EXPERIMENTS ON THE USE OF SOME CHLORONITROBENZENE AND ORGANIC MERCURY COMPOUNDS FOR THE CONTROL OF LOW-TEMPERATURE PARASITIC FUNGI ON WINTER CEREALS

E. A. JAMALAINEN

Department of Plant Pathology, Agricultural Research Centre, Tikkurila

Received September 12. 1958.

Studies have been made at the Department of Plant Pathology of the Agricultural Research Centre on the possibilities of controlling damage from parasitic fungi in dormant plants by treating stands with fungicides in the autumn, shortly before the fall of snow. The results of the experiments carried out before the winter 1955—56 were published in 1956 as Publications of the Finnish State Agricultural Research Board No. 148— »Overwintering of plants and experiments on the chemical control of low-temperature parasitic fungi in Finland» (cf. 3, 6).

The following gives an account of the results of experiments on winter cereals carried out in 1955—1958.

The weather conditions during the winters 1955—1958

The winter of 1955—56 was very snowy. In south Uusimaa (central part of South Finland), where most of the experiments were carried out, there were exceptionally heavy injuries from parasitic fungi on winter cereals. The damage from snow mould [*Fusarium nivale* (Fr.) Ces.] in particular was heavy, but the *Typhula* fungi, *T. itoana* Imai and *T. idahoensis* Remsb., also proved injurious. According to information collected by the Department of Plant Pathology, injuries from fungi were also heavy in the central, eastern and northern parts of Finland. In South-West Finland the damage appeared to be comparatively slight, as usual.

The overwintering conditions for crops in the winter 1956—57 were very different from those of the previous winter (4). The soil had frozen in late autumn before the snow fell; in South Finland the soil was depht frozen. Later in the winter the weather was so warm that rain fell, covering the fields with water. The surface of the soil became waterlogged, and the frost that followed froze the water often forming a continuous surface of ice. In 1956—57 there appeared hardly any injuries from low-temperature parasitic fungi in the winter cereals in the southern part of the country. Damage from low-temperature parasitic fungi appeared in the central and northern parts of the country, although to a lesser extent than usual owing to the fact that the soil had been throughly frozen by the time the snow fell.

Compared to the two preceding years the winter 1957—58 was, in Finnish weather conditions, normal for the overwintering of winter cereals. The ground was almost everywhere frozen before snowfall. Snow fell comparatively abundantly, remaining on the ground all the winter through. Damage caused by water and frost did not appear in the winter cereals to any notable degree. On the other hand low-temperature parasitic fungi (*Fusarium nivale* on winter rye and both *F. nivale* and *Typhula* sp. fungi on winter wheat) had caused considerable damage in snowy places ewerywhere in the country.

Experiments with winter cereals

Earlier experiments carried out in different countries on the chemical control of low-temperature parasitic fungi in winter cereals by a treatment of seedlings in autumn have been more detailed reported in a publication of the author in 1956 (3, p. 18—19). As to the latest studies in this field reference is made to SPRAGUE's experiments (9) in the State of Washington, U.S.A.; these did not lead to any positive results in the control of low-temperature parasitic fungi in winter wheat in 1955—1956. Regarding the experiments in the following year, SPRAGUE reports that positive results were obtained by using organic mercury compounds (10; cp. also 8). — In the mountainous regions of West Germany good results have been obtained in the control of snow mould (*Fusarium nivale*) in winter rye by the use of the spray Brassicol-super, a PCNB preparation (7, 11).

Chemicals used in the tests

Preparation	Active ingredient	Application [1]	Amount per hectare of		Manufacturer
			preparation	active ingredient	
Amatin-Staub	HCNB-hexachloro-nitrobenzene, 20 %	dust	25 kg	5 kg	Farbenfabriken Bayer, West Germany
Avicol	PCNB=pentachloro-nitrobenzene, 20 %	dust	25 kg 50 kg	5 kg 10 kg	Rikkihappo- ja super-fosfaattitehtaat Oy, Vaasa, Finland

