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Brassica and Oilseeds Research in Norwich, Britain

Dr. D.J. MURPHY

Head of Brassica and Oilseeds Research Department
John Innes Centre for Plant Science Research
Colney Lane - Norwich NR4 7UH

The Brassica and Oilseeds Research Department was formed in April 1990 when the IP2SR Cambridge Laboratory moved to its present site in Norwich and was joined by the Oilseeds Research Group from the University of Durham. Since occupying the new laboratories in Norwich the Department has almost doubled in size to its present complement of about 50 staff, students and visitors. The Department is undertaking a wide range of research projects that are focused on the molecular biology, biochemistry and genetics of selected brassica and oilseed crops.

Oilseeds play an important and ever increasing role as crop plants in the United Kingdom and other EEC countries. In addition to their use for edible oil and protein products, oilseeds are now recognized as potential renewable sources of a variety of non-edible products of interest to the chemical, cosmetic and pharmaceutical industries. The major oilseed crop in the United Kingdom and northern Europe is *Brassica napus* - oilseed rape. Other notable oilseed crops grown in the United Kingdom include linseed, mustard, evening primrose and borage. In addition to their use as sources of oil and protein, many brassicas are grown as vegetable crops, such as cabbage, turnip, swedes, cauliflower and broccoli.

The genetical research in the Department involves a combination of conventional and molecular approaches aimed at the identification of genes controlling economically important characters and/or of special scientific interest. This will also involve the preparation of a detailed genome map for the brassicas in order to ascertain the location of important genes. The biochemical research, which also involves physiological and molecular biological approaches, is aimed at elucidating the regulatory mechanisms underlying the synthesis of economically significant storage products in oilseeds. This work includes the purification and characterization of important enzymes and the cloning of their genes. It also involves the use of genetic engineering to improve brassica and oilseed crops, e.g. to produce more valuable oils, to have enhanced disease resistance and to eliminate toxins. The Department is also developing the enabling technologies to support this programme. These range from transformation/regeneration systems for the production of transgenic plants to antisense and transposon tagging methods for selective down-regulation of gene expression.

An important long term aim of the research in the Department is the improvement of crop quality in oilseeds for non-edible applications. The current widespread occurrence of food surpluses in developing countries has focused attention on the possible use of agriculture to generate crops for non-edible uses. Oilseeds are particularly valuable in this respect since their oil components can be used as renewable resources to replace products which are at present derived from non-renewable fossil fuels. The oil quality of a crop such as oilseed rape can be manipulated in a number of different ways to give rise to an oil which is suitable for a non-edible application. In the past, methods such as conventional breeding and induced mutation have been used to generate new crop variance with different fatty acid profiles in their seed oils. The scope for introducing such variation into a crop has been widened considerably in the last few years by the availability of molecular genetic techniques. It is now possible, in principle, to transfer genes of interest from different crop species, or even from bacteria and animals, into a crop such as oilseed rape in order to produce the desired fatty acid profile in the seed oil. While these aims are straightforward and the concepts underlying them are easily understood this research is of necessity long term. This is due to several factors. Firstly, it will be necessary to elucidate in much greater detail the pathways and regulatory mechanisms responsible for the synthesis of storage products such as oil in developing seeds. Progress in this area has been slow but it is encouraging to note that several recent initiatives by Research Councils have resulted in an increase in research funds in the area of plant metabolism. Secondly, the vast majority of gene functions of interest involve singularly recalcitrant membrane-bound proteins whose purification has been bedeviled by many technical difficulties. It has been possible in some cases to use an oblique approach whereby analogous genes are cloned from more easily manipulated systems such as prokaryotes using techniques such as differential screening and complementation, but such an approach has not always been possible. Again while progress has been slow it is now accelerating in this area as well. These and other difficulties mean that it will probably be the turn of the century before we see our first transgenic oilseed crops in the field.

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Oleosins

D J Murphy, I Cummins, M J Hills, Ming Li, J H E Ross

Oleosins are hydrophobic proteins which are specific to oleogenic tissues in plants. Oleosins were first characterized in oil seeds such as maize, soybean and sunflower. Oleosins have only been recognized as a new class of plant protein in the last 2-3 years. These proteins are uniquely associated with the storage oil bodies in plants and are not present in any other tissue or subcellular fraction. Oleosin like proteins have been found in all plant lipid storage tissues that we have so far investigated. These include avocado mesocarp, castorbean endosperm, maize scutellum and oilseed rape cotyledons to name but a few. In oilseeds, such as oilseed rape and sunflower, oleosins constitute in excess of 20% total seed protein. Despite their abundance and frequent location in seed, oleosins should not be considered as seed storage proteins. Oleosins are not found in seed protein bodies, but they are not nitrogen-rich, they are insoluble in aqueous media, regardless of salt concentration pH and, finally, they are synthesized and mobilized at different times to seed storage proteins. We have also found that the expression of oilseed rape oleosin genes, as determined by steady state mRNA levels, occurs later and shows different kinetics to oilseed rape storage protein genes.

The amount of oleosins in oleogenic plant tissues appears to be correlated with the oil content. On the other hand, it has been shown that oleosins are unlikely to play a role in the biosynthesis of triacylglycerols and their release as nascent oil droplets. That oleosins play an important role in the plant tissues in which they occur is evident from their great abundance. We suggest that the function of oleosins is to provide a