Pine Shoot Beetle Compliance Program for Christmas Trees: A Manual for Christmas Tree Growers

Michigan State University Extension Service
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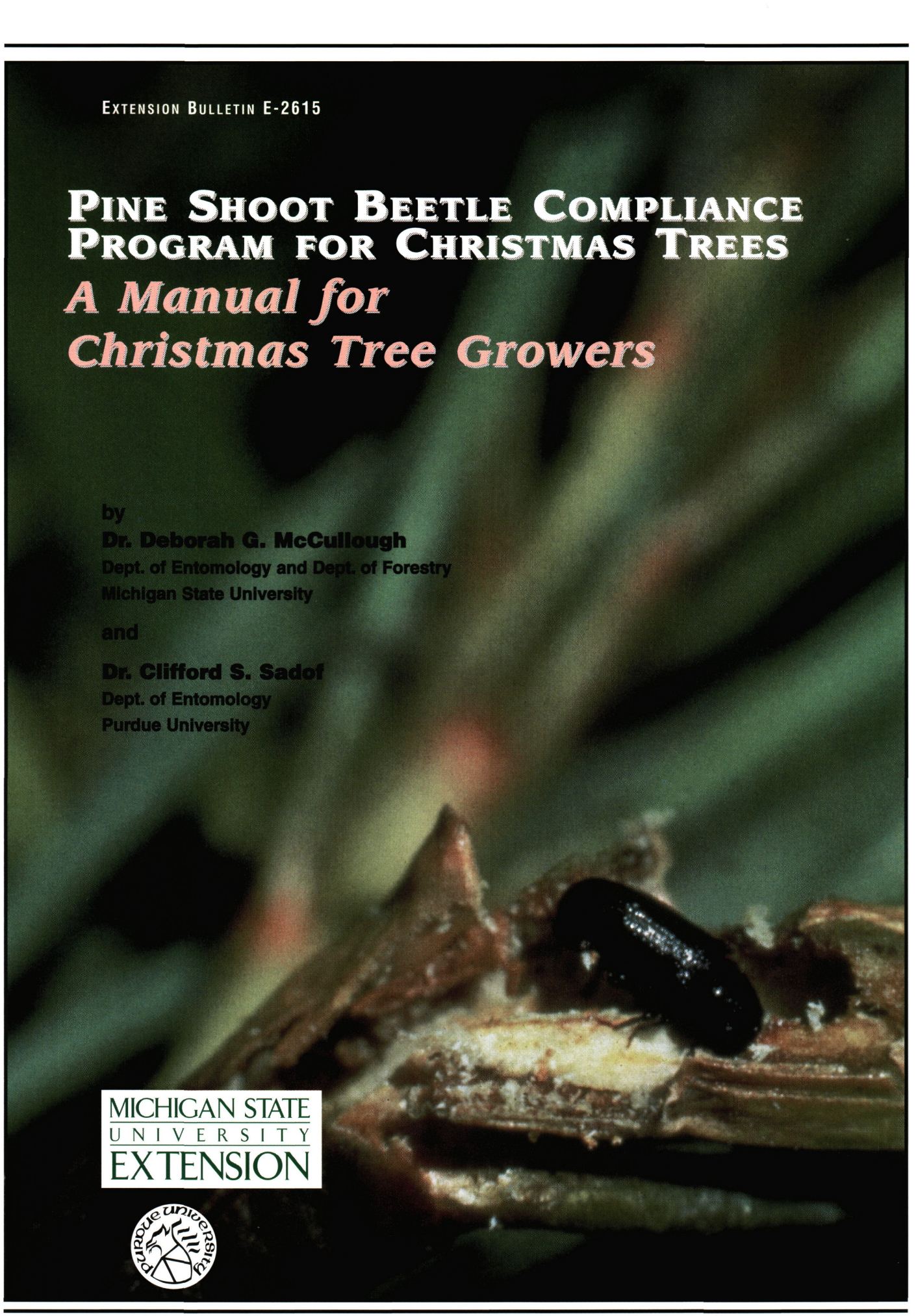

MICHIGAN STATE UNIVERSITY EXTENSION

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A MANUAL FOR CHRISTMAS TREE GROWERS

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MICHIGAN STATE UNIVERSITY EXTENSION

PINE SHOOT BEETLE COMPLIANCE PROGRAM

A MANUAL FOR CHRISTMAS TREE GROWERS

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OVERVIEW AND BACKGROUND

The pine shoot beetle (*Tomicus piniperda* L.) is a native bark beetle in Scandinavia and other pine-growing regions of Europe, Asia and northern Africa. Larvae feed on the inner bark of recently cut or dying pine trees, logs and stumps. Adult beetles feed in tunnels in the shoots of live pine trees during the summer. When adults are present in high numbers and many shoots are killed, tree growth may be reduced.

