

minnows, which would materially reduce the costs of oiling operations. Experiments have also been projected to test out the comparative values of oils, larvicides, etc., and their adaptability to the needs of the district.

It is hoped that at the conclusion of these investigations mosquito control at Banff will have been placed on a fairly sound scientific basis, and that freedom from the mosquito nuisance will be possible with the greatest economy in labour and materials.

THE STATUS OF SPREADERS IN THE POISON SPRAY SOLUTION

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Commercially prepared spreaders were used rather extensively in orchard spraying for the first time this past season. The interest manifested in this recent innovation in our spray practices makes it appear desirable to undertake a general survey of the situation, attempting to develop a summary of the opinions, observations, experiments and reactions of the growers, experimentors and others following the close of the year's trial of the use of spreaders.

HISTORICAL

The addition of materials to the spray solution for the improvement of its physical properties is by no means new. Various materials, including glue, molasses, soap, saponin, casein, gelatine, aluminum sulphate, etc., have been added as spreaders from time to time where the investigator, dealing with a specific pest or disease, appreciated the desirability of improving the wetting and adhering properties of the spray solution.

Probably the first large scale investigation of spreaders for use with poison sprays, having a rather definite application to the economic control of orchard pests, were those undertaken by the Oregon Experiment Station. A variety of materials were tested as spreaders; among the more promising were caseinate, glue, gelatine, saponin and mineral oil emulsions. In considering their qualities as a spreader, the following factors were necessarily taken into account: (1) Availability, (is the source of supply easily accessible and adequate?); (2) Compatibility, (the spreader must not react unfavorably with any ordinary spray water, spray material or combination of spray materials); (3) Efficacy, (in reasonable amounts they must actually give satisfactory results in increased wetting, adherence, etc.); (4) Ease in preparation, (complicated manipulations, cooking; any operation requiring close attention or much additional work meets little favor with the grower); (5) Cost, (must be reasonable in price).

With these factors as the standard of excellence, the caseinate spreader has appeared the most promising. Oil emulsions are a most worthy competitor, but there is a decided element of danger in their use under factors 2, compatibility, and 4, ease of preparation, as outlined above. If we could be sure the growers would appreciate the element of chance and use the necessary precautions in properly handling the oil emulsion, the ranking of these two materials as spreaders might possibly be changed, but in general the risk with oils is too great for their general adoption.

CASEIN SPREADER

In the tests at the Experiment Station and in the earlier field work, ordinary commercial ground casein, mixed with hydrated lime, was employed. In the earlier commercial orchard tests, while growers "mixed their own" casein spreader, not all reports were favorable. The process of mixing the spreader and its addition to the spray solution were of themselves subject to failure where any short cuts were attempted, also the casein available was variable in size of particles and in character.

With the opening of the season of 1921, some commercial companies began the manufacture of a prepared casein spreader. Of the powdered forms, which were by far in the majority, it may be said that in general they represented a high-grade casein, ground somewhat finer than the ordinary commercial product and thoroughly mixed in definite proportions with hydrated lime.

These commercial materials combined to a very satisfactory degree the "essential factors" of a spreader. Particularly in the matter of ease of preparation were they popular, because it was possible to sift them directly into the spray tank, obviating any extra manipulations.

SPREADERS IN THE ARSENATE SPRAYS

The majority of the experimental work with spreaders at the station and in the majority of the cases of their use in the field, they were employed with poison spray solutions. The use of spreaders with the poison spray solution constitutes, therefore, the primary object of this enquiry. Summarizing our knowledge, it may be grouped under the following heads:

1. *Does the Addition of a Casein Spreader Increase the Efficiency of the Poison Spray in Apple-Worm Control?*

Earlier investigations under rather carefully conducted controls at the Oregon Station indicated a fairly marked increase in the percentage of control obtained where spreaders were added to the poison spray solution. During the past two seasons results have been more variable, and certainly less conclusively in favor of the spreaders.

Reports from California are conflicting, some feeling that decidedly better results are obtained, others finding little evidence of improved

control. DeOng, reporting on an arsenate foliage spray for red-humped caterpillars, reports superior control where casein spreader was employed.

In the Wenatchee section of Washington there is a general impression that spreaders improve the efficiency of the spray. In the Yakima section less spreaders have been used, and there is a general sentiment to the effect that spreaders do not improve the killing efficiency.

In the Twin Falls section of Idaho, spreaders were quite generally employed, and their use has received a most hearty endorsement from the growers. It would seem that they are enthusiastically united in the opinion that spreaders materially increased the killing efficiency. Where spreaders have been used in Oregon there is a general feeling that the control has been improved. However, recent investigational plats do not bear this out in any striking detail.

Summarized, we may say that while there is much evidence to indicate that the addition of a spreader to the poison spray solution increases its killing efficiency, it is decidedly doubtful as to just what extent this is true. It is our opinion that the value of a spreader in this regard will be, to a considerable extent, in proportion to the efficacy of the spray outfit; the excellence of the spray technique and the judgment in proper timing of the spray operation. Where any or all of these are faulty, the value of the spreader increases proportionately.

2. *Does the Spreader Improve the Spread of the Spray?*

All reports are agreed that with the addition of a spreader one obtains a smoother, less conspicuous and a more even distribution of the spray. This accomplishes two outstanding results of merit. The even, inconspicuous covering renders the fruit less likely to unfavorable suspicion regarding poison spray covering and makes wiping unnecessary in many instances. By avoiding the heavy blotchy covering of the fruit with the late summer spray, the red varieties of apple color up more evenly, improving the appearance and grade of the mature fruit materially.

