

## **End-Point Royalties for Plant Breeding in Australia**

**Ross Kingwell and Alistair Watson**

**P**UBLICLY financed services to agricultural industries have been under review for some years (Baker et al., 1990; Watson et al., 1992; Industry Commission, 1994). Policy change has occurred in the public funding and provision of agricultural R&D and extension services (Cary, 1993; Godden, 1997). Change could be imminent in the publicly-funded provision of plant breeding services.

Australia's major broadacre industries are supported by mainly publicly financed plant breeding (Begg & Peacock, 1990). State governments finance plant breeding in State agricultural agencies and research institutes. Supporting funds come from the federal government that matches, up to a cap, farmers' levy payments on grain production. The Grains Research and Development Corporation (GRDC) administers these growers' and federal government contributions, and allocates some of the funds to providers of plant breeding services.

Plant breeding is subject to new legislation that enlarges and protects property rights in plant varieties. This enlargement of property rights may prompt change in the publicly financed provision of plant varieties for Australia's broadacre industries. The Plant Breeder's Rights Act 1994 extends intellectual property rights in plant varieties created in previous 1987 legislation.<sup>1</sup>

The 1987 legislation had little effect on the breeding of broadacre crops in Australia because the intellectual property right in new varieties applied only to sales of seed to farmers. Returns to developers of new varieties were limited because the farmers who used the seed needed only to buy small amounts of it. Farmers who initially purchased these small amounts could then 'bulk up' (multiply) the seed and continue to use seed they had saved from the harvest of their own crops.<sup>2</sup> This farmer-saved seed was exempt from any royalty payments to the original developers of the variety. Because farmers save most of the seed they use in Australia's broad-

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<sup>1</sup> See Godden (1998) for a full discussion of the 1987 and 1994 Acts.

<sup>2</sup> This applies to self-pollinated crops that are the main crops of broadacre farming in Australia.

*Ross Kingwell works for Agriculture Western Australia and is a visiting Senior Lecturer in Agricultural Economics at the University of Western Australia. Alistair Watson is a freelance economist based in Melbourne. Initial work by Alistair Watson received funding support from the Grains Research and Development Corporation.*

broadacre industries, returns to the commercial seed industry have been limited. But the 1994 legislation reduces this limitation by, in certain circumstances, extending the breeder's right to harvested material. This allows plant breeders to generate revenue by imposing on the sale of harvested material a royalty known as a 'product royalty' or 'end-point royalty' (EPR). An EPR is a levy imposed on the first sale of harvested material derived from varieties protected by plant breeder's rights.<sup>3</sup>

The main studies dealing with EPRs in the grains industry in Australia all treat EPRs as an option for increasing funds for plant breeding. But they display a variety of views about the desirability and practicality of introducing EPRs to support plant breeding.<sup>4</sup> Most of them acknowledge the uncertainty over continued public investment in plant breeding for the grains industry, and suggest that it is possible and likely that public investment will decline in the future.

### **Will EPRs Hasten the Removal of Public Financing of Plant Breeding?**

Godden (1998), comparing the findings of Lazenby (1986) and Clements et al. (1992), concludes that during 1985-92 the number of plant breeders for main broadacre crop species in Australia fell by 25 per cent, despite a 9 per cent real increase in finance from the GRDC. Watson (1997) observes that falling contributions from consolidated revenue are not being offset by increased revenue from the GRDC and industry partners, and that breeding programmes in several States are being abandoned.

Reporting on future options for crop breeding in Western Australia, ACIL (1997a:1) notes the government's desire to reduce its expenditure and to shift towards 'providing services with a high content of public good and community benefit, and away from areas where there is a large element of private good and individual benefit'. By contrast, Cook (1996) suggests that, apart from Western Australia, government financing of plant breeding is not falling to any significant extent. Cook considers that the introduction of EPRs will lead to withdrawal of public financing for plant breeding, and that those breeding programmes that could not finance themselves by EPRs will cease.

However, this is not a good argument for preventing the introduction of EPRs, since the public financing of plant breeding will be questioned regardless of whether EPRs are introduced. Already there is evidence, in the absence of EPRs, that budgetary pressures are restricting public financing of plant breeding. It is increasingly clear that in small countries like New Zealand and Australia farmers are the principal beneficiaries of varietal development, particularly yield improvement. Because international markets set grain prices, and states or regions are small participants in grain export markets, most financial benefits of regional varietal improvement through breeding are captured by farmers. The principle that beneficiaries should

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<sup>3</sup> It is possible to impose a levy that is a product royalty without dependence on plant breeders' rights. However, the discussion here is restricted to EPRs that stem from breeders' rights.

