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Centre for Agricultural Strategy

Biotechnologies in agriculture and food- coming to the market

Edited by BJ Marshall & FA Miller

STP
S494.5
.B563
B535x
1996

CAS Paper 34

July 1996

1 Expectations of the growers of arable and horticultural crops

Oliver Doubleday

INTRODUCTION

As a farmer and grower I endeavour to produce efficiently the products wanted by my customers. This is important to me since, if I do not have the confidence of my customers, I cannot succeed. I have been asked to give some ideas as to where I would like biotechnology to assist and improve in the efficiency of my production systems and thereby the competitiveness of my business. Before setting out my biotechnology 'wish-list', however, perhaps I should give you a brief outline of my family's farming operations. We farm about 3000 acres in North Kent. We have sheep and beef cattle and grow a range of combinable crops such as wheat, barley, oilseed rape, peas and linseed. We also grow potatoes. We are in a traditional fruit-growing area and grow apples, pears, cherries, plums and strawberries.

CHALLENGES - ARABLE AND HORTICULTURAL

What challenges does this business face in the future? It is fairly clear that the arable side of the business is going to be asked to compete at world market prices and whatever support we receive is likely to be increasingly decoupled from direct production. Our environmental performance is likely to feature more prominently in debates, and our horticultural operations that attract only minimal support, already take place in a global market. Gone are the days when if you bought a cherry it had probably been grown in Kent. We are now in an extremely competitive environment and cherries sold in the United Kingdom (UK) come from all around the world. Thus the concept of seasonality has almost ceased to exist. The choice of fruits available to

consumers has also increased dramatically and mangoes, kiwis, starfruit, lychees have all become quite common.

IMPROVING COMPETITIVENESS, QUALITY AND YIELD

In view of the very high labour component in the horticultural industry, production is cheapest in countries with low labour costs. There is no way that my neighbours can compete with Eastern European blackcurrant producers. The UK horticultural trade deficit in 1994 was some £3 billion, much of which could have been sourced within the UK. How might biotechnology help me compete in the future? There are many ways through which I could be seeking improvements. Anything that decreases my costs of unit production is of interest to me. That might, of course, be increasing yields. It is not always obvious what is the limiting component of a plant's yield. For example, wheat yields are probably currently limited by the ability of the straw to stand up under the weight of the crop. Wind and rain can flatten the crop, making harvesting very difficult and causing loss of yield, and sometimes quality, as the flattened crop is more easily spoilt by moulds. So, for wheat production, straw stiffness is probably the limiting component in production. For many crops, water is the limiting component, and increased drought resistance would be invaluable. An obvious example here is potatoes. In dry conditions we irrigate our potatoes. It is an expensive operation, consuming water resources which may be scarce. Other environmental stresses include both hot and cold temperatures. Frost will be a recognised enemy of many gardeners. It certainly constrains how early one can plant early potatoes, because potatoes dislike frost. In horticulture quality is 'King'. Thus yield must be defined in terms of marketable product. What contributes to quality? Specified size, colour and freedom from surface blemish are the standards used to categorise apples as Class I or Class II (Anon, 1973). More subtle elements that are very important, even though they are not part of the grading criteria, are taste and texture. Any developments that improve these characteristics would be of interest to me. Where do I sustain losses within my production systems? Bruising, premature ripening, and losses within storage and the supply chain are all significant. Significant losses also occur as the result of insect pest damage as well as bacterial, fungal and viral diseases. In view of the high visual quality demanded for horticultural produce a great deal of management resources and agrochemicals may be used to combat these pests and diseases. This is a cost to me, and a worry to my environment- and health-conscious consumers. For further discussion of this topic see Doubleday (1992) and Doubleday & Wise (1993).

There are some more straightforward production issues that could help my horticultural enterprise. Some fruits, such as Cox apples, need

a certain amount of cold weather during the winter in order for bud development to occur properly. This vernalisation may become more of a problem if global warming predictions are accurate. It would certainly help me to know that optimum fruit-bud development was more certain. Many plants need to be pollinated in order to set fruit. This leaves growers praying for good weather over the pollination period, in order to encourage insect activity. Self fertility would therefore be very attractive to me. It would be nice to be less worried about the weather, and indeed less concerned about the potential adverse impact of a late frost. These frosts really worry me, since they can devastate apple and pear orchards, with small fruitlets being particularly vulnerable.

