(1) Less penicillin is excreted when administered in water two hours after breakfast than when administered in water after an overnight fast. This is probably due to decreased gastric acidity in fasting subjects.

(2) Administration of 1.4 to 7.0 gm of trisodium citrate or 2.5 gm disodium phosphate with penicillin after an overnight fast slightly increases the urinary excretion of penicillin over values obtained after administration of penicillin in water alone under the same conditions.

(3) Administration of 1.4 to 7.0 gm of trisodium citrate with penicillin two hours after breakfast, results in approximately a 100 per cent. increase in excretion of urinary penicillin as compared to administration in water alone under the same conditions.

(4) After oral administration, large individual differences in urinary penicillin excretion occur.

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AEROSOL APPLICATION OF GROWTH REGULATORS TO RETARD ABCISSION OF APPLE FRUITS[1]

GROWTH-REGULATING substances have been used effectively both in water sprays and in dust mixtures to retard the abscission of apple fruits before harvest.[2,3] One gallon of spray with a concentration of 10 ppm of growth substance is used for each bushel of fruit on the tree.

More recently the aerosol method[4] has been reported as a convenient and efficient means of dispensing growth-regulating substances.[5] It has been used for the setting of tomato fruits,[5,6] the development of parthenocarpic tomato fruits,[5,6] the development of blackberry fruits[7] and the destruction of weeds.[8] It is more like a fumigation than a spray and avoids the use of water or dust carrier. The growth substance and a carrier solvent are held under pressure dissolved in a liquefied gas. The mixture is released as a very fine mist. The liquefied gas escapes and carries with it the growth-regulating substance and the solvent. The vapor pressure of the gas is sufficient to disperse the solution into very small particles.

Because of the large size of commercial apple trees and the rapid diffusion and drifting of an unconfined gas, the use of the aerosol method with present equipment in large commercial orchard operations has been considered impracticable. However, its use with small trees suggests itself as a possibility. This paper reports results with growth-regulating substances applied in aerosol form to dwarf and semi-dwarf apple trees for the prevention of pre-harvest drop of fruit.

An aerosol was prepared consisting of .25 per cent. naphthalene acetic acid, .5 per cent. lanolin and 94.75 per cent. dimethyl ether.[5] In addition, for comparison, two water sprays were prepared with naphthalene actic acid at 10 ppm, using .5 per cent. ethyl alcohol as the carrier for the growth-regulating substance for the one spray and .5 per cent. Carbowax 1500 for the other.[9]

Eight- and nine-year-old trees of the McIntosh, Macoun and Kendall varieties were selected for treatment—12 trees of the first and 6 trees of each of the other two. They are varieties which do not retain the fruit well and also which are not overly responsive to the pre-harvest spray. They were on dwarf (Malling IX) and semi-dwarf (Malling I, V and VII) rootstocks. The dwarf trees were 5½ feet in height, 6 feet in spread and averaged about 1 bushel of fruit per tree. The semi-dwarf trees were approximately 12½ feet in height, 10 feet in spread and averaged about 2.5 bushels of fruit per tree.

Initial applications were made on September 18 at the time considered most likely to be effective, and repeated at 7-day intervals on September 25, October 3 and October 10. The aerosol was applied by means of a "Sure Shot Pressure Sprayer" weighing about 2 pounds, and the water spray from a 3-gallon knapsack sprayer. Applications were made during the more quiet part of the day, as early forenoon or late afternoon. Because of the small size of the trees and the accessibility of the fruit, it was possible to apply both the aerosol and the water sprays directly at the fruit from a distance of only a few feet. Average mean temperatures on the days of application were 69° F. September 18, 54° F. September 25, 58° F. October 2 and 55° F. October 10.

Approximately 1/3 (.34) of a gallon of water spray was used for each bushel of fruit, and ½ ounce (.034 of a pound) of aerosol for each bushel of fruit. In terms of growth-regulating substance, 13.8 mgs of naphthalene acetic acid were used per bushel of fruit in the water spray and 34 mgs in the aerosol. This compares with the recommended commercial prac-

[1] Journal article No. 615 of the New York State Agricultural Experiment Station.

[2] F. E. Gardner, P. C. Marth and L. P. Batjer, *Proc. Amer. Soc. Hort. Sci.*, 38: 104–110, 1941.

[3] M. B. Hoffman, A. VanDoren and L. J. Edgerton, *Proc. Amer. Soc. Hort. Sci.*, 203–206, 1943.

[4] Lyle D. Goodhue, *Indust. and Eng. Chem.*, 34: 1456–1459, 1942.

[5] C. L. Hamner, H. A. Schomer and L. D. Goodhue, SCIENCE, 99: 85, 1944.

[6] P. W. Zimmerman and A. E. Hitchcock, *Contrib. Boyce Thompson Inst.*, 13(7): 313–322, July–Sept., 1944.

[7] P. C. Marth and E. M. Meader, *Proc. Amer. Soc. Hort. Sci.*, 45: 293–299, 1944.

[8] C. L. Hamner and H. B. Tukey, *Bot. Gaz.*, 106: 232–245, 1944.

[9] J. W. Mitchell and C. L. Hamner, *Bot. Gaz.*, 105: 474–483, 1944.

tice of 40 mgs where 1 gallon at 10 ppm is used for each bushel of fruit.

