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Review of the effects of the relevant insecticides on insects parasitic or predatory on insects harmful to plants

Litteraturstudie af relevante insecticiders virkning på de insektarter, der optræder som parasitter eller predatorer på planteskadelige insekter

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Summary
On basis published laboratory and field experiments, it has been tried to evaluate the effects of insecticides on parasites and predators mainly belonging to the following orders: Hemiptera, Neuroptera, Coleoptera, Hymenoptera and Diptera.

Introduction

It is obvious from the use of the word 'insecticides' to describe substances used to limit population densities in insects that they kill insects: they are poisonous to insects. They differ in e.g. molecular structure, stability, products of decomposition, mode of action, and mobility in media such as soil, water, air and plant tissues. The targets of insecticides, insects, differ just as much. The action of an insecticide can thus depend on the group (Order, Family, Genus or even species) it is used against or on the stage of development the insect is in. By and large there is a certain uniformity of action within a group, but it is by no means exceptional to find closely related species reacting quite differently from each other.

We use the term 'insect pests' for species of insects liable to compete with man for e.g. food. Insecticides have been developed as an aid in reducing the numbers of insect pests. Competition of this nature seldom takes place in small, isolated ecological niches in which we merely find the insect pest alone with our food: as a general rule we find that the numbers of pests which we wish to limit to economically acceptable levels are infinitesimal compared with the rest of the fauna. Part of this fauna is associated with the insect pests by virtue of the fact that they either prey on them or parasitise them. These insects must be regarded as valuable or useful. The advantages of retaining them alive are obvious.

It is worth noting at this point that we neither can nor ought to want to eradicate insect pests. We need to be able to regulate the numbers of insect pests within a given area (regulate the population density) in order to limit the damage they do us to an acceptable level. If we go about this task too vigorously we will knock out our parasites and predators. This will lay the foundations for an insect pest population explosion.

I is a bit more difficult to see what use the rest of the fauna is. These »neutral« insects are not necessarily all that neutral. There are many examples of cases where insecticide campaigns

have turned hitherto obscure insects into serious pests by reducing or eliminating their natural enemies (= useful insects).

It would also seem reasonable to seek to protect »neutral« insects, even where we are unable to see the value (= financial value) of doing so.

In the preparation of this review, every effort was made to include such tests and experiments as had been done on currently-used insecticides, but insecticides which may come to be used were also included as were those which have once been in use but which are no longer on the market because of economic reasons. The aim of collecting this information is to be sought in the light of our efforts to integrate several methods of protecting plants against insect attack as well as a general, noneconomically-motivated wish to avoid unintended effects on the basic fauna to the geatest possible extent.

None of the informations are from Denmark. What information there is comes from widely different areas, and this is obviously a significant factor in the assessment of field trials. It is nevertheless possible to conclude what effects each insecticide has on any given group of insects. It has been decided to present the results of the review of the literature in two ways. The present report merely states conclusions re the individual groups of insects and give a bibliography. In addition the author have prepared an appendix in which are set short resumes of the original sources for each group of insects, with references to a list of species of the insect parasites and predators mentioned. This appendix will be sent on request, permitting anyone with a special interest in this field to obtain further information. The appendix is arranged with resumes covering any one Order, Super-family or Family in alphabetical order by name of author. Each resume refers by means of a number to the list of species, which states which species have been the subject of experiment.

The varying experimental conditions make it difficult to compare the various author's results. It is of more value to compare individual author's results with various insecticides. This is why the author has chosen this »chance« listing in alphabetical order.

It is of course impossible to avoid side-effects when using insecticides, and the present review can only provide information on the way in which one can, by a proper choice of insecticide, obtain the maximum useful benefit from the insect parasites and predators in a chemical plant protection programme.

Of earlier reviews of the literature I wish in particular to mention *Ripper's* (1956), in which he gives the effects of pesticides on various species of insect parasites and predators. Unfortunately this list of pesticides used at that time is of limited value today. *Herfs* (1968) summarises the effects of individual insecticides on groups of insect parasites and predators.

