



# Ohio Pesticide Applicator Training

Seed Treatment

**Student Workbook**

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**Preface**

This workbook was prepared by the Ohio State University Extension for use as a self-study guide or in combination with an educational program. It has been developed to assist pesticide applicators in better preparing themselves for taking the exams required for certification in the seed treatment category. The sample questions presented in this manual will help the reader obtain a general understanding of seed pest problems, approaches to control, and general information needed to apply and use pesticides safely.

**How to Use this Workbook**

This workbook is designed to serve as a supplementary study guide to the following bulletin published by the Ohio Extension. The publication is available through local county Extension offices.

Bulletin 639  
*Seed Treatment for Agronomic Crops*

Users of this workbook should read the bulletin before attempting the workbook. When using this workbook, use the flap on the back cover to conceal the answers while answering the questions on the left-hand page. Once all the questions are answered, the user should check to see if the responses are correct, mark those incorrect, and read the explanation for each question. If the explanation is confusing or if you disagree with the answer or explanation, refer to the section indicated in the reference.

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Seed Treatment

**Student Workbook**

# SEED TREATMENT FOR AGRONOMIC CROPS

1. The first step in ensuring good crop stands is to use high-quality, disease-free seed.
  - A. True
  - B. False
2. Which of the following factors, over the last decade, has increased the need for high-quality seed?
  - A. Early planting
  - B. Narrower rows
  - C. No-till
  - D. Reduced tillage and reduced seed-bed preparation
  - E. All of the above
3. Which of the following factors does not affect the quality of the seed?
  - A. Damaged seed coat
  - B. Sunlight
  - C. Poor seed storage (temperature and humidity)
  - D. Insect feeding damage
  - E. Seed-borne fungi
4. Seed coat damage occurs only during harvest and cleaning of the seed.
  - A. True
  - B. False
5. Fungi infect the seed coat primarily:
  - A. When seed diseases occur due to wet conditions
  - B. When seed is stored below 13% grain moisture
  - C. When harvest of the seed crop is delayed for several weeks
  - D. A & C
  - E. B & C
6. Which of the following practices will reduce seed viability?
  - A. Moisture levels above 13% moisture
  - B. Poor storage conditions (wet and warm)
  - C. Excessive handling of seed
  - D. All of the above
  - E. None of the above

1. **Correct Answer: A, Introduction**

**Explanation:** Obtaining optimum stands is essential to maximizing yields. The use of high-quality, disease-free seed is the first step in ensuring good stands.

2. **Correct Answer: E, Introduction**

**Explanation:** Earlier planting, narrower rows, no-till, and incomplete seed-bed preparation are all factors for using high quality seed. Ultimately, the use of high-quality seed ensures fast-emerging seedlings that grow rapidly, are more tolerant to adverse weather conditions, and are able to better resist disease.

3. **Correct Answer: B, Introduction**

**Explanation:** Sunlight does not have a direct affect on the quality of the seed but seed-borne fungi, insect feeding damage, poor seed storage (temperature and humidity too high), and damaged seed coats can affect seed quality.

4. **Correct Answer: B, Introduction**

**Explanation:** Rough handling of the seed during harvest, cleaning, planting or any time during storage can damage the seed coat.

5. **Correct Answer: D, Introduction**

**Explanation:** When harvest of the seed crop is delayed several weeks or when seed diseases occur due to wet conditions, seed quality may be reduced due to infection by fungi. Infected seed can be detected at harvest; it is discolored, shriveled or moldy.

6. **Correct Answer: D, Introduction**

**Explanation:** Poor storage conditions reduce the viability of the seed drastically. Seed should be handled as little as possible and kept cool and dry. Moisture levels above 13% encourage the growth of fungi that reduce viability.

7. Small cracks in the seed coat assist the seed in germinating quickly.
- A. True
  - B. False
8. Proper seed treatment fungicides will increase germination of seeds if poor germination is the result of fungal infections.
- A. True
  - B. False
9. Fungicides are available which protect seed and young seedlings from all seed-borne pathogens.
- A. True
  - B. False
10. Under which of the following conditions will seed treatments be the most beneficial?
- A. Poor germination caused by excessive mechanical damage
  - B. Poor storage conditions
  - C. Fungal infections
  - D. Genetic or variety differences among seed
  - E. None of the above
11. Fungicide seed treatments always increase stands under poor germination conditions and ensure higher yields.
- A. True
  - B. False
12. Activity against certain soil-borne diseases lasts only as long as it takes the plant to emerge, which is generally less than two weeks under normal weather conditions.
- A. True
  - B. False
13. Since each planting situation is different, which of the following factors does not need to be considered in seed treatment?
- A. Soil moisture and temperature
  - B. Time of planting and planting rate
  - C. Planter type
  - D. Seed quality
  - E. Type of tillage

