Spray Treatment of Sugar Beet Seed

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Most plantings of sugar beets would result in satisfactory stands even though no seed treatments were used. In those cases, however, where damping-off is severe, seed treatment with fungicides will often produce spectacular improvements in stand and may eliminate the necessity for replanting. This protection is particularly important when reduced seeding rates are used.

In the past most seed treatment has consisted of dusting the seed with a fungicide during agitation in either a continuous or a batch treater. This operation has not been entirely satisfactory chiefly because the dusts are offensive to the operator during treating and to the grower during planting. Some of the fungicides are poisonous when ingested, others cause severe skin irritation particularly upon susceptible individuals while others are offensive when inhaled.

A method of treating that would eliminate dustiness but at the same time would be simple in operation, effective and non-injurious to seed germination would be highly desirable.

Among the methods that have been used for eliminating dustiness are: 1.—dusting the seed with a dry fungicide and then spraying it with a soluble sticker, and 2.—application of a suspension of a wettable fungicide by means of a "Slurry" treater.

The first method was used by P. Vogelsang and P. A. Reeve of the Farmers and Manufacturers Beet Sugar Association for the preparation of samples for the 1946 and 1947 cooperative beet seed treatment tests.[2] A very acceptable product resulted and tests showed that the protection was fully equal to the same dosages applied as dusts. This method, however, involves two separate operations and does not eliminate the dust problem during the first step of treatment.

The slurry method and the slurry treater were developed by E. I. du Pont de Nemours and Company. The suspension of a wettable fungicide is smeared over the surface of the seeds in a mixing chamber with so little liquid that drying is unnecessary. This process eliminates all dustiness except during the preparation of the suspension. With smooth seed like corn, peas, beans or milo, a uniform coating is formed over the seeds. With sugar beet seed, however, the corky surface is so rough and absorbent that the small amount of suspension ordinarily applied does not seem to provide a uniform covering. Tests on the comparative protection afforded by dust and slurry treatment of sugar beet seed are insufficient to draw definite conclusions.

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[2]Conducted by The Beet Sugar Development Foundation, Cooperative Seed Treatment Committee, A. R. Downie, Chairman.

Spraying the seed with a suspension of a wettable fungicide or with a soluble fungicide while the seed is being agitated in a revolving drum affords still another method of eliminating dustiness from the seed-treating process.

Preliminary trials indicated that a suspension of a wettable fungicide applied at from 2 to 4 percent of the seed weight provided protection equal to a dust treatment. This method eliminated dustiness and resulted in a product that could be planted satisfactorily without drying. Utilizing this principle Armer (1) of the Spreckels Sugar Company designed and built a semi-automatic batch treater for applying, by means of spray nozzles, suspensions of wettable fungicides in water together with an adhesive, water-soluble binder.

Numerous tests have been conducted under greenhouse conditions in both pasteurized and infested soils to compare the protective effects and safety of commercial and experimental fungicides at different dosages. The results of some of these tests as well as comparisons of treating methods are presented in the following tables.

Comparison of Dust and Slurry Treatments

Seed of variety U. S. 33 was treated with suspensions containing Arasan SF (75 percent tetramethyl thiuramdisulfide), Ceresan M (7.7 percent ethyl mercury p-toluene sulphonanilide) and Wettable Phygon (dichloro-naphthoquinone). These suspensions were applied to the seed by mixing the seed and slurry in a revolving can using liquid equal to 2.5 percent of the seed weight. Samples of the three slurry-treated lots, seed treated with Phygon dust and non-treated seed were planted in randomized rows in soil infested with *Pythium ultimum* Trow. The emergence and survivors are reported in table 1.

Table 1. –Slurry and dust treatment of sugar beet seed.

