

## WINTER COVER WASHES (*conclusion*).

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At the end of the season 1913-14 the most satisfactory mixture found for covering and adhesive properties was one containing whiting, starch, glue and potassium dichromate. It had, however, two distinct disadvantages, first that hot water was required and second that its cost was too high. Accordingly in the season 1914-15 fresh attempts were made to find a mixture that did not labour under these disadvantages.

So far all substances that had been added to lime to increase the adherence of the mixture had had the opposite effect. Either they had caused brittleness or softness. What was clearly wanted was some body that would serve to tie the lime particles together without itself becoming crystalline or gritty when dry. In other words some suitable colloid substance seemed the most hopeful body to search for. Of these glue, starch, casein, resin and humus bodies immediately suggested themselves. It was clear from the beginning that only substances sufficiently cheap need be tried, as comparatively large quantities would have to be used in practice.

Glue had already been ruled out owing to its being rendered insoluble by lime but the others were given a trial. Starch mixes well with lime. The heat of the slaking lime can be used to gell the starch so that no hot water is required. It causes considerable thickening of the mixture and gives a hard and brittle coat. Table I (4).

Subjected to rain outside it becomes gelatinous and is soon washed off. It is therefore unsuitable. Resin was next tried. This could be incorporated in two ways. It could be added to the lime during slaking, in which case it did not increase the adhesiveness of the coat though neither did it detract therefrom, or it could be first boiled with

caustic soda and the solution added. This gave a much softer coat than the control. Resin therefore was not tried further. Table I (2).

Casein was added during slaking of the lime. It is soluble in alkalies so that a good mixture could be obtained. The resulting coat was, however, soft and useless. Table I (3).

Dried dung was used as a source of humus bodies and was added either immediately to the slaking lime or after a preliminary maceration with caustic soda. In both cases the mixture was unsatisfactory. Table I (5).

The use of dung suggested the possibility of increasing adhesiveness by incorporating some fibrous substance in the same manner that hair is used in plasters for house walls. At first filter-paper was used and afterwards newspaper. In both cases the paper was first treated with caustic soda and macerated and then the pulp was added to the slaked lime.

A considerable number of mixtures of different strengths both with and without the addition of starch were tried. On the whole the fibre decidedly improved the coat as it did away with the tendency to flakiness, though the addition of caustic soda seemed always to increase the softness. The method therefore of washing the pulp free from caustic soda was tried and the resulting coat was certainly harder. Some of these mixtures (Table I (6)–(12)) were tried outside (Table II), but the results were disappointing as all were washed off in a comparatively short time if subjected to heavy rain, and none of them could be considered satisfactory. This being the case it is not necessary to enter into details of their manufacture.

The last mixture of Tables I and II containing boiled linseed oil might have given good results if it had been possible, economically, to have used larger quantities. Its expense, however, ruled it out.

#### *Effect of alkalies on glue solution.*

The statement is made in the text-books that gelatine, the essential body in glue, is insoluble in alkalies and that gelatine or glue should not be used in spray fluids where free alkali is present.

This fact explains why mixtures of lime and glue were utter failures. Not only have they no sticking power but the mixture gives a very thin coat, very much thinner in fact than the same quantity of lime without glue would have given. No doubt caustic lime has an energetic action on glue. The mixture gives off bubbles of gas indicating that the glue not only becomes insoluble but is decomposed at the same

time. The thinning effect is very characteristic and may be explained hypothetically as follows:

When lime is slaked under water it breaks up into a great number of extremely fine particles. Whether it is the fineness of the particles or whether it is associated with some other property the solid matter appears to be in a semi-gelatinous state. It is bulky and only sinks very slowly. If allowed to dry and then re-wetted the semi-gelatinous state is not re-acquired, but the particles remain gritty as though they had become flocculated. If a solution of glue is added to milk of lime freshly slaked the probability is that the glue precipitate so formed unites the minute lime particles into larger ones, so that the mixture at once loses covering power and shows the characteristic "thinning." It seemed therefore profitable in view of the uncertainty of the action of alkalis on glue to investigate the reaction. When 10 % solutions of caustic soda were added to hot glue solutions an immediate fibrous precipitate was obtained. A similar result was obtained by the addition of a hot 1 % solution and an immediate slight turbidity with so weak an alkali as lime water provided hot solutions were used.

