Laboratory
Sprayer Hardware and Spray Distribution

I. Components of a Typical Agricultural Spray System

II. Spray Systems

A. Tank

1) Vat that holds spray solution
2) Capacity ranges from 50-500 gallons
3) Tank Composition
   a. Plastic/polyethylene
   b. Fiberglass
   c. Stainless or galvanized steel
   d. Aluminum

B. Pump

1) The heart of the spray system
2) Delivers the spray solution throughout the system and maintains pressure
3) PTO (Power Take-Off) driven pumps
   a. Centrifugal Pump: Pressure created when spray solution enters throughout the center of a rotor (impeller) and is forced to the outer edge of the pump housing by centrifugal force
      • Popular for low pressure sprayers
- Can deliver 70 – 130 GPM at pressures no higher than 75 psi. Most herbicides are applied at 20-40 psi
  - **Pros**: versatility, ease of maintenance, cost
  - **Cons**: bulkier and heavier than roller pumps, requires high rotor rpm

b. *Turbine Pump*: Similar to centrifugal pump, except the spray solution is both picked up and delivered at the periphery of impeller
  - **Pros**: versatility, maintenance, cost, can spray low volumes at lower rpm’s than centrifugal
  - **Cons**: bulkier than roller pumps, lighter and more compact than centrifugal

c. *Roller Pump*: Loose rollers fitted into slots in an impeller push liquid around and out the pump housing
  - Pressures up to 300 psi initially, but this dramatically decreases as pump wears
  - Consists of a cast iron housing, nylon or teflon rollers
  - Spray solution enters pump and is forced between rollers; the spray solution is forced ahead of the rollers to the outlet
  - Abrasive chemicals or gritty water wear the pumps down quickly, reducing maximum output
  - **Pros**: very inexpensive, higher pressures than most other pumps when new, low rpm
  - **Con**: short life, wear easily, may be inaccurate

d. *Piston Pump*: handles all sprayable solutions
  - Develops pressure up to 800 psi
  - Delivers exact volume with each turn of piston
  - **Pros**: most versatile of all pumps, very accurate, high pressures
  - **Con**: very expensive to purchase and repair

4) **Hydraulic Pumps**
   a. Same as PTO pumps except that the pump is run by hydraulic pressure
   b. Easier to work with because they can be mounted on different places on the tractor
   c. Useful when a pump requires higher rpm’s than a PTO can offer
5) Research Sprayers
   a. Compressed air sprayers
      • Requires an air compressor, which is large and heavy
   b. Compressed CO₂
      • Some concern with change in pH of spray solution
      • Good for backpack sprayers

C. Pressure Regulator
   1) Maintains a constant pressure
   2) Set to maintain desired pressure between 20-40 psi

D. Pressure Gauge
   1) Shows constant reading of pressure
   2) Watch closely! Pressure fluctuations during spraying may indicate the following:
      (a) Clogged nozzle(s)
      (b) Clogged screen(s)
      (c) Out of spray solution

E. Agitator
   1) Keeps spray solution evenly dispersed in the tank
   2) Usually accomplished by spray solution recirculating to tank from pump

F. Bypass Line
   1) Functions to return excess spray solution from the pump to tank
   2) Allows the pressure regulator to function and prevents pressure buildup

G. Suction Line
   1) Brings spray solution from tank to the pump

H. Nozzles: Most important component of a sprayer
   1) Delivers spray to target
   2) Helps to determine the spray volume delivered and spray pattern (orifice size)

III. Nozzles and Spray Patterns

A. Parts of a Nozzle
   • Nozzle body
   • Strainer or screen
   • Nozzle tip
   • Cap: Holds nozzle tip and strainer in place

B. Nozzle Tips
   • Brass: most common, wear easily
   • Nylon
   • Stainless steel – wear resistant, expensive
• Ceramic – wear resistant, very expensive

C. Nozzle Types
1) Flat Fan
   • Used for broadcast applications
   • Flat, elliptical shaped pattern
   • Outer edges are a reduced rate; patterns must be overlapped 30% to achieve desired rate
   • 15-30 psi should be used to produce medium droplet size (less drift)
2) Even Flat Fan
   • Used for banding applications
   • Delivers an even volume to outside edge of pattern
   • No overlap required
3) Flood
   • For broadcast applications of soil applied herbicides and fertilizer
   • Less precise than flat fan
   • 100% overlap required
4) Hollow Cone
   • Used for postemergence herbicides, defoliants, and insecticides
   • Small droplet size, more drift
   • Good coverage
   • Circular pattern with no overlap required

