WEEDS SECTION

PROCEEDINGS

of

THE WEED SOCIETY OF NEW SOUTH WALES

VOLUME 1

1967

WEED COMPETITION IN WHEAT

E.G.Cuthbertson
Senior Research Officer
New South Wales Department of Agriculture,
Agricultural Research Institute, Wagga Wagga.

Because weeds are so widespread and always present in field and garden, their significance is not always appreciated by the community. The old adage "familiarity breeds contempt" is, regrettably, only too true in this context. Yet much of the work input of the farmer, and the home-gardener, is directed towards weed control.

As early as 1795 the Australian wheat crop was reported as infested with drake (Lolium temulentum), the tares of biblical times (Campbell, 1901). Other weeds have figured prominently at various periods but those currently important include skeleton weed (Chondrilla juncea) wild oats (Avena spp.), Wimmera ryegrass (Lolium rigidum), the mustards (Sisymbrium spp.), wild radish (Raphanus raphanistrum), turnip (Brassica tournefortii and Rapistrum rugosum), saffron thistle (Carthamus lanatus) and, to a lesser extent, capeweed (Arctotheca calendula), fumitory (Fumaria spp.), spiny emex (Emex australis), dead nettle (Lamium amplexicaule), Amsinckia and some others. In the Mitchell and Coolamon Shires of New South Wales chemical weed control during 1965/66 was directed at skeleton weed, wild oats, ryegrass, capeweed and fumitory. Considering these weeds, and these shires makes some estimate of the losses caused by weeds, however inaccurate, possible.

Soil Preparation

The reasons behind the traditional long fallow of this area, moisture conservation, nitrogen mineralization, seedbed preparation and weed control, are so intermixed that separate accounting is difficult. Working on old clover ground, however, Kohn, Storrier and Cuthbertson (1966), concluded that weed control aspects of the long fallow were more important than water conservation and nitrogen mineralization. They found that, in 3 out of 4 years, grain yield following a single autumn cultivation was as high as that after long fallow (September to May). Since the single cultivation and sowing operations satisfied moisture, nitrogen and seedbed requirements, all other cultivations during the fallow period could reasonably be charged against weed control, which was by no means always satisfactory.

Taking fuel, labour, repairs and depreciation into account, the commonly used fallow of the area, ploughing, harrowing, cultivating twice and sowing, costs approximately $5.00. On the Wagga data, allowing $1.50 and $1.00 for ploughing and sowing respectively, at least $2.50 or half the total preparation costs, could be charged against weed control.

Extrapolation is not strictly valid because of soil, historical, cultivation and climatic differences but it does allow an estimate of costs to be made. Thus, in 1965/66 with a total sown area of wheat of 199,000 acres, weed control costs to the farmers of the Mitchell and Coolamon shires included a basic, hidden charge of nearly $500,000.

Skeleton Weed

This weed occurs in various intensities over 80 per cent of the arable area of these shires. Two sources of loss need to be considered. These are (a) yield reduction resulting from competition and (b) the cost of ensuring ease of harvest. The recommended spring weed control spray using 2,4–D retards stem development, but provides relatively small alleviation from competition except in periods of severe water stress (Ross 1965). Under these circumstances spraying costs represent a charge against harvesting operations. Some 30,000 acres were sprayed in 1965/66 which, at current prices of $0.50 application and $0.35 for material, represents an additional cost of $25,500.

Actual yield loss is hard to determine. However, in a series of experiments, the preplanting suppression of skeleton weed resulted in an overall yield increase of 16 per cent. On the shire yield data this represents a loss of 367,000 bushels or more than $510,000. Since the inclusion of pastures in the rotation is an essential part of the skeleton weed control programme, an additional hidden charge associated with pasture establishment and maintenance must be included.

Wild Oats and Ryegrass

The extent and intensity of the infestations of these weeds is not as well documented as that of skeleton weed. Nevertheless even light infestations reduce yield significantly. A single wild oat plant per square foot can reduce yield by up to 2 bushels per acre. In experiments at Wagga reducing a ryegrass infestation from 5 cwt per acre to ½ cwt per acre, increased grain yield by 11 bushels. As there is no reliable data on the extent of these infestations no estimate of overall yield loss is possible. However, as more than 5,000 acres were sprayed for their control this represents a direct charge of at least $21,850 were barban applied at the recommended rates.

Capeweed and fumitory

These weeds are irregularly prominent and become a serious problem in some areas when the seasonal break is late. A heavy capeweed infestation may mean a complete loss of the crop but an average loss of 2 to 3 bushels per acre would not be unreasonable. Once again about 2,000 acres were sprayed, which represents a direct charge of $5,300 using prometryne.

Conclusion

Briefly skeleton weed, wild oat, Wimmera ryegrass, capeweed and fumitory, whose growth period is similar to that of wheat, cost the farming community in the Coolamon and Mitchell Shires at least $1,000,000 in 1965/66. To this must be added part of the cost of pasture establishment and the loss in yield occasioned by other untreated weed infestation. A loss of $1.5 million would not be an unreasonable estimate.

References

Campbell, W.S. (1901) - Agric. Gaz. N.S.W. 12:1-113.

Kohn, G.D., Storrier, R.R., and Cuthbertson, E.G. (1966) - Aust. J. exp. Agric. Anim. Husb. 6: 233-241.

Ross, M.A. (1965) - M. Agr. Sc. Thesis. University of Adelaide.

*****

THE COST OF WEEDING COTTON

J. B. Fisher and R.R. Schulze,
Auscott Pty. Ltd.,
Narrabri.

Auscott Pty. Limited follows a policy of strict weed control, both in the crop and along channels, roadways etc. The aim of this policy is not only to improve current productivity, but also by not allowing scattered weeds to seed down, to decrease the future weed population. The approach to weed control includes the use of chemicals, mechanical control and hand weeding.

Last season Auscott grew 5,000 acres of cotton. Total weed control cost was over $170,000. - or an average of just over $35.00 per acre. Some 30% of this cost was for chemicals and application.

Already our policy of total weed control appears to be progressively decreasing costs. - See Table 1 below:

TABLE 1

Average per acre Cost of Weed Control 1964-1967:

METHOD	1964-65	1965-66	1966-67
Chemicals and Application 1/.	12.80	16.07	11.40
Hand Weeding	20.43	13.15	12.05
Cultivation 2/.	10.03	8.36	7.93
General Weed Control 3/.	2.10	2.00	4.00
TOTAL	45.36	39.58	35.38

1/. Includes chemicals and application in cotton crop only.

2/. Crop cultivation and proportion of pre planting cultivation which was allocated partly to weed control and partly to seed bed preparation.

3/. Weed control along channels, fences, roads and on non cropped or fallow land. High 1966-67 figure due to seasonal conditions and sterilization costs, spread over reduced crop acreage.

If we look at individual fields we find that most are following this pattern of falling costs. It is interesting to compare the variation in chemical weed control costs with the resulting variation in hand weeding costs. - see Table 2 below:

TABLE 2

Cost per acre of Weed Control - Representative Fields:

FIELD	1965-66			1966-77		
	Hand	Chems.	Total	Hand	Chems.	Total
Zero	45.45	14.55	60.00	28.71	11.50	40.21
No. 1	13.81	14.55	28.36	16.05	4.00	20.05
P2	14.36	14.55	28.91	8.28	11.50	19.78

We hope that future weed control costs will fall even further. Our aim is to reach a level where chemicals can achieve most of the weed control, and hand chipping and even cultivation can be used purely for "tidying up". Our reliance on chemicals as the present and future backbone of our programme is because of the effects of irrigation and unpredictable rain on the physical methods and of the long term uncertainty and rising cost of hand labour.

Weed control on a cotton farm could be divided into several categories:

A. Crop Weed Control - Chemical

B. Crop Weed Control - Physical

C. General Farm Weed Control

A: Crop Weed Control - Chemical:

At Auscott all chemicals are applied before or during the planting operation. So far there does not appear to be a place for post emergent application.

The choice of application method, chemical and rate depends on the weed history of individual areas. Use has been made of both broadcast incorporated and surface band treatments.

Extensive use has been made of trifluralin as a broadcast incorporated treatment. Currently trifluralin is used at 1 lb. a.i. per acre - although this rate is increased if the chemical is applied more than two months before planting. It is applied through a front boom on the tractor and incorporated by Go-Devil discs fitted to the rear bar. This gives immediate and positive mixing about 2½ to 3" deep. Usually the beds are later worked with a Lilliston cultivator to prepare the final seed bed and this improves incorporation. As the population of weeds decreases then so too should the use of trifluralin - although it will still probably be used on a rotational basis.

This year Auscott has used fluometuron (Cotoran®) as an incorporated treatment in virgin areas where a major broadleaf weed problem is expected. It has been used at 1.2 lb. a.i. per acre and has been incorporated with Lilliston cultivators about 1½ to 2" deep.

All areas are treated with surface bands applied during the planting operation. Usually these bands are 13" wide but this year some areas of 19" bands are being tried. (Cotton rows are 38" apart). Diuron, prometryne, and fluometuron have all been used commercially on Auscott, and similar rates of 1.6 to 2.4 lbs. a.i. per sprayed acre are used.

Listed below are some typical situations, the treatments we would use, and approximate cost per acre applied. (P/C/D = Prometryne or fluometuron or diuron).

Virgin high grass and broadleaf population: Trifluralin 1 1 lb. a.i. plus fluometuron 1.2 lb. a.i. per acre incorporated plus band P/C/D at 2.0 lb. a.i. per sprayed acre.
Cost - approximately $18.00 to $20.00 per acre.

High broadleaf: Fluometuron 1.2 lb. a.i. incorporated plus band P/C/D at 2.0 lb. a.i./ sprayed acre. Cost - $8.50 to $10.00.

High grass, Tribulus - some broadleaf: Trifluralin 1 1 lb. a.i. incorporated plus band P/C/D at 2.0 lb. a.i. per sprayed acre. Cost - approximately $11.00 to $13.00.

Medium weeds - mainly broadleaf: Band P/C/D at 2.0 lbs. a.i. sprayed acre. Cost - 13" band $3.00 to $3.50. Cost - 20" band $4.50 to $5.00.

Trials are conducted every year in an effort to find better - and cheaper - chemicals. Chemicals tried include, trifluralin, Planavin(R), Dacthal(R), prometryne, diuron and fluometuron.

B: Crop Weed Control - Physical:

Cultivation is an integral part of weed control, seed bed preparation and furrow maintenance, and much of it is multi-purpose.

Summer fallowed country may receive 4 to 6 cultivations with a Go-Devil or Lilliston cultivator - each costing around $1.50 per acre. Shorter fallowed country may only receive one or two such cultivations.

Inter-row cultivation - which is used in the young crop for weed control - costs about $1.30 per pass. The number of cultivations for the season varies but is usually between 4 and 7. In dry weather one cultivation between each irrigation is common, but often rain leads to a second or even third cultivation. As well as the true mid mounted cultivator, the Lilliston cultivator is also often used for this inter row work.

Hand weeding is regarded as a loathsome necessity. In 1966 the per acre cost of hand weeding individual fields varied from $3.06 to $45.45. In 1967 the variation was from $1.74 to $28.71. On Auscott, contractors are used and these may have gangs of up to 80 or 100 chippers working together. Only rarely will one quick pass suffice - usually two or three are required between December and February. The aim, of course, is by efficient chemical control and cultivation, to reduce the amount of hand weeding.

C: General Farm Weed Control:

Weed control along channels and roadways is mainly a job for a road grader fitted with a sloper blade. Two or three passes over the channels are usually made during the year. Inaccessible spots are usually treated with a knockdown spray of either DNBP and diesel fuel or diquat and paraquat. Although the former is cheaper, both are considerably more costly than mechanical control. Fence lines, building environs etc. are treated similarly. Roughly it costs about $15.00 to $20.00 per acre of weeds for a knockdown spray. We do use sterilization in areas such as the cotton bale storage yard. As true sterilization costs $150.00 to $200.00 per acre we often use partial sterilization followed by later boosting.

An interesting - and very satisfactory - pre planting weed control technique we have used could be called a form of chemical fallow. Occasionally wet weather follows pre crop irrigation and the resultant weed growth poses a problem - especially if it is close to planting time and the ground is too wet to cultivate. In these circumstances we have aerially applied ½ pint diquat plus ½ pint paraquat plus 1% surfactant per acre. The results are rapid and although it costs around $4.50 per acre applied it is often money well spent.

From farmer to farmer the cost of weeding cotton varies considerably. This variation is affected by the farmer's approach to weed control as well as by the weed situation. For simplicity we have reviewed only Auscott's weed control programme. However, this would compare favourably with the cost of other programmes aiming at the same degree of efficient and effective weed control.

*****

THE IMPORTANCE OF WEED CONTROL IN VEGETABLE PRODUCTION

P.F. Rylands,
Research Agronomist,
Hawkesbury Agricultural College,
Richmond.

The need to control weeds in vegetables is easily taken for granted. That this is so is itself an indication of the importance attributed to it.

The most obvious effect of weeds is their potential ability to reduce vegetable crop yields. The unchecked presence of weeds can greatly reduce yields. For example, in carrots grown at Richmond in Spring 1965 and 1966 the following yields were obtained:

Treatment	Yield (tons/ac)	
	1965	1966
Best herbicide	13.7	24.0
Handweeded	12.4	20.6
Unweeded	0.4	2.8

In both years, the highest yields were obtained by herbicide applications which gave complete, or nearly complete, weed control. The unweeded yields can be considered from two points of view. Firstly, weed competition has greatly reduced crop yield, and the figures obtained are a measure of their competitive effects. In the context of this conference, it should also be recorded that in economic terms the unweeded yields could be considered: nil. The carrots which did grow would be unmarketable.

To obtain the highest yields from a crop it should be maintained in a state free from weed competition. Little has been done in attempting to define the type of weed control needed to achieve this state, and even less to find the most economic way of doing it. However, from the results which have been reported two facts emerge:

1. Weed competition commences while the vegetables are very young. Kale, for example, weeded at the 4 leaf stage (4 weeks after emergence) yielded 12 per cent less when harvested 6 months after planting than when weeded 1 week after emergence (Hammerton, 1967). Shadbolt and Holm (1956) showed that the presence of weeds in carrots and onions for more than 3½ weeks after crop emergence gave substantial yield reductions. Dawson (1964) found that the yield of beans was reduced when weeds grew in the crop for more than 8 weeks after planting. He considered the weed population to be light in the experiment and expected a denser stand to have an earlier effect.

Mechanical or manual weed control would normally commence several weeks after sowing a crop and therefore weed freedom from the time of sowing by the use of a pre-emergence herbicide should often give higher yields than other methods of weed control.

2. Small residual weed populations can reduce vegetable yields substantially. In a 3 year study Nelson and Nylund (1962) found that 3 mustard (Brassica hirta) plants per square foot reduced shelled pea yields by between 0 and 64 per cent. In some years even the crop population was reduced.

Significant yield reductions in onions and red beet have resulted from very small weed populations in England (Bleasdale, 1959).

It is evident that weed control should commence as soon as possible after sowing the crop and that complete control of weeds is the most desirable state to achieve. Effective pre-emergence herbicide treatment is the most likely way to obtain this situation.

The use of herbicides in vegetable production provides more than an opportunity to increase yields, or to maintain production at high levels, economically. Together with recent advances in machinery design, herbicides have made large scale vegetable production possible.

Two case histories show how this has happened. In 1966, California produced more than 3,000,000 tons of processing tomatoes from 262,000 acres. Machine harvesters were used on 120,000 acres saving 6.24 million man hours of labour in the harvesting operation (Anon, 1967). In 1965, 41 per cent of the acreage was treated with herbicides (Lange, 1966). The complementary nature of herbicide use, which enables large acreages to be established, and mechanisation, which provides a means for harvesting the expanded production, is clear.

Sugar beet production in Europe can now be almost entirely mechanised. Hanbury and Maughan (1967) found that the use of precision drilled monogerm seed, herbicide treatment and machine thinning reduced labour requirements for crop establishment to 0.5 hr/ac compared to 58.7 hrs/ac when a multigerm crop was hand weeded and singled.

Labour savings from herbicide use may also be possible where a change can be made from transplanting to direct seeding. Most brassica crops are transplanted to permit suitable spacing and enable drastic weed controlling cultivations to take place soon after planting out. Precision seeding and herbicide use would make it possible to establish a suitably spaced crop directly into a weed free environment. Growth set-backs due to transplanting would also be eliminated.

Although yields are most affected by weeds early in the crop's development, weed freedom at maturity is also desirable for ease in harvesting. Examples are weed infestation in mechanically harvested peas and mats of barnyard grass roots in potatoes. Weeds also become more difficult to remove in vine crops once growth is sufficient to prevent inter row cultivation. Yield losses will result because the crop will be more trampled to find the fruits.

In assessing the costs incurred by weeds in vegetable production it must be noted that the Australian vegetable industry is essentially one with only a domestic market. There seems little sense, therefore, in suggesting that on a national basis there are substantial yield losses. If improved weed control did increase yields it would simply lead to over-supply.

Within the present production system, growers could reduce weed control costs by greater use of herbicides. This will particularly apply to crops such as lettuce, beetroot and onions which are direct seeded and relatively slow to establish. In crops which may be cultivated for weed control herbicides still offer an insurance against times when mechanical control cannot take place because of rain.

To the individual grower, if it is accepted that increases in national production are not desirable, two alternatives appear.

Firstly, increases in productivity could make a reduced acreage desirable and the cost of land preparation, seed, fertilizer, crop protection and harvesting per unit yield would be reduced and lead to a greater profit margin.

Alternatively, where operations can be expanded by use of herbicides and mechanisation of production a large scale grower will be able to produce at lower costs than one to whom such equipment would be uneconomic. The specialised production of crops by a small number of growers is the likely result of these trends. This is particularly so in crops which can be processed, such as peas, and to a lesser extent beans and tomatoes.

In a long term view, more efficient weed control will lead to cheaper vegetables for the consumer.

References

Anon (1967), Rohm and Haas Reporter, 25, (2); 16-20.
Bleasdale, J.K.A. (1959), J. Hort. Sci., 34, 7-13.
Dawson, J.H. (1964) Weeds, 12, 206-208.
Hammerton, J.L. (1967) Weed Res., 7, 37-50.
Hanbury, L.F., and G.L. Maughan (1967), J.Agric. Sci. Camb., 68, 275-280.
Lange, A.H. (1966) Calif. Agric. 20, (6); 8-10.
Nelson, D.C. and R.E. Nylund (1962) Weeds, 10; 224-229.
Shadbolt, C.A. & Holm, L.G. (1956) Weeds, 4, 111-123.

*****

WEEDS IN HORTICULTURE

D. S. Leigh,
Special Fruit Officer, (Tropical Fruits),
N.S.W. Department of Agriculture.

Although Horticulture is defined as "the art of garden cultivation", we, as a Department, regard the fruit growing component as one of major importance and this paper will refer only to weeds as they affect the orchardist.

Fruit growing in N.S.W. occupies some 130,000 acres of horticultural land and is by far the greatest activity within the classification of Horticulture.

The areas of production of major importance may be divided broadly into three viz:-

1. Coastal
2. Tableland and Coastal Highlands
3. Inland

For the purposes of this paper these divisions may be regarded as representing three distinct environments which tend to support different plant species. The two most important environmental factors in this regard are temperature and moisture and the variation in kinds of weed species within these divisions is well defined as horticulture activity moves from the warmer, high rainfall coastal environment through to the higher altitudes of moderate rainfall and greater extremes of temperature on the highlands on to the flat, hot, inland low rainfall areas.

EFFECT ON MANAGEMENT

If we regard a plant as a weed only when it is not wanted then it may be conceded that under some circumstances the so called weed would be useful in agriculture - this is certainly so in fruit growing. Thus proper management of the weed problem becomes one of the major factors for the orchardist.

Management in this case involves a series of operations which tend to set up ideal conditions for weed growth in terms of soil preparation, plant food and adequate moisture. The orchardist is well aware of this and accepts the situation of having to compromise somewhere in the course of his management in the matter of weed control.

