What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS

WHAT'S CROPPING UP? -- A NEWSLETTER FOR THE 1990's

Bill Cox
Soil, Crop and Atmospheric Sciences

The 1990s promise to be the decade of change for the production of field crops in the USA and New York.

Current issues in agriculture such as groundwater quality, sustainable agriculture, biotechnology, global warming, integrated pest management (IPM), Geographic Information Systems (GIS), rotational grazing systems, the 1990 Farm Bill, the Conservation Reserve Program (CRP), etc. will impact field crop production in New York in the 1990s. To disseminate timely information on these and other topics in production agriculture, the Field Crop and Soils group at Cornell have created the newsletter, entitled *What's Cropping Up?*. The newsletter will feature topics on field crop production, soils, and other agricultural issues as it relates to agricultural profitability and environmental concerns in New York. Field crop production practices to be discussed regularly include crop rotation schemes, tillage practices, variety selection, planting techniques, soil fertility management, and pest management practices. Agricultural issues to be discussed include Low Input Sustainable Agriculture (LISA), non-point source contamination of ground and surface waters, application of municipal and industrial sludge on agricultural lands, the use of GIS for soil interpretation and land use planning, soil conservation, the wetlands issues, and many more.

What's Cropping Up? will be the third ongoing publication series from the Field Crops and Soils group at Cornell University. The *Field Crops and Soils Handbook*, revised every five years, is a resource reference for the production of field crops as it relates to the soils and climates of New York. *Cornell Recommends*, an annual publication, presents the most recent recommendations for field crop production in New York based on applied research results at Cornell. *What's Cropping Up?*, to be published bimonthly, will present timely topics and issues that are important to field crop production in New York. Regular contributors to *What's Cropping Up?* will include Gary Bergstrom on field crop diseases, Elson Shields on insect pest management, Russ Hahn on weed control, Shaw Reid and Stu Klausner on soil fertility management, Harold van Es on soil management, Bill Waltman on Geographic Information Systems applications and soil interpretation, Steve DeGloria on Geographic Information Systems and land use planning, Jack Martin on the use of municipal, industrial, and animal waste on agricultural lands, Bill Pardee on new crop varieties, Jerry Cherney on forage production, Bill Cox on corn and small grain production, Madison Wright on soybean production, and Jane Mt. Pleasant and Bob Lucey on cropping systems for New York.

Field crop production practices will change in the 1990s because of advances in technology, environmental concerns, consumer preference, and government regulations. *What's Cropping Up?* will provide timely and in-depth information on these and other factors that will influence field crop production practices in New York. We hope you enjoy this complementary copy of *What's Cropping Up?*. You can subscribe to *What's Cropping Up?* and receive six issues per year for an annual fee of $8.00 by completing the subscription form on the back page of this copy.

WEED CONTROL

Triazine-Resistant Biotypes of Common Weeds Plague New York Corn Growers

Russ Hahn
Soil, Crop and Atmospheric Sciences

Although the occurrence of triazine-resistant biotypes of common lambsquarters and smooth pigweed in New York State was confirmed more than 10 years ago, these weeds continue to cause problems. Triazine-resistant strains of common groundsel and common ragweed are now being reported in central and western New York. The failure to recognize these triazine-resistant biotypes and/or the failure to make appropriate changes in weed control practices are responsible for the spread of these weeds.

Herbicide Resistance

Herbicide resistance occurs when weeds that are normally easy to control with a herbicide or group of herbicides are no longer controlled with those herbicides. Triazine resistant strains are usually not different in appearance from susceptible strains. The resistant strains are not considered to be genetic mutations but strains which occurred in the original populations (before use of triazine herbicides) in low numbers compared to the dominant susceptible strains. However, with repeated and often exclusive use of triazine herbicides during the past 25 years, the susceptible strains were controlled while the resistant ones increased in number until they dominated the population in certain fields.

Although triazine-resistant weed populations develop slowly, a population explosion of the resistant biotypes toward the end of this process often catches corn growers off-guard. This is especially true when triazine resistance is confused with a general lack of herbicide performance in years when rainfall is not adequate for proper activation of preemergence herbicides. If poor weed control is weather related, a variety of different weeds should be present in the field. On the other hand, a failure that results from triazine resistance is usually characterized by the presence of only one type of weed - the one that is resistant!