On the other hand if cold 10 % caustic soda solution was added to cold glue solution no precipitate appeared for several hours. The same, as was to be expected, happened if 1 % caustic soda or lime water were added in the cold. The fact that the reaction between alkali and glue could be slowed down opened up new possibilities for lime mixtures.

Further experimentation with milk of lime showed that thinning occurred if incompletely slaked cold milk of lime or completely slaked hot milk of lime were added to glue, while it did not occur if cold well-slaked lime were used.

In working with milk of lime it is of course impossible to see whether the gelatine of the glue is actually precipitated, but it is safe to assume that loss of covering power in the mixture indicates precipitation. From these facts it appeared probable that a satisfactory mixture could be made by adding glue solution to cold well-slaked lime. Such mixtures were made up in the laboratory and it was found that one having the quantities lime 20, glue 2, water 100 gave a firm but thin coat. No sudden loss of covering power was here noticed such as follows when hot or unslaked lime acts on glue, but the coat was rather thinner though much firmer than the control lime 20, water 100.

This slight loss of covering power is no doubt due to the glue in solution. Gelatine is used in some summer sprays in order to increase

their wetting and spreading power and probably the same spreading effect took place in this mixture. By increasing the lime from 20 to 30 a thick and firm coat was obtained. This 30, 2, 100 mixture was tried out of doors where it resisted rain fairly well but still did weather somewhat. It appeared therefore that the glue was not made insoluble on the tree quickly enough. Two methods suggested themselves as likely to overcome the difficulty. The first was to use the lime warm and so to get the glue gradually to become insoluble as it dried on the tree.

This was actually done in one or two cases with successful results but it was found difficult to judge the correct temperature and success was always a matter of luck. Any delay in getting the spray on the tree, owing for instance to choked nozzles, resulted in the glue being made insoluble before it reached the tree and a loss of covering and adhesive power.

The second method was to use potassium dichromate as had already been done the season before when working with glue mixtures. This causes the glue to become insoluble when exposed to light, thus holding the lime coat together. This method proved quite successful. It is necessary, however, to use the correct amount of dichromate. If too much is used immediate thinning is produced and the mixture is spoiled. If only a little too much is used the lime coat on the tree becomes too flaky though at the same time remarkably hard. So hard is it that if one rubs one's hand on the trunk of a tree so sprayed no lime comes off at all and the surface gives one the impression of fine emery paper. The best quantity to use is expressed in the formula:

Lime ...	...	...	...	30 lbs
Glue ...	...	...	...	2 lbs
Potassium dichromate	...	...	...	$\frac{3}{8}$ oz.
Water	...	...	...	10 gallons

To make this mixture 30 pounds of lime are placed in a tub and 6 gallons of water poured over it and allowed to slake. When the lime begins to boil add 2 more gallons of water gradually so as to keep the slaking mixture always as hot as possible. Then 2 pounds of glue are put into a pail with one gallon of cold water and occasionally stirred. After the lime has slaked and become quite cold, which takes 6-12 hours, a gallon of hot water is added to the glue which then immediately goes into solution. This is then added to the lime, well

stirred and filtered through a sieve with 16 meshes to the inch into the spraying machine.

Lastly the potassium dichromate previously dissolved in a small quantity of water is poured into the machine and stirred up. The mixture is then ready for application.

Where the lime is very good the amount might be reduced to 25 lbs as 30 lbs of good lime sometimes makes the mixture too thick for easy straining. It is important to soak glue first in cold water as a direct application of hot leads to the formation of intractable lumps. Where it is desired to avoid the use of hot water, as in continuous spraying, the following procedure may be adopted.

One lot of lime is slaked with water and allowed to cool as above described. Then a second lot is made up and by means of the heat evolved the glue for the first lot can be dissolved by standing the pail of soaked glue in the hot lime. It only needs a temperature of about 100° F. to dissolve glue that has been previously soaked and this is easily obtained by this method.