It is a generally accepted practice to encourage some weed growth in the winter period during dormancy in deciduous orchards, and this often extends to evergreen species such as citrus during this same period - in each instance, weeds are being used as volunteer cover crops to provide organic matter.

Where soil moisture and plant food are adequate seasonal use of weeds has been even further extended to form a basis for the permanent establishment of sod culture in the orchard, in which case legumes and suitable perennial species are often sod seeded to provide a more persistent type of cover.

On the other hand the management of banana plantations differs widely. Weed growth is suppressed at all times - in fact growers are required by law to keep an area around each plant free of weed growth to facilitate inspection procedures. With this crop all plants other than the bananas are regarded as weeds. Moreover, there is little doubt that the excessive weed growth does compete with surface rooting plants and thus adversely affects production. There is no doubt that unthriftiness quickly follows wherever heavy weed infestations are allowed to persist for extended periods and that the first step in the rehabilitation of this situation is to eliminate the weed factor.

Whenever plants (weeds) compete with a commercial fruit crop, growth and production are both adversely affected. This is most evident during the establishment period in an orchard when the plant root systems are restricted in their ability to search for food and water, and there are large surface areas of soil exposed as seed beds for the development of weeds, the effect being, at this stage, to reduce tree size and thus its potential cropping ability.

COST TO FRUIT GROWER

In any attempt to assess the cost of weed control to the fruit industry in N.S.W. one must consider climate and crop together with the categories into which the control measures may fall such as:-

(a) Chemical

(b) Mechanical - Cultivation

(c) Mechanical - Mowing

Chemical weed control is carried out by most growers in the banana industry. This might cost $50 per acre per annum or more during the establishment period for materials and labour only. This figure would decrease to between $25 and $30 per acre per annum as the affect of shading and ground cover of trash, etc. increased. Thus the annual cost to this particular industry, which, at present, occupies approx. 24,000 acres could well be close to $1,000,000 per annum for materials and labour only.

On the other hand the mechanical methods of control, either or both of which are used for all other orchard enterprises are relatively cheap. They might be expected to cost from $6 to $10 per acre per year. However, total weed control in these orchards cannot be effected by mechanical means, and it is necessary to eradicate persistent perennial species by the use of either hand implements or chemicals. In this regard spot chipping might add another $10 per acre per year and spot spraying might add the same amount. Thus for the current acreage the annual cost of weed control to the fruit industries of N.S.W. could well be between $1¾ and $2 million per annum for labour and materials only.

It is significant that the total cost of weed control in the tropical fruit areas of high rainfall and of long growing seasons is approximately one half as much as that of all other fruits combined.

*****

THE INFLUENCE OF WEEDS ON THE SEED INDUSTRY

H.K. Blackwood,
Wright, Stephenson & Co. Ltd.,
Sydney.

The Australian Agricultural seed industry is particularly conscious of the weed problem at all levels of the industry. Weed control has advanced due to the advent of the highly specialised seed producers using row cropping in conjunction with chemical, cultivation and judicious management.

Already leading seed merchants are using modern machinery and highly skilled operators to process the seed into a top quality product for both export and local markets.

WEED CONTROL AT THE PRODUCER LEVEL

Up until only very recent years, approximately 90 percent of agricultural seed producers in this country would have been on a catch crop basis, the producer making up his mind late in the spring to endeavour to harvest seed if seasonal conditions and economic conditions were favourable at the time of harvest. The seed harvested was not classed as the producer's main income earning. Today the position is developing quite rapidly with the advent of the specialised seed producer who is obtaining excellent weed control, using row cropping techniques, but this is still leaving well in excess of 50 percent of our seed producers following old established patterns.

Farmers Dressed Samples

It would be fair to make a comparison at this stage of Farmers Dressed samples that are received into Australian dressing plants for remachining against those samples that would be received by our seed dressing counterparts in other parts of the world. The main seed producing countries other than Australia would be New Zealand, the United States of America, Great Britain and the European countries, and although this is only a very general comparison at this stage, it is recognised within our trade that samples that have to be processed in Australia would be far dirtier than those in the aforementioned countries. This situation creates dressing problems and bottle-necks and is directly related to the weed content and the inert matter content that has to be processed.

A partial answer to this problem is for the farmer to be more conscious of what is present in his paddocks and to eliminate weed content before harvesting and for him also to be more severe with machine blast settings at the time of harvest and not to be frightened to lose a small percentage of good seed over the back of the harvester, thereby further eliminating a large percentage of weeds and inert material.

Specialised Seed Producer

What the industry needs are more specialised seed producers who, through their ability to produce consistently a budgetted harvest every year, would give stability to this side of the industry and because their livelihood was involved, would make sure that the paddocks to be harvested were at maximum seed production with weeds eliminated.

Skeleton Weed (Chondrilla juncea)

Having lived in southern states for quite a number of years, it was very obvious that the fear which existed amongst the farming community that they might introduce skeleton weed (Chondrilla juncea) through the purchase of N.S.W. grown subterraneum clover. This fear is very real at the present time and would be adversely affecting the sale of N.S.W. certified seed in other states. Preference has been shown for the purchasing of subterraneum clover from Western Australia which in my opinion, on an average, would not have as high a purity or germination as the local N.S.W. product.

Barley Grass (Hordeum leporinum)

The presence of barley grass (Hordeum leporinum) in dressed samples of subterraneum clover is briefly dealt with under the heading Weed Control For Export.

WEED CONTROL AT THE SEED MERCHANT LEVEL

Reference has already been made to the condition of a large percentage of the farmers' dressed samples dressed by Australian merchants.

Cleaning

The seed dressing equipment of the main Australian seed merchants is basically identical to that used by overseas companies and where dressing problems have been experienced here in the past, investigation overseas requesting guidance in obtaining a successful dressing result has invariably yielded the answer once the facts have been fully explained, that they do not have the problem of the quantity of rubbish etc. going into the machines that is evidently experienced under Australian conditions. This situation immediately presents the problem of slow dressing which causes bottle-necks and the farming community is very conscious of this situation because Australia is one of the few countries of the world where our harvest has to be processed and made ready for market within a matter of two to three months to catch the autumn planting.

Weeds are not wholly to blame here, but they do contribute to a large extent to the trashy material which is included with the good seed. One point which is possibly not appreciated fully by the producer is that it is very difficult for offals which are the result of a first cleaning to be again recleaned in an endeavour to recover further good seed. The ideal is that a particular line of seed should only be processed once through a battery of cleaning machines. The main reason for repeating dressing is directly related to the excess weed and inert matter content that is originally in the line. Weed species that give the cleaner problems when they are related to the seed crops that they are invariably found in would be rat's-tail fescue hair grass (Vulpia bromoides) which has been broken by excessive drum speed, brome grass/goose grass (Bromus mollis), where the awn has been broken off by the thrasher, thus reducing the broken weed seed left in size to that of ryegrass, phalaris etc.

If a weed seed has not been mechanically damaged at harvest time, the merchant has a better chance of eliminating it in recleaning.

The merchant's machinery has no thrashing action and can only separate on size or by weight.

Uniform State Seed Act Standards

As you are all very much aware, the N.S.W. Seed Act contains various schedules of prohibited and restricted weeds as far as saleability of the machine dressed product is concerned. Merchants have to be very conscious here of the conditions as far as the various State Seed Acts are concerned and when purchasing from interstate, they have to be sure themselves that they are purchasing to comply with the N.S.W. Seed Act. There is a need within the seed industry for uniformity amongst states as far as our weed standards are concerned and for that matter, a complete uniformity of all facets of Seed Act standards. Could a plea be made at this conference for some thought to be given from the weed angle, anyway, to standardisation of Seed Acts amongst all Australian states. One example which is to N.S.W.'s benefit, but still shows up the need for very careful purchasing as far as N.S.W. merchants are concerned, is that of Melilotus indica which is permitted to be sold in South Australia, is restricted in Victoria to 10 to the lb., and is totally prohibited in N.S.W. Unwary resellers of seed in N.S.W. could unbeknown to them quite innocently purchase lines from interstate containing Melilotus.

Import

At the import level, Australian merchants over the years have learnt by some very sad experiences to purchase only from very reliable seed houses overseas. The Australian and N.S.W. quarantine regulations are justifiably set at an extremely high standard and this is to the authorities credit. Main importers in the seed trade today can pretty well isolate their overseas buying to reputable merchants who take pride in their contract growing, dressing and merchandising and the purchaser can be reasonably sure that their product will comply with our regulations. Where odd merchants have purchased away from regular sources of supply because possibly of a price factor, it has invariably been found to their sorrow that the line has been refused entry into Australia because of the presence of prohibited or restricted weeds.

WEED CONTROL FOR EXPORT

From the export point of view one major problem has arisen with certified subterraneum clover being sold to New Zealand. Regulations have been brought in in recent years from New Zealand that barley grass (Hordeum leporinum) is a prohibited weed and this has restricted the tonnage of N.S.W. subterraneum clovers going into the Dominion. I can well imagine that this would be very difficult to control at producer level. This conference could possibly give some thought to greater publicity with Paraquat control of barley grass (Hordeum leporinum) within subterraneum clover stands.

There is another problem with the export of Australian seed to the United States of America, whereby they are particularly conscious of the presence of Rumex species. This, of course, should have been eliminated in the initial cleaning of the line of seed and again the problem could arise where there is such a high proportion of Rumex species originally in the line that continued recleaning makes its total elimination from the line impossible, whereas if its presence had been eliminated prior to harvesting the problem would have been solved at its source.

*****

ECONOMICS OF WEEDS IN FORESTRY

G. N. Baur,
Senior Silvicultural Research Officer,
Forestry Commission of N.S.W.

Forestry is a specialised form of plant production, carried out on a somewhat gargantuan scale and concerned primarily with the management of forests for timber production.

In New South Wales the activities connected with forest management can conveniently be considered in two parts - management of the conifer plantations and management of the indigenous forests. These have, in general, different types of weed problems.

Weeds in the Plantation Programme.

At present there are about 135,000 acres of conifer plantation, notably of Pinus radiata, established in N.S.W. by the Forestry Commission, which hopes within a few years to boost the rate of new plantings up to 25,000 acres a year (from the current rate of about 10,000 acres), and then to maintain it at this higher figure till beyond the end of the century. This emphasis on man-made forests of highly productive species is necessary if N.S.W. is to be self-sufficient in timber. The existing plantations are mostly in the tableland districts, and to a lesser extent along the coast and on the western slopes.

Seedlings, to be planted in the plantations, are raised in special nurseries for periods of from 9 months to several years, the main species requiring less than one year. This is intensive production, and the weed situation is comparable to that in certain forms of agriculture. Both pre- and post-emergent weedicides have been tried, and while various combinations of these are used in many nurseries, considerable reliance is still placed on manual weed control. In 1966/67 the cost of nursery weed control to the Forestry Commission was $30,000.

Sites to be planted, in most cases, carry low-quality native forest which must be removed and destroyed before the seedlings are established in the field. This operation, of removing the original forest, might itself logically be considered a form of weed control.

The debris, resulting from clearing the site, is burnt before planting, and usually is succeeded by woody weed growth, including Acacia (from seed), Eucalyptus (mostly coppice from stumps and lignotubers) and a wide range of other species. Where this growth occurs in quantity it can retard or even completely suppress the pine growth, it can harbour noxious animals, and it can create a serious fire hazard. Indeed one quite major plantation programme (hoop pine on the Far North Coast) was curtailed in 1954 largely because of the difficulties in controlling this rampant weed growth.

Plantation weed control cost the Commission $206,000 in 1966/67, one of the largest single items of plantation expenditure. Manual techniques (brushing, sucker-bashing, etc.) have been largely used until recent years, but these are being displaced by chemical control, both ground and aerial, and at the same time considerable research is under way to determine the combinations of clearing and cleaning techniques that will provide the cheapest, effective control of plantation weeds. The success of the proposed accelerated planting programme will in no small measure depend upon the outcome of this research.

Besides the native woody weeds, such noxious weeds as blackberry and lantana create serious problems in some plantation areas. However, once the pines reach sufficient size to close canopy, weeds usually cease to be of moment, dying out in the gloom of the plantation, and on several occasions deliberate attempts have been made to control weeds by planting pines, e.g. St. John's wort at Mannus, near Tumbarumba; serrated tussock at Mt.Macquarie and Rockley.

Weeds in the Native Forests

Indigenous forests, controlled by the Forestry Commission and consisting of such trees as Eucalyptus, cypress pine and the trees of the rainforests, occupy nearly 8 million acres of N.S.W. About half this area is under fairly active management for the permanent production of these valuable species, which currently supply some 90 per cent of the timber produced each year in this State.

Recognised noxious weeds, even though possibly not of great significance to forest management, occur on many of these forests and must be controlled - at a cost of $32,500 in 1966/67. From the Commission's viewpoint, one of the worst such weeds is lantana, and for a number of years the Commission has been a partner in the joint programme for the biological control of lantana, a programme that, in 1966/67, cost the Commission $5500.

Weeds of the managed native forests are of various types. Frequently they are represented by the trees, useless because of poor form or poor species, which occupy space that could otherwise carry useful regrowth or which interfere with the growth of desirable stems. Allowing for the difference in scale, the similarity between such unwanted trees and the weeds of some agricultural crop is apparent. Yet even in Forestry the elimination of such trees, in the operation known as Timber Stand Improvement (T.S.I.), is rarely considered as an exercise in weed control. Nonetheless this is what it is, and very large sums are spent on T.S.I. each year. As an example, $76,000 was spent during 1966/67 in poisoning, with Tordon, unwanted eucalypts growing above the more valuable Cypress Pine in the inland forests. For the State as a whole, nearly $400,000 was spent in T.S.I., and virtually all of this could, with reason, be considered expenditure on weed control.

In addition, established regeneration in the native forests must frequently be freed from weed competition, which may come from Acacia, vigorous shrubs, vines and so on, as well as from an excess of the desirable species. Such freeing operations cost a further $7500 in 1966/67.

Over 15,000 miles of roads exist within State Forests and, particularly in the native forests of the moister areas, woody weed growth is constantly encroaching on to the edges of these roads. For reasons of easier maintenance, road safety and fire control, this roadside weed growth must be controlled - nowadays largely by chemicals. In 1966/67 the cost of roadside weed control was $38,000.

Other Forestry Weed Costs

Even when the major T.S.I. costs are excluded, weed control cost the Forestry Commission some $320,000 in 1966/67, a figure quite in accord with the trend of recent years. About a tenth of this sum was spent in the purchase of chemical weedicides.

In addition to this amount, weed control research in the Commission cost a further $2000, plus at least $15,000 for the salaries of officers directly concerned with the weed research programme - making a grand total in excess of a third of a million dollars. This sum excludes not only T.S.I. and plantation clearing costs, but also the appropriate administrative overheads such as the salaries of officers who oversee weed control programmes as part of their routine duties. If these costs were added, the expenditure by the Forestry Commission on weed control would be considerably in excess of $1,000,000 a year.

Over the past 5 to 10 years a major revolution has occurred in weed control measures within the Commission. A variety of suitable chemicals, new types of equipment, and the wider use of aircraft and appropriate ground vehicles have all contributed to this, and have resulted in greater areas being treated, more cheaply, more effectively and with less reliance on repetitious manual methods than ever before. Undoubtably these techniques can still be greatly improved, and research, by the Commission and by other organisations, is relied upon to show how this can be done. Certainly few foresters would concede that the existing weed control measures are truly adequate for the need that exists within the State's forests.

*****

VEGETATION CONTROL FOR INCREASED PASTURE PRODUCTION

Frank C. Crofts,
Associate Professor in Agronomy,
University of Sydney.

All pasture improvement and maintenance programmes are directed towards modifying the botanical composition of the existing vegetation. In the next ten years selective chemical herbicides are, for economic and practical reasons, bound to become of vital importance as low-cost, low-labour means of vastly increasing the area and productivity of our pasture lands.

Pastures are created or preserved for the purpose of producing livestock products and the value of all treatments which are applied to them, whether these be cultivation, fertiliser, seed, or pest, weed and disease control, should be assessed in terms of the cost involved and the value of the additional livestock products which are likely to be produced.

The Role of Herbicides

In cropping, single treatments are often applied and it is relatively easy to determine the effect of these single treatments on yield and thereby assess their economic value. In improving pastures it is not easy to obtain a response in livestock production to a single treatment and even if one is obtained it is still difficult to measure the economic effect of this single treatment. Because of this, pasture researchers and pasture users must of necessity become more concerned with the effect on productivity of the interaction of two or more treatments than the effect of any single treatment. In fact, the interaction is often so large that it is not worthwhile even considering, in economic terms, the effect of a single treatment. For example, one might apply fertiliser to existing vegetation and obtain no response. One might apply herbicide or seed separately to the same situation and in each case obtain no response which is measurable in terms of animal products. However, one may also apply herbicide, fertiliser and seed in a well-devised programme and obtain a large and highly profitable response to the total operation which is easily measurable in terms of livestock production. The result of properly combining all three treatments is far more important than the effect of any one alone, and the research which resulted in defining this favourable interaction is likely to have a far greater influence on production than research which studies the effect of only one kind of treatment.

Although herbicides have been used sporadically, but not always successfully, as single, isolated treatments for pastures, I believe that the greatest scope for their future wide-scale use lies in their interactions with other treatments in programmes devised for the purpose of rapidly and cheaply raising the productivity of pasture land. Programmes which have been devised by Mr. Malcolm Campbell of Bathurst for both the control of Nassella tussock and the establishment of improved pastures on non-arable hill country in that area are good examples of the kind of broad-view research that is necessary if herbicides are to play their proper role in economically increasing livestock production.

The Scope for Herbicides

The scope for the profitable use of herbicides in pasture production in Australia is vast and varied. These situations provide most promising possibilities:-

1) <u>In control of native vegetation or introduced weeds, prior to seeding and fertilising, on land too steep for the working of mechanical implements.</u>

Although no detailed estimates of land in this category with greater than 15" A.A.R. in southern Australia and 20" A.A.R. in northern Australia have been made, calculations by Hubble (quoted by Davies and Eyles, 1965 - J. Aust. Inst. Agric. Sci. 31: 81) suggest that this could be as large as one-third of the area of Australia suitable for intensive pasture development and cropping. It would appear therefore, that the area of Australia with satisfactory rainfall, but unsuitable topography for cropping, could exceed 110 million acres (one-third of the area of 431.4 million acres considered suitable for intensive pasture development and cropping). The corresponding figure for New South Wales could be as high as 25 million acres. If, in fact, only half this area were treated with herbicides, fertilizer and seed, and the resulting production increase was only 2 sheep per acre, another 25 million sheep could be added to the New South Wales pastoral scene.

2) In control of native vegetation and introduced weeds on arable land prior to establishing improved pastures.

Total land available in Australia with satisfactory rainfall has been estimated at 359 million acres (Davies and Eyles, 1965). Although such land could be developed as improved pastures by mechanical means without the use of herbicides, the slow rate of development by other means (only 36.3 million acres of improved pasture to 1962) suggests that if improved low-cost systems of development using herbicides were applied to this task, more economic and more rapid development might result. It would not seem unreasonable to suggest that one-third of the 60 million acres of such land awaiting development in N.S.W. might be treated with herbicides and this 20 million acres could be developed to carry 40 million more sheep.

3) In changing clover-dominant improved pastures to grass dominance by adding suitable improved grass species.

Herbicides could, in the long term, be one of the main factors in converting weedy clover-dominant pastures to more stable grass-clover pastures. It is probable that less than half the 34 million acres of improved pasture sown in southern Australia to 1962 carries a satisfactory grass component. Eventually steps must be taken to obtain higher productivity from this 17 million acre area by incorporating appropriate grasses. This could add something like a further 17 million sheep carrying capacity to Australia and 5 million to New South Wales.

There are other places for herbicides in pasture production than those outlined above. Their use in controlling a wide variety of poisonous or harmful weeds and for the purpose of maintaining existing pastures is well established but their effect on productivity, when used in these ways, is difficult to assess.