EFFECTIVENESS OF SELECTED CORN HERBICIDES ON TRIAZINE-RESISTANT STRAINS OF BROADLEAF ANNUAL WEEDS

Herbicides	Common Groundsel	Common Lambsquarters	Smooth Pigweed	Common Ragweed
Preemergence				
Dual	Fair	Poor	Good	Poor
*Lasso	Fair	Fair	Good	Poor
Prowl	Poor	Good	Fair	Poor
Postemergence				
Banvel	Poor	Good	Good	Good
Basagran	Good	Fair	Poor	Fair
*Buctril	Good	Good	Poor	Fair
Prowl	Poor	Exel	Fair	None

* Restricted-use pesticide

Control Programs

Triazine resistance is considered absolute because increased application rates are not effective. In addition, there is cross-resistance among the triazine herbicides. As a result, resistant populations that developed with repeated atrazine use will not be controlled with Bladex, Princep, or with the alfalfa and soybean herbicide Lexone/Sencor.

Effective control programs for triazine-resistant weeds employ crop rotations which alter cultural and weed control practices, cultivation, and herbicide combinations that include other types of herbicides along with, or in place of, the triazine herbicides. The effectiveness of corn herbicides that might be used to control triazine-resistant strains of common groundsel, common lambsquarters, smooth pigweed, and common ragweed are summarized in the above table.

Based on the history of triazine resistance in other areas, it is expected that the triazine-resistant strains of groundsel, lambsquarters, pigweed, and ragweed will continue to spread. It is also expected that triazine resistance will be confirmed for other species. Once triazine-resistant weeds have been identified in a field, the supply of dormant seed will dictate the continued use of alternate control programs for many years.

Sustainable Agriculture: Research and Extension in Field Crops

CROP MANAGEMENT

Jane Mt. Pleasant
Soil, Crop and Atmospheric Sciences

The USDA program known as LISA (Low-Input/Sustainable Agriculture) is designed to help farmers substitute management, scientific information, and on-farm resources for some of the purchased inputs they currently use. The primary goal of the LISA program is to enable growers to farm profitably while conserving and protecting the resource base.

Cornell has received funding through LISA for a cooperative research and extension project with scientists from USDA, Rodale Research Center and Pennsylvania State University. Cornell researchers participate in field experiments that are aimed at finding ways to reduce fertilizer and pesticide use in corn-based cropping systems. Since farmer involvement is an important component of LISA, the project also includes on-farm trials at several sites in the State.

Many people believe that the LISA program represents a radical departure from conventional crop production practices. Quite the contrary. Sustainable-input cropping systems are based on sound agronomic practices well known to both researchers and farmers. For New York field crop production, these include:

Crop Rotations

Rotations represent the foundation of successful sustainable systems. They provide many benefits such as: 1) nitrogen contributions; 2) improved soil tilth and structure; 3) decreased pest infestations; 4) reduced soil erosion; and 5) increased diversification.

Nutrient Management

Fertility management in low-input systems begins with regular soil testing and the use of Cornell soil-test recommendations for fertilizer application. Cornell fertilizer recommendations include credit for nutrient contributions from animal and green manures. On many NY dairy farms, for example, there is little need for large amounts of sidedressed N in corn because of regular manure applications and the use of forage legumes in the rotation. This approach to nutrient management reduces fertilizer costs, limits contamination of ground and surface waters, and ensures productive crop yields.

Integrated Pest Management

By using an array of management tools, farmers can decrease their reliance on pesticides. Cultural practices such as timely planting, resistant varieties, and appropriate fertilization result in vigorous crops that are less susceptible to disease and insect attack. Growers may also reduce pesticide applications by using threshold levels rather than calendar dates as criteria for application. For weed control, cultivation can substitute, at least in part, for herbicides. In row-crops, banded herbicide application in combination with cultivation provides effective weed control while substantially reducing herbicide use.

Reduced Tillage

Reduced tillage systems increase surface residue, providing soil cover and reducing soil movement. But most reduced tillage systems also require additional herbicides to control weeds. Ridge till is a reduced tillage system that relies on a vigorous cultivation to form the ridge. This cultivation also controls weeds, allowing a reduction in herbicide use.