Conclusions

Thysanoptera

Thrips mainly live on plant food – dead or living tissues and fungi – but they may also act as predators. The economic significance of this activity is very limited.

Few experiments have been carried out on thrips. Parathion is very poisonous to thrips whilst dimethoate seems to have a certain selective effect.

Hemiptera

One does not immediately think of usefulness in connection with the Hemiptera. This Order includes the Aphids (greenfly, black fly, ect.). But it also contains families which mainly act as predators. The common feature of the Hemiptera is that they have their mouth-parts formed into a sucking food-tube with which a series of needle-like or brush-like stylets are associated. The majority of predatory members of this Order also feed on plant juices, thus exposing these useful insects to the systemic insecticides carried about inside the plants with their sap.

Aldicarb, azinphos-methyl, chlorphenamidine, diazinon, dicrotophos, dilan, dimethoate,

fenthion, malathion, methiathion, methylparathion, mevinphos, parathion, phosdrin, TEPP, trichlorvinphos and zectran are quoted as being very toxic to Hemiptera.

Carbaryl, carbofuran, demeton, demetonmethyl, phorat, phosmet, phosphamidon, propoxur, ryania and trichlorfon are all insecticides with very variable actions from protective to highly toxic, all depending on external conditions.

Bac. thuringiensis preparations, chinomethinate, endosulfan, isolan, menazon, methoxychlor and naled have been shown to have a selective action. ULV (Ultra Low Volume) spraying appears more protective than conventional spraying.

Neuroptera

This Order includes the well-known Family Chrysopidae which includes the green lacewings. Their larvae prey on e.g. greenfly.

The results in this case depend very much on the stages tested. Here again, ULV sprayings is more protective than ordinary sprays. One single trial carried out with soluble powder shows that this method protects them even better than ULV spraying. All depending on how it is made up and used, an insecticide can vary in its properties from toxic to useful insects, to protective towards them.

Azinphos-methyl, carbaryl, carbofuran, chlorphenamidine, demeton-methyl, dicrotophos, fenchlorphos, fenitrothion, malathion, methylparathion, mevinphos, monocrotophos, parathion, phosmet, tetrachlorvinphos, thiometon and zectran have all been assessed as non selective.

Carbophenothion, dilan, dimethoate, endosulfan, formothion, foschlor, mevinphos, phosphamidon and rotenon are insecticides which either lie midway between the two extremes or whose effects are variable.

Aldicarb, bromophos, carbofenothion, chlorbenzilat, demeton, menazon methiathion, methoxychlor, naled, ryania, sabadilla, schradan, TEPP, tetradifon and trichlorfon are quoted as being selective insecticides.

Coleoptera

Amongst the families in this Order are the three important representatives the Carabidae (ground-beetles), Staphylinidae (rove-beetles) and Coccinellidae (lady-birds). All three families include plant-eating representatives, but this is not a characteristic habit. The majority of species in these three families are predators, and certain staphylinids are also parasitic. In addition a small Family is included, the Malachiidae, of which both the larva and imago are predatory. Most tests have been carried out on ladybirds.

Carabidae

Fenitrothion, phosphamidon and thionazin are stated to be non-protective insecticides.

Diazinon is reasonably protective in dry soil but highly toxic in wet soil.

Carbofuran, chlorphenvinphos and azinphos-methyl are stated to be selective insecticides.

Staphylinidae

Chorphenvinphos in particular – but also diazinon and parathion – are reported to be toxic to rove-beetles.

There is one single report of azinphos-methyl being selective.

Coccinellidae

Variations from species to species and from one stage of development to another are very wide here. But one thing typical of this Family is that it tolerates insecticides better than other predators do.