Preparation	Active ingredient	Application [1]	Amount per hectare of preparation	Amount per hectare of active ingredient	Manufacturer
Bayer 4426	PMA = phenylmercury-acetate, 0.5 % (Hg 0.3 %)	dust	25 kg	125 g (Hg 75 g)	Farbenfabriken Bayer, West Germany
Botrilex	PCNB = pentachloro-nitrobenzene, 20 %	dust	25 kg 50 kg	5 kg 10 kg	Bayer Agriculture Ltd., England
Brassicol	PCNB = pentachloro-nitrobenzene, 20 %	dust	25 kg 50 kg	5 kg 10 kg	Hoechst A.-G., West Germany
Dithane Z-78	Zineb, 65 %	dust	25 kg	16.25 kg	Rohm & Haas Co, Philadelphia, U.S.A.
Fernasan 75	Thiram, 75 %	seed dressing	about 0.5 kg	375 g	Plant Protection Ltd., England
Mercadmine	PMS = phenylmercury-salicylate, 5 % (Hg 2.35 %) and cadmium ricinoleate	spray	4.7 kg	235 Hg 110.5	H. L. Woudhuysen Ltd., New York, U.S.A.
Merculine	PMS = phenylmercury-salicylate, 10 % (Hg 4.7 %)	spray	4.7 kg	470 g (Hg 221 g)	H. L. Woudhuysen Ltd., New York, U.S.A.
Täyssato	metoxethylmercury-chloride, 2.2 % (Hg 1.5 %)	seed dressing	about 0.5 kg	11.0 g (Hg 7.5 g)	Rikkihappo- ja superfosfaattitehtaat Oy., Vaasa, Finland
Verdasan	PMA = phenylmercury-acetate, 5 % (Hg 2.5 %)	dust or spray	8.5 kg	425 g (Hg 212.5 g)	Plant Protection Ltd., England
Usno	Usnic acid	spray		86 g	Lääke Oy., Finland

[1] By spraying 700—800 l water pro hectare; Verdasan mixed with fine sand before dusting.

Tests with winter rye. In the tests carried out with winter rye at the Department of Plant Pathology at Tikkurila (near Helsinki), in which a PCNB preparation was used for the first time in the autumn of 1945, it was ascertained that PCNB effectively reduced injuries by snow mould (*Fusarium nivale*) (2). In tests with winter rye in 1954—55, a noticeable increase in the yield was obtained by the use of both PCNB and PMA (Verdasan) preparations (6).

The fungicide treatment tests with seedlings of winter rye were continued during the autumn of 1955 on the fields belonging to the Department of Plant

Pathology at Tikkurila and Rekola (near Helsinki), as well as on the Fiskars estate (Pohja commune) in the western part of South Finland.

In the tests at Tikkurila with Visa rye variety (Table 1, Exp. I), according to observations made in the spring, snow mould (*Fusarium nivale*) was the sole cause of overwintering injuries. The PMA and PCNB preparations gave the best results in the control of *Fusarium* mould; the effect of the zineb preparations was slight.

In the tests with Pekka rye variety at Rekola (Table 1, Exp. II), the stands treated with PMS preparations overwintered without injuries from fungi. On the other hand, the untreated plots were heavily attacked by *Fusarium* mould, and *Typhula* mould was also present.

In tests on observation plots at Fekola (Table 1, Exp. III) a late application of the PCNB preparation (on Nov. 14th) seemed to produce the best results; the results corresponded to those of earlier experiences (6).

Table 1. Experiments in treating seedlings of winter rye in 1955—56. Seed dressed with organic mercury seed disinfectant. In autumn the sprouting in all plots normal and even.

