WORKING GROUP

"INTEGRATED CONTROL IN OILSEED RAPE"

PROCEEDINGS OF THE MEETING AT
MALMÖ (SWEDEN), 21-22 MARCH 1988

GROUPE DE TRAVAIL

"LUTTE INTEGREE EN CULTURE DE COLZA"

COMPTE-RENDU DE LA REUNION A
MALMÖ (SUEDE), 21-22 MARS 1988

EDITED BY
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Preface

The third reunion of the working group on integrated control in oilseed rape was held in Malmø, Sweden, 21.-22. March 1988.

This issue of WPRS Bulletin contains 16 papers presented and discussed at this meeting. Publishing results from working group meetings is an important stage of the work, not only for group members but for everybody else dealing with pests and diseases in oilseed rape.

At the meeting the following aspects were dealt with: Occurrence and distribution of pests and diseases, monitoring, forecasting, establishment of damage thresholds, parasitoids, plant resistance and crop rotation as well as use of bait plants for pest control.

The main objectives of the group are to encourage research and to coordinate development of integrated pest management systems. What is making this difficult is the fact that the problems in oilseed rape are so diverse. In many aspects basic knowledge is needed before integrated programs can be established.

In order to make progress it is very important that each individual researcher makes the activities in the working group part of his normal work and in this way gives it a higher priority than has been the case so far.

At the meeting professor Dr. Volker H. Paul took over as convenor of the working group. I wish him good luck in his new job.

I want to thank Dr. Hans von Rosen for participating in the meeting as liaison advisor for the IOBC Council and I sincerely want to thank Dr. Ingrid H. Williams and Dr. Peter Gladders for their thorough criticism and correction of the manuscripts.

Bent Bromand
Ex - group convenor

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CONTENTS

DESCRIPTION OF THE GROWTH STAGES IN OIL SEED RAPE

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It is the aim of this paper to compare methods of describing growth stages and to offer them for use in oil seed rape. Many methods have been used and they range from four steps only to very detailed descriptions, particularly at the flowering stage.

Because of the introduction of computers in science it was intended to make these scales suitable for working with them and to make results more comparable between researches when the same stages for observation are used and described accordingly. Too many numbers as e. g. 4.1.2.1 or letters ranging from A to Z should be avoided. Furthermore, the scale for rape growth stages should be comparable with those developed for other crop species, mainly cereals. Because of the different growth habits of various plants the description cannot be identical, but the main features should correspond to similar principles. This would be valuable for technicians working with a range of plant species. They know that stem extension was always defined by numbers 40 to 49 and flowering 60 to 69.

The task of finding a scale for IOBC working group was not to develop a new scale, but to select if possible, the most suitable ones. There is only one key with follows the principles set out on other crops and which has space to add other special criteria if wanted. The main phaenological features should be incorporated as set out for cereals (16). Based on these criteria, Schütte (13) proposed a scale for rape which was incorporated later in official tests (14). In Table 1 a comparison can be made between the main growth stages in cereals and oil seed rape.

Table 1: Comparison of growth stage descriptions for cereals and oil seed rape

1-digit code	For cereals	For oil seed rape
0	Germination	Germination
1	Seedling growth	Emergence
2	Tillering	Shoot development
3	Stem elongation	Stem elongation
4	Booting	
5	Inflorescence emergence	Bud development
6	Anthesis	Flowering
7	Milk development	Pod development
8	Dough development	Maturity
9	Ripening	Dying off

As can be seen fromn the main descriptions only one feature of description does not apply for oil seed rape. Descriptions of some scales are set out in Table 2. It has to be mentioned that a detailed comparison of some scales is published in EPPO-Bul. No. 17.

From the compilation in Table 2 can be seen, that mainly describing methods were used. The first group (1-6) included development stages with sub-divisions. This was started in Canada and was used by others (3,8, 10,4) and was recommended by the FAO. The development went on in this line and seems to have reached a final stage with the data supplied for cereals (16) and for rape (14). The scale for cereals has been accepted by EPPO and that by Schütte et. al. (14) by the Biologische Bundesanstalt and the Bundessortenamt of Germany and was also published by EPPO (1) in comparison with the British-, CETIOM-, Canadian- and Netherland-scales. The last mentioned one was developed for cabbage seed plants.

The second group (7-9) gives numbers or letters to the various growth stages wihtout giving a point in specific development stages. A certain exception was introduced in 1941 (5), when sub-numbers were applied at heading, flowering and ripening stages. The British scale corresponds most with the german one, but the head-numbers are not the same.

An argument against a scale with sub-divisions may be countered with the introduction of development groups, giving immediately the rough stage (1-9) the plants are at observation time. For detailed research, which needs very often more accurate observations, there is the possibillity to go into details. Those interested in seedling diseases or pests can use the stages 01 to 09 and 11 to 19. For the entomologist the stages 50 to 59 and 61 to 69 are mainly of interest.

The technicians working in the field have no difficulty as experiences have shown in recent years. Illustrations are added to the scales to show the main characterists.

At the end of this paper a summarising time table of the development of methods to describe oil seed rape stages may be added.

A.: Without taking into consideration special plant stages

Fritzsche (1957) → Hoßfeld (1963)
Röder, Daebeler and Ledge (1975)
Sylvén and Svenson (1976)
Fabry, Cerný and Folk (1978)
Bennison (1982)

B.: With considering special plant stages

Berkenkamp (1973) → Harper and Berkenkamp (1975)
Harper (1973) → Chiarappa (1977) → FAO-Manual
Knight and Furber (1980)
Lechapt (1977)
Schütte (1979) → Schütte, Steinberger and Meier (1982)
Nichols (1982) | (personal communication)
French (1982) |

Sylvester-Breadly, Makepiece and Broad (1984) ⟶ Sylvester-Breadly (1985)

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Table 2: Description of growth stages in oil seed rape by various authors

Growth stages	Scales with sub-groups						Scales without sub-groups		
	1*	2	3	4	5	6	7	7	9
Germination	0	0							
Dry seed	01								
Start of inbibition (seeds contain 16-20 % water)	03								
Emergence of radicle	05		0						
Shoot length about 1/2 length of seed	07								
Shoot length about twice the length of seed	09							A	
Emergence	10	1	1						
Cotyledons emerging above ground	11				1.1	1.1			
Cotyledons unfolded	13	1,0	2	A				B	
1st true leaf stage	15	1,1	2.1	B 1	1.2.3	1.2.3		C	
2nd leaf stage	17	1,2	2.2	B 2	etc.				
3rd leaf stage	19	1,3	+0.	B 3	number of rough leaves				
Shoot development	20								
4th leaf stage	21	1,4		B 4					
5th leaf stage	22	1,5		B 5				D	1
6th leaf stage	23								
7th leaf stage	24								
8th leaf stage	25								
9th - 11th leaf stage	26								
12 and more leaves completely unfolded	27								
		1,20 20th true leaf							
Stem elongation	30	2		C 1					
Distance between cotyledonary node and tip more 5 cm	31	2,0							
than 10 cm	33	2,1		C 2				E	2
15 cm	35	2,2		beginning					
20 cm	37	2,3		of					
25 cm	39	2,20 20 internodes		growth					
Bud development	50	3	3			2			
		3,0 only leaf buds present							
Plant beginns to develop buds (Buds still enclosed by leaves)	51	3,1		D 1	2.1	2.1	1	F	3
Diameter of inflorescense 1 cm (Buds no longer enclosed by) leaves	53	3,3	3.1			2.2			
		3,4 flower buds level with leaves		D 2	2.2.3 etc.			G	
Diameter of largest bud 2 mm		3,5							
Elongation of inflorescence (Lower bus yellowing)	57	3,6	3.2	E	3.1		11		
		3,7 first flower buds yellow							

* 1. Schütte, Steinberger und Meier (1982), 2. Anonym (EPPO, 1987), 3. Harper und Berkenkamp (1975) 4. Lechapt (1980), 5. Nichols (1982), 6. French (1982), 7. Bennison (1982), 8. Röder, Daebeler und Ledge (1975), 9. Fritzsche (1957).

Continuation Table 2.

1		2	3	4	5	6	7	8	9
Flowering	60	4	4						
1st flowers open	61	4.0	4.1	F 1	4.1	3.1	III		4
Few flowers on main stem	62	4,1		F 2	4.2	4.1	IV	H	
Many flowers present, older petals falling, first small pods visible	63	4,3 30% of all buds open 4.5 50% of all buds open and so on up to	4.2	G 1	4.3 4.4	4.2 4.3 4.4	V		
Full flowering, number of unopen and number of free small pods roughly the same	64	4,8 80% of all buds on raceme flowering or flowered	4.3	G 2	4.5 4.6 4.7	4.5 4.6 4.7	VII	1	5 6 7
End of full flowering, less than 5% of unopened buds	65			G 3	4.8	4.8	VIII		8
Flowering complete	69	4,9	4.4		4.9	4.9	IX		9
Pod development	70	5	5			5	X		
		5,3 30% potential pods (30% of pods have doubled their length and their petals have withered or fallen) 5,7 70% potential pods 5,9 all potential pods		G 4					
1st pod on main stem with seed of normal size	71	6 Seed development 6,1 Seeds expending					V		
Pods of the lower half of main stem with seed of normal size	75		5.1				VI		
Nearly all pods on main stem with seed of normal size	79				5.1				
	80								
Maturity									
Larger pods on main stem and side branches with seed of normal size	81		5.2						
All pods and seeds fully developed except shrivelled pods at the top of stem	83	6,2 6,3 most seeds green 6,4 most seeds green-brown mottled 6,5 most seeds brown							
First seeds with half of their surface black	85	6,6	5.3						
Most seeds with half of their surface black (Mature for harvest)	87		5.4						
		6,7 most seeds black but soft 6,8 most seeds black and hard							
Seeds hard and dark, pods partly dried	89	6,9	5.5	G 5					
Dying off	90	7 Leaf senescence 8 Stem senescence 8,1 most stem green 8,5 half stem green 8,9 little stem green							
Straw dry	92	9 Pod senescence 9,1 most pods green 9,5 half pods green 9,9 few pods green							

Diversities in Oilseed Rape Growing within the Western Palaearctic Regional Section.

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Summary

In the Western Palaearctic Regional Section of IOBC great differences exist in the choice of oilseed crops, in agronomic practices and in the severity of damage caused by different pests and diseases.

Information gathered from Finland, Norway, Sweden, Denmark, United Kingdom, Germany, the Netherlands, France and Switzerland show that oilseed crops are important thoughout the region and are attacked by many pests and diseases. In order to control these in an integrated control program a good deal of basic knowledge is needed and to obtain this, cooperation and coordination of research project is necessary.

Information is given about pests and diseases in each individual country supplied with information about varieties grown and general agronomic practice as well as time of the year when sowing, flowering and harvest takes place.

This information shows where common problems exist and helps in setting up research programmes when a combined effort is necessary to solve key-problems.

1.1. Introduction

Oilseed rape has become a very important crop in Europe during the last 10-15 years. However it is a crop with many pests and disease problems.

During the past years many important projects have been carried out by members of the "IOBC/WPRS Working Group on Integrated Control in Oilseed Rape". From these it is clear that growing techniques, plant species and varieties as well as pests and diseases very much from country to country making it very difficult to compare results from one country to another. A comparison of growth stages have been carried out (Krüger 1990).

In this paper the intention is to look at the differences in oilseed rape growing and problems with pests and diseses within the participating countries in order to improve the possibilities for coordinating the research in integrated control in oilseed crops.

1.2. Materials and methods

A questionaire was sent out to a number of the Working Groups in each of the following contries : Finland (SF), Norway (N), Sweden (S), Denmark (DK), United Kingdom (GB), Germany (D), the Netherlands (NL), France (F) and Switzerland (CH).

Each member was asked to gather information from colleagues and others about the following matters :

1) The area of oilseed rape crops from 1982 - 1987, swede rape (Brassica napus oleifera) as well as turnip rape (Brassica campestris oleifera) and whether it is autumn sown or spring sown.
2) Yield in hkg per ha for 3 years, 1985 - 1987.
3) List of varieties grown.
4) General growing practice. Time of the year for sowing, beginning of flowering, swathing and threshing. Furthermore information about the amount of seed used, sowing depth, distance between rows, prefered number of plants per m^2 and the amount of fertilizer being used per ha.
5) Common pests and diseases. The importance of a specific pest or disease was marked with 0 for nothing, and x, xx or xxx for different degrees of severity. ( ) means that the pest or disease only occasionally causes problems.

The information gathered through the questionaires are summarised into tables and figures and forms the background for this presentation. Differences in climate in the various countries have not been taken into account.

1.3. Results

1.3.1. Area of oilseed crops

The total area of oilseed crops grown is shown in Table 1.

Table 1. Total area of oilseed crops grown, 1000 ha.

Country	1982	1983	1984	1985	1986	1987
SF	64	61	62	58	75	81
N	8	9	9	8	9	9
S	169	170	167	172	166	163
DK	153	163	191	217	226	251
GB	174	222	269	296	299	391
D	180	222	245	256	297	421
NL	11	13	13	10	6	10
F	476	463	430	462	388	735
CH	13	14	14	15	16	17
Total	1248	1337	1440	1494	1482	2078

In Finland, Norway, Sweden and the Netherlands little change in the areas grown are noted whereas in Denmark, U.K., Germany and France there have been great increases from 1982-1987 and especially during the last year. The total areas of oilseed crops grown in 1987 is shown in Figure 1.

From Table 2 it can be seen that Finland and Norway grow 95 and 89 per cent spring turnip rape and only small areas of spring swede rape; no autumm sown crops are grown.

In Sweden 1/3 is turnip rape and 2/3 is swede rape. However only 29 per cent is sown in autumm and that is almost all swede rape.

In the rest of Europe only swede rape is grown. In Denmark about 90 per cent is spring swede rape; further south only 1-5 per cent is sown in spring depending on whether it is possible to sow at the right time in the autumn and sometimes when it is necessary to plough under a poor winter oilseed crop.

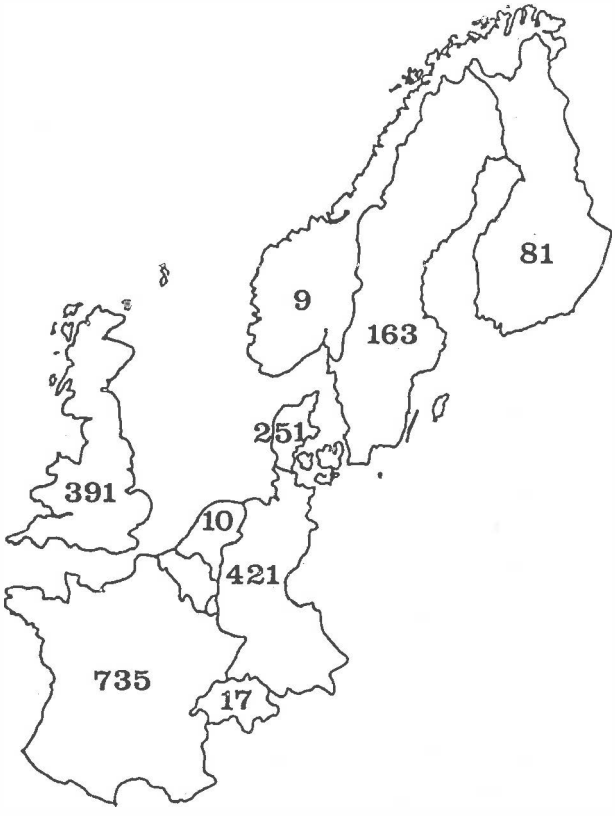


Figure 1. Total area of oilseed crops grown in 1987 in 1000 ha.

Table 2. Percentage area grown.

	Swede Rape		Turnip Rape	
Country	Winter	Spring	Winter	Spring
SF		5		95
N		11		89
S	27	35	2	36
DK	10	90		
GB	95	5		
D	97	3		
NL	100			
F	99	1		
CH	100			

1.3.2. Yield

There are no big differences in yield for a specific type of plant grown, but there is a tendency against a higher yield the further one goes south. For Denmark the difference in yield of winter- or spring swede rape is only 5 hkg per ha, which without doubt is part of the reason why farmers in Denmark prefer to grow spring swede rape. Another reason is that generally the harvest is so late that very often it is only possible to grow winter swede rape after winter barley and seed grasses because the winter swede rape must be sown before 20 August.

The average yield from 1985-87 can be seen in Table 3.

Table 3. Average yield in hkg/ha from 1985-1987

	Swede Rape		Turnip rape	
Country	Winter	Spring	Winter	Spring
SF		16.6		14.3
N		-		-
S	28.9	18.4	18.5	15.9
DK	29.0	24.2		
GB	32.0	20.0		
D	30.4			
NL	33.7			
F	30.9			
CH	26.8			

1.3.4. Varieties grown

Table 4. Varieties of winter swede rape grown

Variety	1)	2)	Country SF	N	S	DK	GB	D	NL	F	CH
Liporto	L	L				X		X			
Ceres	L	L				X		X			
Darmor	L	L				X			X	X	
Lindora	L	L						X			
Tor	L	L			X	X					
Ariana	L	L					X				
Arabella	L	L				X		X			
Elena	L	L						X			
Licantara	L	L						X			
Lirabon	L	L						X			
Liradonna	L	L						X			
Lirakus	L	L						X			
Liropa	L	L						X			
Rubin	L	L						X			
Santana	L	L						X			
Diadem	L	L				X					
Libravo	L	L				X					
Veronika	L	L				X					
Copra	L	L				X					
Liquara	L	L				X					
Monza	L	L				X					
Chrysander	L	H				X					
Belinda	L	H						X	X	X	
Korina	L	H						X		X	X
Limara	L	H						X			
Jupiter	L	H			X						
Doral	L	H						X			
Elvira	L	H						X			
Jet Neuf	L	H			X			X	X	X	X
Emil	L	H			X						
Juno	L	H			X						
Bienvenu	L	H					X			X	X
Mikado	L	H					X				
Rafal	L	H					X		X		
Pasha	L	H					X				
Garant	L	H						X			
Gundula	L	H						X			
Kurander	L	H						X			
Lirakotta	L	H						X			
Mirander	L	H						X			
Ridana	L	H						X			
Tamara	L	H						X			
Primander	L	H							X		
Lingaf	L	H									X
Germander	L	H				X					

1) Erucic acid, 2) Glucosinolates. L = Less than 30 μ mol/g seed. H = More than 30 μ mol/g seed. (HPLC Method).

Table 5. Varieties of spring swede rape grown

variety	1)	2)	Country SF	N	S	DK	GB	D	NL	F	CH
Topas	L	L	X		X		X				
Conny	L	L				X					
Consul	L	L				X					
Tornado	L	L				X					
Callypso	L	L				X	X				
Global	L	L				X					
Optima	L	L				X	X				
Rally	L	L				X					
Omega	L	L				X					
Hanna	L	L			X	X					
Activ	L	L				X					
Loras	L	L				X					
Line	L	L				X					
Puma	L	L			X	X					
Elin	L	L			X						
Cesar	L	L								X	
Drakkar	L	L				X				X	
Pactol	L	L								X	
Primo	L	L				X					
Golda	L	L				X					
Aurora	L	L				X					
Comet	L	L				X					
Opal	L	L				X					
Opus	L	L				X					
Cresor	L	H								X	
Willi	L	H				X	X				
Olivia	L	H				X					
Brutor	L	H								X	
Niklas				X							
Karat	L	H	X								

1) Erucic acid, 2) Glucosinolates. L = Less than 30 µ mol/g seed. H = More than 30 µ mol/g seed. (HPLC Method).

