**CPDA Application Enhancement Program Rationale & Protocol for Testing**

**Background and Rationale**

Industry began promising a drift reduction program to guide applicators in 2001 and the DRT Task Force was formed. As interest grew, so did the number of stakeholders and eventually progress stalled. Since the EPA’s launch of a “Voluntary DRT program” in 2016, little has been achieved. The program was ultimately too narrowly focused on drift reduction, ignored the possible negative impact on biological efficacy, and lacked incentives to participate.

After 20 years of waiting, applicators still need and want guidance in making more efficacious and on-target applications. To meet this industry need, and at the urging of academia, CPDA began socializing the concept of an Application Enhancement Program in 2019. The proposed program recognizes that drift control without biological efficacy is not a successful application and is designed to provide a more complete picture of the likely outcome of the application. This is achieved by highlighting the positive interactions between pesticide formulation type, various nozzle designs and adjuvant selection. The information provided through this program will provide applicators with an easy to understand visual of how to best manage nozzle and adjuvant selection based on the formulation type of the pesticide to be applied.

**Objective and Disclaimers**

This document outlines the rationale and initial protocol for the launch of CPDA’s Application Enhancement Program (AEP). The data collected is a factual finding of how various application parameters affect droplet size and the data represents the actual droplet size distributions for each treatment. In no way should the data generated be used to supersede the label requirement for a given pesticide or adjuvant.

Neither participation in the Application Enhancement Program, the data collected, nor the information generated, by the testing be considered or implied as an endorsement of any product by CPDA.

**Approved Testing Facilities**

While it is desirable in the future for more than one facility to be approved for testing, much work remains to be done to in this area to develop a computer program capable of normalizing data generated at different locations and / or different droplet measurement techniques. Therefore, at the launch of this program the only approved testing facility is:

University of Nebraska-Lincoln Pesticide Application Technology Laboratory West Central Research, Education and Extension Center North Platte, Nebraska

**Selected Nozzle Designs**

There are currently four nozzles to be used in this testing. These nozzles represent the primary nozzle designs most commonly used in ground applications of crop protection products. Included nozzle designs are: single orifice flat fan nozzle, turbulence chamber nozzle, air-inducted flat fan nozzle and an air-inducted turbulence chamber nozzle, specifically these nozzles are manufactured by TeeJet and are denoted as XR11004, TT11004, AIXR11004, and TTI11004, resepectively.

Additional nozzles may be approved and added in the future.

**Selected Pesticide Formulations**

Four of the most widely utilized pesticide formulations are: Soluble Liquids (SL), Emulsifiable Concentrates (EC), Suspension Concentrates (SC) and Water Dispersible Granules (WDG). Literature results show that SC and granule formulations have minimal impact on the spray droplet spectrum. However, the inert systems in both SL and EC formulations play a significant role on influencing droplet spectrum as well as interacting with various types of spray modifier agents.

Based on this, the following four pesticides were chosen to represent the different formulation types that have the greatest influence on spray droplet spectrum:

* Headline® (EC)
* Liberty® (SL formulated with anionic surfactant)
* Roundup PowerMax® (SL formulated with cationic surfactant)
* Shredder® Amine 4 (SL with minimal adjuvancy)

**Droplet Spectra Range and Depiction of the Data**

Industry experts have concluded a specific spray droplet size range to be “effective” for ensuring deposition and retention of the spray solution on plant leaf surfaces. Based on this established range, the following categories will be used to characterize each tested nozzle, pesticide, adjuvant combination:

* Shape, circle

  Description automatically generated% Too Small - % of spray volume less than 164 m
* % Effective - % of spray volume between 164 m to 836 m
* % Too Big - % of spray volume greater than 836 m

These values are derived from the ASABE S572.3 reference nozzle data. The 164 um is the DV10 value of the Medium/Coarse boundary reference nozzle (TP11006 at 29 psi) and the 836 um is the average of the DV90 values of the C/VC nozzle (8008) and the XC/UC nozzle (6510). Note that care should be taken to use the most current version of the S572 standard, as the spray pressures for the three coarsest nozzles were lowered compared to the previous version (S572.2) resulting in significantly larger droplet size values.

Data will be depicted for each combination tested using a “droplet spectra diagram” as shown here. For consistency, this is the only acceptable format for portrayal of the data generated under the Application Enhancement Program.

**Application Instrument and Conditions**

Four nozzles and a total of twenty spray solutions are to be analyzed with a Sympatec Helos Vario KR laser diffraction, particle size analyzer in a low speed (15 mph air flow) wind tunnel. With the R7 lens installed, it can detect particle sizes ranging from 18 to 3500 microns.

The settings below represent the “standard” measurement conditions established by the UNL PAT lab and its cooperators over the past decade and are likely to differ from other cooperating faculties. Additional procedures are being developed and verified for review and potential inclusion by CPDA that will allow for data from any cooperating facility to be adjusted to ensure consistent, relative comparison to all other data accepted as part of this program. The current protocols will be updated upon successful completion of the above described activities.