It does, however, appear that herbicides wisely used in conjunction with other sound pastoral practices, could, during the next twenty years, provide the most economic means of increasing the carrying capacity of pastures in New South Wales by an amount equivalent to more than that required by 70 million sheep. The figure for the whole of Australia could well be six times this amount or 420 million dry sheep equivalents.

The Realities of Production Increases

But hard work is required to convert possibilities into realities and before the foregoing possibilities can be achieved a great deal of additional knowledge is needed from research. Research should, I believe, be directed along at least three different lines.

One line of research should be aimed at determining the reaction of the chemical on a range of pertinent species, and the effect of changes in environment on the herbicide-plant reaction. This would include all the usual questions of treatment rate, time of application, method of application, species tolerance, and residues. Much of this developmental research is already being carried out by chemical companies but more precise knowledge is needed on the effect of environmental conditions likely to be encountered in field situations. Research institutions should, I believe, participate in this kind of research activity and closely liaise with the chemical companies.

Another line should be concerned with the more general aspects of herbicidal use and study such matters as means of application, surfactants, absorption and translocation by the plant and the long term effects of residues.

A further line of research workers, agronomically orientated, should be constantly considering the range of herbicides available in relation to the agronomic problems of the day. Their task would be to devise and test different systems of production which involve the use of herbicides with existing methods of production. They would be expected to make economic comparisons of different methods and to be able to pass their results directly to the extension officers or consultants. Research in these last two categories will, I believe, remain largely the responsibility of research institutions, but if possibilities are to become achievements, greatly expanded research funds will be needed.

*****

LAND CLEARING - TECHNIQUES & COST

K. A. Watson
Amalgamated Chemicals Pty. Ltd.,
Bankstown.

In 1965 Davies & Eyles estimated that in Australia there were 430 million acres of land available for intensive agricultural and pastoral development. Of the suitable land available in the Southern part of the continent 40 per cent has been developed while in the north only 2.5 per cent has been developed. It is likely that a considerable proportion of this undeveloped land carries virgin or regrowth timber.

More recently Davidson has stated that estimates were available showing that there were 8.5 million acres of potential arable land in New South Wales with a growing season of more than five months, which are unoccupied, because the cost of clearing would make farming unprofitable. If these estimates are valid it would appear that trees can be considered a major weed problem in N.S.W. and generally throughout Australia.

In the light of Davidson's statement that the cost of clearing trees is so expensive that farming becomes unprofitable it would seem appropriate to examine the various techniques available for removing or killing trees and to look at such information as is available on their relative costs.

Mechanical Clearing:

The availability of high powered bulldozers and the refinements in their use for land clearing such as the ball and chain method have led to the widespread adoption of mechanical clearing methods in recent years. However the costs of mechanical clearing can be high in some areas as shown in the following examples.

Western N.S.W. (All costs are given as \$ per acre).

Using 2 Caterpillar D9 with ball and chain.
Pulling \$1.50 - \$3.00
Windrowing and stacking \$2.00.

Total cost to prepare land ready for wheat sowing \$4.00 - \$10.00

S.W. Queensland brigalow country.

Virgin brigalow to improved pasture \$4.00 - \$7.00
Usually aerial or ground spraying with 2,4,5–T is required to control sucker regrowth at \$2.50 - \$3.50.
Virgin brigalow to wheat cultivation \$12.00 - \$24.00.

N.S.W. Central Tablelands.

Total cost of land preparation to the stage of sowing a crop on medium timbered country on reasonably level land \$40.00

Victoria.

Medium forest country.

Clearing, packing, burning	\$60.00
Ploughing	\$ 6.00
Picking up, Cultivating for sowing	\$12.00
Total	\$78.00

The costs naturally vary according to the species and density of timber, topography, soil type, soil moisture conditions and the distance a contractor has to travel to a job.

Despite the wide range of these figures it is apparent that mechanical clearing under some conditions can be very expensive. It can be argued that mechanical clearing can be justified only if the following criteria can be satisfied:

(a) The land is required for arable crop production.
(b) The land has sufficient potential to justify the expenditure.
(c) Funds are available.

Apart from cost a major problem with mechanical clearing is subsequent sucker and seedling growth. If the land is to go into crop production the necessary cultivations will usually deal successfully with the regrowth problem. However, when the land is to be sown to pasture the regrowth problem may be so acute that its solution can cost more than the original clearing cost.

Although aerial spraying with 2,4,5–T has been shown to deal successfully with brigalow regrowth sprayed at the correct growth stage and under good soil moisture conditions, eucalypt regrowth is generally less amenable to this treatment.

Much of the land still available for development under virgin timber is mainly suited to pasture development and in such cases dead standing timber constitutes mainly an aesthetic problem. In potential pasture areas therefore it is appropriate to look at clearing methods which kill trees in situ leaving the dead timber to be disposed of when convenient.

Ringbarking

Ringbarking is the traditional method of killing trees in Australia. The object of ringbarking is to kill the tree by preventing the flow of sap. Sap ringing severs both the phloem and xylem sap flows and results in rapid death of the tree. Bark ringing removes the phloem only and prevents translocation of manufactured food from the leaves to the roots and vice versa. Death of the tree takes place more slowly than with sap ringing.

With a few species of Eucalypts ringbarking can result in a kill of the whole tree but with most species ringbarking serves to stimulate bud development below the cut and from the lignotuber resulting in a prolific growth of suckers.

The death of the tree crowns stimulates growth of natural pasture and enables sowing of improved pasture species and spreading of superphosphate be carried out. However, unless the sucker regrowth is removed systematically and thoroughly the end product of ringbarking can be a stand of secondary growth timber with four to six times as many stems as were present originally and consequently an even lower carrying capacity than under virgin timber.

Cost of ringbarking can vary from $2.00 - $8.00 depending on density of timber, species and topography. Removal of suckers may be necessary for four years or more after the original ringing and the cost of this operation in the first years may exceed the original ringing cost. On the Northern Tablelands of N.S.W. ringing plus suckerbashing can cost $20.00 - $24.00.

Ringbarking plus herbicides.

Herbicides have been used for many years as a means of reducing or eliminating the regrowth problem after ringbarking.

Arsenic: This was the first effective herbicide to be used for tree killing. Sodium arsenite solution (approximately 10% As_2O_3 w/v equivalent) is applied to a frill ring made as close to the base of the tree as practicable. Arsenic produces rapid top kills and suckering is reduced provided application is made near ground level. In practice near ground level applications are too difficult or too costly in labour and the material is applied at a more convenient height with a consequent increase in suckering.

Arsenic also suffers from the disadvantages of toxicity and being an unpleasant material to use. Costs of arsenic treatment of timber are estimated at $8.00 - $10.00.

2,4,5–T: Both amine and ester formulations of 2,4,5–T have proved reasonably effective for killing trees. Application is made in the same way as for asenic. The usual recommendation is to apply a 4% a.e., 2,4,5–T solution to a low frill at the rate of 20 cc per inch of diameter. In practice this amounts to saturating the frill with the solution until it starts to run out.

Results with 2,4,5–T correctly applied to a low frill on trees growing under good soil moisture conditions can produce a high percentage of kills with little resuckering. However with the high frills commonly used and in many cases, reduced concentrations of 2,4,5–T, resuckering levels can be very high. Farmer acceptance of 2,4,5–T usage has not been good mainly because of lack of consistency in results and high cost of chemical per acre.

The cost of 2,4,5–T treatment naturally varies: one example from the Northern Tablelands cost $8.00 for ringing plus $2.00 for 2,4,5–T.

Picloram: This new hormone type herbicide has been available commercially in Australia for just over three years and in that period has been widely used for tree killing. Picloram appears to be particularly active against Eucalyptus spp. It is more readily translocated than either arsenic or 2,4,5–T and because of this more latitude in application techniques are permissible. A complete frill of the sap wood and inner bark is not necessary and the height of application does not seem to be critical; these factors together allow a considerable reduction in the labour component of applying picloram compared to arsenic or 2,4,5–T.

The current recommendation for use of picloram is to apply 2 cc of 1% a.e., solution at six inch centres around the circumference of the tree at any convenient height. Under good soil moisture conditions with trees growing actively, kills of up to 80% can be obtained.

Costs of picloram treatment provided by a contractor who has used this treatment extensively were as follows:-

Labour	Picloram
$1.00 - $4.00	$0.60 - $3.00

It has been estimated that about 200,000 acres of timbered country in N.S.W. has so far been treated with picloram. Thus it would appear that the effectiveness of this herbicide plus the reduced labour costs in its application has made this technique widely acceptable for timber killing.

From the data available it is not possible to give other than very crude estimates of the total cost of clearing 8.5 million acres of land in N.S.W. using any one of the techniques currently available. Taking median values for the different methods the following total costs for land clearing or tree killing are as follows:

Mechanical clearing	$340 million.
Ringbarking & Suckerbashing	$170 million.
Frilling plus arsenic	$ 76 million.
Frilling plus 2,4,5–T	$ 85 million.
Partial frilling plus picloram	$ 38 million.

If these figures are even vaguely near the mark it is apparent that the cost of clearing or killing trees represents a major economic barrier to land development in this state and doubtless throughout Australia. Herbicides appear to offer a means of making a substantial reduction in these costs.

*****

EFFECT OF WEEDS ON WOOL PRODUCTION AND QUALITY

R. D. Eastoe,
Special Livestock Officer (Sheep and Wool),
Department of Agriculture.

Plant species exert a major influence in sheep production affecting environmental, endocrinological, sociological and managemental factors. Because of this role plant species play in production and reproduction within the sheep industry it is necessary to view their effects on a broad spectrum.

Paradoxical situations arise. A major number of plant species regarded as weeds cannot be categorically listed as such. They may provide good quality nutrition or protection for a portion of their growing life and become a major problem at another stage. Some species, deliberately sown, but under incorrect management, can be detrimental or even fatal to sheep. A classical example of this is the highly valued Phalaris tuberosa.

Alternatively some species having little value at any stage can be definitely ranked as weeds and do play a major part in the loss of production or quality. Noogoora burr (Xanthium pungens) markedly lowers wool value. Wool production can be reduced by 60 percent on darling pea (Swainsona spp.) addicted sheep and heliotrope (Heliotropium europaeum L.) causes death by hepatotoxic poisoning.

To compartment the various influences, species will be listed under headings. Some suggestions for alternatives to counteract plant effects will be incorporated.

1. The Group Where there is a Paradox

Barley grass (Hordeum spp.) can be regarded as an essential feed supply in late winter /early spring in the lower rainfall zones particularly with the increasing swing to spring lambing. At the seeding stage barley grass counteracts a great deal of its advantages by sheer physical irritation of sheep and may under extreme conditions cause mortalities. On present data, the provision of paddocks where other species compete with or replace barley grass at its damaging stage should be considered.

This is comparatively simple in areas of moderate climate and rainfall because of the wide range of species that can be sown. However, with areas like the central plains of New South Wales the number of competing species is small and the alternative is to provide dry land lucerne (Medicago sativa L.) for grazing to provide required feed supplies during periods of heavy seeding of barley grass and other genera.

As a source of spring grazing and with re-growth from minimal precipitation in summer and autumn spear grasses (Stipa spp. and Aristida spp.) are of importance. However, their mature seed plays havoc with wool production both from the point of view of vegetable fault and lowered production per head.

It is difficult to imagine the Australian grazing scene without trefoils (Medicago spp.), particularly in the lower rainfall regions. The more prolific the growth and consequent increase in available feed, the more is the wool reduced in value per pound because of added vegetable fault. The relationship between higher wool production from more available feed and the reduction in value from vegetable fault has not been studied.

2. Contradictions

For decades skeleton weed (Chondrilla juncea L.) has been listed high as a noxious weed by State Departments and Local Government bodies, due to its drastic effect on wheat production. Even now where chemical treatment is possible it is an added cost to production. This particular plant provides excellent feed for grazing sheep in paddocks or on fallowed land particularly where there is a minimum production of palatable and nutritious grazing.

3. Land Domination

Land costs per sheep unit area are high irrespective of whether they are freehold or lease. Carrying capacities largely determine the rate of return to capital invested. It is essential therefore that maximum utilisation of existing areas be made. A number of genera have species which have little or no feed value but dominate natural pasture to the exclusion of minor but valuable species. The importance of these minor species was shown by Leigh and Mulham (1966.).

The basal leaves of Paterson's curse (Echium spp.) cover a considerable area. Even with a moderate population per square yard the plant can completely cover tracts of land. At maturity the bulk of the material becomes pulverised and is wind blown leaving no residual grazing material.

Thistles such as Silybum spp., Cirsium spp., Carthamus spp. and Carduus spp. dominate on a sporadic or sometimes a seasonal basis. Apart from their broad cover in the early green stages some species contain nitrites and constitute a plant poisoning. Their domination of the grazing area is greatest at their mature dry stage when there is a reluctance by sheep to enter the thick mass in which form they grow, reducing the availability of fodder.

Serrated tussock (Nassella trichotoma) completely dominates land, reducing carrying capacity by four or five hundred percent. It can entirely stop a breeding programme on the affected areas.

Large areas are covered for a short period with cape weed (Arctotheca spp.) This species has a limited feeding value. Some reports of R. H. Falk (personal communication) in 1957 indicated that it may have limited value in preventing posthitis in sheep.

Edible species are at a premium in the arid zone and there are reports of increasing domination by budda (Eremophila mitchellii), hop bush (Dodonaea spp.) and desert cassia (Cassia spp.).

Better species of cotton bush (Kochia spp.) and saltbush (Atriplex spp.) populations are reduced under the domination of low fodder producing roly poly (Bassia spp.) and to a lesser extent some of the spinifexes (Spinifex spp. or Trioda spp.) (Ratcliffe, 1936).

Catheads (Tribulus spp. and Emex spp.) may be credited with some feed value particularly when they shoot after summer storms but basically come under the land domination group. This is because of the length of time the hard spiked fruits remain on the soil surface. They cause lameness in lambs and adult sheep with the result that movement is restricted from pain, and feed intake affected.

There is no easy method of removing prickly pear (Opuntia spp.) and bracken (Pteridium spp.) and these can prove to be a major land dominating genera.

4. Wool Damage

There is a long list of species which contribute to vegetable fault in wool. The most common is the medic group. It is assumed their detrimental aspects are more than compensated for by their major contribution to the nutritional scene, but there is no adequate data to prove this assumption or otherwise (Luff and Darling, 1966; and Robards and Wilson, 1967).

It is probable that burrs (Xanthium spp.) receive the greatest publicity and their costly effect on wool yield and wool fibre is without question.

One of the most insidious forms of vegetable fault is that of the three awned spear grass. The awn of the dry mature seed breaks up into minute pieces, extremely difficult to remove in carding and combing processes. This vegetable material has an entirely different affinity for dyes to the wool fibre and invariably shows up after dyeing. Their removal then becomes extremely costly.

The content of corkscrew in wool can be very high but it has an added serious effect of piercing skin causing intense irritation and reducing body efficiency to the detriment of wool production. Further the pelts of skinned sheep heavily infested with corkscrew have a depreciated value.

Species of lesser effect but still contributory to vegetable fault are saffron thistle (Carthamus lanatus), black thistle (Cirsium vulgare), khaki weed (Alternanthera repens) and subterranean clover (Trifolium subterraneum).

It is difficult to actually determine the cost per annum of weeds to the sheep industry but it has been quoted for the Commonwealth as nearly $2 million per annum by various authorities. On depreciation of wool values alone the figures of Webster and Whan strongly support this. (Paper to this Conference).

5. Plants Affecting Fertility

The clovers, particularly the subterranean clover (T. subterraneum) must be classified as a major contribution to an increased nutritional plane with a consequent boost in per head production of wool and meat. However, the oestrogenic compounds in subterranean clover in particular and even more specifically some of its cultivars have been responsible for lowered production to a stage where sufficient sheep replacements can no longer be bred.

Considerable research has been undertaken in respect to the reproductive losses due to clovers. The effective use of these species is primarily one of management and research has offered sound and effective managemental methods.

6. Physical Damage

The majority of species which would normally be listed in this group have other attributes and have also been listed elsewhere. Such plants as spear grass, barley grass, saffron thistle and cathead are the most notable species.

One that is worthy of mention although it is only found in comparatively limited amounts is devils claw (Proboscidea jussieui Keller). The fruit of this species when dry attaches itself readily to wool but is easily removed by hand. Its worst feature is its ability to attach itself to sheep particularly on the nose of face creating terror with subsequent loss of production. Its action is sufficiently minor not to warrant work on it at this stage.

7. Parasitic Species

With the marked trend to intensive sowings of lucerne as a pasture species in recent years in the central west of New South Wales every care should be taken to avoid losses of this plant by unwanted competition. Lucerne is playing a major role by increasing stocking rates and production in lower rainfall areas and stringent control of dodder (Cuscuta spp.) should be exercised.

8. Vermin Harbour

The family Roseaceae provides two of the main groups of vermin harbour. The most important is the blackberry (Rubus spp.) and to a lesser extent the briar (Rosa spp.). African box thorn (Lycium spp.) plays some part. While these species tend to dominate land their general growth is in isolated clumps and it is this particular characteristic that provides excellent harbour for rabbits. Selective herbicides or ripping, burning and grazing provide some means of control. With the harbour removed the attack on the vermin is simplified.

9. Inhibiting Water Flow

Because of the importance of water to the individual animal as well as the nation as a whole, mention of species inhibiting water flow is warranted. The most specific of these as far as the sheep grazing community is concerned is cumbungi (Typha spp.). Its effect on surface catchments and water flows is quite marked

Some restriction to bore drains occurs from dry roly poly and windmill grass (Chloris spp.) wind blown into the channels. In the minor channels in irrigation areas, barnyard grass (Echinochloa spp.) causes some restriction. Water hyacinth (Eichhornia spp.) can be disregarded in this paper because of its limitation mainly to coastal areas.

10. Poison Plants

Within this group are a number of genera and species known to cause or suspected of causing poisoning of some form or another. This group has been well covered by a paper to this conference.

Discussion

Because of the paradoxical role a number of plants play in the sheep industry it is regarded as essential that research be undertaken to evaluate those which have both advantageous and deleterious effects on sheep and wool production. The purpose of such a study would be to determine whether a programme of elimination should be developed. Some form of economic analysis within the research project would therefore be necessary.

Alternative or competitive species have been sown or encouraged in pasture improvement programmes. An economic study of these species and their necessary management in relation to those with which they are competing should be undertaken. It is hypothesised that the capcity for reducing wool production by some groups of plants can be offset by managemental methods but there is little data to support it. It therefore calls for an analysis of plant/animal relationship.

It is only within very recent years that the interest in increased stocking rates has intensified. The State of New South Wales could effectively run 100,000,000 sheep with similar proportional rises in most other States.

A revision of thinking of the efficiency potential of plant/animal relationship is required to align it with the present day knowledge of plant and animal as individual entities. The ability to weld these two units is trailing the specific available information on each an entity.

ACKNOWLEDGEMENTS

Leigh, J.H., and Mulham, W.E., (1965) - Pastoral Plant of the Riverine Plain (Jacaranda Press, Melbourne).

Leigh, J.H., and Mulham, W.E., (1966) - Selection of Diet by Sheep Grazing Semi-arid Pastures of the Riverine Plain I A Bladder Saltbush (Atriplex vesicaria) - Cotton Bush (Kocia aphylla) Community. Aust. J. Exper. Agric. and Anim. Husb. 6:460-7

Leigh, J.H., and Mulham, W.E., (1966) - Selection of Diet by Sheep Grazing Semi-arid Pastures of the Riverine Plain 2 A Cotton Bush (Kochia aphylla) - Grassland (Stipa Variabilis - Danthonia caespitosa) Community. Aust. J. Exper. Agric. and Anim. Husb. 6:468-74

Luff, A.F., and Darling, G.G., (1966) - Medic Burr as a Source of Protein Agric. Gazette Vol. 77 part 1.

Ratcliffe, F.N., (1936) - Soil Drift in the Arid Pastoral Areas of South Australia. C.S.I.R.O. Pamphlet No. 64.