<sup>4</sup> See Cook (1996), Watson (1997), Hamblin (1997) and ACIL (1997a, b).

pay requires that the financing of plant breeding should rely more on R&D levies on farm products and EPRs.

The introduction of EPRs may also stimulate private firms to enter breeding in their own right. However, the high set-up costs and the long delay between initial investment and generation of royalties from varietal adoption will deter many private investors. Private investors are more likely to emerge as equity partners with publicly financed organisations, which may see such partnerships as providing opportunities for reducing support for plant breeding from general taxation.

The crucial issue is the appropriate equitable mix of financing and management that delivers efficient social outcomes from plant breeding. Withdrawal of all public financing for plant breeding would be difficult to justify, as would failure to introduce mechanisms like EPRs that ensured that growers, as principal beneficiaries of varietal improvement, contributed more to plant breeding. As well, EPRs offer a property right or market-based solution to the provision of plant varieties and allow scarce public finances to be reallocated to higher priority areas.

### **Cooperation Between Plant-Breeding Organisations**

Cook (1996) argues that, because EPRs would introduce commercial considerations into plant breeding, plant breeding organisations would cooperate less. This would affect not only the interchange of genetic material but also the sharing of knowledge about germplasm, plant-breeding techniques and breeding goals.

If EPRs are introduced, their effect on cooperation between host organisations will be influenced by the financing sources of those organisations. Over the last decade the GRDC has become a major financer of plant breeding in Australia. It has encouraged greater cooperation between host organisations and has responded to the lack of coordination across State boundaries and organisations identified in various reviews of plant breeding (Clements et al., 1992; Leslie et al., 1997).

So long as the GRDC remains a substantial financer or equity partner in regional breeding programmes that generate revenue from EPRs, then conditions on GRDC support for plant breeding within host organisations will ensure cooperation between organisations. However, if regional breeding programmes become privatised or national financers such as the GRDC have inadequate influence over the programmes, host organisations may well cooperate less, and the cooperation will become formalised through negotiated contracts and partnership agreements.

Where access to substantial flows of EPRs is at stake, this would provide incentive for some organisations to cooperate as a means of sharing in the EPRs. But in other cases, cooperation between organisations could be made more difficult by competition over access to EPRs, or more costly by the need to bargain over equity shares in collaborative agreements. Since reduced cooperation could impair the rate of varietal improvement, it is important that EPRs be introduced within a financing, equity and management framework that provides incentives or directives for the maintenance of desirable cooperation between organisations. In practice, the introduction of EPRs will increase the R&D funds of the GRDC because of its

past and current equity participation in varietal development, assuming there is no decline in R&D levies currently paid by grain growers to the GRDC. The larger pool of R&D funds held by the GRDC will increase its influence over grains industry R&D, particularly in regions contributing EPRs. Hence, if the GRDC adopts an overseeing role in supporting and coordinating plant breeding, it could ensure that cooperation between organisations continues.

### **EPRs and Plant-Breeding Programmes of Main Broadacre Crops**

Hamblin (1997) expects that EPRs will sustain the breeding programmes of Australia's main broadacre crops, and that a shift will occur away from publicly financed plant breeding. ACIL (1997b) sees EPRs as essential to the survival of a well-resourced plant breeding effort in Western Australia.

However, several preconditions must be met if plant breeding programmes are to rely on EPRs as a main source of financing. First, the organisations that provide new varieties must develop varieties that will be adopted widely. Failure to do so will jeopardise the organisations' future because of limited future financing through EPRs.

Second, the organisations and their equity partners, if any, will need to re-invest some revenue from EPRs into plant breeding. Conceivably, some equity partners with national agendas may at times switch income from one organisation or region to another. As well, some organisations may re-invest EPR revenues in other areas of their R&D portfolio. Such uncertainty in the availability of funds may cause problems in planning and undertaking varietal development.

Third, the organisations must be able to judge whether royalty rates should differ between varieties, whether royalties should change over time and whether flat-rate or ad valorem royalties should apply. Risk management of the variable revenue stream from EPRs will also be important. Such variability contrasts with current public financing of plant breeding.

