SLIDE 1:
This is Steve Johnson, University of Maine Cooperative Extension, bringing you information on Integrated Pest Management. It is possible to receive a Maine Board of Pesticides Control recertification credit for this presentation. As this presentation is approximately a half hour, another presentation would also have to be viewed. Additionally, a test must be passed with a minimum of 80 percent correct answers on each presentation. While there is no charge for viewing this information, there is charge for taking each test, whether the tests are passed or not.

SLIDE 2:
IPM is an abbreviation for Integrated Pest Management.

SLIDE 3:
But what is Integrated Pest Management?

SLIDE 4:
Dr. Perry Adkisson and Dr. Ray F. Smith are generally credited with the development of Integrated Pest Management systems, which initiated with their work in the 1950's. Integrated Pest Management was formulated into national US policy in 1972 when then President Richard Nixon directed federal agencies to take steps to advance the concept and application of IPM in all relevant sectors. In 1979, then President Jimmy Carter established an interagency Integrated Pest Management Coordinating Committee to ensure development and implementation of Integrated Pest Management practices. Drs. Adkisson and Smith received the 1997 World Food Prize for their shared achievement in developing and propounding the practice of Integrated Pest Management programs by farmers around the world.

SLIDE 5:
Integrated Pest Management, or IPM, is a long-standing, science-based, decision-making process that identifies and reduces risks from pests and pest management related strategies. IPM provides an effective strategy for managing pests in residential and public areas to farmland. IPM serves to provide an effective, low-risk approach to protect resources and people from pests.

Integrated Pest Management is a comprehensive approach to solving pest problems using sound scientific solutions for a series of pest management evaluations and decisions on control. Integrated Pest Management can involve buildings, agricultural crops, or any situation where pests interfere with either our livelihood or our enjoyment of life.

Integrated Pest Management uses information on pest life cycles and how these life cycles interact with the environment. Integrated Pest Management uses a variety of pest management techniques that focus on pest prevention, pest reduction, and the elimination of conditions that lead to pest infestations. This information is used in combination with pest control methods to manage damage and loss by the most economical means while minimizing hazards to people, property, and planet.

SLIDE 6:
The U.S. Environmental Protection Agency has defined IPM as: Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. Routine application of pesticides to crops, animals, buildings or landscapes without consideration of need is not Integrated Pest Management. Pesticides are often part of an Integrated Pest Management program, but are rarely, if ever, the first option.

Integrated Pest Management is often associated with agricultural situations but is not limited to them. Integrated Pest Management can be applied to any situation where pest damage occurs. Integrated Pest Management applies control measures to pests only when numbers of these pests exceed or are likely to exceed acceptable numbers. The action or actions are designed to target the specific pest while limiting the impact of the action on people and planet. The Integrated pest management approach has pest management practices compatible with objectives. One object of farmers is to be and stay profitable.

An Integrated Pest Management regime can be quite simple or sophisticated. Historically, the main focus of Integrated Pest Management programs was on agricultural insect pests. Although originally developed for agricultural pest management, Integrated Pest Management programs are now developed to encompass diseases, weeds, and other pests that interfere with the management objectives of sites such as residential and commercial structures, lawn and turf areas, and home and community gardens.

SLIDE 7:
Integrated Pest Management incorporates information on the pest life cycles and pest interaction with the environment. This information, in combination with pest control methods available, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. Routine application of pesticides to crops, animals, buildings or landscapes without consideration of need is not Integrated Pest Management. Pesticides are often part of an Integrated Pest Management program, but are rarely, if ever, the first option.

SLIDE 8:
Integrated Pest Management is often associated with agricultural situations but is not limited to them. One object of farmers is to be and stay profitable.

Integrated Pest Management can be applied to any situation where pest damage occurs. Integrated Pest Management applies control measures to pests only when numbers of these pests exceed or are likely to exceed acceptable numbers.

The action or actions are designed to target the specific pest while limiting the impact of the action on people and planet. The Integrated pest management approach has pest management practices compatible with objectives.

Integrated Pest Management embodies the three P's: People, Planet, and Profit.

SLIDE 9:
Traditionally a pest is defined as any organism that interferes with production of the crop. Generally people think of pests as insects, diseases and weeds, but there are many other types including nematodes, arthropods other than insects, and vertebrates. Pests include the adult Colorado potato beetle seen in the photograph. IPM now deals with pests in many non-crop situations, such as human health and comfort.