Treatment	On the seedlings May 16		Seed yield	
	Fusarium mould %	*Typhula* mould %	kg/ha	rel.
I Tikkurila, finesand clay, Visa rye variety, plots 20 sq.m., 5 replicates, sown Sept. 6, chemicals spread Nov. 14—16.				
Check	10	0	2450	100
PCNB, Botrilex, 25 kg/ha, dust	5	0	2990	122
PMA, Verdasan, 8.5 kg/ha, spray	5	0	3080	126
HCNB, Amatin Staub, 25 kg/ha, dust	10	0	2840	116
Zineb, Dithane Z-78, 25 kg/ha, dust	10	0	2600	106
F-value = 3.025*, m % = 4.9, significant difference = 415 kg				
II Rekola, Helsinki community, mould soil, Pekka rye variety, plots 20 sq.m., 3 replicates, sowing Sept. 9, chemicals spread on Nov. 16.				
Check	60	20	1260	100
PMS, Mercadmine, 4.7 kg/ha, spray	0	0	2360	187
PMS, Merculine, 4.7 kg/ha, spray	0	0	2780	220
PCNB, Avicol, 25 kg/ha, dust	5	+	2040	162
F-value = 70.065***, m % = 2.79, significant difference = 356 kg				
III Rekola, observation plots on mould soil, Pekka rye variety, plots 14.5 sq.m., one replicate, sown Sept. 5, treatment with PCNB preparation Botrilex 25 kg/ha used at each dusting.				
Check	70	10	1350	100
PCNB treatment Oct. 10	40	30	1300	96
» » Nov. 3	40	25	1410	104
» » Nov. 14	20	20	1680	124
» » Oct. 27 and Nov. 3	35	25	1895	140
» » Oct. 27, Nov. 3 and Nov. 14	20	20	2070	153

Of the two tests made on the Fiskars estate, the results of which are not presented, the PCNB preparation increased the seed yield by 39 % in one test with Visa rye variety. In the other test the treatment with PCNB did not improve the yield.

In the seed dressing experiments with winter rye carried out in 1955—56 the increase in yields due to the seed dressing was very considerable (Table 2). The organic mercury preparation Täyssato increased the yield by 140 per cent, the

Table 2. Experiment in dressing seed of winter rye in 1955—56, Tikkurila. Finesand clay, Visa rye variety, plots 19 sq.m., 4 replicates, sowing in Sept. 5. In autumn the sprouting in all plots normal and even.

Treatment	Seed before the sowing germinating %	Seed before the sowing mould %	On the seedlings May 5 *Fusarium* mould %	Seed yield kg/ha	Seed yield rel.
Check	89	1	50	850	100
Org. mercury seed disinfectant, Täyssato, 2 kg/1 kg	88	0	10	2040	240
Thiram, Fernasan 75, 2 kg/1 kg	89	0	20	1950	229
Täyssato, 2g/1 kg + Fernasan 75, 2 g/1 kg	86	0	10	2250	265
F-value 2.707, m% = 11.7, significant difference = 672 kg					

thiram preparation (Fernasan 75) by 129 per cent, and both these preparations used together in seed dressing increased the yield by 165 per cent. It should be noted that mould had not been found on the seed while it was germinating in the laboratory.

In tests with winter rye in South Finland in 1956—57, treatment of the seedlings with fungicides in the autumn did not lead to any increase in the yield, as injuries from low-temperature parasitic fungi did not make their appearance. On the other hand, low-temperature parasitic fungi were found in tests with winter rye made

Table 3. Observations of low-temperature parasitic fungi in experiments on winter rye in 1956—57. In autumn the sprouting in all plots normal and even.

Treatment	Seedlings destroyed during winter %	On the seedlings May 20 *Fusarium* mould %	On the seedlings May 20 *Typhula* mould %
A p u k k a, Polar Circle Exp. Sta., Rovaniemi, finesand clay, Greus rye variety, the seed dressed with organic mercury disinfectant, chemicals spread Oct. 22 on the snow.			
Check	63	47	16
PCNB, Avicol Oct. 5, and Oct. 22, dusting with 25 kg/ha	13	0	7
PCNB, Avicol, Oct. 22, 25 kg/ha dust	17	5	7

Rye varieties	Seedlings destroyd during winter %		On the seedlings May 16 *Fusarium* mould % [2]	
	check	PCNB	check	PCNB
M a a n i n k a, Pohjois-Savo Exp. Sta., mould soil, PCNB (Avicol), spread as dust 25 kg/ha on Oct. 30, seed dressed with organic mercury disinfectant.				
Toivo	50	2	50	+
Toivo, seed not dressed	50	5	50	5.5
Pekka	40	10	30	+
Visa	35	10	30	+
Ensi	10	20 [1]	+	0
Vjatka	2	2	0	0
Vjatka, seed not dressed	15	30 [1]	0	0
Halola	10	30 [1]	0	0
Vatia	5	2	0	0

