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Best Management Practices for Boom Spraying

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Best Management Practices for Boom Spraying

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1 Purpose and Scope

1.1 Purpose of this standard is to identify Best Management Practices (BMPs) to enhance responsible stewardship of pest control products associated with the spray application process, with emphasis on equipment selection, setup, and use for efficient application with minimal off-target spray drift and to comply with the pest control product label. The standard codifies basic BMPs for boom spraying in a step-by-step procedure for a wide audience ranging from those with little familiarity with sprayers to seasoned professionals and researchers. Specific steps apply to many boom spray applications, and the concepts presented will apply to most boom spray applications. Applicators must be well informed about the specific recommendations for a given pesticide, and must follow federal, state, and local government laws and regulations on pesticide application. Ordinances should be consulted to ensure compliance with codes that are more restrictive than those presented in this standard.

1.2 Scope of the standard is inclusive of ground-operated horizontal boom sprayers, which are typically used but not restricted to deposit spraying of production fields, pastures, turf and lawns. Boom sprayers with deposition aides such as air-assistance, shields, foils, or other devices and atomizers that use pneumatic, rotary, electrostatic, or other alternatives – each may require additional steps and considerations beyond the minimum basics outlined by this standard to ensure full application benefit of that technology. Similarly, technologies subjected and approved to validation tests of U.S. EPA Drift Reduction Technology program may complement the minimum basics outlined by this BMP. The scope excludes aerial and orchard/vineyard air blast spray applications.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2.1 ASAE S327, Terminology and Definitions for Applications of Crop or Forestry Production and Protective Agents

2.2 ASAE EP367, Guide for Preparing Field Sprayer Calibration Procedures

2.3 ASAE S572, Spray Nozzle Classification by Droplet Spectra

2.4 FAO Guidelines on Good Practice for Ground Application of Pesticides, FAO, 2001, ISBN 92-5-104718-9

2.5 ISO 22368:2004, Crop Protection equipment — Test methods for the evaluation of cleaning systems

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— Part 1: Internal cleaning of complete sprayers

— Part 2: External cleaning of sprayers

— Part 3: Internal cleaning of tank

3 Overview

3.1 Pest control products must be applied accurately and uniformly to targeted foliage or soil. Too little pesticide results in poor pest control and reduced yields, and/or the potential for pesticide resistance, while too much injures the crop, wastes chemicals and money, and increases the risk of contaminating the environment. Achieving satisfactory results from pesticides depends heavily on pest identification, pesticide selection, spray equipment selection, spray application timing, and sprayer calibration and maintenance.

3.2 BMPs for boom spraying provide guidance to apply pest control products accurately and uniformly. Step-by-step, sequential BMP categories of this standard are outlined in Table 1. All BMP categories should be addressed to ensure accurate and safe application. Omitting and not following any BMP category could jeopardize the application.

3.3 Hydraulic sprayer technology forms the basis for many boom sprayers, and this basic system has ever-increasing levels of advanced technologies available to control spray uniformity, or to handle and apply specific amounts of product to targeted portions of the field. Advanced technologies include, but are not limited to, sprayer controllers, variable-rate technology, direct injection systems, pulse-width modulation control of spray nozzles, and other technologies. In terms of BMPs, general impacts of advanced technologies on BMPs are noted herein when applicable.

3.4 Alternative technologies are additional technologies often considered beyond hydraulic sprayers. In addition to the widely recognized and understood basic variables of nozzle selection, pressure, boom height and application speed, there are other physical and chemical means to alter the spray application that may singly or in combination, increase spray efficacy and/or reduce drift.

The effectiveness of alternative technologies is often complex and at best inadequately defined. Data gaps or lack of conclusive documentation often exists regarding the effectiveness of alternative technologies under a wide range of spray conditions. Alternative technologies are mentioned in this Best Management Practice document to reduce the risk of them being marginalized. Please refer to Annex A for further descriptions.

