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THE TREATMENT OF SEEDS OF SWEDE, TURNIP, AND TURNIP RAPE IN THE CONTROL OF FLEA BEETLES (PHYLLOTRETA SPP.) AND CABBAGE ROOT FLIES (HYLEMYIA BRASSICAE BOUCHÉ AND H. FLORALIS FALL.)

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SELOSTUS

LANTUN, NAURIIN JA RYPSIN SIEMENTEN KÄSITTELY KIRPPOJEN (PHYLLOTRETA SPP.) JA KAALIKÄRPÄSTOUKKIEN (HYLEMYIA BRASSICAE BOUCHÉ JA H. FLORALIS FALL.) TORJUNNASSA

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Introduction

The cruciferous fodder plants marrow kale, rape, swede, turnip and turnip rape are generally cultivated in the whole of Finland, but they have an especially great significance in the more northern parts of the country, where particularly the cultivation of rape and turnip rape as supplementary fodder has in recent years increased considerably. Pests, especially flea beetles and cabbage root flies, are in many cases a limiting factor in the successful cultivation of these plants.

At present there are no problems in the control of flea beetles, since effective insecticides are available both as sprays and as dusts. The only difficulty is that these pests can totally destroy seedlings just emerging. The control of cabbage root flies in small areas is also possible by watering the plants with different insecticides or by applying the preparations to the seeded area or around the seedlings. The insecticides most used are chlorinated hydrocarbons, but satisfactory results have also been given by some organic phosphorus insecticides in liquid form. However, on larger fodder plant cultivations the methods mentioned are unprofitable. Treatment of the seeds with insecticides would be a more economic method of control, especially if the effect of the insecticide gave sufficient control both of flea beetles and of cabbage root flies.

Seed treatment of cruciferous plants has been studied in the control of pests damaging leaves and in the prevention of maggots living in roots. JAMESON (1950) has treated the seeds of turnip, swede and kale with liquid BHC dressing against the turnip flea beetle. The treatment has given protection against attack before emergence of the seedlings and against light to moderate attack after emergence. In the Soviet Union (SHAPIRO 1951) seeds of turnip treated with 50 per cent of their weight of dust containing 12 per cent BHC, were sown in the laboratory. Flea beetles of the genus *Phyllotreta* that were released on the turnip shoots all died within 72 hours. BONNEMAISON and JOURDHEUIL (1954) have obtained good results in the control of *Phyllotreta* flea beetles by treating the seeds of rape with lindane dust or emulsion. Parathion has also had an efficient, but only short action both in dry and in liquid treatment, whereas the effect of aldrin and DDT has been poor. In experiments conducted in Denmark (HAMMARLUND 1957, 1958, and 1959), lindane has proved to be

effective against flea beetles. The effect of aldrin has been somewhat poorer. While 45 g per kg of seed is sufficient of a preparation containing 75 % lindane and 10 % thiram, double this quantity must be used in the case of preparations containing 35—38 % aldrin and 5—10 % thiram. Petroleum has been used as a sticker. Fewer experiments have been carried out with dieldrin, but its effect has proved to be equal to that of aldrin. Good results were obtained with lindane in Norway, with swede as the experimental plant. The effect of aldrin and dieldrin was somewhat poorer (STENSETH 1960).

Chlorinated hydrocarbons were also used in the control of cabbage root flies. In particular, it may be mentioned that EHLERS (1956) has obtained promising results against these pests by treating cauliflower seeds with 90 % dieldrin, using 30—50 g per 100 g of seed. The damage caused by the first generation of *Hylemyia brassicae* was thus prevented effectively enough. In North Sweden HELLQVIST (1957 and 1960) has, during a number of years, carried out experiments on the control of cabbage root flies by treating seeds with 40 % aldrin, 50 % dieldrin, and 25 % heptachlor, using 100—1 000 g per kg of seed. In the experiments of MORETON et al. (1958), however, the effect of dieldrin sprays, proved to be better than the effect of seed treatment with lindane and dieldrin. In Norway RYGG (1960) obtained a fairly good effect by treating seeds with 40 % aldrin (750 g/kg). In the preliminary experiments arranged by the authors, with swede and turnip rape as the experimental plants, a 50 % demeton spray (25 g per kg of seed) and a 20 % lindane seed dressing (125 g per kg of seed) proved to be fairly effective against flea beetles. Demeton did not affect cabbage root flies. Lindane somewhat decreased the damage caused by cabbage root flies, but its action was not sufficiently effective. In the years 1958 and 1959 more extensive experiments were arranged by the Department of Pest Investigation at Tikkurila, mainly to elucidate the possibility of controlling both flea beetles and cabbage root flies merely by seed treatment, without the use of other measures during the growing season.