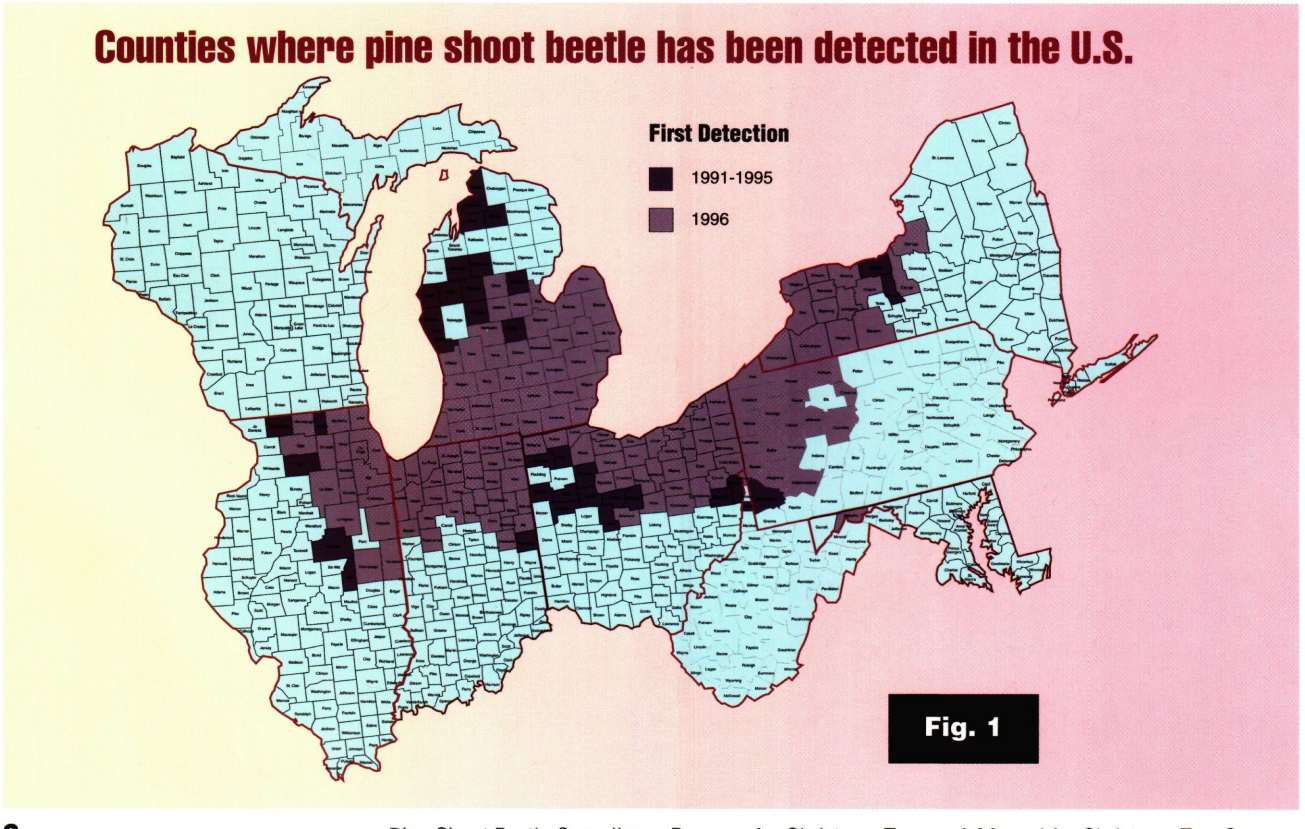
Pine shoot beetle (PSB) was first discovered in North America in 1992, when a Christmas tree grower near Cleveland, Ohio, found an unknown beetle infesting shoots of Scotch pine trees. Once the beetle was identified, state and federal regulatory agencies began surveys to determine the extent of the infestation. As of October 1996, PSB had been found in 187 counties in eight states in the United States (Fig. 1). Surveys are likely to continue and more counties will probably be added to the PSB-infested area each year.

Federal and state quarantines were established in the fall of 1992 to reduce the chance that PSB might be shipped into new, uninfested areas. The quarantines require that all fields of pine trees be inspected by regulatory agencies in late summer or fall.

If one live beetle or a single tunnelled shoot is found during the inspection, the whole field is restricted. Trees from a restricted field can be sold only within the PSB-infested area. Trees cannot be shipped outside the infested area unless they are fumigated. Most growers find fumigation undesirable. It is expensive and may cause needles to become discolored or to drop. If no beetles or tunnelled shoots are found, then the trees are certified and can be shipped outside the regulated area.

Regulations associated with the quarantines have had major impacts on Christmas tree producers, especially those growers who ship large numbers of pine trees to southern or western states. Growers who intend to export pines out of the PSB-regulated counties must wait until inspections occur in September or October to determine if their trees will be certified.

In most cases, these fall inspections occur long after contracts are signed and trees are sold to buyers. Jeopardizing the stability of these agreements threatens growers with the loss of long-standing customers or penalties resulting from their inability to deliver trees. Many growers in the regulated area have reacted to the PSB regulations by spraying trees repeatedly



during the summer, hoping to prevent any shoot feeding from occurring. This obviously has negative economic and environmental consequences.

PSB Compliance Program: an alternative to fall inspections

Growers who elect to enroll in the PSB Compliance Program agree to follow a management program designed to limit PSB populations in their fields. This integrated management program includes the use of trap logs to reduce the adult beetle population, sanitation to eliminate the pine material used by beetles for breeding and a single cover spray to control beetles during the shoot-feeding stage.

Growers who meet program deadlines and maintain accurate records of their actions will be able to ship pine trees from infested counties without any fall inspection. In short, participation in the compliance program provides growers with the certainty they need to meet the sales agreements they have with their customers.

The purpose of this manual is to:

- Introduce the PSB Compliance Program to growers.
- Explain the advantages of participating in the PSB Compliance Program.
- Present an overview of the life cycle of PSB and identify the stages that are vulnerable to management actions.
- Explain the requirements of the PSB Compliance Program.
- Answer some frequently asked questions about the PSB Compliance Program.