Table 6. Varieties of turnip rape grown

Variety	Country		
Winter turnip rape			
Per			S
Spring turnip rape			
Emma	SF	N	S
Tove		N	
Ante	SF		
Kova	SF		
Sigga	SF		
Valtti	SF		
Tyko			S
Sonja			S

1.3.5. Growing practice

Table 7. Sowdate in different countries

	Swede Rape		Turnip Rape	
Country	Winter	Spring	Winter	Spring
SF	-	10.5-15.5	-	15.5-20.5
N	-	1.5-10.5	-	1.5-10.5
S	1.8-20.8	15.3-15.4	1.8-20.8	15.3-15.4
DK	1.8-20.8	1.4-15.4	-	-
GB	20.8-31.8	1.3-31.3	-	-
D	10.8- 5.9	1.4-15.4	-	-
NL	20.8- 5.9	-	-	-
F	25.8-10.9	15.3	-	-
CH	25.8-15.9	-	-	-

Table 7 shows the sowing time for the different plant types in the various countries. In Sweden and Denmark sowing of winter swede repe takes place in August and sowing must be completed by 20 August to ensure a safe overwintering and a good yield. The further one goes south in Europe the later sowing takes place. In France and Switzerland sowing is normal until mid-September.

Spring sown crops are sown in mid-March in France and U.K., in April in Denmark and Sweden and in May in Norway and Finland. That means the sowing time varies 2 months from south to north.

Table 8. Flowering time

	Swede Rape		Turnip Rape	
Country	Winter	Spring	Winter	Spring
SF		Jul.		Jun.
N		Jun./Jul.		
S	20.May	20.Jun.		
DK	15.May	15.Jun.		
GB	25.Apr.	25.May		
D	25.Apr.	1.Jun.		
NL	5.May			
F	15.Apr.	25.May		
CH	1.May			

Flowering of winter swede rape starts in mid-April in France and U.K. and a month later in Denmark and Sweden. See Table 9. Spring swede rape starts flowering about on month later, that is about 25 May in France and U.K. but not until July in Finland.

The period of growth may be of importance for the distribution and the severity of attack of pests and diseases. The time from sowing to the beginning of flowering of winter swede rape is about 45 days longer in Scandinavia than in France due to climatic differences. However, the time from flowering to harvest varies very little form country to country and is about 90 days.

For spring swede rape it takes 70 days from sowing to the beginning of flowering in the countries referred to and an average of 80 days more to harvest. There is a tendency to take

a few days less in the northern and the southern part of the region than in the central part.

For spring turnip rape it takes 45 days from sowing to flowering and a further 70 days to harvest. Thus the growth period for spring turnip rape is one month shorter than it is for spring swede rape and explains why this crop is grown in Finland and Norway.

Table 9. Row distance, plant number and kg N per ha in the various countries

	Row	Plants per m2		Kg N per ha.	
		Swede rape		Turnip rape	
Country	distance cm	Winter	Spring	Winter	Spring
SF	12,5		250-300		80-130
N	12		70-100		120-140
S	12	50-100	200-300	200	120-130
DK	12	70-100	70-100	200	160
GB	10	100-110	100-120	260	150
D	12	40-80		180-220	
NL	12,5-25,0	40-100		230	
F	34	50-100		150-200	120-160
CH	12	80-100		100	

The row distance is in most countries about 12 cm, see Table 9, but in the Netherlands 12,5 or 25 cm is used and in France 34 cm.

A plant density of 70-100 plants per m2 is aimed at in winter swede rape, but as is well known plant density can vary very much, without affecting yield. In spring swede rape there is a tendency towards a grater number of plants per m2 in some countries, but in Sweden and Finland a plant number of 200-300 per m2 is aimed at. The effect of such high plant numbers is that most plants only carry flowers and seed on the main shoot. That gives a shorter flowering time and the seeds ripen over a shorter period.

Fertilization

In winter swede rape about 200 kg N per ha is recommended, but in U.K. 260 kg N per ha is used. In spring swede rape it is about 150 kg N per ha in most countries, but a little less is used in Finland, Norway and Sweden.(see Table 9). Phosphorus is used at the rate of 20-40 kg per ha and potassium at 30-120 kg per ha. Phosphorus and potassium are normally supplied after soil analyses; hence the big variations in the rates used.

It is notable that fertilization with Mg and B only takes place in the Nordic countries and that France is the only country using sulphur.

Plant establishment

Seed is normally to used at the rate of 6-8 kg per ha but it varies from 2-12 kg per ha depending on the seed bed, germination and so on. The normal sowing depth is about 2 cm. In U.K. however only 1 cm is recommended and in France in spring swede rape it is 5 cm.

1.3.6. Common pests and diseases

I Tables 10, 11, 12 and 13 the results from the questionaires concerning the severity of different pests and diseases are collated. I the Tables the following marks are used:

o = not regarded as a pest or disease.
x = common but not very harmful
xx = serious damage
xxx = Very serious damage

Pests in winter swede rape

The severity of pests in winter swede rape can be seen in Table 10 and figure 2. The blossom beetle, the seed weevil and the brassica pod midge are serious pests in most countries where winter swede rape is grown. The cabbage stem flea beetle is a serious pest too, but even though common in the surrounding countries it is very rare in Denmark. The cabbage stem weevil is

a common pest but only in France is it regarded as serious. The rape winter stem weevil is a serious pest in France, Switzerland and U.K. but is not found in Sweden, Denmark, Germany or the Netherlands. Very serious in France and Switzerland only is ceutorrhynchus napi.

The cabbage root fly is very common in oilseed rape but it is only regarded as a serious pest in France. The same is the case for the cabbage aphid. Several other pest species are known, see Table 10, which sometimes causes damage to the crop which not normally is regarded as severe.

Pest in spring swede rape

The severity of pests in spring swede rape can be seen in Table 11 and figure 3.

The blossom beetle is without doubt the most serious pest in spring swede rape whereever it is grown. Attacks by flea beetles are quite common too in most countries. The cabbage aphid is very serious in France and regarded as serious are field thrips in Denmark, the seed weevil in France, the brassica pod midge and the cabbage aphid in Sweden.

From Table 11, it is apparent that a lot of other pests exist in spring swede rape but do not normally cause serious damage. The cabbage root fly is a very common pest, which normally does not cause damage in swede rape, but in Denmark in dry periods in May or June the leaves of rape plants often wilt due to lack of water because cabbage root fly larvae have damaged the roots.

Table 10. Pests of importance on winter swede rape.

Pest species		SF	N	S	DK	UK	D	NL	F	CH
Thrips angusticeps	Field Thrips			0	(X)	0	0	0	0	0
Phyllotreta spp.	Flea Beetles			0	X	0	X	0	X	X
Delia radicum	Cabbage Root Fly			0	X	(X)	X	0	XX	X
Meligethes aeneus	Blossom Beetle			XX	XX	(X)	XXX	XX	XXX	XXX
Ceutorrhynchus assimilis	Seed Weevil			X	XXX	XXX	XX	XXX	XXX	X
C. pallidactylus	Cabbage Stem Weevil			(X)	X	X	X	0	XX	0
C. picitarsis	Rape Winter Stem Weevil			-	0	XX	0	0	XX	XX
C. napi	?			-	0	0	X	0	XXX	XXX
C. sulcicollis	?			(X)	0	0	0	0	0	0
C. pleurostigma	Turnip Gall Weevil			-	0	0	0	0	X	X
Psylliodes chrysocephala	Cabbage Stem Flea Beetle			XX	0	XXX	X	XX	XX	XX
Dasineura brassicae	Brassica Pod Midge			X	XXX	XXX	XX	XX	XXX	X
Contarinia nasturtii	Swede Midge			0	X	0	0	0	0	0
Brevicoryne brassicae	Cabbage Aphids			0	(X)	(X)	0	(X)	XX	X
Pieris brassicae	Large White Butterfly			0	X	0	0	(X)	0	0
Althalia rosae	Turnip Sawfly			(X)	(X)	0	(X)	0	(X)	X
Phytomyza rufipes	Cabbage Leaf Minor			(X)	X	X	0	X	(X)	0
Plutella xylostella	Diamond-back Moth			0	0	0	0	0	X	0
Deroceras reticulatum	Field Slug			-	(X)	(X)	-	-	-	-
Heterodera cruciferae	Brassica Cyst Nematode			-	-	(X)	-	-	-	-
Longidorus spp.	Needle Nematodes			-	-	X	-	-	-	-

Importance : 0 X XX XXX ()= occasionally

Meligethes aeneus

Ceutorrhynchus picitarsis

Ceutorrhynchus napi.

Psylliodes chrysocephala

Figure 2. Occurrence of some insect pests in winter swede rape.

Table 11. Pests of importance on spring swede rape.

Pest species		SF	N	S	DK	UK	D	NL	F	CH
Thrips angusticeps	Field Thrips	(X)	X	X	XX	0			0	
Phyllotreta spp.	Flea Beetles	XX	X	XX	XX	X			XX	
Delia radicum	Cabbage Root Fly	(X)	X	0	X	X			X	
Meligethes aeneus	Blossom Beetle	XXX	XXX	XXX	XXX	XXX			XXX	
Ceutorrhynchus assimilis	Seed Weevil	X	X	X	X	X			XX	
C. pallidactylus	Cabbage Stem Weevil	0	0	(X)	X	X			0	
C. picitarsis	Rape Winter Stem Weevil	0	0	-	0	0			0	
C. napi	?	0	0	-	0	0			0	
C. sulcicollis	?	0	0	0	0	0			0	
C. pleurostigma	Turnip Gall Weevil	0	0	-	0	0			0	
Psylliodes Chrysocephala	Cabbage Stem Flea Beetle	0	0	0	0	0			0	
Dasineura brassicae	Brassica Pod Midge	X	0	XX	X	X			X	
Contarinia nasturtii	Swede Midge	0	0	0	X	0			0	
Brevicoryne brassicae	Cabbage Aphids	0	(X)	XX	X	(X)			XXX	
Pieris brassicae	Large White Butterfly	0	X	0	X	0			0	
Althalia rosae	Turnip Sawfly	(X)	(X)	(X)	(X)	0			X	
Phytomyza rufipes	Cabbage Leaf Minor	0	X	0	X	0			0	
Plutella xylostella	Diamond-back Moth	(X)	X	(X)	(X)	0			X	
Deroceras reticulatum	Field Slug	-	-	-	0	0			-	
Heterodera cruciferae	Brassica Cyst Nematode	-	-	-	0	(X)			-	
Longidorus spp.	Needle Nematodes	-	-	-	0	(X)			-	

Importance : 0 X XX XXX ()= occasionally

Meligethes aeneus

Phyllotreta spp.

Thrips angusticeps

Brevicoryne brassicae

Figure 3. Occurrence of some insect pests in Spring swede rape.

Diseases in winter swede rape

What are regarded as serious diseases differs considerably from country to country (Table 12 and figure 4).

Black leg is regarded as serious or very serious in all countries except Sweden. Downy mildew is serious in U.K. and France, light leaf spot is very serious in U.K. and France and occasionally in Germany too. Stem rot, which is regarded as the most serious disease in some countries, is of little importance in U.K. Notable is that Verticillium wilt is a problem in Sweden and Germany but not in Denmark, which is situated between the two other countries. Grey Mould is regarded as serious in Denmark only and white spot is of little importance in all countries except France, where it is a very serious disease. Another peculiar thing is that dark leaf spot is serious or very serious in Denmark, U.K., France and Switzerland but of no or little importance in Sweden, Germany or the Netherlands.

Diseases in spring swede rape

The severity of diseases in spring swede rape is apparent from Table 13 and figure 5.

More or less the same diseases attack spring swede rape as winter swede rape, but relative seventy can vary. Clubroot is of little importance in winter crops but is regarded as serious in Finland and Sweden in spring sown crops. Black leg is unimportant in spring swede rape and light leaf sport is only serious in U.K.. On the contrary stem rot is very important in spring swede rape in the Nordic countries but not in U.K. or France. In spring swede rape grey mould is serious in Norway and Denmark. The severity of white spot and dark leaf spot is the same as in winter swede rape.

Table 12. Diseases of importance in winter swede rape.

Diseases		SF	N	S	DK	GB	D	NL	F	CH
Plasmodiophora brassicae	Clubroot			X	X	X	(X)	0	X	X
Phoma lingam	Black Leg			X	XX	XX	XXX	XX	XX	XXX
Peronospora parasitica	Downy Mildew			0	X	XX	(X)	X	XX	0
Erysiphe Communis	Mildew			0	0	X	0	0	(X)	0
Cylindrosporium concentricum	Light Leaf Spot			X	X	XXX	(XX)	X	XXX	X
Sclerotinia sclerotiorum	Stem Rot			XX	XXX	X	XX	XX	XXX	X
Verticillium dahliae	Verticillium Wilt			XX	X	0	XX	0	(X)	0
Botrytis cinerea	Grey Mould			0	XX	X	(X)	X	0	X
Mycosphaerella brassicicola	Ring Spot			0	0	X	(X)	0	(X)	0
Pseudocercosporella capsellae	White spot			0	0	X	(X)	0	XXX	0
Alternaria brassicae	Dark Leaf Spot			0	XX	XXX	X	X	XX	XX
Alternaria brassicicola	Dark Leaf Spot			0	XX	XX	X	X	XX	XX
Phytophtora megasperma	Root Rot			-	0	X	-	-	-	-
Virus diseases				-	X	X	0	0	0	-
Bacterial diseases				-	0	-	-	-	X	-

Importance: 0 X XX XXX ()= occationally

Cylindrosporium concentricum

Sclerotinia sclerotiorum

Werticillium dahliae

Alternaria brassicae and
A. brassicicola

Figure 4. Occurrence of 4 diseases in winter swede rape.

Table 13. Diseases of importance in spring swede rape.

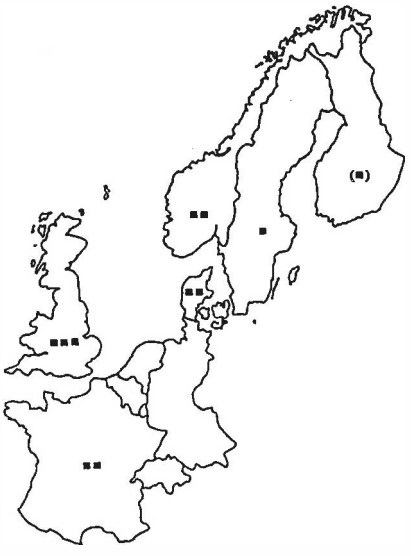
Diseases		SF	N	S	DK	GB	D	NL	F	CH
Plasmodiophora brassicae	Clubroot	XX	X	XX	X	(X)			0	
Phoma lingam	Black Leg	0	0	X	0	X			0	
Peronospora parasitica	Downy Mildew	X	X	0	X	XX			XX	
Erysiphe Communis	Mildew	(X)	0	0	0	X			0	
Cylindrosporium concentricum	Light Leaf Spot	0	0	0	0	XX			X	
Sclerotinia sclerotiorum	Stem Rot	XXX	XXX	XXX	XXX	X			X	
Verticillium dahliae	Verticillium Wilt	0	0	X	X	0			-	
Botrytis cinerea	Grey Mould	X	XX	X	XX	X			0	
Mycosphaerella brassicicola	Ring Spot	0	0	0	0	(X)			0	
Pseudocercosporella capsellae	White Spot	0	0	0	0	X			XX	
Alternaria brassicae	Dark Leaf Spot	(X)	XX	X	XX	XXX			XX	
Alternaria brassicicola	Dark Leaf Spot	(X)	XX	X	XX	XX			-	
Phytophtora megasperma	Root Rot	-	-	-	0	(X)			-	
Virus diseases		0	0	-	X	(X)			0	
Bacterial diseases		-	-	-	0	-			0	

Importance: 0 X XX XXX ()=occationally

Peronospora parasitica

Sclerotinia sclerotiorum

Botrytis cinerea



Alternaria brassicae and
A. brassicicola

Figure 5. Occurrence of 4 diseases in spring swede rape.

1.4. Discussion

It is obvious that oilseed rape is a controversial crop in western Europe with regard to winter or spring forms, growing practice and different pests and diseases. In this presentation main emphasis has been put on swede rape, because turnip rape only is grown in Finland, Norway and Sweden and problems with pests and diseases are mostly the same.

The area has increased a lot in recent years especially the area of winter swede rape. It is likely that Denmark in the future will change the pattern of swede rape growing towards a bigger proportion of winter swede rape and in United Kingdom there is a growing interest in spring swede rape.

Winter swede rape gives a higher yield than spring swede rape but more control measures are needed because winter swede rape is more attacked by pests and diseases. A logical consequence of this could be that winter swede rape is given a higher priority in an integrated programe.

A lot of different varieties are grown in the various countries and new varieties are introduced each year. The aim of a program in the Working Group is to evaluate the attacks by pests and diseases in different varieties. So far the results are scarce but everyone who has the opportunity should go into this programe. There is a strong trend to grow double low varieties and for instance in Denmark only double low varieties of spring swede rape are being grown.

One can ask why the problems with pests and diseases in swede rape are so diverse. One major cause is the different climate which is not taken into account in this paper. An investigation on variations in the climate in the different countries in relation to pest and disease problems might reveal several interesting connections.

The climate is decisive for the development of the plants. So it is for the development of pests and diseases too, but it need not to be the same climatic factors acting. For instance could a certain temperature have different effects on the development of the plants and of a specific pest or disease.

The period of growth is somewhat shorter in Scandinavia than in France. That means the plants are at a vulnerable stage for a shorter time and this could give fewer attacks. However the evolution has synchronized the pathogens to plant development and therefore it is likely to be of minor importance. An effect of the temperature is that certain pests have 1 or 2 generations more in the south of France than in Norway and Finland.

The distance between rows and the number of plants per m^2 give a more or less open crop, which can change the microclimate and therefore have an effect on infection by fungal diseases.

Very little is known about the effect of fertilizer on the attack by pests and diseases. From other crops it is known that use of a high amount of nitrogen can increase attack and this could well be the case for swede rape too.

Pests and diseases in winter swede rape

In making an integrated pest management system it is important to start to look at the key factors. That means the pests and diseases which cause the biggest problems. In many cases it is necessary to carry out special research projects on a specific pest or disease first. In this respect countries with the same problems have to combine their efforts.

From Tables 10 and 12 it can be seen which pest or disease is serious in the various areas. For instance is the rape winter stem weevil a pest in United Kingdom, France and Switzerland only and the cabbage stem flee beetle a pest in all countries but Denmark. For diseases downy mildew is restricted to United Kingdom and France. It is the same for light leaf spot but occasionally it causes problems in Germany too. Stem rot is a very serious disease in most countries but causes only little damage in United Kingdom and Switzerland. Verticillium wilt is restricted to Sweden and Germany and white spot to France.

Differences in climate are important for diseases, but other factors are important too, which is clear from the fact that dark leaf spot has 2 or 3 x's in Denmark, United Kingdom, France and Switzerland, but only one in Germany and the Netherlands.

Pests and diseases in Spring swede Rape

Tables 11 and 13 gives an overview over the situation in spring swede rape. Of pests the blossom beetle is a problem everywhere but the field thrips is a pest in the Nordic countries only. Flea beetles seem to cause problems in Finland, Sweden, Denmark and France but not in Norway and United Kingdom. As the cabbage aphid overwinters as an adult on living plants such as winter swede rape one would expect this crop to suffer most from attack but appearently the problems are bigger in spring swede rape especially in France and Sweden.

Pests laying their eggs in the autumn are of course not able to attack spring swede rape and as a whole there are fewer pest problems in this crop than in winter swede rape.