Robards, G.E., and Wilson, A.D., (1967) - Digestibility of Samples from Oesophageal Fistulas. Aust. J. Exper. Agric. and Anim. Husb. 7:22.

*****

THE EFFECT OF VEGETABLE FAULT ON THE PRICE PAID FOR WOOL

I. D. Webster and R. B. Whan,
Bureau of Agricultural Economics,
Canberra.

In 1963-64 nearly 74% of the wool produced in New South Wales was contaminated with vegetable matter. Of this 58% could be processed on carding machinery fitted with special burr rollers and about 16% with heavy burr would require carbonizing. In both cases the removal of the vegetable fault represents an additional processing cost. Even with wool containing light vegetable fault costs will be incurred because of fibre wastage and fibre breakage caused by the removal of the fault. Further costs may arise because of small pieces of vegetable fault passing through the card into tops, or even worse, into the final cloth.

The aim of the present paper is to compare the prices paid at auction for free wool and wools containing a range of vegetable fault. It would be expected that vegetable matter would have two effects on price; one due to the type of fault and the other to the proportion of fault in the wool.

Vegetable contamination in wool can range in size from shive which consists of small pieces of leaf or straw to the large tough Noogoora burrs. The most common species of vegetable fault is trefoil or clover burr which often breaks up during carding and is difficult to eliminate. Unlike the Noogoora and Bathurst burr, which are produced by noxious weeds, trefoil burr is the seed of an important pasture species and it is likely to remain a feature of the New South Wales wool clip. Unfortunately it is not possible to make price comparisons between wools containing different species of vegetable fault but it is possible to compare prices paid for wools containing different proportions of fault. As vegetable fault can vary from district to district a further distinction that has been made is to identify prices paid for wools grown in separate wool growing areas of New South Wales.

Distribution of Vegetable Fault in the Wool Grown in New South Wales.

The distribution of the fault levels in wool grown in New South Wales is given in Table No.1 and the accompanying graphs. It will be noticed that although no wool district is free of vegetable fault there are marked differences in the proportion of fault in wool grown in the different areas. By way of illustration compare the Southern Tableland with the Southern portion of the Western division. In 1963-64 nearly 69% of the wool grown in the Southern Tablelands was free or nearly free of vegetable fault and only 1% was described as carbonising while in the southern portion of the Western Division there was only 4.8% of free wool and 14.5% of carbonizing types.

The Price Comparisons

The price data used for these comparisons were supplied by the Wool Statistical Service of the Australian Wool Board. The data included the price paid and other details for each lot of wool sold in Sydney during the 1963-64 and 1964-65 selling seasons.

In each comparison the clean price was calculated from the greasy price by using the appraiser's estimate of yield. Any errors in the appraiser's estimates of top and noil yield or vegetable fault content are included in the analysis. These errors are likely to be random and will therefore cancel out. Comparisons were made using an analysis of variance design which allowed for unequal numbers of observations in each cell. In this way the effect of price movements between sales was eliminated from the comparison and so too was the effect of

TABLE No. 1.

VEGETABLE FAULT CONTENT IN NSW - BY DISTRICTS

1963-64

	N.S.W.	Nthn. Table	Central Table	Sthn. Table	N—W Slope	Central West Slope	S—W Slope	North Central Plain	Central Plain	Riverina	Western		
											N.E	N—W	Sthn.
Bales	1,678,000	130,000	165,000	134,300	130,600	143,900	183,100	127,000	199,300	155,700	98,500	71,200	67,800
	%	%	%	%	%	%	%	%	%	%	%	%	%
Fault Content													
FNF	26.35	64.43	41.75	68.55	11.55	6.89	45.01	5.63	1.78	11.96	17.65	33.26	4.84
B	41.96	29.57	43.30	27.69	54.23	39.22	42.19	53.32	30.41	45.42	49.81	52.54	48.50
C	16.26	3.03	8.04	1.85	18.52	26.96	6.96	21.88	34.37	19.67	17.74	9.07	23.19
D	6.26	0.51	2.54	0.41	5.54	13.01	2.21	7.38	16.54	9.10	4.13	0.58	8.79
Carbonising (k)	8.54	1.59	3.77	0.95	9.39	13.40	3.08	11.24	16.34	13.46	9.79	3.89	14.51
Oddments	0.63	0.87	0.60	0.55	0.77	0.52	0.55	0.55	0.56	0.39	0.88	0.66	0.22
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Statistical Analysis No. 46A, Wool Statistical Service 1963-64.

varying numbers of lots in each of the vegetable fault classifications.

The wool types selected for analysis are fully described in appendix A1. The comparisons made are for:-

(a)	Type 62A	compared with	62AB
(b)	" 72A	"	" 72AB
(c)	" 78A	"	" 78AB; 78AS; 78C
(d)	" 84	"	" 84B
(e)	" 159	"	" 159B; 159C; 159D.

Seasonal Averages

The seasonal price differences for each comparison are given in Tables No. 2 and 3. These differences are only given for districts containing a reasonable quantity of wool in both the free and faulty types. In each case a positive value indicates a price advantage for free wools and a negative value a price advantage for wool containing vegetable fault.

A distinction exists in the price discount for vegetable fault in fleece types and the discount in the oddment types. The price discount for fleece wool containing vegetable fault was either very low or negative, (i.e. a price advantage for vegetable fault) but it is unlikely that these differences are significant.

It would appear that with the possible exception of the 78AC wool grown in Central Tableland and South West Slope there is no significant discount on fleece wools containing vegetable fault.

An examination of the price differences for type 159 and its faulty derivations suggests that a significant discount exists for vegetable fault in oddment types. This discount is up to 1.75 cents per pound clean for "B" fault, from 3 to 7 cents per pound for "C" fault and from 9 to 13 cents for "D" fault.

Within Sale Price Differences

A more detailed consideration of price differences for individual sales within a season reveals that the price discount for vegetable fault is subject to large variations.

Price differences for types 78AB, 78AS and 78AC grown in four areas are given for each Sydney sale during 1963-64 and 1964-65 (See Tables No. 4 and 5). Some indication of the source of these changes in the price differences between free and burry wools can be obtained from Table No. 6 where it may be observed that the average price variation within sales is higher for faulty wools than for the equivalent free types.

TABLE No. 2

PRICE PREMIUM FOR FREE WOOLS (CLEAN) BIG LOTS

SYDNEY 1963-64

Type	District: Western N.S.W.	Central Western Slope	Central Table	South Western Slope
		premium		
Fleece Type	c/lb	c/lb	c/lb	c/lb
62A Versus 62AB	*	+ 0.75	+ 1.08	+ 1.00
72A " 72AB	+0.75	+ 0.50	+ 1.00	0
78A " 78AB	+0.58	+ 0.08	+ 0.50	+ 1.83
78A " 78AS	+0.50	*	*	*
78A " 78AC	+0.27	+ 0.83	+ 1.92	+ 1.75
84 " 84B	−0.08 (1)	*	− 0.25	+ 0.25
Oddment Types				
159 Versus 159B	*	+ 1.50	+ 1.75	+ 0.08
159 " 159C	*	+ 6.92	+ 4.67	+ 3.58
159 " 159D	*	+11.08	+10.00	+12.25

* Insufficient observations to make a comparison.

(1) A minus sign shows a price discount for free wools.

TABLE No. 3

PRICE PREMIUM FOR FREE WOOLS (CLEAN) BIG LOTS

SYDNEY 1964-65

Type	District			
	Western N.S.W.	Central Western Slope	Central Table	South Western Slopes
		Premium		
Fleece Types	c/lb	c/lb	c/lb	c/lb
62A Versus 62AB	*	0.58	+ 1.08	+ 0.58
72A " 72AB	+ 0.42	0.08	+ 0.42	+ 0.17
78A " 78AB	+ 0.12	0.33	– 0.08	– 0.08
78A " 78AS	– 1.00 (1)	*	*	*
78A " 78AC	– 0.08	+ 1.25	– 0.33	+ 0.42
84 " 84B	+ 1.33	+ 0.58	+ 0.92	– 0.12
Oddment Types				
159B Versus 159C	+ 7.23	+ 4.83	+ 4.75	+ 4.33
159B " 159D	+13.25	+9.67	+10.17	+10.50

* Insufficient observations to make a comparison.

(1) A minus sign shows a price discount for free wool.

TABLE No. 4

PRICE PREMIUM FOR 78A (FREE) BY SALES

SYDNEY 1963-4 BIG LOTS

Sale	Districts: Western N.S.W.			Central Western Slope		Central Tableland	South Western Slope
	78AB	78AS	78AC	78AB	78AC	78AB	78AB
	Premium						
	c/lb	c/lb	c/lb	c/lb	c/lb	c/lb	c/lb
1	+0.25	+ .83	+4.17	*	*	*	0.75
2	−0.33	*	+0.92	*	*	+1.50	0.67
3	+0.42	−2.17	+3.75	−0.92	−0.58	+4.75	− 2.17
4	+1.33	+1.92	+3.67	*	*	+2.00	+ 2.25
5	+3.50	+0.50	*	+0.50	−0.42	+0.08	− 0.50
6	+0.83	+2.58	−0.58	−0.75	+0.50	+0.33	+ 1.00
7	*	*	*	+0.25	−0.67	+1.92	+ 1.25
8	−0.28	−0.83	*	+0.25	−1.50	−0.17	+ 1.42
9	*	*	*	+5.67	+2.33	−2.00	+ 2.92
10	*	*	*	+1.42	+6.67	+1.33	− 1.00
11	+5.75	−5.50	*	+1.00	−3.92	−0.75	+ 0.33
12	+1.17	+2.25	+6.25	−0.17	+2.67	−0.25	*
13	−2.50	−4.00	+1.08	*	*	+1.00	*
14	+2.33	+3.42	+10.50	−5.50	−4.58	0.42	*
15	+0.75	+0.17	+4.92	−2.08	1.75	+4.00	− 1.50
16	+2.08	+4.25	+2.00	*	*	2.00	*
17	+2.33	+3.08	+4.83	+1.67	−1.58	*	− 2.17
18	+0.25	+3.67	*	+1.08	+4.08	*	*
Best Estimate of the seasonal Difference	+0.58	+0.52	+2.72	+0.04	+0.78	+0.51	+ 0.77

* Insufficient observations to make a comparison.

TABLE No. 5

PRICE PREMIUM FOR 78A (FREE) BY SALES

SYDNEY 1964-5 BIG LOTS

Sale	Districts: Western N.S.W.			Central Western Slope		Central Tableland		South Western Slope
	78AB	78AS	78AC	78AB	78AC	78AB	78AC	78AB
				Premium				
	c/lb	c/lb	c/lb	c/lb	c/lb	c/lb	c/lb	c/lb
1	+1.83	+1.25	+3.58	−2.17	−2.00	*	*	−0.67
2	−1.75	−2.00	+0.75	*	*	−3.67	−0.73	−0.67
3	0	−0.67	−1.17	−1.67	−1.00	−0.33	+0.25	−0.67
4	−0.58	+0.67	+1.58	+2.17	+2.58	−0.50	−1.42	+0.83
5	+0.50	−2.25	*	+1.33	+1.17	+0.42	+1.75	+0.17
6	+1.25	*	*	+1.25	+1.50	−1.33	+3.25	−0.75
7	−0.58	−0.75	−1.75	*	*	+2.58	+11.92	+1.58
8	+1.58	*	+1.58	+1.92	+2.33	+2.92	*	+2.25
9	*	*	*	−2.75	−5.17	−3.17	*	−0.08
10	*	−2.75	−3.83	−1.83	−3.58	−2.50	−2.00	*
11	*	*	*	−1.50	−2.42	+0.92	+2.75	+0.42
12	*	*	*	+1.83	−2.33	+4.42	+0.58	*
13	+1.58	+2.17	−0.67	*	*	−0.17	+0.67	−1.75
14	−1.08	+3.17	+1.83	*	*	−1.50	−4.42	+0.50
15	−0.08	−1.00	+1.42	+0.25	+3.58	+2.17	−1.25	−0.92
16	−1.33	−0.92	+0.17	−0.17	+1.75	−1.67	−0.17	+1.33
17	+0.67	−3.25	+2.78	−1.50	+3.92	−0.50	*	+0.33
18	−0.33	*	−0.33	−2.00	+1.67	+1.58	*	+0.42
Best estimated of the seasonal difference	+0.17	−1.00	−0.09	+0.32	+1.30	−0.05	−0.29	+0.09

* Insufficient observations to make an observation.

TABLE No. 6

WITHIN SALE VARIANCE

1963-4

BIG LOTS

Type	Within Sale Variance
62A	8.99
62AB	43.34
72A	11.06
72AB	10.24
78A	10.80
78AB	10.85
78AS	16.84
78AC	27.04
84	20.47
84B	16.71
159	10.98
159B	16.26
159C	44.34
159D	44.96

Discussion

A consideration of the processing implications of vegetable fault in wool shows quite clearly that a cost must be associated with this fault. The price comparisons set out in this paper support this conclusion in respect to the oddment types considered but failed to show a significant price discount for the fleece types.

It was not possible to include more than one fleece type containing a "C" burr or higher in the comparisons and the main comparisons were for "B" fault. Even so the lack of significant seasonal price discounts was surprising and the existence of premiums for burry wools in individual sales suggest that the processing considerations are not the only factors influencing the market.

It has been shown (3) that a random price variation exists during a single wool sale. This price variation is not the result of technical factors inherent in the wool but rather a series of imperfections in the auction system. These imperfections have been reviewed(4) and in the present case one of the major sources of random price variation could be errors in buyers' estimates of vegetable fault content. The problem of accurately estimating vegetable fault increases as the proportion of fault increases. This could explain the results set out in Table No. 6 where it can be seen that the random variation in clean prices increases for wools containing vegetable fault.

Conclusion

An examination of prices paid at auction for free and equivalent types of wool containing vegetable fault has shown that in general fleece types containing a "B" fault received similar prices as those paid for free wools. A small discount existed for wools with "C" fault.

A significant price discount existed for oddment types containing B, C and D fault; the discount rises with increasing fault.

*****

REFERENCES

1. Australian Wool Board Wool Statistical Service: "Statistical Analysis No. 46A, 1963-4".

2. G.W. Snedecor. Statistical Methods. 5th edition 1957, page 385.

3. R.B. Whan "Wool Selling Strategy for the Wool Grower". Wool Technology and Sheep Breeding July 1967.

4. R.B. Whan, "Prices may vary 8 cents per pound" Sydney Morning Herald July 28, 1967.

APPENDIX A

Description of Types

The properties concerned in describing a wool type are:- Lenth, spinning quality, style, soundness, colour, condition and freedom from vegetable fault and dust.

Description of Types Used in Text:

Type	62A	:	Average Spinners Best Topmaking
			Length: Warp and half
			Quality: 64/60
Type	72A	:	Good Topmaking
			Length: Shafty
			Quality: 64/60
Type	78A	:	Good Topmaking
			Length: Good to average
			Quality: 64/60
Type	84	:	Good Topmaking
			Length: medium
			Quality: 64
Type	159	:	Medium Length pieces
			Quality: 60/64

Vegetable Fault

"B" Fault
(i) For merino fleece wool average to good length and sound, up to 3% burr and/or seed.
(ii) For merino fleece wool, medium to short length, up to 2% burr and/or seed.
(iii) For merino broken, pieces and bellies, medium to good length and sound, up to 4% burr and/or seed.

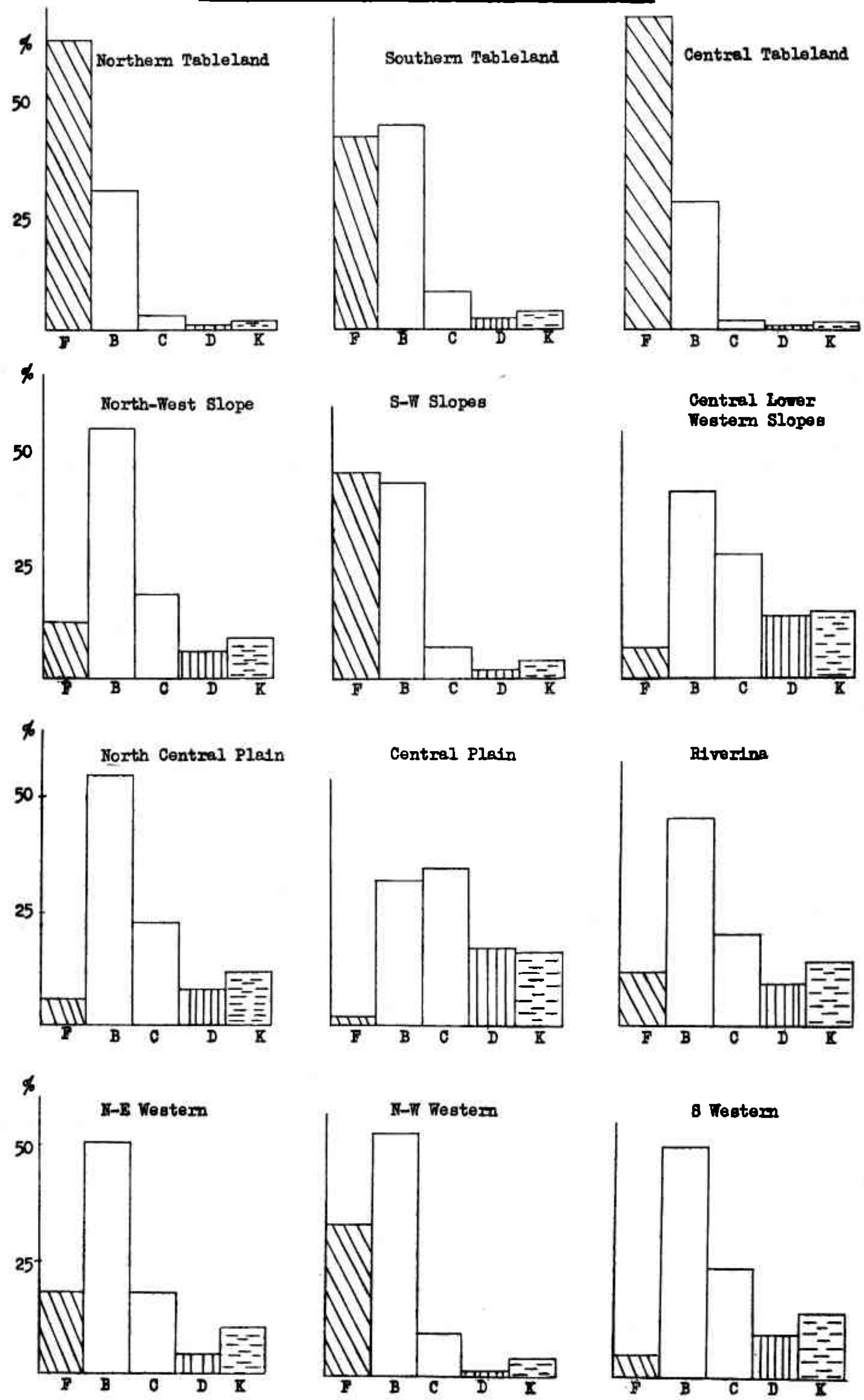
"S" Fault: Light wire grass, Black Jack and/or shive and/or Spinifex.. Corresponds to "B" fault.

"C" Fault:
(i) over 3% and up to 6%
(ii) over 2% and up to 5%
(iii) over 4% and up to 8%

"D" Fault:
(i) over 6% and up to 12%
(ii) over 5% and up to 10%
(iii) over 8% and up to 12%.

*****

BURR DISTRIBUTION IN N.S.W. BY DISTRICTS 1963-4



POISON PLANTS AND ANIMAL HEALTH

E. J. McBarron,
Principal Veterinary Research Officer,
Veterinary Research Station,
Glenfield.

The study of poison plants has a special difficulty in differentiating the available knowledge into that gained from critical examination and experiment as distinct from the mass of information built up from ancient lore and circumstantial evidence of toxicity.