PSB Compliance Program philosophy

The PSB Compliance Program takes a new approach to reducing the spread of an introduced pest. Typically, quarantines attempt to restrict the movement of exotic pests and to prevent their introduction into new areas. This is usually accomplished by inspecting all plants or trees to ensure that none are infested.

In the PSB Compliance Program, regulatory agencies will check to be sure that growers have *complied* with the standardized management program. There will be no inspection of fields in the fall *unless* growers fail to comply with the compliance program procedures or elect not to participate in the compliance program.

This is the very first time that something like this has ever been attempted in this country. The whole idea of a compliance program represents a major change in the way regulatory agencies do business. It means that they have agreed to move away from a philosophy of maintaining "zero risk" of introducing PSB and are willing to accept "minimal risk" of PSB introduction.

The concept of zero risk is based on an assumption that inspecting trees in the fall can eliminate nearly all risks of spreading the beetle infestation. This assumption may not necessarily be true, especially when large numbers of fields and trees must be inspected in a short time frame.

The PSB Compliance Program employs a combination of management tactics that are implemented throughout the year. Research with Christmas tree fields in Michigan and Indiana has shown that the compliance program procedures can limit PSB populations to very low, even undetectable levels. The program is effective even in fields that have been restricted because of PSB detection in previous years. Other states have agreed that trees shipped out of fields under compliance present only a minimal risk of introducing PSB into new areas. Therefore, these states are willing to accept trees grown under the compliance program, without any fall inspection.

Growers will have the option of enrolling fields in the PSB Compliance Program beginning in 1997. Enrolled fields will be placed on a master list maintained by the state regulatory agency, such as the Department of Agriculture or the Department of Natural Resources. If all management procedures and deadlines are met, then trees from fields under compliance will be accepted by regulatory officials in other states.

Growers who fail to meet the compliance program requirements or who fail to adequately document their management activities will be dropped from the list. These growers must have their fields inspected in the fall before their trees can be shipped out of the PSB-infested area.

Advantages of participating in the PSB Compliance Program

1) No risk that fields will be restricted in fall.

Growers who follow compliance program practices and meet all deadlines can ship trees out of their fields without inspections in the fall. This means that growers will not have to worry about fields being restricted for PSB just before trees are harvested.

2) Better pest control with fewer pesticides.

The compliance program includes scouting, cultural controls and a single insecticide spray. Because repeated applications of foliar insecticides will not be necessary, both economic costs and environmental impacts are reduced.

The single cover spray can be timed to control both gypsy moth and PSB.

Trees infested with other insect or disease problems can be used as trap logs. Destroying trap logs and piles of culled trees can reduce damage caused by Zimmerman pine moth, Pales weevil, pine root collar weevil and other species.

3) Support a home-grown solution for PSB.

Scientists, growers and regulatory officials have worked together to develop a PSB compliance program that is both effective and practical for growers. The management procedures in the compliance program were developed by scientists and cooperating growers during a two-year pilot study in Indiana and Michigan. Funding to support this research was provided by state Christmas tree grower associations, as well as state and federal agencies.

4) Increase acceptance of the compliance approach.

State and federal regulatory agencies are looking at the PSB Compliance Program as a model that could be used for other exotic pests. This is particularly important to those of us who live in the Great Lakes region and other areas with major shipping ports. It's likely that we will continue to have problems with introduced exotic pest species. If it's successful, the compliance program could provide a new option for the next insect, disease or weed that becomes established in the United States.

Also, many other states will be watching to see if growers adopt the compliance program. If growers don't participate in the program, it's not likely that similar programs will be developed for other pests in the future.

PINE SHOOT BEETLE BIOLOGY AND IDENTIFICATION

A good understanding of PSB biology is needed to understand how the PSB Compliance Program works.

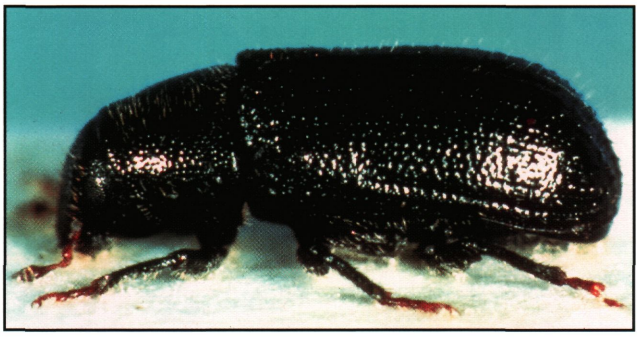


Fig. 2. A pine shoot beetle adult.

Adult beetles overwinter in the bark at the bases of pine trees. In early spring, these beetles fly to recently cut or dying pine trees, stumps or logs. This spring flight generally occurs sometime between late February and early April, usually when the temperature exceeds 50 to 55 degrees F for several days.

