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# Extended Summaries SCI Pesticides Group Symposium Postgraduate Research on Pesticides

*The following are extended summaries based on papers presented at a meeting organised by the Physicochemical and Biophysical Panel of the SCI Pesticides Group, held on 24 March 1993 at Jealott's Hill Research Station, Bracknell, Berkshire, UK. The summaries published here are entirely the responsibility of the authors and do not necessarily reflect the views of the Editorial Board of* Pesticide Science.

## The Plant Growth Regulator Activity of the Fungicide BAS 480F

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Cytochrome P-450 linked enzymes have vital roles in many major pathways, including sterol biosynthesis in plants and fungi, plant growth regulator biosynthesis and metabolism in plants and pesticide detoxification in plants and insects. BAS 480F (2*RS*,3*SR*)-1-[3-(2-chlorophenyl)-2-(4-fluorophenyl)oxiran-2-ylmethyl]-1*H*-1,2,4-triazole, BASF)* is a new triazole fungicide which inhibits sterol biosynthesis in fungi by inactivating the cytochrome P-450 14α-demethylase.[1] However, field trials and glasshouse experiments have shown BAS 480F to inhibit the growth of important dicotyledonous weed species, *Galium aparine* L. (cleavers), *Viola arvensis* Murray (field pansy) and *Papaver rhoeas* L. (corn poppy) being the most susceptible. Symptoms expressed by each species were similar and included stunting, retardation of leaf expansion, an increase in chlorophyll content, an apparent increase in epicuticular wax formation (leaves appeared shiny) and the occasional appearance of purple pigmentation on treated leaves.

BAS 480F applied at field rate (125 g $ha^{-1}$) reduced the leaf areas of *G. aparine*, *V. arvensis* and *P. rhoeas* by 23, 48 and 52% respectively (Fig. 1). A more detailed laboratory study was undertaken to investigate the influence of the compound on leaf development in *G. aparine*. Application at 125 and 250 g $ha^{-1}$ resulted in increased leaf thickness (16 and 27% respectively) and palisade, spongy mesophyll and epidermal cells were all found to be significantly longer. An increase in chlorophyll per unit area was thought to be due to the presence of more chloroplasts per unit area and not to an increase in chlorophyll per chloroplast. Similar symptoms have been reported in sugar beet leaves treated with paclobutrazol.[2] Electron microscopy studies suggested that BAS 480F may affect the arrangement of grana, as thylakoid membranes were less closely appressed in the chloroplasts of treated than untreated leaves. The fungicide appeared to cause an increase in the abundance of starch grains to approximately twice the number found in chloroplasts from untreated tissue.

Treatment of *G. aparine* with BAS 480F (125 g $ha^{-1}$) caused severe stunting with a 54% reduction in plant height (Fig. 2). This was overcome by gibberellin $A_3$ ($GA_3$; $10^{-3}$ M applied in acetone+water, 5+95 by volume) indicating that *ent*-kaurene oxidation, a series of reactions catalysed by cytochrome P-450 in gibberellin biosynthesis, may be inhibited.

Both simultaneous application of $GA_3$ ($10^{-3}$ M) and BAS 480F, and application of $GA_3$ three days after fungicide treatment, overcame the inhibitory effects of BAS 480F, in agreement with previous work which has also shown that the growth-inhibitory effects of triazoles can be overcome by exogenous application of gibberellin.[3] However, whilst BAS 480F alone reduced mean leaf area by 43% (Fig. 2), simultaneous treatment with $GA_3$ did not alleviate this effect.

* The name epoxiconazole has been proposed for this compound, but this has not been approved by ISO/BSI.



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## Long-Term Effects of Current Pesticide Use on Invertebrates in UK Arable Crops

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The UK Ministry of Agriculture, Fisheries and Food (MAFF) 'Boxworth Project' investigated the environmental impact of pesticide use in intensive cereal production in England during the 1980s.[1] The project demonstrated that populations of some polyphagous predators such as ground beetles (Carabidae) and one of their important prey types, springtails (Collembola), decreased substantially and persistently for a long period under a high-input pesticide regime.[2,3]

The Boxworth Project highlighted a number of environmental questions which are now being addressed by the MAFF 'SCARAB' Project (Seeking Confirmation About Results At Boxworth). The SCARAB Project was set up in 1989 and aims to investigate the effects of current and reduced pesticide use in the 1990s on farmland invertebrates in different arable crops and soil types at different locations, using seven study fields located at three different farms in England.[4]

