

former is responsible for injury to plant tissues; the latter gives the combined spray a characteristic colour, indicating that change has occurred.

If prepared in the following manner the combination may be rendered as safe to plant tissues as lime sulphur or lead arsenate alone: First fill the spray-tank with lime sulphur solution. To the required quantity of lead arsenate powder add double the quantity of hydrated lime. Mix into a thin paste with water, and, with the agitator running, pour slowly into the tank. Apply the combined spray as rapidly as possible after its preparation.

The use of hydrated lime with this combination to alleviate injury was advocated by the Department of Agriculture in 1918, and became a regular practice until superseded by lime casein* "spreader." The lime should be of good quality and possess a high Ca(OH)_2 content, since, as Farley (1925) has shown, a sample containing much carbonate of lime tends actually to increase the soluble arsenate content of the spray. Thatcher and Streeter (1924) claimed that comparable results were secured when casein (4 oz. per 100 gallons of combined spray) were added to the lime sulphur, the lead arsenate, or to the mixture. Their work led ultimately to the substitution of commercial lime casein for hydrated lime. This has proved a retrograde step, however, since in recent tests this "spreader" has been found to be less satisfactory and more expensive than hydrated lime.

(c) *Plus Bordeaux Mixture*.—No advantage is gained, so far as is known, by combining lime sulphur and bordeaux mixture. The possible effects of combination are discussed, however, owing to the belief prevalent in certain localities that severe injury is liable to follow when lime sulphur is applied to apple trees sprayed a few days previously with bordeaux mixture.

As is shown elsewhere (Cunningham, 1934), when equivalent amounts of lime sulphur and copper sulphate are combined, a dark-brown precipitate of copper polysulphides is formed; and an apparently similar precipitate is produced when bordeaux mixture (containing the same amount of copper, in the form of copper hydroxide) is used in place of copper sulphate. This precipitate may be applied to apple trees without injury to fruit or foliage, provided equivalent amounts of the copper salt and lime sulphur are used and the lime sulphur is used at summer concentrations. If, however, the lime sulphur is in excess, the precipitate is redissolved, and a spray produced which contains quantities of soluble copper, which increases with the increase in the excess lime sulphur. When this is applied as a spray to apple trees, slight leaf scorch and somewhat severe fruit russet follows.

It is apparent that increased injury is liable to occur only when the concentrations of copper hydroxide and lime sulphur are such that soluble copper compounds are produced—that is, when the copper of the bordeaux is decreased below a certain amount, or the lime sulphur is increased. Soluble copper is not produced when 5-4-50 or 3-4-50 bordeaux is combined with 0.2 per cent. lime

* Lime casein; frequently sold under the name of "calcium caseinate."