Public financing is provided mainly by central agencies (State treasuries) that provide plant breeding organisations with current and outyear financing intentions. Although forecast and actual levels of finance may differ, often the difference is not extreme, with allocations changing by less than 5 per cent in real terms from year to year. Admittedly, the internal allocation of finance to plant breeding within the organisations may be subject to greater variation, but plant breeding is often seen as a priority area of financing, which protects it from marked changes.

Further, the GRDC is a significant financier of plant breeding for agriculture. The level of its commitment varies across crops and regions, but it gives plant breeding a high priority and ensures that several plant breeding programmes have reliable financing. In Western Australia, for example, the GRDC allocates around \$3m annually to crop improvement, or 30 per cent of the expenditure within that State on crop improvement (ACIL, 1997b).

In contrast, EPRs are a more variable source of financing for plant breeding, since royalty payments are affected by crop production, crop prices and the degree

to which growers adopt varieties subject to EPRs. For example, in years with prospects of low (high) yields or prices, farmers reduce (increase) the area they give over to crops. Hence, breeding organisations that wish to rely solely or mainly on EPRs will need to establish and manage reserve funds, implement optimal borrowing and/or investment strategies and decide on EPR rates.

### **Niche or Specialty Varieties**

Cook (1996) considers that EPRs will privatise the market for new plant varieties, leading to the neglect of specialty and niche market varieties. But Watson (1997) believes that such neglect is a minor problem because niche markets are by definition small. Whether introduction of EPRs would cause the neglect of varietal development for niche markets depends on the level of finance available to plant breeding; on the relative returns to investing in breeding of major crops as opposed to minor or niche crops; and on the desired outcomes of financing from equity partners in plant breeding.

However, where plant breeding for niche crops or markets is financed largely through EPRs and is unprofitable, varietal development will not necessarily cease. In these situations, affected growers may choose to support agronomic or plant breeding activity through voluntary financing arrangements, as they do for oats in South Australia and for noodle wheats in Western Australia.

### **Cosmetic Breeding**

Another of Cook's (1996) concerns is that EPRs will encourage waste, with excessive investment in promotion and packaging and inadequate investment in substance. Yet studies of crop and varietal adoption have found that farmers' beliefs about the yield advantage and profitability of varietal changeover significantly influence their adoption decisions (Lindner & Gibbs, 1985; Abadi et al., 1996; Abadi & Pannell, 1998). Several other factors are relevant: farmers' long association with varietal replacement would alert them to cosmetic changes; it would be unwise for a breeding organisation to risk its reputation by developing cosmetic varieties that impose changeover costs on farmers yet deliver no yield or price benefits to them; and if the equity partners in breeding organisations included farmer representatives, these farmers would discourage cosmetic activity that delivered no monetary benefit to growers.

### **Germplasm Development**

Cook (1996:11) argues that germplasm development 'is expensive, long term, and is likely to be an early victim of the introduction of product royalties'. Wright (1996), in his account of the extent of germplasm development in public and private breeding programmes in various parts of the world, finds that many public and privately financed breeding programmes depend on a narrow range of the available germplasm. However, as Allard (1992:144-5) points out:

Breeding in barley and corn, as well as in other major crops, has increasingly focused on crosses among elite materials and rates of progress indicate not only that this strategy has been successful but also there has been little, if any, slowing of progress due to reduction of exploitable genetic material. ... It consequently seems unlikely that readily exploitable genetic variability will soon be exhausted.

It is debatable whether the narrow range of germplasm in many breeding programmes represents an appropriate outcome of the search for desirable traits or indicates under-investment in germplasm development.

Cook's concern is that the introduction of EPRs will result in less finance for germplasm development. Whether this occurred would depend on the overall level of finance available to plant breeding through EPRs and other sources and on the relative returns to investing in the long-term development of germplasm as opposed to the short-term focus on using existing elite lines as parental material. If EPRs made possible an overall increase in finance for plant breeding, investment in germplasm development would not necessarily be a casualty of change. Further, some stakeholders in plant breeding are concerned with the economic and ecological sustainability of plant breeding activity, and would therefore ensure commitment to germplasm diversity and development. In addition, genetic engineering technology will facilitate a widening of the germplasm base of prospective varieties by allowing desirable genetic traits to be incorporated more quickly in parental material.

Admittedly, if EPRs are the sole or dominant source of funds for plant breeding, and if current stakeholders in plant breeding are displaced by private firms managed for short-term profit, then investment in germplasm development is likely to wither. Since current markets do not convey appropriately the value of future desirable varietal traits that reside in currently untapped germplasm, there is a need for preservation and conservation of germplasm.