7. **Correct Answer: B, Introduction**

**Explanation:** Small cracks in the seed coat increases the chances of seed rot by permitting water-soluble nutrients to escape into the soil, thereby activating soil-borne fungi, and providing a quick entryway for seed-rotting organisms.

8. **Correct Answer: A, Introduction**

**Explanation:** This is a true statement.

9. **Correct Answer: B, Introduction**

**Explanation:** Fungicides are available which protect seed and young seedlings from many, but not all seed-borne pathogens.

10. **Correct Answer: C, Introduction**

**Explanation:** Seed infected by fungi before planting, or those planted in cool, wet soils or under conditions that delay emergence benefit the most from fungicide seed treatments. Poor germination caused by excessive mechanical damage to seed, poor storage conditions, genetic differences between variety or other non-pathological factors will not be affected by fungicide seed treatments.

11. **Correct Answer: B, Introduction**

**Explanation:** Fungicide seed treatments generally increase stands under poor germination conditions, however seed treatments do not always ensure higher yields. Generally, increased yields occurs when the seed treatment prevents frequent skips in row of emerging seedlings.

12. **Correct Answer: A, Introduction**

**Explanation:** This is a true statement. Because of these limitations, the grower must identify the potential disease problems associated with the seed and disease history of the field before planting.

13. **Correct Answer: C, Introduction**

**Explanation:** Seed quality, planting rate, tillage and seed bed preparation, soil moisture and temperature, time of planting, and likelihood of rapid emergence are all factors to consider in each planting situation. In most cases, the planter type will remain constant from field to field.

14. Fungicides are chemicals which:
- A. Are used to control diseases caused by fungi
  - B. May be fungicidal, meaning that the chemical actually kills the fungus
  - C. May be fungistatic, meaning that it slows the growth of the fungus or keeps it in check
  - D. All of the above
  - E. None of the above
15. Captan is which type of fungicide treatment when used to control seed-borne fungi?
- A. Protectant
  - B. Surface disinfectant
  - C. Systematic disinfectant
  - D. All of the above
  - E. None of the above
16. Fungicides are marketed under an assortment of names. Which of the following statements are true about fungicide names?
- A. Trade names are given to the product by the manufacturer
  - B. Common names are simple names given to the chemical in lieu of more complicated chemical names
  - C. The trade name of carboxin is Vitavax
  - D. An example of a fungicide chemical name is 5,6-dihydro-2-methyl-1,4 oxathiin-3-carboxanilide
  - E. All of the above
17. Which of the following statements concerning “broad spectrum” fungicides is false?
- A. Most fungicides are useful in controlling a relatively narrow group of fungi
  - B. Fungicide mixtures expand control to a much broader group of fungi are called “broad spectrum” fungicides
  - C. A common practice is to use mixtures of different seed treatment fungicides
  - D. All broad spectrum fungicides have low toxicity
  - E. Vitavax 200, a common broad spectrum fungicide, contains two fungicides, thiram and carboxin
18. Which of the following is not a fungicide seed treatment formulation?
- A. Solutions (S)
  - B. Flowables (F) and Liquids (L)
  - C. Emulsifiable Concentrates (EC)
  - D. Dusts (D) and Wettable Powders (W)
  - E. All of the above



14. **Correct Answer: D, *Seed Treatment Facts***

**Explanation:** All of the statements are true concerning fungicides.

15. **Correct Answer: B, *Seed Treatment Facts***

**Explanation:** Captan is a surface disinfectant used to kill fungi and fungi spores on the seed surface. Captan can sometimes be a protectant such as when used to prevent infection from soil-borne fungi like Pythium. Carboxin is a systematic disinfectant used to kill fungi already established within the seed. Maneb and Mancozeb are examples of protectant fungicides which are used to prevent infections of seeds and seedlings by soil-borne fungi.

