Michigan State University

Field Crops AoE Team

Pesticide Application Technology for Soybean Rust and Soybean Aphids

What are the keys to successfully applying pesticides to control soybean rust or soybean aphids?

The keys to success are: applying the pesticides(s) at the right time; achieving good penetration of the crop canopy; and good coverage of the leaf surfaces.

Preparing your sprayer to apply pesticides to control soybean rust or soybean aphids may require different techniques and nozzles than those used for most herbicide applications. Soybean rust begins in the lower canopy, and aphids are present throughout the canopy, making good spray coverage throughout the entire canopy critical. Delivering and depositing pesticides in the lower canopy is relatively easy at the R1 growth stage, but becomes increasingly difficult as the canopy becomes taller and more dense. Carefully consider the following factors that affect canopy penetration and leaf coverage: **spray volume, droplet size, ground speed, nozzle pressure, boom height, and nozzle type.**

Sprayer characteristics that affect canopy penetration and leaf coverage

Spray Volume has the greatest impact on canopy penetration and leaf coverage. Increasing the volume improves penetration and coverage. The recommended spray volume differs for each pesticide. For aerial applications, the *minimum* recommended volume is 5-7 gallons per acre (gpa). Recent MSU research on soybean canopy coverage for ground applications at different growth stages of soybean (R1, R3 and R5) supports recommendations that spray volume of 15 gpa may provide adequate coverage of the entire canopy early in the growing season (R1, R3) but 20 gpa is necessary later in the growing season (by R5) when soybean canopy density and volume have increased.

Droplet size is the second most important factor affecting canopy penetration and leaf coverage. Research has shown that **fine to medium droplets** having volume median diameters (VMDs) **in the range of 200 to 350 microns** maximize canopy penetration and leaf coverage.

Smaller droplets provide better leaf coverage but lack the momentum to penetrate the canopy. Larger droplets have the momentum to penetrate the canopy but don't provide enough leaf coverage.

Consider ground speed, nozzle pressure and spray volume when selecting nozzles for your sprayer. Choose nozzles that will produce 200-350 micron droplets at 15 to 20 gallons per acre while traveling at the desired speed. In most cases, nozzles for herbicide applications should not be used for fungicide or insecticide applications as they are designed to generate larger droplets at low application rates.

All nozzle manufacturers use a spray classification system (ASAE standard S-572) of six categories with corresponding colors to classify the droplet size range produced by nozzles under various operating pressures. **The color of the nozzle itself should not be confused with the colors listed in table 1.** The nozzle color describes the flow rate for the nozzle and the colors in the table describe the nozzle's droplet size range. When using droplet size classification charts, select nozzles that produce droplets near the fine end of the medium (yellow) category at your operating pressure (table 2, next page).

Table 1. ASAE Standard S-572 Spray Quality Categories

Droplet category	Color	Symbol	VMD (micron)
Very fine	red	VF	<150
Fine	orange	F	150-250
Medium	yellow	M	250-350
Coarse	blue	C	350-450
Very coarse	green	VC	450-550
Extremely coarse	white	XC	>550

Ground Speed affects spray volume and vertical droplet velocity. Ground speeds less than 10 mph are preferred. Remember to select nozzles that produce the optimum spray volume and droplet size at your selected ground speed. For a guide to pressures, travel speed and nozzles, go to:
http://www.ppws.vt.edu/ipm/soybeanrust/index.htm

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Nozzle Pressure affects droplet size, spray volume and droplet velocity. Higher pressures will provide better canopy penetration and leaf coverage as long as droplets remain in the medium category and not too many fine droplets are produced (table 2).

Table 2. Sample table of the effect of spray pressure on spray quality (droplet volume median diameter).

Nozzle size	Spray pressure (psi)				
	30	40	50	60	70
TT 11001	M	M	F	F	F
TT 110015	M	M	M	M	F
TT 11002	M	M	M	M	M
TT 11003	C	C	M	M	M
TT 11004	C	C	C	C	M

Boom Height Setting your boom at the correct height will also improve canopy penetration and pesticide deposition. Boom height controls spray pattern uniformity and droplet velocity. Dr. Erdal Ozkan, (agricultural engineer, the Ohio State University), has developed a new method for setting your boom height when spraying taller soybean plants. Dr. Ozkan suggests establishing the target area as the midpoint on the stem between the lowest leaves and the top of the canopy as shown in figure 1. Use the recommendations from the nozzle manufacturer for your nozzle spacing and spray angle to determine how high to set your boom above the target area. Examples for 20 and 30-inch spacing are shown in table 3.

