use:
 - a. C and N mineralization and soil microbial biomass (SMB).
 - b. leaching rates.
 - c. nitrification rates and soil microbial biomass (SMB).
 - d. SMB accumulation.
5. Study soils were dried at 40° C for 24 hours to ensure:
 - a. homogeneous microbial activity.
 - b. homogeneity of soil moisture content.
 - c. even texture.
 - d. homogeneous structure.
6. Final moisture content of the study soils was:
 - a. 5% w/w.
 - b. 10% w/w.
 - c. 15% w/w.
 - d. 20% w/w.
7. SMB nitrogen was determined by:
 - a. $(\text{NH}_4\text{-N}_{\text{after 10 days}} - \text{NH}_4\text{-N}_{\text{initial}}) / 0.41$.
 - b. $(\text{NH}_4\text{-N}_{\text{after 10 days}} - \text{NH}_4\text{-N}_{\text{initial}}) \times 0.41$.
 - c. $(\text{NH}_4\text{-N}_{\text{after 10 days}} - \text{NH}_4\text{-N}_{\text{initial}}) - 0.41$.
 - d. $(\text{NH}_4\text{-N}_{\text{after 10 days}} - \text{NH}_4\text{-N}_{\text{initial}}) + 0.41$.
8. All treatments were replicated:
 - a. two times.
 - b. three times.
 - c. four times.
 - d. five times.

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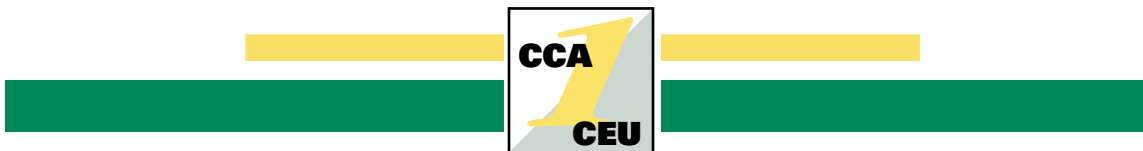
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Continuing Education Self-Study Test

Soil and Water Management Test (continued)



9. Soil organic C, soil pH and clay content:
- a. indicate a soil's ability to mineralize Roundup Ultra.
 - b. do not necessarily indicate a soil's ability to mineralize Roundup Ultra.
 - c. define a microbial environment.
 - d. were homogeneous in the nine soils studied.
10. These data suggest that Roundup Ultra:
- a. does not adversely affect soil microbial communities.
 - b. adversely affects soil microbial communities.
 - c. slows microbial activity and biomass accumulation.
 - d. kills indigenous soil microbes.



SELF-STUDY EXAM REGISTRATION FORM

Name: _____

Address: _____

City: _____ State/Province: _____ Zip: _____

CCA Certification #: _____

Credit Card #: _____ Type of Card: Visa Mastercard Discovery Am Express

Expiration Date _____ Name on Card: _____

A \$2 processing fee will be added to all credit card charges, or enclose \$10 check payable to American Society of Agronomy.

X

Signature of Registrant as it appears on Code of Ethics _____

I certify that I alone completed this self-study course and recognize that an ethics violation may revoke my CCA status.

This exam issued September 2003 expires September 2006.

SELF-STUDY EXAM EVALUATION FORM

Rating Scale: 1=Poor 5=Excellent

Information presented will be useful in my daily crop advising activities: 1 2 3 4 5

Information was organized and logical: 1 2 3 4 5

Graphics/tables were appropriate and enhanced my learning: 1 2 3 4 5

I was stimulated to think how to use and apply the information presented: 1 2 3 4 5

This article addressed the stated competency area and performance objective(s): 1 2 3 4 5

Briefly explain any "1" ratings: _____

Topics you would like to see addressed in future self-study materials: _____

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