Each study field was divided in half to allow two pesticide regimes to be compared. These are: 'Current Farm Practice' (CFP) which represents current average pesticide use for a particular crop by the majority of growers in the UK and a 'Reduced Input Approach' (RIA) which is a managed lower input of pesticides. RIA is based on monitoring pests, weeds and diseases in the crop and aims to avoid the use of insecticides. Invertebrates have been monitored routinely by pitfall trapping and suction sampling at matched locations in the CFP and RIA areas of each field since summer 1990. The comparison of the two pesticide regimes in each field will continue until 1996. As there is no physical barrier between the halves of each field, studies of pesticide drift and of the movement of invertebrates have been carried out to assist interpretation of treatment differences.

In the first two treatment years of the project, insecticides were used only in the CFP part of each study field. Some of these insecticides, such as chlorpyrifos and deltamethrin, had apparent adverse effects on ground beetles (Carabidae), springtails (Collembola) and money spiders (Linyphiidae).[5,6] Some of the effects were persistent, for example median catches suggested there was no substantial population recovery of *Bembidion obtusum* Serville up to 16 months after a chlorpyrifos spray (Fig. 1). *B. obtusum* has a poor dispersal ability and lives in cereal fields throughout the year, so it may be exposed to a number of pesticide sprays during its life-cycle; this is likely to explain its inability to recover following pesticide-induced population perturbations such as those seen at Boxworth.[2,3] Figure 2 shows that a substantial population decrease occurred in one of the important food items of this beetle after the same insecticide spray. Mortality of prey may lead to indirect effects of pesticides on predators, which could explain the poor population recovery. The aim of SCARAB is to examine the effects of two contrasting pesticide regimes on invertebrates over six years, so the results presented here are preliminary, but give an idea of the possible effects which may be expected. The background to this study has been reported in greater detail elsewhere.[5-7]

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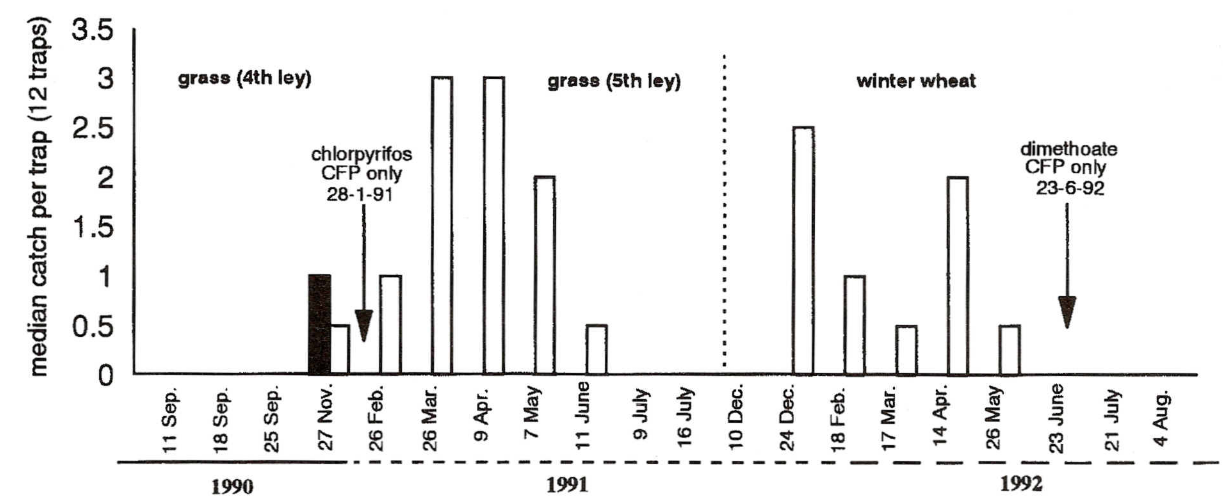


