TROUBLESHOOTING THE SOYBEAN CROP

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Introduction

Many problems with the soybean crop reveal themselves in late summer. Actions taken or not taken will sometimes be very noticeable. Unexpected problems arise, fertility deficiencies become evident, pests move in, etc. Therefore, a review of how to diagnose your crop is likely to be both timely and useful.

Soybean farmers can sometimes diagnose problems themselves by reviewing the field's history, practices used or plants' symptoms. In other cases, soil and/or plant samples may need to be sent to a laboratory for analysis. Diagnosing field problems can be a challenge. Visual aids can be valuable and asking questions is perhaps most important. Signs and symptoms don't always follow the textbook and patterns don't always make themselves evident. But by following general guidelines, soybean farmers can become quite adept at diagnosing problems.

Memories tend to fade, so be sure to document everything. We forget or overlook details when in the field. You can document your visit by taking notes and by making a recording and/or taking pictures with a digital camera. The latter is most useful – sometimes you'll see things in the photos that you missed during the visit. With today's digital cameras, the number of photos taken is not an issue, so take plenty.

The following guidelines will prove useful in troubleshooting problems in your soybean fields.

PRELIMINARY FACT FINDING

You can obtain plenty of information before you even get to the field. Information that can be acquired beforehand includes:

Cropping History

(for at least the two previous growing seasons)

- What crops did you plant?
- What's your typical rotation?
- Is this the first year you grew soybeans in your field?
- Which tillage methods did you use?
- What fertilizer, lime and chemical applications did you apply?
- Have you had problems in this field in the past?
- What varieties/hybrids did you use?
- Did those varieties/hybrids have resistance to a particular disease?
- Were they herbicide or insect-tolerant?

Equipment

- What equipment did you use to plant, spray and harvest during the last two years?
- Was the field wet or dry during planting, spraying and harvesting?
- Was the equipment calibrated correctly?
- Is the equipment new? When was it purchased?

Soil Information

Find out the texture and classification of your soil. Plotting a soil map would be helpful. Gathering soil test results, including soil pH and phosphorus, potassium, calcium and magnesium levels, is also valuable. You might need plant tissue test results, including major nutrients plus most secondary and minor nutrients. Summarize your fertilizer and liming practices, such as time, rate and method of application, for this season.

Weather

It helps to know trends in rainfall, temperature and relative humidity during the growing season. If you suspect chemical injury, then identify rainfall patterns – including amounts, dates and intensity – as well as the temperatures of the soil and air before, during and after the applications. Also, find out the wind speed and direction during and after the chemical application.

Pest-Management Information

Compile information for all herbicide, insecticide and fungicide applications and rates for this and the previous crops. Other valuable information to gather includes past soil nematode species and population levels as well as major weed or insect problems. Don't forget predation – deer and groundhogs are two of our worst pests.

Tillage and Other Cultural Practices

Think back on the planting procedures and equipment you used and whether it was dry or wet during these operations. Find out which soybean variety you planted and obtain characteristics and traits for this variety. Is the seed tag available? What was the lot number? Did you use seed you saved from the previous year? What was the germination rate, and what was the "cold" germination rate?

THE FIELD VISIT

After you obtain as much information as possible before going to the field, follow the general guidelines listed below.

Remember to *DOCUMENT EVERYTHING*.

Materials and Equipment Needed:

- Notebook, paper, pencil and complaint or diagnostic forms
- Mobile phone with a camera
- Camera and accessories. The camera on your phone should be used since images can be sent quickly to specialists by text message or email. However, camera phones sometimes lack quality, so we recommend also taking a digital camera with you.
- Shovel or spade, pocket knife, trowel and other digging tools. Many above-ground symptoms are related to what's going on underground.
- Soil probe, plastic mixing pail and soil sample boxes or bags
- Plastic bags for plant samples that need preserving and paper bags for plant nutrient analysis samples
- Reference books, product labels and other visual aids
- Penetrometer or other soil compaction measurement device, soil probe and metal surveying flag
- Pocket ruler and yardstick
- Magnifying glass and hand lens

Windshield / Whole Field Investigation

Before looking at specific plants, try to get a feel for the problem over the entire field. Are there any patterns or trends to the injury? Check neighboring fields or other soybean fields on the farm.

