**California Environmental Protection Agency**
**Department of Pesticide Regulation**

# Pesticide Air Initiative: Innovative Technologies – Precision Agriculture

New technologies are greatly expanding the range of pesticide application tools. The term "precision agriculture" can be used to describe many of these tools, and refers to a variety of technologies that lead to more precise methods of pesticide application. Precision agriculture tools can include: (1) Special equipment to guard against pesticide leakage and spills, reducing pesticide waste and pollution; (2) Application equipment to better target sprays, lower pesticide expenses, reduce environmental exposure, and reduce drift; and (3) Variable rate technologies (VRT) that allow the rate of pesticide application to change within a single field, according to site-specific conditions determined by maps or sensors. These new tools offer economic, crop management, and environmental advantages.

## Leakage prevention equipment

Positive shutoff valves prevent pesticide leakage, e.g., the drip-free shutoff (Western Farm Service) used in Telone shank applications, ChemSaver® diaphragm check valve for drip-free shutoff, and many others.

## Equipment for targeted pesticide application

Spray nozzles Special nozzles can be used to target spray applications, for increasing efficiency and reducing drift. One example is a double nozzle sprayer that delivers a coarse spray of water surrounding a fine spray of active ingredient, which is drawn into the canopy of target plants, reducing pesticide use by up to 50% with no loss of efficacy. Low and high pressure venturi air induction nozzles also allow better crop coverage with less pesticide use, and have been shown to reduce drift by 35-90%. Other types of spray tips are designed to penetrate dense foliage with small droplets for thorough coverage.

Controlled Droplet Application (CDA) CDA pesticide spray technology has been widely used throughout the world for more than 20 years, particularly in the horticulture and viticulture industries where chemical contamination of soil and fruit has been an issue. CDA is low pressure and low volume, producing a uniform pattern of fine droplets that are directed to the crop foliage and dry quickly.

Electrostatic sprayers Air-assisted electrostatic spraying systems produce small, negatively-charged spray droplets which are carried toward the crop in an air stream that propels them deeply into complex targets such as tall plants. Strongly attracted by the positive charge of plant leaves, the spray particles coat all sides of them. Electrostatic sprayers can help prevent environmental and human exposure by reducing spray runoff and off-site drift. They may reduce worker exposure to pesticides by as much as 82%.

**Variable rate pesticide application**

Variable rate technology (VRT) allows variable rates of pesticide application within a single field, based on site-specific need. VRT not only improves crop management, but also can help protect public health and the environment.

Operator-controlled rate adjustment A highly trained equipment operator can guide variable-rate applications effectively. For instance, some spray equipment allows operators to control pesticide application rate and droplet size in accordance with changing wind and weather conditions, known pest pressures, and different field locations. Larger droplets can be applied at higher speeds, and smaller droplets at slower speeds, without changing spray tips. All these capabilities are useful for directing pesticide where it is most needed, and reducing drift.

Built-in sensors Equipment with stand-alone sensors is increasingly available for better targeting of pesticide applications. For example, some "smart sprayers" turn individual nozzles on and off according to the presence, size, and shape of orchard trees. No pesticide is applied where there are gaps between trees, and none is sprayed below or above the tree canopy. This can save growers up to 30% in chemical costs. Fewer sprayer refills translate into time, labor and fuel savings as well. Less exposure of the environment to pesticides is another big advantage. Similarly, some herbicide application equipment carries infrared optical detectors connected to a computer that sends signals back to the spray unit. The nozzle opens and targets the herbicide application to individual weeds as they pass underneath. This happens within milliseconds, keeping herbicide use to a minimum.

Field mapping and remote sensing for precision pesticide application There are conventional and automated ground methods for understanding and mapping field variability—for instance, soil grid sampling and mapping, and yield information mapped "on the go" by harvest equipment. Now these can be augmented by field maps generated with remote sensing images from radar or optical sensors on satellites or aircraft. For instance, light in specific visible, near- and middle-infrared regions of the electromagnetic spectrum, reflected on optical sensors, is useful for detecting nutrient deficiencies, diseases, insects, and weed infestations. Remote sensing for pest management is an emerging technology, and may require further study in order to be used in some agricultural settings.

Maps can be stored in geographic information systems (GIS) and used for guiding pest scouting efforts, and/or variable-rate pesticide application. Input application equipment used in conjunction with maps is computerized and has a built-in geographic positioning system (GPS). The GPS unit continuously locates the application equipment and links it to a preset GIS map. The application rate changes continuously as the sprayer moves through the crop, in accordance with the GIS map. Several private enterprises already offer remote sensing and associated precision agriculture services in California. Their customers include producers of cotton, rice, corn, wheat, pistachios, and tomatoes.