**Fig. 1.** *Bembidion obtusum* catch in pitfall traps from Field 5, 1990–92. ■ CFP; □ RIA.

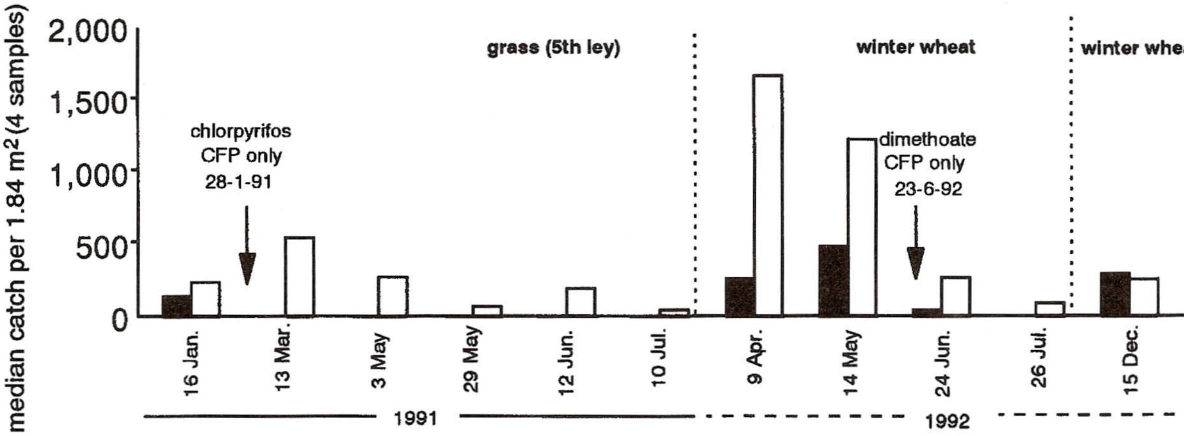


**Fig. 2.** Catches of total Collembola in suction samples from Field 5, 1991–92. ■ CFP; □ RIA.

with the sorting and identification of the samples at Southampton and to Dr G. P. Vickerman for his help and advice.

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## Effect of Prochloraz and Flusilazole on the Growth of Cereal *Fusarium* Species *in vitro* and *in vivo*

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Foot rots of cereals can be caused by several species of *Fusarium* in the UK, alone or as a disease complex. These include *Fusarium culmorum* (W.G.Sm.) Sacc., *Fusarium avenaceum* (Fr.) Sacc. and also *Microdochium nivale* (Fries) (formerly *Fusarium nivale*). Symptoms of *Fusarium* foot root consist of a browning of first or second nodes of the plant, thin brown inter-nodal vertical streaks or a dark brown lesion which girdles the stem base.

In a three-year survey (1985–87)[1] of cereal diseases in England and Wales carried out by the UK Ministry of Agriculture, Fisheries and Food (ADAS), no fungicides controlled *Fusarium* foot rot of cereals effectively. However, there is evidence that growth of *Fusarium* species and *M. nivale* is inhibited on fungicide-incorporated nutrient media (HGCA survey 1991).[2]

In order to study the apparent discrepancy between laboratory and field control of *Fusarium*, an examination of the differential response of *F. culmorum*, *F. avenaceum* and *M. nivale* to the imidazole fungicide prochloraz and the triazole fungicide flusilazole *in vitro* and *in vivo* was undertaken.

Experiments to examine the growth of *Fusarium* species and of *M. nivale* on nutrient media amended with varying concentrations of fungicide showed that growth of *M. nivale* was reduced as the concentration of prochloraz or flusilazole was increased. Growth of a given isolate of *M. nivale* was totally inhibited by prochloraz and flusilazole at 10 and 50 $\mu g\ ml^{-1}$, respectively.

*F. culmorum* showed a more marked response to prochloraz than to flusilazole at low concentrations, with 63% and 100% inhibition of growth at 0·1 and 1·0 $\mu g$ a.i. $ml^{-1}$, respectively, compared to 0% and 45% respectively, at the same concentrations of flusilazole. *F. avenaceum* and *F. culmorum* showed a similar response to both fungicides. In studies using fungal spore suspensions placed on sterile cellophane squares on fungicide-amended tap water agar (TWA), there was no inhibition of spore germination of *F. culmorum* and *F. avenaceum* at 50 $\mu g\ ml^{-1}$ flusilazole after 12 h incubation (Fig. 1). However, flusilazole completely prevented germination of macroconidia of *M. nivale* at 10 $\mu g\ ml^{-1}$ (Fig. 2).