Above-Ground Inspection

Identify the soybean growth stage and know the types of problems that can be experienced at this stage. Did the problem occur in the past or is it ongoing? All affected plant parts should be identified and noted. Compare the plants' symptoms with those found in a troubleshooting guide. Note the occurrence of any weeds and identify them.

Below-Ground Inspection

Check the soil texture, condition, moisture and hardness. Inspect the root system. Dig up the plant to inspect the roots. Never pull up plants since pulling will dislodge roots and nodules. Is the plant well-nodulated? Are roots malformed or injured? Check for compaction.

Take the Appropriate Plant or Soil Samples

In many cases, if not most, you will not be able to fully diagnose the problem. Take plant and soil samples from affected and unaffected areas. Follow the directions on diagnostic forms (see below). Remember, if taking a plant sample, dig up the plant; never pull the plant from the soil. If you can hand-deliver the sample, include the soil around the roots.

Equipment Check

If you suspect that the problem may be related to a piece of equipment, such as a planter or sprayer, check its general mechanical condition, settings and spacing.

Interaction with the Farmer *(for agents, consultants, crop advisors, company representatives, etc.)*

Be courteous and respectful. Approach the situation as a service opportunity to solve a problem. Be positive but careful in your assessment. Know when you are in over your head. Get help when you need it. "I don't know" is a response that can gain respect.

Remember to Document Everything

Record all information in writing. This doesn't have to be written up as you are diagnosing the problem, but document the evidence before leaving the site. Use a prepared form from a university or company or a self-developed form, and fill it out completely. This may be the only opportunity to gather the evidence, so be sure to get all of it on paper.

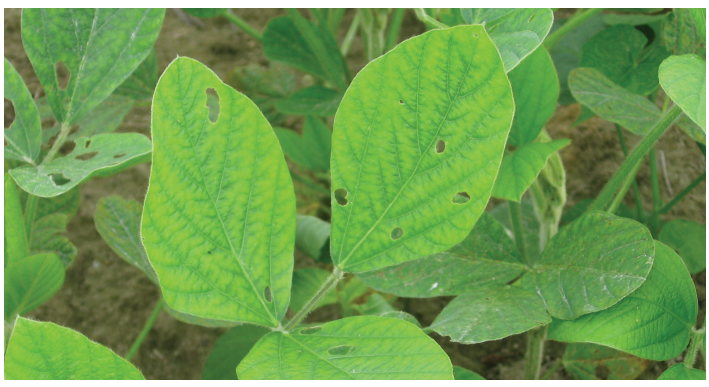
ANALYSIS OF DATA AND FINDINGS

Patterns

Look at any patterns that may be present, including streaks, patterns of emergence, tire tracks, cultivation depths, planting depths and soil types.

Look-Alike Symptoms

Many symptoms of nutrient deficiency, nematode damage and herbicide injury look alike. You might be able to infer from field history information what caused the symptom, but in many cases, further laboratory analysis will be needed.



Interacting Factors/More Than One Problem

In most cases, the problem cannot be attributed to a single factor. Herbicide activity closely follows weather conditions. Nematodes can be more or less severe depending on the weather, soil fertility and cultural practices. The general soil condition (organic matter, structure, etc.) will affect many other issues. Compacted soils will enhance other problems. Certain soybean varieties are sensitive to particular chemicals or combinations of chemicals.

DRAWING A CONCLUSION

Review the facts and data and determine what is normal and abnormal. Eliminate the unlikely causes. Validate the likely causes (for instance, streaks in the field are related to spraying, tillage or planting equipment). Remember, you might not be able to draw a conclusion in the field, especially if laboratory analysis is needed to confirm your suspicions. However, be prompt with your diagnosis. Solve the problem as soon as possible so remedial actions can be taken if needed.

FOLLOW UP

Revisit the field. If you identified a problem and took corrective actions, did they resolve the problem? Gather and read any relevant information, such as extension publications, labels and journal reprints. Forward relevant material to the farmer or others involved.

VEGETATIVE-STAGE SOYBEAN DIAGNOSTIC OUTLINE

The outline below offers some possible causes of the injury symptoms described during the vegetative development stages. However, don't assume your plants are experiencing these issues unless clear proof is available by pest identification or laboratory analysis.

