The importance and control of insect pests of winter wheat and winter oilseed rape in Schleswig-Holstein, 1999 – 2001, and the trends of insecticide use there, 1999 – 2004

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Abstract. Bedeutung und Bekämpfung von Schadinsekten an Winterweizen und Winterraps in Schleswig-Holstein, 1999-2001, und der Trend der Insektizid-Behandlungen von 1999-2004. Winterweizen bedeckte 1999-2004 64 % der Ackerfläche Schleswig-Holsteins, Winterraps 31 %. Die wichtigsten Schädlinge an Winterweizen waren die drei Getreideblattlausarten (Hom., Aphididae)(*Sitobion avenae* und *Metopolophium dirhodum*, selten *Rhopalosiphum padi*) und die beiden *Oulema*-Arten (Getreidehähnchen)(*O. melanopus* und *O. lichenis*) (Col., Chrysomelidae). An Winterraps traten im Untersuchungszeitraum auf: *Meligethes aeneus* (F.) (Rapsglanzkäfer) (Col., Nitidulidae) und *Ceutorrhynchus assimilis* (Payk.) (Kohlschotenrüßler) (Col., Curculionidae). In beiden Kulturen wurden sechs Feldversuche durchgeführt, mit frühen und späten Insektizid-Applikationen (an je zwei Standorten, mit vierfacher Wiederholung). Bei Weizen waren die Parzellen 50 m² groß, bei Raps 90 m². Bei Winterweizen zeigten beide Schaderreger-Gruppen negative Einflüsse auf den Ertrag, wenn sie nicht bei Bekämpfungsschwellen bekämpft wurden. Sowohl der Getreidehähnchen- als auch der Blattlausbefall waren signifikant negativ mit dem Ertrag korreliert. Die ökonomische Auswertung ergab, dass im Untersuchungszeitraum – bei Beachtung der Bekämpfungsschwellen - die frühe Bekämpfung der Getreidehähnchen-Larven wirtschaftlicher war als die spätere der Getreideblattläuse. Bei Winterraps erwies sich die Bekämpfung des Kohlschotenrüsslers als ertraglich und ökonomisch vorteilhaft, selbst ohne Auftreten von *Dasineura brassicae* (Winn.), der Kohlschotenmücke. Die Bekämpfung des Rapsglanzkäfers hingegen war nur in einem von sechs Versuchen ertragsmäßig und ökonomisch erfolgreich. Die Probleme bei diesem Schädling sind 1. die zu niedrige Bekämpfungsschwelle und 2. die Resistenz gegenüber synthetischen Pyrethroiden. Wurden in Schleswig-Holstein 1999 75.000 ha Ackerfläche mit Insektiziden behandelt (22.7 % AF), stieg die Fläche bis 2004 auf 220.000 (66.5 % AF). Die Anteile der einzelnen Wirkstoffe haben sich verändert.

Key words: Winter wheat, winter oilseed rape, pests, control, action thresholds, yield, economy, insecticides

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In the average of 1999 to 2004 winter wheat covered 64 % of the agricultural land of Schleswig-Holstein (331.000 ha), winter oilseed rape 31 %. These two important crops (covering 95 % of the acreage) were attacked in 1999 to 2001 by a) wheat: cereal leaf beetles (*Oulema* spp.Col., Chrysomelidae) and by cereal aphids (mainly *Sitobion avenae* and *Metopolophium dirhodum*; Hom., Aphididae; b) Oilseed rape: by pollen beetles (*Meligethes aeneus* F.; Col., Nitidulidae) and by the cabbage seed weevil *Ceutorrhynchus assimlis* (PAYK.) (Col., Curculionidae). Studies (with six field experiments per crop, at two sites, 1999 to 2001) were done by the first author in the course of the work on a PhD thesis (KIRCH 2006) to clarify the economic importance of these pests, and to look for the validity of the action thresholds published. Additionally, 51 farmers were inquired for their insecticide use, 1999 to 2004.

Study areas and methods

Studies took place near Lübeck, with six field experiments per crop (at two sites, each, every year). Plot size was 50 m² in wheat, and 90 m² in oilseed rape, with four replicates. In wheat an early insecticide spray aimed at the control of cereal leaf beetle larvae, and a later one at the control of cereal aphids, according to action thresholds. In oilseed rape an early insecticide spray aimed at the control of the pollen beetle adults, and a later one at the control of cabbage seed weevil adults, both according to action thresholds. Additionally, for gaining further information, two insecticide treatments were done, in extra plots.