Performance of the experiments

In 1958 the experimental areas were situated on sandy soil. The experimental plants were swede and turnip. The plot contained two treated rows (length 5 m) and there was an untreated row between the treated plots. There were four replications. The insecticides to be investigated were chlorinated hydrocarbons, aldrin, heptachlor and lindane and demeton, of which only demeton was in liquid form. The amounts of insecticides

used are presented in Table 1. In the swede experiment an aqueous solution of syrup was used as the sticker; in the turnip experiments ethylhydroxyethylcellulose was similarly employed. In addition to these experiments, a further one was performed with the same plants on small plots without replications, where the stand was not thinned out, to investigate the effect of different amounts of lindane both on flea beetles and on cabbage root flies (Table 2). The damage caused by flea beetles was examined right at the beginning of the growing season, 8—10 days after sowing, with the exception of an experiment with turnip, where inspection was undertaken 40 days after sowing. The feeding spots of flea beetles in a certain amount of leaves were counted in the inspection and the effects of the various insecticides are given as percentages, on the basis of the values thus obtained. The damage caused by the cabbage root flies was examined in connection with harvesting in different experiments after a growing time of 1 1/2—4 months. In the experiment with swedes 200 plants from each treatment were examined; in the experiment with turnip 500 plants from the main treatment plots and 100 plants from the small plots were inspected. The damage was estimated using a scale of 0—5 (quite healthy-totally destroyed). From the values thus obtained the average value was calculated. On the basis of this value the effects of different insecticides are given as percentages. — The growing season of 1958 was rather rainy and cold.

The 1959 experiments were carried out both on sandy and on peat soil. The experimental plants were swede, turnip, and winter turnip rape. The performance of the field experiments was similar to that in the previous year, but the insecticides and their amounts, details of which are presented in Tables 3 and 4, were to some extent different. Purified paraffin oil was used as a sticker. Compared with aqueous solution of syrup and ethylcellulose, paraffin oil has proved to be the most handy sticker because it is quite ready for use and the seeds become incrusted with equal smoothness and no caking. No experiments were made to compare the possible effect of various stickers on the effect of insecticides. The inspections and the estimation of results were conducted as in the year 1958. In the experiments on sandy soil no damage caused by flea beetles occurred. The reason for this was the especially cold weather prevailing during the seedling stage, when the temperature dropped considerably below 0° C on several nights. In the experiments on peat soil the damage caused by flea beetles was examined 15—16 days after sowing in turnip, 20—22 days after sowing in winter turnip rape, and 24 days after sowing in swede. The damage caused by cabbage root flies was examined in turnip rape and swedes in connection with harvesting, when the growing-time of turnip was a little less than three months and that of swede about four months. Two examina-

tions were undertaken in winter turnip rape both on sandy and on peat soil: the first one after a growing-time of less than two months and the second one after a growing-time of about three months. For each treatment the damage caused by root flies was examined in 200 plants in every inspection. — The growing season of 1959 was very dry and warm. The drought proved the greatest restricting factor in the development of the plants.

The results

Flea beetles (Tables 1—3). The most effective treatment against flea beetles was obtained with lindane. The smallest amount used was 80 g/kg of seed dressing containing 75 % lindane and 10 % thiram. Without the sticker this amount was quite ineffective on swede and turnip. When a sticker was used the effect was better, and it increased considerably when the amount was increased to 120—160 g. Greater amounts than this no longer increased the effect systematically. 50 % dieldrin (200—400 g/kg) had rather a good effect, although not as good as that of the lindane preparation when more than 120 g was used. In 1959 600 g 50 % dieldrin per kg of seed was used in field experiments, but its effect was not so good as that obtained when using 400 g. Parathion gave a moderate effect when 600 g/kg of 1.5 % dust was used. A greater amount, 1 000 g/kg, was less effective in the experiments of the summer of 1959. The effect of demeton

Table 1. Seed treatment in the control of flea beetles (*Phyllotreta* spp.) and cabbage root flies (*Hylemyia brassicae* and *H. floralis*) in 1958. Experimental plants swede and turnip. Sandy soil.

