



## Herbicide Application Best Management Practices for Citrus Grove Workers<sup>1</sup>

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### Personal Protective Equipment (PPE)

PPEs are the work clothes and equipment that help protect the body from chemical contact and exposure. The employer is responsible for providing all PPE required on the herbicide label.

The law requires applicators to correctly wear their PPE. For example some labels require long sleeved shirts, long pants, and boots with socks, while other labels may require additional pieces, such as rubber boots and respirators.

Not all herbicide applications require the same equipment, so be sure to check the label before you start the application. PPE can be made of various materials such as barrier laminates, PVC, and rubber, all which are waterproof. Remember to avoid PPEs made from leather when working with pesticides. Leather products can absorb pesticides and hold them close to the skin making them difficult or impossible to decontaminate. For more detailed information about PPE see "*Personal Protective Equipment for*

*Citrus Grove Workers*" at <http://edis.ifas.ufl.edu/AE244>.

Most importantly, always get immediate treatment for every injury, regardless of how small it may be. Cuts and open sores provide openings where pesticides may be absorbed into the body. Many cases have been reported where small minor injuries such as splinter wounds, or punctures quickly lead to an infection threatening the life and limb of an employee. Even the smallest scratch is large enough for germs and chemicals to enter. All deep cuts should be washed with fresh water, disinfected and bandaged properly. For more detailed information about First Aid see "*First Aid, Heat Stress, and Safety for Citrus Grove Workers*" at <http://edis.ifas.ufl.edu/AE242>.

### Tractor and Herbicider Preventive Maintenance

Preventive maintenance is a schedule of planned maintenance actions aimed at the prevention of breakdowns and failures. The primary goal of

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preventive maintenance is to prevent the failure of equipment before it actually occurs. It is designed to preserve and enhance equipment reliability by replacing worn components before they actually fail. Preventive maintenance activities include equipment checks, partial or complete overhauls at specified periods, oil changes, lubrication and so on. In addition, workers can record equipment deterioration so they know to replace or repair worn parts before they cause system failure

There are multiple misconceptions about preventive maintenance. One such misconception is that PM is unduly costly. This logic dictates that it would cost more for regularly scheduled downtime and maintenance than it would normally cost to operate equipment until repair is absolutely necessary. This may be true for some components; however, one should consider, not only the costs, but the long-term benefits and savings associated with preventive maintenance as well. Without preventive maintenance, for example, costs for lost production time from unscheduled equipment breakdown will be incurred. Also, preventive maintenance will result in savings due to an increase of effective system service life. The following checkpoints will help your equipment last long and run safer.

### Tractor

Tractor checkpoints are similar to those on your car, and should be inspected daily or upon use. Remember the phrase **GOT W?** This phrase and the letters it contains will help you remember the items to check before you start your day.

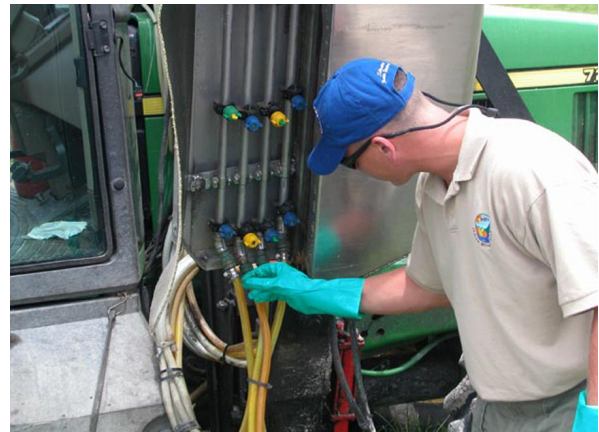
- "G" stands for gas or diesel
- "O" is oil
- "T" is tire pressure
- "W" is water level in the radiator.

### Herbicide Machine

- Check all nozzles, strainers and orifices for obstructions.
- Look for leaks and worn spots on hoses.