[1]) Water injuries
[2]) + = slight traces of mould

at the Polar Circle Experiment Station at Apukka (near Rovaniemi) and at the North Savo Experiment Station at Maaninka (in the eastern part of Central Finland). In analyses carried out at the Polar Circle Exp. Sta. in the spring, a distinct difference with regard to the amount of *Fusarium* mould and *Typhula* mould was established between the check plots and the plots treated with PCNB (Table 3). — In tests with winter rye varieties at the North Savo Experiment Station, differences with regard to the amount of *Fusarium* mould were found between the different varieties and also between the check plots and the plots treated with PCNB (Table 3). *Fusarium* mould appeared in abundance in the Toivo, Pekka and Visa rye varieties; treatment with PCNB during the autumn had proved very effective against this.

In the experiments with winter rye carried out at Tikkurila in 1957—58 (Table 4) the cause of damage during the winter was *Fusarium nivale*. In a treatment time test it was found that treatment with both PCNB and PMA carried out in November gave better results than similar treatment in October (Table 4, Exp. I). In the other experiment with winter rye PMA and PMS (Mercadmine) were effective against *Fusarium* mould as shown in Table 4, Exp. II. The usnic acid preparation Usno had also reduced the *Fusarium* mould (Table 4, Exp. II).

T e s t s w i t h w i n t e r w h e a t. In a test with winter wheat at Tikkurila in 1954—55, treatment with PCNB did not improve the yield (6). The dusting was carried out on Oct. 5th, using 25 kg of PCNB preparation per hectare.

In tests with winter wheat on sandy soil carried out at Tikkurila in the autumn of 1955 (Table 5, Exp. I), both PCNB and PMA preparations effectively reduced injuries from *Fusarium* mould, which resulted in considerable increases in yield. The PCNB preparation was effective against the *Typhula* fungi, a double dosage,

Table 4. Experiments on winter rye in 1957—1958, Tikkurila. In autumn the sprouting in all plots normal and even.

Treatment	On the seedling May 19 *Fusarium* mould %	Seed yield kg/ha	rel.	Stalk yield kg/ha	rel.
I. Tikkurila, finesand clay, Tetra rye variety, plots 19.8 sq.m., 5 replicates, sowing Sept. 5 with undressed seed; chemicals applied by dusting, Verdasan mixed in sand.					
Check	39	1175	100	3220	100
PCBN, Botrilex, Oct. 15, 25 kg/ha	38	1310	111	3380	105
PCNB, Botrilex, Nov. 12, 25 kg/ha	17	1390	118	3620	112
PMA, Verdasan, Oct. 15, 25 kg/ha	8	1620	138	4240	132
PMA, Verdasan, Nov. 12, 25 kg/ha	3	1700	145	4250	132
F-value = 5.1** m% = 17.3, significant difference = 2.1 kg.					
II. Tikkurila, observation plots on finesand clay, Visa rye variety, plots 18 sq.m., one replicate, sowing Sept. 5 with undressed seed, treatment of seedlings Nov. 12.					
Check	35	1030	100	2470	100
PMA, Bayer 4426, 25 kg/ha, dust	1	2720	264	6580	266
PMA, Verdasan, 8.5 kg/ha, dust mixed with sand	0	2270	220	5450	221
PMS, Mercadmine, 4.7 kg/ha, spray	0	2160	210	5070	205
Usno, 86 g/ha, spray	15	1540	150	3790	153

50 kg/ha, having a greater effect than 25 kg/ha. On finesand clay soil (Table 5, Exp. II) the PMA preparation effectively reduced injuries by *Fusarium* mould, and a particularly large increase in yield was obtained from the test plots treated with this preparation. The effects of PCNB, HCNB and zineb preparations were slighter. — In tests carried out on sandy soil on the Anttila experiment farm at Tuusula (Table 5, Exp. III) the overwintering of wheat was particularly poor, owing to *Fusarium* mould. PCNB treatment (25 kg/ha) had improved the yield fourfold, though it still remained low.

In 1956—57, as there were no noteworthy injuries from low-temperature parasitic fungi in South Finland, no indications of control by either PCNB or organic mercury preparations were noted in the tests with winter wheat.