SLIDE 10:

Do Integrated Pest Management and organic production differ? Yes. Integrated Pest Management permits fertilizers and pesticides derived from synthetic materials where organic production permits fertilizers and pesticides derived from natural materials. Like pesticides used in integrated pest management programs, pesticides used in organic programs also can have harmful effects on humans, animals and the environment, and must be used carefully and only when needed. Integrated Pest Management strategies can help organic production systems reduce pesticide hazards.

SLIDE 11:
Are all pesticides bad? No. The World Health Organization estimates that 1964, Sri Lanka reduced cases of malaria from 3 million per year to 29. Malaria cases reported to increase to 600,000 a few years after insecticidal sprays were halted. Additionally, that there were 243 million cases of malaria and 863,000 deaths from Malaria in 2008. Almost 90% of the deaths occurred to African children under 5 years old. The introduction of an integrated pest management of mosquito netting treated with insecticide has reduced malaria deaths from 66% to 97%.

SLIDE 12:
Can I use integrated pest management? Yes, integrated pest management can be used by anyone that deals with pests. Integrated pest management can be labor and management intensive and requires planning. Planning includes efforts before planting on what varieties to grow, which fields to grow them as well as planning during the season for monitoring the field. As always, weather conditions can nullify past or potential decisions based on integrated pest management.

SLIDE 13:
Adoption of integrated pest management is not all or nothing proposition. Adoption of integrated pest management is a continuum from one mainly based on preventative chemical control measures to one based on multiple strategies with intensive biological approaches. The practice of integrated pest management can be site-specific, with individual tactics determined by site-specific scenarios of crop development, pest levels, and environmental considerations.

The goal of most integrated pest management programs is not to eradicate a pest but to manage the pest at levels acceptable for the situation. After consideration of all available preventive and curative options, an integrated pest management approach uses multiple objectives at appropriate timings in the pest's life cycle. Curative options are based on informed decisions and are implemented to achieve optimal results.

SLIDE 14:
Pest Identification

The first step of Integrated Pest Management is the proper identification of the pest. Like most first steps, this is the most critical aspect of integrated pest management. Mistaken identity of the pest will undoubtedly result in, improper and unwarranted actions. These actions could be ineffective as well.

For example, every spring my office gets a large number of homeowner calls and visits with concerns about insects on the outside of their home. Home owners are concerned about the insects biting them, their pets, or damaging their home. In some cases, the homeowner has applied a general use insecticide on the outside of their home to control these pests.

As it turns out, these homeowners are along one of the larger rivers in the area and they have brought in adult stoneflies. Stoneflies are insects that have an aquatic larval from and a terrestrial adult from. Adult stoneflies mate, the females produce eggs and deposit them in water and die soon after. These insects are an important food source for fish in the river and do not bite humans or pets nor do they damage structures. The value of these insects to the environment make killing them a questionable decision. The short life of adult stoneflies assures that the spring flush of adults will be short lived and soon they will be gone. The happy ending to this story is that when the insect is identified and the situation explained to the homeowner, they tend to be very happy to leave them alone and let nature run its course.

Similarly, bedding plant samples have been diagnosed with fungal infection and have been treated with a fungicide. When the plant condition does not improve, they have been brought to my office for intervention. It turns out that some of these problems are plant damage from over watering. Proper watering solved the problem.

SLIDE 15:
Do you really have a problem? Are stoneflies on a building exterior a problem or a nuisance? Are carpenter ants in the house a problem or a

nuisance? Are cluster flies in the house a problem or a nuisance? Once the pest has been properly identified, assessment of the situation is required. Assessment will include what pests are active, why they are active, and where they are active. Assessment methods include surveys, scouting, trapping and similar activities

SLIDE 16:
A thorough understanding of pest and host biology is essential. Understanding pest biology will explain why the pests are active, where they are active, where they live, and the best life stage to manage the pest.

SLIDE 17:
Shown is the life cycle of *Sclerotinia sclerotiorum*, causal agent of Potato White Mold. Understanding a pathogen’s life cycle vulnerable periods to help target pest control practices or timing of specific pest control strategies to control the pest.

SLIDE 18:
After identification of the pest, monitoring of the pest is needed. This is a key component of any Integrated Pest Management program. Monitoring is not a disorganized approach but rather a standardized approach with proven techniques. Monitoring can be direct observations or trapping of pests, or indirect observations such as feeding damage on leaves, pest droppings, or something similar. Monitoring the pest population can help guide control tactics. Scouting is common form of monitoring and is one of the foundations of integrated pest management.