Interseeding and Cover Crops

Seeding crops such as red clover, ryegrass and winter rye in corn when it is 12-24 inches tall provide substantial benefits to the cropping system. These interseedings add organic matter to the soil, provide soil cover, and recycle nutrients that might otherwise be lost. Cover crops such as winter rye, planted after corn harvest perform similar functions adding organic matter and providing soil cover. Interseedings and cover crops may also reduce weeds by limiting fall invasions.

Record Management

Managing cropping systems to reduce inputs while maintaining productivity is a complex job. A complete record of soil-test results, planting and harvest dates, varieties, pest identification, fertilizer and pesticide rates, application dates, and crop yields on a field basis is a powerful tool for improving productivity and decreasing costs.

Many farmers are already using many of these practices. Land Grant institutions like Cornell have been developing and extending to farmers information on soil testing, manure management and integrated pest management for many years. Our current research and extension program in the area of low-input sustainable agriculture builds on this foundation of productive and environmentally sound agricultural practices.

SEED & VARIETIES

Seed, the High Value Input

Bill Pardee
Plant Breeding

Improved seed will soon be the high value input in crop production. So say research directors of several major crop supply companies. And they're backing this view with millions in research dollars. The seeds of tomorrow, they tell me, will carry bred-in resistance to many pests that we now spray to control. Biological seed coatings will enhance seedling growth, even provide life-long pest resistance to plants. And biotechnology will develop crops for new uses, (industrial as well as agricultural), provide diagnostic probes for ailing plants, and quicken the pace of plant breeding.

Much of this will come by necessity. Many investors see chemical pesticides as a market that has peaked and on the decline. Sure, we'll still see new pesticides. And we'll use IPM tactics to fine-tune the use of the chemicals we now have. But public outcry and legislative pressures will tighten the noose around pesticide use. So will the threat of lawsuits for real or imagined harm. Rational or not, it's clear that our use of chemical pesticides will be increasingly limited.

Several chemical companies are switching their pesticide research from chemistry to biology, to find bio-controls for pests that they can market in a future when few chemical pesticides will be permitted. And many of these chemicals will be attached to or placed inside the seed.

Breeders are also searching through exotic strains and wild relatives of domesticated plants, looking for traits that may yield imroved pest resistance. Others look for industrial oils, new antibiotics, usable enzymes, or any other product that might open new markets for farm crops. Such human-made crops as canola and triticale have just scratched the surface of our potential for new plant development.

Anatomical features on plants that were once ignored are now stirring interest. Certain types of hairs on plant leaves can catch and hold insects, while secreting a toxin that kills them. Tough plant exteriors can resist insect egg-laying and fungus penetration. These traits can be bred into crop plants to expand our range of pest resistance, and reduce our need for pesticides.

Chemical fertilizers will continue to be widely used. But current rates are about as high as economics will dictate. Pollution of surface and ground waters is a growing public concern. We'll see improvements in products, and greater efficiency in their use. But ecological concerns will keep fertilizer from being the growth industry that it was during the sixties and seventies.

So seed remains the major input with important growth potential. We have just scratched the surface of crop genetics. Recent court decisions and national legislation have defined ways that plant breeders or plant breeding organizations can patent their developments. This means that companies can now gain profit from their investment in seed research. This has brought forward an explosion in varieties in some crops, and the wave is building in others.

Biotechnology offers help to plant breeders to speed steps in the breeding process, and to permit the transfer of genes between unrelated plants. Developments in biotechnology have been slowly accumulating, as plant breeders find new uses for this tool.

Plant scientists are actively examining crop species to determine ways to alter plants like corn and wheat to enable them to fix their own nitrogen from the atmosphere. This research is advancing slowly, with many hurdles still ahead. but when successes come, they'll be marketed through the seed.

So those who work with seed can look forward to exciting decades to come. Seed growers will have better varieties to grow, with strong resistance to a broad range of insect and diseases. Plant breeders will be able to modify crop plants to fit the needs of new markets, including industrial as well as agricultural uses. Seed companies will be able to add value to seeds through treatments and coatings that will protect seedlings from pests, stimulate growth, provide protection from herbicides, and improve seed plantability. Farmers will benefit from superior crops in their fields, with less need for pesticides, and reduced crop risk. And consumers will benefit from improved products.