Table 3. Suggested spraying heights for given angles

Spray angle	20- inch spacing	30-inch spacing
80 degrees	17 to19 inches	26 to 28 inches
110 degrees	16 to18 inches	20 to 22 inches

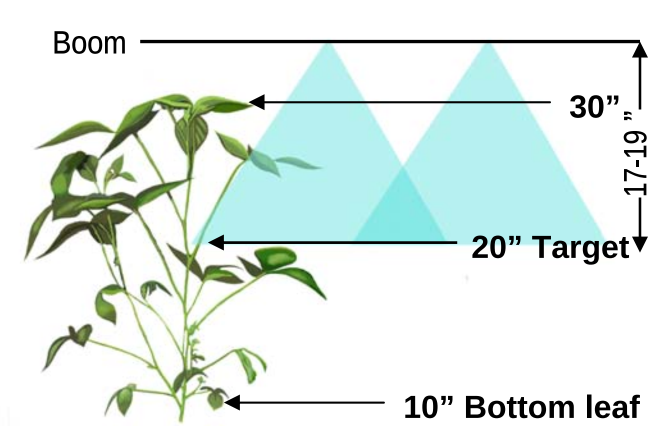

Figure 1. Height adjustment for a spray boom equipped with 80 degree flat fan nozzles spaced at 20" and used in 30" tall soybeans

Nozzle Type Flat fan nozzles perform better than cone nozzles. Properly sized pre-orifice or low-drift flat fan nozzles may perform better than traditional flat fan nozzles as they can be operated at higher pressures and still produce the optimum droplet size. Venturi or air induction nozzles are generally not recommended, as they require very high pressures to obtain 200 to 350 micron droplets. Individual nozzles or combinations of a nozzle body and two nozzles that produce two flat fan patterns-one angled toward the front and one toward the rear of the boom- will improve coverage on smaller plants but have produced mixed results in tall, dense canopies. A single flat-fan nozzle improved canopy penetration in R5 soybeans in Ohio State University research.

Air-Assist Sprayers Researchers at the Ohio State University found that an air-assisted sprayer provided significantly better canopy penetration and leaf coverage than a conventional sprayer. Air-assisted sprayers cost $10,000 to $15,000 more than comparable conventional sprayers. However, the increased cost may be justified in a relatively short time if repeated applications for rust or aphids become necessary and the sprayer is used for other insecticide and fungicide applications..

Environmental Conditions Pesticide efficacy may be reduced when temperatures exceed 90º F and/or when humidity is low (<50%) due to excessive evaporation of smaller droplets. Foliage should be dry when products are applied to avoid product dilution or runoff. To minimize drift, avoid spraying during windy conditions.

Adjuvants and Tank-mixtures Adjuvants are recommended to improve spray application effectiveness of some pesticides- consult the label. Before tank-mixing fungicides with insecticides to control soybean aphids check the label. Tank-mixing fungicides or insecticides with herbicides is not recommended. The application targets are different, and require different nozzle types. You are unlikely to obtain good results in controlling both weeds and rust or aphids due to conflicts in timing. Herbicides generally need to be applied much earlier than the fungicides for rust or insecticides for aphids.

** Prepared by D. Brown-Rytlewski, M. Staton, and C. DiFonzo, Michigan State University. Sources include: “2005 Soybean Rust Fungicide Guidelines” developed by D. Hershman (University of Kentucky), A. Dorrance (Ohio State University) and M. Draper (South Dakota State University), “Asian Soybean Rust --Frequently Asked Questions: Sprayer and Nozzle Technology R. Grisso, D.Holshouser, P. Phipps, E. Stromberg and E. Bush (Virginia Tech), “Evaluation of Various Spraying Equipment for Effective Application of Fungicides to Control Asian Soybean Rust” by E. Ozkan, H. Zhu, R. Derksen, H. Guler, A. Dorrance and D. Mills (the Ohio State University).