There is a lack of information on critical work on the chemistry of the active principles and their pharmacological actions. It is highly probable that the supposed toxicity of many plants could be resolved biochemically into general disorders of metabolism with no specific toxins in the particular plants.

It is also pertinent to examine the changes wrought by more intensive settlement and agriculture in some regions of the State by the combined effects of housing, bulldozers, fertilisers, herbicides and the introduction of exotic species. Many of the plants mentioned in Hurst's Poison Plants of N.S.W., 1942 are now of historical interest only and it is doubtful whether their present incidence is likely to cause any serious problems in plant poisoning. This is particularly evident in coastal N.S.W. where plants associated with brush forests of the nature of Breyenia, Phyllanthus, Goodia, Indigofera, and Zieria and vines represented by members of the genera Parsonsia, Marsdenia, Hoya and Passiflora have had little mention in the past 30 years. By contrast, nardoo (Marsilea), billy buttons (Craspedia chrysontha) and lagoon spurge (Phyllanthus lacunarius) in which there is strong evidence of phases of toxicity, exist over large areas of flooded country in western N.S.W. and present a formidable problem either to eradicate or avoid grazing during the dangerous period.

A poison plant may be defined as one, when eaten in normal amounts or by contact, detrimentally affects the health of the animal.

Strict adherence to this definition, creates the apparent paradox where plants of major economic importance are included, e.g. the phytopestrogens contained in subterranean clover (Trifolium subterraneum) and other Trifolium species which produce infertility and dystocia in ruminants; tryptamine alkaloids in Phalaris tuberosa associated with phalaris staggers of sheep; perennial rye grass (Lolium perenne) staggers in sheep and cattle; the bloat problem and the grass tetany complex associated with a low serum magnesium in grazing animals. For purposes of this symposium, a brief survey is made of the common and more usual poison plants.

The term "weed" is used in the classical concept as a "plant out of place" and is here applied to indigenous species, even though no evidence of spread from its native habitat occurs, but because of its chemical constitution is poisonous. This condition may be precipitated by factors of grazing intensity, or in times of shortage the plant may be eaten in the absence of other palatable and innocuous herbage.

Common and important poison plants of N.S.W.

1. Rock Fern (Cheilanthes tenuifolia)

This small fern is widely distributed in N.S.W. and in other states of Australia. It is poisonous to sheep and cattle with clinical signs of staggers and enteritis. Trouble is experienced mostly in the summer months by the ingestion of older plants which are more toxic but less palatable.

A recent mortality of 150 out of a mob of 1300 ewes occurred where sheep were introduced to a grazed paddock with a considerable growth of Rock Fern. The toxic principle has not yet been determined.

This fern is hardy and is often dominant in rough rocky country but also occurs with a sparse grass cover under native pine (Callitris) woodlands. Intense grazing in these situations forces the stock to eat quantities of the fern with harmful effects.

2. Bracken Fern (Pteridium esculentum)

Bracken fern poisoning is a world-wide problem. This perennial is widespread throughout the higher rainfall areas of Australia. In N.S.W. it thrives in coastal, tablelands and parts of the slopes divisions, infesting country of low as well as high fertility. Cattle are mostly involved.

The green fronds are held responsible for stock losses. The primary disease is probably an induced thiamine deficiency but clinically the chronic condition is similar to an aplastic anaemia.

Judging from the frequency with which bracken fern is recovered from paunch material in suspected cases of plant poisoning, together with other ancillary laboratory examinations, it can be assumed that bracken fern is a common poison plant in N.S.W.

3. Pyrrolizidine Alkaloidosis

This condition is produced in man and animals by the consumption of plants containing pyrrolizidine alkaloids most of which are hepatotoxic (liver poisons). These alkaloids have been found to be present in several genera of the plant families, Compositae, Leguminosae and Boraginaceae, especially the genera Senecio, Crotolaria, Heliotropium, Cynoglossum and Echium.

Heliotropium europaeum (heliotrope) is an annual weed which has now become widespread in south-eastern Australia and is continuing to spread. Poisoning mostly occurs in the British breeds of sheep, less so in merinos; cattle are less frequently affected. Under experimental observations a death rate of 50 per cent has been recorded after the first season's grazing and 90 per cent within eight months following the second season of grazing. The disease is seen as a chronic wasting condition in sheep and cattle, but is also complicated in sheep by the abnormal accumulation of copper in the liver, which, under stress is released causing a rapid breakdown of the red blood cells and jaundice.

Another plant of similar action is cotton fireweed (Senecio quadridentatum) which has been involved in serious mortalities in cattle in the Upper Hunter and Merriwa districts of N.S.W. In this region the plant has become more prolific after top-dressing with superphosphate of lime and/or gypsum. The problem is further aggravated by dry winters and a scarcity of spring feed.

4. Waterblooms of Blue-green Alga (Cyanophyta)

Within the past two years stock poisonings, have been observed in sheep by a species of blue-green alga - Anacystis cyanea, (syn. Microcystis aeruginosa). During late summer and autumn, this microscopic, planktonic species, under certain environmental conditions, rapidly multiplies to form a "waterbloom". The deaths of 153 sheep, 2 cattle and 30 turkeys are attributed to this species involving cases from diverse areas of the state. Toxicity may be either acute, or chronic depending on the dose received from the infested water. In the more prolonged forms, cirrhosis of the liver is involved with photosensitisation.

Recently the presence of another toxic waterbloom - Anabena sp. has been confirmed and toxicity of the infested water demonstrated in mice.

Although the use of soluble copper salts is recognised as an effective algicide, this treatment cannot be adopted in many parts of N.S.W. where sheep are prone to accumulate abnormal amounts of copper in the liver and precipitate the fatal disease of Chronic Copper Poisoning.

5. Oxalate - containing plants

Significant amounts of oxalate sufficient to cause poisoning in livestock are found in some members of the Aizoaceae, Amaranthaceae, Chenopodiaceae, Oxalidaceae, Polygonaceae and Portulaceae. Toxicity is due to the oxalate ion which can either cause fixation of the ionised calcium of the blood plasma or precipitate as the insoluble calcium oxalate in kidney or brain tissue. Furthermore there is the association of urinary calculi (bladder stones) of the carbonate type with oxalate containing plants. Plants commonly incriminated in oxalate poisoning are sorrel (Acetosella vulgaris, syn. Rumex acetosella), wood sorrel (Oxalia pes-caprae), pigweed (Portulaca oleracea) and roly-poly (Salsola kali).

Injurious effects of oxalates are more likely to occur in autumn and winter when oxalate plants may be more prevalent and it has been shown in Western Australia that as many as 25 percent of sheep may suffer some degree of kidney damage during one season and the damage may be cumulative over years.

6. Darling Pea (Swainsona) poisoning

These perennial herbs of the legume family are widely distributed over central and western N.S.W. The two species most incriminated in stock poisoning are Swainsona greyana and S. galegifolia.

Continued ingestion of Swainsona induces a condition of "pea-struck" or "star gazing", especially in young sheep, less so in cattle and horses. Clinical signs may develop after 3-4 weeks grazing and recovery is possible if stock are removed within 5-6 weeks of access to the plant. Emaciation, anaemia, stiffness and defective eye-sight are in evidence.

Stock losses are usually higher in drier years because of the perennial nature of the weed; the lack of annual pasture plants and the resultant high rate of pea consumption by animals. It was estimated in 1950 that 300,000 acres of fair to rich, hilly to mountainous grazing country was infested in the Warrumbungle area of N.S.W. This area sustained annual losses of sheep varying on different properties from 6 to 17 per cent of the total. No medicinal prevention or treatment procedures are known.

In addition to the plants already mentioned, there are those which produce photosensitisation, nitrate poisoning, hydrocyanic acid poisoning due to the presence of cyanogenetic glucosides, alkaloid poisoning, especially in members of the Solanaceae and a large group of poison plants which cannot be classified into any particular category.

Prevention and treatment.

Control of many plant poisonings is not in the removal of the offending plants – often a temporary and costly expedient – but by changes in management and husbandry to accommodate the problem. This may involve grazing the plants at periods of low toxicity or regulation of the grazing intensity such that the plants form a relatively low proportion of the total herbage available.

Newly introduced animals are, in many cases, particularly susceptible to poisonous plants. The mitigation of the poison plants problem is a challenge for the agronomist.

*****

IMPACT OF WEEDS ON ANIMAL HUSBANDRY & PRODUCTION

Associate Professor I.L. Johnstone,
School of Wool and Pastoral Sciences,
The University of New South Wales.

A "weed" has been defined as a "useless" or "troublesome" plant and in this paper the "troublesome" rather than the "noxious" or "toxic" plants have been considered.

The impact of weeds on animal production may be described as direct when ingestion leads to interference with metabolism, tissue damage or death; the plant being referred to as poisonous or toxic. Here the concern is with the indirect effects on production where changes in management or husbandry are involved. In this case the economic importance of weeds is difficult to assess, the loss being more in the nature of an opportunity cost than a direct decrease in production.

Perhaps the most important aspect is one of fear and risk, arising from an inadequate knowledge of the behaviour of the plant and the inability to assess or predict a potential risk or danger. Areas of pasture are left unstocked, sheep are moved on to inferior feed, the class of stock is changed and alternative enterprises introduced resulting in sub-optimal use of grazing areas.

Some of the many ways in which weeds affect production indirectly are discussed and examples given.

Effect of Weeds on Land Use.

Land may not be used to the optimal economic advantage because of the presence of some weeds and alternate enterprises or activities may be introduced. A good example of this is the Swainsona or Darling Pea problem of the non-arable Liverpool Range area where mature wethers largely replace breeding flocks and graziers are often reluctant to use aerial topdressing measures for fear of encouraging this legume rather than destroying it by competition or providing adequate alternate grazing plants. Cattle may replace sheep on bracken fern areas (Pteridium aquilinum) after losses occur as they appear to be less vulnerable and exercise better control through trampling. Again cropping has replaced grazing to defeat the Bathurst Burr (Xanthium spinosum).

Plants such as Cape Weed (Cryptostemma calendulaceum) high in copper may force changes in enterprises and classes of stock and introduce the desirability of forage crops for alternate grazing.

Many plants reduce land use and serrated tussock (Nassella Trichotoma) on the Central and Southern Tablelands of N.S.W. is a particular case in point gaining dominance to the extent that production is greatly reduced or even abandoned and some "Tussock" areas are now being sown to Pines. Similarly, prickly pear (Opuntia spp) in some of the rougher country in the Mudgee - Wellington area can introduce an economic problem too great for the individual land holder. Ragwort (Senecio Jacobea) because it is toxic and Noogoora Burr (Xanthium chinense) or Bathurst Burr because they form such dense stands, often force high quality land into temporary disuse. Many of the oxalate containing plants come within this category.

Affect of Weeds on Animal Husbandry Systems

Rotational grazing systems which may be potentially more productive are avoided on burr country to reduce wool fault in better class fleeces, so that inferior classes of sheep are sometimes used on badly infested high quality land.

One of the most striking examples of an interaction between a husbandry system and a troublesome plant in recent years has been a very heavy mortality of wethers in an intensive rotation system on Phalaris tuberosa on the Northern Tablelands of N.S.W. Systems which rapidly reduce a plant to ground level, provide a high level of return in faeces and urine and then allow the plant to grow rapidly can upset the normal metabolic processes in the plant leading to the development of metabolites toxic to the animal.

Even set stocking at high grazing pressures has its problems in drier periods forcing sheep to eat undesirable but potentially dangerous plants such as Bracken or Darling Pea. Similarly, strange sheep and particularly young sheep in a new environment consume toxic plants forcing a grazier to adopt a breeding policy to provide his own replacements in an environment unsuited to breeding. Heliotrope is another plant which becomes more troublesome with high grazing pressures.

Plants responsible for tainting of milk may mean a change of husbandry on dairy farms forcing the withdrawal of cows from otherwise valuable feed and adding to hand feeding costs.

In many cases it has been necessary to develop completely new husbandry systems to offset losses occasioned by troublesome plants. For instance in Western Australia, lupins which have become an essential component in the development of low quality land have proved to be toxic and it is more important to develop systems of supplementary feeding and deferred grazing rather than to dispense with the lupins.

Impact of Troublesome Plants on Reproductive Performance

Perhaps the best example of this is barley grass (Hordeum leporinum). Seeds of this plant penetrate the fleece of spring lambs in countless thousands, severely reducing the viability and growth of the lamb and forcing changes from spring to autumn lambing with a considerable decrease in lambing percentages.

Information is increasing as to the level of oestrogenic substances in subterranean clover and other legumes and of their effects on rams and ewes at different times of the year. Mating and lambing dates are being changed to avoid the periods of greatest danger and in some cases breeding has been abandoned for wool growing wethers. Even this move is not entirely successful in the Esperance area of Western Australia where urinary calculi problems occur, and enlargement of the bulbo-urethral glands reduces the productive life of the animal from five or more to as little as three years.

The Impact of Weeds on Management and Labour Utilisation

Many examples can be listed of the opportunity cost of labour and management from weeds, and brief reference is made to some of these.

1. The shearing of sheep and particularly lambs before the grass seeds and burrs mature in

order to reduce the detrimental effects on the sheep and on the wool.

2. Tracks are frequently mown through Noogoora burr, Bathurst burr, and grass seed areas and thistles to give access to water and neglected areas of a paddock. Failure to do this can be disastrous and also means that equipment otherwise unnecessary must be purchased and maintained.

3. Crossbred sheep in particular often get caught up in Blackberry bushes when in full wool and feed is becoming scarce and more frequent inspections are necessary. A goat enterprise with its consequent problems may be desirable.

4. Many weeds, particularly bracken fern, blackberry and briar offer good harbour for rabbits which compete with stock for the better feed in the adjacent areas and mitigate against eradication, all leading to increased labour and management costs.

5. Early weaning of lambs so that they may be located on the cleanest paddocks to avoid grass seed problems that couldnot be avoided if ewes, and lambs were continued to be run together.

6. Plants causing photosensitization might be included in this category as often although not resulting in mortalities may lead to specialised treatments and "dark room" facilities to keep stock away from sunlight. Lantana, St. Johns Wort (Hypericum perforatum), summer grass (Panicum effusum) and even trefoil (Medicaco denticulata) come within this category.

The Fear and Risk Factor Associated with Weeds.

Not all the decreases in production from loss of use of pasture would occur if a greater knowledge of the weeds and of their danger is available. A recent example in the arid zone emphasises this. In the middle of the dry period in 1966, with lambing approaching, a storm passed over one section of a property and one of the first plants to germinate was an unidentified plant classified as a "caustic weed". This area was not used through fear of this plant, although it was the only area on the property with reasonable alternative feed.

Other examples of plants which are a constant source of worry to the grazier are many of the sorghum and millet species and even, rape, kale, Phalaris or perennial rye.

Troublesome Plants Associated with Trauma Causing Reduced Production.

Many species, although causing few deaths directly, damage the eye or mouth leading to reduced ability to seek and ingest food, or damage the skin leading to such acute discomfort as to remove the desire to graze. Undoubtedly, some of the same species lead to foot problems and lameness with consequent reduction in performance. Indirectly they may also precipitate diseases such as actinomycosis, actinobacillosis, contagious opthalmia, tetanus, and multiple absess formation. Arsenic poisoning following dipping is often directly attributable to heavy grass seed infestation. Some of the more dangerous plants in this regard are:-

Barley grass (Hordeum leporinum), Stipa and Aristida spp.

Weeds in Situations of Undernutrition or Starvation.

Losses in travelling stock consuming toxic plants when coming off trucks or stock trains are well known but perhaps the most spectacular example was when drought fed sheep, fed on sheep-nuts consumed the fruit of the Macrozamia palm with disastrous results.

A less immediate but more insidious problem has been the introduction of weeds into new areas with hay and fodder for drought feeding. Cape weed and Mexican Poppy (Argemone mexicana) have appeared in many new parts of New England as a direct result of the introduction of hay from Victoria and South Australia, in 1965.

General Discussion.

The list of plants which can be classified as "troublesome" is extensive and many more plants will continue to be added to the list. Each in its own way is causing damage or loss of production and although it is not possible to estimate what Australia is losing financially, it is without doubt a large and significant amount.

Weed control by chemical means is advancing rapidly but we may still need to learn to live with some of our weeds. New Management and husbandry systems may be required and perhaps the most neglected area of research is in this field. New approaches to this problem are being continuously suggested but few have been adequately tested, modified and established.

* * * * *

THE WEED CONTROL PROBLEM WITHIN THE DEPARTMENT OF RAILWAYS, NEW SOUTH WALES.

M.D. Mahoney,
Inspecting Engineer,
Department of Railways.

INTRODUCTION:

Weed control by the Department of Railways has passed through a transition, and is now approached and dealt with in a scientific and economic manner. Weeds constitute a problem to railway administrations throughout the world, and in New South Wales this problem has existed since the first lines were opened 110 years ago.

At first the control task was small but as the railway lines spread out in the development of the State, the task grew and was multiplied by the ever increasing variety of weeds. In the early decades it was the hand and hoe which gave control. Then simple chemical sprays took over, until to-day the problem is countered with a wide range of modern herbicides and equipment.

This paper is intended to describe how weeds affect the operations of the Department of Railways, New South Wales, to explain why and how systematic control is practiced, and to summarise the economic effect.

DESCRIPTION OF THE RAILWAY SYSTEM:

The New South Wales Railways total 6,054 route miles which reach into almost every portion of this State. It traverses the North Coast with its high rainfall and prolific weed growth, the South West wheat growing area with its good winter rainfall and the North West with its heavy summer falls to aid growth. Even on the Western plains with low unreliable rainfall, nature can demonstrate the recovery and adaptability of plants.

The railway track itself is built on ballast to give it support and stability. This ballast is packed under and around the sleepers and is of three types. On the main lines metal is used as ballast, and ranges in depth from 10" to 24". On the less important country lines, the ballast is of earth or ash with a depth of 10". This track, with ballast, is built on the formation which has a width varying from 20 to 28-ft., and the whole is located on a strip of land called the "right of way" usually about 2 chains wide, and owned by the Railway Department. This right of way is maintained free of tree and scrub growth.

Railway station yards occupy a considerable number of acres and are maintained similarly to the right of way.

REASONS INFLUENCING WEED CONTROL:

The functions of the Department may be grouped into –

a) The transport of people and goods in a safe and reliable manner,

and

b) The maintenance of the equipment, tracks and facilities by railway personnel.

Both functions demand weed control.

TRANSPORTATION:

A weed growth of sufficient height to cover the rails will considerably reduce the adhesion of locomotive wheels. This will cause slipping and bring a train to a standstill. Dry growth around bridges may be ignited by various means and this can cause timber bridges, which exist on country lines, to catch fire with risk of accidents to trains. Similarly, dry growth can disrupt signal and communication channels. At level crossings, scrub and tall grasses growing out of control can reduce or impair visibility with resultant risk of accident.

MAINTENANCE:

On railway tracks, adequate and reliable inspection is more difficult where weeds are prolific. The human side must be listed here, as personnel will not work efficiently among weed growth. Weeds increase the various tasks on railway maintenance by preventing effective drainage, impairing the condition of ballast, and decreasing the life of materials because of poor drainage. This causes premature renewals, and in turn an increased staff required for the maintenance work.

There are two other reasons influencing weed control. The improved appearance of the right of way lifts the Department's image and increases morale and employee safety. The Railway Commissioner has moral and legal obligations to eradicate noxious weeds, and to remove fire hazards caused by dry vegetation. A firebreak must be provided inside the boundary of railway land and this involves the removal of vegetation. This will be detailed in a later section of this paper.

ORIGIN OF WEEDS ON RAILWAY LAND:

Weeds come from various sources and because of the network, the Railway Department encounters practically every known weed in New South Wales. Last century, little consideration was given by the various authorities to the potential dangers of undesirable weed species, and the Department has at times been blamed for transporting noxious weeds. This blame cannot be fixed fairly on the Department.

Sources of weeds occurring on Railway land are listed as follows:-

NATURAL.

Those that have always existed in a particular part of the State such as natural grasses. These do not present any major problem and can be readily controlled.