4 Best Management Practices (BMPs) for Boom Spraying

4.1 Read product label for specific recommendations/requirements. Pest control product labels should be first consulted for application-specific language. Product labels have legal implications so adherence to application-specific language takes precedence. Product labels may contain, but are not limited to, the following areas as recommendations or requirements:

4.1.1 Equipment selection and setup. Identify any specification of sprayer, nozzle, nozzle spacing, nozzle pattern angle, travel speed, spray release height, or other sprayer equipment factors listed on the label.

4.1.2 Spray application rates (l/ha, gal/ac). This information helps determine nozzle flow rate and thereby influences nozzle type, size, operating pressure, and potentially number of nozzles per row or unit width.

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Table 1 – Sequential BMP categories and section number in this standard.

Sequential BMP Categories[1]	Section Number in Standard
Pesticide product label language	4.1
Sprayer operating capabilities	4.2
Spray nozzles and classifications	4.3
Sprayer setup and nozzle selection	4.4
Sprayer calibration	4.5
Chemical mixing	4.6
Spray additives	4.7
Spray timing	4.8
Site assessment	4.9
Spray drift reduction	4.10
Records, safety	4.11, 4.12
Pesticide waste and containers	4.13
Final and periodic checks, cleaning, continuing education	4.14-4.17

[1] All categories should be followed as best management practices for boom spraying.
Note: category titles in this table are abbreviated from section titles in standard.

4.1.3 Spray classification/droplet sizes. Labels may indicate required droplet size as a spray classification category (i.e., extremely fine, very fine, fine, medium, coarse, very coarse, extremely coarse, and ultra coarse) (per ASAE S572). The applicator selects a nozzle based on manufacturers' nozzle classification to match the label classification requirement for droplet size. Some labels indicate droplet size classification corresponding with buffer zones or distance to sensitive areas or to obtain acceptable product efficacy performance.

4.1.4 Product agitation. Many product labels specify mixing requirements, required spray tank additives, sequence to add products, and degree of agitation. Though it may be only a general term, such as "moderate" or "heavy" agitation, it is critical to thoroughly mix the solution. This will increase pump flow requirements if hydraulic agitation is used. Pre-mixing the chemical in a smaller container before adding to the sprayer tank, filled to 1/2 to 2/3 full with water, unless label has other mixing/agitation instructions and provided that this quantity of tank mix is needed, helps achieve uniform mixing. Premix containers should be thoroughly rinsed into the spray tank.

Insufficient agitation may result in non-uniformity of active ingredient concentration across the target field. Large or irregularly shaped tanks when applying wettable powder-type or dispersible granule-type pesticides may be problematic due to "dead spots" in the tank and settling of solids. Or, dry pesticides may float on the surface before uniform mixing.

4.1.5 Adjuvants. Many product labels specify the use of specific adjuvants to provide improved product performance. Adjuvants are often formulation and tank mix specific in their effect, so adhere to the specific recommendations of a product label.

4.1.6 Application type. Some pesticides are volatile and may require incorporation into soil following application. Follow label recommendations to avoid drift from volatile pesticides.

4.2 Identify sprayer operating capabilities (limitations). Sprayer selection depends on sprayer capability. Capabilities may be observed, measured, or specified by the operator's manual. The operator's manual may not reflect sprayer component wear, replacement component performance, or outdated information.

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4.2.1 General inspection of sprayer. Carefully examine sprayer components (tank, nozzles, hoses, pressure gauge, pump, etc.) to ensure proper type and size, and ability to function under various conditions (for example, output of most pumps declines with increased pressure). Ensure no leakage from the spraying system and that pressure gauges return to zero with zero line pressure. Check hydraulic tank agitation for adequate flow rate under maximum spray rate conditions, and check mechanical agitation for leaks and effectiveness under load. Check and clean sprayer system screens, strainers, and filtration systems. Check tire pressure because variations from recommended pressure may affect travel speed and application rate. If the sprayer is equipped for automatic control of spray rate and pressure, controller operation, valve settings, and programming should be understood and verified.