- Check for leaks or obstructions in filters and strainers.
- Make sure valves operate freely with no leaks.
- Check for leaks on connections on the application and agitation lines.
- Be sure pressure gauges operate freely. The gauges should come up to pressure and remain steady when the valve is open and return to zero when the valve is closed. If it does not function as required replace it prior to operation.

Clean, well functioning nozzles are important because they are responsible for delivering the herbicide to the target weeds. Clogged or worn nozzles are not in calibration and will not produce the proper pattern or flow. It is important to allow your nozzle patterns to overlap by 30% for best coverage. Some nozzles require more overlap depending on boom height, design, etc.



**Check equipment.** Valves and nozzles should be checked routinely to ensure they are working properly. If one malfunctions, it can have a large effect on the outcome of your job. Credits: UF/IFAS

Inside the nozzle there is a strainer, a mesh screen that filters the fluid as it flows through to the boom or back into the tank. Obstructions in these screens can cause the gauges to fluctuate. Strainers should always be checked before each application to maintain optimum coverage.



**Strainer.** Strainers like these allow a worker to see if debris has plugged a screen. Filters, like nozzles, should be checked regularly. Credits: UF/IFAS

## Pre-Operation Quiz

### Multiple Choice Questions and True or False

- Which of the following items would an operator check before he/she starts an application?
  - Radiator
  - Oil
  - Hydraulic
  - Tire Pressure
  - All of the above
- Which of the parts listed below should be checked before a herbicide application?
  - Nozzles
  - Strainers
  - Valves
  - Lines
  - All of the above
- \_\_\_\_\_ All herbicides require the same PPE s.
- \_\_\_\_\_ Chemicals are more dangerous right out of the container because they are in their most concentrated form.

5. \_\_\_\_\_ Chemicals can be absorbed into leather where they can't be cleaned.

6. \_\_\_\_\_ Herbicide nozzles get worn and don t perform as well as new ones.

7. \_\_\_\_\_ Strainers have mesh screens inside that can get clogged between, or even during an application.

8. \_\_\_\_\_ Fluctuating gauges can indicate problems for herbicide systems.

9. \_\_\_\_\_ Rubber products are better for handling and mixing herbicides because they do not absorb chemicals.

## Mixing and Loading

### Why it is important?

Mixing and loading are components of the herbicide process that requires special attention and care. Before mixing, chemicals are in their most concentrated state. Exposure and toxicity levels are high while handling the container. When mixing and loading chemicals, follow all label directions and safety procedures.

The label is the law, it's purpose is to protect you. Wear extra protection, especially for your eyes. Splashes can occur as chemicals are transferred from containers. Follow recommended label amounts to avoid applicator harm, crop damage, and environmental contamination. If you can not find the information you need, ask your supervisor or the chemical supplier for a the products Material Safety Data Sheet, or MSDS for short.

MSDS's contain safety information about the herbicide materials such as physical, chemical and toxicological properties, regulatory information, and recommendations to ensure safe handling. MSDS's usually have more detailed information than does the product label.

### How to Mix and Load Herbicides

- Conduct pre-operation tractor/equipment check.

2. Fill tank 1/3 full with water.
3. Start the agitation in the tank.
4. Carefully measure all chemicals on a flat surface, below eye level. Be sure the measuring cup is precise enough for the measured units. This step is critical so don't rush!

Examples:

- Don't use a 5-gallon bucket to measure 4 ounces.
- Don't cut an aluminum can to measure 12 ounces.

Follow all label instructions and recommendations because some chemicals are incompatible in a tank mix.

5. Slowly add chemicals to the tank. Don't forget the proper PPE and be careful to follow the mixing orders! Remember to use the word **WALES** to help remember mixing orders for product solutions. Add water to the tank until 1/3 full, then add the chemicals materials in the following order:

- **W**-Wettable Powders
- **A**-Agitation
- **L**-Liquids
- **E**-Emulsifiables
- **S**-Surfactants

Slowly add your chemicals to the tank with the agitation in operation. Always be careful to prevent spills and prevent overflows when filling the tank. Cardboard can be used to catch chemicals that miss the tank and spill onto the ground.