Some diseases appear in both winter swede rape and spring swede rape but other are more or less confined to one of these two crops. In spring swede rape clubroot causes problems in Finland and Sweden and light leaf spot is harmful in United Kingdom. Stem rot does not seem to be a great problem in France and Verticillium wilt is not so severe in spring swede rape in Sweden. Grey mould is a disease, which is more pronounced in the northern part of the region than in the southern. Dark leaf spot is a serious disease in most contries where spring swede rape is grown.

1.5. Acknowledgements

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1.6. References

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INVESTIGATIONS ON THE USE OF TURNIP RAPE AS TRAP PLANT TO CONTROL OILSEED RAPE PESTS.

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Summary
Rape fields (Brassica napus) were sown in mixture with 2 % turnip rape (Brassica rapa var. silvestris). A heavier infestation in turnip rape than in rape resulted for the following pests: cabbage stem flea beetle, Psylliodes chrysocephala; rape stem weevil, Ceutorhynchus napi; cabbage stem weevil, Ceutorhynchus quadridens and the rape pollen beetle, Meligethes aeneus. The cabbage seed weevil, Ceutorhynchus assimilis, prefers rape plants for egg laying. The Brassica pod midge, Dasineura brassicae, did not show any preference for either one of the two rape types.
With sticky traps we found evidence that the light-green colour of turnip rape is one reason for its attractiveness.
Because 2 % turnip rape in a rape field is not sufficient to control rape pests, we changed the experimental layout. A perimeter strip of 6 - 12 m within the field was sown with 5 % turnip rape to attract and concentrate rape pests. Depending on the number of the important pests (C. napi and M. aeneus) the perimeter strip could be treated with an insecticide.
With this method of integrated control the amount of insecticide in rape could be reduced by up to 80 %. In the future when more and more farmers practise this method the population of beneficial arthropods could perhaps be enhanced. It could therefore be eventually possible to completely eliminate to the application of insecticides in rape fields.

1. Introduction

Günthart (1949) and Dosse (1951) reported that turnip rape (Brassica rapa var. silvestris or Brassica campestris var. oleifera) attracts some rape pests more than rape (Brassica napus L.). We found evidence for this in our trials to control the rape winter stem weevil, Ceutorhynchus picitarsis Gyll. in turnip rape cultures for seed production (Büchi, 1986).

The idea to use turnip rape as a trap plant for rape pests comes from the fact, that turnip rape grows faster than rape. It also blooms earlier than rape and in this way it is very attractive for the pollen beetle. More pollen beetles would fly to turnip rape and would spare rape.

2. Materials and methods

During 1985 and 1986 we investigated six species of rape pests for their behaviour in the presence of turnip rape. The six species are:

- Cabbage stem flea beetle (Psylliodes chrysocephala)
- Rape stem weevil (Ceutorhynchus napi)
- Cabbage stem weevil (Ceutorhynchus quadridens)
- Rape pollen beetle (Meligethes aeneus)

- Cabbage seed weevil (Ceutorhynchus assimilis)
- Brassica pod midge (Dasineura brassicae)

In small plot trials we checked the feeding behaviour of the adult cabbage stem flea beetle. We had plots (12.5 m2) with 2 %, 4 % and 8 % turnip rape with 4 replicates.
On the other hand we had fields which were sown homogenously with 2 % turnip rape in rape and other fields which were sown one half with a pure culture of rape and the other half with the mixture. On sunny days, the number of beetles per plant was counted in the field (60 plants per rape type). The number of larvae was also counted by taking plant samples (60 plants per rape type) at different times. To investigate if the colour of the plants is responsible for its attractiveness we used sticky traps (Insect trapping adhesive, Tanglefoot Company, 314 Straight Avenue, S.W. Grand Rapids, Michigan 49504, USA) with different colours: yellow as control, light green like turnip rape and dark green like rape.

3. Results

3.1 Cabbage stem flea beetle (Flea beetle)

In plots with different proportions of turnip rape we counted the number of holes in the leaves made by the flea beetles (Table 1). We found significant differences (Z-test, p = 0.05) in damage between turnip rape and rape. The same holds true for the number of larvae per plant (Table 2).

Table 1. Flea beetle damage in 12 plots with different proportions of turnip rape. Average of 40 controlled plants. (4 x 10 plants/plot)

	2 %		4 %		8 %	
	turnip rape	rape	turnip rape	rape	turnip rape	rape
Number of holes per plant	13.0	0.7	13.4	0.6	10.5	0.2
Damage per leaf in %	6.3	1.5	5.4	2.2	4.0	0.4

Table 2. Number of flea beetle larvae in 5 different rape fields 1986 sown in mixture with 2 % turnip rape. Average of 60 plants per figure. Figures in a row with different letters are significantly different (Z-test, p = 0.05)

	Number of flea beetle larvae per plant		
Site	turnip rape	rape in mixture	rape in pure culture
Bützberg I	2.15 A	0.55 B	0.40 B
Bützberg II	1.70 A	0.05 B	0.15 B
Langenthal I	0.80 A	0.35 AB	0.10 B
Langenthal II	2.43 A	0.43 B	--
Langenthal III	1.45 A	0.90 A	1.0 A

3.2 Rape stem weevil

We found more larvae of the rape stem weevil in turnip rape than in rape (Table 3).

Table 3. Number of rape stem weevil larvae per plant in 6 rape fields. Average of 60 plants per figure. Figures in a row with different letters are signifcantly different (Z-test, p = 0.05)

year and site	Number of rape stem weevil larvae per plant		
	turnip rape	rape in mixture	rape in pure culture
1985, Bützberg I	0.57 A	0.27 A	--
1985, Bützberg II	1.62 A	0.65 B	--
1986, Bützberg I	1.30 A	0.40 B	0.65 B
1986, Bützberg II	0.68 A	0.70 A	0.70 A
1986, Langenthal I	1.90 A	0.40 B	0.72 C
1986, Langenthal II	1.65 A	0.45 B	

3.3 Cabbage stem weevil

For both the rape stem weevil and the cabbage stem weevil we counted more weevils on turnip rape than on rape (results not presented here). By dissecting plants we found more larvae of the cabbage stem weevil on turnip rape than on rape (Table 4).

Tabelle 4: Number of cabbage stem weevil larvae per plant in 2 fields. Average of 60 plants per figure. Figures in a row with different letters are significantly different (Z-test, p = 0.05)

Year and site	Number of cabbage stem weevil larvae p. plant		
	turnip rape	rape in mixture	rape in pure culture
1986, Bützberg	1.10 A	0.30 B	0.77 A
1986, Langenthal	1.22 A	0.33 B	0.72 A

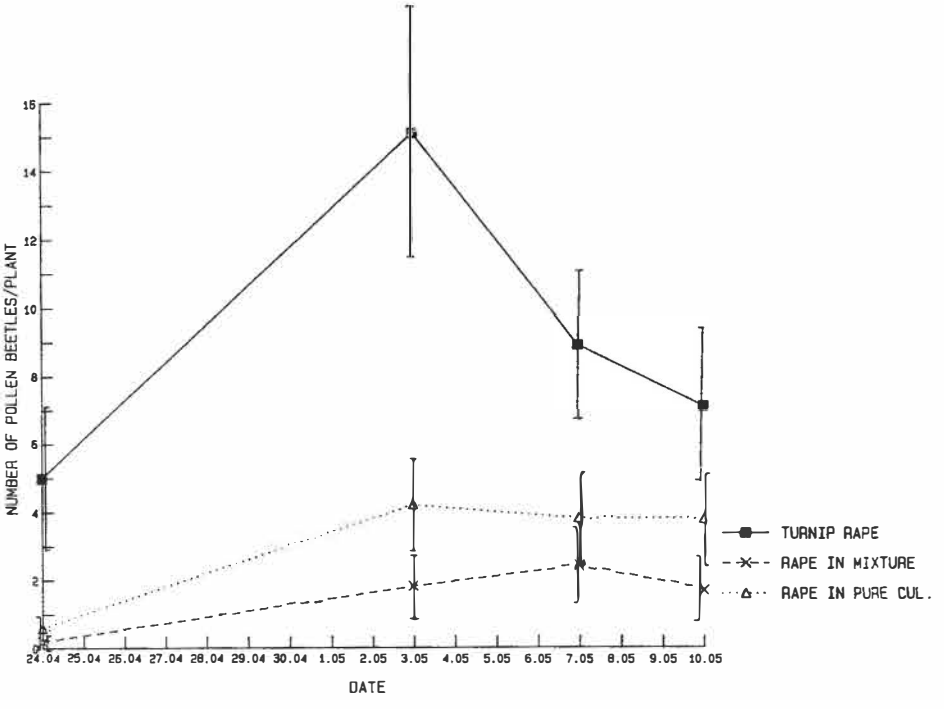
3.4 Rape pollen beetle (pollen beetle)

Turnip rape is very attractive for the pollen beetle; we found up to 60 beetles per plant. During 1985 and 1986 we counted the number of pollen beetles at different dates in 4 rape fields. Table 5 shows the results on one date in each field. In Figure 1, the results of 4 observation dates at the site Langenthal I (1986, Table 5) are plotted.

Tabelle 5: Number of pollen beetles per plant in 4 rape fields. Average of 60 plants per figure. Figures in a row with different letters are significantly different (Z-test, p = 0.05).

date and site	Number of pollen beetles per plant		
	turnip rape	rape in mixture	rape in pure culture
1985, May 5, Bützberg I	7.7 A	1.0 B	--
1985, May 5, Bützberg II	12.6 A	1.6 B	--
1986, May 6, Bützberg I	19.4 A	1.1 B	2.6 C
1986, May 6, Langenthal I	15.1 A	1.8 B	4.2 C

Figure 1: Number of pollen beetles/plant in rape field. One half of the field was sown with rape in pure culture, the other half with a mixture containing 2 % turnip rape. Vertical lines give the standard deviations.



3.5 Cabbage seed weevil

The adult cabbage seed weevils were found more often on turnip rape than on rape (results not presented here), but for egg laying they prefer rape. We found a greater proportion of infested pods on rape than on turnip rape (Table 6).

Table 6: Percent infested pods with cabbage seed weevil larvae. Average of 60 plant figure. Figures in a row (3 figures) with different letters are significantly different (Z-test, p = 0.05).

	% infested pods					
	main stem			secondary stem		
year and site	turnip rape	rape in mixture	rape in pure culture	turnip rape	rape in mixture	rape in pure culture
1986, Bützberg	3.12 A	4.07 A	4.33 A	1.89 A	2.23 A	1.75 A
1986, Langenthal	3.72 A	5.18 A	7.56 B	2.56 A	4.76 B	2.53 A

3.6 Brassica pod midge

The brassica pod midge did prefer neither the pods of main stem of turnip rape nor rape. For the secondary stem pods we found more damaged pods on rape in mixture than on turnip rape (Table 7), but the results are not significantly different (Z-test, p = 0.05). Rape plants in pure culture had significantly (Z-test, p = 0.05) less infested pods than rape in the mixture.

Table 7: Percent damaged pods by the brassica pod midge. Average of 60 plants per figure. Figures in a row (3 figures) with different letters are significantly different (Z-test, p = 0.05).

	% damaged pods					
	main stem			secondary stem		
year and site	turnip rape	rape in mixture	rape in pure culture	turnip rape	rape in mixture	rape in pure culture
1986, Bützberg	11.93 A	10.23 A	10.10 A	4.65 A	6.07 A	3.05 B
1986, Langenthal	16.53 A	16.60 A	16.81 A	6.78 A	8.79 A	4.53 B

3.7 Trap catches with sticky traps

Catches of 4 rape pests on sticky traps with different colours are listed in Table 8.

Table 8: Catches of 4 rape pests on sticky traps with different colours. Figures are means of captures on 2 traps for each colour. Catch period 20.3. - 17.5.1986.

pest, site	Number of catched animals		
	yellow	light-green	dark-green
Rape stem weevil			
Bützberg	115	134	23
Langenthal	41	21	8
Cabbage stem weevil			
Bützberg	222	73	16
Langenthal	76	24	6
Pollen beetle			
Bützberg	333	103	69
Langenthal	142	111	17
Cabbage seed weevil			
Bützberg	1015	358	50
Langenthal	33	7	3

4. Discussion

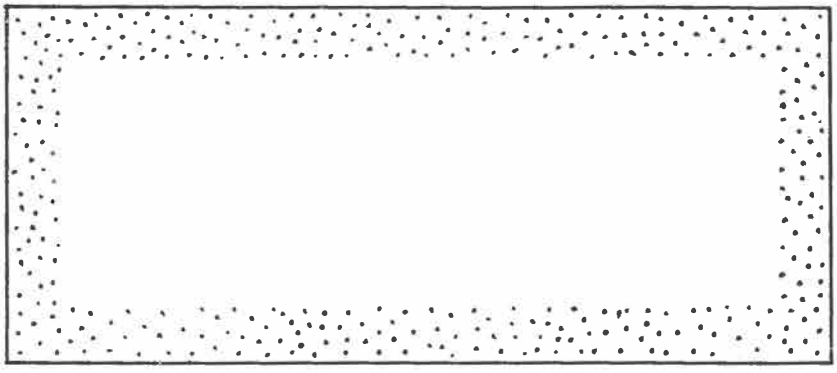
Our results show that out of six rape pests (materials and methods) 4 prefer turnip rape both for oviposition and feeding (Table 1-5). One reason for this preference for turnip rape is the light-green colour of the crop as demonstrated by our results with sticky traps (Table 8). The earlyness in development of the turnip rape is another reason which explains the attraction of the pollen beetle. At flight time of the pollen beetle turnip rape has great yellow-green buds whereas rape has still very small dark-green buds.

Now the question is whether 2 % turnip rape in a rape field are sufficient to prevent the rape from getting damaged by rape pests. Two percent turnip rape means that there is 1 turnip rape plant in 50 rape plants. Let us assume that there are 7 pollen beetles per plant on average and the goal would be a reduction to 5 beetles per plant (critical value for economical damage). Each turnip rape plant would have to attract 100 pollen beetles which is to much. We have found a maximum number of 60 pollen beetles per turnip rape plant. On the other hand it is not desirable to increase the proportion of turnip rape above 2 % mainly for two reasons: at harvest time of rape turnip, rape generally has lost its seeds which results in a yield loss; turnip rape has higher contents of erucic acid and would reduce the quality of the crop.

To solve the problem we must change the experimental layout. In a perimeter strip of 6-12 m (depending on the area of the field) within the field we sow 5 % turnip rape. The middle of the field is rape in pure culture (Figure 2). The area of the perimeter should not exceed 20 % of

the field in order to have not more than 1 % turnip rape in the hole field for the above mentioned quality reason. These figures are, however, aproximate. Further trials should improve the knowledge about the best layout. Depending on the number of pests (mainly the rape stem weevil and the rape pollen beetle) the perimeter strip could be treated with an insecticide. With this method of integrated control the amount of insecticide used in rape could be reduced considerably. In the future when more and more farmers practise this method the population of the beneficial arthopods could perhaps be increased to a level which would eliminate the necessity of insecticide application.

Figure 2: Rape field with a perimeter strip (6 - 12 m) within the field with 5 % turnip rape.



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Monitoring *Dasineura brassicae* by means of pheromone traps

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Summary

Delta traps baited with live virgin female brassica pod midge, empty delta traps and sticky traps were compared for their effectiveness in monitoring brassica pod midge populations in a crop of winter rape. All three trap types indicated a similar pattern of adult flight activity. The virgin female traps caught more brassica pod midge (mostly male) than the non-attractant traps and because they caught the target species selectively their catches were easier to sort.

Introduction

Brassica pod midge (*Dasineura brassicae*) is an important, widespread and common pest of oilseed rape crops in England, but there is at present no monitoring system for this pest.

In studies of the phenology of emergence of brassica pod midge from overwintering sites, and the subsequent infestation of spring and winter rape crops on farms in southern England, water and sticky traps were used successfully to monitor adult populations (Williams, Martin & Kelm, 1987 a & b). However, such non-attractant traps are difficult to use and their catches laborious to sort. Williams and Martin (1986) have shown that male brassica pod midge are attracted by odour (probably a sex pheromone), produced by live virgin females. A pheromone trap that is easy to use and selective for brassica pod midge could prove useful for monitoring this pest. The effectiveness of delta traps baited with live virgin female brassica pod midge, empty delta traps and sticky traps, has been compared for monitoring the brassica pod midge population in a crop of winter rape.

METHOD

Traps were placed in a field of winter oilseed rape at Rothamsted Experimental Station, along a sampling transect 5 m in from the edge of the crop. Fifteen traps, i.e. 5 sticky traps, 5 empty delta traps and 5 delta traps baited with live virgin female brassica pod midge, were placed at 5 m intervals along the transect; the positions of the traps were allocated at random along the transect. They were put out on 9 May and removed on 30 July. The sticky plates and virgin females in the traps were replaced with new ones three times a week.

Sticky traps consisted of a cylinder of acetate sheet, held vertically around an aluminium pole inserted into the ground. The outer surface of the cylinder (20 cm x 20 cm) was coated with adhesive (Oecotak A5), and the cylinder was 10-30 cm above ground.

The cardboard delta trap (Oecos Ltd., Kimpton, Herts) had a sticky plate (19 cm x 7.5 cm) held horizontally 10 cm above ground, beneath a canopy, triangular in cross-section. Those baited with virgin females had 1-3 females, inside a cylindrical glass tube (5 cm long, 3 cm diameter) with muslin ends, suspended below the canopy ridge. The glass tube contained drinking water in a small glass vial plugged with cotton wool.

RESULTS

Of the total number of insects caught by the traps, 58% of those in the virgin female delta traps, 3% of those in the empty delta traps and 11% of those in the sticky traps were brassica pod midge.

The numbers of brassica pod midge caught by the traps are given in Table 1. Delta traps baited with virgin females caught 44 times more brassica pod midge than empty delta traps but only 1.5 times as many as sticky traps. However, taking into account the larger sticky catching area of the sticky traps, the delta traps baited with virgin females caught about 4 times more midges per unit area than the sticky traps.

All three trap types caught their first brassica pod midge on 21-23 May; thereafter virgin female delta traps and sticky traps caught specimens almost continuously until 28-30 July, when traps were removed, whereas empty delta traps caught few midges during late May and June. Peak numbers occurred from early to mid-July. Virgin female delta traps caught predominantly males throughout the trapping period; by contrast, before the emergence of second generation adults in early July, the empty delta traps and the sticky traps caught mostly females and thereafter mostly males (Fig. 1).

DISCUSSION

The trap catches indicated a similar pattern of adult flight activity on winter rape to that described by Williams *et al.*, (1987a). All three trap types caught their first brassica pod midge simultaneously on 21-23 May. From then until the end of June, the empty delta traps and the sticky traps caught predominantly females, whereas the virgin female delta traps selectively caught males. Presumably both the females and the males caught during this period had migrated to the rape crop from their emergence sites. The large numbers of individuals caught during July were mostly second generation adults that had emerged from larvae in cocoons in the soil of the rape crop, and were predominantly male. Male predominance in the non-attractant traps was probably because they fly more than females as suggested by Williams *et al.*, (1987a).

All three trap types indicated a similar pattern of adult flight activity. However, the delta traps baited with virgin females caught more midges than the non-attractant traps despite the probability that they were not continuously attractive because of the 326 females used in the traps during the experiment, only 55% were still alive 2 or 3 days later when they were replaced with newly-emerged females. Because they caught brassica pod midge selectively, catches from virgin female traps were easier and quicker to sort than the catches from the non-attractant traps, which caught a large

proportion of other insects.

Because the sticky traps caught about 10 times more brassica pod midge per unit area of sticky surface than the empty delta traps, it seems worth investigating whether a pheromone trap design based on a sticky cylinder would be more effective than the delta trap for monitoring this pest.