IMPORTED.

This is by far the most troublesome group and includes the skeleton weed, St. John's wort, Paterson's curse, blackberry, lantana, thistles of all types, sorrel, khaki-weed and many others. This group often requires selective treatment at different times of the year and those growing in mountainous country are difficult to treat. Paterson's curse will flourish in the high cooler climates, but has also adapted itself to the drier western areas. The blackberry and lantana are troublesome because of size and rapidity with which they spread. In coastal areas, paspalum and summer grass has become firmly established because of their resistance to most of the common herbicides. It has been found that these two species, together with couch have increased when the more easily eradicated species are gone. St. John's wort exists on the tablelands and like blackberries, presents difficulties for access by spraying.

SEASONAL.

In this group are the perennials such as wheat, barley, oats, linseed, which fall or are brought on to railway land. They are susceptible to the common types of herbicides. The main lines running to Sydney are ready germinating beds for these seeds falling from trains.

The transportation of seeds on to Railway land is by floods, wind, animals, stock coming into railway yards, stock moving through on trains, from bulk loading on trains, from bags and other containers picked up at farm sheds, and from motor tyres. All these factors have brought and are continually bringing fresh seeds for germination.

LOCATION OF WEEDS ON RAILWAY LAND:

Weeds grow on the track itself, that is in the track ballast, on the track formation, on the right of way and in railway yards. The method of treating them depends on this location.

POLICY ON WEED CONTROL:

Using the definition of a weed as - "a plant growing out of place" [1] not all growth is necessarily removed. On the tracks and formation width a complete programme to control weeds is planned.

Noxious species are controlled as far as possible and a general control is maintained on the right of way on other species. A cover of vegetation is essential to prevent erosion within the right of way, and at many locations special grasses have been planted for just this purpose. A neat, controlled cover of vegetation reduces dust, glare, and is necessary for aesthetic purposes.

ORGANISATION TO CONTROL WEEDS:

The Way and Works Branch of the Department controls weeds in the course of its normal function of track maintenance. The Branch is under the control of the Chief Civil Engineer, to whom are responsible the Engineers in charge of various divisions of the State. Each division carries out its own weed control, and is equipped with a rail tanker of 6,000 gallon capacity. Other equipment includes portable spraying machines for spot treatment, and pumps fitted to power take-off units on tractors for heavy spraying on the right of way.

The herbicides used are selected from those supplied by contract to the Department. These cover the full range required to control all weeds in New South Wales. They include those which will give a quick knock-down of weeds, those which are selective and only control certain species of weeds and those where a residual effect is desired to build up in the soil.

Tests have been carried out by the Department in conjunction with various firms which supply herbicides and these tests will be continued. They are carried out to test any new herbicide on the market and also to select those herbicides which will be most effective and economical in controlling the various species of weeds in the varying climatic conditions in the State.

1 – "Weeds" K. R. Green, Dept. of Agriculture.

Weed control is seasonal and the tracks are sprayed twice a year to combat autumn and spring germination. Two applications per annum over a number of years raise the question of soil sterility. Tests indicate that this is a remote possibility at the present economical rates of application. Perhaps in the lower rainfall areas partial soil sterility may eventually emerge.

FIELD METHODS:

The methods adopted for the application of herbicides, depend on the location of the weeds on the right of way, the variety, and the type of herbicide to be used. The more common methods are outlined.

Tanker.

Ideal for use on running lines. It is made up and runs as a train, at speeds of 15 or 20 m.p.h. and worked by one operator. The capacity is 6,000 gallons and with low volume herbicides has a track range of up to 60 miles. It is fitted with a 3 h.p. motor which can supply a herbicide mixture through spray bars on to the track at a rate of 80 gallons per minute. A variety of herbicides are used. It is the most efficient method of weed control on the tracks. The minimum width sprayed by the tanker is now 16-ft. but this is being extended to spray to a width of up to 28-ft.

Tractors with Pumps.

These are used to control and eradicate weeds on the right of way not accessible to the tanker. It is operated by one man and has a carrier holding 4/44-gallon drums of solution. This unit is used in station yards, around bridges and buildings, and in particular the Metropolitan Area for spraying around signal and communication channels.

Manual.

Granular chemicals are applied manually. The method is costly, but effective in confined conditions.

Scrub.

In some mountainous and sub-tropical locations, scrub regrowth is either hand cut or chemically treated to retard further growth. Either method is expensive. These problems exist on the Unanderra to Robertson Line particularly and control measures are necessary to maintain telephone lines and access. Effective application of herbicides made by helicopter, using stationary flat rail cars as a base is also being investigated.

FIRE PREVENTION:

A major problem associated with the prevalence weeds in their dry state, is the fire risk. This risk must be eliminated, reduced, or controlled and involves the Department in heavy expenditure. The problem can be linked to weeds in two ways. Firstly, the growth on the right of way has to be removed, generally by burning, and secondly, to do this a firebreak has to be constructed and maintained. This is an annual task, and is handled mechanically by graders, dozers or tractors, or chemically by herbicides. Approximately 10,000 miles of firebreaks are constructed each year. Experiments are being conducted using herbicides for a comparative cost basis against mechanical methods.

The "burning off" of dry weed growth on the right of way is carried out each year on up to 5,000 miles of Railway land, each side of the track, or a total of 10,000 miles.

This burning off involves considerable risk to surrounding grazing land and crops, and experiments are being conducted in the use of dessicants to dry off the growth sufficiently to burn within the confines of Railway land while the adjoining growth is still too green to burn.

It is difficult to give an accurate cost of "weeds and weed control" within the Department, but they are considerable.

However, an adequate weed control programme is essential to maintain operational efficiency. Because of the extent and diversity of climatic regions, and also the Department's moral and legal obligation to control some species of weeds, the problem of control is a large and growing one. However, it must be faced for as soon as one growth is controlled, re-infestation occurs making the process continuous.

******

COST OF WEEDS ON ROADS AND INDUSTRIAL SITUATIONS

B. L. Winter
Manager, Contracts Department, Agserv. Division,
Geigy Australia Pty. Ltd.,
Pendle Hill.

Introduction:

Unwanted vegetation is very costly. No accurate statistics are available on the direct and indirect costs.

Uncontrolled growth on roadsides is one proven cause of road tragedies and the cost cannot be measured in dollars and cents.

Estimates of costs from fires spreading from roadside weeds and grasses do not take into consideration all aspects such as destroyed pasture, effect on desirable species, resowing and loss of income to farmers.

Some industries accept weed growth as inevitable without realising costs of lost tools, effect on timber and metal, staff morale and customer opinions. Medical costs can be reduced if allergic growth is not present.

Too often the cost of controlling unwanted weeds and grasses is considered without comparing the loss when they are uncontrolled. Temporary mechanical removal is accepted as good enough and benefits and profit from modern herbicides are not always appreciated or even understood.

Frequently control measures are too little and too late. Neglect, and apathy, by responsible authorities should be culpable negligence when road safety is allowed to deteriorate and lives endangered.

Weeds are costly, dangerous and a nuisance –

Tall, rank vegetation on roadsides and industrial land is unnecessary and undesirable from any point of view.

Weeds mar the beauty of the countryside; reduce the value of properties; impair operating efficiency; become a serious safety hazard.

Uncontrolled growth is costly - in lives, goodwill and dollars and cents.

Weeds, grasses and scrub obstruct visibility for public and traffic, road maintenance personnel, pedestrians, and travelling stock. They conceal signs, guide posts, bridge approaches, drains and numerous markers established for your safety. Weeds trap and hide rubbish and provide cover for snakes, rodents, vermin and insects.

Each year some of the nation's most serious fires, start in, and are spread by, weeds. A discarded cigarette or even a piece of broken glass in the sun's rays cause unwanted vegetation to burn like tinder in dry weather.

Is it not much cheaper to spray weeds than put out fires?

Preventing weed growth in the first place with suitable herbicides eliminates this threat and saves property, buildings, grazing and livestock. Not necessarily is bare soil wanted. Controlled turf species may be desirable while the benefits and savings from chemical mowing are sometimes rejected even by responsible engineers.

Many weeds, especially when wet, cause slippery conditions. On industrial land, store yards, roadside picnic areas, they act as a moisture trap and increase humidity which encourages rusting and decay of fences and buildings, and block drains, with unhealthy conditions. Weeds increase maintenance costs by causing deterioration of concrete and asphalt surfaces, and by preventing drainage, water seeps back and undermines the valuable sealing.

This growth causes other problems, perhaps less serious or less costly, but worthy of attention. Some weeds have offensive odours. Some produce pollen causing allergic reactions. Ragweed is a more serious cause of asthma than generally realised. Weeds are always unsightly, reduce enjoyment of country outings, affect staff morale, and cause valuable equipment to be depreciated in value.

Most serious of all is the cost in human lives. The continuing road toll, throughout Australia mounting to astronomical proportions, is the result of many factors. One of these, and by no means the least important, is the "narrowing" of roads by encroaching vegetation. The responsibility for obscured warning signs, lack of vision of approaching traffic, and resulting fatal accidents and bereavement must be accepted by the appropriate individual who fails to attend to this work.

Highways –

For good visibility and improved appearance, modern herbicides provide economical weed control around guard rails, keep road shoulders free of growth, signs clean and readable and fences and poles uncluttered and protected from creeping vegetation.

With suitable herbicides adjacent crops and ornamentals are safe from spray drift or volatile fumes and livestock may graze safely.

Chemical weed controlis not practiced adequately in Australia. There is still the tendency to use graders to reform road shoulders and mowers to remove some growth. Often guide posts and signs are left surrounded by growth the equipment cannot reach. Regrowth of perennials follows rapidly after cutting and the weed problem is then worse and more costly.

Sometimes herbicides are regarded as "costly" because their purchase price shows as an individual expense, whereas weed pruning following mechanical rebuilding of shoulders is not isolated. The cost of repair and maintenance of mechanical equipment is not charged against "weed control" any more than the capital expenditure on mowers and graders when laying idle for lengthy periods.

Substations, pole yards, power stations –

Usually a high standard of safety from fires and to personnel dictates an equally high standard of weed control. The cost should not be a serious consideration and preventive weed control is cents per square yard compared to tens of thousands of dollars for the station itself.

Lack of conductivity, no corrosive or fire dangerous materials must be used. Cheap weed-killers may possess these undesirable qualities.

Oil installations and timber yards –

A similar situation to the above utilities exist with many oil companies carrying their own fire insurance.

Pipes and other installations are easily inspected and maintained and leaks of inflammable liquids quickly seen. Improved air circulation about stacked timber means better and faster seasoning. Retained moisture encourages wood rotting and warping, harbours vermin and timber destroying insects and fungi. Customers are impressed by efficient appearance.

Fence lines –

Weeds and fences just don't go together. Control of weeds, by chemicals, along fence lines is a cheap insurance against deterioration from rust or fire which affects galvanising, and protects a capital asset amounting to hundreds of dollars per mile.

Hand trimming costs are avoided, repair work is unhindered and appearance greatly improved, whether it's around a store yard, along a road, about a power station or anywhere a fence is necessary.

Noxious weeds –

The benefits of spraying noxious weeds, and unwanted vegetation, at the correct time, has a national value. These problems occur not only on roadsides and industrial land, but in many situations on and off the farm.

Ditchbanks, drains and gutters harbour noxious or unwanted weeds and grasses. If controlled crop contamination is reduced, fire hazards removed, harbour for pests and rabbits destroyed, electric fences do not "short", fences and machinery preserved, moving and storing equipment facilitated, and farmer relations substantially improved.

Conclusion:

The cost of weeds on roadsides and industrial land cannot be accurately estimated. Certainly they cost Australia millions of dollars per year over 563,565 miles of roads. An estimated $17,000,000 p.a. is spent on "maintenance of roads and bridges". This is approximately $30 per mile per year. With road improvement programs, necessity to seal surfaces, repair bridges, widen highways and improve traffic flow generally, pitifully little is available for roadside weed control. Yet the cost from weeds goes on year after year. Weed patches doubling their radius each year means the actual infestation is quadrupled, and therefore it is four times easier and more economical if the problem is tackled now rather than next year.

Modern herbicides reduce this tax significantly and protect our heritage.

*****

WEEDS IN PARKS AND GARDENS

R. W. Boden,
Research Arboriculturist, Parks and Gardens Section,
Department of the Interior,
Canberra, A.C.T.

For the purpose of this discussion the term parks and gardens covers sports grounds, golf fairways and greens, bowling greens, and domestic and public gardens. Ornamental lakes and ponds have also been included.

In many of the fields covered at this conference, it has been possible to measure, in precise terms, the losss in productivity attributable directly to weeds; by contrast it is virtually impossible to do this for parks and gardens. The main reason being the difficulty of valuing parks and gardens, trees, lawns and flowers, in domestic and public life. Parks and managed open space, particularly in large cities, are invaluable and must be considered in the same light as public libraries, art galleries and historic monuments, whose value lies in meeting the leisure needs of urbanised society.

Just as it is impossible to value parks and gardens, it is difficult to place a cost on weed control in these areas. It is certainly not adequate to take a figure from the budgets of each council, shire, bowling club etc. and debit this to weed control because clearly, the degree of control is not a reliable measure of the extent of the problem.

Therefore, unlike some of the other papers presented at this conference this one will not attempt to estimate the economic loss due directly to weeds in parks and gardens.

In many cases, weeds in parks and gardens are an aesthetic rather than an economic problem. One exception is weeds in nurseries which may be a costly problem for the nurseryman, another is aquatic weeds which may develop to a major extent in ornamental ponds and lakes, and present a hazard to swimmers, boaters and picnickers. Although rare, there are recorded cases of drownings resulting from entaglement in water weeds. Fortunately these are rare, and the major adverse effect of aquatic plants is in damage to fishing lines, providing breeding ares for mosquitoes, and reducing the effectiveness of lakes for boating, sailing and water ski-ing.

Perhaps the best way of examining the role of weeds in parks and gardens is to discuss the various situations where weeds occur, the type of weed problem and the current methods of control.

WEEDS OF TURF:

Weeds may be a major problem in bowling greens, golf greens, cricket pitches and lawn tennis courts where a fine, even well mown turf is essential for true play. Weeds not only spoil the appearance, but also the quality of the turf from the player's point of view.

They may also be a problem in the home garden by spoiling the effect of the lawn as a feature in the landscape, and restricting the use of the area by children where weeds such as Bindii (Soliva pterosperma) are present.

Weeds in these areas are of two major types:-

(a) unwanted grasses and (b) broad leaved plants.

The former are by far the most difficult to control without damaging the existing turf e.g. paspalum in kentucky blue grass, couch grass in bent and fine lawns.

The latter, on the other hand, may be relatively easy to control using selective weedicides which kill broad leaved weeds but do not harm the turf, if used at the right dosage rates at the correct growth stage of weed and grass. The development, and use, of hormone weedicides has been of considerable benefit to the greenkeeper in meeting the problem of maintaining weed free turf, however despite the use of hormone weedicides there are some 'problem' weeds which cannot readily be controlled, and require particular study. Although of great value, weedicides should not be adopted as an alternative for good management practice. Generally speaking, healthy vigorous well maintained turf offers little opportunity for weed invasion and establishment, and good management techniques are in themselves an effective aid to weed control.

There are more than 700 bowling clubs in N.S.W. with a total of at least 1400 greens, and more than 300 golf clubs with an average area of 80 acres, 90% of which receives some form of weed control. Together with ovals and sportfields this therefore represents a sizeable area of highly maintained turf.

Apart from turf requiring a high level of intensive maintenance there are large areas throughout each of more than 200 municipalities and shires of N.S.W. which are covered in various forms of lawn requiring mowing and some degree of weed control. These include sportsgrounds, parks, recreational areas, laneways and street verges.

The level, or intensity, of maintenance of these areas varies considerably from place to place depending upon the use of the area, finance available, and interest of the local authority. In many cases, weed control consists merely of infrequent mowing whilst in others, either total or selective chemical control, is practised.

Selective weedicides have been discussed above, in relation to sports areas, however these chemicals are more difficult to use in public places and home gardens because of the potential drift problem on to trees, flowers and shrub beds both privately and publicly owned. The greenkeeper is dealing with a contained, regular and even area and is able to determine the dosage with considerable accuracy, however it becomes more difficult to do this in park areas of varying size, and with a wide variety of obstructions.

WEEDS OF OPEN AREAS AND BUILDING SURROUNDS:

This aspect has been discussed by previous speakers in relation to roadways, railways, electrical undertakings etc. but it must also be mentioned in the context of parks and gardens.

There are many areas within city and municipal parks where weeds can be a fire hazard, may harbour pests, including spiders, snakes etc., be unsightly and create a nuisance to pedestrians e.g. paspalum seed heads. Total vegetation control, which is best achieved by using herbicides, is desirable in many of these situations. Areas in parkland where total vegetation control is desirable, include immediate surrounds to park fixtures such as seats, toilets, dressing sheds, drinking fountains, fences etc.

In some cases, it is desirable to retard growth rather than eliminate it leaving a bare surface, which may be subject to erosion. Growth can be retarded either by mechanical means such as mowing or, in some cases, by the use of chemicals. Generally speaking, growth retardants have been used largely in horticultural glasshouse crops such as chrysanthemums and azaleas, and to a lesser extent on hedges and trees to reduce pruning frequency.

There is scope for the use of retardants to control weed growth on steep banks and roadverges etc. where mowing is difficult, and complete removal of vegetation will result in erosion.

The limiting factor to the use of growth retardants at this stage is the relatively high cost of chemical, although this might be expected to improve in the future.

WEEDS OF NURSERIES AND FLORAL BEDS:

One of the most vulnerable stages in the life of all plants is the germination phase. Weeds do not differ from other plants in this respect and the pre, or immediately post-emergent period is a suitable time to achieve control. There is a wide range of herbicides which are effective on the young germinating seedling, and may be used to considerable advantage for weed control amongst ornamental plants in nurseries, field plantings and floral beds.

In nurseries, weeds are a major problem as they restrict growth of desirable plants, by competing for water and nutrients, harbour insect pests and restrict access to the plants for budding and pruning operations. By the use of pre-emergent weedicides, such as simazine, it is possible to control most germinating weed seedlings without damaging the nursery plants.

Weeds are a major problem at the base of street and park trees because they are untidy, tend to gather rubbish and compete for water and nutrients. Where mechanical control of these weeds is practised, either by hoeing or mowing, there is considerable risk of damage to the lower stems of the plants; damage which may lead to fungal and insect problems.

In the Parks & Gardens Section, Canberra, simazine has been used widely to control germinating weeds around young, newly-planted trees. The cost of treatment of an area of approximately 2 square yards around each tree is in the order of 8-10 cents, which is more than covered by the saving in hand weeding, with possible damage to the plants, during the following season.

The third main sphere for pre-emergent weed control in parks and gardens is in shrub and annual flower beds. Floral displays are prominent features in most urban parks and, whilst they are attractive, they are also costly to establish and maintain. One of the main costs is in weed control, which must usually be carried out by hand. As annual flowers are planted as small seedlings they are often sensitive to some of the more common pre-emergent herbicides, however, new chemicals appearing on the market may overcome this problem. Pre-emergent weedicides are particularly useful in bulb beds and rose beds both in public parks and private gardens, and their use can result in considerable economies in manpower.

AQUATIC WEEDS:

As mentioned above, aquatic weeds are a serious problem in lakes and ornamental ponds.

A later paper in this conference will undoubtedly reveal the importance of aquatic weeds, and the cost of their control, in irrigation systems.

In addition to irrigation schemes there are large areas of inland water being developed for recreational purposes such as fishing, swimming and boating. In many cases, these water features are relatively shallow and provide ideal conditions for rapid and extensive growth of aquatic plants. Where this growth goes unchecked it can colonise vast areas rendering the aquatic feature unusable. Control of weeds is therefore essential for the continued use of these areas. Methods used include mechanical and chemical, both of which have disadvantages as far as cost and repetitive nature of the treatment are concerned. The long term aim should be a biological means of control, possibly using herbivorous fish, however, to date there has been no Australian research work in this interesting and potentially rewarding field.