These seeds of the future will carry far more value than those of today. And they'll priced accordingly. Companies will need profits from the value they'll be adding. Sales personnel will need to be rewarded for marketing these improved seeds. Farmers will be able to pay more for these improved seeds, since they'll be grow higher yields, with less risk and cost from pest control. And they may grow crops for totally new markets. In research, and on the farm, seeds are where the action will be in the coming decade.

Status of Soil Fertility

SOIL FERTILITY

Shaw Reid
Soil, Crop and Atmospheric Sciences

During 1988, the Cornell Nutrient Analysis Laboratory analyzed approximately 22,000 soil samples. Field crops represented 76% of the samples, horticultural crops 15%, vegetable crops 5% and fruit crops 3%. The establishment of annual crops such as corn was the most frequent crop (42%) following soil sampling. The establishment of a hay crop such as alfalfa or birdsfoot trefoil occurred nearly as often (37%) and was followed by hay topdressing (21%). The approximately 16,000 field crop samples were taken from 162,000 acres, thus each sample represents an average of 10 acres. Less than one-fourth of the cropland in New York is sampled for the soil fertility status at any time within the rotation. The average soil test results for some of the crops are given in the table.

Soil pH

The average pH for all crops is 6.2, up from 6.0 in 1979. The pH for alfalfa topdressing is the highest for the major crops at 6.5. Even at this pH more than 10% of the alfalfa fields are established at pH's below 6. Lawns appear to be established at more favorable pH's than most of our field crops.

Phosphorus

The average soil test phosphorus (P) values are in the high range for all crops. This reflects the very high residual value of phosphorus fertilizers and the relatively low crop uptake of phosphorus and a long history of phosphorate fertilization. The higher the value of the crop the more fertilizer that is applied and the higher the soil test values for P. This is illustrated by a soil phosphorus value of 12 for the lower valued silage corn at 24 for sweet corn, 37 for mixed vegetables, 51 for potatoes, and 60 for gardens. The phosphorus values are sufficiently high in most fields that reduced quantities of fertilizer P could be used without loss of yields.

The potassium (K) values average in the high range for most crops. They do not normally remain excessively high for long periods of time because when K is high the clay minerals will remove K from the soil exchange and will release K when soil test K is low.

Magnesium

The magnesium soil test values are generally high and do not vary with crops with the exception of potatoes and gardens. The fertilizer and lime recommendations for potatoes call for extra magnesium.

Zinc

The zinc values average in the high range for all crops, but are very high for crops such as potatoes, gardens and lawns. The very high zinc values for gardens and lawns are probably the result of using organic fertilizers from sewage sludge or fertilizers highly fortified with zinc.

AVERAGE SOIL TEST VALUES FOR 1988

Crop	pH	P	K	Mg	Zn
Alfalfa					
Establishment	6.3	1	195	340	3.3
Topdressing	6.5	12	195	340	3.9
Birdsfoot Trefoil					
Establishment	6.0	8	170	310	2.6
Topdressing	6.2	9	145	360	2.8
Corn					
Silage	6.2	12	200	340	2.8
Sweet	6.5	24	190	330	3.7
Vegetables					
Mixed	6.1	37	270	340	2.8
Gardens	6.7	60	390	450	17.5
Potatoes	5.7	51	290	410	8.1
Lawns					
Establishment	6.5	17	113	300	14.4
Topdressing	6.5	26	164	350	17.5

Summary

Thus as is shown from the soil test values, the average soil fertility of fields on New York farms is excellent. The pH is in the desirable range, the phosphorus, potassium, magnesium and zinc values all average in the high range; however, not all the fields are average. The only way to tell if an individual field has the correct soil fertility is to have a soil test. Less than one fourth of the fields are tested within a rotation. With the pressure on profits, the need for dependable production to be environmentally sound soil testing is a necessary evaluation tool. Contact your local cooperative extension agent for assistance in planning a regular soil testing program.

INSECT MANAGEMENT

Management of Corn Rootworm in New York

Elson Shields
Entomology

Populations of western corn rootworm continue to increase across the state in 1990. As a result of these increasing populations, economic populations of this insect are being reported in more than 95% of the continuous corn fields within the Western NY corn growing region. High beetle numbers have also been reported within the Finger Lakes region resulting in recommendations for soil insecticide usage during planting to control larval populations and prevent root injury.

