AE-1042

CALIBRATION OF BAND SPRAY EQUIPMENT

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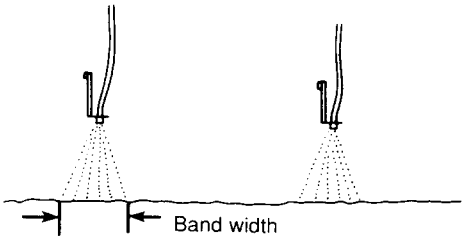
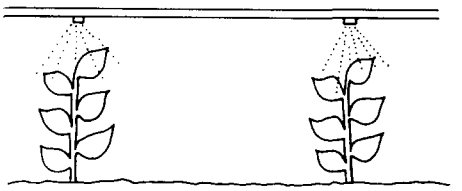
Many row crop producers can save money with band or directed application of herbicides. Some newer pesticides have created an increased interest in banding because of the high cost for broadcast application. When compared to broadcast application, the cost savings can be substantial.

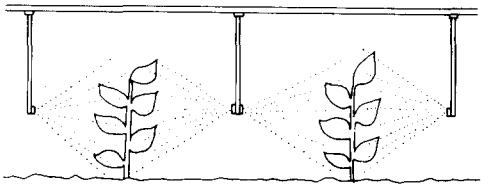
Band application of pesticide is applying a product in parallel bands, leaving the area between the bands free of chemical. Directed spraying is application of a chemical to a specific area such as a plant canopy, a row or at the base of plants. Several nozzle configurations may be used when foliage penetration or row crop height present a problem (Figure 1). The two and three nozzle configurations give better lower leaf coverage than a single nozzle. Hose drops installed with hollow cone nozzles are excellent for total plant coverage with insecticides and fungicides. Hose drops fitted with even flat fan nozzles are useful to apply herbicides at the base of plants to reduce the risk of crop injury and spray drift. In smaller row crops, a row application kit with even spray nozzles is helpful to provide uniform plant coverage.



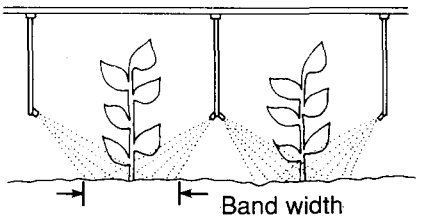
A. Band spraying on row crop (behind planter).



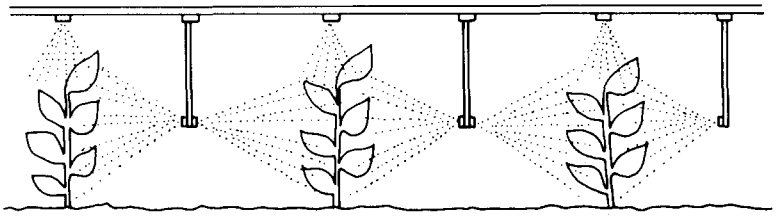
B. Direct spraying with one nozzle over the row.



C. Directed spraying with two nozzles.



D. Directed spraying at base of plants often used with herbicides.



E. Directed spraying with three nozzles often used for herbicides and fungicides.

Figure 1. Nozzle placement for band and directed spraying.

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Some growers have made costly mistakes in calculating band application rates. Errors which underapply the pesticide often result in poor control of the target pest and errors which overapply the pesticide may result in crop injury and always cause a higher cost per acre. **Remember, only a portion of the field is treated, so the total amount of pesticide applied is less with band applications than with broadcast applications.** Banding during planting: To properly set up band spray equipment on a planter, follow these steps:

Step 1. Consult the pesticide label

Does the label give guidelines on band width? When applying herbicides, the band sprayed should be wider than the uncultivated band because weeds at the edge of the band will sometimes be poorly controlled due to incomplete coverage. Unless otherwise specified, application rates are given on a broadcast basis. **For band application, the rate per treated acre should be the same as the label rate. Remember, the total amount of pesticide used is less because only a portion of the field is treated.** If the spray volume is not specified on the label, use about one gallon of spray solution per inch of band width.