D. Nozzle Size

E. Nozzle Height
1) 80° tips: 18-20 inches above target
2) 110° tips: 15-17 inches above target
F. Droplet Size

1) Dependant on application type
   • Soil applied
   • Foliar applied

2) Droplet size determined by:
   • Nozzle size
   • Nozzle type
   • Pressure
   • Carrier viscosity
   • Environment (wind, temperature)
Spray Distribution

Information obtained from www.teejet.com

The following factors can significantly affect spray distribution.

- Nozzles
  - type
  - pressure
  - spacing
  - spray angle
  - offset angle
  - spray pattern quality
  - flow rate
  - overlap
- Boom Height
- Worn Nozzles
- Pressure Losses
- Plugged Filters
- Plugged Nozzles
- Plumbing Factors Influencing Liquid Turbulence at Nozzle

Additionally, in the field during the spraying application or during a dynamic distribution test, the following can influence the distribution quality:

- Boom Stability
  - vertical movement
  - horizontal movement
- Environmental Conditions
  - wind velocity
  - wind direction
- Pressure Losses (sprayer plumbing)
- Sprayer Speed and Resulting Turbulence

The effect of distribution uniformity on the efficiency of a crop production chemical can vary under different circumstances. The crop production chemical itself can have dramatic influences over its efficiency. Always consult the manufacturer's chemical label or recommendation before spraying.
Spray Tip Wear

Tips Don't Last Forever!

There is sufficient evidence that spray tips may be the most neglected component in today's farming ... yet they are among the most critical of items in proper application of valuable agricultural chemicals.

An Inside Look at Nozzle Orifice Wear and Damage

While wear may not be detected when visually inspecting a nozzle, it can be seen when viewed through an optical comparator. The edges of the worn nozzle (B) appear more rounded than the edges of the new nozzle (A). Damage to nozzle (C) was caused by improper cleaning. The spraying results from these tips can be seen in the illustrations below.

Determining Tip Wear

The best way to determine if a spray tip is excessively worn is to compare the flow rate from the used tip to the flow rate of a new tip of the same size and type. Charts in this web site indicate the flow rates for new nozzles. Check the flow of each tip by using an accurate graduated collection container, a timing device and an accurate pressure gauge mounted at the nozzle tip. Compare the flow rate of the old tip to that of the new one. Spray tips are considered excessively worn and should be replaced when their flow exceeds the flow of a new tip by 10%.

Spray Tip Care is the First Step to Successful Application

The successful performance of a crop chemical is highly dependent on its proper application as recommended by the chemical manufacturer. Proper selection and operation of spray nozzles are very important steps in accurate chemical application. The volume of spray passing through each nozzle plus the droplet size and spray distribution on the target can influence pest control.

Critical in controlling these three factors is the spray nozzle orifice. Careful craftsmanship goes into the precision manufacturing of each nozzle orifice. Although a dealer can help in spray tip selection, the maintenance of those tips rests solely in the hands of the user.
The illustration below compares the spraying results obtained from well-maintained vs. poorly-maintained spray tips. Poor spray distribution can be prevented. Selection of longer wearing tip materials or frequent replacement of tips from softer materials can eliminate misapplication due to worn spray tips.

Careful cleaning of a clogged spray tip can mean the difference between a clean field and one with weed streaks. Flat spray tips have finely crafted thin edges around the orifice to control the spray. Even the slightest damage from improper cleaning can cause both an increased flow rate and poor spray distribution. Be sure to use adequate strainers in your spray system to minimize clogging. If a tip does clog, only use a soft bristled brush or toothpick to clean it -- never use a metal object. Use extreme care with soft tip materials such as plastic. Experience has shown that even a wooden toothpick can distort the orifice.
**TeeJet Pattern Check**  Successful applications depend on a quality pattern from your spray tips and proper operation of your spraying equipment. The TeeJet pattern check makes it easy to see if your sprayer is properly set up to provide the even distribution needed for safe and effective pest control. By sliding the pattern check under the sprayer boom while spraying clean water, you get an immediate indication of the spray distribution along the boom.