The introduction of EPRs may make it possible for public funds currently devoted to plant breeding to be diverted to germplasm development and conservation. On the other hand, it may also facilitate privatisation of breeding activity, with government also withdrawing support for related activity such as germplasm development. It needs to be stressed that EPRs, although extending an intellectual property right in varieties, do not redress completely the market failure associated with germplasm development and conservation.

### **Linking EPRs to Investment in Breeding**

Both Cook (1996) and Watson (1997) observe that there is no requirement or certainty that EPR revenue would be returned directly to support plant breeding. By contrast, Hamblin (1997) implies that EPRs will directly support plant breeding. Watson (1997:17) notes that 'Paying the owners of cultivars some of the proceeds of levies collected for research does not guarantee that these funds will be spent on

plant breeding in the future'. There are various ways to ensure that EPRs support further plant improvement. Certainly, the politics of introducing EPRs suggests that farmers would accept EPRs more readily if they were confident that mechanisms existed to ensure that royalties supported further plant breeding. If organisations developing varieties depended on equity partnerships with growers, growers would ensure that EPRs supported plant breeding.

In neither the public nor the private sector is there any certainty that all EPR revenues will flow to support plant breeding. Usually, public sector host organisations are subject to government intellectual property policies that require a return of revenue share to State treasuries. In the private sector, large companies will direct some EPR revenue as dividends to shareholders; and income from EPRs could be used to finance other ventures unrelated to plant breeding. Even where support for plant breeding continues, it could flow to plant breeding in other regions or countries that offers greater returns.

### **Development of Varieties with Only Quality or Price Premia**

Watson (1997:23) argues that 'product royalties cannot handle spillovers between crops as efficiently as the current system', leading to the development of varieties that offer quality or price premia rather than farming system or agronomic advantages. This argument is valid, especially in cases where breeding activity is solely or mainly financed through EPRs and is undertaken by private firms with limited species portfolios in their breeding programmes. Take the case of grain and pasture legumes that bestow a range of rotational benefits to following cereal crops (Ewing et al., 1987). Legume breeders are aware that the adoption by farmers of a new legume variety depends not only on how it performs with respect to its yield and quality, but also on the rotational benefits it promotes (Abadi et al., 1996).

However, EPRs flowing to legume breeders would be based only on sales of harvested legume grain subsequently sold. Further, because grain legumes are used widely on farms as animal feed, a significant portion of production may escape payment of an EPR. Hence, if the breeding of the grain legume were to depend mainly on EPRs, it would be difficult not only to generate a level of EPR revenue commensurate with the benefits farmers derived from using the variety, but also to establish an equitable EPR. The latter difficulty arises where legume breeders impose a high rate of royalty in the hope of increasing EPR revenue to compensate for forgone EPRs on legume production. The high rate of royalty will lead farmers whose production attracts an EPR to consider it inequitable that other farmers are free-riding through having greater access to grain that escapes EPR payment.

The introduction of EPRs will also complicate plant-breeding investment decisions in species that offer farming system or rotational benefits, as well as yield and quality improvements. The current system of production levies, disbursed by bodies such as the GRDC with its national priorities and partnerships with State agencies, is better able to allocate appropriate finance to support a range of plant breeding activity for these species than finance based on EPRs.

### **EPR Collection**

Both Watson (1997) and Cook (1996) foreshadow problems in EPR collection, and point out that EPR collection would require costly varietal identification. ACIL (1997b), however, reports a feasible, relatively inexpensive collection system for Western Australia, and finds that the cost of varietal identification is not as costly as claimed.

The cost of compliance reflects several factors, such as grower acceptance of EPRs, increased income through adopting varieties subject to EPRs, and whether or not varieties differ in their royalty rate. Lazenby et al. (1994) find that less than 2 per cent of varieties delivered by farmers were wrongly named, and conclude that the incidence of false declaration has probably been exaggerated. However, this degree of compliance may not continue with EPRs, which initially will provide growers with a greater incentive to make false declarations. Increased testing for varietal compliance may need to accompany the introduction of EPRs.

A further problem is that harvested grain may escape EPR collection. For example, grain retained on-farm for use as animal feed, or sale of grain by farmers to their neighbours, will mostly escape EPR payment. In regions where a large proportion of grain is retained on-farm and EPRs are the sole source of finance for plant breeding, the reduced effectiveness of EPR collection will reduce the level of breeding.