Step 2. Select operating conditions

Select the planter ground speed in miles per hour. To check your speedometer, if speed is unknown, measure the speed with the use of the following formula:

$$\text{MPH} = \frac{\text{Distance (ft)} \times 60}{\text{Time (seconds)} \times 88}$$

Herbicide banding on the row can be done either at crop planting (Figure 2) or postemergence, after the crop and weeds have emerged (Figure 3). Cultivation can control weeds between the crop rows. Even flat-fan nozzles are recommended for pre-emergence band application since they provide a uniform application across the entire width of the band.

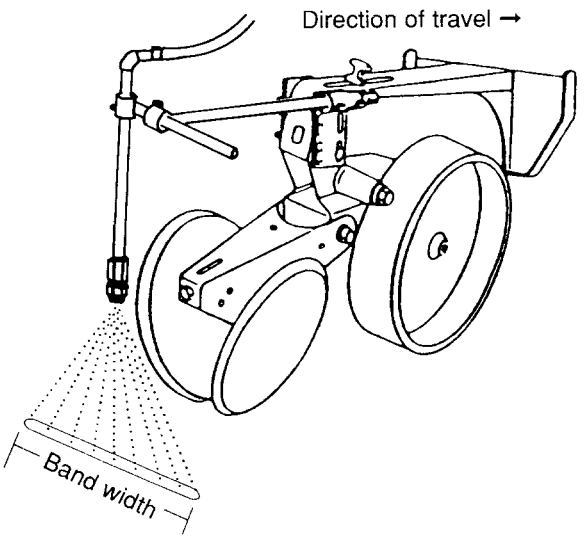

Figure 2. Banding nozzle placement on a row crop planter.

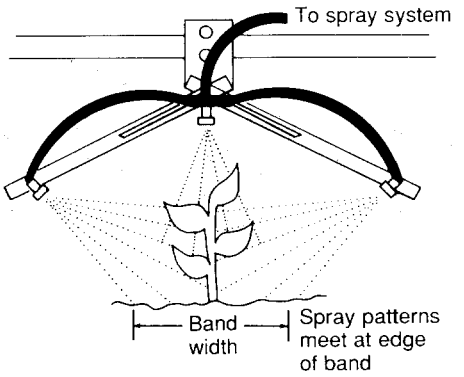

Figure 3. One possible nozzle configuration for postemergence spraying.

Check the speed of the applicator in the field. Speed will be different in the field to be treated compared to a road or another field even with the same tachometer setting. Select the desired band width in inches and band spray volume (Table 1). Select a band width that controls weeds in and adjacent to the row where mechanical cultivation is not possible. Band widths of 6 to 12 inches are appropriate for most cultivator equipment. Narrower band widths can be used if the cultivator is equipped with a guidance system.

Step 3. Calculate required nozzle discharge

Using the band spray volume, band width, and travel speed, calculate the required nozzle discharge as follows:

$$\text{Nozzle discharge} = \frac{(\text{travel speed}) \times (\text{band width}) \times (\text{band spray volume})}{5940}$$

where: Nozzle Discharge = gallons per minute (gpm)
Travel Speed = miles per hour (mph)
Band Width = inches
Band Spray volume = gallons per treated acre (gpa)

Step 4. Consult the nozzle catalog

Use the manufacturer's catalog to select the appropriate even flat-fan nozzle. Even flat-fat nozzles are available in three spray angles (40, 80, or 95 degrees). Select an orifice size that gives the required discharge rate at a pressure

Table 1. Band width adjustments for even flat fan spray tips.

Band width (inches)	Spray Angle		
	40 degrees	80 degrees	95 degrees
	Approximate height (inches)		
6	8	4	3
8	10	5	4
10	12	6	5
12	14	7	6
14	17	8	7
15	19	8	8
16	20	10	9

between 20 and 50 psi. Operating at 20 to 30 psi reduces the drift potential and spray pattern distortion from wind. Some pesticides may give better control at 40 to 50 psi than at 20 to 30 psi so higher pressures may be better when spray drift is not a concern. Read the label for suggested spray pressures.