16. **Correct Answer: E, *Seed Treatment Facts***

**Explanation:** All the statements are true.

17. **Correct Answer: D, *Seed Treatment Facts***

**Explanation:** Broad spectrum fungicides are just as toxic as the individual fungicides. All the other statements are true. In Vitavax 200, thiram is used on wheat to control seedling blights and carboxin is used to control loose and common smut. This fungicide combination controls all major seed-borne diseases of wheat.

18. **Correct Answer: A, *Applying Seed Treatments***

**Explanation:** Seed treatments come in a variety of formulations except Solutions (S). These materials may be used in slurry and mist-type seed treaters after mixing with water. Dust formulations have been developed for use as a planter box treatment by using special adhesives which adhere fungicide particles to the seed surface.

19. Pesticide treated seed requires special labeling if it is going to be sold.
- A. True
  - B. False
20. Leftover treated seed can be mixed into animal feeds.
- A. True
  - B. False
21. Which of the following fungicides are excellent, low toxicity, broad spectrum, largely protective contact fungicides used to control many plant diseases on barley, corn, oats, rye, sorghum, soybeans, and wheat? They are registered for use as wettable powders or flowable liquids.
- A. Captan + Carboxin
  - B. Captan + Lindane
  - C. Mancozeb and Maneb
  - D. A & B
  - E. None of the above
22. Which of the following fungicides is commonly combined with an insecticide such as Diazinon or Lindane formulated as a planter box treatment?
- A. Captan
  - B. Benlate
  - C. Carboxin
  - D. Maneb
  - E. Thiram
23. Which of the following is a systematic fungicide available as a seed treatment for the specific control of Pythium and Phytophthora?
- A. Thiram
  - B. Metalaxyl
  - C. Benomyl (Benlate)
  - D. Diazinon
  - E. Lindane
24. Which of the following organisms cause damping-off in plants?
- A. Fusarium
  - B. Pythium
  - C. Phytophthora
  - D. Rhizoctonia
  - E. All of the above

19. **Correct Answer: A, Requirements for Labeling**

**Explanation:** If pesticide treated seed is to be sold it must be colored with a dye to prevent use for food or feed. In addition, the treated seed must be labeled with the chemical name of the pesticide used and a warning statement that the seed has been treated.

20. **Correct Answer: B, Safety Precautions**

**Explanation:** Introducing treated seed with food and feed channels may cause serious injury to poultry, livestock and humans. Leftover treated seed should not be disposed of on soil surface where it might harm birds and wildlife. Destroy seed by burying at least 18" in isolated areas away from water supplies or according to label directions.

21. **Correct Answer: C, Fungicide Seed Treatments**

**Explanation:** Both Mancozeb and Maneb fit this description. Their activities are fair against seed-borne smuts and barley stripe and fair to good against seed rots and seedling blights.

22. **Correct Answer: A, Fungicide Seed Treatments**

**Explanation:** Captan is an excellent, low toxicity, broad spectrum fungicide used in combination with insecticides to control seed corn maggot, seed corn beetle and wireworm.

23. **Correct Answer: B, Fungicide Seed Treatments**

**Explanation:** Metalaxyl (Apron 25W) effectively controls damping off of Pythium and Phytophthora during the first 10 to 14 days of seedling growth. Metalaxyl has no activity against seed-born Phomopsis or Rhizoctonia stem rot of soybeans. Etridiazol(Terrazole) plus PCNB are also effective for controlling Pythium and Phytophthora. Diazinon and lindane are insecticides. Thiram and benomyl (Benlate) are broad spectrum fungicides used to control seed decay and seedling blights.

24. **Correct Answer: E, Seed and Soil-Borne Diseases of Field Crops**

**Explanation:** All of these organisms can cause damping-off. Damping-off disease is a general term used to describe the destruction of young seedlings by seed-borne or soil-borne organisms.

25. Damping-off disease is characterized by:
- A. Bare spaces where seed rotted or young seedlings were killed.
  - B. Poor stands associated with soil fungi attacking seed in cold, wet soils when germination is slow.
  - C. Wilting and death of seedlings after they emerge from the soil.
  - D. Brown water-soaked, soft sunken areas on seedling stems near the soil surface.
  - E. All of the above
26. Corn seedling diseases are more prevalent in cold wet soils than in soil with temperatures above 55 degrees Fahrenheit.
- A. True
  - B. False
27. Fungicide seed treatment is recommended for all seed corn to prevent or reduce seed decay and seedling blights.
- A. True
  - B. False
28. Corn smut, the leaf blights, stalk and ear rots, and virus diseases are controlled by seed treatment fungicides.
- A. True
  - B. False
29. Which of the following fungicides can be used to treat sorghum to control seedling blights, loose kernel smut, and covered kernel smut?
- A. Captan
  - B. Thiram
  - C. Carboxin
  - D. All of the above
  - E. None of the above
30. Seed treatment of small grains is recommended to treat which diseases?
- A. Smut diseases
  - B. Seed decay
  - C. Seedling blights
  - D. All of the above
  - E. None of the above