PLANTS ARE WILTED OR DEAD

Plant broken off at ground level
Three-cornered alfalfa leaf hopper
Surface-applied dinitroaniline herbicide (e.g., pendimethalin)
Lesser cornstalk borer

Leaves discolored or wilted
Silver to light brown striping along the major veins or over the whole leaf
• Thrips
Yellowing followed by browning and necrosis of leaf margins
• Triazine herbicide (e.g., atrazine, simazine, metribuzin)
Leaves are yellow, maybe wilted; some plant death
• Phytophthora rot
• Nematodes
• Lesser cornstalk borer
• Grubs, wireworms or other soil larvae
Leaves wilted, dead or dropped
• Lesser cornstalk borer
• Grubs, wireworms or other soil larvae
• Lightning
Leaves yellow-speckled; plant stunted; webbing and/or mites present on underside of leaflets
• Spider mites

Stems discolored or showing fruiting structures
Discolored stem, reddish fruiting bodies present
• Red crown rot

Stems discolored or showing fruiting structures cont.
Discolored lower stem
• Phytophthora rot
• Rhizoctonia solani
• Fusarium spp.

PLANTS HAVE DAMAGE TO LEAVES OR STEMS

Leaves
Torn
• Hail damage
Show signs of insect feeding
• Circular holes - Bean leaf beetle
• Irregular holes - Green cloverworm, Mexican bean beetle, grasshoppers or other defoliators
Show signs of animal feeding (tops of plants are missing; two stems arising from an older single stem)
• Deer or groundhogs

Stems
Stem girdled, bruised or dark ring at soil line with possible adventitious root development
• Three-cornered alfalfa hopper
• Surface-applied dinitroaniline herbicides
• Hail damage

Stems
Fed on at or below soil line
• Cutworms
• Wireworms
• Lesser cornstalk borer
• Slugs

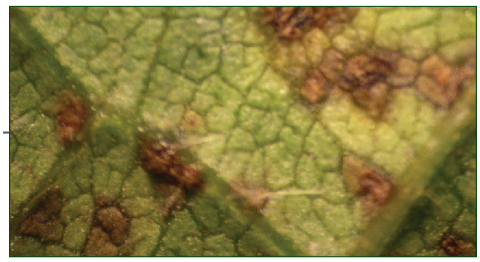
Stems
Stem tunneled into at or below soil line
• Lesser cornstalk borer

Stems
Stem snaps off at base when plant is bent or blown over
• Three-cornered alfalfa hopper
• Lesser cornstalk borer
• Surface-applied dinitroaniline herbicides
• Hail damage

Stems
Small sand-covered silken tube attached at soil line
• Lesser cornstalk borer

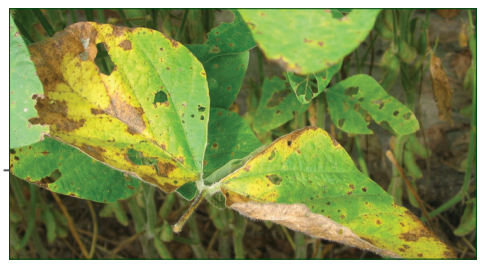
PLANTS HAVE SPOTS, DISCOLORATION OF LEAVES AND/OR ABNORMAL STEM GROWTH; ROOTS MAY ALSO SHOW STUNTED OR ABNORMAL GROWTH

Leaves showing spots, streaks, mottling or necrotic areas
Dead spots with pustules (raised areas) on underside of leaf, usually on upper leaves
• Bacterial pustule



Leaves showing spots, streaks, mottling or necrotic areas
Leaf spots with light-colored centers and dark margins
• Frogeye leaf spot

Leaves showing spots, streaks, mottling or necrotic areas
Brown spots and/or yellowing on lower leaves
• Brown spot



Leaves showing spots, streaks, mottling or necrotic areas
Brown spots on upper leaf surface & gray tufts of fungal growth on undersides of leaves
• Downy mildew

Leaves showing spots, streaks, mottling or necrotic areas
Angular reddish brown to black spots, usually with yellow halos, on middle to upper leaves
• Bacterial blight

Leaves showing spots, streaks, mottling or necrotic areas
Leaves are speckled or burned; new growth not affected
• Membrane-disrupting herbicide
• Sunburn
• Air/ozone pollution

Leaves Yellowing
Yellowing along leaf margins, followed by browning and necrosis
• Potassium deficiency
• Triazine herbicide

