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Nordic Guidelines for Biological Evaluation of Pesticides

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NORDIC GUIDELINE FOR THE BIOLOGICAL EVALUATION OF PERSTICIDES

This guideline is made by a working group under the Nordic Committee for Biological Evaluation of Pesticides.

The aim is to provide a general scheme for testing of pesticides in the Nordic countries and to improve the cooperation concerning biological evaluation and to make the testing of pesticides standaardized and efficient.

The guideline is based on EPPO guideline and national guideline for biological evaluation of pesticides and contains a short description of the biology of noxious organisms and how to establish, manage, evaluate and report plant protection trials.

The work has been financed by the Nordic Council.

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NORDIC GUIDELINE NO. 7

POWDERY MILDEW OF *BEGONIA* IN GREENHOUSE

1. PATHOGENS

Powdery mildew of *Begonia* spp., caused by *Oidium* spp. (*Erysiphe "polyphaga" Hammarlund*, *Microsphaera begoniae* Sivanesan).

Normally only det conidial stages of these species are seen, and they are difficult to distinguish. By measuring the length and width of 25-50 conidia it is possible to separate them, and this operation should be carried out as there may be differences in fungicide sensitivity between the species. Measurements of conidia (length x width, in mikrometer):

Erysiphe polyphaga:	34.4 x 13
Microsphaera begoniae:	50.2 x 14.5

1.1. Hosts
Begonias (*Begonia* x *cheimantha*, *B.* x *hiemalis*, *B.* x *tuberhybrida* etc.). Several greenhouse plants may be hosts for the genus *E. polyphaga* ('greenhouse mildew').

1.2. Symptoms are the same for both Species. Powdery Mildew Develops as a Superficial, Mealy coating, forming small white spots which expand and may cover the upper surfaces of the leaves completely. Lower leaf surfaces, stems and flowers are more sparsely colonized.

1.3. Epidemiology
The pathogens are spread by the conidia and overwinter in the conidial stages on host plants in greenhouses. Cleistothecia are seldom found and are of no importance to the survival of the pathogens in the Nordic countries.

1.4. Possibilities for Misidentification
None.

2. EXPERIMENTAL CONDITIONS

2.1. Selection of Crop and Cultivar
A susceptible cultivar of one of the above-mentioned host plants should be used throughout the test. The test plants must be at the same growth stage at det time of treatment.

2.2. Environmental Conditions
The trial should be carried out in a greenhouse with uniform cultural conditions for all plants. Irrigation/fertilizing should preferably be from below (capillary pad or something similar).

The growth medium and type of pot should be recorded, likewise type, time and intensity of artificial lighting, if used.

Air temperatur and relative humidity should be recorded continuously during the entire test period, or max./min. and average figures should be noted.

2.3. Disposition and Size of Plots
Replicates: normally 3-4.
Experimental design: randomized block or systematic block design.
Plot size: 3-10 pots.
Buffer plants: not required; if adequate spacing between plots.

Separate greenhouses or compartments should be used for each treatment if products with high vapour pressure, fumigants, aerosols and fogs are to be tested.
In such cases, the trial may be carried out without replicates.

2.4. Inoculation
In order to ensure infection, the crop may be inocultated (e.g. by attacking 1 cm discs from a heavily infected leaf, for 24 h, to the plants/leaves to be infected, or by spraying conidial suspension on the plants and keeping the environment humid). The method used should be recorded.

3. APPLICATION OF TREATMENTS

3.1. Product(s) to be Tested
According to the trial description.

3.2. Reference Product(s)
Registered product(s) which have widely proved satisfactory in practice. Formulation type and mode of action should be as close as possible to those of the product(s) to be tested.

3.3. Mode of Application

3.3.1. Type of Equipment used
Application with currently used equipment. The system used should provide an even distribution of the product on all plants in the plot. Give information on the type of equipment and operating conditions (working pressure).

3.3.2. Time and Frequency of Application
The first application should take place when infection is first noticed, if no other recommendations have been made. Application should normally be repeated at 7-10 day intervals, at least three

times. An alternative number of applications and length of intervals should be used if requested. The number of applications and the date of each, as well as the state of development of the plants, should be recorded.

3.3.3. Doses and Volumes
The product should normally be applied at the dosage recommended by the applicant.
Plants should be sprayed until total wetness (start of runoff).
Data on concentration (%) and volume should be given.

3.3.4. Data on Chemicals used against other Pests, Diseases or Weeds
If other chemicals have to be applied, provision must be made to ensure that interference is minimal. These chemicals have to be applied uniformly on all plots and, normally, should be applies separately from the product(s) being tested.
If biological control of insects or pathogens is being carried out, care should be taken that organisms are uniformly spread on all plots.
Precise data on these applications must be given (time of tretment, stage of development of the plant and pesticide or organism used).

4. MODE OF ASSESSMENT, RECORDING AND MEASUREMENTS

4.1. Assessment of Effect of Fungicide(s) on Powdery Mildew of *Begonia*

4.1.1. Time and Frequency
The first assessment: immediately before treatment.
Intermediate assessment: at least three intermediate assessments should be made, timed according to desease development (generally just before the next treatment).
Final assessment: 7-14 days after the last treatment. Plants treated with eradicant fungicide should have their leaves marked and infection level repeatedly checked on the same leaves. Yellow or necrotic leaves should not be taken into account.
Date of each record should be noted as well as state of development of the plant.