When supplying water to the tank, remember to use a backflow prevention device. This can be a check valve, artesian pressure, or simply keeping a gap between fill hose and tank.

6. Remember, always leave enough space for the liquid inside the tank to move. An overfilled tank can force the lid off, allowing the tanks contents to spill onto the ground.

7. The application portion of the job often requires different PPEs than that used for mixing and loading. Be sure to check the label again for specific application requirements. When mixing and loading is completed, properly seal and store the unused portions of the chemicals. All the PPEs must be washed after the mixing and loading process is complete.

## Posting

There are a number of good reasons keeping records of chemical use can help chemical users with their business, and it's not only that keeping records is sometimes required by law.

Records can also provide valuable information in other cases too. There are a number of examples where a particular chemical has not performed the way it was expected to and the user suspects a problem with the product. In these cases, the Batch Number or Date of Manufacture is vital to being able to identify the sample of the batch retained by the manufacturer, because it may be important to analyse that sample.

Records of chemical use can also track chemical use patterns to aid in resistance management, and if follow up inspections are made, comments can provide local information on the effectiveness of particular chemicals against particular pests.

Making an accurate record of chemical use takes only a minute or so, which is good insurance if things go wrong later on. For all these reasons and more, there is logic in keeping chemical use records not only for the restricted chemicals as required by law, but for all chemicals used.

### Posting information

Remember the careful steps taken to insure the tank is mixed correctly will pay off as you begin applying herbicides. Before you start the herbicide

treatment, post all the information in a central location where all the workers can see it. The Worker Protection Standard (WPS) board is a perfect spot.



**Posting.** Information concerning where and when pesticides are applied should be centralized and accessible to all employees. Credits: UF/IFAS

This posted document must contain:

- Name of applicator
- Date and time of application
- Area to be sprayed
- Restricted entry interval
- Name of the chemical in use (common name)
- Percent of formulation (active ingredient)
- Method of application
- Amount applied

Once posted on the WPS board, inspect the equipment one more time to make sure everything is working correctly and nothing is leaking before the application begins.

## Important Steps to Take Before Application

### Check the Weather

Check for approaching weather, ensure the target weeds growing under the canopy are dry. Remember that rainfall or dew on the foliage can dilute a spray mix and reduce its control. Drift concerns with

herbicides require that you watch wind speed and direction during the application. Some products require recordkeeping every hour the product is in use. Be sure to check the label of the products you apply for application and record keeping requirements.

### Check Operational Hazards

Before you begin an application check the area to be sprayed. Look for obstacles, people, pets, and other crops that could be damaged by the herbicide. Picking bins and ladders are sometimes forgotten and left behind by harvesting crews. These can become hazards during chemical applications. Take a few minutes to ride the grove out and look down the rows for these types of obstacles before you start applying chemicals. It is much easier to handle these types of problems before you start. If you come across these obstructions during an application you may have to remove PPE and shut down your equipment and lose valuable time.

## Mixing and Loading Quiz

### Multiple Choice

- 1)\_\_\_\_\_ The product label and MSDS sheets include what information?
  - a) Potential health risks
  - b) Disposal guidelines
  - c) Spill procedures
  - d) All of the above
  
- 2)\_\_\_\_\_ Before mixing chemicals fill the tank with how much water?
  - a) One-third
  - b) Two-thirds
  - c) One-half
  
- 3)\_\_\_\_\_ When should an operator start the tanks agitation?
  - a) Before adding water

b) After adding water to the tank and before adding chemicals

c) After adding chemicals

4) \_\_\_\_\_ Which of the following is a good measuring device?

a) Cold drink

b) Coffee mug

c) Beer bottle

d) None of the above

5) Put the following chemicals in the proper mixing order: (a) Surfactant (b) Liquids (c) Wettable Powders.

1. \_\_\_\_\_ 2. \_\_\_\_\_

3 \_\_\_\_\_

**True or False**

\_\_\_\_\_ 6) Extra protection should be given when an operator is mixing and loading chemicals.

\_\_\_\_\_ 7) Operators should always follow label instructions because some chemicals are incompatible and don't mix well.

