nopeziza brassicae, Alternaria brassicae, Peronospora parasitica and *Botrytis cinerea,* and that some used in the field can increase yield. Some metabolites active against pathogens are also semiochemicals for insect pests, so interrelated pest and pathogen management based on complex mixtures of natural chemicals with optimized release rates is a likely outcome of the research. Thus, the new approach will require a full investigation of interactions within the ecosystem, including pest-host plant (e.g. *C. assimilis* and rape), pest-pest (e.g. *C. assimilis* and *D. brassicae*), pest-pathogen (e.g. *P. chrysocephala* and *L. maculans*) and pest-insect pathogen interactions.

Successful practical application of results from these studies on metabolites, semiochemicals, pests and pathogens requires that research also be done to assess the physical characteristics of sprays produced by novel and conventaional spray equipment. This work will include assessment of spray deposits, principally of semiochemicals but also of other biological agents and the measurement of their distribution and persistence under field conditions.

In parallel with work on these aspects of crop protection, biochemists will study the detailed enzymology and metabolic regulation of glucosinolate biosynthesis. The aim is to devise effective strategies for manipulating the genes responsible for producing semiochemical and fungicidal secondary plant metabolites. To complement the enzymology there will also be a programme of selection for induced mutants with lesions in the pathway of glucosinolate biosynthesis, and an analysis of these at the genetic, physiological and biochemical levels. It is hoped that this contribution to basic research will underpin and advance breeders' efforts to produce better pest and disease resistant "double low" cultivars. The information combined with knowledge of the biological activity of semiochemicals and metabolites, should provide the basis for genetic manipulation leading to new cultivars with an accurately determined spectrum of biologically useful metabolites in green tissue, yet still meeting EEC requirements for low levels of glucosinolates in seed. The aim would be to engineer a crop so that pest and disease pressure could be countered by tactical production of endogenous crop protection agents. A crop protection system which combines exploitation of externally applied and internally manipulated natural products can be expected to have minimal harmful impact on the environment and leave minimal residues in oil and meal.

All the research outlined will require close collaboration between entomologists pathologists, chemists and biochemists. In keeping with the theme of a team- approach, the new work will be co-ordinated by a scientific management committee comprising the authors of this report.

The results (Figures 1a and 1b) indicate clearly that for mature seed, a good correlation exists between each of the two physico-chemical methods and the glucose-release method. Regression analysis explained approximately 94% of the variation in the observed glucosinolate values. However, in each case some samples were shown to be unusual (outliers). These outliers were specific to the particular method, only one being common to both methods. All outliers were samples having a high glucosinolate content and thus it would be expected that the analysis of low glucosinolate material would present fewer problems. Although the reasons for the occurrence of outliers is not known, recent work (Schnug and Haneklaus,1988) has shown that glucosinolate content, as measured by glucose-release, increases as the seed approaches maturity and it is suggested that the glucosinolate side chain or glucose residue may be subject to modifications, affecting quantization by this method. X-ray fluorescence on the other hand measures glucosinolate sulphur in whatever form it exists, similarly it will measure and report as glucosinolates, any sulphur-containing compounds resulting from degradation of glucosinolates. Thus results obtained from seed which has been subjected to excessive drying after a wet harvest should be interpreted with caution. Despite these problems and the difficulty of calibrating any physical technique against acceptable "wet" methods, XRF has been received with enthusiasm and is now a national method in the German Federal Republic and is one of two authorised national alternatives in the United-Kingdom.

This study further confirms that whilst NIR will provide a satisfactory indication of glucosinolate levels using a monochromator instrument and first derivative data, a more realistic goal for industrial application would involve transfer to more robust filter instruments and the use of log I/R data.

Figure 1a: Analysis of 115 samples of rapeseed by X-ray fluorescence spectroscopy and glucose-release.

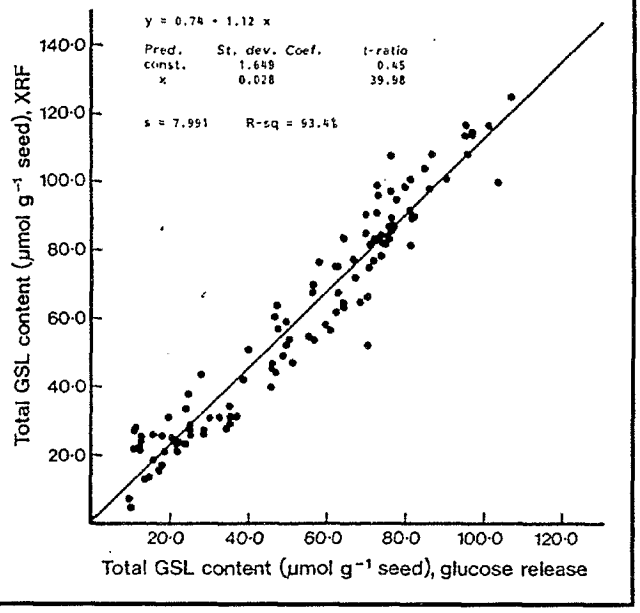
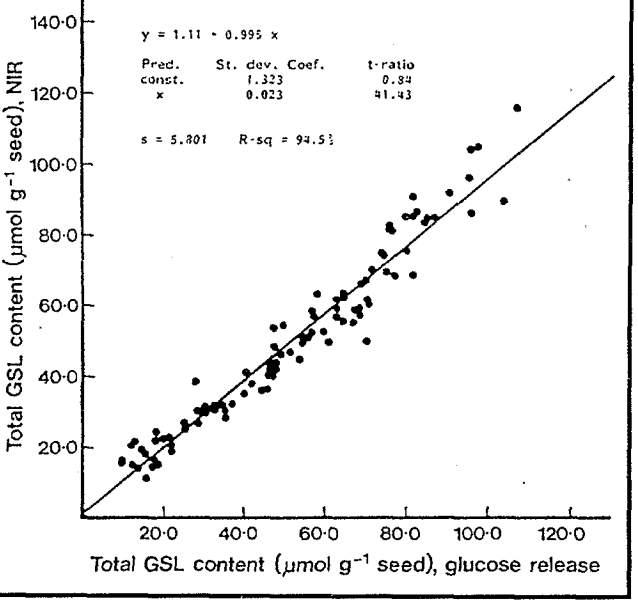


Figure 1b: Analysis of 101 samples of rapeseed by near-infrared reflectance spectroscopy and glucose-release.



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