4.1.2. Type
Assess the percentage leaf area affected on the upper surfaces of 5-10 leaves of the same age/position on all plants, starting with the youngest leaf infected on unsprayed plants and downwards. If appropriate, infection on lower leaf surfaces and/or in flowers should also be assessed.

A scale such as the following may be used (cf. figure 1):

Grade	% leaf area infected
1	0
2	0 - 1
3	2 - 5
4	6 - 20
5	21 - 40
6	> 40

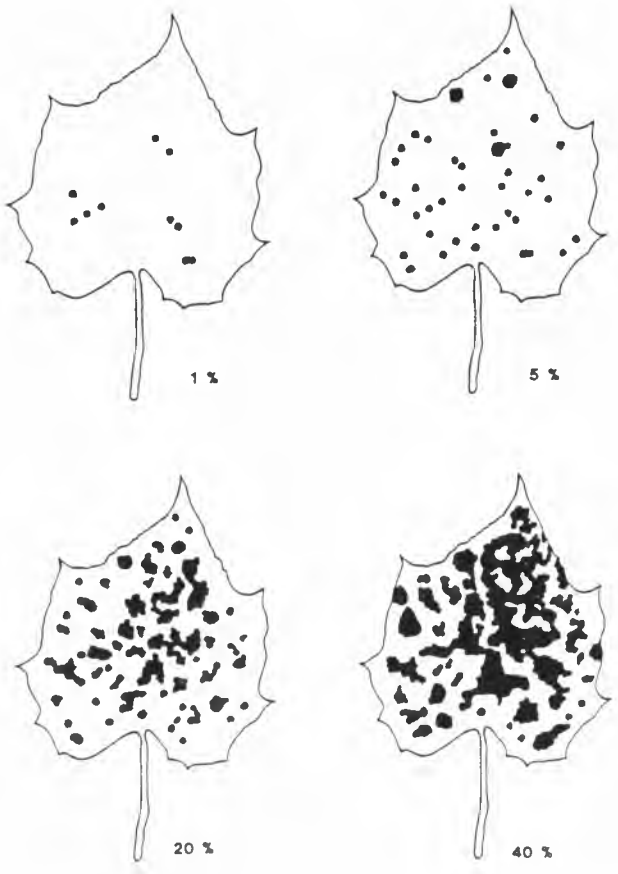


Figure 1. Diagram on powdery mildew infection - percentage of leaf area infected

Guideline for the Biological Evaluation of Fungicides Powdery Mildew of Ducurbits No. 57 EPPO 1983

If infection is light, it may be useful to count the number of mildew spots per plant.
Brown mycelium is regarded as being dead and should not be taken into account in the assessment.

Calculation of infection degree (P) according to Townsend & Heuberger:

$$P = \frac{n \times (v - 1) \times 100}{(Vmax - 1) \times N}$$

The formula expresses the infection level in percent of the strongest possible infection level

n = number of occasions at a certain level
v = infection levels 1-6
Vmax = infection level 6
N = total number of leaves studied

4.2. Observations on Phytotoxicity

The type and extent of such damage should be described and assessed, if appropriate, after a scale from 1 to 6 as for infection level.

4.3. Qualitative and/or Quantitative recording of Yield

Any positive effects should be noted (accelerated or longer flowering, increases vigour, increased colour, etc.)
Presence of visible residues on the leaves should be recorded and assessed (gade 1-6 as for infection level).

4.4. Interpretation of Results

The results should be analysed by appropriate statistical methods, and the statistical method used should be indicated. LSD values should be given.

4.5. Detrimental Effects on Beneficial Arthropods

Information about detrimental effects on beneficial arthropods, especially *Encarsia formosa* and *Phytoseiulus persimilis*, should also be noted.

NORDIC GUIDELINE NO. 8

(BIOLOGICAL EVALUATION OF PESTICIDES)

1. THE BLOSSOM BEETLE IN OILSEED OR TURNIP RAPE

1.1. Pathogen

The blossom beetle (*Meligethes aeneus Fabr.*) is a 3 mm long green metallic beetle. The larvae are whitish with two rows of brown spots on the back and a pronounced head.

Figure 1 shows the beetle, the larvae and the damage they cause on oilseed rape plants.

1.2. Host Plants

The blossom beetle prefers cruciferous cultures grown for seed, but many of the wild crucifereous plants can be used as host plants.

1.3. Symptoms

At the early bud stage several buds can be destroyed by the beetles' gnawing to sustain life. The eggs are laid in 2-5 mm long flower buds which are destroyed when more than two or three larvae are present in a bud. This causes blind stalks on the stem instead of pods or the pods become misshapen as a result of the gnawing of the larvae. The effect of the blossom beetle as a pest is small after the host plant starts to flower, because the larvae mainly live on pollen. The attack may cause delayed flowering. In late summer and autumn the blossom beetle can cause damage by gnawing the heads of cauliflower in the field.