**Recommended Climatic data and instrument used during testing**

|  |  |
| --- | --- |
| Metric | Data |
| Wind speed (mph) | 15 |
| Temperature (°F) | ~ 70-75 |
| Relative humidity (%) | ~ 60-70 |
| Measurement distance (in) | 12 |
| Particle size analyzer  Replicated measurements per treatment | HELOS KR with R7  Minimum of 3 |

**Protocols**

1. Nozzles & pressure selections:

The four Spray System Company nozzles used for this protocol are:

* XR11004
* TT11004
* AIXR11004
* TTI1104.

All nozzles will be operated at 40 psi.

1. Pesticide formulations: The following four pesticides, covering different formulations and chemistry types, are to be tested in combination with each of the above nozzles with and without a candidate adjuvant to gain a full understanding on the adjuvant impact on the spray quality:

* Headline® (EC) at 0.625% v:v
* Liberty® (SL) at 2.5% v:v
* Roundup PowerMax® (SL) at 2.5% v:v
* Shredder® Amine 4 (SL) at 2.5% v:v

1. Treatment list, products, use-rates and abbreviations

|  |  |  |  |
| --- | --- | --- | --- |
| Trt | Solution | Rate (%v:v) | Nozzle |
| 0 | DI Water | 0 | XR11004, TT11004, AIXR11004, TTI11004 |
| 1 | Headline | 0.625 | XR11004, TT11004, AIXR11004, TTI11004 |
| 2 | Headline + adjuvant | 0.625 + A | XR11004, TT11004, AIXR11004, TTI11004 |
| 3 | Liberty | 2.5 | XR11004, TT11004, AIXR11004, TTI11004 |
| 4 | Liberty + Adjuvant | 2.5 + A | XR11004, TT11004, AIXR11004, TTI11004 |
| 5 | Roundup PowerMax | 2.5 | XR11004, TT11004, AIXR11004, TTI11004 |
| 6 | Roundup PowerMax + Adjuvant | 2.5 + A | XR11004, TT11004, AIXR11004, TTI11004 |
| 7 | Shredder | 2.5 | XR11004, TT11004, AIXR11004, TTI11004 |
| 8 | Shredder + Adjuvant | 2.5 + A | XR11004, TT11004, AIXR11004, TTI11004 |

**DATA Generation and Review Process**

1. The initial phase of the AEP will consist of executing the above protocol at the University of Nebraska-Lincoln, Pesticide Application Technology facilities with the selected four nozzles and four pesticide formulations, in combination with a single candidate adjuvant. Total cost for full protocol dataset for initial, single adjuvant is anticipated to be set at $5,000.00.
2. In addition to the test combinations presented above, each candidate data set should also include droplet size distribution data for the ASABE S572.3 reference nozzles and the specified reference operating pressures (see following table). NOTE: The newest version of S572 (version 3) uses updated pressure for the three coarsest classifications. Measurements should be made under the same conditions and protocols as all program candidate treatment data.

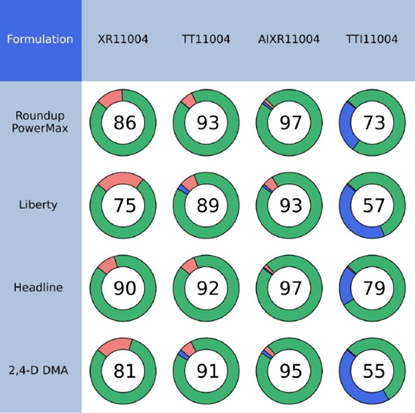
|  |  |  |
| --- | --- | --- |
| **Classification** | **Nozzle** | **Reference Pressure (psi)** |
| VF / F | 11001 | 65.3 |
| F / M | 11003 | 43.5 |
| M / C | 11006 | 29.0 |
| C / VC | 8008 | 31.9 |
| VC / XC | 6510 | 17.4 |
| XC / UC | 6515 | 14.5 |

1. “CPDA” review of submitted data for completeness. The proposed data output format is:

Date, Time, Measurement Range, Optical Conc., Solution, Nozzle, Orientation, Orifice, Pressure, Airspeed, Measurement Distance, Rep, DV10, DV50, DV90, %<30um, %<50um, %<80um, %>100um, %>141um, %>150um, %>200um, %>730um , Ch 1, Ch 2, Ch 3, Ch 4, Ch 5, Ch 6, Ch 7, Ch 8, Ch 9, Ch 10, Ch 11, Ch 12, Ch 13, Ch 14, Ch 15, Ch 16, Ch 17, Ch 18, Ch 19, Ch 20, Ch 21, Ch 22, Ch 23, Ch 24, Ch 25, Ch 26, Ch 27, Ch 28, Ch 29, Ch 30, Ch 31. The Chxx data are either the cumulative or incremental distribution values across all measured droplet size bins.

1. Each candidate data distribution will be segregated to their respective EPA Classification categories according to the set breakpoints:

From here, visual representation of the results for each candidate product can be established. As an example:



1. Formal review of the results and diagram by the AEP Data Quality Assessment Committee for accuracy.
2. Notification of approval sent to submitter with license to use appropriate marks identifying the product as AEP Certified.
3. Final diagram posted to CPDA website.