Leaves Yellowing
Narrow yellowing along leaf margins and leaf cupping
• Potato leafhopper (symptoms are more pronounced in varieties with little leaf pubescence)
• Glyphosate herbicide (on glyphosate-resistant soybeans)

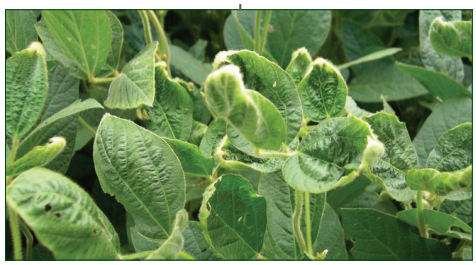
Leaves Yellowing
Interveinal yellowing of young leaves
• Manganese deficiency
• Sulfonylurea herbicide
• Brown stem rot
• Sudden death syndrome

Leaves Yellowing
Yellowing of old and young leaves
• Nitrogen deficiency
• Sulfur deficiency
• Molybdenum deficiency
• Oxygen deficiency (waterlogged soils)
• Zinc deficiency
• Nematodes
• Magnesium deficiency (interveinal)

Leaves Yellowing
Scorching along leaf margins
• Chlorine toxicity
• Boron toxicity

Leaves Crinkled or Disfigured
Leaves crinkled or disfigured but not stunted
• Various viruses, including soybean mosaic, bean pod mottle and peanut mottle
Leaves crinkled and/or distorted with possible stunting
• Phenoxy herbicides
• Glyphosate herbicide
• Manganese or boron toxicity
Leaves cupped up
• Benzoic acid herbicides (e.g. dicamba)
• Potato leafhopper
• Glyphosate herbicide (on glyphosate-resistant soybeans)

Stunted or Abnormal Roots
Little or no nodule development
• Nitrogen deficiency
• Greater than 25-30 pounds of nitrogen applied pre-plant to soil
• Nematodes
• Low soil pH
• Molybdenum deficiency
• Soil compaction
Little or no secondary root development
• Nematodes
Secondary or lateral roots swollen
• Dinitroaniline herbicide (e.g., trifluralin, pendimethalin)
Proliferation of secondary roots
• Root-knot nematodes
• Phenoxy herbicides
Root galls formed
• Root-knot nematodes
Small, yellow, lemon-shaped cysts present
• Soybean cyst nematode
Secondary roots show bottle-brush appearance
• Imidazolinone herbicide (e.g., imazaquin, imazethapyr, imazamox)
• Root-knot nematodes
Irregular or L-shaped roots
• Compaction
Evidence of insect feeding
• Wireworms or white grub



REPRODUCTIVE-STAGE SOYBEAN DIAGNOSTIC OUTLINE

The outline below offers some possible causes of the injury symptoms described during the reproductive development stages. However, don't assume your plants are experiencing these issues unless clear proof is available by pest identification or laboratory analysis.

PODS ARE DAMAGED OR LOST

Pods show evidence of insect damage
Pods with evidence of feeding into seed cavity
• Corn earworm
• Grasshoppers

Pods show evidence of insect damage
Pods with superficial feeding or scarring rarely reaching the seed cavity
• Bean leaf beetle
• Velvetbean caterpillar
• Mexican bean beetle

Pods are stunted, shriveled or discolored
Fruiting bodies present on the pod
• Pod and stem blight
• Anthracnose

Pods are stunted, shriveled or discolored
Pods are not cut off but have fallen from the plant
• Drought
• Boron deficiency

Pods are stunted, shriveled or discolored
Pods are shriveled with one or more aborted seed
• Stink bug
• Pod and stem blight
• Anthracnose
• Drought

Pods are stunted, shriveled or discolored
Pods are abnormal, distorted, small, are missing one or more seed; seed may seem to be vacuum-sealed inside of pod
• Bud blight virus
• Phenoxy or benzoic acid herbicides

LEAVES AND/OR STEMS ARE PHYSICALLY DAMAGED

Leaves skeletonized or lacy in appearance

- Mexican bean beetle
- Japanese beetle

Holes eaten in leaves

- Bean leaf beetle (circular holes)
- Green cloverworm
- Soybean looper

Leaves showing yellow mottling; leaves may appear scorched

- Spider mites

Yellow leaf tips and upper margins; leaves may be cupped upward

- Potato leafhopper (more pronounced on varieties with little leaf pubescence)