SLIDE 19:
Field scouting includes walking through a field or an area and stopping at a set number of locations to make observations. The number stops and the number of samples at each stop changes from crop to crop and pest to pest. The walking pattern can be different for different shaped fields. Generally an M-shaped walking pattern is most efficient with rectangular or square areas. A Z walking pattern is also commonly used.

SLIDE 20:
Shown here is a monitoring sheet – these should be kept for a record.

Proper record keeping is essential while monitoring pests. Information from records will establish if the pest population is changing, as well as provide guidance on when pests may appear.

SLIDE 21:
Shown here is a weather station.

Another foundation of integrated pest management is forecasting. Weather data are collected and used to predict pest outbreaks. This allows treatment applications to be optimally timed. Forecasting has long been used in potato late blight disease control onset and timings. Maine uses a system called NoBlight.

SLIDE 22:
Late blight is forecasted with severity values. Severity values are calculated from a combination of temperature, relative humidity, and rainfall. The onset of preventative applications and the frequency of the subsequent applications are determined by the accumulation of severity values over the previous 7 days. It is an example of the application of IPM principals. Applications of plant health medicines are timed for when they are needed based on weather and pathogen biology.

SLIDE 23:
Insect pests are also forecasted in Maine. Insect life cycles are strongly influenced by weather, or more importantly, temperature. Growing degree days are used to predict the development of the European corn borers in potato systems in Maine. The insect life cycle is used to predict when different insect stages will appear. This helps target the vulnerable life stages and better time control applications. This can be coupled with monitoring of individual fields to determine if an application is needed.

SLIDE 24:
The base development temperature used for the European corn borer, shown here, is 50 degrees Fahrenheit so.

SLIDE 25:
To calculate GDD:

Given a high temperature	75
Given a low temperature	55

Calculate a mean temperature = (high + low) = (75 + 55)/2 = 65
Determine GDD for the day
= Mean temperature – GDD base = 65 – 50 = 15

Maine European corn borer Degree Day Accumulations

Thresholds:

First moths of the year	600 degree days
First eggs	800 degree days
Egg hatch	900 degree days

These GDD are accumulated from January 1 each year.

SLIDE 26:
First, it is critical to understand that not all pests have to be controlled at all times.

SLIDE 27:
The economic injury level or EIL is the lowest population that will cause economic damage. The economic threshold or ET is the pest population level that will result in economic loss. The ET is never higher than the EIL. An environmentally safe insect growth regulator may be highly targeted to one species but takes 5 days to be effective. The ET levels for this insect are set at levels that would increase unchecked to the EIL level in 5 days. Often, farming practices limit instantaneous decisions. If it takes a half a day to prepare the sprayer and one day to spray the crop, the ET has to reflect this.

Shown is a hypothetical chart of a pest population over time with the economic injury level and the economic threshold noted. The solid red line of pest population increases beyond the economic injury level resulting in loss. Treatment at the economic threshold limits the population increase to where it never reaches the level where loss would occur.

The economic threshold or ET is an action threshold. The economic threshold is the pest population level at which control should be initiated to keep the pest population from reaching an economic injury level. In other words, the term “economic threshold” is used to describe the level of pest presence that justifies control. After pest identification and pest monitoring, an economic threshold needs to be established. Economic thresholds can be economic, health, or aesthetic thresholds. In most cases, economic thresholds where human health or aesthetics are concerned are lower than those set on the economic productivity of a crop. Most crops can tolerate a certain number of pests before economic loss occurs as there are costs associated with control measures. Economic thresholds are the point at which the cost of damage by the pest is more than the cost of control.

Economic thresholds for plant diseases can be the occurrence of specific accumulation of climate conditions over a period of time or they can be based on phonologic development of the host. Economic thresholds for weed control are generally based on weed populations. Economic thresholds for insect pests are generally based on population levels or feeding damage. Economic thresholds for agricultural crops are based on field research and further scientific studies overlain with economics. As expected, economic thresholds vary considerably from pest to pest and from crop to corp.

It would not make economic sense to spend $25 per acre to treat a crop for an insect pest that is at a population level that relates to a $15 per acre loss.

When the pest is properly identified, the level of the pest accurately measured and the level is above the pest’s economic threshold, a pest control treatment may be warranted.

SLIDE 28:
Shown here is a monitoring sheet with thresholds circled.