This lime-glue-dichromate mixture has been tried against ordinary lime-wash at Long Ashton and has given decidedly superior results. An application to an apple tree stopped aphid hatching to such an extent that hardly an aphid was to be seen on it throughout the season though control trees were very badly attacked. The tree stood out all the season from its fellows by the healthy green uncurled leaves and at the end of the season by its very numerous well-developed fruit buds.

Hide glue can be obtained in hundredweight quantities at 4½d. a pound so that the cost of the spray per 10 gallons works out as follows:

					s.	d.
Lime	30 lbs @ 1s. per cwt.	...	...	...		3
Glue	2 lbs @ 4½d.	...	...	...		9
Potassium dichromate	¾ oz. @ 6d. per lb.	...				½
Total						1 0½

giving an approximate cost of 1½d. per gallon.

TABLE I. *Indoor Trials.*

Parts by weight including in each case water 100			Remarks	Resulting coat
(1)	Lime .....	20	Control wash	
(2)	Lime .....	20	Resin added during slaking Resin dissolved in caustic soda	About same as control
	Resin .....	$\frac{1}{2}$		Soft and brittle
(3)	Lime .....	20	Casein added during slaking	Softer than control
	Casein .....	$\frac{1}{2}$		
(4)	Lime .....	20	... ..	Hard but very brittle
	Starch .....	$\frac{1}{2}$		
(5)	Lime .....	20	Dung macerated first with a little caustic soda	Soft and thin
	Dung .....	2		
(6)	Lime .....	20	... ..	Well matted coat firm but uneven
	Filter-paper .	xs		
	Caustic soda.	xs		
(7)	Lime .....	20	... ..	Not quite so firm as (6) but thick and good
	Filter-paper .	$\frac{1}{2}$		
	Caustic soda.	$\frac{1}{2}$		
	Starch .....	$\frac{1}{2}$		
(8)	Lime .....	20	... ..	About the same as (7)
	Newspaper ...	$\frac{1}{2}$		
	Caustic soda.	$\frac{1}{2}$		
	Starch .....	$\frac{1}{2}$		
(9)	Lime .....	20	... ..	Moderately hard, not flaky Firm
	Washed pulp	1		
(10)	Lime .....	20	... ..	Softer than (9)
	Unwashed pulp	1		
(11)	Lime .....	20	... ..	Irregular in thickness, firm but fairly hard
	Washed pulp	1		
	Starch .....	1		
(12)	Lime .....	20	... ..	Not quite so firm as (11)
	Unwashed pulp	1		
	Starch .....	1		
(13)	Lime .....	20	Starch treated with the caustic soda and the boiled oil stirred in and whole mixture added to the lime	Not enough boiled oil to affect the coat
	Boiled oil ....	4		
	Starch .....	2		
	Caustic soda.	4		

TABLE II. *Outdoor Trials.*

Figures indicate parts by weight and include in each case water 100

	Lime	News- paper	Caustic soda	Starch	Washed News- paper pulp	Boiled oil	Remarks	Results
(1)	20	—	—	—	$\frac{1}{2}$	—	—	Fair coat
(2)	20	—	—	$\frac{1}{2}$	$\frac{1}{2}$	—	—	Rather better than (1)
(3)	20	—	—	1	$\frac{1}{2}$	—	—	Resisted rain fairly well
(4)	20	—	—	1 $\frac{1}{2}$	1	—	Kept 12 hrs before application	Rather spotty but only slightly flaky
(5)	20	—	—	—	$\frac{1}{2}$	—	Applied fresh	Very flaky
(6)	20	—	—	—	$\frac{1}{2}$	—	Kept 6 hrs before application	Not nearly so flaky as (5)
(7)	10	$\frac{1}{2}$	$\frac{1}{2}$	3	—	—	—	Slightly flaky
(8)	10	—	—	3	$\frac{1}{2}$	—	—	Powdery
(9)	10	—	4	2	—	2	—	Too thin