1.4. Epidemiology

The blossom beetle hibernates as a beetle (imago) in the leaf cover at the edge of the wood. At temperatures above 15°C an emigration takes place to fields with oilseed rape. This usually happens at the beginning of May. In the fields the beetles feed on the plants, mainly on the young

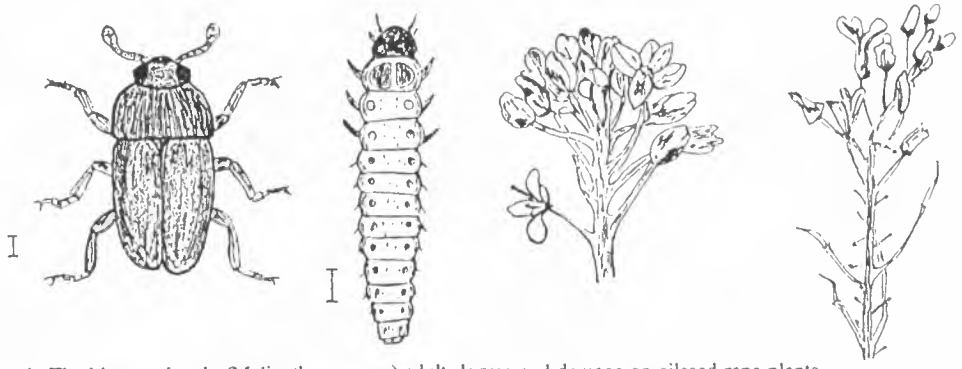


Figure 1. The blossom beetle (Meligethes aencus) adult, larvae and damage on oilseed rape plants

buds. After a short time the beetles mate and egg laying starts. The eggs are laid in flower buds of about 2-5 mm. The larvae hatch after 4-6 days and larval development lasts 2-3 weeks. The larvae feed on pollen. When they are fullgrown they pupate in the soil 2-3 cm below the surface. After a pupal stage of some 2-3 weeks the beetles of the new generation appear. The young beetles eat pollen from different plants until they find suitable places for hibernation in the autumn. There is only one generation every year.

1.5. Possibilities for Misindentification
None.

2. EXPERIMENTAL CONDITIONS

2.1. Selection of Crop and Variety
The trials should be carried out on oilseed rape or turnip rape. There are no special requirements as to variety or seed treatment.

2.2. Environmental Conditions
The trials are carried out the fields. Good and homogeneous experimental conditions are essential with regard to soil type, fertilizer and weed control. Hilly areas, border areas and shaded parts of the field should be avoided. Watering with N-fertilizer is not allowed because of the risk of burning.
As the blossom beetle is most numerous at the edge of the field it may be advantageous to place the trial there, for instance one width of the sprayboom from the borderline.

General notes are made on special research schemes.

2.3. Research Plan
The trial should contain at least one untreated plot, one plot for each chemical to be tested and one plot treated with a standard product for each specific group of chemicals in the trial.

The trial should be carried out with four replicates (blocks) and random plot distribution within blocks.

Plot size depends on local circumstances and technical equipment, but if possible the plots should be at least 100 m^2.

To avoid wind drift to the trial by spraying of the surrounding field an untreated and well-marked area of 5 m can be placed around the trial.

The trial starts and ends with plots treated with the standard product.

3. APPLICATION OF TREATMENTS

3.1. Product(s) to be tested
According to the trial description.

3.2. Reference Product(s), Standards
Registered product(s) having widely proved satisfactory in practice. Formulation type and mode of action should be as close as possible to those of the products to be tested.

3.3. Mode of Application

3.3.1. Type of Equipment
Only spraying equipment which ensures an even distribution of the spraying fluid should be used. As far as possible, spraying is carried out when there is no wind or the sprayboom must be shaded to avoid wind drift. Any dose error of more than 10% must be noted as well as type of spray and nozzle and working pressure.
3.3.2. Time and Frequency of Application
This is according to the individual test plan in which the directions for use of the applicant are taken into account.

Spraying is carried out at stages 3.1 and again six days later, unless otherwise stated. Spraying takes place at a threshold of 0.5 beetles per plant.

Each treatment is dated and the growth stage of the crop is noted (figure 2).

3.3.3. Doses and Volumes
The products should be applied in the dosage recommented by the applicant and if possible at half of this dose. The quality of liquid used is noted.

3.4. Data on Chemicals used against other Pest, Diseases or Weeds
If other chemicals have to be applied, provision must be made to ensure minimum interference. The chemicals have to be applied uniformly on all plots and normally separately from the products being tested and the reference product.

Diseases and weeds may be controlled as in the surrounding field. Insecticides must not be used before full flowering.

The dates of the treatments, the groth stage and the chemicals used must be noted.

4. MODE OF ASSESSMENT, RECORDING AND MEASUREMENTS

4.1. Meteorological Data

At the time of spraying the following are noted: Temperature, wind direction and speed, relative humidity and whether the plants are wet or dry. Other climatic influences are only recorded if they are necessary for understanding the results. Adverse conditions such as hail, drought or excessive precipitation should always be noted.