\_\_\_\_\_ 8) Allowing the tank to agitate while mixing and loading keeps the tank well mixed.

\_\_\_\_\_ 9) Backflow methods include using artesian pressure or a gap between the tank and water hose.

\_\_\_\_\_ 10) PPE for application can differ from PPE for mixing and loading practices.

**Herbicide Application**

**Safe Distance**

While spraying, maintain a safe distance between the boom and the tree. If using an offset nozzle on the boom end make sure it minimizes applying the herbicide directly to the tree trunk. Rather, applications should be close enough to overlap applications from both sides of the tree. Avoid hitting tree trunks with the boom. Wounds on

the bark expose the tree to diseases and chemicals that damage the trees.



**Boom placement.** The herbicide boom should be far enough below the tree canopy to avoid fruit damage. The boom must be high enough for the weeds to pass under and be sprayed by the herbicide. Credits: UF/IFAS

**Boom Placement**

Keep the boom low and level or parallel to the soil surface. Pass the boom underneath the tree skirt high enough to avoid entrapment by thicker grasses and broad leaves growing near the soil surface. If the boom does get caught up in the vegetation, it may bend back. Simply, lift the boom and let the grass pass under the boom and continue on. Ensure the boom is laying the foliage over and the nozzles are wetting the target's surface. The wiper mat on the back side of the boom is used to keep herbicide drift out of the tree canopy and off the fruit.

**Rounding the Ends**

Shut off all valves when making your rounds at the row end. Oftentimes, grass gets caught on the boom and it may be necessary to get off the tractor and untangle the mess. If this is necessary, be sure to completely shut off all nozzles and shut the tractor down. During the job, check periodically to ensure the nozzles are not clogged. Both of these jobs require using the proper PPE.

**Precision Application Herbicides**

New technology helps growers apply herbicides more accurately. Some growers are using sensors to shut off nozzles where there are missing trees or on row ends as a way to improve herbicide application

efficiency. These systems can also be configured to turn on a separate line on the boom to apply a different product for resets or smaller trees. This saves time by not having to make a separate application for the younger trees in a later operation.



**Shut off nozzles.** Above is an example of a herbicide application where the applicator did not shut the nozzles off at the end of the tree row. This wastes material, can lead to erosion, or could damage the tree. Credits: UF/IFAS

### Finishing a Tank

When the tank is running out of material, the gauges on the application line begin to fluctuate. This is the pump losing prime as the material inside the tank sloshes past the pump's intake. Some herbicide tanks have clear tubing on the outside of the tank so operators can see exactly how much material is in the tank. When the tank is empty, be sure to flag the row where you left off. If another operator has to finish the job, he/she will know where to start.

### Clean-Up

At the end of each work day, first insure that your tractor is parked in a secured location. While wearing the proper PPE, make sure all chemicals are placed in the chemical storage facility and all your measuring tools are cleaned and stored. Most importantly, make sure the chemical storage room gets locked after you finish with your entire mix/load clean up operations.

## Equipment Clean Up

### Cleaning the Equipment



**Clean up.** After an application, the equipment needs to be cleaned up. Facilities like the one above are designed with sloped floors and tanks for capturing rinsate. Credits: UF/IFAS

Once the herbicide application is complete, the equipment needs cleaning. While still wearing appropriate PPEs, park the tractor in a permanent or temporary wash station and clean thoroughly. If you need to wash the equipment in the grove, choose a location away from canal, ditches, or ponds. These washdown locations should be rotated to avoid chemical buildup in the soil.

Extra attention needs to be given to the areas of the tractor that came in contact with the herbicide:

- Boom
- Pump
- Tires
- Tank

It is the employee's responsibility to ensure their PPE is clean and properly maintained. Cleaning is particularly important for eye and face protection where dirty or fogged lenses could impair vision. PPE should be inspected, cleaned and maintained at regular intervals as instructed by the supervisor.

It is also important to ensure that contaminated PPE, which cannot be decontaminated, is disposed of in a manner that protects employees from exposure to hazards.

### Cleaning your PPEs

While wearing gloves, remove the plastic suit and dispose of it properly.

