

BENEFITS OF HERBICIDES

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The primary industries of agriculture, forestry and fishing earn over 40 per cent of Australian exports compared with 30 per cent from mining and less than 30 per cent from all other activities.

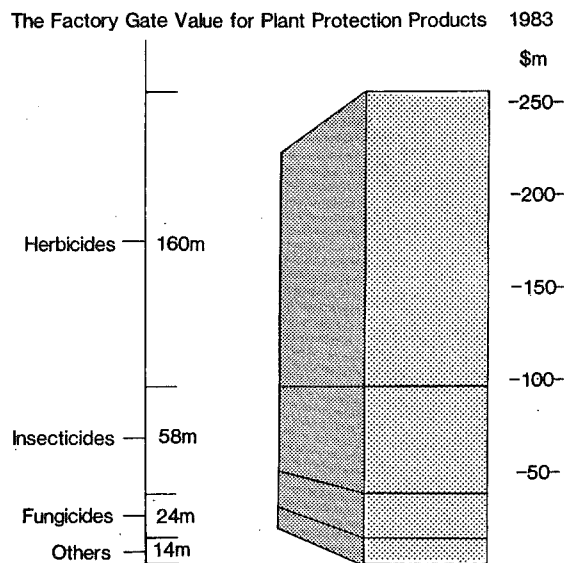
High technology in agriculture is largely responsible for the high living standard in Australia, primarily because of our ability to compete on world markets with produce grown with great efficiency and very low labour input. In under-developed countries the great majority of the people are engaged in producing food, and much of their time is spent in hand pulling weeds.

Anything which affects agriculture as a benefit or a cost can therefore be of great significance, not only to the farmer but also to society in general.

Few would disagree with the proposal that the use of herbicides in agriculture, particularly in crops, has been one of the most significant developments over the past 40 years.

The expenditure on herbicides has grown by 108 per cent over the past five years to reach \$160 million in 1983. Herbicide costs are almost double the expenditure on all other agricultural chemicals combined.

Figure 1.



In Western Australia the rate of growth in the use of herbicides has been greater than the rest of Australia and by far the largest market is in the cropping industry. The Table illustrates this increase. In the past five years the annual increase in expenditure has been from 40 to 50%.

Table 1. The area treated and the cost to the farmer of herbicides applied for weed control in cereals and lupins in Western Australia.

Year	Area treated ha millions	Cost \$M
1980	2.99	15.13
1981	4.42	20.9
1982	4.94	31.9
1983	6.23	46.7
1984	-	70.0*

* estimate

Add the cost of machinery and application and the expenditure on chemical weed control becomes the greatest single cost to cropping farmers. The growth in the expenditure on herbicides for crops is not as great in the other States as in Western Australia. This is encouraging as some people in this State see the seeds of disaster in such a large escalation of use.

While in this paper we are looking at the great benefits that have come with modern herbicide technology, the comments made should be considered in relation to the next paper presented by Mr Bill Roy. He will be directing our attention to a particular area of the costs being paid and problems which may face the farming community in the future.

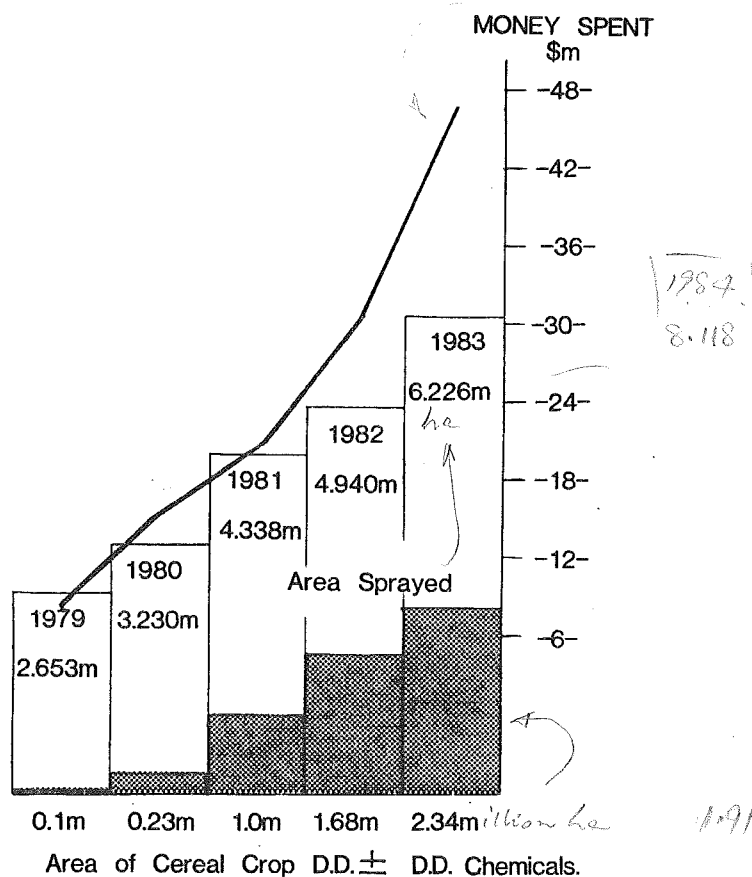
We might ask "Why such an increase?"