SUMMARY:

Weeds in parks and gardens can be broadly grouped by the situations in which they occur:

Weeds of lawn and turf

Weeds of open areas and building surrounds

Weeds of nurseries, shrubberies and flower beds

Weeds in aquatic features.

All are important in the effect they have on the attractiveness and usefulness of park areas, and their control represents an important part of the park manager's programme. In many cases, improved management techniques are the most effective means of reducing the impact of weeds on parks and gardens, whilst at the same time giving more attractive and useful areas for enjoyment by the people.

In most cases the park superintendent has the horticultural expertise to initiate improved management methods, but is hampered by the restricted funds resulting, to a large degree, from the lack of public awareness of the value of parks and gardens in the life of the community.

*****

"EFFECTS OF AQUATIC WEEDS ON THE COMMUNITY"

W. P. Dunk
Chief Irrigation Officer,
State Rivers and Water Supply Commission,
Victoria.

Like most other weeds, water weeds can be useful on occasions. But generally they cause a great deal of trouble and expense - particularly to irrigation, water supply and draingage authorities to local councils and farmers.

Wherever there is clear, still, shallow water to a depth of less than about 15 feet, water weeds can be expected to grow sooner or later. This growth may then interfere with the distribution of water through irrigation systems, with the drainage of land, with the use of water for domestic stock or irrigation purposes, and with navigation, commercial fishing and recreation on dams, lakes and rivers.

THE PROBLEM

Water weeds thrive under the hot, moist and silty conditions which are commonly found in many of our natural rivers, lakes and reservoirs. The main water weeds which grow in Australia are listed below.

I. Emergent

1.	Typha angustifolia	....	Bulrush or cumbungi
2.	Paspalum distichum	....	Water couch grass
3.	Phragmites communis	....	Cane grass or common reed
4.	Eichornia crassipes	....	Water hyacinth

II. Submersed

1.	Potamogeton spp.	....	Pondweeds
2.	Myriophyllum spp.	....	Milfoils, cattail
3.	Vallisneria spiralis	....	Ribbonweed
4.	Elodea canadensis	....	Canadian water weed
5.	Algae spp.	....	Blanket weed

Although the emergent weeds are the more obvious of the two groups to the casual observer, the submersed weeds are just as important and are widely distributed in lakes, reservoirs and irrigation systems.

In addition to these there is a third, less important group of channel bank weeds such as Paspalum dilatatum (Paspalum). These are land plants growing in an aquatic situation and will not be dealt with here.

Aquatic weeds make their greatest impact on the community when growing in irrigation and drainage systems. Unless this growth is removed the capacity of flow of the channel is greatly reduced, often to less than half. This results in less water for irrigators and in flooding of drainage systems. In addition weedy channels silt up more quickly and waste more water than clean channels.

CONTROL

In general terms the control of water weeds presents an unusually costly and difficult problem, there are four reasons for this:-

1. Water weeds are protected to some extent from herbicides or mechanical equipment by the water medium which surrounds them.
2. Access is often a problem.
3. Water weeds spread very rapidly indeed, and regular and systematic control measures are necessary. For example, with water hyacinth one plant can cover 700 square yards in one year and ten plants can multiply to 65,000 in 8 months by vegetative reproduction. Cumbungi (Typha angustifolia) also spreads rapidly by vegetative reproduction and its seeds prolifically as well. Some 700,000 seeds, 95% of them viable, may occur in a single head. Submersed weeds too, with the exception of ribbonweed, also spread extremely quickly, any small piece being likely to start a new infestation when it lodges in silt.
4. Pollution of water must be taken into account, from the point of view of the eventual use of the water whether, for domestic and stock purposes, for irrigation of crops, for recreation or for fish. This is particularly important and in Victoria most of our research now is to establish the safety of spray treatments rather than to establish their effectiveness.

Despite these difficulties the stage has now been reached where effective and cheap chemical controls have been worked out for all the main weeds in irrigation systems and these are being used on a large scale. A brief summary of the treatments in use in Victoria is given in Table I.

TABLE I

CHEMICAL TREATMENTS FOR WATER WEEDS USED IN VICTORIA.

WEED	CHEMICAL *	ACTIVE INGREDIENT PER ACRE**	APPLICATIONS
	I. EMERGENT WEEDS		
Typha angustifolia	(a) 2,2,DPA	50lbs/acre	January - March
	(b) amino triazole + amonium thiocyanate	10lbs of each chemical	
	(c) 2,4-D Butoxy ethanol ester	12lbs/acre acid equivalent	October-December
	(d) TCA + 2,2DPA	100lbs TCA & 35lbs. 2,2,DPA	Soil treatment, apply when dry.
Paspalum distichum	(a) amino triazole + amonium thiocyanate	10lbs of each chemical	Spray twice in same season at 6 week intervals. First treatment Dec.-Jan.
	(b) diruon	10lbs/acre	Not effective unless mineral soil exposed. Double spray concentration may be needed for first treatment of an old drain.

Table I Cont'd.

Phragmites communis	(a) 2,2,DPA (b) TCA & 2,2,DPA	50lbs/acre 100lbs TCA & 35 lbs. 2,2,DPA	January - March Soil treatment, apply when dry.
	II. SUBMERSED WEEDS		
	(a) acrolein	1½ gallons per cusec of flow applied over 5 hours.	Used in flowing water. Can be applied in still water, but relatively expensive. Treatment requires special equipment and training.
Potamogetan, spp Vallisneria, spp Myriophyllum, spp Elodea spp.	(b) 2,4-D Butoxy ethenol ester + microtomic sulphur	6-12lbs.2,4-D acid equivalent per acre and 10 lbs. of microtomic sulphur.	Used where flow can be completely stopped and level reduced to less than 6". Treat before the weeds dry out or become frost affected.
	(c) TCA & wetting agent	80lbs/acre	Use where soil is exposed.
Algae	Copper sulphate	Rate of application varies with the species; 4lbs /per million gallons is normal.	

* Wetting agent is added to all emergent weed sprays.

** High spray volumes are necessary, 450 gallons of water per acre are used for all emergent weeds and 300 gallons per acre for submersed weeds.

Although these treatments have proved most satisfactory and effective, in irrigation systems there remains an urgent need for an economical and safe method of controlling submersed weeds in lakes and farm dams. At present these situations can only be handled by draining the lake before applying the chemicals and this is usually not practicable. Alternatively acrolein can be used, which is an expensive treatment costing at least $40 an acre a year for a lake about 4ft. deep, moreover aqualin is not a practicable treatment for farmers to use and it is toxic to fish. Other chemicals such as caseron and fenuron may have their uses, but here again the costs are very high indeed for large scale application.

There is clearly a need for a new chemical or a new method of formulating and applying existing chemicals to handle submersed weeds in lakes and farm dams. Here it is worth noting that most submersed weeds are very susceptible to 2,4-D if the chemical is injected into the plant. The problem is to get 2,4-D into the plant system.

THE WATER WEED BILL

It is not an easy matter to count the cost of water weeds to the State and Nation.

In Victoria the extent of the water weed problem and the cost of dealing with it is indicated by the fact that we have 5,000 miles of irrigation channels, 3,000 miles of drainage channels and 8,000 miles of domestic and stock channels administered by the State Rivers and Water Supply Commission. To this must be added private channels, farm dams and water supply and drainage systems administered by local councils and trusts. As well as this there are lakes, rivers and reservoirs where both water supply and recreational activities can be severely upset by water weed growth. The problem therefore is one of very substantial magnitude.

The Water Commission alone in Victoria spends about $400,000 on water weed control every year, over half of which is for chemical control methods. One can only say that water weeds are a very costly pest and that the cost of controlling them throughout Australia amounts to millions of dollars. If on the other hand no measures at all were taken to control them, production of our irrigation areas could be expected to drop to half and the production of these areas would drop by hundreds of millions of dollars.

CONCLUSION

The use of chemicals for controlling water weeds is now a well established practice in Southern Australia. This practice has made a substantial contribution towards the profitability of our irrigation areas.

Satisfactory control measures exist for all the main weeds except for submersed weeds growing in still water. Existing chemicals are not effective here primarily because they have been screened, developed and formulated for use against land weeds. It is scarcely surprising therefore that these chemicals are not effective when used in an aquatic medium. There is clearly a need for a new chemical or biological control measure to fill this gap, one which will enable submersed weeds to be controlled economically and with safety in lakes, large reservoirs and farm dams.

*****

NOXIOUS WEEDS AND THEIR REGULATIONS

Councillor H. R. Carter,
Member, Noxious Plants Advisory Committee and Chairman,
Central Northern (Weeds) County Council.

The expression that noxious weeds respect no boundaries applies not only to territorial limits but similarly to financial losses from a national view point when co-related to the considerable expenditure involved in the importation of chemicals from overseas sources.

Our theme "The impact of weeds on the Australian Community" brings into focus the effect of weeds on the rural community where the impact is felt primarily by pastoral and agricultural sections. Here each landholder pays the cost of weed treatment on private land in addition to contributing towards control campaigns on public property by way of Local Government and Pastures Protection Board rates.

I make these comments knowing full well that there is an ever-growing appreciation of the need for effective noxious weed eradication and control particularly in view of the increasing overhead costs associated with land ownership and the need for improved returns. It is unfortunate that this appreciation has only become evident in this State during the past decade and as a result, costs in obtaining satisfactory measures of control are now considerably in excess of expenditure which should have been incurred before the weed problem reached significant proportions. At the same time, due credit must be given to improved methods of control as a result largely, of intensive research work.

It is easy to be wise after the event and although we now see the effects of the lack of early awareness of the tragic development of noxious weeds, we cannot really blame the absence of quarantine regulations.

The spread of noxious weeds particularly in Australia is encouraged by the apparent suitability of climatic and relative broad-acre farming prinicples which produce two effects - one a lack of conscientious farm husbandry and secondly a lack of appreciation of the fortunes of land holding in this continent.

HISTORICAL REVIEW

At this stage it may be of interest to mention that control of noxious plants has always been a Local Government function and Municipal and Shire Councils since 1906 have been entrusted with power to enforce control measures. Here I quote a circular letter from the Department of Public Works to Local Government Authorities dated 22nd July, 1907:

"Circular No. 85.

Sir,

re Noxious Weeds

> I have the honor, by direction, to inform you that, as many of the plants which will probably be declared 'noxious' by the Councils, are known by different common names, the question as to the necessity of declaring the botanical names has been under consideration.
>
> It is pointed out that the adoption of such a course will avoid confusion, will better preserve the identity of the plants, and will not leave an opening in that direction for prosecutions by the Local Authorities to be rendered abortive.

In this connection, attention is invited to the following copy of a letter received from the Director of Botanical designations of Bathurst Burr, Scotch Thistle, Cape Dandelion and Wild Verbena:

(a) Bathurst Burr; Xanthium spinosum

(b) Scotch Thistle; by this the Black Thistle (Carduus lanceolatus, figured in the Agricultural Gazette for April, 1895, is usually meant. If the large cottony thistle (the Scotch Heraldic thistle), then Onopordon Acanthium.

(c) Cape Dandelion (usually called Cape-weed); Cryptostemma calendulacea.

(d) Wild verbena; there are two species; Verbena bonariensis and V. venosa figured in the Agricultural Gazette for August, 1906 and July, 1905, respectively. It is always safer to insist on Shire Councils, who desire certain weeds declared noxious, sending specimens for determination. Some weeds have a dozen vernacular names and some vernacular names may be fitted on to half a dozen botanical names.

I have, therefore, to request that, before applying for approval to any plant being declared 'noxious', the Council will, in the first instance, forward a specimen of same direct to the Director of Botanic Gardens for the botanical name. On receipt of the reply the Council will be in a position to furnish this Department with the correct name of the plant which they desire to be declared noxious.

I have the honor to be,
Sir,
Your obedient Servant,
W. J. HANNA,
Under Secretary."

Local Government bears the greatest proportion of responsibility for noxious plant control and it is my firm conviction that Councils, either Shire or County, are fully capable of carrying out the work entrusted to them.

PLANTS DECLARED NOXIOUS

A noxious plant is a weed which has been declared noxious by proclamation. It may be noxious State-wide or in a specified area.

The plants declared noxious in all Shires and Municipalities in the State are: galvanised burr, Indian hemp, coca leaf, opium poppy, Noogoora burr and Bathurst burr. Two aquatic plants, water hyacinth and thread of life are prescribed as aquatic pests and noxious plants for the State.

Also the following are declared noxious in all areas in the eastern and central division:- skeleton weed, Canada thistle, bindweed, 1 leaved cape tulip, St. John's wort, hoary cress, blackberry, mint weed and ragwort. Other important noxious plants declared in many areas include: serrated tussock, Crofton weed, mist flower, groundsel bush, African boxthorn, spiny burr grass, sweet briar.

Of the declared noxious plants, those underlined cause the greatest loss to primary production.

CONTROL

The three recognised methods of weed control are mechanical, chemical and cultural. Where weeds have taken possession and it is not possible to deal with infestations by mechanical means, landowners look to the use of chemicals as a means of destruction but the question of cost must be considered and although chemicals can be effective, the cost is often prohibitive where the land is badly infested. In an endeavour to obtain some financial return and at the same time institute control measures, cultural (pasture) control can be effectively employed. Due to climatic and soil conditions varying over the State this method is not generally applicable.

STATE AUTHORITY

Realising the need for co-ordinated approach to the weed problem the State Government in 1965 set up the Noxious Plants Advisory Committee consisting of the following members:- An officer of the Department of Agriculture (Chairman), an officer of the Department of Local Government, an officer of the Department of Lands and two representatives of the Shires Association including one representative member of a "Weeds" County Council.

The Committee was constituted to furnish reports and recommendations to the Government on any matter relating to noxious plants generally, to review noxious plants policy regularly, to make recommendations accordingly, to recommend to the Government annually the principles on which the $400,000 State Vote (1966/67) is made by grants to Councils, to recommend any amendment of the law relating to the control of noxious plants, to carry out advisory and educational functions, to provide an avenue for Local Government and Primary Producers to contribute to noxious plants policy and its implementation and to co-ordinate the activities of an improved liaison between landholders, Councils and Government.

LOSSES CAUSED

Noxious weeds generally cause losses in many ways by:-

1) reducing land values;
2) competing seriously with crops for available plant food, moisture and light;
3) increasing the cost of production by necessitating extra work and cultivation;
4) lowering the quality of agricultural produce and increase costs of preparing the products for market;
5) harbouring insect pests and fungus diseases of economic crops;
6) possessing poisonous properties in some cases;
7) obstructing waterways and irrigation channels.

One example of losses caused by weeds is evident when it is realised that Noogoora Burr was first recognised in Queensland in the early 1860's and it is now estimated that between 15% and 25% of the weight of all greasy wool delivered, is Noogoora Burr. Fleece values are estimated as depreciating 10 to 14 cents per lb. In addition other costs for which no reliable figures are available include losses from stock eating poisonous seedling plants, freight on unwanted burr and damage to wool fibres during processing. *

The repercussions from losses due to the spread of Skeleton Weed in the North Western

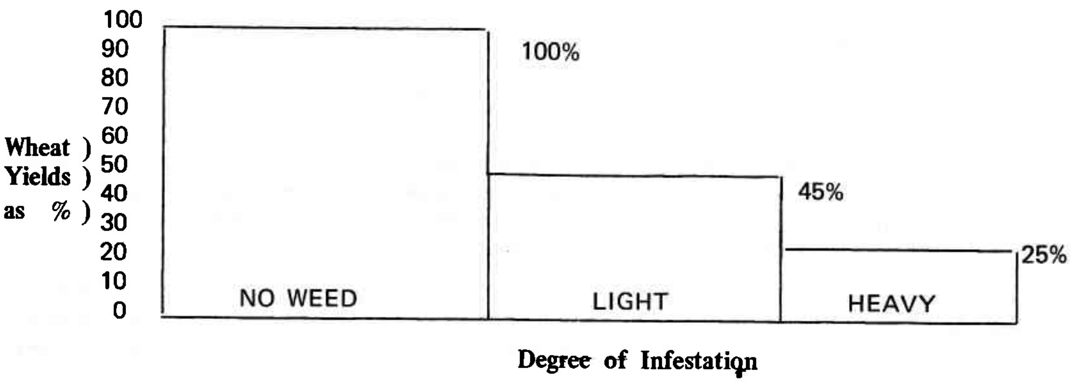
* Authority: K. S. T. Larwood, Department of Agriculture, South Australia.

area of the State are extremely alarming. This is not surprising when it is realised that the North West has developed into one of Australia's greatest wheat producing areas and that Skeleton Weed is capable of entirely directing the farming practices and products of this area resulting in serious fluctuations in production levels and returns.

Unfortunately, three years of research costing $321,400 has failed to find any means of economically eradicating large infestations of Skeleton Weed according to W.A. Department of Agriculture weeds research Officer, Mr. G. A. Pearce, who reported this after a recent meeting of the technical sub-committee on Skeleton Weed research in Australia.

The severity of losses caused by Skeleton Weed in wheat can be seen from the following statistical table:-

EFFECT OF SKELETON WEED ON WHEAT



STATISTICAL TABLE

Degree of Weed		Skeleton Weed Plants/Sq. Yd.	Wheat Plants/Sq. Yd.	Wheat Tillers/Plant	Wheat Tillers/Sq. Yd.
1.	Nil	—	49.5	6	297.0
2.	Light	9	45.0	3	135.0
3.	Heavy	67.5	38.3	2	76.6

ACTS AND REGULATIONS

A review of legislation in New South Wales will show that probably the most important enactment relating to weeds is the Local Government Act. Other Statutes applicable are the Prickly Pear Act, Agricultural Holdings Act, Agricultural Seeds Act, Stock Foods and Medicines Act, Federal Quarantine Act (Plants), Plant Diseases Act, Western Lands Act, and the Irrigation Act.

Councils are responsible for the administration of the provisions of the Local Government Act and Ordinances 50 and 50A and many Local Authorities have delegated their powers in this respect to weeds county councils. Present legislation has been designed to co-ordinate the declaration of noxious plants and to permit control measures where eradication is impracticable or economically impossible.

While the Act vests Councils with responsibility it also defines the obligations of land-owners and lessees in addition to covering the duties of public bodies including the Pastures Protection Board.

Only two ordinances have been made to prescribe measures, methods and notices and section 475J makes further provision for ordinance making with respect to:-

The disposal or sale of hay, chaff, fodder or grain made or produced from any crop grown on land with noxious plants.

The agistment of stock and fencing of infested land.

The inspection of stock, hay, chaff, fodder or grain and the granting of certificates, and

The inspection of anything with a view to eradicating, preventing or lessening the risk of the growth of noxious plants.

(These are only some of the matters referred to in this section).

EXPENDITURE ON WEEDS

Figures available to the Noxious Plants Advisory Committee reveal that the present average annual expenditure in New South Wales is $6,000 per Shire for 133 areas making a total of $798,000 to which must be added expenditure by Pastures Protection Boards estimated at $122,000 and $346,000 by the Prickly Pear Commission.

The cost of administering this expenditure at the Local Government level ranges from 5% to 9%. In the case of Weeds County Councils the administration costs are higher primarily because of additional advisory, educational and research services normally beyond the scope of individual Shire Councils.

Management costs are relative to direct expenditure on weed control and eradication and it is considered that County Councils could administer a larger works programme on present costs. Additional powers and functions with commensurate financial resources would also achieve the same result.

Some of the additional services provided by the Central Northern County Council include field days, weed exhibits, weeds refresher courses, school exhibits and competitions and field trials and experiments.

Whilst I realise that some County Councils would exceed the expenditure level of the Central Northern County Council, I can only quote from our Council's current estimates.

Field operations in the 4,500 square mile County District are expensive and the cost of our operations this year will exceed $50,000. Of this amount $13,000 represents salary and wage payments and an amount of $8,000 will be spent on maintenance, operation and depreciation of spraying plant and equipment. The total cost of chemicals will exceed $15,000.