All the treatments proved effective in delaying the abscission of the fruit. With the McIntosh variety, the percentages of fruit remaining on the trees on October 12 (22 days after commercial harvest) were:

Carbowax-water spray	78 per cent.
Aerosol	75 per cent.
Alcohol-water spray	74 per cent.
Control	36 per cent.

On October 30 (41 days after commercial harvest), 12 per cent. of the fruit still remained on the trees, whereas on the untreated trees no fruit remained.

With the Macoun variety the results were similar. Fifty-six per cent. of the crop remained on the aerosol-treated trees on October 17 (22 days after commercial harvest) compared with 33 per cent. on untreated trees; and on October 31 (36 days after commercial harvest) 27 per cent. of the fruit remained on treated trees as compared with 4 per cent. on untreated trees. The most striking results were obtained with the Kendall variety—87 per cent. of the fruits remaining on the treated trees on October 30 (35 days after commercial harvest) as compared with 2 per cent. on untreated trees. In fact, many of the fruits which remained were cracked and split due to continued growth.

No attempt was made to be economical with material in the aerosol treatment; the cylinder was exhausted at each application. It may be that the amount was in excess of what was needed. Nevertheless, even at the relatively high concentration of 40 mgs of growth-regulating substance per bushel of fruit, as used in commercial orchard spraying, 1 pound of aerosol containing ¼ per cent. of growth-regulating substance is equivalent to 28¼ gallons of water spray containing 10 ppm of growth substance.

The efficiency and ease of application by the aerosol method suggests the possibility of applying other materials by the same method, such as insecticides and fungicides,[6] at least to small trees, and of developing special equipment for application to large trees. The effectiveness of repeated applications at 7-day intervals is of interest in this connection.

An aerosol of 2–4 dichlorophenoxyacetic acid was also effective in delaying the abscission of the fruit. Not only did the fruits adhere tenaciously for a long period but they were more highly and more completely colored—especially those fruits which were in close proximity to the point of aerosol application. There may be other materials as well, which may prove useful in aerosol form for the prevention of pre-harvest drop of fruit.

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EFFECT OF MERTHIOLATE (LILLY) ON CERTAIN SPECIFIC PRECIPITATION REACTIONS[1]

THE use of Merthiolate (Lilly) as a preservative for blood serum is a general practice.[2] Since Merthiolate (Lilly) is sodium ethylmercurithiosalicylate ($C_2H_5HgSC_6H_4COONa$), a substituted benzoic acid, and would be expected to combine with antibenzoic acid serum, we have tested this possibility. Quantitative determinations were made of the effect of this compound on the precipitation by two antigens of antiserum (anti-X serum) obtained from rabbits inoculated with beef serum coupled with diazotized *p*-aminobenzoic acid. The precipitating antigens used were 1,8-dihydroxy-2,7-di(*p*-(*p*-azophenylazo) benzoic acid)-3,6-disulfonic acid naphthalene (Chrom X'_2) and ovalbumin coupled with diazotized *p*-amino benzoic acid (X-ovalbumin). Determinations were also made of the effect of Merthiolate (Lilly) on the specific precipitation of antisera obtained from rabbits inoculated with sheep serum coupled with *p*-arsanilic acid (anti-R serum) or with sheep serum coupled with diazotized *p*-(*p*-aminophenylazo)phenylarsonic acid (anti-R′ serum). The following antigens were used: 1,8-dihydroxy-2,7-di(*p*-azophenylarsonic acid)-3,6-disulfonic acid naphthalene (antigen XXXI); 1,8-dihydroxy-2,7-di(*p*-(*p*-azophenylazo)phenylarsonic acid)-3,6-disulfonic acid naphthalene (antigen XXX); and ovalbumin coupled with diazotized *p*-(*p*-aminophenylazo)phenylarsonic acid (R′-ovalbumin).

Evidence of interaction of antibody and Merthiolate (Lilly) was observed in several of these systems.

EXPERIMENTAL METHODS

Materials: The antisera and antigens have been described previously.[3,4,5]

The Reaction of Antiserum with Antigen and Merthiolate (Lilly): The reaction mixtures were set up in triplicate, with use in each series of experiments of the amount of antigen giving the largest amount of precipitate in the absence of hapten; borate buffer was used as diluent.[6] The tubes were allowed to stand one hour at room temperature and overnight in the refrigerator, and the precipitates were then analyzed by our usual method.[7]

The final concentrations of Merthiolate (Lilly) in the precipitating mixtures covered the range usually

[1] Contribution from the Gates and Crellin Laboratories of Chemistry, California Institute of Technology, No. 962.

[2] W. C. Boyd, "Fundamentals of Immunology." Interscience Publishers, Inc., New York, 1943, p. 342.

[3] L. Pauling, D. Pressman, D. H. Campbell, C. Ikeda and M. Ikawa, *Jour. Am. Chem Soc.*, 64: 2994, 1942.

[4] D. Pressman, J. T. Maynard, A. L. Grossberg and L. Pauling, *ibid.*, 65: 728, 1943.

[5] D. Pressman, S. M. Swingle, A. L. Grossberg and L. Pauling, *ibid.*, 66: 1731, 1944.

[6] D. Pressman, D. H. Brown and L. Pauling, *Jour. Am. Chem. Soc.*, 64: 3015, 1942.

[7] D. Pressman, *Ind. Eng. Chem., Anal. Ed.*, 15: 357, 1943.