Although it is mainly the fertilised females that migrate from emergence sites to rape crops (Williams *et al.*, 1987a), in this study, enough males had apparently moved from the emergence site to the rape crop for the pheromone traps to detect the start of infestation. This may have been because the rape crop was only 200 m from the emergence site. Further work is needed to determine whether pheromone monitoring on rape crops is feasible when they are further away from emergence sites.

Thus, if the sex pheromone produced by the virgin female brassica pod midge could be identified and synthesised, to provide a continuously attractive lure for males, it could prove a powerful tool for early detection of this pest and lead to more efficient control.

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Table 1. Numbers of brassica pod midge caught during 9 May - 30 July

	Total	♂	♀	%♂
Virgin ♀ delta traps				
9 May - 2 July	166	164	2	98.8
2 - 30 July	2561	2558	3	99.9
Empty delta traps				
9 May - 2 July	9	2	7	22.2
2 - 30 July	53	51	2	96.2
Sticky traps				
9 May - 2 July	326	90	236	27.6
2 - 30 July	1438	1387	51	96.5

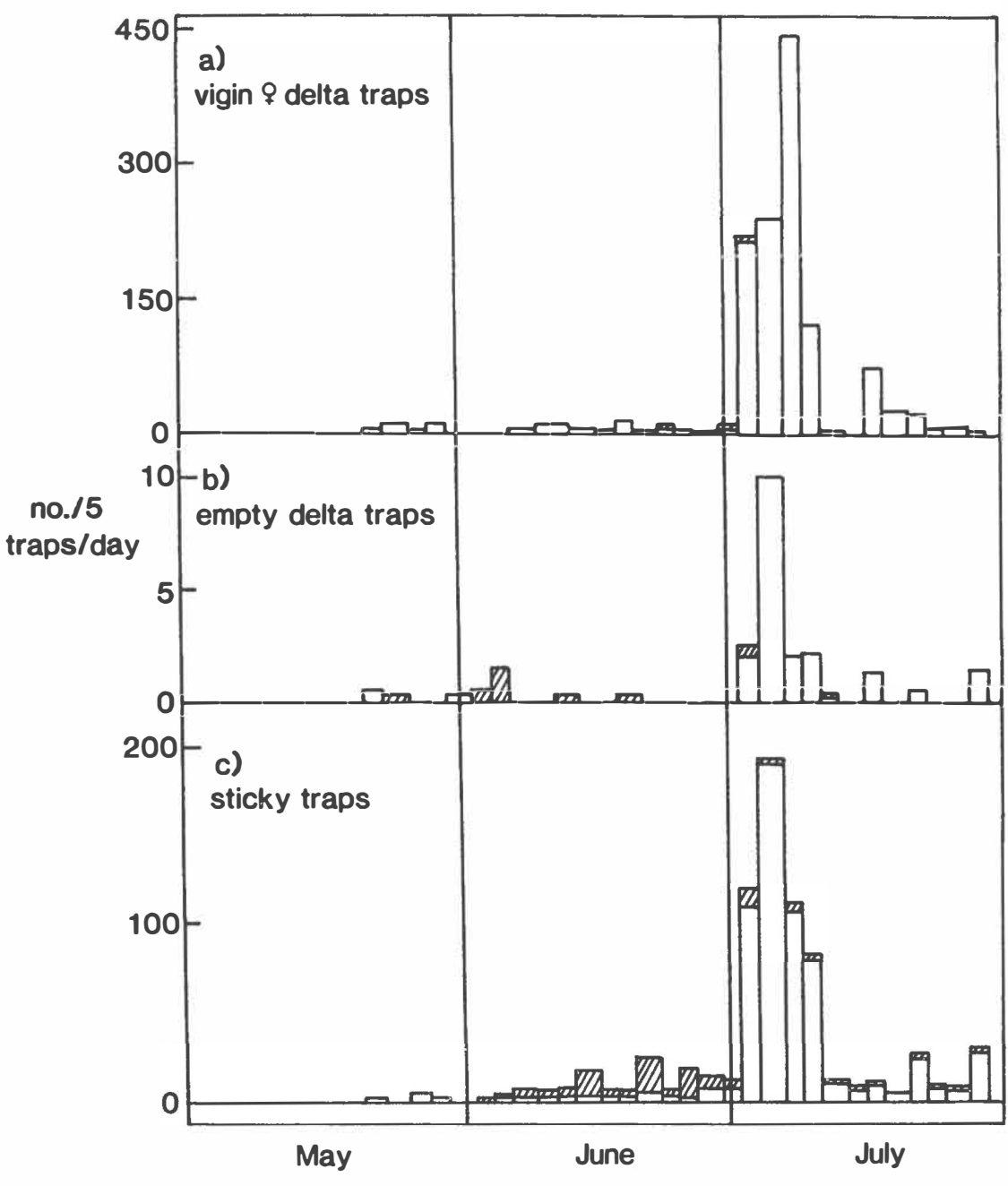

Fig. 1. Numbers of adult *D. brassicae* caught in traps in a winter oilseed rape crop, □, male; ▨ female.

A BIBLIOGRAPHY OF THE PARASITOIDS OF THE BRASSICA POD MIDGE, (*DASINEURA BRASSICAE*, WINN).

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A search of the literature has revealed twenty publications in which reference is made to the parasitoids of the brassica pod midge (*Dasineura brassicae*) in Europe. These are listed in the references and cite a total of 30 species/genera of parasitoid from seven different families which attack various stages of this pest (Table 1).

The most extensive investigation is that of Czajkowska (1978a) in Poland; she reared 12 parasitoid species from field-collected brassica pod midge larvae and found that the three species, *Prosactogaster* (= Platygaster) *oebalus*, *Tetrastichus epicharmus* and *Pseudotorymus brassicae* accounted for more than 96% of the individuals reared but that on average only 1.8%, 1.5% and 0.7% of larvae were parasitised by these species respectively. Some (18%) larvae in overwintering cocoons were parasitised, the most numerous parasitoids reared from them being *Synopeas* sp. (39%), *Prosactogaster* (= Platygaster) *iolas* (28%), *Aphanogmus abdominalis* (15%) and *P. oebalus* (13%). In France, Coutin (1961) reported *Prosactogaster* (= Platygaster) sp. as being the most important parasitoid, parasitising 29% of overwintering lavae, followed by *Inostemma* sp. (16%). In Germany, Laborious (1972) reared 10 parasitoid species from cocoons collected over three years from four different sites and found 0.8- 14% parasitised, the dominant species being *P. oebalus*, *A. abdominalis* and *Ceraphron serraticornis*. Also in Germany, Buhl (1960) found *Prosactogaster* (= Platygaster) sp. to be the main egg parasitoid with an average of 18% of the first and 7% of the second generation parasitised, while Speyer (1923) found 7-68% of larvae parasitised by the two species, *Pseudotorymus brassicae* and *Tetrastichus brevicornis*.

Because so few recent investigations on the incidence of parasitoids of brassica pod midge have been made, their general importance in regulating pest populations is difficult to assess.

Table 1. List of parasitoids of *Dasineura brassicae* and references in which they are cited.

Parasitoid	Reference
Family Ceraphronidae	
Aphanogmus abdominalis (Thoms.)	3, 4, 5, 8, 11.
Ceraphron insularis (Kieff.)	3, 4, 8.
Ceraphron pallipes (Thoms.)	11.
Ceraphron serraticornis (Kieff.)	11.
Ceraphron tenuicornis (Thoms.)	10, 19.
Ceraphron xanthosoma (Kieff.)	3, 4, 5, 8, 11.
Family Eurytomidae	
Eurytoma aciculata (Ratz.)	5.
Eurytoma dentata (Mayr.)	13.
Family Eulophidae	
Omphale clypealis (Thoms.)	3, 4, 10, 11, 13, 19.
Omphale coilus (Walk.)	5.
Neochrysocharis sp.	1, 5.
Tetrastichus brevicornis (Panz.) (= *Geniocerus brevicornis* (Panz.))	13, 18, 20.
Tetrastichus epicharmus (Walk.)	3, 4, 5, 6, 7.
Tetrastichus sp. (= *Syntomophyrum* sp.)	5, 13, 19.
Necremnus leucarthros (Nees)	5.

Family Pteromalidae

Trichomalus perfectus (Walk.)	5. 16.
Mesopolobus morys (Walk.)	5. 13. 15. 16.

Family Torymidae

Pseudotorymus brassicae (Ruschka)	5. 6. 13. 17. 18. 20.

Family Megaspilidae

Conostigmus rufescens (Kieff.)	11.

Family Platygastridae

Platygaster (= *Prosactogaster*) *oebalus* (Walk.)	3. 4. 5. 6. 11.
Platygaster (= *Prosactogaster*) *iolas* (Walk.)	5.
Platygaster (*Prosactogaster*) *nitida* (Thoms.)	5.
Platygaster (= Prosactogaster) sp.	1. 2. 5. 10. 12. 13. 18. 19. 20.
Inostemma boscii (Jur.)	1. 9. 14. 20.
Inostemma walkeri (Kieff.)	5. 11.
Inostemma nov. sp. pr. *reticulatum* (Szel.)	3. 4. 11.
Inostemma sp.	2. 11.
Synopeas nov. sp. pr. *lugubris* (Thoms.)	3. 4.
Synopeas thomsoni (Kieff.)	3. 4. 11.
Synopeas sp.	5. 10. 12. 19.

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YIELD LOSSES IN WINTER RAPE CAUSED BY CABBAGE STEM FLEA BEETLE LARVAE (Psylliodes chrysocephala (L.))

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Summary

During 1982-1984 chemical control trials against cabbage stem flea beetle in winter rape were carried out in the southern part of Sweden.
From each plot a sample of 10 plants was taken in early spring. Dead and living larvae were counted in the 424 samples.
The mean losses in oil yield were 35, 23 and 114 kg per larva per plant respectively for 1982, 1983 and 1984. Economic thresholds for control were less than 0.5 larva per plant for seed dressing and less than 1 larva per plant for spraying.

Introduction

In Sweden winter rape is grown on approx 60 000 ha. Most of the acreage is located in the province of Skåne in the southern part of Sweden. The larvae of two beetle species the cabbage stem flea beetle, CSFB, Psylliodes chrysocephala (L.), and Ceuthorrhynchus sulcicollis Payk., occur in winter rape stems or petioles during winter and spring. Although the latter species can cause severe damage in middle Sweden, it is quite local in its appearance. In contrast the CSFB is rare in middle Sweden. The situation is just the opposite in the southern part of Sweden where the CSFB is very common some years and can cause great economic damage to winter rape crops.

Populations of CSFB were monitored in about 100 fields in Skåne for 20 years (Andersson, 1986). Two outbreak periods have been recorded, lasting 4 and 3 years and with peaks in 1975 and during 1983 respectively. At present (i.e. 1988) population levels are very low. Eggs are layed during mild spells throughout the winter and also during early spring. Cold winters kill most of the adults and larvae. For example in February 1986 about 90 % of the larvae died during a period of very cold weather. Consequently, the most severe attacks occur in the coastal areas of Skåne where the climate is milder.

Seed dressings have been used to prevent plant damage. According to an agreement reached with the seed firms, dressings have only been used in years when census figures indicated a build-up of the population. Dust formulations of lindane (gamma-HCH) and, after mid-1970, Oftanol T (isofenphos 40% + thiram 10%), applied as seed dusts have been used at 40 g/kg seed. Since mid-1980, micropelleting has been the only application method. Seed dressings are ineffective once plants have developed more than 1-2 leaves. During the last outbreak many farmers sprayed with a pyrethroid during the first half of September, which gave excellent control (Smith & Hewson 1984, Table 4).

The efficacies of seed dressing and spraying were investigated in a comparative study during 1982-1984 using a variety of application techniques, pesticides and dose rates. Using data obtained from these trials an evaluation of the effects of larval numbers on yield of winter rape was also carried out. The results of this evaluation are presented here.

Material and methods

In all, 20 trials were conducted during 1982-1984 in the southwest corner of Skåne. Four replicates of each treatment were set out in randomized blocks in farmers' rape fields. The varieties Emil and Jupiter were used at seed rates of 6-7 kg/ha. Row distances were 0.45 m except for 2 trials in 1983 with 0.12 m. Samples including 10 plants, were taken at random in each plot in early spring before the plants had started growing. The plant samples were stored at about 5° C. Stems and petioles were dissected under a stereo microscope and numbers of dead and live larvae recorded.

The yield from a 25 m^2 area in each plot was measured. A seed sample (1.00 kg) from each treatment was analysed for cleanness, moisture and oil content. An analysis of variance was used to compare the treatment effects within a trial.

The relationship between larval numbers (in 40 plants per treatment) and oil yield was analysed with multiple regression. Only trials with AVOVA F-ratios with a level of significance greater than 0.75 for both larval numbers and oil yield were subjected to regression analysis. Dummy variables were introduced to eliminate any inherent differences in yield between fields. The mean beetle number and mean yield were used for trials with lower F-ratios.

Both dead and living larvae were counted in this study. Since dead larvae are impossible to find after a few weeks, those recorded must have died during the latter part of winter. Consequently, they were active during and before the winter and should have contributed to the measured damage.

Results

In 1982 oil yields were around 1.2 tonnes/ha, and about 3 larvae per plant were recorded in the most heavily attacked plots (Fig. 1). The oil yield fell by 35 kg for each additional larva per plant (mult. corr. coeff 0.95; 3 dummy variables). Similar infestation levels were found in 1984 (Fig. 1). However, in 1984 many more plots had no or very few larvae. About 114 kg oil/ha was lost for each larva/plant. (mult. corr. coeff 0.90; 1 dummy variable).

In 1983 infestation levels were very high, with up to 20 larvae/plant (Fig. 2). Oil yields in treated plots varied between 0.9 and 1.5 tonnes/ha. For each larva per plant the oil yield was reduced by 23 kg/ha. The multiple correlation coefficient was 0.95 and highly significant.

For the 3 years together the multiple correlation coefficient was 0.92. Based on these data the following regression equation with 3 dummy variables was formulated: $y = 0.918-0.15x$, where y = oil yield (tonnes/ha) and x = no. larvae per plant.

Discussion

There were no apparent differences in plant stand between plots with high larval populations and those with low populations in the same trial. The plant stand data showed great variability, and more precise counts would probably reveal that CSFB larvae cause more plants to out-winter. The main effect of the larvae seems to be a reduction in plant vigour in the spring, resulting in a lower seed yield. A yield reduction appeared to occur even at very low larval densities. Infection with Phoma lingam has been shown to be higher in plants infested with CSFB larvae than in uninfested plants, which could be one of the explanations (Schultz & Daebeler 1984).

The treatment threshold is generally considered to be 5 larvae per plant (Godan, 1950). The data presented here show that the yield loss per larva varies strongly between years. The cost of seed dressing is equivalent to the cost of 9 kg oil while spraying with a pyrethroid costs 21 kg. This means that spraying was economically justifiable at 1 larva per plant in 1983 and at 0.6 and 0.2 larvae per plant in 1982 and 1984 respectively. Seed dressing halved the number of larvae in the trials and increased yields by an average of 100 kg. Seed dressing has evidently been very profitable, and thresholds were very low, i.e. 0.25, 0.40 and 0.08 larvae per plant 1982, '83 and '84 respectively. Thus the need for chemical control of CSFB is apparently much greater than hitherto recognized.

Better knowledge of the factors influencing the variability in plant sensitivity to damage and yield loss should make it possible to better advice farmers as to the relative cost/benefits of varions treatments, based on population forecasts.

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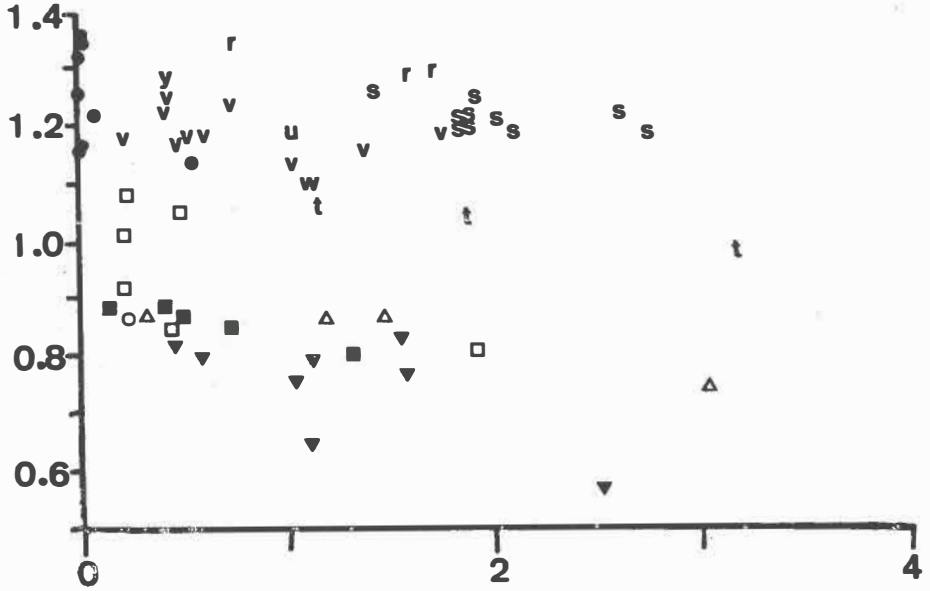

Figure 1. Oil yield (tonnes/ha) and number of cabbage stem flea beetle larvae per plant. Field trials in 1982 (letters) and in 1984 (symbols). Different letters or symbols denote different trials.

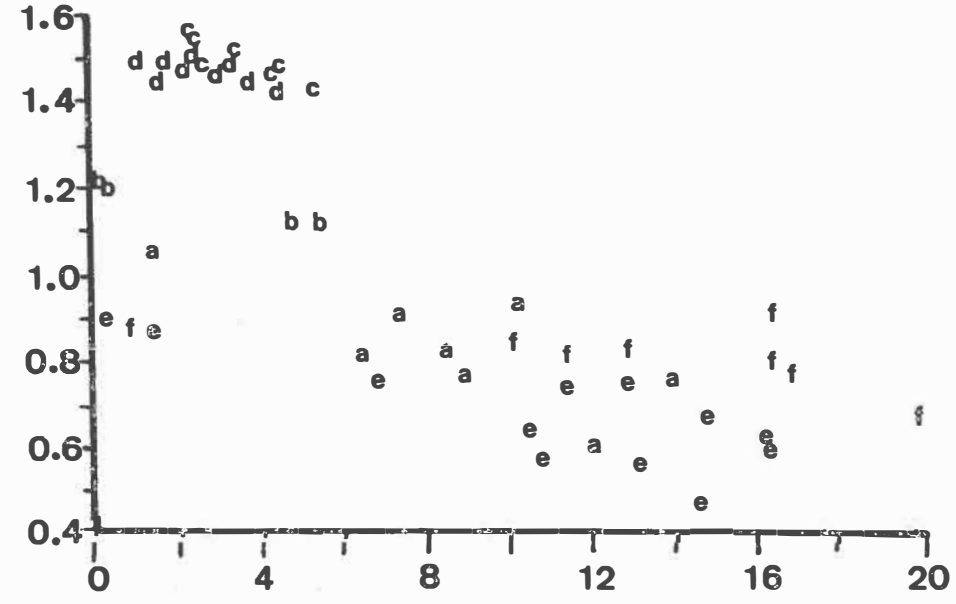

Figure 2. Oil yield (tonnes/ha) and number of cabbage stem flea beetle larvae per plant. Field trials in 1983. Different letters denote different trials.