Treatment	Method	Dosage (percent)	Emergence per 100 seed units	Survivors per 100 seed units
Non treated	----	---	111.5	46.0
Arasan SF	Slurry	0.67	103.5	65.5
Ceresan M	Slurry	0.375	142.5	128.5
Phygon	Slurry	1.00	139.0	100.5
Phygon	Dust	1.00	142.0	107.0

The results indicate that the protection from a Phygon slurry is approximately equal to that afforded by a Phygon dust treatment. Ceresan M gave somewhat better and Arasan SF somewhat poorer protection under the conditions of this test. Another investigator who tested samples of the same lots reported as good protection from Arasan as from the other fungicides. In this trial the treatment was not applied in a commercial slurry treater and the results, therefore, provide no measure of coverage by such equipment.

Comparison of Spray and Dust Treatments

When applied as a spray, Wettable Phygon with a binder (Armer's formula) gave about the same protection as the same fungicide applied as a dust (table 2) and was about as effective as Ceresan (ethyl mercury chloride) applied as a dust.

Table 2.—Comparative protection of spray and dust seed treatments on sugar beets planted in infested soil.

Treatment	Emergence per 100 seed units	Survivors per 100 seed units
Non treated	41.5	13.5
Phygon spray[1]	105.5	93.5
Phygon dust[2]	105.0	92.0
Ceresan dust[2]	111.0	101.5

[1]Wettable Phygon 1 pound in 2 quarts of liquid (consisting of 1/3 molasses and 2/3 water) per 100 pounds of seed.
[2]Dosage 1 pound of dust per 100 pounds of seed.

In another set of tests, spray applications of Arasan SF and Wettable Phygon at three dosages were compared with dust applications of Arasan, Phygon and New Improved Ceresan (ethyl mercury phosphate).

All of the fungicidal applications shown in table 3 improved emergence and survival as compared to non-treated seed. Protection was improved with each fungicide as dosages were increased.

Table 3. Comparison of dust and spray seed treatments.

Treatment	Method	Dosage (percent)	Seedlings per 100 seed units: Emergence[1]	Survivors	Disease rating
Non treated			48	24	73.3
Arasan SF	Spray	0.22	86	58	48.9
Arasan SF	Spray	0.44	107	81	34.5
Arasan SF	Spray	0.88	112	84	31.6
Arasan	Dust	1.00	127	108	19.6
Phygon	Spray	0.22	92	69	43.8
Phygon	Spray	0.44	114	96	28.0
Phygon	Spray	0.88	123	93	24.7
Phygon	Dust	1.00	122	107	22.0
N. I. Ceresan	Dust	0.25	130	102	19.6
Significant difference	19 :1 Odds		22.5	20.4	

[1]Potential emergence 150 seedlings per 100 seed units.

The disease rating (last column) was obtained by comparing emergence and survival with the potential emergence of this seed lot, giving twice as much weight to pre-emergence damping-off as to post-emergence infection. This difference was made because in the writer's opinion greenhouse conditions are relatively much more favorable to post-emergence infection than are ordinary field conditions.

At the highest dosages used the three materials were about equally effective and considering the severity of infection, all except the lowest dosages of Arasan and Phygon gave satisfactory protection. The seed used in this trial was variety U. S. 15 and carried a moderate amount of seed-borne *Phoma betae* (Oud.) Frank.

Additional comparisons of the protection afforded by different dosages of Arasan SF, Wettable Phygon and Ceresan M are presented in table 4. Trial 1 was conducted in less heavily infested soil than trials 2 and 3 and, therefore, direct comparisons between the three materials cannot be made. With Arasan and Phygon the protection improved as the dosage increased although the differences between the two higher dosages were not great. With Ceresan M a dosage of 0.25 percent appeared to delay and reduce emergence although the protection was good. With this material, applied as a spray, additional trials and storage experiments are required before its safety can be determined.

Table 4. Dosage relations with three fungicides in spray applications.

Treatment	Dosage (percent)	Emergence[1]	Survivors[1]	Disease rating
Trial 1				
Non treated		53	7	65
Arasan SF	0.15	74	42	40
Arasan SF	0.30	80	68	29
Arasan SF	0.60	88	71	23
Significant difference	19:1 Odds	19.8	18.8	--
Trial 2				
Non treated		6	1	96
Phygon (W)	0.22	70	30	48
Phygon (W)	0.44	96	49	25
Phygon (W)	0.88	97	59	21
Significant difference	19:1 Odds	20.3	17.0	--
Trial 3				
Non treated		6	1	96
Ceresan M	0.06	65	15	55
Ceresan M	0.12	86	54	30
Ceresan M	0.25	76	67	32
Significant difference	19:1 Odds	23.6	13.6	--

[1]Seedlings per 100 seed units; potential emergence—107 seedlings per 100 seed units.