In an experiment with winter wheat sown on sandy soil in 1957—58 there appeared much damage from low-temperature fungi (Table 6, fig. 1) in spring. The damage was caused by the *Typhula* fungi, mainly by *T. idahoensis*; *T. itoana* was found to be rather scarce. In contrast with the spring of 1956 there appeared very little *Fusarium nivale* on the winter wheat. The experiment showed that a treatment with PCNB as well as with PMA preparations carried out late in November was noticeably distinctly more effective than one performed in October. PCNB and PMA if used together controlled almost totally the damage from low-temperature fungi. The PMA preparation Bayer 4426 was more effective than the

Table 5. Experiments on winter wheat in 1955—56. In autumn the sprouting normal and even. + = traces of mould

Treatment	On the seedlings May 16 *Fusarium* mould %	*Typhula* mould %	Seed yield kg/ha	rel.
I. Tikkurila, sandy soil, Ertus wheat variety, plots 9 sq.m., 4 replicates, sown Sept. 5 with undressed seed, chemicals spread by dusting Nov. 14.				
Check	50	20	1530	100
Seed dressed with org. mercury preparation Täyssato, 2 g/l kg	45	25	1830	119
PCNB, Botrilex, 25 kg/ha, dust	25	10	2840	186
PCNB, Botrilex, 50 kg/ha, dust	25	5	2890	189
PMA, Bayer 4426, 85 kg/ha, spray	20	20	2890	189
F-value = 3.315***, m% = 12.626, significant difference = 904 kg				
II. Tikkurila, finesand clay soil, Ertus wheat variety, plots 14.5 sq.m., 5 replicates, seed dressed with organic mercury preparation, sown Sept. 6, chemicals spread by dusting Nov. 14—16.				
Check	90	+	510	100
PCNB, Botrilex, 25 kg/ha, dust	60	+	1920	376
PMA, Verdasan, 8.5 kg/ha, spray	25	5	4250	833
HCNB, Amatin Staub. 25 kg/ha, dust	85	5	1070	210
Zineb, Dithane, Z-78, 25 kg/ha, dust	75	5	1340	263
F-value = 35.351***, m% = 11.9, significant difference = 672 kg.				
III. Anttila Exp. Farm, Tuusula, sandy soil, Antti wheat variety, seed dressed with organic mercury preparation, sown Sept. 10, chemical spread Nov. 19, damages caused by *Fusarium* mould during winter.				
Check			170	100
PCNB, Brassicol, 25 kg/ha, dust			780	459

PMA preparation Verdasan (cf. the amounts of active ingredients in these preparations on page 253). The increases in yields of both grain and stalk were very considerable owing to the treatment. The increase in the yield of grain due to treatment with PCNB preparation in November was 31 per cent, with the PMA preparation Verdasan it was 30 per cent, with the PMA preparation Bayer 4426 42 per cent, and with PCNB + PMA preparations 46 per cent. Judging by the damage by low-temperature fungi showing on the seedlings in spring (Table 6) even greater increases in yield were expected, but during the period of growth the surviving seedlings tillered very richly. The results of the yield are nevertheless in direct correlation to the results obtained by analysing the seedlings in spring.