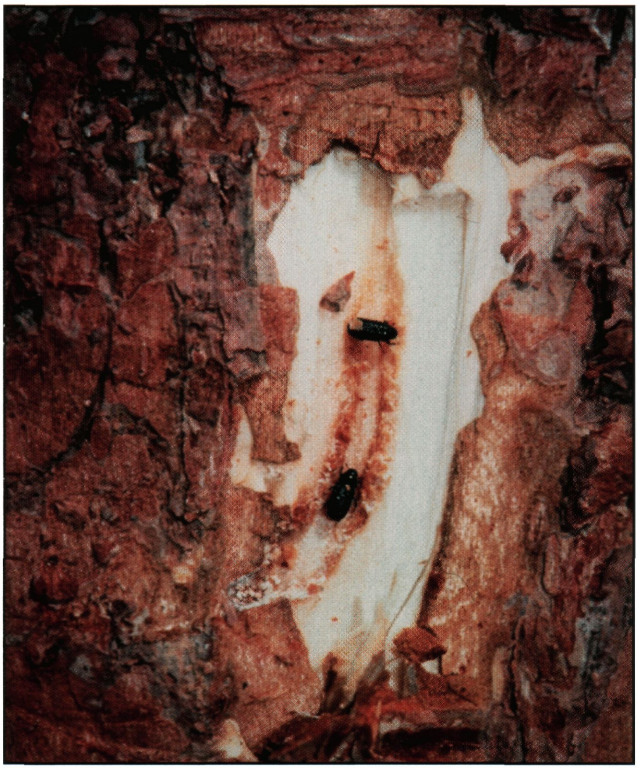


Fig. 3. After mating, each female beetle will construct an egg gallery that runs parallel to the grain of the wood.

When the adult beetles find a suitable pine stump, cut tree or log, they chew their way through the bark. Reddish boring dust can often be seen on the bark of recently infested logs.

Once they are under the bark, each male beetle will mate with one female beetle. The females then lay eggs along a gallery that runs parallel to the grain of the wood. The gallery is usually straight with a bend or hook at the end.

The felled pine trees, logs or stumps infested by the beetles in the spring are called "brood material." Pine trees, logs or stumps cut within the past 5 to 9 months are suitable brood material for PSB. Eventually the brood material becomes too dry and is no longer suitable habitat for the beetles.

Parent beetles can colonize nearly all the native and exotic pine species that grow in north central and northeastern states. The beetles do not prefer eastern white pine (*Pinus strobus*), probably because it has thin, smooth bark and produces too much pitch.

Fig. 4. Pine shoot beetle larvae are small white grubs. They feed in the inner bark of pine logs, stumps and other brood material.

Small, legless white larvae hatch from the eggs and feed on the inner bark and cambium — the area between the wood and the bark. The larvae feed in small tunnels that radiate away from the egg gallery.

Fig. 5. This is the inner bark from a Scotch pine log that was colonized by many pine shoot beetles. The long egg galleries run parallel to the grain of the wood. The larval galleries are narrow and radiate away from the egg galleries.

Larvae feed on the inner bark for 4 to 8 weeks, depending on temperatures in spring. Larvae develop more rapidly when temperatures are warm than when temperatures remain cool. Pupation usually occurs in May.

Fig. 6. Pine shoot beetle adults are reddish brown when they emerge from brood material, like the beetle on the left. After feeding in shoots for a few weeks, they darken to a shiny black, like the beetle on the right.

Fig. 7. A round hole and pitch are often seen on shoots recently attacked by a pine shoot beetle adult.

The new generation of adult beetles will begin emerging from the brood material in early June or at roughly 450 to 500 degree-days, base 50 degrees F. It may take 4 weeks before all beetles emerge from brood material. The new beetles are usually reddish brown when they emerge from the brood logs.

This new generation of adult beetles will spend the rest of the summer feeding in the shoots of live pine trees. Beetles feed in tunnels in the pith of the shoot. Tunnels are usually found in current-year or one-year-old shoots. Each beetle may feed in two to six shoots during the summer. This shoot-feeding behavior is called maturation feeding. After a few weeks of shoot feeding, the beetles darken to a shiny black.

Fig. 8. A pine shoot beetle adult in a Scotch pine shoot. Infested shoots eventually break and fall off of the tree.

A round hole seen on the outside of a shoot indicates that the shoot was infested by a PSB adult. The hole is often surrounded by pitch. Some shoots will have only one tunnel; other

Fig. 9. A hollow feeding tunnel in a Scotch pine shoot attacked by a pine shoot beetle adult.

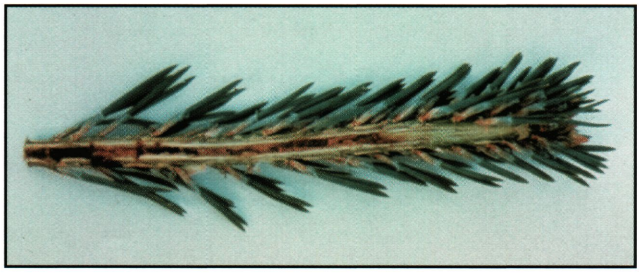


Fig. 10. A Scotch pine shoot that was infested by eastern pine shoot borer, a native shoot-boring insect. This caterpillar packs frass into the feeding tunnel in the center of the shoot.

shoots may have several short tunnels. Tunnelled shoots eventually become discolored, die and fall off the tree.

There are several other insects, mostly caterpillars, that feed in shoots of pine trees. One way to determine if a shoot is infested by PSB is to split the shoot down the middle. Shoots infested with PSB are hollow, while shoots infested by other shoot-boring insects often have sawdustlike frass packed into the tunnel.

One group of native beetles in the genus *Conopthorus* also feeds in hollow tunnels in pine shoots. These beetles look so much like PSB that an expert will be needed to tell the two beetles apart. Conopthorus beetles such as jack pine tip beetle are not common and rarely cause important damage.

In late fall, approximately 2 weeks after the first hard frost, the beetles leave the shoots and move down to the base of the tree. They chew a niche into the bark and spend the winter there, insulated by the bark and snow.

Fig. 11. A pine shoot infested by jack pine tip beetle, a native species.