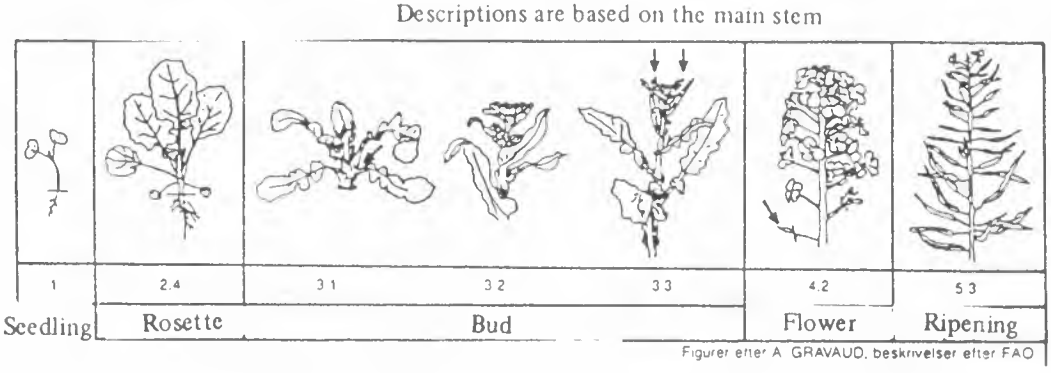
The temperature, clouds and precipitation are noted at all treatments and evaluations.

4.2. Assessment of Effect

4.2.1. Time and Frequency

The first counting is carried out before spraying, the day after spraying and then every second or third day thereafter until the difference between treated and untreated plots has been equalized. All plots are counted. The countings are carried out preferably in the morning and at det same time each day.

Each counting is noted by date and growth stage.



0 Pre-emergence

1 Seedling

2 Rosette

- 2.1 First true leaf expanded
- 2.2 Second true leaf expanded (add 0.1 for each additional leaf)

Bud

- 3.1 Inflorescence visible at centre of rosette
- 3.2 Inflorescence raised above level of rosette
- 3.3 Lower buds yellowing

4 Flower

- 4.1 First flower open
- 4.2 Many flowers opened, lower pods elongating
- 4.3 Lower pods starting to fill
- 4.4 Flowering complete, seeds enlarging in lower pods

5 Ripening

- 5.1 Seeds in lower pods full size, translucent
- 5.2 Seeds in lower pods green
- 5.3 Seeds in lower pods green-brown mottled
- 5.4 Seeds in lower pods brown
- 5.5 Seeds in all pods brown, plant senescent

Figure 2. Growth stages in oilseed rape. (Modified fram Berkenkapm, B. 1973. Can. J. Plant Sci. 53:413 and Harper, F.R. 1973. Can. Plant Dis. Surv. 53:93-95)

4.2.3. Methods
The number of beetles is counted on 50 plants per plot.
The results are expressed as number of beetles per plant.

4.3. Side-effects

4.3.1. Phytotoxicity
The crop is evaluated for positive or negative effects of the treatments. The symptoms are described, as for instance change in colour, burning or deformation. By damage evaluation a code for phytotoxicity symptoms can be used. If it seems reasonable the effect can be expressed as a degree of coverage.

4.3.2. On Flora and Fauna
Secondary effects are described, especially effects on beneficias, bees, lady-birds, etc.

4.4. Other Diseases and Pests

4.4.1. Diseases
If attacks by diseases occur they are evaluated according to the guide lines for this specific disease.

4.4.2. Pests
The damage is discribed. If it seems reasonable the percentage of corverage is noted. If the damage is evenly distributed over the trial an average evaluation is given.

4.5. Recording of Yield
The plots or the net plots are harvested by combine, and the yield is expressed as kg per ha with 9% water. Thousand kernel weight and if possible oil content are determined.

5. INTERPRETATION OF RESULTS

5.1. Statistical Methods
The results should be analysed using analysis of variance and the means compared using a muliple range method (Duncan, SNK). The coefficient of variation and LSD 95% are computed. The statistical method used should be indicated.

NORDIC GUIDELINE NO. 9

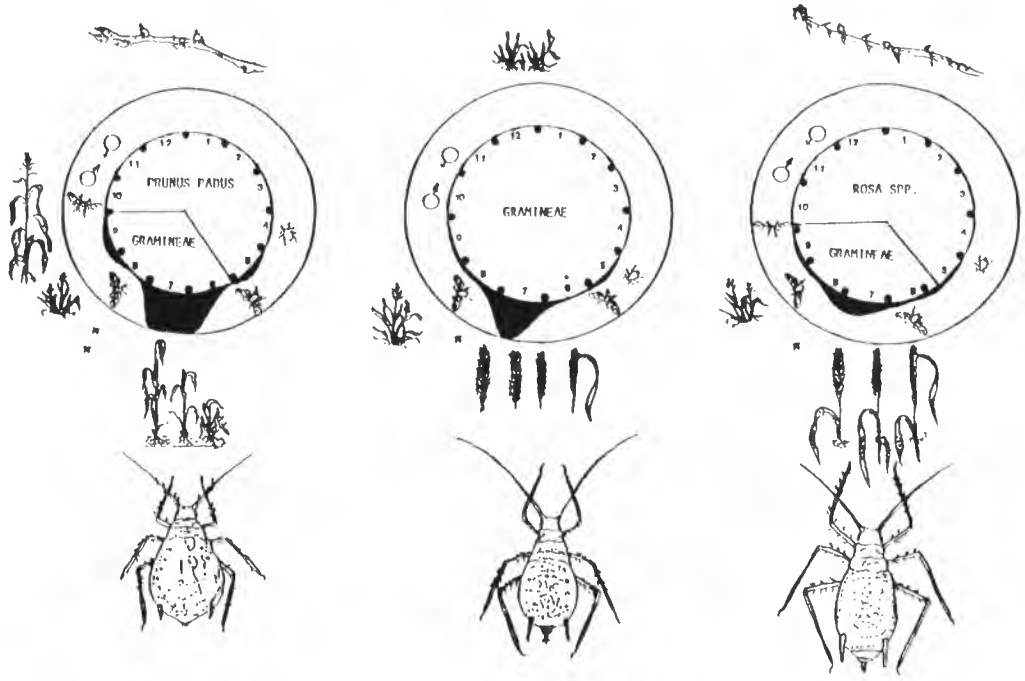
1. APHIDS ON CEREALS

1.1. Pathogen

The three species are: Bird cherry oat aphid, *Rhopalosiphum padi* (L.) grain aphid, Sitobion *avenae* (F.) and Rose-grain aphid, *Metopolophium dirhodum* (Wlk.). Descriptions are presented in Figure 1.