If 250 adult Colorado Potato Beetles are found on 50 plants, yield reductions will likely result that will have a higher economic value than the cost of control. By comparison, seeing a single black widow spider in your basement would indicate a need for some sort of control. When a pest control is warranted, there are a number of strategies that can be used. Frequently, more than one strategy is used at the same time. Pest control strategies include, among others, cultural, mechanical, biological, and chemical pest control.

SLIDE 29:
Pest control strategies include, among others, cultural

Cultural pest controls include choosing plant varieties that are resistant to certain pests or tolerant to certain levels of pest injury. Orientation of crop row to facilitate foliage drying is another example of cultural control. Proper fertilization can also be a cultural control method to encourage healthy plant growth. Crop rotation has long been used as a cultural control of soil-borne pathogens as has planting pest- resistant varieties or rootstocks. Proper crop rotation can reduce the level of Rhizoctonia on potatoes, shown in the slide. Using certified seed limits contaminates, be they pathogen or weed seeds, introduced into the field.

Choosing a crop and variety adapted to local environmental conditions will help produce a healthy crop. Properly growing the crop with appropriate fertilizers and rates based upon current soil tests can give the crop a competitive edge over weeds and help shade the soil and reduce weed seed germination. Proper spacing within the row and between the rows can also help shade the soil and reduce weed seed germination.

SLIDE 30:
Pest control strategies include, among others, cultural.

Cultural control may be aimed at making the environment less favorable to pests. Keeping areas mowed around production fields can reduce some insects that prefer this type of area for an alternative host, shelter, mating, or egg laying. Burying crop residue with plant pathogens or overwintering insect larvae can lessen pests the potential for future crops. Cultural control methods can be very effective and cost-efficient and present little to no risk to people or the environment. It is easy to see here where late blight occurred in the shade of the hedge row. Not planting specific areas or paying particular attention to certain areas may be required.

SLIDE 31:
Pest control strategies include, among others, mechanical.

Show here is timely cultivation for weed control. Timely cultivation not allowing weeds to get established or go to seed will go a long way to reducing weed populations the following year. In some situations, it may be cheaper than applying herbicides on the emerging weed crop. Understanding pest biology will explain why the pests are active, where they are active, where they live, and the best life stage to manage the pest. The use of row covers, plastic or otherwise, are mechanical pest control strategies.

Mechanical or physical pest controls include picking pests off plants, such as picking Colorado potato beetles off potato plants. The application of netting to exclude birds from blueberry plants is an example of mechanical or physical pest control. This is a tactic for late blight control.

SLIDE 32:
Shown here is a mechanical control by killing a small area in a potato field to reduce the inoculum and slow the spread of the pathogen. The aim is save the rest of the field. This is a tactic for late blight control.

SLIDE 33:
Shown here is a mechanical control by burning infected plants in the field.

SLIDE 34:
Pest control strategies include, among others, biological.

Natural control and biological control are sometimes regarded as similar but in fact, they are not. Biological control involves the introduction of natural predators, parasites, or competitors in the field. Natural control is an attempt to enhance naturally occurring beneficial organisms. Introduction of ladybug larvae into a field is an example of biological control. Choosing a fungicide that does not kill naturally occurring entomopathogenic fungi that parasitize aphids is an example of natural control. Shown here is a ladybeetle larvae eating aphids and a biological control.

SLIDE 35:
Pest control strategies include, among others, chemical pest control.

Chemical control involves the targeted application of pesticides including herbicides, insecticides, and fungicides. First and foremost, always read the label before using any chemical product. Chemical application using properly calibrated equipment with the pesticide that has the lowest toxicity to humans and non-target organisms at the lowest effective rate is an integrated pest management approach.

Integrated pest management stresses a multidisciplinary approach to pest management and control. Reliance on a single control tactic can shift pest complexes, favor pests that are resistant to the single control tactic, or cause other undesirable effects. Pests interact with other pests, parasites, competitors, the host, and their environment. Integrated pest management mirrors these interactions.

SLIDE 36:
This is Steve Johnson, University of Maine Cooperative Extension, bringing you this information on Integrated Pest Management. It is possible to receive a Maine Board of Pesticides Control recertification credit for this presentation. As this presentation is approximately a half hour, another presentation would also have to be viewed. Additionally, a test must be passed with a minimum of 80 percent correct answers on each presentation. While there is no charge for viewing this information, there is charge for taking each test, whether the tests are passed or not.