While there has been some increase in the area planted to crops in Western Australia in recent years, this is not of the same magnitude as the growth in crop spraying.

There is little doubt that the increase in spraying is due to the revolution that has occurred in planting techniques now used by farmers. About 40 per cent of cereal crops in Western Australia are planted with a single cultivation at the time of planting. With lupins the proportion would be more than 90 per cent. Such planting methods automatically result in more weeds in the crop. So that the farmer is relying almost solely on herbicides to control the weed problems in his crop.

Figure 2 shows for Western Australia the amount of money spent by farmers on crop herbicides and the area that could be sprayed with the quantity purchased. The bottom hatched areas are the estimated area for each year sown with minimum tillage.

Figure 2. The five year annual expenditure of farmers on crop herbicides in Western Australia, the area of crop which could be treated and the estimated area sown with minimum tillage practices.



While this is the situation in Western Australia, there is no reason to expect the same trend not to occur in other States in future years. What are the benefits from this huge expenditure?

Tables 2 and 5 are examples of results from an immense number of trials which can be quoted showing that removing weeds from crops will increase their yield. The size of the increase varies from year to year because of climatic differences, the species of weed present, the density of the population and particularly the potential yield of the crop involved. The growth stage of the crop when the weeds are killed determines the significance of the competition of the weeds. The following tables give typical results obtained in trials demonstrating these effects.

Table 2: Crop yields obtained after annual ryegrass has been killed by spraying at 10 sites, using Hoegrass applied when the crop was in the 2 to 3 leaf stage.

Site	Yield kg ha ⁻¹		% Increase
	Not sprayed	Sprayed	
Avondale	1,643	2,308	40
Merredin	847	1,342	58
Esperance	822	2,740	233
Newdegate	1,067	2,419	126
Newdegate	1,208	2,364	95
Wongan Hills	1,008	1,874	85
Kukerin	1,815	2,681	47
Pingelly	985	1,552	57
Cunderdin	1,500	2,450	63
Dumbleyung	800	1,240	55

Table 3: The effect of time of spraying on wheat yield when different weeds were killed by spraying at 3 sites.

Treatment	Crop yield kg ha ⁻¹		
	Doublegee	Radish	Capeweed
1. 2-leaf stage	2,500	3,210	1,018
2. Tillering	2,180	2,520	781
3. Nil	1,880	1,600	475
SITE:	Wongan Hills	Moora	Merredin

Table 4: The wheat yields obtained when different densities of brome grass were sown with a wheat crop.

Brome density plants m ⁻²	Wheat yield kg ha ⁻¹
0	1874
131	1418
218	1178
335	997
605	835
903	533

Table 5: The effect of time of spraying of ryegrass on crop yield, using Hoegrass.

Growth stage at spraying	Crop yield kg ha ⁻¹	
	Newdegate	Katanning
1 - 2 leaves	1,658	1,235
3 - 5 leaves	1,387	1,058
5 - 6 leaves	1,376	414
Tillering	625	243
Nil	563	248
Ryegrass plants m ⁻²	438	276

The cost benefit of spraying particular weed infestations is not always obvious as so many factors govern the final outcome.

Another approach to appreciating the benefits of herbicides is to examine the situation which would have developed without them. While it may be argued that other methods of control, such as biological, might have been developed in some cases, there are undoubtedly many examples which would have eventually prevented or severely restricted various activities.

Amor (1983) has recorded the historical development of weeds, control practices and the introduction of herbicides in Victoria since the 1920s. The progress described is likely to be similar for most other States in Australia. One of the main conclusions is that without herbicides cropping would not have survived in many districts. He records that despite improvements in control measures involving cultivation machinery, cultural and biological control measures, pasture manipulation techniques, new crop species and also the use of herbicides, weeds have held their own. Without herbicides the balance would have swung in their favour. Today in every State of Australia there are more weed species, more widely distributed, requiring a larger proportion of crops to be sprayed despite a continuing supply of new and more selective herbicides than ever before. Where would we have been without herbicides?