Active ingredient %	Insecticide	Dosage	Swede, sown 14/5				Turnip, sown 5/6			
			Flea beetles		Root flies		Flea beetles		Root flies	
			Feeding spots/ 400 plants	Effect	Damage 0—5 [1])	Effect	Feeding spots/50 plants	Effect	Damage 0—5 [1])	Effect
		g/kg	24/5	%	17/9	%	14/7	%	26/7	%
40	Aldrin	620	8 567	22	1.67	44	12 328	14	0.12	83
50	Demeton	140	6 742	39	2.88	3	13 804	4	0.59	15
15	Dieldrin	80	9 110	17	2.73	8	7 465	48	0.44	36
25	Heptachlor	1 000	10 009	9	0.96	68	11 564	19	0.08	88
75+10	Lindane+ thiram	80	3 295	70	2.81	5	7 571	47	0.43	38
	Untreated		10 961	—	2.96	—	14 331	—	0.69	—

[1]) 0 = quite healthy root
5 = root destroyed totally by cabbage root flies

Table 2. Seed treatment in the control of flea beetles (*Phyllotreta* spp.) and cabbage root flies (*Hylemyia brassicae* and *H. floralis*) in 1958. Experimental plants swede and turnip. Small plots. Sandy soil.

Active ingredient %	Insecticide	Dosage	Swede, sown 24/6				Turnip, sown 24/6			
			Flea beetles		Root flies		Flea beetles		Root flies	
			Feeding spots/50 plants	Effect	Damage 0—5	Effect	Feeding spots/50 plants	Effect	Damage 0—5	Effect
		g/kg	2/7	%	19/9	%	2/7	%	19/9	%
50	Demeton	200	153	62	3.47	3	304	39	3.36	0
50	Dieldrin	200	281	29	0.96	73	236	53	1.18	58
75+10	Lindane + thiram [1])	80	463	0	2.41	33	585	0	2.60	7
75+10	Lindane+thiram	80	178	55	0.14	96	422	16	2.14	24
75+10	Lindane+thiram	160	73	82	0.16	96	189	62	0.67	76
75+10	Lindane+thiram	240	100	75	0.12	97	121	76	0.28	90
75+10	Lindane+thiram	320	113	72	0.20	94	159	68	0.49	83
	Untreated		398	—	3.58	—	502	—	2.80	—

[1]) In this the seed was dressed without sticker.

varied in different experiments, but generally 200 g of the preparation per kg had a rather good effect. The results with aldrin did not seem very promising. Only one aldrin preparation was used. The effect of heptachlor was very poor.

Table 3. Seed treatment in the control of flea beetles (*Phyllotreta* spp.) in 1959. Experimental plants swede, turnip, and winter turnip rape. Peat soil.

Active ingredient %	Insecticide	Dosage	Swede sown 27/5		Turnip sown 2/6		Winter turnip rape sown 2/6	
			Feeding spots/25 plants	Effect	Feeding spots/25 plants	Effect	Feeding spots/25 plants	Effect
		g/kg	20/6	%	18/6	%	23/6	%
40	Aldrin	800	1 576	40	1 506	25	2 232	20
50	Dieldrin	400	961	64	727	64	1 547	44
50	Dieldrin	600	977	63	1 022	49	1 997	28
25	Heptachlor	1 000	1 911	28	1 332	34	2 433	13
75+10	Lindane+thiram	120	697	74	633	69	1 365	51
75+10	Lindane+thiram	160	609	77	441	78	1 154	59
75+10	Lindane+thiram	240	617	77	357	82	1 384	50
1.5	Parathion	600	801	70	866	57	2 004	28
1.5	Parathion	1 000	1 145	57	881	56	2 573	7
	Untreated		2 638	—	2 014	—	2 781	—

Table 4. Seed treatment in the control of cabbage root flies (*Hylemyia brassicae* and *H. floralis*) in 1959. Experimental plants swede, turnip, and winter turnip rape. Soil a) sand b) peat.