Corn Rootworm Biology and Management

Two different species of corn rootworm (CRW) can cause economic loss in our commercial field corn fields. Northern corn rootworm adult beetles are bright lime green and have been inhabitants of our corn fields for many years. The western corn rootworm which is yellowish with dark stripes has invaded New York only in the past few years and currently is most numerous in western New York. Field population of CRW can occur as mixed populations or as only a single species.

Life Cycle and Damage

Both species of CRW have similar life cycles and can be discussed together. Adult CRW beetles are found in corn fields from pollination until the first killing frost (late July - September). During this time the adult females are laying eggs in the soil cracks and around the bases of corn plants which will overwinter and hatch in late May (next spring). Newly hatched larvae locate the young corn plants and begin feeding on the developing roots. Larval development and root feeding damage is completed by mid July, larvae pupate and emerge as adult beetles during late July and early August to begin laying eggs to complete their life cycle.

CRW larvae damage corn by feeding on the root system and if present in sufficient numbers, will reduce corn yields by inhibiting the ability of the corn plant to uptake water and nutrients. Additional yield loss occurs as the CRW feeding destroys the plant's brace roots resulting in harvest loss due to lodging. Potentially damaging populations of CRW are controlled by soil insecticides incorporated in the seed bed at planting or by rotation to a non-susceptible crop.

Fields at Risk

Fields planted to continuous corn are at greater risk to economic CRW infestations than first year corn since CRW eggs are laid the previous fall in existing corn fields. Fields in continuous corn production increase in likelihood of developing economic CRW infestations, the longer corn is planted to the field on a continuing basis. Continuous corn planted after late planted corn the previous year is at high risk due to the attractiveness of the late pollinating corn to the adult CRW resulting in heavier than normal egg laying in the field.

The need to use a soil insecticide at planting for control of CRW can be determined by counting the number of adult CRW beetles per 55 corn plants (5 plants in 11 different field locations within a field) in each corn field during and shortly after pollination. If these beetle counts exceed 1 beetle per plant as a field average, then a registered soil insecticide** is recommended at planting the following spring. Interactions do occur between survival of the CRW larvae and soil texture, however, these interactions are not well understood. It is interesting to note that sandy soils rarely develop economic CRW infestations.

REGISTERED CORN ROOTWORM INSECTICIDES**

Compound	Placement	Rate per 1000 lin. ft.	Root Rating	Cost Range
Counter	In-furrow or T-band	8 oz.	2.2-2.7	$10-$12/ac
Dyfonate	T-band	6 oz.	2.9	$10-$12/ac
Furadan	In-furrow or T-band	8 oz.	2.2-2.8	$10-$12/ac
Lorsban	In-furrow or T-band	8 oz.	2.2-2.4	$10-$12/ac
Thimet	T-band	6 oz.	2.4	$7-$9/ac
Untreated check plot			3.7	

* T-band -- Banded in front of the press wheel.
* In-furrow -- Placed in the seed furrow with the corn seed.
** Please refer to the 1991 Cornell Recommends for Field Crops for the current insecticide recommendations and read the insecticide label application.

Root damage ratings below 3 are usually not severe enough to cause economic loss.

New Bulletins on Nutrient and Pesticide Management

WATER QUALITY

Harold van Es
Soil, Crop and Atmospheric Sciences

Nutrients and pesticides used as part of common agricultural management practices may reach streams and lakes through runoff and erosion, or may reach groundwater through soil leaching. Pollution of lakes and streams by agricultural chemicals can adversely affect aquatic ecologies. Chemicals in groundwater are also undesirable, because they may be toxic to humans and livestock. Farmers can use soil and crop management practices which reduce the potential for nutrients and pesticides to reach surface and groundwater. Two new bulletins, "Nitrogen and the Environment" and "Pesticide Management for Water Quality" provide background information and recommendations for nitrogen and pesticide management to protect water quality.

Nitrogen

Groundwater surveys in New York have shown extensive contamination by nitrates, with up to 19% of the samples exceeding the drinking water standard of 10 ppm NO_3-N. For the 65% of the crop-land acreage in New York associated with dairy farms, nitrogen management is very critical because most of the nutrients are applied through manure applications. In addition, excessive fertilization is common on cash-grain, fruit and vegetable farms because of the low expense of inorganic fertilizers relative to the economic risks resulting from plant nutrient deficiencies. However, nutrients applied in excess of the amount required for optimum yields results in additional losses to the environment. "Nitrogen and the Environment" provides the reader with an understanding of the chemical and physical processes involved in the movement of nitrogen through soil. Nitrogen in soil is continually being transformed through a complex network of reactions collectively called the Nitrogen Cycle (see fig.). The chemical form of nitrogen in soil (e.g. nitrate, ammonium or organic nitrogen) greatly affects its potential for loss to water resources or the atmosphere.