When the three materials were compared in heavily infested soils (table 5) Arasan SF did not appear to be as effective as Wettable Phygon or Ceresan M at the dosages compared in three trials.

Table 5. Protection afforded by three fungicides in spray applications.

Treatment	Dosage (percent)	Trial 1 Disease rating	Trial 2 Disease rating	Trial 3 Disease rating
Non treated		96	98	91
Arasan SF	0.30	--	--	82
Arasan SF	0.60	71	68	--
Phygon (W)	0.44	--	--	46
Phygon (W)	0.88	23	48	--
Ceresan M	0.12	--	--	36
Ceresan M	0.25	32	35	--

As a further test of the spray application of suspension of wettable fungicides, seed lots of 50 pounds each were treated with three dosages of Wettable Phygon and with two dosages of Arasan SF all applied in Armer's spray treater. Emergence and survival of seedlings in Pythium infested soil (table 6) indicate that all three dosages of Phygon gave good protection with the highest dosage slightly better than the others. Arasan SF in trial 2 also provided considerable protection but was somewhat less effective than the same dosages of Phygon.

Table 6.—Protection afforded by applying Phygon and Arasan to beet seed with the Spreckels Spray Treater.

Treatment	Dosage (percent)	Trial 1		Trial 2	
		Emergence[1]	Survivors[1]	Emergence[1]	Survivors[1]
Non treated	---	26	9	30	15
Phygon	0.50[2]	96	76	89	75
Phygon	0.75	96	76	--	--
Phygon	1.00	111	87	94	76
Arasan SF	0.50	--	--	62	41
Arasan SF	1.00	--	--	79	55
Significant difference	19:1 Odds	12.1	13.1	16.2	18.1

[1]Seedlings per 100 seed units; potential emergence 124.
[2]Applied in a suspension equivalent to 4 percent of the seed weight.

Summary

One of the most objectionable features in the treatment of sugar beet seed is the offensive nature of the fungicidal dusts now in use. Some are poisonous when ingested, others cause severe skin irritation to susceptible individuals while others are irritating when inhaled.

Dustiness can be reduced or avoided by spraying the seed with a soluble binder after it has been dusted or by treating the seed by the slurry method. Using equipment currently available, however, the slurry treatment does not appear to provide uniform seed coverage because of the rough and absorbent surface of sugar beet seed.

It has been found that good coverage and complete elimination of dustiness can be obtained by spraying soluble fungicides or water suspensions of wettable fungicides with a suitable binder through nozzles onto seed during agitation in a rotating container. Sugar beet seed treated in this manner was protected against damping-off as effectively as by the same materials in dust form. Spray treated seed could be planted through precision planters since the small amount of moisture applied either evaporated or was absorbed into the seedballs.

In moderately infested soils, seed treated by the spray method with either Arasan SF, Wettable Phygon or Cerasan M was adequately protected. The degree of protection with Arasan SF and Phygon increased as the dosage was increased up to 1.0 percent although the difference between 0.5 and 1.0 percent was not great. With Cerasan M the spray application gave excellent protection but indications of retarded emergence were

obtained in one trial at 0.25 percent dosage. In heavily infested soil, Phygon and Cerasan M applied as sprays or New Improved Cerasan applied as a dust gave somewhat better protection than Arasan in some of the trials.

Spray application of a wettable fungicide in suspension or of a soluble fungicide appears to be an effective method of treating sugar beet seed and in addition eliminates dustiness, the most objectionable feature of dust seed treatments.

Literature Cited

(1) ARMER, AUSTIN.
1948. A mechanical spray treater for sugar beet seed. Proc. Amer. Soc. Sugar Beet Technologists. Page 108.