Active ingredient %	Insecticide	Dosage	Swede				Turnip				Winter turnip rape							
			a sown 12/5		b sown 27/5		a sown 12/5		b sown 2/6		a sown 13/5				b sown 2/6			
			Damage 0—5	Effect	Damage 0—5	Effect	Damage 0—5	Effect	Damage 0—5	Effect	Damage 0—5	Effect	Damage 0—5	Effect	Damage 0—5	Effect	Damage 0—5	Effect
		g/kg	10/9	%	18/9	%	7/8	%	18/8	%	1/7	%	15/8	%	20/7	%	20/8	%
40	Aldrin	800	1.57	34	2.44	10	0.91	52	2.38	0	0.50	75	0.82	71	0.36	54	2.27	15
50	Dieldrin	400	2.15	10	2.66	2	1.40	26	2.39	0	1.12	44	0.94	67	0.27	65	2.37	11
50	Dieldrin	600	2.20	8	2.58	5	1.15	39	2.18	0	0.69	65	1.09	62	0.39	50	2.23	16
25	Heptachlor	1 000	1.57	34	2.65	2	1.20	36	1.84	7	0.51	74	0.77	73	0.38	51	2.31	13
75+10	Lindane+thiram	120	2.35	2	2.60	4	1.49	26	2.18	0	0.38	81	0.77	73	0.18	76	2.06	23
75+10	Lindane+thiram	160	2.18	9	2.59	4	1.29	31	2.31	0	0.25	87	0.67	77	0.13	83	2.08	22
75+10	Lindane+thiram	240	2.06	14	2.44	10	1.05	44	2.25	0	0.21	89	0.56	80	0.14	82	2.12	21
1.5	Parathion	600	2.44	0	2.62	3	1.64	13	2.13	0	2.38	0	2.27	22	0.44	44	2.48	7
1.5	Parathion	1 000	2.36	2	2.63	3	1.61	14	2.06	0	2.30	0	2.10	27	0.44	44	2.50	6
	Untreated		2.40	—	2.71	—	1.88	—	1.97	—	1.99	—	2.89	—	0.78	—	2.67	—

Cabbage root flies. In 1958 treatment with aldrin and heptachlor gave an 80—90 % effect, which in practice must be considered very satisfactory, as also the 68 % effect obtained in swedes by treatment with heptachlor (Table 1). In these treatments there were 91 % and 93 % healthy or only slightly damaged roots (0—1) in turnip and 79 % in swedes. Although in proper field experiments the effect of lindane and dieldrin was not good, the results obtained in small plots (Table 2) indicated that by increasing the amount of the insecticide it should be possible to control successfully cabbage root flies both in swede and turnip by seed treatment with lindane and perhaps with dieldrin, too.

In the 1959 experiments the results in the control of cabbage root flies were not so good as the results of the foregoing year. The cause of this is not quite clear, but at any rate the fact that the majority of the flies occurring in 1958 consisted of *Hylemyia brassicae* specimens, whereas in the year 1959 the proportion of *H. floralis* specimens had increased, constitutes a factor. In the results obtained, presented in Tables 3 and 4, there are some interesting features however: firstly, the best result was obtained in turnip rape, and secondly, the effect of chlorinated hydrocarbons was generally distinctly better and more lasting on sandy than on peat soil.

Lindane gave the best result in winter turnip rape. Its effect on sandy soil remained sufficient during the entire growing-time, in this case three months (the growing-time of rape and turnip rape cultivated for fodder is about two months). The effect of aldrin and heptachlor was satisfactory, too, but that of dieldrin was somewhat poorer. On peat soil the results with lindane after a growing-time of 1 1/2 months were only somewhat poorer than on sandy soil, whereas the effect of aldrin and heptachlor was noticeably poorer. After a growing-time of 2 1/2 months the effect of all the insecticides on peat soil was very poor. The 44 % effect of parathion seed treatment on the damage caused by maggots on peat soil after a growing-time of 1 1/2 months seems unexpected.

In turnip and swede no treatment gave even a satisfactory result. In turnip differences appeared in the effect of various insecticides on sandy and on peat soil. The fact that the result was better in turnip than in swede evidently depends on the shorter growing-time of the turnip.

Summary

In the control of flea beetles the best effect was obtained with lindane. The smallest amount used, 80 g/kg of seed dressing containing 75 % lindane and 10 % thiram, was quite ineffective on swede and turnip without sticker. With sticker the effect was quite good, and it increased considerably when the amount of lindane was increased. The effect of 1.5 % parathion (600 g/kg) and that of 50 % dieldrin (200—400 g/kg) was quite good in many cases, but the effect of the 40 % aldrin seed dressing used was not very promising, and the effect of 25 % heptachlor remained poor.

In the control of cabbage root flies in fodder turnip rape 75+10 % lindane + thiram seed dressing (120—160 g/kg) proved the most effective and was quite sufficient in practice. In most cases the effect of other chlorinated hydrocarbons, 40 % aldrin (800 g/kg), 25 % heptachlor (1 000 g/kg), and 50 % dieldrin (400—600 g/kg), was satisfactory. In turnip and swede no seed treatment with any of the insecticides was certain. The effect of chlorinated hydrocarbons was generally distinctly better and more lasting on sandy soil than on peat soil.

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Selostus

Lantun, nauriin ja rypsin siementen käsittely kirppojen (Phyllotreta spp.) ja kaalikärpästoukkien (Hylemyia brassicae Bouché ja H. floralis Fall.) torjunnassa.