Integrated management of PSB populations

The PSB Compliance Program uses three tactics to reduce beetle numbers in Christmas tree fields. The three tactics are:

Sanitation. Brood material that could be colonized by beetles in the spring is eliminated before the new generation of beetles can complete development and begin feeding in shoots. In the compliance program, all brood material must be destroyed by burning or chipping by May 20. This should prevent emergence of the new generation of beetles, even during warm springs.

Trap logs. Freshly cut pine logs or trees are placed in fields in late winter or early spring. These logs are used to attract beetles that may have spent the winter in the field *or* in nearby fields. After the adult beetles have colonized these logs, the logs are collected and destroyed before the new generation of beetles can develop.

Cover spray. A single insecticide spray is applied to tree foliage in early summer to kill any beetles remaining in the field. The cover spray should be applied in early summer, just as the new generation of beetles begins tunnelling into shoots.

In addition, growers will be asked to scout fields and to maintain records of all PSB management activities.

The PSB Compliance Program is explained in detail in the next section.

THE PINE SHOOT BEETLE COMPLIANCE PROGRAM

FLOW OF OPERATIONS
Flow chart

The flow chart on the next page is designed to help lead you through the steps in the PSB Compliance Program. The numbers in the flow chart boxes correspond to the numbers of the paragraphs below.

1. ENROLL IN THE COMPLIANCE PROGRAM

Contact your local state plant regulatory official (SPRO) to find out how to enroll your field(s) in the PSB Compliance Program. Procedures for contacting this person vary among states. Contact your local Department of Agriculture, Department of Natural Resources or county Extension office for up-to-date information on enrollment procedures.

Enroll only those fields where you expect to harvest trees this year for shipment out of the PSB-regulated area. You will be expected to provide information on the location and size of the field, and the species, approximate age and height of trees in the field.

2. SANITATION

Eliminate brood material

Sanitation is the most critical part of the PSB Compliance Program. Any potential brood material must be destroyed before a new generation of beetles can complete their development.

Brood material includes pine stumps more than 4 inches tall, pine tree tops, branches or other slash greater than 2 inches in diameter, cut or killed trees, logs and dying trees. Pine trees or slash may attract beetles for 9 to 12 months after it is cut.

Burning and chipping are the best methods to destroy brood material. Piles of culled trees can be burned during the winter (scattering straw over the pile is often useful to get the pile burning during cold or damp weather). Brood material can also be buried in some states. Be sure that all of the material is buried at least 12 inches deep.

Fig. 12. Piles of recently cut pine trees provide brood material for pine shoot beetle adults. Burn or chip these piles by May 20.

Fig. 13. Brood material must be chipped or burned, not brush-hogged. Large chunks of pine left after a field is brush-hogged can still be colonized by pine shoot beetle adults.

Fig. 14. This close-up shows a pine shoot beetle egg gallery on a chunk of pine from the brush-hogged field.

Don't use a brush hog or bush hog type mower to chip brood material or to destroy unsold trees after harvesting. The large chunks