Carbaryl, carbofuran, demeton (as a contact poison), demeton (aphids killed with demeton fed to larvae) dicrotophos, dilan, DN-111, endosulfan (to the image stage), fenthion, formethanat, formothion, lindane, malathion, methoxychlor, methylparathion, mevinphos, parathion, pyrethrum, ronnel, rotenon and zectran have alle been described as being the most toxic insecticides.

Azinphos-methyl, carbofenothion, chlorphenamidine, demeton-methyl, diazinon, dimethoate, endosulfan (larvae), oxydemeton, phos-

phamidon, plictran, TEPP and trichlorfon (as well as ethion, lindane, naled, parathion, sabadilla, schradan, TEPP, tetradifon and trichlorfon administrered as gastric toxins) come between the two extremes.

Aldicarb, chlorfenson, demeton, (green flies killed with demeton and given as food to imagines), demeton, endosulfan (eggs), endothion, isolan, monocrotophos, neotran, nicotinsulfat, phosalone, phosmet, pirimicarb, ryanina, sabadilla, schradan, TEPP, tetradifon and vamidothion are referred to as selective insecticides.

ULV spraying is also less hard on ladybirds than conventional spraying.

Malachiidae

Azinphos-methyl, carbaryl, dimethoate, methylparathion are regarded os toxic to malachiids.

Demeton, dicrotophos and phosphamidon are reported to lie between the two extremes,

Aldicarb, dilan, Bac.thuringiensis preparations, trichlorfon and zectran are reported to be selective.

Hymenoptera

The representatives of this Order of particular interest to us are those which parasitise other insects. This parasitic activity may take place at any phase in the life cycle of the host. In addition, some of these parasites are hyperparasites: they parasitise other parasites. This Order is remarkable for the great specialisation of structure exhibited by its members. Few of the species discussed are found in Denmark, but the high degree of uniformity in the results of the use of insecticides in this Order make them highly applicable in this country.

The majority of the publications reviewed describe species belonging to two important super-families: the Ichneumonoidea and the Chalcidoidea. The former super-family contains the Braconidae, Ichneumonidae and Aphidiidae and the latter contains the Trichogrammatidae, Pteromalidae, Encyrtidae, Aphelinidae and Eulophidae.

A few papers about the families Cynipidae, Bethylidae, Ceraphronidae, Scelionidae and Formicidae will also be mentioned. Work on the Hymenoptera is set out under one head.

It is a little more difficult to describe the general effects of insecticides on the Hymenoptera than for other orders of insects as a result of their parasitic habit. The greater part of the life cycle of a parasite takes place in a protected environment. The eggs, larval stages and pupae are the most frequently protected by a host. This introduces en extra protective factor in addition to the varying effects of insecticides on the different phases of development. Following classification of insecticides must therefore be applied with some caution.

Carbaryl, carbofuran, diazinon, dichlorvos, dilan, disulfoton, fenithrothion, formothion, guthoxon, malathion, methylparathion, menazon, mevinphos, monocrotophos, parathion, phorate, phosphamidon, propoxur, ronnel, thiometon and zectran are listed as being harmful insecticides.

Aldicarb, azinphos-methyl, carbophenothion, chlorinated insecticides, demeton, demeton-methyl, dimethoate, disulfoton, endosulfan, isolan, methoxychlor, rotenon, TEPP and trichlorfon are comparatively selective.

Bac. thuringiensis preparations, chlorbenzid, chlorfenson, dioxathion, DN-111, EPN, ethyltrichlorfon, fenson, isopropylparathion, naled, nicotinpowder, nicotinsulfat, pirimicarb, ryania, sabadilla, stroban, tepa, tetradifon, tetrasul and triamiphos are stated to be selective.

Diptera

The Syrphidae (hover-flies) are the family of the greatest interest to us in this connection, but only a small proportion of it, since not all species act as predators. Their larvae are one of the most significant groups of predators on aphids under field conditions.

There is little information on the effects of insecticides on hoverflies. It is, however, possible to conclude that hover-flies are very sensitive to most insecticides, particularly at the larval stage. Aphids killed by insecticides and fed to the larvae are tolerated better than direct

treatment. There are species differences in tolerance.