KATRI TIITTANEN ja ANNA-LIISA VARIS

Maatalouden tutkimuskeskus, Tuhoeläintutkimuslaitos

Tikkurila

Kirjoituksessa selostetaan niitä kokeita, joita Tuhoeläintutkimuslaitoksella Tikkurilassa on v. 1957—1959 järjestetty kirppojen ja kaalikärpästoukkien torjumiseksi siementen insektisidikäsittelyllä.

Koekasveina olivat lanttu, naattinauris ja syysrypsi ja tutkittavina aineina 40 %:n aldriini, 50 %:n dieldriini, 25 %:n heptakloori ja 75 %:n lindaani sekä 50 %:n demetoni ja 1.5 %:n parationi. Kiinnitysaineina käytettiin vettä, siirapin vesiliuosta, etyyliselluloosaa ja parafiiniöljyä, joista viimeksi mainittu osoittautui tarkoituksenmukaisimmaksi.

Paras teho kirppoihin saatiin lindaanilla. Pienin käytetty määrä oli 80 g 75 % lindaania ja 10 % tiramia sisältävää valmistetta siemenkiloa kohti. Ilman kiinnitysainetta tämä määrä tehosi huonosti. Kiinnitysainetta käytettäessä teho oli melko hyvä, mutta nousi vielä huomattavasti, kun valmistemäärää lisättiin 120—160 grammaan. Tätä suurempien ainemäärien käyttö ei enää järjestelmällisesti nostanut tehoa. 50 %:n dieldriini (200—400 g/kg) tehosi melko hyvin, joskaan ei parhaiden, 120:tä grammaa suurempien lindaanivalmistemäärien veroisesti. Vuonna 1959 käytettiin kenttäkokeissa 50 %:n dieldriiniä 600 g siemenkiloa kohti, mutta teho ei ollut niin hyvä kuin 400 g:n määrää käytettäessä. Parationilla saatiin kohtalainen teho käytettäessä 1.5 %:n pölytettä 600 g/kg. Suurempi määrä, 1 000 g/kg, oli kesän 1959 kokeissa teholtaan heikompi. Demetonin teho vaihteli eri kokeissa, mutta yleensä 200 g valmistetta kiloa kohti tehosi melko hyvin. Aldriinilla saatiin jonkin verran tehoa, mutta tulokset eivät näyttäneet kovinkaan lupaavilta. Kokeissa käytettiin ainoastaan yhtä aldriinivalmistetta. Heptakloorin teho jäi heikoksi.

V. 1958 antoi siemenen aldriini- ja heptakloorikäsittely kaalikärpästoukkia vastaan nauriissa 80—90 %:n tehon, mitä on käytännössä pidettävä jo erittäin tyydyttävänä, kuten myös heptakloorikäsittelyn lantussa antamaa 68 %:n tehoa. Terveitä tai vain aivan lievästi vioittuneita juuria oli näissä parhaissa koejäsenissä nauriissa 91 ja 93 % ja lantussa 79 %. Vaikka varsinaisissa kenttäkokeissa ei lindaanin eikä dieldriinin teho ollutkaan hyvä, viittasivat alustavissa kokeissa saadut tulokset siihen, että lisäämällä ainemäärää olisi myös siementen lindaani- ja ehkä myös dieldriinikäsittelyllä mahdollista menestyksellisesti torjua kaalikärpästoukkia sekä nauriista että lantusta.

Vuoden 1959 kokeissa olivat tulokset kaalikärpästoukkien torjunnassa huonommat, kuin mitä edellisen vuoden tuloksien perusteella odotettiin. Syy tähän ei ole selvinnyt, mutta osatekijänä on se, että vuonna 1958 esiintyneistä kärpäsistä oli suurin osa *Hylemyia brassicaeta*, mutta vuonna 1959 oli *Hylemyia floraliksen* osuus lisääntynyt. — Saaduissa tuloksissa on kuitenkin muutamia mielenkiintoisia piirteitä: ensiksikin parhaaseen tulokseen päästiin rypsissä, ja toiseksi kloorattujen hiilivetyjen teho oli yleensä selvästi parempi ja kestävämpi hiekka- kuin turvemaassa.

Siementen lindaanikäsittely, 75 % lindaania ja 10 % tiramia sisältävää valmistetta 120—160 g/kg, riitti kaikissa kokeissa suojaamaan rehurypsin sekä kirppojen että kaalikärpästoukkien tuhoilta. Myös lantussa ja nauriissa oli tämän käsittelyn teho kirppoihin riittävä, mutta kärpästoukkiin epävarma.