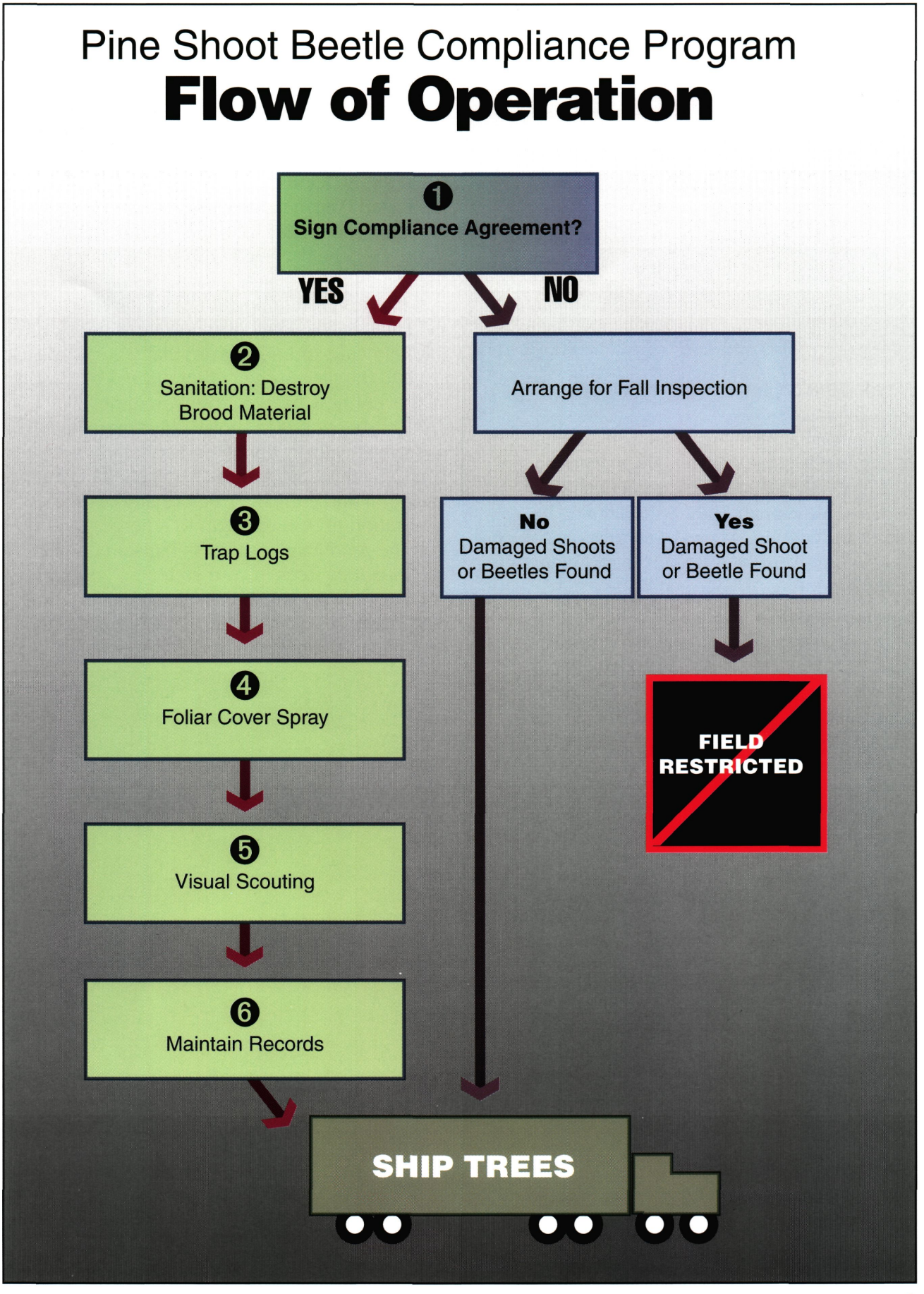

Pine Shoot Beetle Compliance Program
Flow of Operation
1
Sign Compliance Agreement?
YES
NO
2
Sanitation: Destroy Brood Material
3
Trap Logs
4
Foliar Cover Spray
5
Visual Scouting
6
Maintain Records
Arrange for Fall Inspection
No
Damaged Shoots or Beetles Found
Yes
Damaged Shoot or Beetle Found
FIELD RESTRICTED
SHIP TREES

Fig. 15. Pine trees that are cut between May 20 and July 1 should be burned or chipped within 4 weeks of cutting.

of wood left behind can still be colonized by breeding beetles.

All potential brood material must be burned or chipped **BY MAY 20!**

Brood material such as culled trees cut between May 20 and July 1 should also be destroyed within 4 weeks of cutting. This is necessary to prevent later broods from completing development.

Manage stumps

Stumps present a problem for Christmas tree growers because new stumps are created every year when trees are harvested. Therefore, it's important to be sure that fresh stumps don't become a breeding site for PSB each year.

The best option for reducing potential brood material is to cut stumps as low to the ground as possible (less than 4 inches) during harvest. Good stump sanitation will also reduce problems with Pales weevil, northern pine weevil and pine root collar weevil. In addition, customers will be provided with a nice "handle" for their trees.

If stumps cannot be cut low at harvest (e.g., the snow is too deep), you can recut the stumps the following spring. Be sure that the stumps are cut and the pieces chipped or burned by May 20 to prevent new beetles from emerging.

A third option is to thoroughly spray the bark of stumps with an approved insecticide such as Lorsban. This spray should be applied between late April and early May, before any of the new generation of beetles begin to emerge. Be sure that the product you select is registered for use on Christmas trees in your state.

Finally, if you pull stumps out of fields before replanting, be sure to destroy them by May 20 by chipping, burning or burying.

Fig. 16. This stump is too high. Tall stumps can be colonized by pine shoot beetle adults.

Fig. 17. Stumps should be cut off as close to the ground as possible.

Fig. 18. The stumps in this block were cut nearly flush with the ground. Few pine shoot beetle adults will be able to colonize these stumps.

3. TRAP LOGS

Pine logs are used to attract and trap parent beetles when they search for suitable brood material in March or April. Logs must be placed out by the critical dates specified for each state in the compliance agreement.

Trap logs must be pine logs or cut trees. They need to be at least 2 to 3 feet long and 3 to 4 inches in diameter. Don't use white pine logs for trap logs — PSB adults rarely colonize white pine. You can use whole Christmas trees for trap logs or cut larger trees into pieces. You do not need to cut the branches off of whole trees.

Trap logs should not be cut earlier than November 1 of the previous year. The fresher the trap logs are, the more attractive they will be to the beetles.

Trap logs must be in fields by:

West Virginia and Maryland .....February 1

Illinois, Indiana, Ohio
and Pennsylvania .....February 15

Michigan and New York.....March 1

Trap log placement

Place trap logs evenly and systematically along the edges of fields or blocks of trees. This will make it easier for you and the beetles to find the trap logs. It is absolutely critical that all trap logs be collected and destroyed by May 20. One hundred or more beetles can emerge from a single trap log. Leaving logs out after May 20 could be a disaster!

According to the compliance program, you will need to set out 8 to 10 trap logs per acre.

You can use the following formula to calculate the number of trap logs that must be placed along the edge of each block.

Fig. 19. Cut trees or bolts of pine can be used for trap logs. Trap logs should be placed along the edges of fields and blocks.

$$\text{number of trap logs per block} = \frac{(\text{size of field in acres} \times 10 \text{ logs per acre})}{(\text{Number of blocks} + 1)}$$

For example, if you have a 25-acre field planted in six blocks, you will need 35.7 trap logs per block. Round this off and you get 36 trap logs per block.

Trap log collection and destruction

The logs need to remain in fields until May 1 to ensure that all parent beetles in the area have colonized a log. All the logs must then be collected and destroyed by May 20 to prevent any of the new generation of beetles from emerging. This is a relatively short time to accomplish this task. Be sure to incorporate trap log placement, collection and destruction into your planning.

Select your trap logs wisely!