Wash boots with soap and water and allow them to air dry.

Wash all protective eye wear with soap and water.

Wash gloves while still wearing them with soap and water. Then wash the inside and allow them to air dry.

Make sure to wash all work clothes separate from the family's clothing. Work clothes may contain chemicals that could get transferred to a family's clothing in the washing machine. Wear fresh, clean clothes to work each day and always keep a spare change of clothes at work for decontamination purposes. On the job, there should be an area designated as a decontamination station. Make sure there is always plenty of water, soap and disposable paper towels and a clean change of clothes.

## Spill Containment

Pesticide spills can pose serious threats to human health and cause significant environmental contamination. A thorough knowledge of the appropriate steps to take in the event of a spill will allow you to minimize the potential for adverse effects and may save you a great deal of money in expensive cleanup costs. Always be prepared to handle spills before they occur. It is a good idea to have a spill kit in storage and mixing areas. Contamination can greatly increase when delaying response to a pesticide spill.

Spills may be relatively minor, involving one or a few leaking containers. However, major spills, such as when a sprayer overturns spilling its contents, can and do occasionally occur. Regardless of the magnitude of the spill, the objectives of a proper response are the same.

These three steps are frequently referred to as the "Three C's of spill control.

1. **CONTROL** the spill.
2. **CONTAIN** the spill.

### 3. **CLEAN IT UP.**

#### CONTROL

When attempting to control the flow of the chemical, do not expose yourself to the spill. Always carry protective clothing and equipment when transporting pesticides. Use this equipment if pesticide emergencies occur.

#### CONTAIN

After the leak has been controlled as well as possible, contain the spilled material in as small an area as possible. With liquid spills, use a shovel or other device to construct a dam to prevent the chemical from spreading. It is particularly important not to allow any chemical to get into any body of water, including wells or ditches. Do not hose down the area; this will cause further spread of the chemical. Liquid spills can be further contained by spreading absorbent materials such as fine sand, sawdust, or oil-sorb over the entire spill. For absorbing small spills and minor leaks, kitty litter is particularly useful.

#### CLEAN UP

After the spill has been contained, if possible, pump or vacuum up as much of the liquid as possible into a tank designed for this purpose or another empty spray tank or one with the same material or a compatible pesticide, so that it may be applied to a labeled site. After the material is picked up, spread absorbent material over the contaminated area, if this has not already been done. Sweep up the absorbed pesticide and place it into a heavy duty plastic bag. Continue to add absorbent material until all the liquid has been soaked up.

After these preliminary stages of cleanup have taken place, it may be necessary to further decontaminate and neutralize the area. This is particularly recommended if highly hazardous pesticides are involved.

When large amounts of pesticides are spilled on soils, effective decontamination is often not possible. In these instances, the top 2-3 inches of soil should be removed and disposed of.



Before a spill ever occurs, call your chemical retailer or manufacturer to get information on cleanup of specific chemicals. They can also provide you with special safety advice and other information.

### DURING MAJOR SPILLS

During major spills, someone must remain at the spill site at all times until it has been effectively contained and cleaned up. The contaminated area should be isolated, preferably by roping it off. Keep people at least 30 feet from the spill. Avoid coming into contact with any drift or fumes that may be released. At times it may be necessary to evacuate people downwind from the spill. Do NOT use road flares if you suspect the material to be flammable.

### REPORTING

Spills on public property and all spills involving pesticides that are considered to be highly hazardous must be immediately reported to local and state emergency planning personnel. Police or fire officials typically are local contacts to whom such spills should be reported. These agencies will advise you of the proper procedures for cleaning and disposing of accidentally released pesticides. Failure to report such spills is considered to be a violation of the Emergency Planning and Community Right-to-Know Act (EPCRA/SARA III). Such violations can result in fines of up to \$25,000 for each day the violation continues.

## **Application and Clean Up Quiz**

### Multiple Choice

1)\_\_\_\_\_ Which of the following information is required on the WPS posting report?