Angle of spray pattern and mounting height of the nozzles are critical in controlling band width. Mounting the nozzle too low results in a narrower band than intended and the herbicide will be overapplied. Mounting the nozzle too high results in a wider than intended band and the herbicide will be underapplied. Mounting nozzles too high also increases potential for drift. Use Table 1 as an initial setting, then "fine-tune" the band width with the unit running. Band width should be measured to the ground for soil-applied pesticides but toward the top of plants for postemergence chemicals. Direct the application at the "target." All nozzles should have an output within 10 percent of one another Even some new nozzles may not meet this standard and will need to be replaced. Be sure to check all nozzles for uniformity of delivery. If nozzle flow rate exceeds rated capacity by more than 20 percent, replace them.

Step 5. Calibrate the sprayer

After the nozzles are selected and the mounting kits assembled, flush the system before installing the nozzles, then calibrate. One way to "fine-tune" a sprayer is to adjust the spray pressure until the nozzle discharge per minute equals the desired spray volume.

The broadcast spray volume is used to determine the total field acres that a full tank will treat. Calculate by multiplying the band spray volume by the ratio of the band width to row spacing:

$$\text{Broadcast spray volume} = \frac{\text{Band width}}{\text{Row spacing}} \times \text{Band spray volume}$$

Note: A band spray volume (volume per treated acre) of 20 GPA in a 12-inch band with 30-inch rows is the same as a broadcast volume (volume per total acre) of 8.0 GPA. All the spray is applied in 12 inches with no spray applied to 18 inches of the row width.

Band application example

A label recommends a spray volume of 20 gallons per acre and the producer operates a planter at 6 miles per hour. Based on previous experience with crop cultivation, a 12-inch band width is desired. The row spacing is 30 inches. To select the proper orifice size, calculate the required nozzle discharge:

$$\text{Discharge} = \frac{6 \text{ mph} \times 12 \text{ inches} \times 20 \text{ gpa}}{5940} = 0.24 \text{ gpm}$$

Table 2. Even flat-fan nozzle information for band example

Nozzle	Catalog*		Calculated**	
	psi	gpm	psi	gpm
--02E	40	0.20	58	0.24
--03E	30	0.26	26	0.24
--04E	20	0.28	15	0.24

* 1990 Spraying Systems Catalog, No. 42, pg 16

** Equation is: Where subscript 1 is desired condition and subscript 2 is known condition.

$$PSI_1 = PSI_2 \left(\frac{GPM_1}{GPM_2}\right)^2$$

After reviewing manufacturer's catalogs for even flat-fan nozzles, three nozzles operate close to the desired discharge rate (0.24 gpm) (Table 2). The nozzles are listed in the table without spray angles. Nozzles "--02E" and "--04E" are outside the manufactuers recommended pressure range and should not be selected. Nozzle "--03E" can be operated at 26 psi to obtain 0.24 gpm. Note: This pressure is calculated by using the formula in the footnotes of Table 2 Some spray pressure adjustment may be necessary to obtain the desired 0.24 gpm since actual pressure at the nozzle may not be the same as indicated by the pressure gauge. Be sure to check calibration. Using a 12-inch band on 30-inch rows gives the broadcast spray volume of:

$$\text{Broadcast Spray Volume} = \frac{\text{12-in band}}{\text{30-in row}} (20 \text{ gpa}) = 8 \text{ gpa}$$

A 40, 80 or 95 degree nozzle can be selected. Final selection depends on the clearance behind the planting unit. In this case, for a 12-inch band, the mounting height would be 14, 7, or 6 inches for 40, 80 or 95 degree nozzles, respectively (Table 1). Mount the nozzles and readjust the height until the band width is achieved at the target. In this example, the target is the soil surface behind the planter so the proper band width would be set on the soil surface. To double check your application rate, follow the "ounce" calibration procedure. In the future, if any changes in application rate are made, recalibration should be done.

Ounce Calibration Procedure

1. From the chart (Table 3) determine the length of row needed to equal 1/128 acre for your row spacing. Stake this distance off in a field you will be spraying.