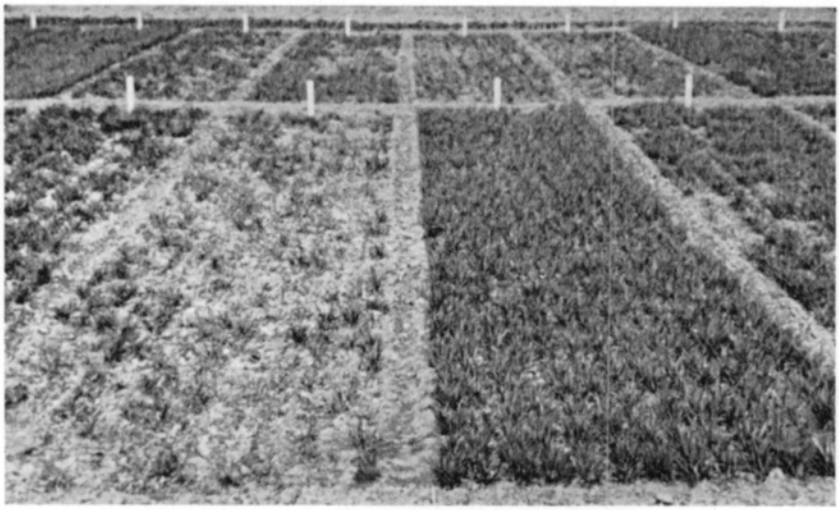

Fig. 1. An experiment at the Department of Plant Pathology in Tikkurila by Ertus winter wheat variety. To the right, plot with stands treated on Nov. 12 with the PMA preparation (Bayer 4426); to the left, untreated plot, damages caused chiefly by *Typhula idahoensis*. Photo taken in May. 1958.

Table 6. Experiment on winter wheat in 1957—58, Tikkurila.
Sandy soil; Ertus wheat variety; size of plots 20 sq.m., four replicates; sown Aug. 30.
In autumn the sprouting normal and even.

Treatment	On the seedlings May 12 [1])		Seed yield		Straw crop	
	Fusarium mould %	*Typhula* mould %	kg/ha	rel.	kg/ha	rel.
Check	4.5	63.1	3125	100	3795	100
Seed dressed, Täyssato, 2 g/1 kg	2.8	52.2	3305	106	4185	110
PCNB, Botrilex, Oct. 15, 25 kg/ha, dust	2.9	50.6	3510	112	4690	124
PCNB, Botrilex, Nov. 12, 25 kg/ha, dust	0.5	34.9	3775	121	4965	131
PMA, Verdasan, Oct. 15, 8.5 kg/ha, dust	1.3	41.1	3655	117	4660	123
PMA, Verdasan, Nov. 12, 8.5 kg/ha, dust	0.7	13.3	3775	121	4950	130
PCNB, Botrilex, 25 kg/ha + PMA, Verdasan, 8.5 kg/ha, Nov. 12, dust	0	3.3	4035	129	5545	146
PMA, Bayer 4426, Nov. 12, 25 kg/ha, dust	1.1	21.6	4045	129	5395	142

F-value = 3.79*** m% = 8.3, significant difference 0.86 kg.

[1]) Analysis made by counting the seedlings in each plot of two square metres; *Typhula* mould chiefly *T. idahoensis*, *T. itoana* was rather scarce.

Experiments with winter barley. Winter barley is not grown in Finland because its overwintering is often unsuccessful. The main reason for the poor overwintering of winter barley in this country is damage caused by low-temperature parasitic fungi and frost. The significance of low-temperature fungi is shown in an experiment carried out at Tikkurila in 1957—58 with the Bore variety of winter barley (of Danish origin), sown Sept. 13, 1957. Two plots, both one are large, were used in the experiment, one of them untreated, the other treated with PCNB + PMA in the autumn. The seeds sprouted normally in the field in the autumn. The results of the test were as follows:

Treatment	On the seedlings on May 13 *Fusarium* mould %	Seed yield kg/ha	rel.
Check	52	281	100
Treatment in Nov. 12: PCNB, Botrilex 50 kg/ha + PMA, Verdasan, 8.5 kg/ha ..	9	628	224

The yields was modest, which was probably due to frost injuries. The treatment with the PCNB + PMA preparation in the autumn had effectively controlled the injuries from *Fusarium* mould.

In this experiment in 1957—58 another variety of winter barley was also used, Pioner HF (the seeds were obtained from England). This had totally disappeared during the winter, apparently because of the frost. In the autumn the seeds of this variety had sprouted normally.

On the amount of fungicides effective against low-temperature fungi

According to results of previous tests 20 % PCNB preparations applied 25 kg/ha were effective against both *Fusarium* mould and *Typhula* mould on winter cereals. However, they did not entirely control the injuries of low-temperature parasitic fungi in all the tests.

The mercury compounds PMA and PMS were in the experiments distinctly more effective against low-temperature fungi than PCNB. It should be noted that with the mercury compounds the amounts of active ingredients per hectare were very low (cf. p. 253). If the amount of Hg per hectare is calculated, it is in the PMA preparation Bayer 4426 only 75 grams, in the PMA preparation Verdasan 212.5, and in the PMS preparations 110.5 and 221 grams.