- a) Applicator
- b) Chemical used
- c) Time of application
- d) All of the above

2)\_\_\_\_\_ Which of the following can be an operational hazard in a grove?

- a) Picking Ladders
- b) Picking Bins
- c) Equipment or people
- d) All of the above

3)\_\_\_\_\_ What should be done with application valves when rounding the ends?

- a) All on
- b) All off
- c) Some on
- d) Some off

4)\_\_\_\_\_ What is considered a safe operating distance?

- a) Boom way above grass and in tree canopy
- b) Boom laying grass over but below tree canopy

### True or False

\_\_\_\_\_ 5. The law requires applicators to post an application after the job is complete.

\_\_\_\_\_ 6. The barn bathroom is a good location to post WPS information.

\_\_\_\_\_ 7. Most agricultural operations should have a central location to post WPS information.

\_\_\_\_\_ 8. Weather has little affect on how well the chemicals work.

\_\_\_\_\_ 9. Proper boom placement is an important aspect of the herbicide application because improper placement can damage trees and equipment.

## **References**

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<http://www.epa.gov/pesticides/safety/>,  
<http://www.epa.gov/oppfead1/safety/workers/workers.htm>

- CEPEP Worker Protection standard Resources, <http://www.colostate.edu/Depts/SoilCrop/extension/CEPEP/wpsResources.htm>
- University of Florida, Pesticide Safety, <http://edis.ifas.ufl.edu/pdf/CV/CV10800.pdf>
- U.S. DEPARTMENT OF AGRICULTURE, <http://www.usda.gov/agency/oce/oce/labor-affairs/wpspage.htm>
- Clemson University, Agricultural Worker Protection, <http://entweb.clemson.edu/pesticid/safetied/workrpro.htm>
- Occupational Safety and Health Administration, OSHA Training Menu, <http://www.free-training.com/osha/ppp/ppemenu.htm>
- American Association of Pesticide Safety Educators, <http://www.vtpp.ext.vt.edu/homepage.html>
- Oklahoma State University, Environmental health and safety, Pesticide Safety, <http://www.pp.okstate.edu/ehs/links/pest.htm>

### Additional Reading

The following publications that provide information for citrus grove workers are available through EDIS, the UF/IFAS on-line document system.

#### English

- (Forthcoming) First Aid, Heat Stress, and Safety for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE242>
- Understanding the Pesticide Label for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE243>
- Personal Protection Equipment for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE244>
- Equipment Safety for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE245>



- Herbicide Application BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE246>
  - (Forthcoming) Pesticide Application BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE247>
  - (Forthcoming) Fertilizer Application BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE248>
  - (Forthcoming) Aquatic Vegetation Management BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE249>
  - (Forthcoming) Drainage BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE250>
  - (Forthcoming) Irrigation Management BMPs for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE251>
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- #### Spanish
- (Forthcoming) Primeros Auxilios, Insolación y Seguridad para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE270>

- (Forthcoming) Entendiendo la Etiqueta del Pesticida para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE271>
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- (Forthcoming) Mejores Prácticas de Manejo en Aplicaciones de Malezas Acuáticas para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE276>
- (Forthcoming) Mejores Prácticas de Manejo con Drenaje para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE277>
- (Forthcoming) Mejores Prácticas de Manejo con Irrigación para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE278>
- (Forthcoming) Mejores Prácticas de Manejo con compuertas de retención de agua para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE279>
- (Forthcoming) Mejores Prácticas de Manejo para el Mantenimiento en Facilidades Agrícolas, <http://edis.ifas.ufl.edu/AE280>

**Pre-Operation Quiz.**

Question Number	Correct Answer
1.	e
2.	e
3.	False
4.	True
5.	True
6.	True
7.	True
8.	True
9.	True

**Mixing and Loading Quiz.**

Question Number	Correct Answer
1.	a
2.	a
3.	b
4.	d
5.	c,b,a
6.	True
7.	True
8.	True
9.	True
10.	True

**Application and Clean up Quiz.**

Question Number	Correct Answer
1.	d
2.	d
3.	b
4.	b
5.	True
6.	False
7.	True
8.	False
9.	True