Arachnida

Spiders are stated to be little sensitive to insecticides. The general conclusions to be drawn from most of the publications available is that chlorinated insecticides (with the exception of methoxychlor) are the most toxic whilst the organophosphates (with exception of azinphosmethyl which is highly toxic to spiders) and carbamates are tolerated best.

Indledning

Af betegnelsen insekticider for de stoffer der anvendes til begrænsning af populationstætheden hos insekter fremgår, at de er insektgifte. Insekticiderne er forskellige med hensyn til bl.a. molekylstruktur, stabilitet, nedbrydningsprodukter, virkemåde på insektet, bevægelighed i medier så som jord, vand, luft og plantevæv. Målet for insekticiderne, insektet, er mindst lige så forskelligt. Insekticidets virkning kan således afhænge af hvilken insektgruppe (orden, familie, slægt eller endog art), det anvendes imod, eller hvilket udviklingsstadie insektet befinder sig i. Generelt er det således, at der er en vis ensartethed i virkning inden for en gruppe, men det er ingen undtagelse, at se nærbeslægtede arter påvirkes forskelligt.

Som skadelige insekter betegnes de insektarter, der kan konkurrere med mennesket om bl.a. føden. Som hjælpemiddel til at nedbringe antallet af de skadelige insekter har vi udviklet insekticiderne. Denne konkurrence foregår sjældent i små aflukkede økologiske nicher, hvor kun de skadelige insekter befinder sig sammen med føden, men som regel således at de skadelige insekter, som vi ønsker at holde nede i et økonomisk acceptabelt antal, er forsvindende få i sammenligning med den øvrige fauna. En del af denne fauna har tilknytning til de skadelige insekter på den måde, at de enten fortærer dem helt eller parasiterer på dem. Disse insekter må betegnes som gavnlige eller nytteinsekter. Fordelen ved at bevare dem er umiddelbart indlysende.

Her er det på sin plads at påpege, at vi ikke er i stand til og ej heller bør ønske at udrydde de skadelige insekter. Vi skal kun foretage en regulering af antallet af skadeinsekter på et givet areal (regulere populationstætheden) for således at begrænse deres for os skadelige virksomhed til et acceptabelt niveau. Går vi for hårdt til denne opgave, indses let at grundlaget for skadeinsektets parasitter og predatorer forsvinder. Der er således skabt muligheder for en eksplosiv udvikling af skadeinsektet.

Lidt vanskeligere er det at se nytten af at skåne resten af faunaen. Disse indifferente insekter er dog ikke så indifferente endda. Der er mange eksempler på, at indgreb med insekticider har gjort insekter som førhen var upåagtede til alvorlige skadedyr, da man reducerede eller fjernede deres naturlige fjender (= nytteinsekter).

Endvidere synes det at være rimeligt at stræbe efter at skåne også de »indifferente« insekter, selvom vi ikke kan se nytten deraf (økonomisk nytte).

Ved udarbejdelsen af dette review er det søgt at sammenfatte forsøg og eksperimenter, der er foretaget med aktuelle insekticiders virkning, men desuden er medtaget insekticider, som kan blive aktuelle, eller som har været anvendt tidligere men på grund af økonomiske forhold er gået ud af markedet. Formålet med at indsamle disse informationer, skal ses i sammenhæng med bestræbelserne på at integrere flere metoder i beskyttelsen af planter mod insektangreb, samt et alment ikke-økonomisk motiveret ønske om i så vid udstrækning som muligt at undgå utilsigtede effekter på faunaen iøvrigt.