FLEA BEETLES (PHYLLOTRETA SPP) IN SPRING OILSEED RAPE IN SWEDEN

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Summary

Flea beetles of the genus Phyllotreta have long been recognized pests of spring oliseed rape. The beetles are economically most important in areas of Sweden around Lake Mälar. Seed dressing with insecticide is commonly practiced in this area. Generally seed treatment does result in yield increases. An alternative to seed dressing, such as monitoring the crop and spraying if flea beetle numbers are high is not practical. The following factors are being studied in Uppsala: 1. Species distribution: for 1985-1987 the dominate species was Phyllotreta undulata. 2. Biology of the most important species. 3. Economic loss due to the beetles. 4. Natural enemies: In Sweden flea beetles have been shown to be attacked by a parasitoid and nematodes.

1. Introduction

Spring oilseed rape (Brassica napus) and turnip rape (B. campestris) are important crops in some parts of Sweden. In the area around Lake Mälar (including for example Stockholm, Uppsala, Västerås) these forms are much more common than winter oilseed crops. The spring sown oilseed crops germinate and the cotelydons emerge at a time when the weather is, in this part of Sweden, often warm and dry. This stage in the plant's development often coincides with the spring migration of flea beetles of the genus Phyllotreta. The beetles leave their hibernation spots and are attracted by the newly germinated oilseed. If the numbers of flea beetles are very large they may destroy many small plants. This damage is most important in oilseed rape as opposed to turnip rape as B. napus grows somewhat slower than B. campestris. The best method of protection presently available is the use of seed dressings. Treatment of B. campestris, however, does not result in yield increases as great as those for B. napus (Bengtsson, 1982).

Despite the pest status of the genus Phyllotreta little is known about the biology, species distribution, economic damage, and natural enemies in Sweden. The following is a preliminary study of some of these aspects.

Material and Methods

Untreated rape (variety Topas) and turnip rape (variety Torkel) were sown in a field in Uppsala in 1985-1986. In 1987 Sinapis alba (variety Trigo) was also sown together with the other two oilseed

cultivars. Four or five petri dishes (diameter 14 cm) were placed in each of the plots. The dishes were filled with water and detergent. The dishes were emptied every one or two days and flea beetles were counted, identified, and in 1986 and 1987 dissected.

In 1986 and 1987 flea beetles were collected using an aspirator from trays sown with turnip rape and Sinapis alba (variety Trigo). Some were preserved in a fixative (Weaver & Thomas 1956) while others were kept alive in petri dishes. Those preserved were later dissected to determine sex and to check for parasitization. Parasitoid larvae emerged from some of the live beetles and a few parasitoids were able to complete development to adult.

Field trials were conducted within our general pesticide testing program, treated and untreated seed were sown. Plant counts and counts of feeding marks made on the cotyledon were done twice each season. Yield levels were determined and chemical analysis was done to obtain the level of crude fat. Trials were done from 1983 to 1987.

3. Results and Discussion

3.1 Species distribution

For 1985-1987 the most common species caught in Uppsala was Phyllotreta undulata. The second most abundant species caught in oilseed crops was, interestingly enough, P. vittula which is a pest on cereals. P. nigripes, P.atra, and P. vitata were also caught in the traps but only in very small numbers. Material collected in Denmark (courtesy of JK Nielsen) on turnips in 1987 showed another species distribution, about 65% P. undulata and 35% P. nigripes.

In the area of Sweden around Uppsala only one other survey of the Phyllotreta species has been done (Kemner 1923), this also showed P. undulata to be the main species. There are some indications that P. atra is more abundant in southern Sweden (Mühlow & Sylvén 1953, Jonasson 1982).

P. vittula does not have crucifers as host plants. It reproduces on grasses and cereals. It seems to usually be the earliest Phyllotreta species out of hibernation. P. vittula does not stay in oilseed as they are not found there in the middle of the summer. They seem to stop temporarily during migration to and from overwintering sites.

3.2 Biology of the species

After overwintering the adult flea beetles arrive in the field towards the end of May. Oviposition begins about the first or secon week of June. Larvae of P. undulata live under the soil on the roots of the plants. Pupation also occurs in the soil. The new adults start to emerge at the end of July and continue through August. Temperature is extremely important for the levels of activity. In 1987, when Sweden had an extremely cold summer, field catches were much lower than in proceeding years.

3.3 Economic loss due to damage by the beetles

Experimental trials in oilseed rape have shown that treatment does result in yield increases (Table 1). However, where flea beetle damage is small or non-detectable the treatment does not pay for itself in yield increase. It is common practice to sow treated seed. The alternative, which would be to monitor the crop for flea beetle occurrence and spray if flea beetle numbers are high, is not thought to be reliable. In addition to chemical treatments all measures which promote better and faster crop development are recommended.

The level of flea beetle attacks varies between years and locations. In our field trials (Table 1) the attack level has been determined by 'gnaw marks' on the cotelydons. When the attack level has been less than 4 'gnaw marks' per plant there has been no significant yield increase in treated plots. At higher attack levels larger differences in yield could be seen, the largest and only significant difference was in crude fat yield.

During 1987, an extremely cold and wet year, low yield levels were common. The damage as measured in number of feeding marks was very high in all 5 trial. This should have resulted in larger differences between treated and untreated plots. However, because of the cold weather the plants stayed in the cotyledon stage much longer and were therfore available for attack for a longer period. The damage was limited to feeding marks on the leaves rather than destruction of the plants.

3.4 Natural enemies

Results from dissections are shown in Table 2. The few adult parasitoids which emerged were identified as Townesilitus bicolor (Wesmael) (Hymenoptera: Braconidae, Euphorinae), (Haeselbarth & Loam 1983).

Table 2. Parasitization by Hymenoptera and nematodes for Phyllotreta undulata.

	males	females	total
Number dissected	174	97	271
Parasitized (Hymenoptera)	27 (16 %)	15 (15 %)	42 (15 %)
Nematode infections	20 (11 %)	16 (16 %)	36 (13 %)
Double infections	2 (1 %)	2 (2 %)	4 (1 %)

Rates of parasitism were not high. One reason may have been that adult parasitoids probably emerge in the field in early July when many fields are aprayed against blossom beetles (Meligethes spp.)

Some P. undulata were found to be infected by nematodes. The nematodes were not, in general, as damaging to their host as the parasitic wasps. No ovaries or eggs were found in female P. undulata parasitized by Hymenoptera while females with nematode infections had developed ovaries and sometimes eggs.

Table 1. Control of flea beetles (*Phyllotreta spp.*) in sparing oilseed rape, 1983-1987.

Treatment	1987		1985-1987		1983-1986		1983-1986[1]	
	Yield dt/ha	Crude fat dt/ha	Yield dt/ha	Crude fat dt/ha	Yield dt/ha	Crude fat dt/ha	Yield dt/ha	Crude fat dt/ha
Untreated	18.8	8.0	19.3	7.6	18.0	6.6	15.3	5.8
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)
Isofenphos (Oftanol)	19.3	8.2	20.4	8.0	17.8	7.6	16.3	7.1*
	(103)	(103)	(104)	(105)	(99)	(115)	(107)	(122)
Number of trials	5	5	12	12	20	20	12	12

Values in parenthesis are relative values.

1. Only trials where there was a noticable attack (more than 4 feeding marks per cotyledon) were used in this analysis.

* significantly different from untreated ($P<0.05$)

It is not known how many generations the parasitoids have in Sweden. The flea beetles which emerge in the late summer and early autumn are parasitized and take the parasite with them into hibernation. Parasites found in beetles collected in the early spring are most often first instar larvae.

There are still many unanswered questions about the biology of the beetles and their natural enemies. Further studies are needed to determine the effects of environment on the interaction.

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CONTRIBUTION TO THE STUDY OF FUNGICIDE EFFECTS ON A WHEAT-OILSEED RAPE ROTATION: A JOINT PROJECT

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Summary
Intensive use of fungicides in controlling cereal and oilseed rape diseases has increased in France. Diseases were normally reduced after fungicide applications. However some diseases increased dramatically and are referred to as iatrogenic diseases. They generally result from disturbances in the pathogenic and/or saprophytic floras. The range of active compounds used on both crops is fairly similar, and moreover fungicide resistance might develop. Against this background a 3 year project was launched in September 1987. Its purposes are (i) to evaluate the effects of fungicide applications on both the saprophytic and pathogenic microfloras in rapeseed and wheat, (ii) to compare the efficacy of different fungicides on wheat and oilseed rape diseases, (iii) to forecast the development and spread of resistant isolates. Field experiments and microbiological procedures are discussed.

1) Introduction

In France numerous fungicides have been applied to cereals during the growing season for over 20 years. These treatments are used to control a number of both stalk and ear diseases, such as *Pseudocercosporella herpotrichoïdes, Fusarium sp.*, and *Septoria nodorum* (1, 2, 3, 4).

Although fungicides clearly have a direct effect on diseases, indirect effects on leaves have been found. In particular, fungal diseases so far considered to be of minor importance have increased (1, 5). In other cases, one of the pathogen was only partially controlled, and this could not be ascribed to fungicide resistance. These failures result from changes in the nature and structure of the populations harboured on leaf surfaces. For example, the antagonistic role of some micro-organisms such as yeasts with respect to *Septoria nodorum* and *Cochliobolus sativus* has been demonstrated (6, 7). This antagonistic effect alone does not adequately control leaf blotch, but when antagonistic populations are destroyed or reduced, a drop in fungicide efficiency may follow.

As already observed on other crops, populations of the pathogen *Pseudocercosporella herpotrichoïdes* were modified by the selection pressure due to fungicides (8). The pathogenicity of fungicide resistant strains is as high as that of susceptible ones. Moreover resistant strains appear to have a greater ability to spread (9).

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A similar change has been noted in oilseed rape crops. The area of this crop has increased from 142,300 ha in 1965 to over 865,000 ha in 1988 mainly because new varieties with low erucic acid content have been introduced. In addition winter rapeseed is beneficial in rotations with cereals. Intensive cropping has brought new plant protection problems which require more and more frequent use of fungicides. Oilseed rape plots presently receive on an average 3 fungicide applications, mainly against (i) *Cylindrosporium concentricum*, (ii) *Sclerotinia sclerotiorum*, *C. concentricum* and sometimes *Pseudocercosporella capsellæ*, (iii) *Alternaria brassicæ* or *P. capsellæ*. Although there is a low probability of selecting fungicide resistant isolates of *S. sclerotiorum* , there is a higher risk for *C. concentricum* and *P. capsellæ* which have numerous cycles during the same growing season. This hazard appears still greater when considering rotations instead of individual crops. The same fungicides are frequently used on both wheat and rapeseed in short rotations (ex rapeseed-wheat-wheat). An active ingredient may be efficient in controlling a given pathogen, and also favour the selection or spread of fungicide resistant strains of pathogens of the next crop. However this potential inoculum cannot be detected for lack of host plants.

Although much research has been devoted to the effects of fungicides on the fungal flora, it only concerned one crop (10, 11, 12, 13, 14, 15). Because progress in cultural practices is rapid, it is urgently required to investigate the effects of fungicides on the pathogenic and saprophytic floras within the same field in a rotation. A multidisciplinary programme gathering Institut Technique des Ceréales et des Fourrages and CEntre Technique Interprofessionnel des Oléagineux Métropolitains both technical institutes for the development of cereals and rapeseed, as well as Association de Coordination Technique Agricole and Institut National de la Recherche Agronomique under the auspices of Ministère de la Recherche et de l'Enseignement Supérieur has been developed.

As part of this programme, the fluctuations of the various phylloplane components for a wheat crop and a rapeseed crop grown successively on the same field will be investigated. Monitoring of variation will be performed on plots with different patterns of fungicide treatments. The chosen procedures will be specially designed to enhance differences.

2) Materials and methods.

Field experiments

Trial schedule: Trials were carried out on an experimental farm of ITCF near Versailles. The plot was composed of two parallel stripes (one for each crop) with 6 individual plots each. Individual plots were 24 x 50 m with harvest areas of 3.6 x 40 m. Experimental plots were surrounded by 24 m wide border of the same crop, and separated by a 6 m broad path between the two stripes. The total area for this trial was 3.6 ha (Figure 1). Each year the wheat stripe will be substituted for the rapeseed stripe, and vice-versa.

Crop management: Straws of the previous crop were chopped and two stubble-ploughings were made with a cover crop. Tillage occured just before seed bed preparation. Weedkiller against Gramin and Dicotyledons was applied at emergence. P and K main fertilization was supplied before ploughing. The wheat crop received N fertilization in 2 applications as advised by ITCF (end of winter and end of tillering). On the rapeseed crop N and S fertilization was applied once or twice in spring as advised by CETIOM. Winter wheat cv. Thésée and winter oilseed rape cv. Bienvenu were used.

Insects were controlled as they appeared. On each individual plot a pattern of fungicide applications was applied as described in Tables 1 and 2. The fungicides used are summarized in Table 3.

Figure 1: Field schedule.

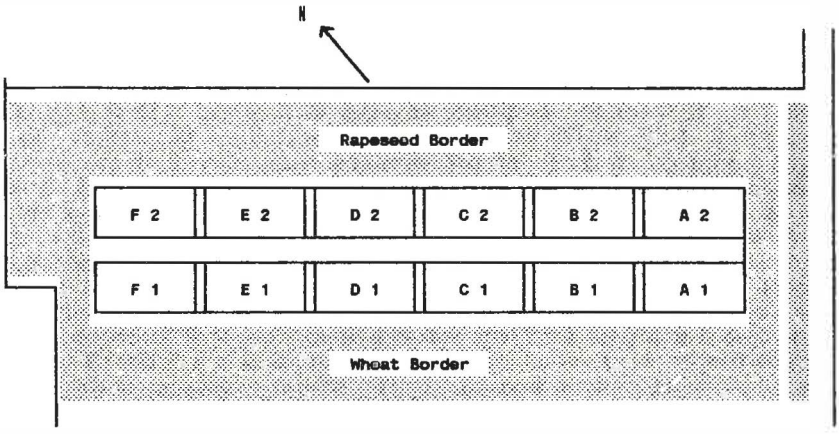

Table 1: Pattern of fungicide applications on winter wheat.

PLOT	SEED	GROWTH STAGE 6	8-10	10.1-10.5	11
A1	Cuprolate plus T4	-	-	-	-
B1	Cuprolate plus T4	Sportak MZ 2	-	Punch C	-
C1	Cuprolate plus T4 + Baytan 15	Sportak MZ 2	Sportak MZ 2	Punch C	Punch C
D1	Cuprolate plus T4 + Baytan 15	Punch C	Punch C	Punch C	Punch C
E1	Cuprolate plus T4	Bavistine FL	Bavistine FL	Bavistine FL	Bavistine FL
F1	Cuprolate plus T4	-	-	-	-

Growth stages from Large E.C. 1954 Plant Pathology n°3 (4):128-129

Table 2: Pattern of fungicide applications on winter rapeseed.

PLOT	SEED	GROWTH STAGE 1.8-1.10	2-3	4.1	5.5
A2	(thiram)	-	-	-	-
B2	(thiram)	-	-	Sumisclex	Rovral or Kidan
C2	(thiram)	Bavistine FL	Bavistine FL	Sumisclex	Rovral or Kidan
D2	(thiram)	Sportak PF	Sportak PF	Sportak PF	Impact RM
E2	(thiram)	Bavistine FL	Bavistine FL	Bavistine FL	Bavistine FL
F2	(thiram)	-	-	-	-

Growth stages from Silvester-Bradley R., Makepeace R.J. 1984 Aspect of Applied Biology 6:399-419.

Table 3: Fungicides used.

ACTIVE INGREDIENT	RECOMMENDED RATES	REGISTERED NAME
Bavistine FL	wheat 0,4 l/ha rapeseed 1 l/ha	carbendazim 50%
Baytan 15	0.2 kg/q	triadimenol 15%
Cuprolate plus T4	0.4 kg/q	lindane + Cu-oxyquinoleate + endosulfan + anthraquinone 10% 5% 25% 12.5%
Impact RM	1 l/ha	flutriafol + carbendazim (117.5 + 250 g/l)
Kidan	2 l/ha	iprodione 50%
Punch C	0.8 l/ha	flusilazol + carbendazim (250 + 125 g/l)
Rovral	1 kg/ha	iprodione 50%
Sportak MZ 2	1.33 + 4.7 l/ha	prochloraz + mancozeb (450 + 430 g/l)
Sportak PF	1 l/ha	prochloraz + carbendazim (300 + 80 g/l)
Sumisclex	1.5 l/ha	procymidone 50%
seed coating	0.2 kg/q	thiram 80%

Assessment of the microflora.

Plots were sampled just before and 10 to 15 days after each fungicide application. Fifty leaves were collected at random from the sampling area of each plot and carefully placed in polyethylene bags. Microbiological procedures were then carried out on the same day as sampling, or on the following day after storing the material at about 5° C overnight. Every wheat leaf was cut with scissors so that the analysed area corresponded to the middle and to the 40 percent of the total area of the blade. One disk (16 mm diam.) per rapeseed leaf was cut with a cork borer from the middle part of the leaf. The cork borer was sterilized before each cutting by dipping in alcohol and flaming.

The 50 samplings were transferred to 250 ml screw-cap Erlenmeyer flasks each containing 50 ml of sterile distilled water. The Erlenmeyer flasks was then shaken for 30 min on a reciprocating shaker (280 throws of 3 cm/min). Immediately after shaking, appropriate dilutions of the resulting suspensions were prepared and aliquots plated out on malt extract agar plus antibiotics (16). These plates were incubated at 15-19° C, 14 h lighting for 4 days before the organisms which developed were identified and counted.

Disease assessments

Rapeseed leaves and wheat blades collected for assessment of the microflora were incubated as indicated above in polyethylene boxes. Intensity of main diseases were noted .

Field observations

In the wheat experiment the method used was that in ITCF fungicide tests. The diseases observed were *Pseudocercosporella herpotrichoïdes, Septoria sp., Puccinia triticina, Erysiphe graminis, Rhizoctonia solani, Fusarium sp* and *Helminthosporium tritici* .

In the rapeseed experiment the method of assessment was defined by CETIOM. *Peronospora parasitica, Alternaria brassicæ, Pseudocercosporella capsellæ, Cylindrosporium concentricum, Sclerotinia sclerotiorum* and *Phoma lingam* were noted.

Assessment of resistance

Susceptibility of the various pathogens to the active compounds used was checked at regular intervals.

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OCCURENCE AND DISTRIBUTION OF OIL SEED RAPE DISEASES IN THE FEDERAL REPUBLIC OF GERMANY AND OUTLOOKS ON CONTROL

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Summary

A report is given on regional and comprehensive surveys about the occurence of Verticillium dahliae Kleb. in the Federal Republic of Germany in 1985, 1986 and 1987. Symptoms are described and differences between Verticillium and other diseases are explained. Discolourations in the stalks and the roots were caused by a range of fungi.

The survey was carried out at growth stage 85 (time of swathing) or wind-rowing or after harvest. Criterion for presence of infection was based on microsclerotia. In 1987, when the survey was carried out over the whole of the Federal Republic of Germany, other diseases and pests were included as root rot, root collar and stalk rot (P. lingam), and on several samples infestation by larvae of Psylliodes crysocephala and/or Ceutorhynchus quadridens.

From the data it can be seen, that V. dahliae occurred over the whole country, but predominantly in the north (Ostholstein, and parts of the districts Plön and Nordfriesland), where the disease was found in 65 % of fields. In the other parts less than 20 % fields were positive. Generelly the severity (degree) was low. On few fields, however, a degree of more than 5 in a scale 1 - 9 was reached. Differences between cultivars were very slight. Root rot and Phoma-root collar and stalk rot was high and gave an impression about these diseases. It should, however, be mentioned, that the determination after harvest was too late for an accurate estimation of these two diseases.