4.2.2 Nozzle spacing. Application equipment generally is set-up with boom nozzle spacing for the sprayer type (i.e., row crop sprayer, floater, etc.). Select nozzle spacing and angle to most efficiently achieve desired results (banding, broadcast, directed spraying, etc.). Some nozzles may be shut-off or nozzle spacing may be modified for certain applications based on the crop, spray application rate, release height, nozzle flow rate, and pattern angle. Nozzle spacing can vary from 25 to 150 cm (10 to 60 in.) in many applications. Nozzle spacing limits should be considered in selecting nozzles and arrangement on the boom.

4.2.3 Nozzle flow rate and number of active nozzles. Nozzles have flow rate (l/min, gal/min) and pattern limitations. The spray application rate (l/ha, gal/ac) depends on flow rate per unit of boom width, which is determined by the number of nozzles per unit of boom width and the flow rate delivered by each nozzle. More nozzles at a closer spacing, multiple nozzles at each outlet, or increased flow rates will provide an increased application rate. If nozzle flow rate is limited, selecting more nozzles per unit of boom width may be necessary to achieve the desired application rate.

4.2.4 Maximum nozzle flow rate. Evaluation of sprayer operating capabilities helps establish the potential flow rate for each nozzle. The maximum flow rate of the selected nozzles will be limited by the flow rate and pressure-delivering capacity of the pump (and controlled by a pressure regulator or flow control valve) minus any agitation requirements. When the application rate is determined according to label instructions, then a nozzle flow rate can be determined using travel speed and nozzle spacing.

4.2.5 Spray pressure range. Spray pressure affects the performance characteristics of a hydraulic-nozzle sprayer. It changes the application rate and the size of droplets. Generally, the operating pressure for a typical boom-sprayer ranges from 100 to ~550 kPa (15 to ~80 psi). Most nozzles produce a greater volume of spray in finer droplets at higher operating pressures, though exact atomization characteristics for the nozzle need to be verified with the nozzle droplet size classification at the pressure during application (see 4.3.5 Spray classification/droplet sizes). The lowest practical pressure that will provide adequate coverage and efficacy generally should be chosen to reduce drift, unless a sprayer controller is used which would benefit from selecting a nozzle that delivers the desired droplet size classification in its mid-range of operating pressure. A good-quality and accurate pressure gauge should be plumbed into the boom or on a dedicated remote line from the boom so that actual boom pressure is registered. The pressure used to deliver the spray solution is determined by the pump and should be maintained by a pressure regulator or bypass flow control.

4.2.6 Sprayer speed range. Sprayer travel speed is critical in achieving the desired application rate. All sprayers have an upper limit on travel speed, including sprayers mounted or towed by tractors. The range of possible sprayer speeds will partially determine the flow rate required of the nozzles for the selected application rate. A higher travel speed will require a higher nozzle flow rate to achieve a given application rate; conversely, a higher nozzle flow rate may permit higher travel speeds to achieve a specified application rate under otherwise similar conditions. However, higher travel speed increases aerodynamic turbulence and boom instability, which gives greater opportunity for smaller droplets to be carried aloft by wind or thermal updrafts, and thus increase the potential for drift. Higher speeds may reduce canopy penetration of spray. If automatic rate controllers adjust pressure to maintain rate with speed variation, make sure you do not exceed the nozzle spray droplet classification quality pressure range.

4.2.7 Boom height range. Boom height and orientation, nozzle spray pattern angle, and nozzle spacing influence overlap and uniformity of spray application. Proper height should be measured and maintained at all sections of the boom. Boom height affects the spray pattern overlap, deposition uniformity on the target, and the time during which the droplets are exposed to wind and evaporation, both of which directly influence drift. Spray release height should be kept to a minimum in order to reduce drift and should be consistent with nozzle

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