25. **Correct Answer: E, *Seed and Soil-Borne Diseases of Field Crops***  
**Explanation:** Pre-emergence damping-off disease is characterized by bare spaces where seed rotted or young seedlings were killed and poor stands associated with soil fungi attacking seed in cold, wet soils when germination is slow. Post-emergence damping-off is characterized by wilting and death of seedlings after they emerge from the soil with brown water-soaked, soft sunken areas on seedling stems near the soil surface.
26. **Correct Answer: A, *Recommendations for Specific Crops, Corn***  
**Explanation:** This is a true statement. Therefore, early-planted corn especially needs the added protection of a good seed treatment fungicide.
27. **Correct Answer: A, *Recommendations for Specific Crops, Corn***  
**Explanation:** This is a true statement. The germination and early growth of the seedling is a critical period in the life cycle of corn. Soil-borne organisms may invade and kill the embryo before germination or during the seedling stage. Surviving seedlings are often less vigorous.
28. **Correct Answer: B, *Recommendations for Specific Crops, Corn***  
**Explanation:** These corn diseases are not controlled by fungicide seed treatments.
29. **Correct Answer: D, *Recommendations for Specific Crops, Sorghum***  
**Explanation:** All of these fungicides are labeled for controlling seedling blights, loose kernel smut and covered smut. Head smut cannot be controlled by presently labeled fungicides. Most fungicides labeled for use on corn can be used on sorghum, however read the label to be certain of proper use and to determine whether the smut diseases are controlled.
30. **Correct Answer: D, *Recommendations for Specific Crops, Small Grains***  
**Explanation:** Seed treatment is recommended for all of these diseases in small grains. The smut diseases include stinking smut (common bunt) of wheat, loose smut of wheat and spelt, and loose and covered smuts of oats and barley.

31. Which diseases of small grains contribute to poor stands and poor quality seed which causes lightweight, shriveled grain?
- A. Head scab
  - B. Stinking smut
  - C. Glume blotch
  - D. A & B
  - E. A & C
32. The major cause of poor quality soybean seed in Ohio is Pythium.
- A. True
  - B. False
33. Seed treatment for soybeans is recommended for which of the following disease situations?
- A. For control of Rhizoctonia
  - B. When poor quality seed is used for planting (germination below 80%)
  - C. For early control of Phytophthora damping-off
  - D. A & B
  - E. B & C
34. When planted at recommended seeding rates, bin-run soybeans seed with greater than 80 percent germination, generally will not benefit from seed treatment.
- A. True
  - B. False
35. Decisions to use poor-quality soybean seed should be based on the fact that any seed treatment fungicide effective against seed-borne diseases will not increase germination more than 30 percent.
- A. True
  - B. False
36. Which of the following fungicides is not commonly used as a seed treatment in soybeans.
- A. Captan
  - B. Thiram
  - C. HCB (Hexachlorobenzene)
  - D. Carboxin-thiram
  - E. PCNB-terrazole
37. Phytophthora damping-off is a serious disease of soybean seedlings found in light, well-drained Ohio soils.
- A. True
  - B. False

