The BRIGHT PROJECT - Botanical and Rotational Implications of Growing Genetically Modified Herbicide Tolerant Crops

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A major new research project - the BRIGHT project - has been initiated in Autumn 1998 to study the agricultural implications arising from the use of herbicide tolerant crops, including genetically modified varieties, in arable rotations. Environmental consequences will also be monitored, although this is not the primary aim of the project. The research is being conducted by the Institute of Arable Crops Research, Morley Research Centre, The National Institute of Agricultural Botany and the Scottish Agricultural college in an industry/government sponsored consortium sponsored by MAFF, plant breeders, crop protection specialists and farming organisations.

Genetically modified (GM) herbicide tolerant (HT) oilseed rape, sugar beet, fodder beet and maize are now approaching commercialisation. They offer potential improvements in weed management, reduced crop damage and economic and environmental advantages. It is important that this new technology is thoroughly understood so that it can be appropriately incorporated into agricultural practice and farmers realise its benefits. This research programme is studying the interactions between the different herbicide tolerances in a number of crops grown in rotation and will develop guidelines for their management.

Two GM herbicide tolerances and one non-GM tolerance are currently being developed in oilseed rape and at least two GM tolerances in sugar beet/fodder beet and maize. While this new technology may offer advantages in weed management to growers, there are concerns about how these crops will be managed and about potential adverse effects arising from inappropriate management. Land could become infested with herbicide tolerant weeds and volunteers to the extent that GM crops could no longer be exploited and conventional crop management would need to be modified. This project provides an opportunity to explore such issues as the persistence of herbicide tolerant volunteer populations and rates of evolution of multiple tolerance especially in oilseed rape, arising from adjacent and sequential crops with different herbicide tolerances. In addition the impact on botanical diversity of changing from the use of selective herbicides to broad spectrum herbicides requires examination.

In year one of the four year project a series of rotation experiments have been started which include three herbicide tolerant oilseed rape varieties and two GM herbicide

tolerant sugar beet varieties. Three of the rotations include oilseed rape and have been designed to investigate the effects of growing herbicide tolerant rape in both normal farm rotations and in worst case scenarios (Table 1.). When the second broad-leaved crop is grown the plots will be sown at 90? to the first crop, so that each sub-plot arising from this lattice approach will have a unique sequence of herbicide tolerant volunteers in sequences of the same or different herbicide tolerance . In the third year of Rotation 3 a different broad-leaved crop (HT and conventional) will be grown on the five sites, to compare the consequence of growing sequences of different herbicide tolerant crops.

Table 1. Four year Rotation design

Year	**Rotation 1**	**Rotation 2**	**Rotation 3**	**Rotation 4**	**Rotation 5**
1	Winter oilseed rape	Sugar beet	Winter oilseed rape	Winter cereal*	Winter cereal*
2	Winter cereal	Winter cereal	Winter cereal	Winter oilseed rape	Winter cereal
3	Winter cereal	Winter cereal	SpringGM/ non GM	Winter cereal	Sugar beet
4	Winter/spring rape	Sugar beet	Cereal/fallow	Cereal/fallow	Cereal/fallow

* The two rotations designated as undersown in year 1 would receive GM HT and conventional rape (R.4) or beet (R.5) seeds during late summer which are ploughed under to simulate seeds shed from the previous crop establishing a seedbank of potential volunteers.

NB: All broad-leaved crops will compare 2 or 3 herbicide tolerant cultivars and a `conventional'. The winter cereal will be standard across all plots.

The weed control and the species diversity of surviving weeds will be assessed each season in each herbicide treatment. Control of tolerant and non- tolerant rape volunteers will also be assessed once the first volunteers are present in following crops In the second transgenic crop the effects of the different herbicide treatments will be assessed.

In the first season assessments have focused on recording weed plant populations prior and after herbicide treatments, crop condition post-herbicide treatment and weed seed bank levels, which will be also be recorded at the end of the project. On completion of the project the economic evaluation of the various rotations and treatments will be made. Optimum management systems for GM/non-GM herbicide tolerant crops will be developed and the results communicated to farmers as guidelines for the management of herbicide tolerant crops.