SPRAY DRIFT MANAGEMENT AND THERMAL INVERSIONS

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Avoiding Drift Under Conditions of Thermal Inversion (with particular reference to the meteorology of mountain valleys)

The droplet size spectra emitted by agricultural spray nozzles will always contain some proportion of spray droplets that are liable to drift. For this reason, pesticide products should never be sprayed under conditions of thermal inversion, because drift potential is high.

Thermal inversions contain air that has no turbulence, and no vertical air mixing. This situation can result in small droplets, emitted by agricultural nozzles remaining in a concentrated cloud within the inversion. Such a cloud can move in unpredictable directions due to the light variable winds which may be present during inversions. Thermal inversions are characterized by increasing temperature with altitude and are common on nights with limited or no cloud cover and light to no wind. Inversions begin to form as the sun sets and often continue into the morning. The presence of an inversion may be indicated by ground fog. However, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally as a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates, indicates good vertical air mixing.

The meteorological situation in valleys, particularly mountain valleys is further complicated by local winds which are produced by differences in temperature in the local terrain. The local topography, orientation and geometry of the valley will dictate the formation of local winds, and the method of formation of thermal inversions.

The following is a general description of the mechanism of formation of thermal inversions in mountain valleys, such as the San Luis Valley in Colorado.

As the sun sets, solar heating of the land ceases and is replaced by radiative cooling of the air adjacent to the cooling land. This cool air has a higher density and moves down the incline of the valley as a light wind. Basically, this cold air begins to fill up the mountain valley and it is often described as a drainage wind. There is also a counter wind of warmer air above the cold air wind in the valley. As the night progresses, it is possible that a fully developed valley inversion will form (although this does not always happen). If this happens, the inversion in the valley may trap fine pesticide spray droplets as a concentrated cloud, because there is little or no turbulence in the air within the inversion.

After sunrise, the sun warms the land followed by the air adjacent to the land, which is warmed by radiation from the land. The warm air will tend to move back up the valley very slowly, but tends to hug the land, (the bottom and sides of the valley), leaving the inversion air layer in the central portion of the valley, when viewed in cross-section. As the warm air moves up the valley, the cool air of the inversion subsides and then, mixes in, and is eliminated from the valley. At this point any pesticide droplets held in the inversion, will move in unpredictable ways and may deposit on non-target crops present in the valley. These droplets may also be carried out of the valley by upward air currents, or away from non-target crops.

It is clear that the only way to prevent this type of pesticide spray drift which occurs within thermal inversions is to ensure that no spray applications (either aerial or ground), are made during conditions of thermal inversions.