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THE USE OF CALCIUM CYANAMID IN HOP DOWNY MILDEW CONTROL;  
IN THE SOLUTION OF THE "DORMANT HILL" PROBLEM  
AND AS A FERTILIZER FOR HOPS

by

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By means of laboratory tests conducted early in 1933, it was demonstrated that very dilute solutions of calcium cyanamid killed the swimming spores of the downy mildew fungus. This discovery indicated that the material might be effective as a crown treatment in the field.

Crown Treatment Experiments - 1933

An experimental plot of Late Clusters was laid out so as to permit a comparison of calcium cyanamid, copper-lime dusts and hydrated lime.

On March 23, one-half pound of granular calcium cyanamid was applied to the soil surface over an area comprising a circle eighteen inches in diameter about each treated hill. A total of 340 pounds per acre was thus provided. On April 10, the other materials used in the test, at the average rate of one ounce per hill, were applied by means of sacks to the crowns of plants which had previously been hoed and left uncovered. Aside from the calcium cyanamid, no fertilizers were used in the plot.

From the standpoint of downy mildew control, the materials were ranked as follows: (1) calcium cyanamid, with 80.2 per cent healthy hills, (2) copper-lime dust (1-6), with 71.8 per cent healthy hills, (3) Copodust, with 68.3 per cent healthy hills, (4) hydrated lime, with 67.2 per cent healthy hills, (5) untreated, with 65.3 per cent healthy hills.

It was apparent that the calcium cyanamid was a promising crown treatment material, since better control of downy mildew was secured with it than with any of the other materials used. Furthermore, all vegetation with which the calcium cyanamid had come into contact was killed, including hop seedlings, which are often infected with downy mildew as they come through the ground in early spring. These diseased seedlings are a source of infection to the hop shoots that usually appear somewhat later. Used in equal amounts, calcium cyanamid costs less per acre than the copper-lime dusts, and in addition has fertilizing value which the copper-lime dusts may not have.

Yields from the plot, in green hops, were generally good. The calcium cyanamid-treated hills, however, averaged highest with 11.4 pounds per hill. This was five-tenths of a pound higher than the next best yield of 10.9 pounds secured with hydrated lime, but 2.0 pounds better than the poorest yield secured with copper-lime (1-6). Copodust-treated hills averaged 10.0 pounds and the untreated hills 10.3 pounds per hill.

On the basis of these preliminary results, and because of considerable publicity, one thousand pounds of powdered and twenty-eight thousand pounds of granular calcium cyanamid were distributed by the manufacturers to thirteen hop growers in Oregon the past season. These field trials generally were decidedly inconclusive. In most instances, information as to the exact method and date of application, amounts applied per hill, and carefully recorded results of the treatments, in comparison with untreated portions of the yards, was lacking. On the whole, the material was probably applied too late in the season to affect the most satisfactory mildew control, and in addition varying degrees of injury resulted in a great many cases.

#### Crown Treatment Experiments - 1934

Experimental work was again undertaken this season in a yard of late Clusters. In one plot the hills had been hoed, fertilized with one-half pound each of 8-8-4, and left uncovered. A comparison was made between the two copper-lime dusts used last season and both granular and powdered calcium cyanamid, all applied on April 27. The granular calcium cyanamid was used at the rate of approximately one-half pound per hill. The amount of powdered calcium cyanamid used in this plot was reduced to approximately two ounces per hill in order to compare more closely, from a fungicidal standpoint, with the copper-lime dusts which were applied at approximately the same rate.

Listed in order of control of downy mildew, the materials were ranked as follows: (1) powdered calcium cyanamid, with 94.5 per cent healthy hills, (2) granular calcium cyanamid, with 88.8 per cent healthy hills, (3) copper-lime dust (1-4), with 82.6 per cent healthy hills, (4) copper-lime dust (1-6), with 80.6 per cent healthy hills, (5) untreated, with 64.3 per cent healthy hills.

In yields of green hops, the hills treated with one-half pound of granular calcium cyanamid led with an average of 10.6 pounds per hill as compared with 8.1 pounds per untreated hill; 9.5 pounds per hill treated with Copodust; 9.3 pounds per hill treated with copper-lime dust (1-6); 9.0 pounds per hill treated with powdered calcium cyanamid.

The second plot was the same as that used last season. The same materials, with the exception of hydrated lime, were used. An opportunity was afforded for a comparison of the effects of two years' applications on the same plants with the residual effects of the same materials applied last season but omitted this year.

A light hoeing was given all plants on February 16, except those that were treated with hydrated lime last year. With the exception of the lime-treated plants and those to which calcium cyanamid was applied, the entire plot was fertilized with one-half pound of 8-8-4 per hill.

Crown treatments were completed February 17. Hoed hills were recovered with soil before treatment with calcium cyanamid and after treatment with the copper-lime dusts. One-half pound of granular calcium cyanamid was applied per hill and approximately three ounces of each of the copper-lime dusts.

Growth in the plot generally was very poor, dormant, weak and dead hills being so numerous as to limit seriously the usefulness of the data on downy mildew control. Vine growth was definitely stimulated, however, where calcium cyanamid had been applied for two years on the soil surface about the crowns. This stimulation was evident as early as March 23 and continued apparent throughout the season.