1.2. Host Plants

Bird cherry, *Prunus padus*, is the primary host for *R. padi* and roses, *Rosa* spp., for *M. dirhodum*. Grain aphids live on gramineous plants all the year round (compare Figure 1). Among the gramineous host plants, all the cultivated cereals including maize are infested. Of the wild gramineous species, *Lolium perenne* and *Phleum pratense* are known to bear high populations. The aphids can live in a few plants of the *Juncaceae* and *Cyperaceae* species, too.



R.padi S. avenae M. dirhodum

1.3. Symptoms

Symptoms are difficult to see in the early stages of infestation. In strong infestations symptoms resemble those of drought stress: plants become wilted and senescent, growth is inhibited and,

finally, plants turn yellow. Honeydew around the aphids can be seen first as shining droplets and later covered by black fungus.

The damage is correlated to the number of aphids per plant during the peak population period and a to the effect of aphids counted by the daily cumulative sum of aphids per plant (=aphid index). Yield loss is manifested in a decrease in shoot number, decrease in number of grains per ear and a decrease in 1000 seed weight. The importance of each of the components depends on the time of aphid arrival, number of aphids and growing conditions.

1.4. Epidemiology

Normally, *R. padi* is the first of the three species to arrive on cereal vegetation, just after seedling emergence in northern Scandinavia and later in southern Scandinavia. *S. avenae* arrives later at the boot stage and *M. dirhodum* between the first two.

On cereals, the bird cherry aphid colonizes the stem bases, not coming to the top leaves until population peak. The rose-grain aphid lives essentially on leaves in the middle part of the plant and the grain aphid is the pest of flag leaf and ear, exclusively.

Development rates of populations are strictly temperature dependent (Table 1). In addition, development is affected by host variety and growth rate and cultivation conditions, especially nitrogen fertilization and irrigation.

Table 1. The relationship between development time and rate of increase in the three species of cereal aphids in constant temperature.

	Temperature	Development time (days)	Rate of increase/ female/week
R. padi	10	14.7	2.2
	15	9.3	6.7
	20	6.1	16.4
	25	5.0	33.1
S. avenae	10	16.9	2.2
	15	10.8	6.7
	20	8.8	9.0
	25	8.4	7.4
M. dirhodum	10	14.7	2.7
	15	11.8	6.7
	20	7.8	7.4
	25	9.3	1.5

The formation of migrating alates at certain intrinsic stages, is induced by high density and senescence or maturing of the host (Figure 1).

Population increase in the aphids on cereals is restricted by natural enemies and diseases. Major aphid-feeding predators are carabids, staphylinids, coccinellids, syrphid larvae, predatory gall midge larvae, chrysopids and spiders. Hymenopeterous parasites are numerous. Diseased aphids are normally fungus infected.

1.5. Possibilities for Misidentification
None.

2. EXPERIMENTAL CONDITIONS

2.1. Selection of Crop and Variety, Test Organisms
Barley or oat is used for testing products against *R. padi*. Spring or winter wheat is used for testing products against *S. avenae*. Products for *M. dirhodum* can be tested with any of the four hosts. All stages (apterae) of aphids are counted the test organisms.

2.2. Environmental Conditions
Field trials are preferably organized in a locality with a high aphid population. Sowing time should follow the local standard. In late sown areas or otherwice delayed areas, barley yellow dwarf virus may disturb yield evaluation. Fertilizing according to standard advice. High levels of nitrogen may cause increased intensity of population growth. Irrigantion increases the compensatory potential of the crop.

2.3. Research Plan
Components: product(s) to be tested, reference product(s) and untreated controls, arranged in a randomized plot design. The shape of the plots should be such as to ensure precise application of the products and to allow for the crop to be harvested with available aquipment. The experiment ought to be surrounded by the same crop and a 5 m wide range area around the treatments should not be treated. The other areas should be treated in order to avoid too rapid reinfestation of the treated plots. If the product to be tested has a gas effect (vapor pressure above 1.0 mPa, in 20 °C) protective plots should be left on both sides of the treated one. These protective plots should be treated with contact insecticide.

Plot size: net at least 25 m^2, gross preferably 50 m^2
Replicates: at least 4

3. APPLICATIONS OF TREATMENTS

3.1. Product(s) to be tested
According to the applicant.

3.2. Reference Products, Standards
Registered product(s) having widely proved satisfactory in practice. Formulation type and mode of action should be as close as possible to those of the product(s) to be tested.

