

Evaporation and Coverage Area of Pesticide Droplets on Hairy and Waxy Leaves

Spray deposition and coverage are the two major components of spray performance. Little research has been conducted on how droplets spread, how long droplets last on target surfaces, nor have the effects of individual variables on these mechanisms been quantified. The objective of this research was to determine effects of individual variables including the addition of surfactant or drift retardant, droplet size, and relative humidity on the evaporation and maximum coverage area of single droplets deposited on waxy and hairy leaf surfaces, in an effort to further maximize pesticide spray application efficiency.

Evaporation times and the maximum coverage areas of single droplets on hairy and waxy geranium leaf surfaces were determined under controlled conditions. Stereoscopic sequential images of the evaporation processes for five droplet sizes (246, 343, 575, 765, and 886 μm), three relative humidity conditions (30, 60, and 90%), and thirteen different sprays (combinations of three insecticides, a fungicide, a non-ionic colloidal polymer drift retardant, an alkyl polyoxyethylene surfactant, and distilled water) were taken.

Droplet evaporation times were longer on the waxy geranium leaves than on the hairy geranium leaves for all droplet diameters, spray types, and relative humidity conditions (Figure 1). Addition of the alkyl polyoxyethylene surfactant to the spray significantly reduced the evaporation times of droplets on both hairy and waxy leaves, while addition of the non-ionic colloidal polymer drift retardant only slightly increased the evaporation times. Droplet evaporation times increased exponentially as diameters and relative humidity increased.

Spray combinations without surfactant showed maximum coverage area was greater on waxy leaves than hairy leaves within the same droplet diameter; however, this trend was opposite with the addition of surfactant. Adding surfactant increased the maximum coverage area 4.5- 10.1 times on the hairy leaves and

3.4- 4.1 times on the waxy leaves. The maximum coverage areas increased exponentially as droplet diameters increased (Table 1, data presented for waxy leaves only). Coverage area was not significantly influenced by a change in relative humidity or the addition of insecticide, fungicide, or drift retardant.

Droplet size, leaf surface structure (waxy or hairy), and addition of surfactant greatly influenced the evaporation times and maximum coverage areas. These variables should be taken into consideration for the development of efficient and effective foliar pesticide applications.

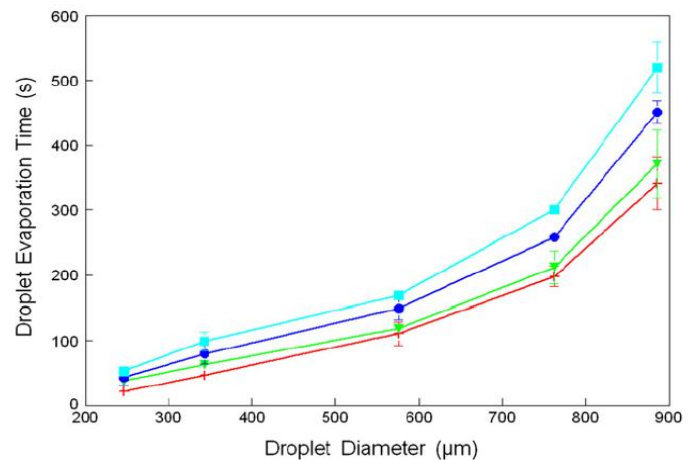


Figure 1. Evaporation time of different size droplets containing insecticide No. 3 on hairy leaf (+), hydrophilic surface (▼), waxy leaf (●), and hydrophobic surface (■) at 60% RH. Data for droplet evaporation for hydrophilic and hydrophobic surfaces are from Yu *et al.* (2009).



For more information, contact: Heping Zu, heping.zu@ars.usda.gov, USDA-ARS-ATRU, 1680 Madison Ave, Agricultural Engineering Building, Wooster, OH 44691

Table 1. Mean maximum deposition coverage area (mm^2) of droplets containing different mixtures on waxy geranium leaf at three values of RH. Standard deviations are presented in parentheses.

Sprays ^a	RH (%)	Droplet diameter (μm)				
		246	343	575	762	886
Water only	30	0.123(0.012)	0.208(0.016)	0.363(0.019)	0.787(0.006)	1.198(0.019)
Water only	60	0.199(0.052)	0.230(0.027)	0.444(0.002)	1.052(0.123)	1.401(0.074)
Water only	90	0.119(0.014)	0.193(0.013)	0.405 (0.104)	0.647(0.056)	0.999(0.062)
Pesticide ^b	30	0.140(0.026)	0.256(0.036)	0.450(0.022)	0.778(0.072)	1.187(0.130)
Pesticide	60	0.165(0.033)	0.257(0.040)	0.536(0.052)	0.944(0.095)	1.373(0.114)
Pesticide	90	0.154(0.016)	0.264(0.066)	0.445(0.057)	0.805(0.071)	1.232(0.124)
Pesticide + drift retardant	30	0.172(0.016)	0.301(0.029)	0.610(0.036)	0.963(0.046)	1.426(0.091)
Pesticide + drift retardant	60	0.196(0.031)	0.324(0.056)	0.607(0.065)	1.074(0.207)	1.406(0.184)
Pesticide + drift retardant	90	0.200(0.034)	0.348 (0.045)	0.630(0.065)	1.147(0.116)	1.700(0.145)
Pesticide + surfactant	30	0.477(0.035)	0.989(0.097)	2.005(0.119)	3.825(0.163)	5.846(0.389)
Pesticide + surfactant	60	0.692(0.127)	1.115(0.065)	2.136(0.111)	3.944(0.152)	5.606(0.376)
Pesticide + surfactant	90	0.544(0.117)	0.948(0.045)	1.769(0.095)	3.120 (0.248)	4.281(0.295)

a All sprays used water as the carrier.

b Coverage area for pesticide was averaged from values of fungicide, insecticide No. 1, insecticide No. 2 and insecticide No. 3.