Det er meget begrænsede oplysninger, der foreligger om lige netop de insektarter, det klima og de afgrøder, der forekommer i Danmark. Informationerne stammer ligeledes fra vidt forskellige geografiske områder, og har selvsagt stor betydning for vurderingen især af markforsøg. Trods dette er det muligt for hver gruppe af insekter, at konkludere hvilken effekt et insekticid besidder. Forfatteren har valgt at præsentere resultatet af litteraturstudiet på to måder. I denne beretning gives kun kon-

klusionerne for de enkelte insektgrupper samt litteraturlisten. Desuden er et bilag udarbejdet, hvori der for de enkelte insektgrupper er lavet korte resumeer af kilderne med henvisninger til en artsliste over omtalte insektparasitter og -predatorer. Dette bilag kan på opfordring tilsendes. Særligt interesserede vil således have mulighed for at opsøge yderligere informationer. Bilaget er delt op således at resuméer inden for en insektorden, overfamilie evt. familie er er samlet i alfabetisk orden efter forfatter. I det enkelte resumé henvises ved hjælp af et nummer til artslisten, som da angiver hvilke arter der er udført forsøg med.

Det er vanskeligt at sammenligne forskellige forfatteres resultater indbyrdes grundet forskellige forsøgsbetingelser. Mere værdifuldt er det at bedømme den enkelte forfatters resultater med flere insekticider. Derfor den »tilfældige« opdeling i alfabetisk rækkefølge.

Det er selvsagt en umulighed at undgå bivirkninger ved anvendelse insekticider, og denne litteraturoversigt kan kun bidrage med oplysninger om, hvorledes man ved valg af insekticid kan optimere den gavnlige indsats af insektparasitter og -predatorer i et kemisk plantebeskyttelsesprogram.

Af tidligere lignende litteraturoversigter kan især nævnes *Ripper* (1956), hvor effekten af pesticider er angivet mod forskellige arter af insektparasitter og -predatorer. Aktualiteten af de dengang anvendte pesticider er meget begrænset. *Herfs* (1968) bedømmer virkningen af de enkelte insekticider mod grupper af insektparasitter og -predatorer summarisk.

Konklusioner

Thysanoptera *(Thrips)*

Hovedsagelig lever thrips af planteføde, levende eller dødt væv og svampe, men kan også optræde som prædatorer. Den økonomiske betydning heraf er dog begrænset.

Forsøgene med thrips er få. Parathion er meget giftigt for thrips, dimethoat synes at have en vis skånende virkning.

Hemiptera *(Næbmunde)*

Det er ikke just nytteinsekter tanken falder på når næbmunde nævnes. Bladlus hører jo (blandt andre) til denne orden. Men ordenen indeholder også familier, som lever hovedsageligt som predatorer. Fælles for næbmunde er, at munddelene er udformet som en sugesnabel, hvori er anbragt nåle- eller børsteformede stikredskaber. Selv de fleste predatorer hørende til næbmundenes orden suger plantesaft, og disse nytteinsekter er således også udsat for systemiske insekticider, som netop transporteres rundt med plantens saftstrøm .

Aldicarb, azinphos-methyl, chlorphenamidin, diazinon, dicrotophos, dilan, dimethoat, fenthion, malathion, methiathion, methylparathion, mevinphos, parathion, phosdrin, TEPP, trichlorvinphos og zectran er angivet som meget giftige for næbmunde.

Carbaryl, carbofuran, demeton, demetonmethyl, dimecron, phorat, phosmet, propoxur, ryania og trichlorfon er insekticider hvis virkning er meget svingende fra skånende til absolut giftige, afhængig af ydre forhold.

Bac. thuringiensis præparater, chinomethionat, dibrom, endosulfan, isolan, menazon og methoxychlor har vist skånende virkning. U.l.v. sprøjtninger (ultra low volume) synes at være skånende fremfor konventionel sprøjtning.

Neuroptera *(Netvingede)*

Denne orden indeholder den velkendte familie Chrysopidae hvorunder guldøjer hører. Larverne er predatorer og lever bl.a. af bladlus.