1. Introduction

Oil seed rape is attacked by several fungi of which only two can be satisfactorily controlled. Sclerotinia stem rot caused by Sclerotinia sclerotiorum and white leaf spot caused by Cylindrosporium concentricum. The others are Botrytis cineria, Phoma lingam, Verticillium dahliae. Due to local outbreaks of V. dahliae in last year, it was necessary to get information on the importance of it, because it may become increasingly important due to the presence of microsclerotia which may remain viable for several years. It was concluded that the only possible way to reduce V. dahliae would be to breed resistant cultivars. A survey was, therefore, conducted to get an insight into the geographical distribution and the severity of V. dahliae on each field, in order to demonstrate the importance to breeders, farmers and agronomists of not using short rotations with oil seed rape.

Based on the results of this survey, there is scope to decrease the incidence of the disease by integrated control.

2. Methods

In 1985, 1986 and 1987 some regional observations in the northern part of Germany were carried out at growth stage 85 (time of swathing) according to the growth stage described by Schütte, Steinberger and Meier (1982). The presence of microsclerotia was the criterion used for plant infection.

In 1987 an additional survey was carried out over the whole of Germany immidiatly after harvest. This late date was chosen to ensure that all plants which may have developed microsclerotia during the last 14 days of the vegetation period were assessable.

About 100 plants were taken at random from a field. The roots were washed and included in the assessment.

3. Results

Observations at growth stage 85 showed that infection depended on the geographical location. About 50 to 80 % of the fields had diseased plants. Within the infested fields the number of infected plants ranged from 2 to 88 %. On several fields quite a number of plants were badly infected and were scored "8 and 9" within the following scale 1 to 9 which was established for this assessment:

1 = no infection
2 = slight (1 - 5 cm), one sided extension of microsclerotia on stalks
3 = still slight, one sided extensions of microsclerotia (3 - 10 cm), also inside the stalk
4 = value between 3 and 5
5 = symptoms very well developed. The microsclerotia can be seen on a portion of about 15 - 20 cm of the stalk, also on the pith
6 = value between 5 and 7
7 = more than half of the stalk shows microsclerotia, which are located around the stalk. The pith is also surrounded by microsclerotia.
8 = value between 7 and 9
9 = plants completely covered with microsclerotia and prematurely dead.

In 1987 the estimation of the diseases included the following:

1. : Prematurely ripened plants. These were plants which were yellow to brown in contrast to still green plants and were assumed to have prematurely ripened because of fungal infection.
2. : Root rot. The degree of root rot was scored according to a scale 1 - 9 (Krüger, 1985).
3. : P. lingam root and stalk rot. This disease was also scored according to a scale 1 - 9 (Krüger, 1983)
4. : Verticillium-stalk rot. This disease was scored also with a scale 1 - 9. Because it was intended to have the most information on this disease, the mean degree of infection and the percent plants infected are stated in the tables.
5. : On several samples the occurrence of larvae of Psylliodes crysocephala or Ceuthorynchus quadridens was given as % plants having feeding damage.

The results are tabulated in Tabels 1 and 2. It would exceed the aim of this article to include the results of all the 170 fields. In Table 2 the distribution of Verticillium in the Federal Republic of Germany is shown. From the results it can be seen, that the main infection centred in the northern part of Germany. About 70 per cent of the fields had some infected plants. In most of these fields the

degree of infection was slight (index 1 - 3), but there were some fields with a mean degree of infection of more than 5. This indicates, that the disease was present on many plants, some of them with a degree of severity 9, what means dead plants. In the other districts of Germany the incidence was much lower and about 20 percent of the fields had slightly infected plants (1 - 2). Only very few exceptions were observed, in which single fields had severly attacked plants.

4. Conclusions

These results show, that V. dahliae may occur in all districts of Germany but up to now the most severe attacks are centred in the northern parts. The reason for this may be the long period of rape growing in the area. In the other districts rape growing increased only over the last six years. The crop rotation in the northern part of Germany is also very favourable for disease increase as wheat, barley and rape are grown in succession. It may be assumed that the rotation has to be regarded as the main reason for the dominace or V. dahliae in that area rather than the cooler climate in summer.

Future work should consider two aspects. The First one is to determine the damage caused by this disease and the second one is to develop a screening method for breeders. As this fungus seems to enter the plants mainly at late growth stage, it might not be easy to find a rapid method which correlates with the infection of the plants in the field. Cooperative experiments with colleagues in Sweden, where V. dahliae is also appearing are planned.

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Table 1: Occurrence of Verticillium dahliae, root rot, premature plants and larvae of insects mining in the stems of winter rape in the Federal Republic of Germany in 1987

Location of sample	Cultivar	% premature ripened plants	Root rot (1 - 9)	P.lingam root and stalk rot	Degree of infection of plants with V. dahliae (1 - 9)									Mean disease severity	% Plants infected with V. dahliae	% Plants with larvae feeding marks
					1	2	3	4	5	6	7	8	9			
Steinburg/IZ		90	7.9	7.7	35									1.0	0	
Nordstrand/NF			6.9	5.9	28	3	3	1	3	5	3	2	1	2.8	43	
Fehmarn/OH	Liporta		7.8	7.7	5	1	3	3	6	7	8	11	2	5.7	89	
Birkenmoor/RD			6.4	5.5	49	0	1	0	2	1	0	1	1	1.5	11	17
Husum/NF	Jet Neuf	50	5.6	4.0	20	0	0	0	1	2	3	4	6	4.0	44	
Husum/NF	Arabella	92	6.2	5.8	0	0	1	4	3	1	2	3	1	5.8	100	
Bojendorf/OH	Korina		7.5	6.7	59	0	0	1	0	0	1	0	0	1.1	3	27

Table 2: Regional occurrence of Verticillium dahliae on winter rape in the Federal Republic of Germany in 1987

Districts	Number of fields within the following degrees of infection (Scale 1 - 9)						Total number of fields
	1	1.1 - 2	2.1 - 3	3.1 - 4	4.1 - 5	> 5.1	
Schleswig-Holstein	16	15	3	7	1	5	47
Niedersachsen	28	5	0	1	0	0	34
Hessen	15	2	0	0	1	0	18
Baden-Württemberg	14	3	1	0	0	0	18
Rheinland-Pfalz und Saarland	13	4	1	0	0	0	18
Bayern	20	2	1	0	1	1	24

RESISTANCE OF OIL SEED RAPE TO DISEASES: A MEANS TO CONTROL THEM

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Summary

Breeding resistant cultivars is the main means of controlling diseases. Screening of cultivars has to be done according to the symptoms caused by the various diseases. Unfortunately some fungi cause similar symptoms, which are difficult to distinguish. Isolations were carried out to find the main fungi present in discoloured areas on roots,root collar, stems and from inside roots and stems.

A description is given on the symptoms and the fungi isolated from the affected areas. Blue-black to black areas on roots and root collar yielded mainly Phoma lingam (about 70 % of isolations). Grey flecks of watery appearance appeared to be caused by Rhizoctonia solani and from corky rinds of roots P. lingam was predominantly isolated. The same happened with discolourations inside the root cylinder or the root collar.

Grey appearance of the stems which have the same colour inside but no pycnidia of P. lingam present yielded mainly P. lingam. Verticillium dahliae was only found in the rind of stems which had dark stripes.

It is suggested to carry out the observation on diseases at different times. Whilst S. sclerotiorum, Botrytis and P. lingam should be scored at growth stage 85 (time of swathing), V. dahliae is best recognised at the end of the season when the microsclerotia have developed and can be the criterion for disease assessment.

1. Introduction

Growing resistant cultivars is the most effective means to control diseases and fits into the scheme of integrated plant protection. Success was achieved by programmes to breed cultivars with resistance to Phoma lingam, the cause of root and stalk rot. By changing the breeding aim to cultivars low in glucosinolate content, some of the disease resistance was lost and has to be improved again. Resistance is need not only for P. lingam, but also for Sclerotinia and other diseases. When cultivars are screened for resistance, disease symptoms must be known. This is not easy to achieve, because similar symptoms can be caused by a range of fungi. A survey on the occurrence of rape diseases gave some opportunity to make isolations from particular symptoms, and these are described later.

2. Methods

Plants were collected ad random from the field, the roots were washed and the degree of special diseases determined. These plants were afterwards used for isolations in following ways:

Root rot: Discoloured roots were cut off, 1.5 hours washed in fast running tap water, afterwards surface sterilized in 4 % NaOCl-solution for 10 sec. and finally washed 3 times with sterilized water to remove the disinfectant. From infected roots a piece of about 2 mm was cut and dried by pressing with a scalpel on dry filter paper to get as many water out of the tissue as possible. This piece was placed on agar. The pressing of the root on filterpaper is necessary, because too many bacteria developed if there is too much water, even when the agar contained antibiotics (see below). Maltpeptone agar was used throughout. To avoid bacterial growth the following antibiotics were added to the agar: oxytetracycline (40 mg/l), streptomycin-sulfate (40 mg) and penicillin G (30 mg/l). These antibiotics were diluted in water and added after autoclaving and cooling the agar to 50° C. The petri dishes were incubated at room temperature. After 20 days the fungi were identified by microscope.

In the case of special symptoms the same procedure was followed up. When samples were taken from inside the plants, no sterilisation was necessary. These plants were cut with a sterilised knife and a sample of the tissue was taken out from inside the stalks and roots avoiding any contact with surface tissue.

3. Results

The results are compiled in Tables 1 to 3 for the main fungi isolated. Details about all the fungi present are to be published elsewhere. From **roots** the following fungi were predominantely found:
Without taking any special symptom into consideration Fusarium tabacinum and P. lingam were the most frequently ones isolated. Rhizoctonia solani was isolated from 12 % of the sites. The pathogenicity of F. tabacinum is not yet clear, but it seems to be weak and may be a secondary invader.

Blue-black to black discolourations contained about 72 % P. lingam and 35 % F. tabacinum.

In grey spots of various shades F. tabacinum, R. solani and P. lingam were the fungi most frequently observed.

From slightly yellow discolourations F. tabacinum, R. solani and P. lingam were isolated.

If the roots were cut alongside and when darker tissues were visible, P. lingam dominated. Second and third ranged F. tabacinum and R. solani which were found in 29 % and 11.1 % cases respectively.

On some fields, mainly on light soils, large grey flecks of the rind were found which tended to be a soft rot and which included the whole rind. From these rotted patches 58.0 % R. solani was isolated predominantly accompanied by 25.0 % Gliocladium species.

A very special symptom was observed on plants from marshlands. The surface of the rind had a corky appearance. P. lingam was the main fungus isolated and F. tabacinum was present at a rate of 30 %.

At the **root collar** a similar fungus spectrum was isolated as from the roots. Generally F. tabacinum was most common (54 %), P. lingam was found in 27 %, F. avenaceum in 13 %. R. solani and Alternaria spp. occurred in 11 % each. The fungus spectrum was slightly higher in abundance at the root collar than at the roots.

Blue-black to black discolourations as already described at the root cylinder contained about 75 % P. lingam and the same amount of F. tabacinum. Other species were isolated at a very low level. If the root collar was discoloured inside, even more P. lingam was isolated, but less F. tabacinum was present.

Stalks which lacked fruiting bodies or microsclerotia but which had a grey appearance internally contained F. tabacinum, P. lingam and R. solani.

Sometimes a slight pink discolouration was observed when the stalks were cut longitudinal. It appeared to originate on feeding trails of insect larvae. Isolations yielded a high amount of P. lingam, less F. tabacinum and one third of the isolations did not contain any fungus.

4. Conclusions

The isolations from infection sites on winter oil seed rape in which no fruiting bodies or microsclerotia were present revealed a very high proportion of P. lingam, F. tabacinum, R. solani and some F. avenaceum and Alternaria spp. In these discoloured areas V. dahliae was found only occasionally. Therefore, when cultivars are to be screened for resistance, it is possible to distinguish between some fungi. P. lingam can be identified by present pycnidia or the grey appearance inside the stalks and the blue-black to black flecks at the root cylinder or the root collar. R. solani causes watery grey flecks of the rind and if the rind is already deteriorated, brown runner hyphae can be seen at the root cylinder. V. dahliae can be identified on the microsclerotia at the end of the season. If such microsclerotia are not present, V. dahliae is unlikely to be isolated from discoloured areas.

For the pathologist who has to do the scoring some problems are caused by Verticillium. Whilst P. lingam, Sclerotinia stalk rot, R. solani and general root rot have to be scored at growth stage 85 (time of swathing), V. dahliae should be recorded at the end of the vegetations period after threshing, because of the delay in microsclerotia development up to that time.

Table 1. Isolation frequency of fungi mainly present in root rot of winter rape (% isolation sites with fungi)

Fungi isolated	General symptom	Special Symptoms					
		Discolouration			Inside discoloured	Grey flecks on rind	Corky appearance of rind
		black	grey	light			
F. tabacinum	38.5	34.7	54.5	43.5	29.0	8.0	29.5
P. lingam	37.6	71.9	14.5	28.6	61.5	0.0	77.5
R. solani	11.7	4.3	30.3	15.0	11.1	58.0	0.0
V.dahliae	1.4	0.0	1.8	0.0	5.4	0.0	0.0
Number of isolations	800	380	120	280	200	80	40

Table 2. Isolation frequency of fungi mainly present in root collar rot of winter rape (% isolation sites with fungi)

Fungi isolated	General symptom	Special symptoms	
		black discoloured flecks	Inside discoloured
Alternaria spp.	11.1	3.3	0.0
F. avenaceum	13.3	3.3	2.5
F. tabacinum	54.4	74.8	41.5
P. lingam	27.4	74.5	82.5
R. solani	11.3	4.8	5.0
V. dahliae	0.4	0.0	0.0
Number of isolations	700	140	40

Table 3. Isolation frequency of fungi present in discoloured stems of winter rape (% isolation sites with fungi)

Fungi isolated	Stalk inside grey	Special symptoms			
		Stalk inside pink	Discolouration directly below rind		Dark hyphae in rind
			growth stage 85	after harvest	
F. tabacinum	58.4	19.2	18.1	60.6	100
F. dimerum	9.6	5.0	0.8	10.0	0.0
P. lingam	40.2	37.6	29.6	38.8	0.0
R. solani	12.4	0.0	0.0	1.3	0.0
V. dahliae	1.7	0.0	0.0	0.6	20.0
Not grown	3.2	32.0	52.7	3.1	0.0
Number of isolations	100	55	260	400	20

FIRST EXPERIENCES WITH AN EARLY METHOD OF SELECTION FOR RESISTANCE OF WINTER RAPE TO PHOMA LINGAM

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Summary

The best method of controllig stem canker *(Phoma lingam)*, the most important disease on winter oilseed rape world wide, is to grow tolerant or, if possible, resistant varieties. As there is at time no variety in 00-quality which is completely resistant to *P. lingam* commercial varieties which have at least the resistance level of the 0-variety Jet Neuf to the pathogen are needed urgently. A method has been developed with the aim of making early breeding selections for disease resistance to *P. lingam*. Its reliability was tested with "standards" in series of breeding material for five years. The early selection method seems to be suitable for breeding resistance to *P. lingam* in winter rape.

1. Introduction

Stem canker caused by *Phoma lingam* (sexual stage: *Leptoshaeria maculans)* has a world wide distribution and is considered to be the most serious fungal disease in winter rape. At present there are no efficient direct control measures for *P. lingam* in the growing crop. (2). As there are no fungicides with good effiency against stem canker, the most promising control, also from the environmental point of view, will be the cultivation of 00-varieties with the resistance level of the 0-variety Jet Neuf. However, all currently grown winter oilseed rape varieties with 00-quality do not have a degree of resistance equivalent to Jet Neuf. Therefore a rapid and early selection against *P. lingam* is required for resistance breeding of new 00-varieties.

2. Materials and Methods

P. lingam was cultivated on autoclaved oat grains, then mixed with soil (6 g of *P. lingam* grown on oat grains in 94 g soil) and filled in Jiffy pots (size 6 x 6 x 5 cm). In each pot 2 00-rape seeds were sown and after germination singled so that one per pot were left.

Root collar rot and stem canker was evaluated 8 - 10 and 10 - 12 weeks after inoculation at the 4 - 6 or 6 - 8 leaf stage respectively.

Disease evaluation was carried out after a modified scale of Krüger (2). 1 = healthy, no symptoms; 2 + = small brown flecks on the epidermis of the hypocotyl, epidermis sometimes slightly cracked; 2 = brown discolouration of the hypocotyl, slight corky necrosis; 3 = hypocotyl completely necrotic or deep necrotic lesions, many pycindia; 4 = plantlet killed or died during germination.

3. Results

The results of numerous tests (Tables I and II) showed that Jet Neuf was the variety least susceptible to *P. lingam* confirming results over several years from field trials (1).

Table I. Mean attack by *Phoma lingam* of some winter rape varieties after artificial infection

Variety	Stage of disease evaluation	Trial no.	No. of seeded plants	Stem canker*				
				Diseased plants (%)	No. of seedlings/disease index			
					1	2+	2	3	4
Jet Neuf (0)	6 leaves	1/86	20	75	4	0	11	1	0
	5 leaves	2/86	30	60	10	5	6	2	2
	4-5 leaves	1/87	30	80	6	0	9	10	0
	5-6 leaves	2/87	30	81	5	0	8	11	3
	4-5 leaves	1/88	30	67	10	0	8	11	3
	4-5 leaves	2/88	30	60	12	0	0	18	0
	4-5 leaves	3/88	30	48	15	0	14	0	0
	6-8 leaves	4/88	30	53	14	0	16	0	0
	Mean			66					
Bienvenu (0)	6-8 leaves	2/86	30	73	8	0	10	12	0
	5-6 leaves	1/87	50	78	8	4	4	12	4
	5-6 leaves	1/88	30	79	6	0	17	4	2
	Mean			77					
Lirabon (00)	4-6 leaves	1/86	20	100	0	0	5	13	0
	6 leaves	1/87	30	87	4	11	3	12	0
	5-6 leaves	2/87	30	73	8	5	10	7	0
	Mean			87					
Ceres (00)	4-7 leaves	1/87	50	87	5	0	7	15	11
	4-5 leaves	4/87	30	100	0	0	3	13	2
	5-6 leaves	5/87	30	82	5	0	5	18	0
	5-6 leaves	6/87	30	96	1	0	3	15	0
	4-5 leaves	1/88	30	86	3	0	3	15	0
	Mean			90					

*Disease index 1 - 4 scale

The variety Bienvenu was similar to Jet Neuf in its reaction to *P. lingam*. The 00-varieties Lirabon and Ceres were susceptible.

Selections of breeding material of 00-winter oilseed rape from 1984 - 1988 showed interesting improvement in resistance to stem canker when the described method of early selection (Table II) was used from the beginning of the selection process.

Table II. Selection of winter rape progenies (00) on susceptibility for *Phoma lingam* from 1984 - 1988

Trial (no. and year)	Number tested progenies x plants	Germination (%)	Stem canker[1] Diseased plants (%)	Stem canker[1] Disease index[2] (%) 1/2+ 2 3/4	Jet Neuf standard (%)
1/1984	64 x 50 (3200)	98	83	- - -	71
2/1986	54 x 50 (2700)	85	82	- - -	82
2*/1986	replication	94	82	- - -	70
3/1986	53 x 50 (2650)	93	91	- - -	65
4/1987	127 x 30 (3810)	94	50	50 39 11	63
4*/1987	replication	96	65	35 22 43	76
5/1988	104 x 30 (3120)	84	73	26 22 52	60
5*/1988	replication	96	71	29 57 14	58
Mean			75		69

[1] Disease index as Table I

[2] calculation base: diseased plants=100%

4. Discussion and Conclusion

The method of early selection for resistance of winter rape to *Phoma lingam* in glasshouse showed a good correlation (Table I) to the results of the field evaluation for the German recommended list for winter oilseed rape varieties (1). The variety Jet Neuf is a suitable standard for early selection tests.

