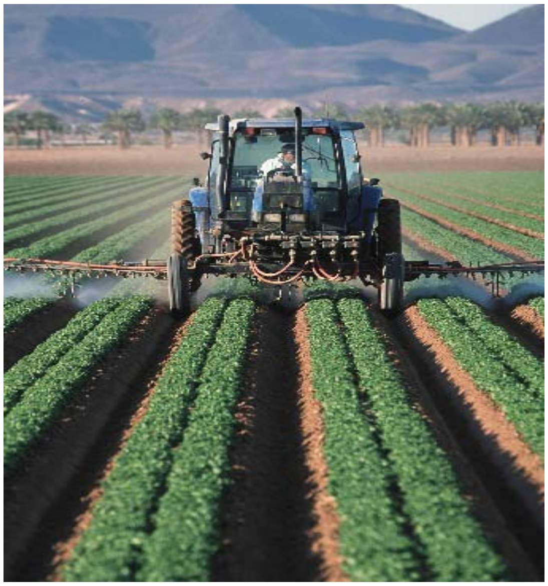
United States Department of Agriculture
Natural Resources Conservation Service

2013 Ranking Period 1

Air Quality Enhancement Activity – AIR07 – GPS, targeted spray application (SmartSprayer), or other chemical application electronic control technology



Enhancement Description
Utilize electronically-controlled or managed chemical spray application technology to more precisely apply agricultural pesticides to their intended targets.

Land Use Applicability
Cropland, Pastureland, Rangeland, Forestland

Benefits
These activities will provide improvements in water and air quality by reducing the total amount of chemical applied, and reducing the potential for airborne chemical drift when agricultural chemicals are applied. This enhancement can be used only if chemical applications are done according to label directions. Reducing chemical drift will help to reduce both particulate matter (liquid droplets) in the air and the production of volatile organic compounds, which are an integral part of production of ozone, a pollutant in the lower atmosphere. Reduced chemical drift will improve water quality by minimizing the delivery of chemical compounds through the air to water bodies.

Conditions Where Enhancement Applies
This enhancement applies to all crop, pasture, range or forest land use acres.

Criteria
The implementation of this enhancement for precision pesticide application technology to reduce spray drift and the total amount of pesticide applied requires the use of GPS data loggers (i.e., devices that record the track, time and location of field trips for download to maps) in order to document site-specific compliance with all label requirements for drift mitigation, and additionally, one or more of the following techniques:

1. Precision guidance systems that reduce ground or aerial spray overlap to less than 12 inches
2. Variable rate technologies (VRT) that allow the rate of pesticide application to dynamically change for site specific applications
3. “Smart sprayers” that utilize automatic sensors and computer controlled nozzles to turn individual nozzles on and off
4. Computer guided application systems that integrate real time meteorological data and computer model guidance to reduce pesticide drift from aerial application
5. Re-circulating spray technologies that capture and reuse overspray to reduce overall pesticide application rate and off-site spray drift

6. Electrostatic spray technologies to reduce overall application rate and off-site spray drift

Adoption Requirements

This enhancement is considered adopted when site-specific compliance requirements plus one or more of the above criteria have been implemented and documented to satisfaction of the NRCS State Office.

Documentation Requirements

Each year the following must be supplied:

1. Type of electronic spray control technology used,
2. Dates technology is used, and
3. Acres treated.

References

Brown D.L., D.K. Giles, M.N. Oliver, P. Klassen. 2008. Targeted spray technology to reduce pesticide in runoff from dormant orchards. Crop Prot. 27(3-5):545-52. DOI: 10.1016/j.cropro.2007.08.012

Downey D. and D.K. Giles. 2005. Reducing orchard spray rates and ground deposit by using tree sensors and sprayer control. Ann Rev Ag Eng. 4:229-36.

Giles D.K., M.J. Delwiche and R.B. Dodd. 1987. Control of orchard spraying based on electronic sensing of target characteristics. Trans ASAE. 30(6):1624-30.

Giles D.K., P. Klassen, F.J.A. Niederholzer and D. Downey. 2011. *California Agriculture.* 65(2):85-89. DOI: 10.3733/ca.v065n02p85.
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Tien, L. 2002. Development of a sensor-based precision herbicide application system. Computers and Electronics in Agriculture, 36:133-149.

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IDAHO ADDENDUM 2013
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Additional guidance on Electronic Control Technology

GPS/GIS[1]

The Global Positioning System (GPS) and Geographic Information Systems (GIS) provide farmers with the capabilities to manage field variability on a site-specific basis. When installed on agriculture equipment, a GPS receiver provides position information for soil sampling, crop scouting, applying inputs, etc., and allows farmers to continually return to the same location in a field. A GIS retrieves, stores, and analyzes spatial data and can be used to generate field and prescription maps for application of crop inputs.