In this connection note should also be taken of the effect of seed dressing on the low-temperature parasitic fungi during the overwintering period. In the seed dressing experiment with winter rye in 1956—57 (Table 2) there was no mould on the seed used in sowing. In the spring there was far less snow mould in the treated plots than in the check plots resulting in considerable increases in the yield.

In the preceding autumn the sprouting was even in all plots. The small amount of fungicide which accompanied the seed into the field must have protected the seedlings from damage by *Fusarium* mould during the overwintering. With the org. mercury preparation Täyssato about 7.5 g of Hg got into the soil and with the preparation Fernasan 375 g of thiram. — The increases in the yields of winter cereals due to seed dressing are very considerable in Finland. In experiments made in different parts of the country during the period 1928—1950 (1) the increases in yields of winter rye due to treatment with organic mercury compounds were on an average 19.4 per cent (131 tests trials) and of winter wheat 6.1 per cent (35 tests trials). The seeds used in these tests sprouted in general normally, accordingly the increases in yield must be considered as being mainly caused by the fungicidal effect of the mercury compounds on the low-temperature fungi in the soil during overwintering (cf. 5).

Summary

The cause of damage from low-temperature parasitic fungi during overwintering was in the experiments with winter rye mainly *Fusarium nivale* (Fr.) Ces., in the experiments with winter wheat both *F. nivale* and the *Typhula* spp. fungi, *T. itoana* Imai and *T. idahoensis* Remsb.

The pentachloronitrobenzene compounds PCNB and the organic mercury compounds phenylmercuryacetate (PMA) and phenylmercurysalicylate (PMS) were effective against both the *Fusarium* and the *Typhula* fungi in the experiments in which the treatments of the seedlings had been performed in November under weather conditions normal for South Finland. The effect of treatments performed correspondingly earlier in October was slighter.

In experiments made in South Finland in the winter 1955—56 and in the winter 1957—58, when low-temperature parasitic fungi appeared in abundance, the increases in yield due to treatment of the seedlings with PCNB and with the mercury compounds PMA and PMS performed in November were very considerable: winter rye (7 tests) 12—122 per cent, winter wheat (4 tests) 31—735 per cent, and winter barley (one test) 124 per cent. — In the experiments made in 1956—57 in South Finland no increase in yield was obtained through treatment of the seedlings because low-temperature fungi did not appear.

The mercury compounds PMA and PMS when applied on the stands in autumn were more effective against low-temperature parasitic fungi on winter cereals than the PCNB preparations.

The effect of zineb and hexachloronitrobenzene (HCNB) preparations in controlling low-temperature parasitic fungi on winter cereals by treating the stands in autumn was found to be much slighter than the effect of PCNB and of the organic mercury fungicides.

The amount of active ingredient in the PCNB preparations was in most experiments 5 kg per hectare. In the two PMA preparations used in the experiments the amount of active ingredient was 125 and 425 kg per hectare, the corresponding

amounts of Hg were 75 and 212.5 g per hectare. The amount of active ingredient in the two PMS preparations was 235 and 470 g per hectare, the corresponding amounts of Hg were 110.5 and 221 g per hectare.

In the experiment on seed dressing with winter rye in 1955—56 it was ascertained that in addition to the organic mercury preparations also the thiram preparation was effective against *Fusarium* mould.

In seed dressing experiments in Finland considerable increases in yield especially of winter rye have been obtained by using organic mercury compounds when the seed has been normally germinating and not infested by mould. This shows that the small amount of mercury that accompanies the seed into the soil is effective in controlling the low-temperature fungi during the winter.

Acknowledgment. The author expresses his deep gratitude to Mr. MATTI HAAVISTO, Plant Protection Inspector, who assisted him in carrying out the experiments reported in this paper. The valuable work of Mr. Haavisto was interrupted by his death from heart failure in February 1958. — The Department of Plant Pathology wishes to express its gratitude also to the persons who took part in organising the experiments on the Experimental Stations and on the private farms.