The calcium cyanamid-treated hills again produced the greatest number of healthy hills, 97.6 per cent as compared with the untreated hills with 75.9 per cent. Hills treated with hydrated lime last season produced 70.6 per cent healthy hills. Hills treated with copper-lime dust (1-6) last season produced 96.5 per cent healthy hills and those treated with the same material for two seasons, 94.4 per cent healthy hills. Hills treated with Copodust last season produced 96.8 per cent healthy hills and those treated with the same material for two seasons, 71.1 per cent healthy hills.

Yields of green hops on the plot were, on the whole, much lower than last season. The calcium cyanamid-treated plants produced an average of 11.3 pounds per hill as compared with the next best yield of 6.3 pounds per hill from plants treated with hydrated lime last season and 5.5 pounds per hill from the untreated hills. Hills treated with copper-lime dust (1-6) last season averaged 4.7 pounds per hill and where treated with the same material for two seasons, averaged 3.7 pounds per hill. Hills treated with Copodust last season averaged 5.4 pounds per hill and where treated with the same material for two seasons, averaged 6.2 pounds per hill.

When the number of replants figuring in the yields was considered and yields adjusted on a basis of allowing each replant one-fourth the yield of mature plants, the figures changed to 12.5, 6.7, 6.2, 5.2, 4.2, 6.7 and 7.6 pounds, respectively.

A part of this increase in yield of the calcium cyanamid-treated hills might, of course, be attributed to a reduction in the amount of downy mildew in the harvested hills, which would also be true of other materials used wherever any control of downy mildew was obtained.

The possible effect of calcium cyanamid on the dormant hill situation was determined by eliminating replants and securing the percentage of old vines that were represented in harvested hills. The hills not harvested were either dead, dormant, or so backward as to bear no mature cones at harvest time. The calcium cyanamid-treated hills produced plants 84 per cent of which were harvested, as compared with but 62 per cent of the untreated hills; 56 per cent of the hills treated with hydrated lime last season; 72 per cent of the hills treated with copper-lime dust (1-6) last season and 44 per cent of the hills treated with the same material for two seasons; 60 per cent of the hills treated with Copodust last season and 73 per cent of the hills treated with the same material for two seasons.

Experimental work is being continued with granular calcium cyanamid, since preliminary results reported herewith indicate it to be valuable as a crown treatment material for downy mildew control and possibly in the solution of the dormant hill problem as well as being of value as a fertilizer material, particularly where properly supplemented by other elements such as phosphoric acid.

There is, of course, fertilizing value in old hop vines. Their proper use improves the physical characteristics of the soil. Left intact over the winter, they aid in preventing soil erosion. When not badly diseased, their use probably does not greatly increase the danger of perpetuating hop diseases. Some sterilizing action may be expected where calcium cyanamid is broadcast over them as suggested below.

For the benefit of growers interested in the use of commercial fertilizers and who may contemplate the use of calcium cyanamid both as a fertilizer and as a possible means of controlling downy mildew, the following suggestions may prove timely.

1. After fall rains start, 500 pounds of granular calcium cyanamid per acre may be broadcast over the vines, or direct to the surface of the soil if vines have been removed. A hand fertilizer distributor may be used, or an end-gate lime and fertilizer distributor. The material should be applied directly over the hills as well as between the rows. The object is to sterilize the upper few inches of soil over the area treated in the hope that if the practice is continued for at least two seasons many of the soil-borne winter spores of the downy mildew fungus will have been brought to the surface and killed by coming into contact with the calcium cyanamid in the upper layers of soil. We do not have, however, experimental data to indicate that the soil sterilizing action desired will be achieved.

The toxicity time period of calcium cyanamid varies with the moisture, amount of organic matter in the soil, and other factors. A fall broadcast will probably destroy all vegetation with which the material comes in contact, and prevent germination of weed and other seeds located within a few inches of the soil surface at the time of application.

If a fall cover crop is desired, a seeding will have to be made after the calcium cyanamid has been applied. For each one hundred pounds of calcium cyanamid used per acre, allow a three-day interval before seeding. On very sandy soils wait twice as long. The nitrogen is soon changed to the ammonia form; consequently, there is little danger of loss of fertilizing value by leaching.

2. The fall broadcast should be followed, as early in the spring as weather conditions will permit, with an application of two ounces per hill applied in a two-foot circle on the soil surface about each hill before the vines are hoed and previous to any emergence of dormant buds. The use of this amount of granular calcium cyanamid is considered sufficient, in view of downy mildew control secured with approximately the same quantity of the same material in powdered form. No application should be made to replants. If these instructions are not followed closely more or less serious injury is apt to result.

3. Following spring hoeing the use of a phosphate fertilizer applied around the hills will tend to increase hop production. On sandy soils or those low in organic matter, the fertilization program should include potash.

4. Growers who prefer not to destroy natural cover crops already established or who do not care to reseed cover crops already planted and who require cover crops to prevent soil erosion during the winter or who for other reasons do not desire to broadcast the calcium cyanamid in the fall may still apply two ounces of the material per hill in the spring as suggested above, as a crown treatment.