3.3. Mode of Application

3.3.1. Type of Equipment
Application with up to date equipment. The equipment used should provide an even distribution of the product on all points of the plant. Any incorrect dosage of more than 10 % should be reported. If formulation types of the product(s) to be tested and the referebce product(s) are the same, the same type of equipment should be used. Give information on the type of equipment and operating conditions (e.g. operating pressure) used.

3.3.2. Time and Frequency of Application
First application when about 20 % of plants of spring cereals are infested by aphids. When *R. padi* is the major species, application should be carried out before it passes stage 51 in the decimal scale. When *S. avenae* is the major species applications should be carried out before plant stage 69 has been passed. All plots to be treated on the same day, under similar weather conditions. Timing of further applications according to the applicant. Applications should comply with good agricultural practice. The number of applications and the date and time of the day and the growth stage at each application should be recorded.

3.3.3. Doses an Volumes
According to the applicant. The amount of water used should be recorded.

3.4. Data on Chemicals used against other Pests, Diseases or Weeds
If other chemicals have to be applied, provision must be made to ensure that they cause minimum interference. These chemicals must be applied uniformly on all plots (i.e. the whole area of the trial) and should be applied separately from the products to be tested and the reference product(s). Precise data on these applications must be given.

4. MODE OF ASSESSMENT, RECORDING AND MEASUREMENTS

4.1. Meteorological Data
Time of application: temperature, wind speed and direction, sunny/cloudy, humidity, precipitation

(24 hours after application), time of the first rain (if within 24 hours after application).
Overall climate records: daily mean temperature, frost precipitation mm.

4.2. Assessment of Effect

4.2.1. Time and Frequency

1st assessment:	immediately before treatment
2nd assessment:	2 days after treatment
3rd assessment:	a week later
4th assessment:	a week later and so on until there is no difference between treated and untreated plots or the aphids population breaks down because of parasites or fungal diseases.

4.2.2. Methods
The number of living aphids on at least 25 plants or the incidence of aphids per 100 (50) plants is counted or estimated before application. After application, always, the number of living aphids per plant is counted.

4.3. Side-effects
Special attention should be paid to distinguishing between damage caused by aphid feeding and phytotoxicity caused by the products. If possible, attack by BYDV is evaluated. Major effects on beneficials should be recorded.

4.4. Other Pests and Diseases
Is attacks by diseases or pests occur they are evaluated according to the quideline for this specific disease or pests.

4.5. Recording of Yield
Grain yield (adjusted to a fixed moisture level of 15%)
1000 seed weight (per treatment)
Hectolitre weight (per treatment)

5. INTERPRETATION OF RESULTS

5.1. Statistical Methods
Analysis of variance with LDS and coefficient of variation (95%), T-test or SNK-test

NORDIC GUIDELINE NO. 10

1. FRIT FLIES IN OATS

1.1. Pathogen

The most common species of frit flies in oats is *Oscinella frit* L. The adult is black and about 2 mm long. The larvae are pale yellow-white. The pupae are brownish red and 2-4 mm long. Other species, mainly *O. pusilla.* may also be encountered. They are similar in appearance.

1.2. Host plants

Apart from oats (*Avena sativa*), wheat (*Triticum aestivum*), barley (*Hordeum spp*), maize (*Zea mais*) and a wide range of cultivated and wild grasses are suitable host plants.

1.3. Symptoms

The main shoot of the young plant is damaged, stops growing, turns yellow and can easily be pulled loose. The plant responds to the attack by excessive tillering, giving it a bushy appearance. The side shoots are also often damaged in the same way. Sometimes the entire plant is killed at an early stage.

Later in the season the panicles are attacked. Individual kernels are damaged or completely destroyed by the larvae.

1.4. Epidemiology

The frit fly overwinters mainly as larvae in the shoots of grasses and winter cereals. Pupation takes place in the spring, and the adults of the first generation start to emerge in May. The emergence period is correlated with the temperature development in the spring. The eggs are laid 1-2 weeks after emergence. The female places the egg between the slightly bent coleoptile and the base of the plant. The optimum development stage for egg-laying is 1,5-2 leaves. The eggs hatch in 4-7 days, and the young larvae bore into the shoot.

The second generation hatches in late June-early July, and may attack the panicles of oats, as well as shoots of grasses. The third generation appears in August-mid September, attacking grasses and early sown winter cereals. The number of generations is less in the northern parts of Scandinavia.

1.5. Possibilities for Misidentification

Oat Sterile Dwarf Virus causes short, bushy plant and excessive tillering, but without the typical wilting of individual shoots.

2. EXPERIMENTAL CONDITIONS

2.1. Selection of Crop and Variety

The trial is carried out with a common variety of oats. The site should be chosen because of its known attack risk expectancy. If the crop is sown relatively late, the chances of attack are further

increased. Monitoring of adult flies is possible with blue sticky traps or water traps.

2.2. Environmental Conditions
Homogeneous experimental conditions are essential. Soil type, fertilization and moisture must not vary within the trial. Soil type and fertilization are noted. Shaded or strongly slanted parts of the field should be avoided.

2.3. Research Plan
Components: product(s) to be tested, reference product(s) and untreated controls are arranged in a randomized plot design. The shape of the plots should be such as to ensure precise application of the products and to allow for the crop to be harvested with available equipment. If possible, more than one rate of application should be included.

Plot size: depends on the available equipment, and should be at least 30 m^2, of which at least 25 m^2 are harvested. A 5 m wide zone surrounding the trial should remain untreated with insecticides.