   Note: The ounce calibration method can be used for broadcast sprayers as well. Instead of using row spacing to determine travel distance, use nozzle spacing on the boom.

2. Measure the time (in seconds) needed to drive the required distance at normal operating speed with all equipment attached with the spray tank 1/2 to 2/3 full.

3. Collect the discharge from all nozzles directing spray to one row for the time measured in Step 2. All collected spray mix added together in ounces is gallons per treated acre.

Table 3. Distance for each row to spray 1/128 acre. (Ounces discharged from all nozzles per row equals gallons per treated acre.)

Row Spacing (inches)	Distance (feet)
20	240
22	186
24	170
30	136
36	113
38	107
40	102
42	97

Example: For 30-inch row spacing, measure out 136 feet in the field. If the tractor/planter unit is traveling at 6 mph, it will travel 136 feet in 15.5 seconds. With the planter in a stationary position, set the pressure at 26 psi. The number of ounces collected over 15.5 seconds is the number of gallons per broadcast acre. Using a measuring cup and a stop watch, adjust the pressure until the nozzle discharges 8 ounces in 15.5 seconds. Measure the output for all nozzles to check for wear so output does not vary more than 10 percent.

In this example, keep in mind that only 40 percent of the field is receiving chemical (12-in. band width ÷ 30-in. row spacing = .4). Suppose you have a 50-acre field, but only 20 acres is being treated (50 ac x 0.4 = 20 acres). To complete the example, how many gallons of water are needed to band spray the field. If the chemical label recommends 2 pints of pesticide per treated acre, how many pints must be added to the spray tank?

Twenty acres are being treated at 20 gallons per acre or 50 total acres will be planted while using 8 gallons per total acre. This will require 400 gallons of water (20 ac. x 20 gpa = 400 or 50 ac x 8 gpa = 400 gallons of water). The amount of pesticide to add to the tank is 40 pints (20 ac x 2 pt/treated acre = 40 pints or 50 ac x 0.8 pt/total acre = 40 pt). A gallon has 8 pints, so 5 gallons of pesticide must be added to the spray tank.

Row banding postemergence

Band applying postemergence herbicides has economic benefits. A multiple nozzle configuration often is used when foliage penetration is needed or crop coverage by spray would be inadequate from a single nozzle. Two or three even spray tips can give better leaf coverage than a single nozzle (Figure 3). Also, some manufacturers sell shrouds or plastic hoods to reduce drift and pattern distortion due to wind.

When selecting the proper size nozzle, the procedure is similar to the procedure described for a band application at planting except output is from more than a single nozzle. During calibration, the output from all nozzles within the treated band is combined and the ounces collected is gpa when calibrated over 1/128 acre as described in the ounce calibration procedure.

Weight and Measure Conversions

Weight

16 ounces = 1 pound = 453.6 grams
1 gallon water = 8.34 pounds = 3.78 liters

Liquid Measure

1 fluid ounce = 2 tablespoons = 29.57 milliliters
16 fluid ounces = 1 pint = 2 cups
8 pints = 4 quarts = 1 gallon

Length

3 feet = 1 yard = 91.44 centimeters
16.5 feet = 1 rod
5280 feet = 1 mile = 1.61 kilometers
320 rods = 1 mile

Area

9 square feet = 1 square yard
43,560 square feet = 1 acre = 160 square rods
1 acre = .405 hectare
640 acres = 1 square mile

Speed

88 feet per minute = 1 mph
1 mph = 1.61 km/h

Volume

27 cubic feet = 1 cubic yard
1 cubic foot = 1,728 cubic inches = 7.48 gallons
1 gallon = 231 cubic inches
1 cubic foot = .028 cubic meters

Common abbreviations and terms used

GPM = gallons per minute
GPA = gallons per acre
PSI = pounds per square inch
MPH = miles per hour
GPH = gallons per hour
FPM = feet per minute

The information for this publication was obtained from University of Nebraska, NebGuide, G91-1019 entitled "Set up of Tillage, Planting and Directed Spray Equipment," authored by Robert Grisso and Elbert Dickey, Agricultural Engineering Department, Lincoln, Nebraska.

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