The problems of cruciferous weeds in the 1930s threatened the wheat industry because of their ability to survive. Despite their susceptibility to numerous herbicides these weeds have survived the best of man's efforts to control their influence. Without these efforts there is little doubt that cultural methods by themselves would not have been adequate to hold the cruciferous weeds in check. Even now they are a major problem.

There are many similar examples which persons from different parts of Australia could quote, frequently with examples even more significant than these.

The benefits of herbicides are seen in many other examples which are obvious to most people attending a meeting such as this.

Killing weeds as a fire protection when they are growing adjacent to valuable property and under power lines is an accepted practice. Weeds on roadways and rail tracks are killed with herbicides for a number of reasons. These are just a few examples of the many obvious uses of herbicides. Other advantages

of herbicides can be quoted and demonstrated by persons involved with forestry, orchards, irrigation projects, other agricultural industries and even the mining industry.

Turning again to agriculture, the numerous weeds which have survived 30 years of crop spraying have properties which ensure their survival despite the use of cultural practices and spraying to eliminate them. Seed dormancy and the ability to germinate throughout most of the growing season are their main protective mechanisms. One example is sufficient to demonstrate the dramatic effect on crop yields that can result from these types of weeds.

Annual ryegrass was promoted for many years as a pasture species throughout most of the agricultural areas of southern Australia. Its ability to survive amongst a wide range of other species and from year to year with varying climatic conditions resulted in it becoming the dominant grass and pasture species in many districts and introducing a new disease. Because of its staggered germination, resulting in a further germination of seed after each successive cultivation, numerous cultivations are required to thin down the potential population of the weed in a crop. Six or seven cultivations have not been uncommon. Where the length of the growing season is limited any delay in planting is automatically reflected in crop yield, and relying on cultivation would frequently make cropping unprofitable. The value of herbicides in such situations is obvious.

In more recent years various influences have made farmers, agriculturalists and the general community very much aware of the need to conserve the meagre natural resources in our farming land.

Like many great benefits to mankind, the value of herbicides in the area of conservation has resulted as a side benefit to the simple objective of killing weeds without cultivation. There are many reasons to expect that this benefit may in the long run be the greatest advantage of all.

Cultivation destroys soil structure, encourages wind and water erosion and produces effects which are extremely costly to reverse. Eliminating cultivation by the alternative use of herbicides can bring great rewards. This, of course, is what is happening with the wide acceptance of reduced tillage practices for planting crops.

Hamblin (1983) reporting on long term continuous cropping trials on a red brown earth site at Merredin, comparing nil, one and three cultivations to plant wheat, found striking differences on crop water balance. The differences in the surface soil structure which have developed after seven years of treatments, have caused very significant changes in water balance, crop growth and yield. Improvements in water absorption, ease of cultivation, smoother seed beds and generally easier planting conditions are now being achieved by skilled farmers.

The picture painted has been very rosy and should only be taken as part of the whole story. In the next paper some of the costs of the herbicide revolution not only related to the actual dollars spent, but other immediate and long term effects will be mentioned.

There are lessons to be learnt from the escalation of expenditure on herbicides for the cropping programme in Western Australia. I believe we have often used chemicals which kill weeds without gaining any increase in yield. The actual tolerance of crop varieties is a huge question mark which needs investigat-

ion. The density of the weed population needed to be present to justify the use of a costly spray treatment, is governed by a number of factors and is not easily defined. Research on the manipulation of weed populations is a high priority need. The interaction of different influences such as nutrients, water relations, temperature and soil type with herbicides has opened up a whole new pandora's box of possible problems.

In 20 years' time those of you who are still around, with the knowledge available, will look back on these years and smile at the reckless abandon with which herbicides were used, mixed and applied in so many different ways. Yet despite the problems, herbicides will continue to be of great benefit to the farmer. We live in a wonderful world. I am sure the chemical companies will continue to produce amazing new products whose toxicity to people and the environment will become more and more acceptable. It is up to those involved on the local scene to ensure that the finer details necessary for their safe use in specific situations are defined.

You are living in an amazing time of developing technology; I hope you realise it.

LITERATURE CITED

- Amor, R.L. and de Jong, R.W. (1983). Changing weed problems in cereal cropping in Victoria since 1920. J. of AIAS 49 No. 3.
- Hamblin, A. (1983). Plant Research Division, Dept. Agric. W.A. Annual Report.