Resultaterne her er meget afhængige af hvilke stadier der testes. U.l.v. sprøjtninger er igen mere skånsomme end almindelige sprøjtninger. Et enkelt forsøg viser, at sprøjtninger foretaget med »soluble powder« (sprøjtepulver), er endnu mere skånende end u.l.v. Således afhængig af formulering og anvendelse kan et insekticid ændre sine egenskaber fra at blive betegnet som et giftigt insekticid mod nytteinsekter til at være skånende.

Azinphos-methyl, carbaryl, carbofuran, chlorphenamidin, demeton-methyl, dicrotophos, dimecron, fenitrothion, malathion, methyl-

parathion, mevinphos, monocrotophos, parathion, phosmet, ronnel, tetrachlorvinphos, thiometon og zectran er bedømt som ikke skånende.

Carbophenothion, dilan, dimethoat, endosulfan, formothion, foschlor, mevinphos og rotenon er insekticider, som enten ligger midt mellem de to ydergrupper eller har vist svingende virkning.

Aldicarb, bromophos, carbophenothion, chlorbenzilat, demeton, dibrom, menazon, methiathion, methoxychlor, phosphamidon, ryania, sabadilla, schradan, TEPP, tetradifon og trichlorfon er angivet som skånende insekticider.

Coleoptera *(Biller)*

Denne orden indeholder bl.a. tre vigtige familier nemlig Carabidae (løbebiller), Staphylinidae (rovbiller) og Coccinellidae (mariehøns). Alle tre familier indeholder planteædere, hvad der dog ikke kan siges at karakterisere dem. Hovedparten af arterne i de tre familier lever af rov, og visse staphylinider optræder ydermere som parasitter. Endvidere er en mindre familie medtaget her, Malachiidae, hvor ligeledes larver og imagines lever af rov. De fleste undersøgelser er foretaget med mariehønsene.

Carabidae (Løbebiller)

Fenitrothion, phosphamidon og thionazin er angivet som ikke skånende insekticider.

Diazinon er forholdsvis skånende i tør jord, men yderst giftig i våd jord.

Carbofuran, chlorfenvinphos og azinphos-methyl er angivet som skånende insekticider.

Staphylinidae (Rovbiller)

Især chlorfenvinphos, men også diazinon og parathion er rapporteret som giftige for rovbiller.

Azinphos-methyl er i et enkelt tilfælde beskrevet som skånende.

Coccinellidae (Mariehøns)

Variationen fra art til art og imellem insektets udviklingsstadier er her stor. Dog er det typisk for denne familie, at de tåler insekticiderne bedre end andre predatorer.

Carbaryl, carbofuran, demeton (som kontaktgift), demeton (demeton-dræbte bladlus givet som føde til larver), dicrotophos, dilan, DN-111, endosulfan (til imagines), fenthion, formethanat, formothion, lindan, malathion, methoxychlor, methylparathion, mevinphos, parathion, phosdrin, pyrethrum, ronnel, rotenon og zectran er bedømt som de giftigste insekticider.

Azinphos-methyl, carbofenothion, demeton-methyl, diazinon, dimethoat, endosulfan (larver), galecron, oxydemeton, phoshamidon, plictran, TEPP, trichlorfon og trithion (samt dibrom, ethion, lindan, parathion, sabadilla, schradan, TEPP, tetradifon og trichlorfon givet som mavegift), hører til imellem de to ydergrupper.

Aldicarb, chlorfenson, demeton (demeton-dræbte bladlus givet som føde til imagines), demeton, endosulfan (æg), endothion, ethion, imidan, isolan, monocrotophos, neotran, nikotinsulfat, phosalon, pirimicarb, ryania, sabadilla, schradan, TEPP, tetradifon og vamidothion er henført til skånende insekticider.

For mariehønsene gælder også, at u.l.v. sprøjtninger er mere skånsomme end konventionelle sprøjtninger.

Malachiidae

Azinphos-methyl, carbaryl, dimethoat, methylparathion anses for giftige mod malachiider.

Demeton, dicrotophos og phosphamidon er rapporteret hørende til imellem de to ydergrupper.