Precision Guidance Systems[1]

GPS systems help farmers "guide" their equipment when traversing fields in order to maintain the desired path. These guidance systems reduce application overlap, or skips, and improve in-field efficiency. These systems come it two basic forms for ground application: manual and automated guidance.

Manual Guidance

The equipment guidance system that is the simplest and least expensive for farmers to adopt is the lightbar. Lightbar guidance systems require the operator to drive the vehicle with the lightbar providing navigation cues to the driver based on the GPS location and swath width of the equipment. Newer lightbar systems feature last-pass-guidance, color screens and as-applied mapping. Units typically provide 4" to 12" pass-to-pass accuracy.

Automated Guidance

Auto-steer guidance systems work along the same principle as lightbar systems, but they actually steer the machinery instead of the equipment operator. The operator must manually turn the equipment at field ends. Assisted steering devices can provide 2" – 12" accuracy depending on the GPS correction utilized for the application. Auto-steer systems utilizing Real-time kinematic (RTK) can provide year-to-year repeatable accuracy to the sub-inch level.

For aerial applications, there are several computer-guided application systems that integrate real time meteorological data and computer model guidance to help reduce drift. These include systems like AIMMS, WingMan, and NextStar.

Variable Rate Technologies[1]

Variable-rate technology (VRT) describes any technology which enables producers to vary the rate of crop inputs. VRT combines a variable-rate (VR) control system with application equipment to apply inputs at a precise time and/or location to achieve site-specific application rates of inputs. A complement of components, such as a DGPS receiver, computer, VR software, and controller are integrated to make VRT work. A site-specific approach allows growers to apply products only where they are needed in a field. Varying the application of inputs can reduce input and labor costs, maximize productivity, and reduces the impact over-application may have on the environment. Information used to develop and apply variable rates is often based on yield monitoring or remotely sensed data.

Yield Monitoring

Yield monitors use GPS, GIS, a computer, and sensor technologies to accurately measure the amount of crop harvested at a specific location and time. Yield monitors are installed on harvesting equipment, and can also allow for the recording of crop moisture, elevation, variety, and a number of other harvest variables. Yield monitors use sensors to measure the crops' mass or volume and are found to be accurate to +/- 3% of actual harvested amounts, but require routine calibration to maintain accuracy. The volume or mass measurements are recorded in the on-board computer to produce indirect yield measurements. GPS provides the field location for each measurement. The location and yield data are recorded onto a storage device and transferred to a software package for processing, viewing, and analysis. Maps depicting yield variations across fields can be developed and used to provide farm management decisions to improve crop productivity.

Remote Sensing

Remote sensing obtains information about an object without directly contacting it. In an agricultural environment, information about the soil or crop is usually gathered from a plane-based, satellite-based, or agricultural equipment-based sensing device. Data collected can range from a simple color photograph to the crop's emission of electromagnetic energy. Remotely sensed data can provide farmers real-time information regarding their crop condition, allowing them to respond and make corrective or other management decisions to maximize crop production. Examples of remote sensing tools used in agriculture include aerial photographs, near-infrared (NIR) date, and thermal imagery. Integrating remotely sensed data into a GIS can reveal information about soil characteristics and general crop health that can be a valuable tool for site-specific management.

Advanced Spray Technologies[2,3,4]

Targeted spray applications are performed using a variety of technologies that apply herbicide only to the target weeds. A "smart sprayer" combines computer software, high-power light, infrared emitters with sensitive silicon photo detectors, or other real-time sensing or "vision" technology to determine the precise location of individual weeds or patches. Then, individually-controlled nozzles apply herbicide in short bursts only to the weeds. One caveat to this application methodology is that current herbicide product labels are designed for broadcast applications using conventional sprayers. It may be difficult to determine the best smart sprayer chemical input amount for different crop/weed coverages, control zone size and timing combinations.

Specialized sprayers are typically used for high value vegetable crops, in vineyards, orchards, and greenhouses. These include electrostatic sprayers and recirculating sprayers.

Electrostatic sprayers produce electrically charged spray droplets which are carried to the target (crop) in an air stream. Electrical charges on the surface of the spray particles cause them to be attracted to the target where they are directed. Recirculating sprayers direct solid streams of highly concentrated pesticides directly across rows above a crop. Spray material not contacting the crop is caught in a box or sump on the opposite side of the row and re-circulated. Typically used to control weeds that are taller than the crop – specialized situations.

<u>References</u>

[1] Alabama Extension, Precision Agriculture Overview.

[2] USDA-ARS Application Production Technology Research Unit, Stoneville, MS.

[3] University of Illinois Extension, Remote Sensing and Variable Rate Technology

[4] EPA, Drift Reduction Technologies.

This activity may NOT be used with the following enhancements: WQL01, WQL19, WQL20, and WQL21.

Potential duplicate practices:
595-Integrated pest management