The possibility of extending the seasons for fruit and vegetables is of real interest to me. For example, the most significant market developments for cherries and strawberries have recently been towards late production. Imported fruit from warmer climates comes in before main domestic production. We then get domestic production, with relatively little competition towards the end of our production cycle. Indeed there are probably export possibilities for late-produced fruit.

RESISTANCE TO PESTS AND DISEASE

Let us consider other areas where biotechnologies are of interest to me. I would be attracted to crops with enhanced resistance to pests, most of which are insects, and diseases of bacterial, fungal and viral origin, since these would reduce the amount of agrochemicals that I need to grow my crops. This clearly has potential environmental benefits, and I believe that these advantages would also be attractive to consumers who, in general, dislike the use of chemical pesticides. I find viral resistance particularly attractive, since there is no cure for Mosaic Virus in potatoes or Barley Yellow Dwarf Virus. I therefore have to wage a fairly vigorous war on the insect vectors of these diseases, since I do not want any significant populations that could spread the disease. Insecticides are often unfriendly to both operator and environment. Another example of a sub-cellular organism is the mycoplasma-like organism that causes Pear Decline (or Parry's Syndrome). This is a serious condition, which has significantly reduced the attraction of growing Conference pears in this country.

NOVEL CROP OPPORTUNITIES

One field where I am really optimistic that biotechnology may be able to make a significant contribution is that of novel crops, both food and non-food. I find plants extraordinarily clever - in that they can make

such an astonishing range of chemicals. Society has clearly benefited from this as folk remedies have been refined as medicines. A high proportion of all drugs are of plant origin. I find the idea of using plants to generate cleanly feedstocks for the chemical industry very exciting since they should be significantly less polluting than the alternative methods of synthesis, which are likely to rely heavily upon the use of fossil fuels. Non-food crops have considerable attractions to farmers. They are not subject to the complexities of the General Agreement on Tariffs and Trade (GATT) or the World Trade Organization (WTO). They could present useful opportunities for farmers to use Set-aside land productively. I also think that the right products could be competitive. I maintain a keen interest in rubber. Natural rubber, harvested by manual tapping, still accounts for roughly one third of the world's rubber consumption. I feel sure that biologists will be able to find equally useful chemicals in plants, and will be able to develop economic ways of exploiting them. Novel foods should not be overlooked. It is clear that certain diets are protective of human health. As the elements that contribute to this protection are identified and studied it is possible that markets will arise for products containing enhanced levels of these compounds. Some commentators believe this will in the future be a very significant market. If that proves to be the case, I would like to be producing for that market. I think that I have given a fair, if not comprehensive, 'wish-list' indicating where I might be looking for help.

CUSTOMER SATISFACTION

I would now like to look at some of these things in more detail, particularly against the criterion that I set out at the beginning of my talk - customer satisfaction. In general, as far as risk benefits are concerned, I think that the public are very reasonable in asking whose risk, whose benefit? I certainly believe that the public will be more suspicious if they perceive that they are being asked to take a risk for the benefit of somebody else. I think that this is relevant to today's meeting, since we are discussing the introduction of a very new technology which raises apprehensions in some people. It is important that informed public debate about biotechnology should take place. I have stressed the importance of customers and consumers in my talk because I think that it is essential that I retain their confidence.

THE REGULATORY FRAMEWORK

I think it is appropriate to consider briefly the regulatory framework for biotechnological products in this country. The Advisory Committee on Novel Foods and Processes (ACNFP) advises government as to whether new foods, including the products of biotechnology, should be

approved for sale. Similarly, the Advisory Committee on Releases into the Environment (ACRE) advises government as to whether permission should be granted for genetically-modified crops to be grown here. It is unfortunate that ACRE has rather narrow responsibilities, that do not include indirect consequences of any new releases, such as changes in agrochemical usage. There is also no procedure in place for the continued monitoring of releases once they have been approved. These appear to be significant shortcomings in our regulatory system which may have a negative impact on consumer confidence, and indeed the confidence of farmers and growers. Similar concerns have also been raised in the second report of the British Government's Panel on Sustainable Development (DOE, 1996). The UK Government is not the only player in this. The European Union (EU) has an important role to play, particularly over issues of patents. The availability, or otherwise, of genetically-engineered products is likely to be determined in part by the deliberations of the WTO and the *Codex Alimentarius*. These powerful bodies substantially influence the terms of world trade for food. A topical example of this concerns the treatment of cattle with growth hormones. Such treatment is currently banned within the EU, but the USA is likely to challenge the exclusion from this market of their beef from hormone-treated cattle. Credible defence by the EU looks difficult in view of the weight of scientific evidence which suggests that hormone treatment is quite safe.