Experiences with the test in a breeding programme for five years showed that this method of selection of resistance to *P. lingam* shows promise. How far the results obtained in glasshouse relate to field conditions has not been established.

Other methods of early selection e. g. in vitro by using toxins of *P. lingam* in an early stage of "haploids" development could also be of interest in breeding for resistance against stem canker.

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FORECASTING METHOD ON SCLEROTINIA SCLEROTIORUM IN CO-OPERATION WITH FARMERS WITH THE AIM TO REDUCE SPRAYING IN OIL SEED RAPE

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Summary

The infection of oil seed rape by Sclerotinia sclerotiorum occurs at full flowering, when leaf petals have fallen onto leaves and into leaf axils. The infection is very much dependant on prevailing climatic conditions. It was the aim of this research to collect as much climatic dates as possible in order to draw conclusions about conditions which may have favoured the disease most and to establish an accurate forecast of spore flight and infection.

From the results obtained it was obvious, that conditions in those districts, where the disease was present, were favourable for infection. Rainy weather followed by some dry days were suitable for spore discharge and spore germination. On two fields, where apothecia were found no infection was observed. The reason for this appeared to be a long wet phase with heavy rains which may have washed the spores onto the soil.

For the advisory service it will be very difficult to forecast in each case accurately, because slight weather changes seem to have major influence on the amount of infection.

1. Introduction

The aim of this project was to reduce spraying of oil seed rape to fields which are at high risk of infection. Sclerotinia sclerotiorum (Lib.) de Bary occurred throughout the participating countries but with great geographic fluctuations. Even within similar areas there are pockets of infection (Hornig 1981). Previous research has shown that there is no or very slight infection when dry weather is present during formation of stipes and apothecia. Under these conditions the apothecia dry up and do not release ascospores. A similar effect is observed when very wet conditions occur after the formation of the apothecia in spite of excellent development of the fruiting bodies. Spores are not discharged during periods of heavy rainfall because the spores are washed off the apothecia and are not available for discharge (Krüger 1975). This infection does not occur even though fallen petals may be present.

2. Methods

A questionaire was drawn up and sent to colleagues and farmers to fill in the observations. Some of them were returned and evaluated. The results are compiled in Table 1 about weather conditions and disease development.

3. Results

From the data may be seen, that in Great Britain the conditions were favourable for infection. Slight rains at the beginning of full flowering were interrupted

by seven days without rain during which there might have been the discharge of the spores which landed on moist plants. Only one field was affected and nine others with similar climatic conditions had little or no infection. In these fields the infestation with sclerotia may have been very slight or nil.

Four fields in Germany behaved quite opposite. Sclerotia were buried in small plots in field 1 und 2 near Braunschweig, which were only a few 100 meters apart so the climatic conditions were very similar. Throughout flowering the fields remained moist, with exception of one day (30. May 1987). Some continuous rains were experienced. It spite of the presence of apothecia no infected plants were found. It appears that these rains may have washed the ascospores from the apothecia onto the soil.

The results from the other two fields are from marshlands. In spite of some rains at the beginning of flowering, most days had little or only very slight rains (+ = not measurable), which may have been sufficient to enable apothecia to discharge the spores. Subsequently severe infection occurred at these sites.

4. Conclusions

From these observations, it is obvious, that the forecast of Sclerotinia stalk rot of winter rape may be possible only to certain extent. Besides the two extremes- dry weather during apothecia development and full flowering and very moist weather during flowering - the forecast will be difficult if a wet phase is interrupted by some dry days. A few days of rainless weather, during which the crop does not have dry leaves, will lead to only slight infection. If, however, dry spells are somewhat longer and the crop canopy has a chance to become dry and spores are discharged from the apothecia, then severe infection may be experienced. This may have taken place at one field in Great Britain and fields 3 and 4 in Germany.

Forecasting infection remains difficult, because it is not yet known, for how long the dry period has to last. Even if it was known from experimental work, the application of criteria to the field situation would be difficult. It is important to remember that when rains stop for a few days, there will be the danger of infection. As weather forecasts yet cannot be given reliably for longer periods, there remains the possibility that a recommended spray may be without effect, if rain washes the spores off the apothecia or plants.

Future work should be centered on the period during flowering after rain, when dry weather makes it possible to have discharge of ascospores from apothecia. In particular, the length period of drying of apothecia before discharge of ascospores occurs should be examinded. The significance of humidity on spore discharge should be considered in further investigations.

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Table 1: Rain fall, full flowering of winter oil seed rape and the incidence of Sclerotinia-stalk rot (1987)

field/ rain fall (mm)	Dates: April:			May:																	Plants infected %
Great Britain,	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
rain fall	3	4	1	1	0	2	0	0	0	0	0	0	0	2	1	10	1	+	+	6	1	21
	(Nine fields under similar climatic conditions had very slight or no infection)																				
Germany, field 1/	May: 14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31			
rain fall	+	+	2	0	0	0	1	9	0	5	0	0	0	0	15	0	0	4				0
field 2/																						
rain fall	see field 1																					0
field 3/																						
rain fall	7	8	6	2	0	2	5	7	4	0	0	0	0	0	1	0	1	3				45
field 4/																						
rain fall	8	7	5	4	0	2	4	1	+	0	0	0	+	0	0	+	3	1				60

period of full flowering

single apothecia

several apothecia

SCLEROTINIA DEVELOPMENT IN ENGLAND

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Summary
The results from depots of sclerotia of Sclerotinia sclerotiorum monitored during 1984-87 in England are summarised. First apothecia were detected as early as 15 April and as late as 28 June. Apothecia continued to develop up to July at many sites and were occasionally recorded up to November.
The peak of apothecial development occurred 2-8 weeks after the first apothecium was detected. Ascospores were detected about two weeks after the appearance of apothecia. Most plant infection occurred at Wye and Chichester in South East England where apothecial development was most closely synchronised with flowering.

1. Introduction

Although stem rot caused by Sclerotinia sclerotiorum is widespread in winter oilseed rape crops in the UK, severe infections have been rare (1). Surveys of commercial crops have given a mean incidence of 2% plants affected in 1985 (2), 0.7% in 1986 and 0.5% in 1987 (N. V. Hardwick, personal communication). ADAS Plant Pathologists have monitored the appearance of apothecia at various sites in England (Fig. 1) and the results from 1984 to 1987 are summarised in this paper.

2. Materials and Methods

Sclerotia of Sclerotinia sclerotiorum were collected from a severely affected crop of winter oilseed rape in South East England in July each year and distributed to participating centres. The sclerotia were buried equally spaced and 2 cm deep in 12.5 cm pots containing field soil which were buried up to their rim in experimental plots in October or November. The plots were sown with winter oilseed rape in the autumn to produce crop cover comparable to that in commercial crops.

Spore trapping was carried out at some sites following the appearance of apothecia. A sticky glass microscope slide mounted on a stake was positioned with the trap surface facing downwards 15-20 cm above a pot containing sclerotia.

Counts of apothecia and ascospores on spore traps were made several times each week. Just prior to harvest assessments were made on the incidence of Sclerotinia symptoms on plants close to the pots. The locations of the sclerotial depots are shown in Fig 1. The results from 1984-87 are presented in Tables 1-4

3. Results

In 1984, the first record of apothecia varied from 4 May in Kent to 28 June at Hull. They appeared between 2 and 25 days (mean 12 days) after the first rainfall in May following a dry period in April. Apothecia were generally produced up to mid-July but at Wye and Chichester small numbers of apothecia were detected up to 22 November. Spore release from apothecia was detected 2-47 days (mean 17 days) after the first appearance of apothecia. Petal infection was detected by culturing onto potato dextrose agar at Wye and Chichester but not at Harpenden. No spores were detected at some centres (Table 1).

Fig 1.

Sites used to monitor germination of sclerotia of Sclerotinia sclerotiorum

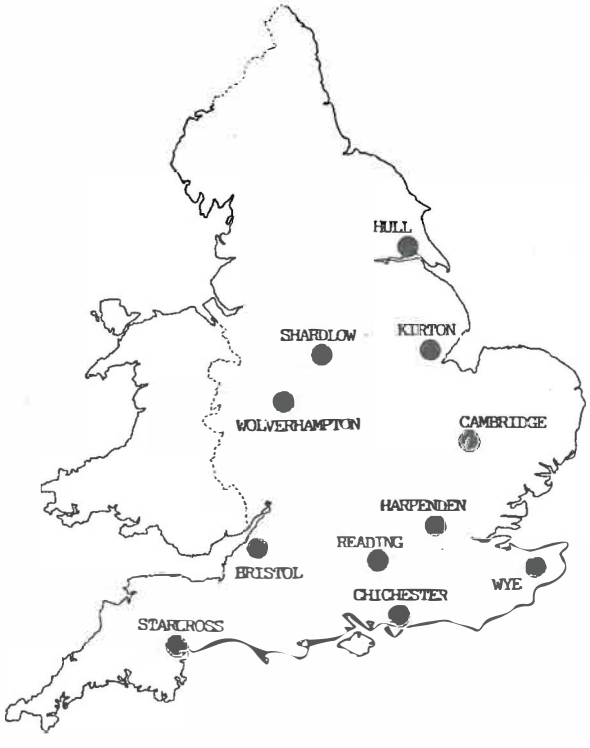

Table 1. Sclerotinia sclerotiorum: monitoring of apothecia, ascospore release and disease of various sites 1984

Record	Wye	CH	SC	Bristol	H	W	Shardlow	CB	Hull
Date of first apothecia	4 May	8 May (field)	15 May	21 May	25 May	26-30 May	4 June	6 June	28 June
Duration of apothecia	17 July (22 Nov)	16 July (22 Nov)	N/A	1 June	23 July	22 June	9 July	N/A	N/A
Date of first rain after April dry period	2 May	2 May	2 May	10 May	18 May	10 May	10 May	20 May	Not known
First ascosporey detected	31 May	23 May	0	23 May	6 June	0	20 July	0	N/A
End of spore production	11-13 July	N/A	N/A	1 June	16 July	0	20 July	0	N/A
Peak period of ascospore production	2-4 June	23 May**	N/A	23 May	11-13 June*	0	20 July	0	N/A
	10-11* June	13 June	N/A	1 June	20-22 June	0		0	N/A
% plants affected (untreated)	27%	48%	0	0	0	0	0	0	N/A

N/A - Not assessed
Petal infection confirmed by culturing:-
* Petal infection
** Petal infection detected from 23 May to 4 June (none up to 21 May)

CH - Chichester SC - Starcross
H - Harpenden CB - Cambridge
W - Wolverhampton

Table 2. Monitoring of apothecia disease and rainfall at various Sclerotinia depots, 1985

Site	Wye	CH	H	Reading	CB	Hull	SC	Shardlow	W
Date of first apothecia	16 April	17 May	17 April	24 April	20 May	13 May	31 May	24 May	23 May
Date of first "significant" apothecia	1st week May	17 May	17 May	13 May	20 May	13 May	31 May	24 May	23 May
Duration of apothecia or records finished	24 July	N/A	1 July	10 July	End July	Mid October	End July	16 Aug	N/A
Periods of peak production of apothecia	2/3 week June	N/A	2nd week June	2/3/4 week June	2/3 week July	2nd week June End July Mid Aug	2nd week June Mid July	End June End July Early August	Peak ascos-pores mid June
Amounts of rain (mm) 7 days prior to "significant" apothecia	4.3	15.4	24.6	4.1	N/A	N/A	41.6	29.4	N/A - -
Diseased plants	23%	High in commercial crops	0	0	0	N/A	Several	N/A	0

N/A - Not assessed

CH - Chichester
H - Harpenden
W - Wolverhampton
SC - Starcross
CB - Cambridge

Table 3. Monitoring of apothecia and ascospores of S sclerotiorum at 3 sites, 1986

Record	Chichester	Wye	Cambridge
Date of first apothecia	30 April	8 May	12 May
Date of last apothecia	11 July *	24 June	10 June *
Peak of apothecia	14 May	9 June	6 June
Date of first ascospores	16 May	0	N/A
Date of last ascospores	6 July	0	N/A
Peak of ascospores	12 June	0	N/A

N/A - Not assessed

* date of last record

A few apothecia were detected in April 1984 but records of significant numbers of apothecia varied between early May in South East England and 31 May in South West England. Most apothecia developed between 13-24 May following 4-41 mm rain in the previous 7 days. Some plant infections occurred at Starcross even though apothecia were first detected one week after the end of flowering (Table 2).

Observations in 1986 (Table 3) and 1987 (Table 4) illustrate that the peak appearance of apothecia in various parts of England can vary by 3 or 4 weeks. Although first apothecia were found in mid to late April at most centres in 1987, germination was particularly late at Wye. The time to reach apothecial production ranged from two weeks after first apothecia appeared at Chichester and Wye to 4 weeks at Kirton, Bristol and Reading in 1987.

Some depots were monitored for a second season and small numbers of apothecia were recorded during May to July.

4. Discussion

Although occasional severe attacks of stem rot (> 20% plants affected) have been recorded throughout England, the area near Chichester has been the only district with consistent problems. Mean monthly maximum and minimum temperature records for the Chichester area are slightly higher than Kiel, FRG and Malmo, Sweden by 1-2°C in April, maximum temperatures are comparable in May (16°C) but minimum temperatures are slightly higher at Chichester (8°C) than both Kiel (6.9°C) and Malmo (6.1°C) (C. Hume, personal communication). Temperature is unlikely to be a limiting factor for apothecial production in England.

Table 4. S sclerotiorum: Apothecial and ascospore production at various sites, 1987

Record	Wye	Chichester	Wolverhampton	Kirton	Bristol	Reading
Date of first apothecia	27 May	22 April	16-21 April	5 May	15 April	17-20 April
Date of last apothecia	6 July	30 June	3 July	3 July	23 July	19 May *
Peak of apothecia	9 June	4 May	8 May	4 June	11 June	15 May
Date of first ascospores	0	5-8 May	1 May	N/A	N/A	1 May
Date of last ascospores	0	28 May	26 June	N/A	N/A	19 May *
Peak of ascospores	0	19 May	18 May	N/A	N/A	1 May
% plants affected	0	22	10	Trace	Trace	Trace

N/A - Not assesed

* date of last observation

Observations on apothecial development in England reported here indicate that ascospores were produced during flowering of winter oilseed rape which occurs from late April to early June. At some sites, particularly in 1984, apothecia were produced at the late flowering stage and no significant plant infection was recorded at these sites.

The influence of rainfall and temperature on apothecial development in Germany has been discussed by Kruger (2, 3). He concluded that risks of infection were high when apothecial development and early flowering were synchronised. In England, this occurred most consistently at sites in Wye and Chichester (where plant infection was also high). Low levels of infection in other districts may be partly explained by the rather late development of apothecia and by prolonged periods to reach peak production of apothecia. Severe infections in Germany usually occur when apothecia develop rapidly (within 2 weeks) after the first appearance of apothecia (W. Kruger, personal communication).

However the authors have noticed that some severe attacks of stem rot in areas outside South East England have occurred where apothecia were detected in adjacent fields. This suggests that the general level of inoculum may be lower in England than in parts of Europe where significant losses from Sclerotinia occur regularly.

Acknowledgements

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DEVELOPMENT OF LIGHT LEAF SPOT (PYRENOPEZIZA BRASSICAE) IN WINTER OILSEED RAPE IN AUTUMN

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Summary

The spread and development of light leaf spot was investigated at 3 sites using pots of oilseed rape seedlings exposed in small plots of winter oilseed rape for 7 day periods. Seedlings were kept under ambient conditions or incubated in polythene bags in a glasshouse and examined for light leaf spot. Bait plants detected spread of light leaf spot during October-December at all sites particularly after symptoms were found in the field plot (late October/early November). Some infection occurred in the absence of recorded rainfall and when mean minimum temperatures were below zero.

1. Introduction

Recent ADAS surveys of winter oilseed rape crops in England and Wales have shown light leaf spot to be the most common disease on stems and pods (1). To date only a small proportion of commercial crops have been severely affected by light leaf spot. Symptoms are often not found until spring but the most serious losses occur when the disease becomes well established in the autumn (2, 3). A clear understanding of the factors affecting the early stages of disease development may enable seasonal variations in disease severity to be predicted and also enable fungicide treatments to be used selectively at an early stage. The results of the first year of this investigation are presented and discussed.

2. Methods

Seed cultivar Jet Neuf and stubble with light leaf spot collected after harvest in 1986 was provided by Dr C. Rawlinson of Rothamsted and allocated to each of 3 sites in England. Plots (approximately 5 m x 5 m) sown on 29 August 1986 or 12 September 1986 at the other two sites, Harpenden and Reading and stubble was scattered over the plots at sowing at Bristol or seedling emergence on 22-25 September. Seed was also sown into pots at the same time as the field plot to provide bait plants which could be introduced into the inoculated field plot for 7 day periods. Two or three seedlings were raised in each 12.5 cm

pot. Ten seedlings (4 pots) were placed in the inoculated plot each week and removed after 7 days. Five seedlings were then placed inside an inflated polythene bag and transferred to a heated glasshouse (minimum temperature 14°C) together with comparable control plants. A further 5 seedlings together with control plants were kept outside under ambient conditions. The area used to raise seedlings in pots and the area used to incubate plants at ambient was isolated from the inoculated plot as far as practicable (at least 25 m).

Assessments of the incidence and severity of light leaf spot was recorded weekly on all the bait plants in pots. Plants incubated in the glass house were kept for a minimum of 4 weeks and then discarded. As far as possible samples of 10-20 plants were examined regularly in the inoculated plots to monitor disease progress. Plants kept at ambient temperatures were retained until the end of the experiment.

Records of temperature, rainfall and leaf wetness or hours of relative humidity above 90% were recorded during the course of the experiment. The mean results for each exposure period were calculated.

3. Results

The results from each of the 3 sites are summarised in Figures 1-3. At Bristol (Fig. 1) light leaf spot was first seen in the field plot on 31 October (growth stage 1.7) when 20% plants showed active sporulation on leaves and a further 50% plants showed sporulation after incubation in the laboratory. Most infection was found on the 2 youngest fully expanded leaves which were first detected during early October. By 7 November light leaf spot had started to cause leaf collapse and affected 90% plants.

Rainfall was recorded every week from 3 October onwards and the lowest weekly mean minimum temperature was only 2.5°C, much higher than at other sites. Infection was detected after glasshouse incubation only 2 occasions during 21-28 November (100% plants affected) and 28 November - 5 December (50% plants affected) but was frequently found after prolonged ambient incubation. Only the periods 19-26 September and 10-17 September was no infection found after ambient incubation. Symptoms on these ambient plants were first seen on 19 December on plants exposed during 7 November - 5 December. Symptoms appeared most quickly on the last batch of these plants exposed during 28 November - 5 December and were seen after only 3 weeks on 19 December. The results of ambient incubation shown in Fig. 1 are for full assessment on 2 January and show the percentage of plants with leaf symptoms. Plants exposed during the period 31 October to 28 November had 50-72% leaves with light leaf spot infection.

Fig. 1 Incidence of light leaf spot on bait plants incubated under ambient or glasshouse conditions and mean maximum and mean minimum temperatures rainfall and leaf wetness during the period of exposure of bait plants at Bristol.

