JOINT ACTION OF WHEAT ALLELOCHEMICALS

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INTRODUCTION

It has been postulated that allelopathic activity is nearly always the result of a simultaneous effect of two or more compounds (1). The allelopathic activity of wheat has been attributed to hydroxamic acids and related compounds (2,3) and phenolic acids (4,5). The objective of the present study was to assess the joint action of two- and three-way mixtures of phenolic acids and hydroxamic acids applying the Additive Dose Model (ADM) as reference model.

MATERIALS AND METHODS

Germination test

The following compounds were included in the study: ferulic acid (FA), p-coumaric acid (CA), vanillic acid (VA), p-hydroxybenzoic acid (HBA), 2,4-dihydroxy-1,4-benzoxazine-3-one (DIMBOA), 6-methoxy-2-benzoxalone (MBOA) and benzoxazolinone (BOA). Two pieces of filter paper were placed in each Petri dish (9 cm diameter) and 2 ml of a dose range of each of the compound or binary or tertiary mixtures of the compounds in fixed ratios were added. All compounds were dissolved in methanol and the Petri dishes were left uncovered until the methanol had evaporated and then 4.5 ml deionised water was added. Fifteen seeds of *Lolium perenne* L. or *Myosotis arvensis* L. (Hill.) were placed in each Petri dish where after the Petri dishes were covered and sealed with Para film. Seeds were allowed to germinate in the dark at 22-25^{o}C. The day of germination and root length was recorded for each seed. All treatments had three replicates.

Statistical analyses

The response of root length and root growth/day to doses of wheat allelochemicals was described using a log-logistic model and ED_{50} and ED_{90} doses were estimated and joint action of the mixtures was assessed using the ADM assuming additivity of doses (6). Significant deviations from ADM were classified as antagonism or synergism.

RESULTS AND DISCUSSION

The estimated ED_{50} and ED_{90} doses of the hydroxamic acids MBOA and BOA were generally 2-4 times lower than the corresponding doses of the phenolic acids on both plant species. MBOA tended to be more active than BOA and among the phenolic acids the cinnamic acid derivatives FA and CA were more phytotoxic than the benzoic acid derivatives VA and HBA.

Mixtures of phenolic acids either followed ADM or were slightly antagonistic relative to the ADM. Deviations were more pronounced on *L. perenne* than on *M. arvensis* and particularly the mixture of FA and HBA on *L. perenne* performed antagonistic. The mixture of MBOA and BOA followed ADM very closely. In contrast mixtures of MBOA or BOA with FA or VA always performed antagonistic irrespectively of plant species. In figure 1 is shown typical examples of results with binary mixtures.

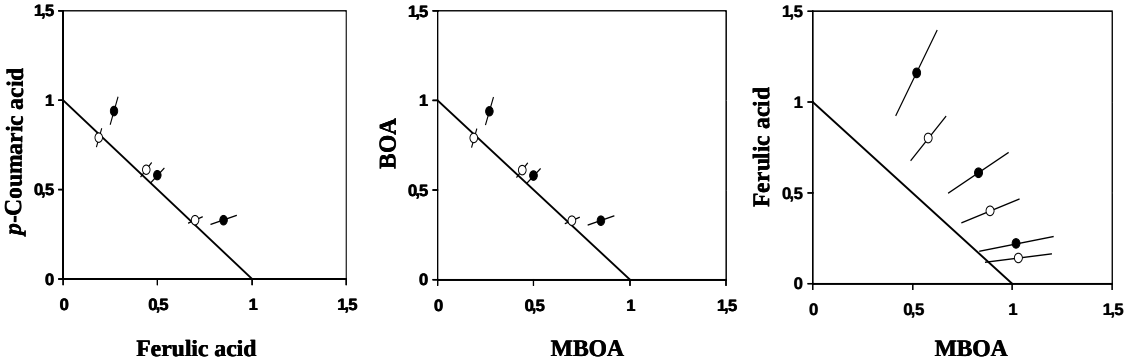

Fig. 1. ADM isoboles and estimated ED_{50} (○) and ED_{90} (●) doses of mixtures of FA+CA, MBOA+BOA and MBOA+FA on *L. perenne*. Bars indicate 95% confidence intervals for the estimated ED_{50} and ED_{90} doses. The doses have been scaled so that the doses of the herbicides applied separately are 1.0.

A three-way mixture of MBOA, FA and VA also tended to perform antagonistic but only the mixture with the highest ratio of MBOA deviated significantly from the ADM.

The present study has shown that mixtures of compounds implicated in wheat allelopathy either performed additively or were antagonistic and it can be concluded that synergism seems to be rare phenomena among wheat allelochemicals.

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