Similar complications could occur in the field of biotechnology. This is important, since it suggests that we may see the products of biotechnology on our market regardless of British consumer preference. This raises important matters of competition, for example, apple ripening involves the same plant hormone, ethylene, as tomato ripening. Genetically-modified tomatoes have been developed and marketed in which the ripening process is slowed down. Cold storage of apples to increase the season over which they are available, is the traditional way in which growers slow down the ripening process, but since apples can also be genetically modified, it should now be possible to control the production of ethylene using biotechnology. The best cold stores have sophisticated, and expensive, facilities to reduce the build-up of ethylene. Clearly biotechnology could be a real help to me here, since I have not been able to afford ethylene scrubbers. A bad scenario for me would be if imported long-storing apples were to become available and I was unable to use the technology, either because it had not been developed for my apple varieties, or because there was no approval for release in the UK.

HERBICIDE RESISTANCE

One product that is likely to be offered to me fairly soon is seed for herbicide-resistant plants. The development of such plants has

essentially been the result of curiosity-driven research. It has also yielded valuable research tools. However, the developers are now interested in marketing seeds of plants with herbicide resistance as commercial products. I confess to some interest in this technology, but I also have considerable reservations about it. I acknowledge that the substitution of some herbicides by other more benign chemicals could have some benefits. Reduced mammalian toxicity would reduce operator risk, while reduction in the use of herbicides that are known to pollute water would bring environmental benefits. My unease over herbicide resistance stems from worries over possible problems with herbicide-resistant volunteer plants, and from the possibility of the spread of this resistance to non-target species, resulting in currently useful herbicides becoming useless. This is a real concern. From a practical point of view I think that the crops that would benefit the most from herbicide resistance are minor horticultural crops where pesticide registration procedures have led to a very restricted availability of agrochemicals. However, such minor crops are, of course, unlikely to excite the interest of commercial biotechnology companies.

DEVELOPING COUNTRIES

I think that biotechnology has particular significance for Third World countries as potential winners or losers, and as contributors of genetic material. It is obvious that countries that have difficulty in feeding themselves could benefit from this technology. The possibilities of introducing drought- or salinity-tolerance genes, as well as those for pest resistance must offer hope of real help for some countries in desperate need. I wonder whether they will get that help. I profoundly hope so. I have some worries that, as biotechnology creates opportunities, it may also create disadvantages among people least able to withstand further disadvantage. Imagine manipulating bananas to greatly extend the range over which they can be grown. What would be the effects of such a development upon the economies of those countries dependent upon the banana?

BIODIVERSITY

Finally, there is the issue of biodiversity. This is a very proper and indeed fashionable cause. The UK's Biodiversity Action Plan Steering Group has published its report (DOE, 1995). The Minister of State for the Environment has encouraged this process and indeed has sought and, I believe, found a sponsor for the dung beetle. I am very happy for him. However, we all know that the really big global cauldrons of biodiversity reside in the tropics, particularly in the rainforests. We are, of course, exhorting those countries to preserve their biodiversity,

while often asking them to repay debts incurred by governments with less than exemplary records over corruption and democratic procedures. These countries are clearly places where genetic fishermen will, sometime in the future, be profitably employed. I hope that the custodians of those genetic resources receive some just reward.

CONCLUSIONS

In conclusion, I am very optimistic about biotechnology. I look forward to papers today telling me what benefits I can hope to receive. I am sure that there will be situations where I, the producer, and my customers and the wider environment will gain advantages. I look forward to those and would not want to be disadvantaged by not having access to them. However, I am nervous about developments where I can less clearly see unambiguous advantages for all. There are also significant issues that need to be resolved in order to put my mind at rest. I have mentioned my unease about some aspects of the regulatory processes in this country. I have alluded to wider considerations of the WTO and the *Codex Alimentarius*. I have mentioned my concerns about the impact of this technology upon the Third World. There are other considerations involving ethics and intellectual property rights that will need to be addressed. Above all the public must be engaged in the debate of these issues. I applaud the Biotechnology and Biological Sciences Research Council's 1994 Consensus Conference on Plant Biotechnology as major step in trying to understand better the public's perceptions of this issue. I do hope that we manage to make progress on these matters as quickly as the science is undoubtedly proceeding.

ACKNOWLEDGEMENT

I would like to thank Mrs Clare Gosling, Food Science Adviser at the National Farmers' Union, for her help and advice.

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