SCRIPT FOR POWERPOINT PROGRAM

"MANAGEMENT OF INSECT PESTS OF CORN IN WESTERN NORTH CAROLINA"

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Slide 1. Title ---- "Management of Insect Pests of Corn in Western North Carolina"

Slide 2. "Chapter 1. Corn insects in the NC Piedmont and Mountains"

In western NC (Piedmont and Mountains), field corn is primarily grown under conservation tillage (no-tillage or strip tillage). On average, fields tend to be small and often bordered with wild vegetation. Rotation, a cultural technique important in keeping certain insects low, is often not practiced by corn growers. Optimal yield potential of corn, for both grain and silage, requires a full population of healthy plants. Many fields will have damaging populations of pest insects and, in particular, western corn rootworm is often a problem. However, many fields also will not have damaging insect infestations and it is difficult to identify fields that are at risk from those that are not.

Slide 3. "Field corn IS"

Field corn is a plant population sensitive crop – it requires a full stand of productive, mature plants for optimum yield of grain or silage. Newly planted corn seed and small seedlings are very sensitive to insect damage and become more tolerant to insect feeding as they grow larger. All the plant sizes shown in this slide are very vulnerable to insect feeding. Yield potential of corn fields is often reduced during the first three weeks following planting.

Slide 4. "Corn, a population sensitive crop"

These graphs, from Dr. Ron Heiniger, NCSU Ext. Corn Specialist, depict the relationship of plant population to yield. Although not shown, the yield curve for populations below 19,000 plants per acre drops even more steeply with plant loss than the higher populations shown.

Slide 5. "Early season insect pests that may reduce plant stands and seedling quality"

Early season insect pests of corn can be categorized by the plant stage attacked. Pests that attack planted seed and **feed on germinating seed or pre-emerging seedlings** include wireworms, seed corn maggot, southern corn rootworm (aka spotted cucumber beetle), seed corn beetles, and a few other miscellaneous

insects. **Small, emerged seedlings** may be attacked by wireworms, southern corn rootworm, cutworms, white grubs, root aphid, brown stink bug, and sugar cane beetle. After seedlings grow beyond the eight leaf stage most of the previously mentioned insects no longer pose a threat to the plants; these plants have become more massive, are typically growing fast, and out-run most insect damage. However, a few insects can attack and damage these larger plants. Western corn rootworm and stalk borer are the two most common pest insects at this growth stage.

NOTE: slides #6 - #11 are intended to give more description of the pests and to present pictures of the specific early season insect pests.

Slide 6. "A. Insects on corn seed"

Swelling and sprouting corn kernels are attractive to certain insects living in the soil. Wireworms, several species, are by far the most common. If wireworms are numerous, corn plant stands can be greatly reduced before seedling emergence.

Slide 7. "A. Insects on corn seed" (continued from slide 5)

Seed corn beetle and other seed-feeding ground beetles (not shown) may also attack germinating kernels but usually do not do major damage. However, on occasion, seed corn maggot (shown), the larvae of a small fly, may cause serious damage. This most often happens when fields are moist and covered with decaying litter or manure. Seed corn maggot adult, larvae, and damage are shown.

Slide 8. "B. Insects on small seedlings"

Following emergence, but before seedlings reach the 8 leaf stage, additional stand loss often occurs. Young seedlings are very vulnerable to insect damage; the meristem (growing point) at the base of the seedling is often damaged. Once damaged in this manner plants usually die or loose apical dominance and sucker, and become unproductive. Other insects that damage seedlings include southern corn rootworm (shown), corn root aphid (shown), brown stink bug, and others. Seedling loss to insects is typically most common in no-tillage fields with abundant litter.

Slide 9. "Insects on small seedlings" (continued from slide 8)

Black cutworm and other species of cutworm also attack seedling plants. Small seedlings may be cut-off or larger seedlings may be tunneled. Brown stink bug also feed on the meristem tissue and can kill or deform plants.

Slide 10. "Insects on larger, whorl-stage plants"

Western corn rootworm eggs carry-over in fields planted with corn the previous season. Eggs begin hatching in May. Small larvae feed upon root hairs but later tunnel and eat roots. Heavy root-feeding will reduce the root mass.

Slide 11. "Insects on larger, whorl-stage plants"

A caterpillar pest, the common stalk borer, can often be found in field margins or weedy areas. Larvae bore into the whorl and rag the leaf tissue. If young stalks are tunneled, plants will die or become unproductive. Leaf feeding does not cause significant damage to the plant.