This factor of a smooth, inconspicuous covering, thus avoiding the blotchy spray deposit and resultant uneven coloring, is really important, and to many growers serves as a good and sufficient reason for the enthusiastic adoption of spreaders in their late summer applications.

3. *Does the addition of a Spreader Increase the Covering Power of the Spray Solution so More Trees may be Covered per Tank of Spray?*

Some growers have checked on this point fairly carefully and are convinced that there is a material increase in the number of trees one may cover with a tank of spray where a spreader is added. Many have not checked on this, and a note of warning on the point is worthy of thoughtful consideration. It would be a most unfortunate situation if the grower, imbued with this idea of a quicker covering with less material, actually failed to use sufficient time or solution on the tree to

obtain the thorough spray covering required. So while it is conceivable that by increased wetting due to the spreader we would get quicker covering, this should not become a factor of first importance when deciding for or against the spreader.

4. *Are Spreaders Advisable with all Arsenical Applications?*

The consensus of opinion seems to be that spreaders should be used with all the lead arsenate applications from calyx or pink to the last cover spray. Considered strictly from a comparative point of view and valued on the beneficial results one might logically expect from its use in actual apple worm control, it would appear that the spreader in the solution could be dispensed with in the earlier applications if desired, but is of especial merit in the late cover spray.

SPREADERS WITH OTHER SPRAYS

No careful experiments have been made at the Oregon Station with spreaders except with the poison sprays. Opportunities for observations on their use with other materials have been frequent, and other experimentors and growers have used them in a great variety of ways.

Fisher, of Washington, investigating the control of apple mildew with the application of lime-sulphur, developed a casein spreader for use and finds it a highly desirable addition. He also recommends it with the lime-sulphur spray for brown rot on prunes and cherries.

Jones, of California, finds the casein spreader a most satisfactory and practical substitute for glue in their lime-sulphur-oil-glue and their B.T.S.-oil-glue formulae in citrous spraying for scale in Tulare County.

Smith, of Idaho, considers the addition of the spreader decidedly improves the efficiency of the dormant spray of lime-sulphur for scale control and of lime-sulphur in the delayed dormant for red spider control.

DeOng, of California, considers the addition of casein spreader advantageous in red spider and aphid control sprays.

Wenatchee authorities of Washington feel that there is an improvement in most of their spray applications from the addition of a spreader. It was observed that in the lime-sulphur-arsenate of lead combination sprays, the addition of the casein spreader materially reduced the amount and retarded the development of sludge.

Where increased wetting, covering and adherence of the spray solution is desirable, the casein spreader improves. Bordeaux mixture is apparently improved to an equal degree with the other spray solution, though no careful experiments are at hand regarding the use of spreaders with the Bordeaux. One caution is apparently worthy of mention here—excessive amounts of spreader, i.e., more than one and one-half pounds of commercial caseinate to 200 gallons of Bordeaux solution may cause trouble; one pound is probably advisable.

WHAT ARE THE ADVERSE REPORTS ON CASEIN SPREADER

With a new substance introduced extensively for the first time, and tested under a great variety of circumstances, some adverse reports and serious criticisms are to be expected. Vague rumors and occasional reports coming in during the season led one to expect a rather definite and general unfavorable report upon some points. May I say that, everything considered, I am most agreeably surprised at the general and united favorable attitude on spreaders.

The one rather general complaint of the commercial casein spreaders is their cost. In this paper, I shall attempt neither to condone nor defend; I do hope it will be possible, as the business develops, for the commercial companies to decrease the cost of their product.

D. F. Fisher, Federal Pathologist of Wenatchee, has developed two modified casein formulae, and they were used rather extensively in the Wenatchee fruit section by growers this season. Two different methods have been used:

Water	1 gallon
Caustic soda	3 ounces
Casein	1 pound

The caustic soda is dissolved in the water while bringing to a boil, then the casein is slowly sifted in with careful stirring to avoid lumping. A little boiling will dissolve the casein, and this solution then forms the stock solution and may be used as a spreader at the rate of one pint to the 100 gallons, or the above amount is sufficient for 800 gallons of spray.

The second method is similar except that one employs baking soda instead of caustic soda, and the material does not need to be cooked. Probably a rather finely ground casein would be advantageous, and two gallons of water would avoid working with so thick a paste as otherwise. This stock must be used within reasonable time after its preparation because of the deterioration with a development of most unpleasant odors.

Summarizing our information on the casein spreaders, then, we may say that:

1. While there is considerable room for question as to the value of spreaders in increasing the toxic efficiency of the poison spray application where high-powered outfits are employed in the hands of experienced operators and the applications carefully timed, for the vast majority of growers the addition of spreaders is of advantage.

2. By increasing the evenness of the spray deposit, it is possible to obtain a more even coloring of the fruit, a point of more than passing importance. If it will avoid the necessity for wiping, as was the case with many growers this season, this likewise will prove a decided factor in favor of their more general adoption.

3. The addition of spreaders to other applications than the poison sprays seems equally desirable and effective in increasing their values under the same conditions.

It is our opinion that spreaders have come to stay. Undoubtedly improvements and modifications will take place as our knowledge and experience of spreaders increase.