We realize that this part of the program can seem costly and will appear to require a substantial amount of work. However, you can use this process as an opportunity to cull trees with poor form and trees with previous pest damage. For example, trees infested with Zimmerman pine moth, gall rust, scales or needlecast disease will make good trap logs, even though they may not make good Christmas trees. Removing and destroying these trees will also reduce the rate that these other pests spread through your field.

You also get another bonus if you practice good sanitation, cut stumps low, and destroy trap logs and culled trees in spring. Pests such as Pales weevil, northern pine weevil, pine root collar weevil and even Zimmerman pine moth will breed and develop in cut trees and stumps. Destroying this material will reduce the damage that these pests cause to living trees.

Cull trees can be dropped and simply dragged to the edge of the block or field for use as trap logs. You can also use unsold Christmas trees as trap logs, provided that the trees were cut no earlier than November 1.

4. FOLIAR COVER SPRAY

Applying a cover spray just as the new generation of PSB adults begins shoot feeding will help reduce PSB populations in Christmas tree fields. The best time to apply the cover spray is when new adult beetles are leaving the brood material to infest the shoots of live trees. In the past three years, this has occurred in early to mid-June, at 450 to 500 degree-days, base 50 degrees F. This timing also coincides with the first cutting of alfalfa fields in most north central states.

Use an insecticide registered for use on Christmas trees in your state. In field tests, applications of Baythroid 2, Orthene plus Talstar 10 WP, Dursban 4 EC and Lorsban 4E were found to be effective. In Michigan, Baythroid is registered for use on pine shoot beetle (and other pests) in Christmas tree fields. Check with your distributor when you purchase the product. In some states, you will need to pick up a special supplemental label for a particular product at the time of purchase.

Growers who must also spray trees for gypsy moth control should use a product approved for both pests. A single application of a product such as Lorsban, Baythroid or Talstar in early June will control both PSB and gypsy moth.

5. VISUAL SCOUTING

One of the compliance program requirements is that growers inspect their fields for infested shoots during the summer (between July and October). Any damaged shoots should be removed and destroyed by burning or burying.

This requirement can be incorporated into normal production practices. Watch for damaged shoots anytime trees are handled, such as when you shear, paint, harvest and bale trees. Discolored shoots, shoots with holes or tunnels, and dead shoots should be removed and destroyed. Be sure to watch for discolored shoots when you scout trees for other pests, too. Scouting becomes especially important late in the summer and in the fall, as harvest time approaches. Make sure that workers are familiar with the symptoms of PSB infestation. Instruct work crews to cut off and destroy any infested shoots that they find.

6. MAINTAIN RECORDS

Keep records of all PSB management activities, including the date that trap logs were placed into fields, when trap logs and other brood material were destroyed, dates and method of stump treatment, and all pesticide applications. Be sure to record each occasion when you scouted trees to look for evidence of infested shoots. You will need your records to show that you have completed the compliance program and met all deadlines.

FREQUENTLY ASKED QUESTIONS
ABOUT THE PINE SHOOT BEETLE COMPLIANCE PROGRAM

What is the Pine Shoot Beetle Compliance Program?

Growers who choose to enroll in the Pine Shoot Beetle (PSB) Compliance Program will agree to follow a set of management practices designed to control PSB in their fields. These management practices include reducing the brood material available to pine shoot beetle, using trap logs, applying a cover spray if needed, and maintaining records of these activities. If all deadlines are met and the procedures are completed, trees can be shipped without an inspection in fall. In other words, if you follow the management plan, there will be no chance that your fields will be restricted in autumn because of PSB.

Do I have to participate in the compliance program?

No. The current fall inspection and certification process will continue to be an option.

What happens if I burn my piles of culled trees but forget to set out trap logs?

ALL parts of the compliance program must be followed and completed by the specified deadlines. If you skip any portion of the program, you will no longer be in compliance. If you are not in compliance, then you will have to arrange for your fields to be inspected in the fall.

Do I have to implement the compliance program practices in all of my pine fields?

No. Only fields that you plan to harvest in the next year should be enrolled in the PSB Compliance Program. It is a good idea, however, to adopt some of the cultural practices in all fields. Burning or chipping cull trees and cutting stumps low will prevent PSB populations from ever building up to high levels. It will also reduce problems caused by other pests that breed or develop in cut trees and stumps.

I also grow fir and spruce trees. Do I need to enroll these fields in the compliance program?

No. The pine shoot beetle requires pine trees for breeding and feeding. Nearly all native and exotic pines can be colonized by PSB adults or used for shoot feeding. Other species such as Douglas-fir, true firs and spruce species are not suitable hosts for PSB. Fields of fir, spruce or Douglas-fir trees do not need to be enrolled in the compliance program. Note, however, that good sanitation will reduce pest problems in all fields.

I plan to burn my piles of culled trees and slash. But my state imposes a burning ban in spring. How do I deal with that?

First, try to do most of your burning in fall, winter or early spring, before any ban begins. You may also wish to consider renting or buying a chipper to avoid problems associated with burning trap logs between May 1 and May 20. Other growers in your area may be interested in cooperating with you and sharing the cost of renting or purchasing a chipper. You may also want to contact your local fire marshall, the Department of Natural Resources or another appropriate agency. Find out when the ban will be imposed and how long it will last. In many cases, agricultural burning will not be restricted by the ban.

I have a pile of trees and some high stumps that were left over from operations a couple of years ago. Do I need to manage these stumps or destroy the culled trees?

Trees, logs or stumps that were cut more than 12 months ago are not likely to be suitable hosts for pine shoot beetle. Focus your efforts on trees that have been cut in the past year. If you have any doubt about the age of cut trees, it's best to destroy them according to the recommendations given in the PSB Compliance Program.