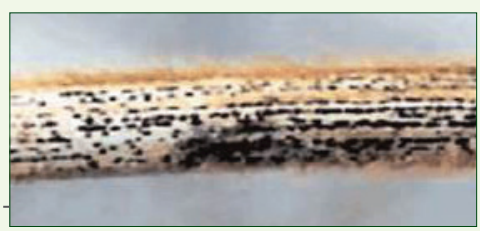
LEAVES AND/OR STEMS DISCOLORED AND/OR STUNTED

Interveinal yellowing of young leaves

- Manganese deficiency

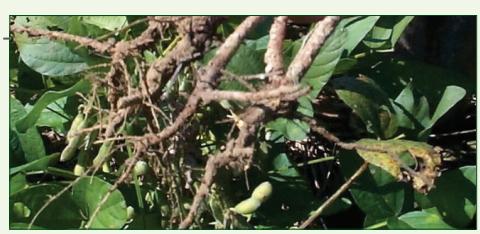
Upper leaves have interveinal chlorosis and necrosis

- Red crown rot
- Stem canker
- Brown stem rot
- Phytophthora rot
- Sudden death syndrome



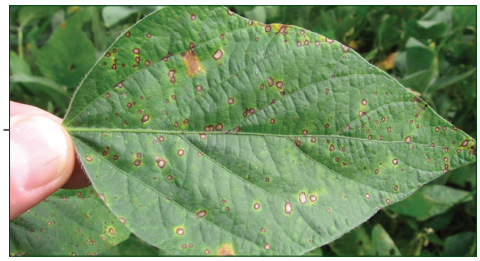
Stems blighted with fruiting bodies present

- Pod and stem blight
- Anthracnose
- Red crown rot
- Southern blight



Cankers from the lower to middle section of the main stem, mostly near the axils of branches
• Stem canker

Leaves showing spots or necrotic areas
Light-colored centers and dark margins
• Frogeye leaf spot
Brown spots and/or yellowing on lower leaves
• Brown spot
Brown spots on upper leaf surface & gray tufts of fungal growth on underside of leaves
• Downy mildew
Angular, reddish brown to black spots, usually with yellow halos, on middle to upper leaves
• Bacterial blight
Pale green spots with elevated centers on either or both sides of the leaf, later forming pustules usually in lesions on lower leaf surface
• Bacterial pustule
Yellow spots with no tufts of fungal growth on underside of leaves, changing to small, gray to tan lesions; older lesions will contain small pustules with masses of tan spores
• Asian soybean rust



Leaves are speckled or burned; new growth is not affected
• Membrane-disrupting herbicide
• Sunburn
• Air/ozone pollution

Premature leaf yellowing with a gray discoloration under the bark on the roots and stem just above the soil line
• Charcoal rot

PLANTS STUNTED WITH POSSIBLE ABNORMAL GROWTH

Leaves crinkled, mottled, distorted, or appearing to be blistered
• Virus

Leaves yellow; roots contain galls, cysts, root proliferation or stubbiness
• Nematodes

PLANTS REMAIN GREEN PAST MATURITY IN PARTS OF THE FIELD WHILE REST OF THE FIELD IS MATURE

Few pods are present, but plant is otherwise healthy and green
• Stink bugs

Few pods are present; most are 1-bean pods appearing in clusters; leaves may be crinkled
• Bud blight virus
• Other viruses
• Phenoxy or benzoic acid herbicide injury

Normal pods with mature color, but stems and petioles remain green after maturity
• Green stem syndrome
• Excess foliage for the number of pods present due to drought during pod formation
• Stink bugs
• Virus

PLANTS ARE WILTED OR DEAD

Plants are dead; no evidence of disease or nematode damage
Plants are broken off at ground level; callus tissue and adventitious roots present
• Three-cornered alfalfa hopper
• Lesser cornstalk borer
• Surface-applied dinitroanaline herbicide
• Hail damage
Scorched-looking, dead areas in the field
• Spider mites
Circular pattern of dead plants
• Lightning