### **Effects on the Adoption of New Varieties**

Hamblin (1997) notes that the introduction of EPRs will lower the cost of seed. In a related comment, Watson (1997) observes that EPRs are preferred by the commercial seed industry as a means of encouraging adoption of new varieties. Both authors note that EPRs facilitate adoption by shifting part of the risk of new varieties from the farmer to the breeder. Lazenby et al. (1994) agree that EPRs would encourage the more rapid adoption of new varieties.

Without EPRs, varietal release procedures in many mainly publicly financed organisations involve calling for tenders for seed bulk-up. Usually a variety is released to only a few tenderers, who pay for the exclusive right to bulk-up the seed and subsequently profit from seed sales. Payments by tenderers help finance plant breeding. Competitive tendering arguably limits the early adoption of a variety because of the higher seed prices charged by tenderers who need at least to recoup tendering and bulk-up costs. However, introduction of EPRs could enable varietal release procedures to change and become less reliant on tender income.

With EPRs, the commercial interest of those releasing a variety can be best served by the early and widespread adoption of the variety. Firms could be paid by the plant breeding organisation to bulk-up seed. In this case, EPRs facilitate early adoption of a variety because breeding programmes would dispense with the need to gain revenue through the tender process for seed bulk-up. However, an EPR could deleteriously affect varietal adoption. When EPRs were introduced, new va-

ieties attracting an EPR would be competing for market share against older varieties not subject to an EPR. As a result of the presence of an EPR, the new variety would need to offer yield and quality improvements whose expected values exceeded the costs of varietal changeover, including the payment of EPRs. Hence, initial adoption of varieties subject to EPRs would be less than when almost all varieties sown are subject to EPRs. However, even when most farmers are sowing varieties subject to EPR, adoption would be impeded if the EPR rate on a new variety is set too high.

### **Farmers' and Breeders' Objectives**

Hamblin (1997) argues that EPRs will lead to greater synergy between farmers' and breeders' objectives. The financing of future plant breeding will depend on breeders developing varieties that are widely demanded. Breeders will therefore face strong commercial incentives to develop varieties that are quickly and widely adopted.

Yet such greater synergy may in practice be difficult to achieve. Varietal development has long lead times, with breeders selecting parents and making early selections that affect traits available in prospective varieties a decade later. While it is clear which plant traits farmers prefer today, it is not clear which varieties and traits they will prefer in a decade's time. This uncertainty limits the synergy between farmer and breeder objectives. In practice, most breeders maintain a cohort of material through many stages of their breeding programmes. This provides diversity for selection when and if economic or agronomic changes call for changes in required traits.

### **Concluding Remarks**

Whereas all the main studies of EPRs identify some problems in relying on them, they differ in their final assessments. Cook (1996:14) concludes:

Both the current system of funding broadacre crop plant breeding, and the proposal to fund it through product royalties, have advantages and disadvantages. Those of the current system are clear, and comparatively well known. Those of the product royalty system are much less clear, and subject to speculation and special pleading.

In similar vein, Watson (1997:2) concludes: 'While end-point royalties are still a useful way of increasing funds available for plant breeding, there are conceptual and administrative problems'. However, 'Despite these difficulties, end-point royalties can be useful for minor crops and where marketing channels are concentrated, for major crops'. On the other hand, Hamblin (1997:2) believes that something like EPRs are a necessary response to a likely decline in public financing of plant breeding for agriculture. And ACIL (1997b:2) concludes that EPRs 'have the potential to provide substantial financing levels to plant improvement activities but seasonal

variations and competition from other plant breeding organisations will provide some limitations on this source of revenue’.

The introduction or extension of any new property right, such as plant breeder’s rights that underpin EPR collection, requires a legal, policy and management framework in which these rights can function properly. In the case of EPRs, a badly designed framework could lead to inappropriate levels, types or structures of investment in plant breeding, and a sub-optimal level of plant improvement .

If EPRs become the sole source of financing plant breeding for Australia’s broadacre crops, and breeding becomes privatised, there is a risk of some crops or regions becoming disadvantaged. Crops or plant species with either spillover benefits or characteristics that make EPR collection difficult risk under-investment in their germplasm protection and development and under-investment in their plant breeding. Introducing EPRs may inhibit cooperation between some plant breeding organisations. Accordingly, the role of the GRDC is crucial. Its equity or financing participation in plant breeding and its national mandate could ensure that policy, management and financing of plant breeding address such potential deficiencies. If the GRDC adopts an overseeing role in supporting and coordinating plant breeding in the grains industry, it could ensure that potential deficiencies of EPRs are lessened.

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