Replicates: at least 4.

3. APPLICATION OF TREATMENTS

3.1. Product(s) to be tested
According to the trial description.

3.2. Reference Product(s), Standards
Well-known, registered product(s), giving a satisfactory predictable degree of control.

3.3. Mode of Application

3.3.1. Type of Equipment
a. Spray treatments
Application with suitable, up-to-date equipment. The sprayer should give even coverage (maximum deviation 10%). Avoid spraying in wind speeds over 3 m/s. If the sprayer leaves tracks within the intended harvest plot, it should also be run through plots that are not sprayed.

b. Seed dressing
The product is applied to the seed as evenly at possible, preferably using a suitable seed-dressing machine. It must be ensured that the specified rate of application is reached. All seeds for an entire trial/trial series must be from the same lot, including those which are sown untreated. Seed should not have been previously dressed with fungicides, unless otherwise specified by the applicant. Prior to sowing, checks and necessary adjustments must be made to ensure that the drilling machine feeds the same number of seeds per area in all treatments.

3.3.2. Time and Frequency of Application

a. The correct time for spray treatment is the 1.5 leaf stage, i.e. when the second leaf is visible. Treatments carrried out even slightly later will be much less effective; correct timing is therefore crucial.

b. Seed-dressing products should not be applied earlier than one month prior to sowing.

3.3.3. Doses and Volumes

The products should be applied in the dosages recommended by the applicant. Spray liquid volumes should conform with common practice if not otherwise specified.

3.4. Data on Chemicals used against other Pests, Diseases or Weeds

If other chemicals have to be applied, provision must be made to ensure minimum interference. The chemicals must be applied uniformly on all plots and normally separately from the products being tested and the reference product(s). Precise data on these applications must be given.

4. MODE OF ASSESSMENT, RECORDING AND MEASUREMENTS

4.1. Meteorological Data

Time of application: temperature, wind speed and direction, relative humidity and whether plants are wet or dry. Other climatic conditions are only recorded if they are necessary for understanding the results. Adverse conditions such as hail, drought or excessive precipitation should be noted.

4.2. Assessment of Effect

4.2.1. Time and Frequency

Assessment is made twice, in development stage 21-22 and stage 29-30.

4.2.2. Methods

Assessment is made on ten adjacent plants in a row at five randomly selected places in each plot. The number of attacked main shoots, side-shoots/plant and attacked side-shoots/plant is recorded. The final number of tillers with developed panicles is recorded per m^2.

4.3. Side-effects

4.3.1. Phytotoxicity

All suspected effects (discoloration, scorching, abnormal growth, etc.) should be described and graded.

4.3.2. On Flora and Fauna
Secondary effects are described, especially on beneficials, bees, ladybirds, etc.

4.4. Other Pests and Diseases
Aphids are (i) counted on 10 plants/tillers per plot at 7-day intervals, from development stage 21-29 and until the aphids have disappeared in all treatments or (ii) treated with Pirimor at a population density > 5 aphids/tiller.

Incidence of Barley Yellow Dwarf Virus is assessed if relevant as number of infected plants/m^2, or as the percent of infested plants on at least 10 m^2/plot. Assessment is usually best made towards the end of July.

If other pest or disease attacks occur, their type and estimated extent (by plot) are reported.

4.5. Recording of Yield
Grain yield adjusted to a fixed moisture level content of 15%.
1000 seed weight.
Hectolitre weight.

5. INTERPRETATION OF RESULTS

5.1. Statistical Methods
Data are analysed using analysis of variance (after appropriate data transformations), and means are compared using a multiple range method. The coefficient of variation and LSD 95 % are computed.

NORDIC GUIDELINE NO. 11

1. FLEA BEETLES IN SPRING RAPE AND TURNIP RAPE

1.1. Pathogen

Common flea beetles (*Phyllotreta* spp.). Adult beetles are 2.0-3.0 mm long, black with two yellow bands, one on each elytron.

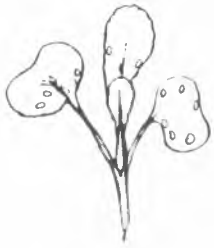
1.2. Host Plants

Cruciferous plants of all the cultivated species and many of the wild ones.

1.3. Symptoms

Small holes in the young leaves. When the beetles are numerous the entire leaf may be eaten.

a) 2% leaf area eaten



c) 10% leaf area eaten

b) 5% leaf area eaten

d) 25% leaf area eaten

Illustrations of flea beetle damage to young rpae plantes

1.4. Epidemiology

The beetles overwinter as adults and appear from their hibernation sites early in the spring. One generation is produced per year.

1.5. Possibilities of Misidentification

None, unless the plants are totally eaten as soon as they germinate.

2. EXPERIMENTAL CONDITIONS

2.1. Selection of Crop and Variety

Oilseed rape (*Brassicae napus oleifera*) or turnip oil rape (*Brassicae campestris sativa*) should be used.

2.2. Environmental Conditions

The experiment should be carried out as a field trial. Good and homogeneous experimental conditions are essential with regard to soil type, fertilizer and weed control. Hilly areas, border areas and shaded parts of the field should be avoided. Watering with N-fertilizer is not allowed because of the risk of burning.