What about choose-and-cut operations?

The compliance program was designed mainly for wholesale growers who ship large numbers of trees out of the PSB-regulated area. However, the management recommendations in the compliance program can be used in any pine field. Following the management practices will ensure that PSB populations do not ever build to damaging levels. These practices will also help reduce problems with other insect pests.

Is there any chance that the requirements of the compliance program will change in the future?

Yes! This is a brand new program and we are still learning about PSB biology and the best ways to manage this pest. Some parts of the program could be revised or modified as we gain experience. Be sure that you keep in touch with your state regulatory agency, Christmas tree grower association or county Extension office to get the most up-to-date information available on the compliance program.

Information Needed for Fields Enrolled in the Pine Shoot Beetle Compliance Agreement

Maintaining good records of your management activities will be an important part of the compliance program. Regulatory agencies will use the records to determine if you have met all deadlines and complied with the program requirements. Keeping good records will also help you manage other pests or evaluate the success of specific management tactics. Listed below are some types of information that will likely be requested by regulatory agencies.

Grower and field information

Name, address and phone number
Field name and location; map of field
Field size (in acres)
Species of trees in the field
Age and estimated height of trees in the field

Stump management

Stumps were cut lower than 4 inches
- Date that stumps were cut

or

Bark on stumps was sprayed with an approved insecticide
- Product name and formulation
- Rate of application
- Date of treatment

or

Stumps were pulled out of fields
- Date stumps were destroyed
- Method of destruction (chipping, burning, burying)

Trap logs

- Number of trap logs used
- Species of logs (or culled trees) used for trap logs
- Date trap logs were placed in field
- Date trap logs were collected from field
- Date that trap logs were destroyed
- Method of destruction (burning, chipping, burying)

Destruction of brood material

- Date(s) piles of culled trees or other brood material was destroyed
- Method of destruction (burning, chipping, burying)

Foliar cover spray

- Date(s) cover spray was applied
- Name and formulation of product
- Finished spray volume (gallons applied/acre)

Visual inspection of shoots

- Date(s) fields were inspected

List of U.S. Counties Known to be Infested by Pine Shoot Beetle (187 counties in 8 states as of October 1996)

Illinois— 22 Counties

BOONE
CHAMPAIGN
COOK
DEKALB
DU PAGE
GRUNDY
IROQUOIS
KANE
KANKAKEE
KENDALL
LAKE
LA SALLE
LEE
LIVINGSTON
MCHENRY
MCLEAN
OGLE
PIATT
STEPHENSON
VERMILION
WILL
WINNEBAGO

Indiana— 32 counties

ADAMSIN-ALLEN
BENTON
BLACKFORD
CASS
DE KALB
DELAWARE
ELKHART
FULTON
GRANT
HUNTINGTON
JASPER
JAY
KOSCIUSKO
LA PORTE
LAGRANGE
LAKE
MARSHALL
MIAMI
NEWTON
NOBLE
PORTER
PULASKI
RANDOLPH
ST. JOSEPH
STARKE
STEUBEN
TIPPECANOE
WABASH
WELLS
WHITE
WHITLEY

Maryland— 1 county

ALLEGANY

Michigan— 52 counties

ALLEGAN
ANTRIM
BARRY
BAY
BERRIEN
BRANCH
CALHOUN
CASS
CHARLEVOIX
CLARE
CLINTON
EATON
EMMET
GENESEE
GLADWIN
GRATIOT
HILLSDALE
HURON
INGHAM
IONIA
ISABELLA
JACKSON
KALAMAZOO
KENT
LAKE
LAPEER
LENAWEE
LIVINGSTON
MACOMB
MANISTEE
MASON
MECOSTA
MIDLAND
MISSAUKEE
MONROE
MONTCALM
MUSKEGON
OAKLAND
OCEANA
OSCEOLA
OTSEGO
OTTAWA
SAGINAW
SANILAC
SHIAWASSEE
ST. CLAIR
ST. JOSEPH
TUSCOLA
VAN BUREN
WASHTENAW
WAYNE
WEXFORD

New York— 16 counties

ALLEGANY
CATTARAUGUS
CAYUGA
CHAUTAUQUA
ERIE
GENESEE
LIVINGSTON
MONROE
NIAGARA
ONTARIO
ORLEANS
OSWEGO
SENECA
STEUBEN
WAYNE
WYOMING

Ohio— 43 Counties

ALLEN
ASHLAND
ASHTABULA
AUGLAIZE
CARROLL
COLUMBIANA
CRAWFORD
CUYAHOGA
DEFIANCE
DELAWARE
ERIE
FULTON
GEAUGA
HANCOCK
HARDIN
HARRISON
HENRY
HOLMES
HURON
KNOX
JEFFERSON
LAKE
LORAIN
LUCAS
MAHONING
MARION
MEDINA
MORROW
OTTAWA
PORTAGE
RICHLAND
SANDUSKY
SENECA
STARK
SUMMIT
TRUMBULL
TUSCARAWAS
UNION
VAN WERT
WAYNE
WILLIAMS
WOOD
WYANDOT

Pennsylvania— 19 counties

ALLEGHENY
ARMSTRONG
BEAVER
BUTLER
CAMERON
CLARION
CLEARFIELD
CRAWFORD
ELK
ERIE
FOREST
JEFFERSON
LAWRENCE
MCKEAN
MERCER
VENANGO
WARREN
WASHINGTON
WESTMORELAND

West Virginia— 2 counties

HANCOCK
OHIO