Slide 12. "Chapter 2. Management of corn insect pests of seeds and small seedlings"

Rotation, is an important tool for managing certain pests of corn but has little affect on insect pests of planted seed and young seedlings. However, conservation tillage contributes to the abundance of several pest species (e.g. wireworms, cutworms, brown stink bug, corn root aphids and others). Also, sites that have been in pastures or other weedy situations and are planted to corn frequently have high populations of seed and seedling pests. On these sites an insecticide designed to protect young crop stages is often required to obtain full yield.

Slide 13. "Tactics for managing corn insect pests of seed and small seedlings"

Practices that improve corn tolerance to insect feeding and those that reduce insect pest pressure are used in a systems approach. Planted kernels and small seedlings are very susceptible but larger plants are quite tolerant. Thus, management of insect damage must address rapid germination and grow-off. Accordingly, using favorable agronomic practices (e.g. maintaining proper pH and fertility levels, selecting favorable hybrids, planting properly, using starter or pop-up fertilizers, avoiding no-tillage if necessary, etc.) can have a major role in insect pest management. Also, if high populations of pest insects are anticipated, an effective insecticide may be justified.

Slide 14. "Field factors affecting the abundance of at-planting insect pests of corn"

Populations of insect pests in fields before planting can not be precisely determined. However, predictions can be made by using ecological characteristics of each field which favors or disfavors those pests. Fields can be judged as being "more" or "less" likely to have an insect population and can be used to justify insecticide use. Some of these characteristics include:

Soil moisture holding capacity – more moisture favors insect pests

Tillage – disking and plowing directly kills many insect pests and exposes others to predation (e.g. birds) and to the elements.

History of infestation – some fields are often infested whereas others seemingly never have many insect pests; this may be for unknown reasons but having this knowledge helps one make new predictions of insect pest occurrence.

Manure application – dairy farmers often use their silage corn fields for disposing manure; repeated applications of cow, chicken, or green manures can favor certain insect pests.

Litter / mulch– conservation tillage results in a litter cover that provides a favorable zone near the soil surface, facilitates tilth, provides protection for soil and soil surface dwelling insects, and sustains insect and worm tunnels in the soil.

Rotation – Growing corn after corn is essential to the pest status of western corn rootworm since it lays eggs in the previous crop and larvae from those eggs infest the current crop.

Previous crop – most of the soil and soil surface dwelling insect pests of corn seed and seedlings favor grassy plants and corn fields following a pasture or grassy weeds will likely have more insect pests.

Slide 15. "Is an insecticide needed to protect planted corn seed and seedlings?"

Not all corn fields justify the use of an at-planting insecticide. A scoring system has been devised that allows growers predict the likelihood of profitably employing a soil insecticide. The system is a general guide based on field factors that increase the odds of high pest numbers (refer to Slide 14). The system is not infallible. The system can be applied to single fields or groups of similar fields in proximity. If needed, an at-planting granular insecticide or Poncho or Cruiser seed treatments are recommended (see the NCSU Agricultural Chemicals Manual).

Slide16. "Guide for determining insecticide need to protect from seed and seedling insects"

The guide is a point system where field factors are judged as being less favorable for insect pest habitation (fewer points) or more favorable (more points). Each field or group of similar fields is scored on each of the 7 factors and awarded the appropriate point number from the low, moderate, or high columns. Total points for each field must equal 66 or more points to justify insecticide treatment.

NOTE: The following 8 slides are intended to show the effectiveness of the insecticide seed treatments Cruiser and Poncho 250 against a complex of seed / seedling feeding insect pests (in the Wilkes and Iredell county tests) or against a very high population of corn wireworm (in Pasquotank Co.).

Slide 17. "At planting insecticides in conventional tillage corn. Wilkes Co., NC. 2004"

This table, from Wilkes Co., shows that plants per acre on 5/26, plants per acre on 9/04, and silage yield on 8/11 were all positively increased by using a soil insecticide (Force granular applied in-furrow at planting or Poncho or Cruiser at 1.25 mg/kernel, or Poncho at 0.25 mg/kernel). The addition of Yieldgard corn rootworm resistant corn did not improve productivity indicating that the benefit resulted from controlling seed and seedling insects in 2004, not from controlling western corn rootworm.