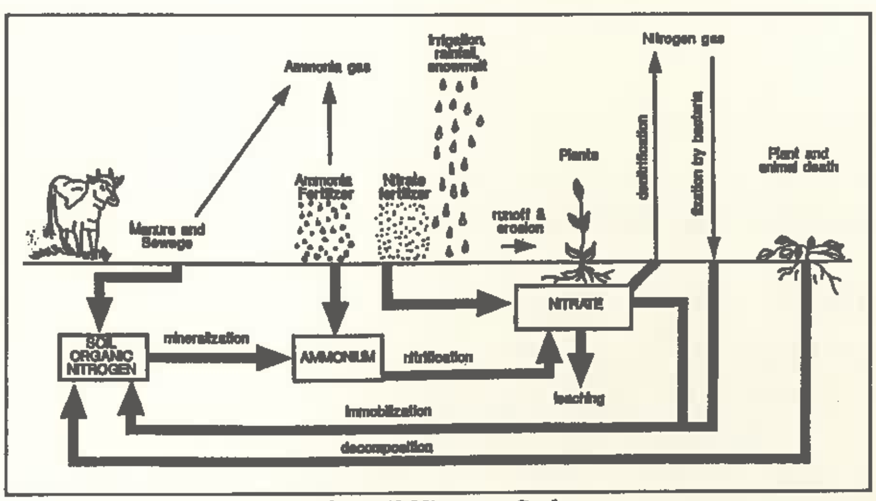
The bulletin discusses management practices which limit nitrogen contamination of water. These include avoiding overfertilization, proper timing of nitrogen applications, providing good growing conditions for maximum nitrogen uptake, proper irrigation practices, manure analysis, manure application plans, etcetera.

Pesticides

Estimating the potential for contamination of water resources by pesticides is complicated by the multitude of chemicals and environmental conditions. "Pesticide Management for Water Quality" explains how pesticide characteristics combined with soil, weather and geologic conditions affect runoff and leaching of pesticides.

Farmers can use soil and crop management practices which reduce pesticide losses to water resources. First, the potential for pest infestation can be reduced through the use of appropriate crop rotations, maintenance of optimum soil nutrient and pH levels, timely planting and harvesting, and water management. Integrated Pest Management practices can be used to reduce unnecessary usage of pesticides and, in some cases, substitute pesticides for non-chemical control methods. Finally, pesticides can be selected based on their potential for loss through leaching or runoff/erosion.

"Nitrogen and the Environment" and *"Pesticide Management for Water Quality"* will be available by December 1, 1990 through the Cornell Distribution Center, 7 Research Park, Ithaca, NY 14850.



The Soil Nitrogen Cycle

Calendar of Events

October 21-26, 1990	American Society of Agronomy Meetings, San Antonio, Texas
November 12-15	Pest Management Conference, Ithaca, NY
November 14-15	Soil and Water Conservation Forum, Albany, NY
December 13	Cornell Seed Conference, Ithaca, NY
January 7-10, 1991	Northeast Weed Meeting, Baltimore, MD
January 8-9	Empire State Soil Fertility Association Meeting, Auburn, NY
January 21	Corn Congress, Phelps, NY
January 22	Corn Congress, Batavia, NY
January 16	Forage and Grassland Meeting, Waterloo, NY
February 14-15	Northeast Corn Improvement Conference, Baltimore, MD

What's Cropping Up? is a bimonthly newsletter distributed by the Department of Soil, Crop, and Atmospheric Sciences at Cornell University. The purpose of the newsletter is to provide timely information on field crop production and environmental issues as it relates to New York agriculture. Articles are regularly contributed by the following Departments at Cornell University: Soil, Crop, and Atmospheric Sciences, Plant Breeding, Plant Pathology, and Entomology. To subscribe for 1991 send a check for $8.00 along with the form at the right.

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