Plants are dead and showing evidence of disease or nematodes on stems or roots
White fungal growth and mustard seed-like structures on the lower stem
• Southern blight
• Sclerotinia stem rot
Charcoal-appearing discoloration on the roots that generally extends to just above the soil line; reddish-brown stains in the wood along with black streaks
• Charcoal rot
Discolored stem with reddish fruiting structures present
• Red crown rot (Cylindrocladium black rot)
Discolored stem without fruiting structures but with cankers present near stem nodes
• Stem canker
Roots with galls, cysts, root proliferation or stubbiness
• Soybean cyst nematode
• Root-knot nematode
• Sting nematode

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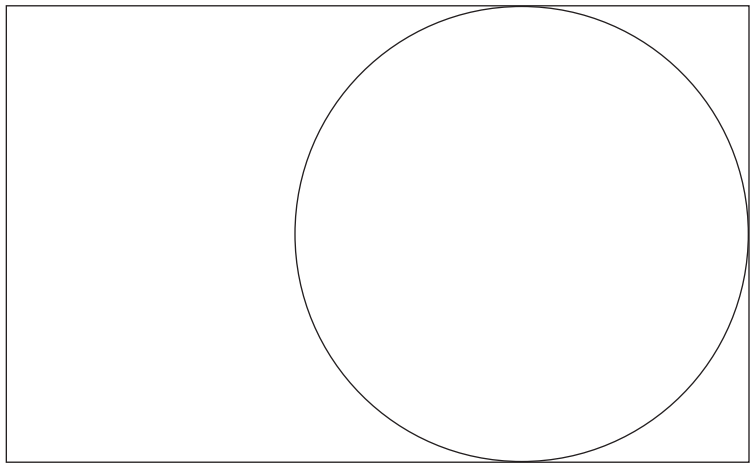
Crop Scouting & Diagnostic Form

Send samples to:
Tidewater AREC
College of Agriculture & Life Sciences
6321 Holland Rd, Suffolk, VA 23437
dholshou@vt.edu



Field ID _____

Date _____ Time _____

Farm/Grower _____

Address _____

_____

Contact _____

Cropping History:

Crops: 20__ _____ 20__ _____ Next Yr. _____ Rotation _____

Tillage: _____

Equipment: _____

Past Problems: _____

Crop Observations:

Variety _____ Seed Tag? ___ Saved? _____ Germ % ____ Planting Date _____

Seed Rate _____x1000 plt/A Plant Pop _____x1000 plt/A Seed Depth _____ Row Spacing _____

Stage: V__ R___ Height ____in % Canopy Cover ____

Soil Information:

Soil texture _____ Soil Class _____ pH _____ P____ K ____Ca ___Mg __ Other _____

Soil Test? ___ Attached? ___ Get? ___ Sampled: Bad ID _____ Good ID _____

Fertilizer: 20__ _____
& Lime 20__ _____

Weather (general; before, during, after application):

Rainfall _____ Temperature _____

Humidity _____ Wind: Speed _____ Direction _____

Pest Management Info:

Chemicals: 20__ _____
20__ _____
20__ _____
20__ _____

Weeds: _____ Sample ID_____
Insects: _____ Sample ID_____
Disease: _____ Sample ID_____
Nematodes: _____ Sample ID_____
Mammals? _____ Sample ID_____

General Crop Appearance: _____

_____

_____

Problems: Y____ N____

Date Noticed _____ Field Distribution _____

Patterns/Trends _____

_____

General Description _____

In Neighbor Fields? _____ Other Observations _____

Above-Ground Inspection in Problem Area:

Spatial Distribution (every plant?): _____

Plant Parts Affected: _____

Signs/Symptoms: _____

Sample Taken? ___Bad ID _____ Good ID _____

Below-Ground Inspection in Problem Area:

Topsoil texture _____ Subsoil texture _____ Moisture _____

Compaction? ____ Depth _____ Description _____

Soil Sampled? ____ Bad ID _____ Good ID _____

Root condition _____

Signs/Symptoms: _____

Sampled? ___ Included with Plant Sample? ____

Equipment Check:

Planter: condition _____ settings _____ spacing _____

Sprayer: condition _____ settings _____ spacing _____

Tillage: condition _____ settings _____ spacing _____

Analysis/Recommendations: _____

_____

_____

_____

_____

_____

_____

_____

Your name

Virginia Cooperative Extension

Tech Transfer is a soy checkoff program, in collaboration with state soybean boards and universities, providing research results to improve profitability of U.S. soybean farmers.

www.UnitedSoybean.org

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