Aldicarb, dilan, Bac. thuringiensis præparater, trichlorfon og zectran er angivet som skånende.

Hymenoptera *(Årevingede)*

De repræsentanter for denne orden, som især har interesse her, er parasitter, det vil sige, at de lever i andre insekter. Selve denne parasitære virksomhed kan foregå i alle værtens stadier. Endvidere er nogle af disse parasitter såkaldte hyperparasitter, det vil sige, de parasitterer (eller snylter på) andre parasitter (snyltere). Denne insektorden omfatter arter, som i langt højere

grad end andre ordener er specialiserede. En stor del af de omtalte arter eksisterer ikke i Danmark, men på grund af en større ensartethed i resultaterne af behandling med insekticider indenfor ordenen er disse resultater, omend de beskriver mere eksotiske forhold, formentlig af stor gyldighed her.

Hovedparten af de gennemgåede publikationer beskriver arter fra to vigtige overfamilier, nemlig: Ichneumonoidea og Chalcidoidea. Til første overfamilie hører Braconidae, Ichneumonidae og Aphidiidae. Til den anden overfamilie hører: Trichogrammatidae, Pteromalidae, Encyrtidae, Aphelinidae og Eulophidae. Desuden skal omtales enkelte arbejder om familierne Cynipidae, Bethylidae, Ceraphronidae, Scelonidae og Formicidae. Arbejder vedrørende hymenopterer beskrives samlet.

Indvirken af insekticider på hymenopterer er lidt vanskeligere at beskrive generelt end for andre insektordener, grundet deres levevis som parasitter. En stor del af parasittens liv foregår beskyttet. Æg, larvestadier og puppe er hyppigst beskyttet af værten. Foruden insektets forskellige udviklingsstadier, hvor insekticiderne indvirker forskelligt, er der således en ekstra faktor, som i reglen medfører, at parasitten beskyttes mod påvirkning fra insekticiderne. Derfor skal følgende opdeling af insekticiderne tages med forbehold.

Carbaryl, carbofuran, diazinon, dichlorvos dilan, disulfoton, fenitrothion, formothion, guthoxon, malathion, methylparathion, menazon, mevinphos, monocrotophos, parathion, phorat, phosphamidon, propoxur, ronnel, thiometon og zectran er angivet som skadelige insekticider.
Aldicarb, azinphos-methyl, carbophenothion, chlorerede insekticider, demeton, demeton-methyl, dimethoat, disulfoton, endosulfan, isolan, methoxychlor, rotenon, TEPP og trichlorfon er relativt skånende.

Bac. thuringiensis præparater, chlorbenzid, chlorfenson, dibrom, dioxathion, DN-111, EPN, ethyltrichlorfon, fenson, isopropylparathion, nikotinpulver, nikotinsulfat, pirimicarb, ryania, sabadilla, stroban, Tepa, tetradifon, tetrasul og triamiphos er angivet som skånende.

Diptera *(Tovingede)*

Syrphidae (svirrefluer) er den familie, som har størst interesse her, men kun en meget begrænset del af den, da ikke alle arter optræder som predatorer. Svævefluernes larver er en af de mest betydende grupper af predatorer på bladlus under markforhold.

Oplysninger om insekticidernes virkning på syrphider er sparsomme. Dog kan konkluderes at syrphiderne er meget følsomme for de fleste insekticider, især i larvestadierne. Bladlus dræbt med insekticider og anvendt som føde til larverne tåles meget bedre end direkte behandling. Der er forskel imellem arternes følsomhed.

Arachnidae *(Spindler)*

Her skal kun kort resummeres vedrørende edderkopper.

Edderkopperne er angivet at være relativt lidet følsomme mod insekticider. Generelt kan konkluderes på de få publikationer, der foreligger, at giftigst er chlorerede insekticider (undtagen methoxyclor) og bedst tolereres organofosfater (undtagen azinphos-methyl som er meget fatalt for edderkopper) og carbamater.

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