Slide 18. "At planting insecticides in conventional tillage corn. Iredell Co., NC. 2004"

This table, from Iredell Co., presents data that again indicates that the seed treatments controlled seed and seedling feeding insects but that Yieldgard corn rootworm resistant corn did not increase silage yield over the seed treatments, and thereby indicating that corn rootworms were not an important factor in that field in 2004 (however, the following year another test was conducted in the identical locations with much different results; see Slide 40).

Slide 19. "Corn plant stand under a high wireworm population; At-planting insecticide test. Pasquotank Co., NC. 2003"

An insecticide screening test was conducted in Pasquotank Co. in 2003. There was a very high population of corn wireworm in the field at planting. The figure shows that Poncho 250 and Cruiser (at the same rate, 0.25 mg/kernel) protected the plant stand well in comparison to the untreated control (UTC), Kernel Gard (a hopper box treatment), and Lorsban 15G, a standard at-planting applied in-furrow granular insecticide.

Slide 20. "Corn grain yield under a high wireworm population: At-planting insecticide test. Pasquotank Co., NC. 2003.

Yield data shown in this slide, from the same test, support contentions made on Slide 19 and clearly indicates the importance of protecting corn seed and seedlings in order to obtain favorable yields.

Slide 21. Photograph of Pasquotank Co. corn insecticide test – untreated plot.

Wireworms destroyed the untreated plot. On 7/25/2003, this plot retained an average of 3717 plants per acre, only 14% of the original seed population planted.

Slide 22. Photograph of Pasquotank Co. corn insecticide test –Lorsban 15G plot (6.5 lbs/acre applied in-furrow at planting)

Lorsban 15G, the standard treatment, failed to protect the seed and seedlings adequately in this test; this treatment retained an average of 13626 plants per acre, only 51% of the original seed population planted.

Slide 23. Photograph of Pasquotank Co. corn insecticide test –Cruiser plot (0.25 mg/kernel rate applied as a seed treatment).

Cruiser performed much better than the standard, Lorsban 15G in this test. Clearly, there are more plants and they appear more robust. This treatment retained an average of 19939 plants per acre, 75% of the original seed population planted.

Slide 24. Photograph of Pasquotank Co. corn insecticide test –Poncho 250 plot (0.25 mg/kernel rate applied as a seed treatment).

Poncho 250 performed much better than the standard, Lorsban 15G, in this test. The performance was similar to Cruiser. This treatment retained an average of 20239 plants per acre or 76% of the original seed population planted.

Slide 25. "Chapter 3. Western corn rootworm"

Three species of corn rootworms can be found in the Piedmont and Mountain regions of NC. They all can be significant pests of corn. The western corn rootworm and northern corn rootworm are very similar in appearance and have similar life cycles. These insects have one generation per season, over-winter as eggs, and larvae attack corn roots. The southern corn rootworm has the same body shape and size but has a very different life cycle than the western and northern corn rootworms. The southern corn rootworm has many generations per season, over-winters in the adult stage, and larvae are a pest of plant corn seed and small seedlings. Western corn rootworm is by far the most important pest of the three rootworms and it will be emphasized in this talk. (Provide audience with dialogue presented on Slide 25).

Slide 26. "WCR larvae"

Adult western corn rootworm lays its eggs in the soil, in corn fields, and the eggs over-winter. The eggs hatch in late May and early June and new larvae feed upon corn root hairs and roots for about 6 weeks (provided that corn is planted in the field that harbors the eggs). Larger larvae eat larger roots and tunnel roots.

Slide 27. “Corn root damage”

These photographs show western corn rootworm damage to corn roots. The result is a much reduced root system. Yield reduction usually does not occur until #3 or higher is achieved on the Iowa State 6 point damage scale. With ratings above #3 roots cannot properly take-in needed moisture and nutrients. Also, plants are not well anchored and are prone to blowing over.

Slide 28. “Lodging following root damage by WCR larvae”

Significant root damage from western corn rootworm reduces the plants resistance to lodging. Once plants blow-over they grow back toward the sky, crooking upward. A condition called “goose necking”.

Slide 29. “WCR pupa”

Larvae become full grown and transform to the pupal stage within the soil in June.

Slide 30. “WCR adult”

This photograph shows a “typical” marking pattern and coloration of a western corn rootworm adult. However, the dark stripes may be broken and coloration may be lighter or darker. Adults emerge in June and July and mostly stay within the corn field, mating and feeding on whorl leaves, silk, and pollen, depending on the crop stage.