The following action thresholds, which are adopted by farmers in Schleswig-Holstein, were also used in this study. A. Winter wheat. 1. Cereal leaf beetles: 0.5 to 1 larva per flag leaf of wheat at BBCH 51-55 (OBST & GEHRING 2002). 2. Cereal aphids: 30 % of ears and/or flag leaves attacked at BBCH 69 (BASEDOW et al. 1994). B. Winter oilseed rape. 1. Blossom beetle adults: 2 beetles per plant at BBCH 55-57 (HOSSFELD 1987). 2. Cabbage seed weevil: 1 beetle per plant (at low incidence of the pod midge *Dasineura brassicae* Winn.) (HOSSFELD 1987). Pest attack (per 50 plants) was measured weekly, especially around the critical thresholds, and yield was assessed (by a small combined harvester, without plot margins), and economy was calculated, taking into account the costs of treatments (Table 1). The actual price of wheat/oilseed was used.

For statistics, a program of Syngenta Co. was used (ACSAPWIN), analysis of variance at p = 0.05. If values were not normally distributed, they were transformed to logarithms.

Table 1. Calculating economy of treatments: the values of the last column had to be substracted from the yield

Treatment(s)	Crop	Driving (€/ha)	Insecticide(s), €/ha	Expressed as dt/ha
One, early	Winter what	10.-	7.50	1.67
	Oilseed rape	10.-	5.00	0.83
One, late	Winter wheat	10.-	12.00	2.10
	Oilseed rape	10.-	7.50	0.97
Two	Winter wheat	20.-	19.50	3.76
	Oilseed rape	20.-	12.50	1.81

Results

1. Winter wheat

Pests: *Oulema* spp. proved to be represented in five of six cases with 0.7 to 1.1 larvae per flag leaf (at BBCH 51-55), i.e. above the action threshold of 0.5 to 1. One site in 1999 had only 0.2 larvae per flag leaf. Cereal aphids were observed at BBCH 69 in five of six cases with 25 to 40 % attack, i.e. near or above the action threshold of 30 % attack. 0ne site in 1999 had only 10 % attack. Three significant correlations were observed. One negative between the yield (relative) and the leaf area damaged by *Oulema*-larvae:

$y = -0.2489x + 100.09$; $R^2 = 0.6574$. The other negative between the yield (relative) and the number of aphids per plant: $y = -0.3482x + 100.6$; $R^2 = 0.6387$. In one case, a positive correlation was observed between aphid attack and sooty moulds (which may be also important for the yield): $y = 1.948x + 9.6617$; $R^2 = 0.7233$.

Yield: Table 2 shows that wheat yields significantly increased by the treatments, due to pest control. The late treatment alone (with Pirimor) showed the lowest yield increase. But it was important to look at the economy.

Ecomomy: In Table 3 the economic data for the experiments in winter wheat are shown. In the average it turned out, that the early treatment against the cereal leaf beetle larvae gave a net output of 33.0 €, while the later control of the cereal aphids gave a net output of 15.1 €, only. The two treatments against both pests, gave the same net output as the early treatment: 35.5 €. That is to say, a double treatment is not economic.

Table 2. The yield of winter wheat, dt/ha in Untreated, and relative, in the field experiments near Lübeck.
* All treatments increased the yield (dt/ha) significantly at p=0.05 (ANOVA)

Treatment(s)[1)]	year	Site I (dt/ha)/relative	Site II (dt/ha)/relative	Yield relative, average
Untreated	1999	90.5 dt/ha	112.8 dt/ha	100
	2000	86.6 dt/ha	81.3 dt/ha	100
	2001	78.0 dt/ha	102.6 dt/ha	100
Karate CS, at BBCH 51-55	1999	105*	105*	105.0*
	2000	108*	105*	106.5*
	2001	105*	104*	104.5*
Pirimor, at BBCH 69	1999	103*	103*	103.0*
	2000	105*	104*	104.5*
	2001	107*	103*	105.0*
Karate CS, early + Pirimor, late	1999	107*	107*	107.0*
	2000	109*	107*	108.0*
	2001	107*	108*	107.5*

[1)] All products were applied at registered concentration

Table 3. The economic description of the 6 field experiments in winter wheat near Lübeck at two sites (I & II)

Treatment	year	Yield gain (dt/ha)		Yield gain (dt), economic		Net output (€)		
		I	II	I	II	I	II	Average
One, Early	1999	4.6	5.7	2.9	4.0	30.8	42.3	36.6
	2000	7.9	4.0	4.9	2.3	51.2	23.9	37.6
	2001	3.9	4.2	2.2	2.5	23.5	26.6	25.1
One, late	1999	2.6	3.1	0.5	1.0	5.3	10.5	7.9
	2000	4.5	3.5	2.4	1.4	25.4	14.7	20.1
	2001	5.4	3.3	3.3	1.2	35.1	12.6	17.3
Two	1999	6.2	8.1	2.4	4.3	25.6	45.6	35.6
	2000	7.9	6.1	4.1	2.3	43.5	14.0	33.8
	2001	5.5	8.0	1.7	4.2	17.9	44.5	31.2