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SELOSTUS:

SYYSVILJOJEN TALVITUHOSIENTEN TORJUNTAKOKEISTA ERÄILLÄ KLOORINITROBENTSEENI- JA ORGAANISILLA ELOHOPEAVALMISTEILLA

E. A. Jamalainen

Kasvitautien tutkimuslaitos, Tikkurila

Kasvitautien tutkimuslaitoksen syysviljakokeissa vv. 1955—1958 oli päähuomio kohdistettu talvituhosienien aiheuttamien vahinkojen torjuntaan käsittelemällä oraat syystalvella eräillä kloorinitrobenseeni- ja org. elohopeavalmisteilla. Useimmat kokeet oli suoritettu Etelä-Suomessa.

Runsaslumisena talvena 1955—56 aiheuttivat talvituhosienet suuria vahinkoja peltokasveille kaikkialla Suomessa, myös etelä-osissa maata. Talvella 1956—57, jolloin lunta oli vähän ja maa oli syystalvella syvään routaantunut, ei talvituhosienien aiheuttamia tuhoja esiintynyt syysviljoissa sanottavammin maan etelä-osissa. Keski- ja pohjois-Suomessa esiintyi talvituhosienivaurioita, mutta ne olivat tavallista vähäisemmät. Talvi 1957—58 oli normaali syysviljojen talvehtimiselle; lumisilla seuduilla ja runsaslumisissa kasvupaikoissa olivat talvituhosienien vauriot syysviljoilla melkoiset.

Talvehtimisvaurioiden aiheuttajina oli syysruiskokeissa etupäässä *Fusarium nivale* (Fr.) Ces., syysvehnäkokeissa sekä *F. nivale* että *Typhula* spp. sienet, *T. itona* Imai ja *T. idahoensis* Remsb.

Pentakloorinitrobentseeni (PCNB) ja org. elohopeavalmisteet, fenyylimerkuriasetaatti (PMA) ja fenyylimerkurisalisylaatti (PMS), vaikuttivat tehokkaasti sekä *Fusarium* – että *Typhula*-sieniin kokeissa, joissa oraiden käsittely oli suoritettu etelä-Suomen olosuhteissa marraskuussa. Vastaavasti aikaisemmin lokakuussa suoritettujen käsittelyjen teho jäi heikommaksi marraskuun käsittelyihin verrattuna.

PCNB-valmisteilla sekä PMA- ja PMS-elohopeavalmisteilla marraskuussa suoritettujen oraiden käsittelyn ansiosta johtuvat sadonlisäykset olivat koetalvina 1955—56 ja 1957—58, jolloin talvituhosieniä esiintyi runsaasti, varsin huomattavat: syysrukiilla (7 koetta), vaihdellen 12—122 %, syysvehnällä (4 koetta), vaihdellen 31—735 %, ja syysohralla (yksi koe) 124 %. V. 1956—58 kokeissa ei talvituhosienien puuttuessa oraiden käsittelyllä saatu etelä-Suomessa sadonlisäyksiä.

Elohopeavalmisteet PMA ja PMS olivat tehokkaampia syysviljojen talvituhosieniin kuin PCNB-valmisteet.

Zineb- ja heksakloorinitrobentseeni- (HCNB-) valmisteiden teho syysviljojen talvituhosieniin oli huomattavasti heikompi kuin PCNB- ja org. elohopeavalmisteiden.

PCNB-valmisteissa oli vaikuttavan aineen määrä useimmissa kokeissa 5 kg halle. Kokeiltavana olleessa kahdessa PMA-valmisteessa oli vaikuttavan aineen määrä 125 ja 425 g halle, vastaavat Hg-määrät 75 ja 212.5 g halle, sekä kahdessa PMS-valmisteessa 235 ja 470 g halle, vastaavat Hg-määrät 110.5 g ja 221 g halle.

Syysrukiin peittauskokeessa v. 1955—56 tehosi org. elohopeavalmisteiden ohella myös tiramvalmiste hyvin *Fusarium*-homeeseen.

Kylvösiemenen peittauskokeissa on Suomessa saatu varsinkin syysrukiilla huomattavia sadonlisäyksiä org. elohopeavalmisteilla, siemenen ollessa normaalisti itävää eikä lumihomesienen saastuttamaa. Tämä osoittaa, että siemenen mukana maahan tuleva vähäinen määrä elohopeaa vaikuttaa talven aikana talvituhosieniä torjuvasti.