31. **Correct Answer: E, *Recommendations for Specific Crops, Small Grains***  
**Explanation:** Seedling blight phases of head scab (*Gibberella zeae*) and glume blotch (*Septoria nodorum*) contribute to poor stands of small grains and poor quality seed, causing lightweight, shriveled grain.
32. **Correct Answer: B, *Recommendations for Specific Crops, Soybeans***  
**Explanation:** Phomopsis is the major cause of poor quality soybean seed in Ohio.
33. **Correct Answer: E, *Recommendations for Specific Crops, Soybeans***  
**Explanation:** Seed treatment for soybeans is recommended for two disease situations: 1) when poor quality seed is used for planting (germination below 80 percent) and 2) for early season control of *Phytophthora*.
34. **Correct Answer: A, *Recommendations for Specific Crops, Soybeans***  
**Explanation:** This is a true statement. One sure way of getting good quality seed is to buy certified seed that has the percent germination listed on the certified label along with the variety name and the seed treatment material.
35. **Correct Answer: B, *Recommendations for Specific Crops, Soybeans***  
**Explanation:** Decisions to use poor-quality soybean seed should be based on the fact that any seed treatment fungicide effective against seed-borne diseases will not increase germination more than 20 percent. If bin-run beans of 50 percent germination are treated with a fungicide, the grower should not expect over 70 percent germination in the field.
36. **Correct Answer: C, *Recommendations for Specific Crops, Soybeans***  
**Explanation:** Captan, thiram, and carboxin-thiram and PCNB-terrazole fungicide combinations are the most widely used soybean seed treatment materials. See Table 3 for relative activity of these fungicides against seed and seedling diseases.
37. **Correct Answer: B, *Recommendations for Specific Crops, Soybeans***  
**Explanation:** *Phytophthora* damping-off is a serious disease of soybean seedlings in the more heavy, poorly drained Ohio soils.

38. Which of the following procedures should be used to control Phytophthora in soybeans?
- A. Highly tolerant soybean varieties
  - B. A fungicide like Apron 25W (Metalaxyl) to prevent damping-off
  - C. Optimal drainage, tillage, rotation, and fertility
  - D. All of the above
  - E. None of the above
39. By itself, high tolerance to Phytophthora is good enough to control root rot.
- A. True
  - B. False
40. Inoculation of soybean seed with nodulating bacteria (Rhizobium) is generally not necessary if a well-nodulated crop has been grown within the past five years.
- A. True
  - B. False
41. Significant improvement in stand establishment of alfalfa has been noted in research plots when seeds were treated with metalaxyl for control of seedling damping-off caused by Phytophthora.
- A. True
  - B. False
42. Germinating corn seed can be attacked by several seed-borne and/or soil-borne fungi. Pre-emergence and post-emergence damping-off caused by fungi is most common in poorly drained, cold soils.
- A. True
  - B. False
43. Kernels with surface cracks caused by mechanical harvesting are especially susceptible to seed rots caused by soil-borne pathogens.
- A. True
  - B. False



38. **Correct Answer: D**, *Recommendations for Specific Crops, Soybeans*

**Explanation:** All of these factors affect the severity of Phytophthora root rot in soybeans. The backbone of integrated control is to use varieties with a high level of Phytophthora tolerance. Tolerance is the relative ability of susceptible varieties to survive and yield well when infected with Phytophthora. In contrast, resistant varieties do not become diseased by races to which they are resistant.

39. **Correct Answer: B**, *Recommendations for Specific Crops, Soybeans*

**Explanation:** By itself, high tolerance to Phytophthora is not good enough to completely control root rot. Varieties with high tolerance appear to be very susceptible to early season damping-off. Research indicates that the use of highly tolerant varieties in combination with Apron seed treatment controls Phytophthora as well as multi-race resistance without the possibility of damage from development of new races.

40. **Correct Answer: A**, *Recommendations for Specific Crops, Soybeans*

**Explanation:** This is a true statement. Fungicide seed treatment can be used if inoculation is necessary. Most fungicides have little or no adverse effect on Rhizobium bacteria if exposure before planting time is short. Plan to plant fungicide-treated soybeans seed within two hours of being inoculated with Rhizobium.

41. **Correct Answer: A**, *Recommendations for Specific Crops, Alfalfa and Other Small-Seeded Forage Legumes*

**Explanation:** This is a true statement. In areas where Phytophthora root rot has caused a serious problem in reducing alfalfa stands or preventing establishment alfalfa, a variety with resistance to Phytophthora that has been treated with Apron seed treatment is highly recommended.

42. **Correct Answer: A**, *Seed & Soil Borne Diseases of Field Crops*

**Explanation:** This is a true statement. Seed rots and seedling blights are commonly caused by Phythium and Fusarium species, and may be caused by Penicillium and Helminthosporium species. All of these fungi can rot seed before germination. Infected seedlings typically show a marked softening of stem tissue at the soil line.

43. **Correct Answer: A**, *Seed & Soil Borne Diseases of Field Crops*

**Explanation:** This is a true statement. Broad spectrum, protectant-type fungicides are highly recommended for both corn and sorghum, especially when early planting in cold, wet soils is attempted.

## **Disclaimer**

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