2.3. Research Plan

The trial should include at least one untreated control and a standard (reference) product as well as the insecticide(s) to be tested. If possible, more than one rate of application should be included. The trial is conducted in a randomized, complete block way, with at least three replicates.
The plot size depends on local circumstances and technical equipment. If yield assessment is intended it should be a least net 25 m^2, gross preferably 50 m^2. There should be at least a zone of 1 m between plots.
To avoid wind drift of spray to the trial from the surrounding field, an untreated area of 5 m can be placed around the trial field.

3. APPLICATION OF TREATMENTS

3.1. Product(s) to be tested

According to the trial description.

3.2. Reference Product(s) Standards

Registered product(s) having widely proved satisfactory in experiments and practice.

3.3. Mode of Application

3.3.1. Type of Equipment

a. Seed dressing

If possible seed dressing should be carried out in a seed-dressing machine. The dressing may be carried out with or without using a sticker, depending on the seed-dressing product and dosage to be applied.

b. Spraying

The spraying should be carried out with suitable, up-to-date equipment.
The sprayer should give even coverage (maximum deviation 10%). Spraying in wind speeds of

over 3m/s should be avoided. If the sprayer leaves tracks in the harvest plots it should also be run through unsprayed plots.

3.3.2. Time and Frequency of Application
a. Seed-dressing products should not be applied earlier than three months before sowing.

b. Spraying should be carried out immediately the flea beetles appear on the germinating plants.

3.3.3. Doses and Volumes
The products should be applied at the dosage recommended by the applicant and at one lower dose.

3.4. Data on Chemicals used against other Pests, Diseases or Weeds
If other chemicals have to be applied provision must be made to ensure minimum interference. The chemicals must be applied uniformly on all plots and normally separately from the products included in the experiment.

The dates of treatments, the growth stage and the chemicals used must be registered.

4. MODE OF ASSESSMENT, RECORDING AND MEASUREMENTS

4.1. Meteorological Data

Temperature and clouding at spraying are noted and possible rainfall during the subsequent 24 hours after spraying.

4.2. Assessment of Effect

4.2.1. Time and Frequency
a. Seed dressing: When the plants have developed 2-3 lasting (true) leaves.

b. Spraying: Counting of beetles is done immediately before and the day after spraying, and then one or two times more at 2-3 day intervals.
Plant damage is assessed 8-10 days after spraying.

4.2.2. Methods
When the plants are on the 2-leaf stage the following data should be registered on 10 m of row: The total number of plants. The number of plants with flea beetle damage which is expressed as percent of leaf area eaten.

For evaluation of damage see figure 1. Depending on the level of attack plants with more than 2% or 5% of leaf area eaten are registered as damaged plants.

4.3. Side-effects

4.3.1. Phytotoxicity
All suspected effects (discoloration scorching, abnormal growth, etc.) should be described and graded.

4.3.2. On flora and Fauna
Secondary effects are described, especially on beneficials, bees, ladybirds, etc.

4.4. Other Pests and Diseases

4.4.1. Diseases
If disease attacks occur they are evaluated according to the guidelines for the specific disease.

4.4.2. Pests
The damage is described and evaluated.

4.5. Recording of Yield
Harvest for yield control is carried out when it is considered to be of relevance for interpretationof the results.

5. INTERPRETATION OF RESULTS

5.1. Statistical Methods
The results should be analysed using approriate statistical methods. Raw data should be included and the statistical method indicated.

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INSTRUCTIONS TO AUTHORS

THE MANUSCRIPT

The manuscript shall be typewritten on one side of the paper only. It shall be double spaced and have margins of at least three centimetres. Each of the following elements of the manuscript shall begin on a new page: (1) the title, (2) abstract, (3) the text, (4) summary, (5) list of references, (6) tables, (7) figure legends.

The pages shall be numbered consecutively beginning with the title page.

Articles will usually be organized as follows: (1) introduction, (2) materials and methods, (3) results, (4) discussion and (5) summary. Up to three grades of headings can be used to divide up the text. Articles must not exceed 20 manuscript pages, and two copies should be submitted to the managing editor.

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The title page shall contain:

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2. A short title of not more than 40 letters and spaces for use as a running headline.
3. The full names of all authors.
4. The name and adress of the institution and/or departments in which the research was carried out. Names of institutions shall be in English.

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Do not use more than 10 keywords and list them alphabetically.

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ACKNOWLEDGEMENTS

Acknowledgement shall be made only to persons who have contributed substantially to the results of the research. Authors are responsible for ensuring that individuals named are recognized as being identified with the results and conclusions described in the article.

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Each table shall be typed double spaced on a separate sheet of paper. They shall be numbered consecutively with Arabic numerals and have a concise descriptive heading. Abbreviations in tables shall be explained in footnotes, using the following symbols in this order: [1]), [2]), [3]), [4]), [5]).

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Høeg, O.A. 1971. Vitenskapelig forfatterskap. 2. utg. Universitetsforlaget, Oslo. 131s.

Oen, H. & S. Vestrheim 1985. Detection of non-volatile acids in sweet cherry fruits. Acta agriculturae scandinavia 35: 145-152.

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Uhlen, G. 1968. Nitrogengjødsling til ettårig raigras. Jord og avling 10(3): 5-8.

Aase, K.F., F. Sundstøl & K. Myhr 1977. Forsøk med strandrøyr og nokre andre grasartar. Forskning og forsøk i landbruket 27: 575-604.

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