Table 4. The yield in the six experiments in oilseed rape, at two sites near Lübeck.
* figures followed by an asterisk are significantly different from Untreated at p=0.05 (ANOVA)

Treatment	Year	Site I, dt/ha and relative	Site II, dt/ha and relative
Untreated	1999	35.9 (100)	43.4 (100)
	2000	35.4 (100)	45.0 (100)
	2001	53.2 (100)	42.8 (100)
Karate CS, at BBCH 55-57	1999	101	101
	2000	101	101
	2001	102	103*
Karate CS, at BBCH 61	1999	103*	105*
	2000	103	104
	2001	103*	104*
Karate CS, at BBCH 55-57 + 61 (twice)	1999	105*	104*
	2000	104	104
	2001	104*	107*

2. Oilseed rape

Pests: The attack by the pollen beetle *M. aeneus* at BBCH 55-57 was in one case 1/plant, in five cases < 3. So its control was in all experiments justified according to the available action threshold. The attack by the cabbage seed weevil *C. assimilis* was 1.0 per plant and higher at BBCH 61 in four experiments, i.e. above the action threshold, and 0.6 per plant in two experiments, i.e. shortly below the action threshold. The occurrence of the pod midge (*Dasineura brassicae*) was negligible during our studies (otherwise the action threshold would have to be lowered to 1 beetle per 2 plants; HOSSFELD 1987).

Yield: From Table 4 can be seen, that the early insecticide treatments against *M. aeneus* resulted only in one of six cases in a significant yield increase. The later treatment against *C. assimilis,* however, gave a yield increase in four of six experiments. The two experiments with insignificant yield increase were not those with the low attack, shortly below the action threshold.

Economy: The economic calculation (Table 5) showed that the early insecticide treatment against *M. aeneus* according to the action threshold was economic in 50 % of cases, only. This is to say, that the action threshold is apparently too low. The control of *C. assimilis*, also according to action threshold used so far, was economic in five of six cases. So the action threshold is alright. The double treatment was only economic, like the early treatment, in 50 % of cases, only. So a double treatment is not economic.

Table 5. The economic description of the six field experiments in winter oilseed rape near Lübeck at two sites (I and II)

Treatment	year	Yield gain (dt/ha)		Yield gain, economic, dt		Net output (€)		
		Site I	Site II	Site I	Site II	Site I	Site II	Average
Karate CS, early	1999	0.4	0.5	-0.43	-0.34	-7.20	-6.12	-6.66
	2000	1.1	0.4	0.26	-0.44	4.68	-7.92	-1.62
	2001	1.3	1.1	0.46	0.26	8.28	4.68	6.48
Karate CS, late	1999	1.1	2.3	0.13	1.33	2.34	23.94	14.14
	2000	1.7	0.9	0.73	-0.07	13.14	-1.26	5.94
	2001	2.4	1.7	1.43	0.73	25.74	13.14	19.44
Karate CS, early + late	1999	1.7	1.9	-0.11	0.09	-1.98	1.62	-0.18
	2000	1.8	1.5	-0.01	-0.31	-0.18	-5.68	-2.38
	2001	3.0	1.9	1.19	0.09	21.42	1.62	11.52

3. Insecticide use

The inquiry of 51 farmes showed, that 1999 75.000 ha had been treated with insecticide (22.7 % of the acreage), being 220.000 ha (66.5%) in 2004, a threefold increase. The percentage of the different insecticides has changed, new and old ingredients coming up.

Discussion

In winter wheat it seems important to look besides cereal aphids also for the cereal leaf beetles, according to action thresholds. It has to be pointed out, that a double treatment has not shown to be economic.

For winter oilseed rape it must be said, that the blossom beetle *M. aeneus* is a major problem, due to two facts: 1. The action threshold of two beetles per plant is apparently too low. DAEBELER et al. (1980) have shown, that oilseed rape action thresholds can 8 to 10 beetles per plant (at very favourable conditions), or 5 to 6 (under less suitable conditions). 2. The upcoming resistance of the blossom beetle to synthetic pyrethroids (HANSEN 2003, HEIMBACH 2005) makes it necessary to re-consider the concept of its chemical control. *Ceutorhynchus assimilis*: its control is mostly necessary (according to action thresholds), especially if *Dasineura brassicae* will occur.

For a small area near Kiel, BASEDOW (2002) has shown that the insecticide use had been gone down to zero in 1999. The more wide spread present inquiry has shown, that insecticide use was low in 1999 (not zero), but increased again. This shows, that farmers in Northern Germany are aware of pests, due to a good information and education.

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