Slide 31. “Leaf feeding damage by adult western corn rootworm”

Adults will readily feed upon corn leaf tissue and “window-pane” strips along the upper leaf surface. Adults will also extensively feed on silks and, if very numerous, can interfere with proper pollination of the ears. Western corn rootworm adults also love to feed on various types of squash.

Slide 32. “WCR eggs”

Following mating and feeding, females move to the soil and deposit numerous eggs. Most eggs are laid in corn fields.

Slide 33. "Cultural tactics for managing western corn rootworm"

Several cultural practices can be used to reduce damage from western corn rootworm. Rotation is very effective, since the eggs are laid at high numbers only in corn fields. Rotation can be successfully done with almost any alternative crop since western corn rootworm is a pest of corn only. Early planting and rapid seedling growth will help the plants become larger and more tolerant by the time larvae hatch and reach a damaging size.

Slide 34. "Insecticidal management of western corn rootworm"

When western corn rootworm populations are high, only insecticide or Bt biotech corn will prevent the crop from suffering significant damage. To determine the need for using an insecticide or Bt corn for western corn rootworm, a scoring system has been developed (Slide 35). An insecticide is recommended if a score of 60 or more points are reached. The NCSU Agricultural Manual can be consulted for insecticide recommendations. Generally, recommended insecticides work well; however, very early planted fields may have lost much of the insecticide by the time eggs hatch and thus may not give adequate performance. This problem can be avoided by using biotech Bt corn.

Slide 35. "Guide for selecting insecticide of Bt corn for western corn rootworm management"

The guide is a point system where field factors are judged as being less favorable for corn rootworm habitation (fewer points) or more favorable (more points). Each field or group of similar fields is scored on each of the 6 factors and awarded the appropriate point number. Total points for each field must equal to 60 or more to justify remedial action. Since western corn rootworm is only a pest if corn follows corn the next season, a total of 60 points or more can not be reached unless corn follows corn. The higher the score over 60 points the more likely for corn rootworm to occur in higher numbers and the larger the benefit of a remedial treatment.

Slide 36. "Western corn rootworm management with biotech corn"

Both Monsanto Company and Dow Agrosciences have developed biotech traits that are delivered in hybrid seed corn. The trait brands are Yieldgard Rootworm (Monsanto) and Herculex RW (Dow) and are genes that enable corn plants to express two different Bt toxins that are effective against rootworm larvae feeding upon the respective plants. These toxins are expressed in the roots and are present season-long. Both have done well in university trials. However, neither trait is effective against the various seed and seedling feeding insect pests. If these

insects are a problem an at-planting granular or seed treatment will be needed for control.

Slide 37. "Do you expect both seed and seedling insect pests and corn rootworm?"

If an at-planting granular insecticide is used for corn rootworm it will also satisfy the need for seed and seedling pest control. The companies selling Poncho and Cruiser seed treatments recommend the high rate of these products (1.25 mg/kernel) when used against western corn rootworm and these treatments will satisfy the need for seed and seedling pests. However, these products are effective for a relatively short duration and only perform at a moderate level; they may not perform well under very high rootworm populations. Bt biotech corn (Yieldgard Rootworm or Herculex RW) perform very well against corn rootworm but are not active against seed and seedling insects. Therefore, a low rate of a seed treatment (0.25 mg/kernel) is ordinarily delivered on the seed upon purchase.

Slide 38. "Summary of Yieldgard Rootworm tests under light and moderate-to-heavy corn rootworm pressure. Iowa. 2003."

Data shown in this table demonstrates expected results for insecticides or biotech Bt corn under light or moderate-to-heavy corn rootworm populations. No response was observed for Yieldgard Rootworm or insecticide when the corn rootworm population occurred at a low level. However, under moderate-to-high pressure a favorable response was observed with Yieldgard Rootworm but not for the insecticide. In other trials in the mid-west US, Herculex RW has performed equal to or better than Yieldgard Rootworm

Slide 39. "At-planting insecticides in no-tillage corn. Iredell Co., NC. 2005"

This test was located on the identical site as in 2004 (see Slide 18) but the pest complex had changed in 2005. Whereas seed and seedling pests predominated in 2004 the western corn rootworm dominated in 2005. Silage tonnage was greatly improved by Yieldgard Rootwoom Bt corn. Seed treatments showed benefit but had lower yields vs. the Yieldgard. The conventional granular insecticide, Force 3 G, showed no improvement over the UTC. Gross dollar returns are presented.

Slide 40. "Questions"