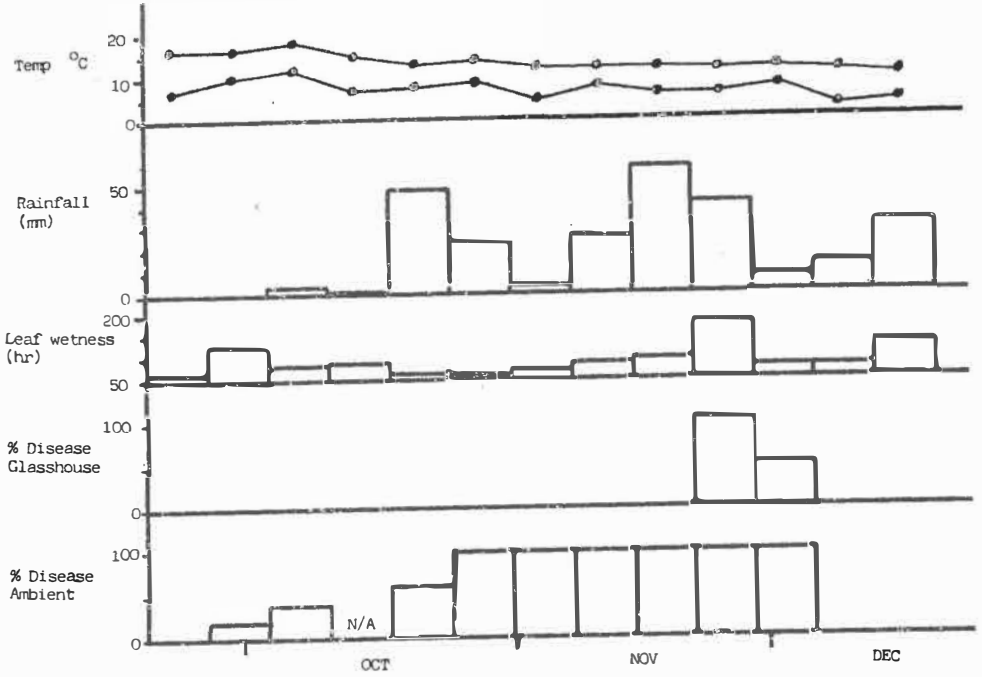


Fig. 2 Incidence of light leaf spot on bait plants incubated under ambient or glasshouse conditions and mean maximum and mean minimum temperatures rainfall and leaf wetness during the period of exposure of bait plants at Reading.

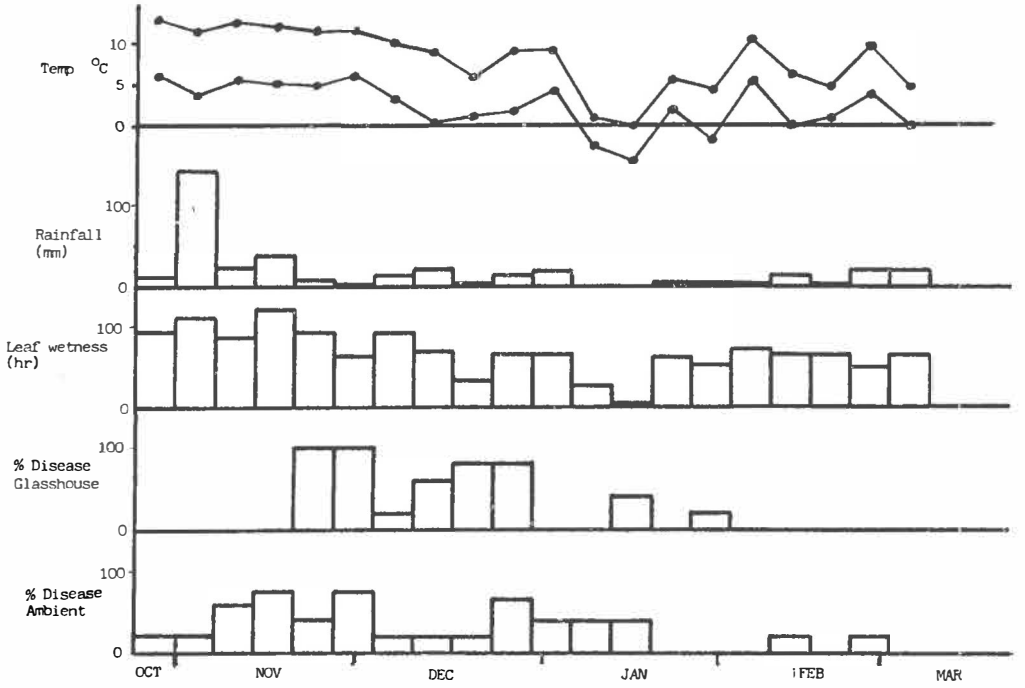
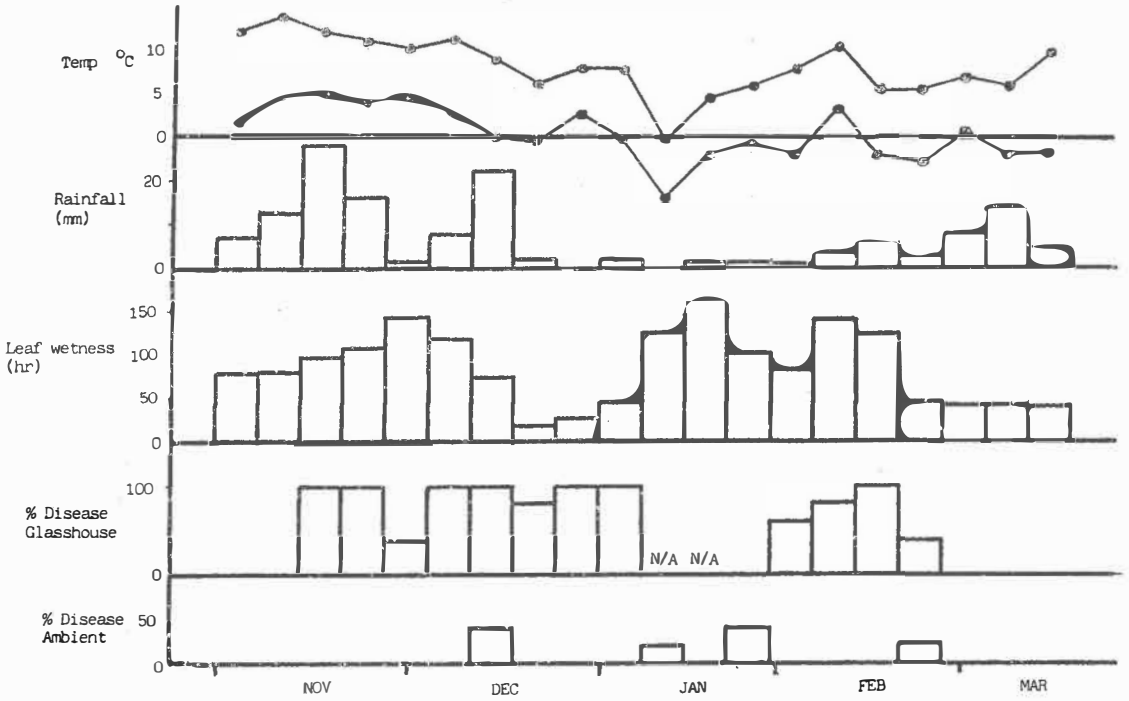


Fig. 3 Incidence of light leaf spot on bait plants incubated under ambient or glasshouse conditions and mean maximum and mean minimum temperatures rainfall and leaf wetness during the period of exposure of bait plants at Harpenden.



The Reading site results are for the period 23 October - 9 March as shown in Fig. 2. Light leaf spot was first seen in the field plots on 6 November when 95% plants were affected at trace levels. Glasshouse incubation for 4 weeks detected light leaf spot spread during 20 November - 29 December but not during 29 December - 12 January. Additional spread was also detected during 12-19 January and 26 January - 2 February. Spread of infection was detected even when mean weekly minimum temperatures were well below zero. No spread during February was detected on glasshouse bait plants but was twice detected on plants retained under ambient conditions. However by February 36-77% of control plants at ambient also showed light leaf spot infection indicating contamination of the nursery beds. Ambient incubation continued at this site until symptoms appeared, generally 4-8 weeks, but continued for 10 weeks on plants exposed during the period 4-11 December.

A trace of infection in the field plot was noted on 23 October at Harpenden (Fig. 3) but no further symptoms were seen until 11 December when 60% plants were affected. Ambient incubation was continued for only 4 weeks at this site and only detected spread during 11-18 December where as glasshouse incubation demonstrated spread of light leaf spot during 13 November - 8 January. Control plants showed some light leaf spot infection from 22 January onwards. The spread of infection occurred even in the absence of detectable rainfall during 23 - 31 December at Harpenden.

4. Conclusions and discussion

Bait plant studies suggested that spread of light leaf spot occurred throughout the autumn and winter. High levels of light leaf spot infection occurred on bait plants at all 3 sites after the appearance of symptoms in field plots. There were some differences between ambience and glasshouse incubation between the various sites; the former was slow and required up to 12 weeks incubation before symptoms appeared. Under these conditions there was some risk of contamination or plant to plant spread within the nurseries. Under optimum conditions light leaf spot developed within 3 weeks of exposure to the plots under both glasshouse and ambient conditions.

There were a few weeks when no spread was detected and this could not be readily attributed to fundamental factors such as the absence of rainfall or very low temperatures.

There was some problems with bait plant techniques notably the maintenance of the older green leaves during glasshouse incubation and avoiding background or seed-borne contamination. It was clear that the light leaf spot was well established within control plants from late January onwards and results from this period onwards are of limited value. Prolonged incubation was needed before some seedlings showed leaf symptoms and this

suggests limited spread of infection took place during the period of exposure. Conversely bait plants which developed symptoms rapidly probably indicate movement of high levels of inoculum. Further work is required to investigate the very early stages of light leaf spot establishment particularly in late August and during September. Circumstantial evidence from the appearance of field symptoms suggests that the disease became established during late September or early October (ie 3-4 weeks before the appearance of field symptoms) at these sites. However it is not yet possible to distinguish between symptoms which arise from high levels of inoculum dispersed several weeks after emergence and those which develop after disease development within the plant after dispersal of low levels of inoculum at emergence. The use of spore traps may assist resolution of this difficulty.

Acknowledgements

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[a:ppath.9/JR]

OCCURRENCE OF LIGHT LEAF SPOT (PYRENOPEZIZA BRASSICAE) IN WINTER OILSEED RAPE

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Summary
The incidence and severity of light leaf spot was determined in England in 1986 and 1987 in the spring and again prior to harvest. Symptoms were found in the spring in 75% and 74% crops in 1986 and 1987 but mean severity was low. Stem and pod symptoms were found in 75-95% crops in July although fungicide sprays had been applied. In the Federal Republic of Germany light leaf spot was found in 61% crops at the full flowering stage in 1987 but mean severity was low. In FRG most cultivars were double low type but in England 98% of crops were single low (high glucosinolate) cultivars.

1. Introduction

Recent surveys of diseases in winter oilseed rape crops in England have shown that light leaf spot caused by the fungus Pyrenopeziza brassicae was the most common disease on stems and pods. A collaborative project was organised by the Working Group "Integrated Control in Oilseed Rape" of the International Organisation for Biological and Integrated Control of Noxious Animals and Plants to establish the importance of light leaf spot in major areas of oilseed rape production in Europe. This paper summarises the results from England and the Federal Republic of Germany during 1986 and 1987.

2. Materials and Methods

The incidence and severity of light leaf spot infection was determined on samples of 25 plants per crop. In England samples were collected from 95 crops in 1986 and 98 crops in 1987. Representative crops were selected from all areas of production in England and Wales in proportion to the cropped area and sampled at early stem extension (March/early April) and

again just prior to harvest in July. In Germany samples were taken at the full flowering stage from 23 crops in 1987 and disease severity was assessed on a 0-9 scale.

3. Results

In England light leaf spot was found in 75% crops in spring 1986 and 74% crops in 1987 with mean percentage leaf area affected 1.1% and 0.8% respectively. In July 1986 94% crops showed stem infection (mean 54% plants) and 95% crops had pod symptoms which affected 2.2% pod area. Stem symptoms were found in 83% crops (mean 37% plants affected) in 1987 whilst pod infection occurred in 75% crops in 1987 and affected 3.7% pod area.

Survey fields were predominantly cultivar Bienvenu in both seasons (76% crops in 1986 and 77% crops in 1987), and double low cultivar comprised 2% of crops examined in 1987. Fungicides, primarily for light leaf spot control were applied in the spring to 17% crops in 1986 and 43% crops in 1987. At the end of flowering fungicide sprays were applied to 37% crops in 1986 and 52% of survey fields in 1987.

In Germany, 61% crops had light leaf spot infection which occurred at trace levels in half these crops and at mean severities below 10% leaf area affected (Index 2 or 3 on 0-9 scale) in the remainder. There had been little use of fungicide sprays and cultivars were mainly "double low" types.

4. Discussion and Conclusions

These observations indicate that Pyrenopeziza brassicae is widespread in both England and Germany (FRG). The disease showed an increase in incidence between the spring and summer surveys in England which suggests infection was more common in England than in Germany. Differences in the timing of the survey however prevents comparising of the severity of infection in the participating countries.

Further monitoring of fungal diseases in Europe is needed to establish the impact of "double low" cultivars on disease incidence. New cultivars are likely to be introduced rapidly over the next two years despite limited observations on their susceptibility to pests and diseases.

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[a:ppath.8/JR]

CONTRIBUTION TO THE OCCURRENCE AND DISEASE DEVELOPMENT OF VERTICILLIUM DAHLIAE IN WINTER RAPE

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Summary

Occurrence and importance of *Verticillium dahliae* in winter rape in different parts of West Germany varies considerably. In 1987 the disease caused locally severe attacks in Schleswig-Holstein, moderate infection at one site in Niedersachsen and was observed for the first time in Westfalen. First visible symtoms were wilting during flowering of only very few plants follwed by a brownish longitudinal stripe at the ripening stage, early ripening of the plant and, finally as a brown-greyish discolouration of the stem with greyish-black microsclerotia at or after harvest. As the occurrence of early ripening caused by *V. dahliae* resembles that caused by *Sclerotinia sclerotiorum* or *Phoma lingam* it is the microsclerotia, the last stage of disease development, that is characteristic for the evaluation of *V. dahliae* in the field.

1. Introduction

As there is little known about occurrence and disease development of rape wilt and stem rot caused by *Verticillium dahliae* in Germany (2), further investigations were carried out in several counties of the Federal Republic in 1987. The disease has been regarded in Sweden as a serious problem in oilseed rape since 1960 (4) and could threaten rape production in some parts of Germany. The aims of this study were to monitor the disease development in the field and to indentify definite stages for disease assessment of *V. dahliae*. Studies from Krüger (3) showed that it is rather difficult to make a precise diagnosis of *V. dahliae* in the field or, after infection of rape with *V. dahliae*.

2. Materials and Methods

In Schleswig-Holstein, Niedersachsen and Westfalen various fields were assessed visually at flowering, ripening, harvest and after harvest for *V. dahliae*. Final indentification was carried out by digging up 100 plants after harvest from each field and cutting them in half longitudinally with a knife for visual identification of diseases.

In case of doubt tissue samples from the bark and the central part of the stem base and from the bark and the central part of the main root were rinsed for 24 hours in running water, incubated on agar (SNA, PDA) at room temperature and examined microscopically.

3. Results

Investigations carried out in Schleswig-Holstein, Niedersachsen and Westfalen showed that *V. dahliae* was present in all the examined fields (Table I). Very often the pathogen occurred in connection with other fungi of foot diseases such as *P. lingam, S. sclerotiorum* or *Fusarium spp.* (Table I and Table II).

Table I. Observations on *Verticillium dahliae* and other pathogens in three counties in West Germany 1987[1]

Cultivar	Hohenlieth (Schleswig-Holstein)				Göttingen (Niedersachsen)			Verne (Westfalen)			
	%diseased plants	Pathogen* *P.l.*	*V.d.*	*S.scl.*	%diseased plants	Pathogen* *P.l.*	*V.d.*	%diseased plants	Pathogen* *P.l.*	*V.d.*	*Pl+Vd*
Belinda	12	1	3	8	65	0	65	58	13	21	24
Lirakotta	25	2	21	2	69	1	68	50	15	21	14
Jet Neuf	22	1	15	6	57	1	56	55	7	27	21
Rubin	12	2	9	1	47	1	46	54	12	22	20

1) Rapoolringversuch
*) evaluation from 100 stems/cultivar in laboratory *P.l.= Phoma lingam, V.d. = Verticillium dahliae, S. scl. = Sclerotinia sclerotiorum*

The most severe attacks of *V. dahliae* in winter oilseed rape occurred in Schleswig-Holstein. Locally some rape fields were severely attacked by the pathogen (Table II) as the primary cause of the disease.

Table II. *Verticillium dahliae* on winter rape from different places in Schleswig-Holstein 1987

Cultivar	Location	Pathogen*			
		Stem base		Main root	
		primary	secondary	primary	secondary
Jet Neuf	Tralauerholz	*V. dahliae*	*P. lingam* *F. spec.*	*V. dahliae*	*P. lingam* *F. sp.*
Rubin	Wulmenau	*P. lingam*	*F. sp.*	*P. lingam*	*F. spec.*
Ceres	Althorst 1	*V. dahliae*	*P. lingam* *F. sp.*	*V. dahliae*	*P. lingam* *F. sp.*
Ceres	Kogel 1	*V. dahliae*	*P. lingam*	*V. dahliae*	*P. lingam* *F. sp.*
Ceres	Althorst 2	*P. lingam*	*V. dahliae*	*P. lingam*	*V. dahliae*
Rubin	Kogel 2	*V. dahliae*	*P. lingam*	*V. dahliae*	*P. lingam*
Rubin	Kogel 3	*V. dahliae*	*P. lingam*	*V. dahliae*	*P. lingam* *F. sp.*

*Isolation and diagnosis in laboratory: primary=pathogen in the centre of the stem base/in the centre of the root; secondary= pathogen in the bark

V. dahliae caused as the main pathogen in single fields in Niedersachsen medium attack (min. 46%, may. 68%) and, in Westfalen slight attack (min. 21%, may. 27%).

First visible symptoms of *V. dahliae* occurred at the late flowering stage of winter rape as wilting. However this was rarely observed. Normally disease symtoms showed as a light brown longitudinal stripe starting on the main stem and then going over to the side branches of the rape plant, whilst the other parts of the plants remained green. At the ripening stage, stem and branches became complete brown. Later, affected plants showed early ripening. This symptom of disease development of *V. dahliae* can be easily confounded with that caused by *S. sclerotiorum* or *P. lingam*. A very late stage of disease development is that of a brown-greyisch discolouration of the stem with many microsclerotia on and inside the stem. This is very readily seen especially after harvest. The roots are discoloured blue-greyish.

In case of doubt regarding visual indentification of *V. dahliae*, plants should removed from soil with their roots and be inspected by means of a hand lens or even a stereo-microscope.

4. Discussion and Conclusion

V. dahliae the cause of rape wilt and stem rot has been severe in some parts of Schleswig-Holstein. It appears to occur where crop rotations for oilseed rape have been short. Very often the fungus is to be found in combination with other fungal pathogens.

The symptoms of the disease occur rather late in the field and can be easily confused with those of other fungal pathogens of rape. Therefore visual indentification of *V. dahliae* as the main cause of early ripening is rather difficult.

Many biological and environmental factors of the etiology are still unknown. The control of the disease is very difficult. The most promising one seems to be breeding for resistance. (1). Most of the rape cultivars are susceptible to the disease. How far antagonistic microbes in soil can support disease control is unknown.

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