It will be appreciated that this is only a portion of the cost borne by the rural community. I instance one case where a 5,000 acre property incurs an average annual expenditure of $6,000 on noxious weeds.

I conclude this submission by emphasising -

- THAT further intensive research is essential to develop more effective and more economical weed control methods and measures, and

THAT progressively increasing State Government Votes for weed destruction must continue with the resultant overall expenditure if we are to check and reduce primary production losses through noxious plants.

INFLUENCE OF WEEDS ON HUMAN HEALTH

Dr. D. O. Cross,
Physician and former Deputy Director,
National Herbarium.

1. What is a Weed?

A weed can be classified as any plant growing out of place, but this, of course, has its difficulties because some plants are useful in some places but are a nuisance elsewhere. For instance - a medical man may regard a plant as a weed in this definition because it has some hampering effect on human health while the plant otherwise is regarded as useful. This could apply to the Clovers and Medicago species; it could apply to Privet hedges, to Old Man Salt Bush hedges, to Cypress Pine trees, Cedar trees and Sunflowers, as well as useful crop plants such as Rye grass or Maize. Any plants while not growing out of place may still be troublesome under certain conditions to certain people while at the same time being useful as show trees, crops or feed for stock. A medical man might also regard fungi (lower plants of course) to be weeds in this definition or in regard to their troubleness to human beings.

I then define a weed for the purposes of this paper as a plant which is causing some troublesome effect on human beings. Nevertheless many plants which may be regarded as weeds are often under certain conditions very useful and one has to weigh up the pros and cons in this respect.

One often hears of plants being classified into weeds, trees, shrubs etc. I feel for our purposes, we must regard weeds as running through all these categories.

2. INFLUENCE ON HUMAN HEALTH

In considering the influence of weeds on human health we must recognise that many so called weeds have no affect whatsoever or may have good affects or may have troublesome affects. Some lucky people are not affected in any way by weeds whilst other people are affected in various ways by the same weeds. This is a variation in human beings. These, of course, can be important factors when one is considering the cost of control or eradication of certain weeds because they may affect a small percentage of people. It must be remembered that on the whole, our so called weeds are part of the normal environment in which we live and many people will pass them by quite unnoticed. This occurs particularly in built-up areas, suburbia, etc., and may be important economically again since many plants unnoticed may gradually develop to a point where they become troublesome to human beings - note particularly in this respect the Ragweed - thus the lack of notice may lead to neglect in some cases because these weeds have no affect on certain people.

GOOD AFFECTS

The good affects of weeds are, of course, many. We sometimes tend to overlook their value as stock feed as well as providing land cover, particularly in drought time, thus keeping down dust which in itself can be very troublesome to human health. They may, of course, reduce erosion, thus cutting down a worry factor in human beings, and of course again, they can provide shade and shelter for stock or human beings and all these things can lead to a happier, healthier human existence and thus reduce cost.

BAD AFFECTS OF WEEDS

What we might term "bad affects on human health" would be any affects leading to illness, pain or suffering or any affect that would reduce the ability to work or one's efficiency or the ability to concentrate on work or study or even one's capacity to enjoy a normal life. The affects could be classified as direct or indirect. The less important direct ones would be injuries caused by thorns, scratches, cuts or stings, such as caused by lantana, patersons curse, tussock grasses (Poa Spp) Blady grass (Imperata Spp), Typha Spp, etc., (cutting hands if pulled), Black Thorn Bush (Bursaria), Thorn Apple, Noogoora Burr, Bathurst Burr, Tumbling Weed (Salsola Spp), Bassias, Caltrops (Tribulus). Prickles in lawns (Soliva), Spiny Emex (Emex Australis), Prickly Pears, Khaki Weed, Nettles etc., causing stinging. Of course, many others could be mentioned also.

Some weeds are poisonous mainly if ingested such as Thorn Apples (Datura Spp), Night Shades (Solanum Spp), Wild Passionfruit (Passiflora) Hemlock (Conium Spp), Caper Spurge (Euphobia lathyris). The fungi or mould group can also be classed as weeds in many cases and, of course, are responsible for many ill effects. Such are the poisonous Toadstools, the Ergot Parasitic fungus on Paspalum grass which causes sores on the legs of children.

The handling of mouldy weeds such as the mouldy variegated thistle etc., can cause mould infections in human lungs. The more important direct affects of weeds would be perhaps allergy troubles. These could be grouped into:

(a) contact allergy
(b) pollen allergy.

Some people possess the unfortunate ability to develop antibodies in their blood (or become sensitised) to certain plants or plant products and it is these people (and they are a very large percentage), who have inherited this tendency, who become sensitised to pollens or contact affects of certain plant products. These, of course, are all produced by some of the weeds. Many contact allergy troubles occur mostly due to Oleoresins possessed by these plants. Examples of weeds causing contact rashes are the Noogoora Burr, Bathurst Burr, Stink Wort, St. Johns Wort, the Medicago Spp., the so called Smart Weeds (Polygonum Spp), and many garden plants which can escape and become weeds such as Primulas "Snow On the Mountains", (Euphorbia), Rhus trees, Ivy Creepers, just to name a few.

Pollens produced by many weeds can cause pollen allergies. These are hay fever, vernal conjunctivities, rhinitis, asthma, skin eczemas, swollen lymph glands, gastric troubles, kidney troubles, colitis and many others. Some examples which the physician may regard as weeds which do cause these troubles are grasses, (Gramineae) and many wind or partly wind pollenated weeds of other families - for example Cyperacaea, Typhaeaea, Compositiae, Chenopodiacae, Plantaginaea, Cruciferae and trees and shrubs such as native cypress Pines, cedar trees, Cupressus trees, Pepper trees, Tea trees, She Oaks, Willows, Poplar and even citrus fruit trees. Other garden plants which may become weeds are the Privet hedges, the Old Man Salt Bush hedges, Tamarix, Coriopsis, Sunflowers and, of course, the well known Rye Grass, such a valuable fodder grass, which is one of the most troublesome pollen producing grasses causing hay fever and asthma etc.

The indirect ways in which weeds can be troublesome are many and varied, such as infections resulting from cuts, scratches, thorns, etc. Contact allergies from pests and diseases carried by weeds such as caterpillars, ticks, fungal diseases such as Smuts Bunts, Ergots and Rusts etc. These can also cause contact poisons, stings and injuries apart from allergies or the sensitising reactions. The effects in milk, when especially children are fed on milk from cows having eaten certain weeds. The effects upon some people of volatile oils from certain weeds, for example, Stink grasses and Hexham scent; some of these when breathed cause nasal congestion.

SUMMARY

In summary we may say that many weeds have no effects on human beings and many plants regarded as useful are sometimes troublesome weeds from the medical angle for human beings. Many weeds also cause troubles in a small percentage of people but here the cost of the eradication etc., for these few people have to be seriously considered. It should, however, be recognised that there are many weeds perhaps not very important - agricultural weeds which are very important from the medical angle seriously affecting members of the farming and rural community, apart from the weeds on roadsides, vacant allotments etc., in suburbia which cause many a trouble in human beings. We might even remark upon the troubles brought about in human beings by the cost of the eradication of weeds, the physical strain and worry brought about by these weeds, all of which can cause mental strain and sometimes serious impairment of efficient work. The cost of treating troubles in man from weeds is considerable at times and can lead to much loss of time from work. Hay fever and asthma which are very prevalent from weed pollens also lead to loss of efficiency or actual absence from work. These troubles, however, can be treated by determining the specific sensitivities in people to the pollens and building up a resistance (Hyposensitisation) by injections with specific pollen extracts. All this, however, leads to costs, both in time and money, and while it may be the only answer in some cases, eradication must be also seriously considered in certain other cases, irrespective of whether the weed happens to be troublesome from a rural or any other point of view.

*****

THE ECONOMICS OF HERBICIDES

F. C. McDiarmid,
Agrichemicals Manager,
Du Pont Far East Inc.,
Crows Nest.

INTRODUCTION

The history of man has been termed "the record of a hungry creature in search of food". Since 1650, world population has soared from 45 million to more than 3 billion and children living today will be alive when 10 billion people inhabit the earth. To meet the enormous caloric demand of such a population, modern agricultural technology will have to be exploited to the fullest.(1)

Chemical pesticides, in particular herbicides, have already proved their value in boosting acreage yield of many crops. No other section of the chemical pesticide industry has developed so swiftly in the last decade as herbicides. In 1956, 40 herbicides were tabulated as being available, six years later the figure was 90, and in 1967 this has further increased to over 120.(2) The economics of herbicides should be looked at from two aspects:

(a) as they effect the user

(b) as they effect the industry.

USER ECONOMICS

It is estimated that today in Australia, the bill to the community for herbicides is 7.8 million dollars annually, or nearly 60c for every man, woman and child each year. Over the last 7 years this figure has been increasing at the rate of 10% per annum. Use of herbicides in crops accounts for over 50% of the entire market, the remainder being divided between the control of specific weeds and the non-agricultural use of herbicides.

What return is the community as a whole getting from an expenditure of this magnitude? Precise and accurate figures are not available but we can presume that the returns more than justify this expenditure. Virtually every crop and ornamental plant has a weed problem which can today be relieved, to varying degrees, by the correct application of a suitable herbicide. Cereal crops in Australia, particularly wheat, are the backbone of the agricultural industry. In 1966/67, 20.6 million acres of wheat produced 462 million bushels (average yield 22.4 bushels per acre) - a record year. As an export item, this accounted for 500 million dollars.(3) Therefore, a significant example of the economics of herbicides can be obtained by looking at this crop. It would also be interesting to know by how much total yields could be increased and the economics of production improved, if the results obtained in the following examples are applied to the total acreage of that crop.

Skeleton weed (Chondrilla juncea L.) is the weed that has received the most attention, not only because of the reduction of yields that it has caused, but also because of the mechanical problems at harvest time resulting from an infestation. Moore and Robertson (1960) report results of trials carried out in 1951 at Walla Walla in southern N.S.W. using sodium 2,4-D at rates varying between 2 and 32 oz. of 2,4-D acid equivalent per acre with the specific objective to determine the effect of Skeleton weed on crop yields. The following table shows the percentage reduction of Skeleton weed plants from the original weed densities, the corresponding increases of wheat yield and the value of these increases in yield after spraying costs are deducted.(4) See Table I, below:

TABLE I.

2,4-D TREATMENT.	% REDUCTION OF SKELETON WEED FROM ORIGINAL FIGURE AT TRIAL COMMENCEMENT.	MEAN YIELD OF WHEAT BUSHEL/ ACRE.	VALUE ACRE AFTER SPRAY COST DEDUCTED.	INCREASE IN RETURN PER ACRE. *
			$	$
Nil	6	10.0	13.90	-
8oz./acre	30	12.3	16.50	2.60
12oz./acre	33	12.8	16.95	3.05
16oz./acre	39	13.9	18.20	4.30

*BASED ON $1.40/BUSHEL.

Pearce in Western Australia has found, from trials carried out at Wongan Hills Research Station, that wheat heavily infested with doublegee (Emex australis) and sprayed in two leaf stage with linuron (4 oz. a.i. per acre) gave an increase of 10 bushels per acre over the unsprayed control, or a return to the grower of $12 per acre over and above the cost of the chemicals. Similarly, in another trial, where capeweed (Cryptostemma calendula) was the problem, the increase was 8.7 bushels per acre; a return of more than $10 per acre after deducting the cost of the chemicals.

The Vermin and Noxious Weed Destruction Board of Victoria has published results of trials carried out with use of herbicides to selectively control Amsinckia in wheat in Victoria.(5) See Table II, below:

TABLE II.

EFFECT ON SPRAYING AMSINCKIA IN WHEAT CROPS

CHEMICAL		AMSINCKIA KILL	CROP YIELD	INCREASE	INCREASE IN RETURN PER ACRE. *
	(MALLEE SOILS - BEULAH, VICTORIA, 1966)				
			bush./acre	bush./acre	$
No treatment		Nil	16.8	-	-
Prometryne	4 oz a.i.	Very Good	24.0	7.2	10.08
Linuron	6 oz a.i.	Very Good	24.5	7.7	10.78
Bromoxynil	4 oz a.i.	Excellent	26.7	9.9	13.86
	(WIMMERA SOILS - DOEN, VICTORIA)				
No treatment		Nil	25.9	-	-
Hand Weeding		Complete	34.0	8.1	11.34
Prometryne	4 oz a.i.	Very Good	39.6	13.7	19.18
2,4-D	4 oz a.i.	Fair	32.2	6.3	8.82
Picloram	2 oz a.i.	Excellent	29.1	3.2	4.48
Linuron	4 oz a.i.	Very Good	37.4	11.5	16.10

* BASED ON $1.40/BUSHEL.

If we assume that only 20% of the wheat acreage is treated with herbicides in Australia at the present time this would leave approximately 16.5 million acres not treated. Taking the lowest return quoted in above examples, $4.48 or for simplicity $4.50 per acre, we could have increased the value of this crop by a minimum of a further 74 million dollars.

Similar examples may be quoted "ad infinitum" in this crop and most others of economic importance, to conclusively point to the value of controlling weeds by chemical means. Many examples which perhaps point even more clearly to this conclusion are probably better known to many of you who are present today.

INDUSTRY ECONOMICS

The herbicides which are used today in this country, as well as the promising compounds under test, are without exception, overseas discoveries. The reason for this is obvious. Only the large commercial organisations, orientated to this industry have the necessary combination of resources and incentive. Research facilities, large amounts of capital, technical 'know-how' and experience are pre-requisites in an industry where successful discoveries average one for every 18,000 compounds screened. Research and development of the successful compound may cost from 1.5 million dollars and take two to five years to complete.

It seems obvious therefore, that we will have to rely on overseas discoveries as our major source of new compounds for many years to come.

Broadly speaking, the development to the commercial stage of any promising candidate herbicide in Australia follows the same broad pattern:-

The local company, having received from its overseas principal, samples and data, including results of toxicological studies, as well as limited biological data, draws up a development programme as indicated by the initial field testing carried out in the country of its origin. Such a programme will include field testing by the company's own staff and, at the same time, close liaison with those Government workers likely to be interested in the product's potential and will include the supply to them of both data and samples. The development of the product then proceeds to the commercial stage through a set of field trials conducted on the one hand by the company concerned and on the other by the various Government authorities. The procedure may take one, three or more years and in the meantime, additional data is also coming in from overseas where the product's development is following along similar lines.

The question that we should probably now be asking ourselves is:-

"Are we - Government and Industry, collectively satisfied that the present procedure employed in this country to get a candidate herbicide from the development stage to commercial status, is the best available in terms of time and money expended"?

In answering this question, consideration must be given to the fact that the development of any herbicide incurs certain costs. Naturally, these costs are eventually borne by the community through the expenditure of public monies as well as the influence they have on the final consumer price of the commercial product.

I estimate that an average size field trial of say 12 treatments replicated 4 times, i.e. 48 plots, would cost in the vicinity of $250 to $400, in direct costs only. Add such items as the provisions for compensation to the co-operator, particularly if the trial takes place on a crop destined for harvest, i.e. in the case of selective herbicide work - administrative overhead and other cost factors for staff and the figures given above, could realistically be doubled. There is therefore, an obvious economic reason for the careful planning of field trial programmes.

The requirements of the registering authorities in all States are now more numerous and more rigidly enforced than has been the case in the past. By and large, this is a realistic acknowledgement of the many hazards and pitfalls which face us all in this new era of altering the natural environment by the use of sophisticated organic compounds, our knowledge of which is, of necessity, initially limited. Nevertheless, the amount of work involved by both Government and Industry in meeting these requirements is of sizeable proportions, extenuated to a significant degree by the lack of uniformity between the various State regulations.

All are aware of the problems that exist in this general area and there appears to be a general movement towards the finding of a realistic solution. I urge that we, as a Society, should lend our weight to this in order to speed up the process so that the economic value of herbicides in the community may be maximised.

The size of the Australian herbicide market by world standards, although significant, is not at present sufficiently large to justify the complete process of production of the more complex materials. There are a few minor exceptions but only where the process is not so complicated and markets are available to justify production. Basically, we are formulators of imported technical material. In the remainder of cases the smallness of the markets and/or the complexities of manufacture, force us to import the finished product. In such cases, it is not uncommon for the importing company to be faced with payment of import duty which may be as high as 40%, based on the current domestic value (of the country of origin), or the FOB value, whichever is the greater. Obviously, tariff protection is only given where "suitable equivalent goods" are available, firstly in Australia or secondly, from other Commonwealth countries and nobody will dispute this principle. However, conflicts may occur as to what is and what is not a "suitable equivalent" and it is in this area that I believe we should interest ourselves. The most logical or pertinent solution would seem to be that first consideration should be given to providing the end user - the farmer or grazier or public instrumentalities, etc. with the product of their choice at the lowest price. To what extent the local formulating industry should receive protection at the expense of the remainder of the community is certainly not one that I would care to answer. However, I believe we should interest ourselves in the degree to which any such protection may penalise the end user, thus restricting our efforts to combat the problem of weeds.

*****

REFERENCES:

Economics of Herbicides.

1 & 2. "Chemical Week" - Report (Pesticides - Part II), May 1963.

3. Australian Wheat Board, Melbourne. Personal communication.

4. Booth P.C. - Paper presented at the AVCA Conference, Melbourne, October 1962.

5. Welsh N.S. - "Recommendations for control of Amsinckia" - 1967, Pamphlet No. 20. Vermin & Noxious Weeds Destruction Board, Frankston, Victoria.

THE FUTURE OF WEED SCIENCE

K. R. Green,
Principal Agronomist (Weeds),
N.S.W. Department of Agriculture.

Four years ago, W.C. Shaw and A.J. Loustalot wrote of a "Revolution in Weed Science". They referred to the large-scale replacement of mechanical energy by chemical energy in the destruction of unwanted vegetation. It has been apparent from to-day's discussions that a similar revolution is in progress in Australia.

When the revolution burst here, farmers were admonished not to let herbicides interfere with "sound farming practices". These practices appear to have been traditional soil preparation and crop rotation as determined in the absence of herbicides. Thus herbicides were rather frowned upon. I prefer to regard as sound those farm practices likely to produce a high farm income for many years - a more flexible approach which has room for the simplification of some of the traditional English rotations which became possible following the introduction of herbicides. All too often, of course, herbicides and other farm tools are used unsoundly by expecting far too much from them.

The future of weed science will depend, in no small measure, on the impact of weeds on the community - hence the choice of the theme of our conference. At the time of writing, those papers I have seen certainly indicate that the costs directly attributable to weeds are great. Wheat growers in N.S.W. appear to suffer losses running into tens of millions of dollars and spend over a million dollars a year on herbicides. The forestry and cotton industries each incur annual costs of a million dollars on herbicides. Many losses cannot be estimated because of the interaction of weed and other effects or because the weed effects have not been measured.

The papers before the conference demonstrate the magnitude of many of the effects of weeds. Although our problems have much in common with those in other countries, they have many differences. The need for development of the discipline of weed science is obvious.

Note: This paper will be developed in the light of discussions at the symposium.

PROBLEM DEFINITION.

Let us consider further the impact of to-day's discussions for weed science. They point out the need for adequate problem definition. Barley grass (Hordeum spp.) may, it seems, be valuable, irreplaceable feed in winter and yet a major stock problem in spring. Perhaps the job for weed science is not to control it but to off-set its ill effects while retaining its uses. Conflicting attitudes to other weeds are also apparent — skeleton weed (Chondrilla juncea), our most serious perennial weed of wheat growing, is good stock feed. Would control by biological means be acceptable?

Eastoe's plea for a better understanding of the plant - animal relationship is especially relevant to a better definition of the problems and to determining how they can be overcome.

THE NATURE OF WEEDS.

In defining the problem, it is becoming necessary to learn the nature of the competition between weed and crop, indeed of the whole botany of the weed complex - its ecology and physiology. These are basic to a complete understanding of weeds - and indeed of crops - yet our present knowledge is small. Good work has been done in this country, particularly on pasture weeds, by Milton Moore and others. Particular reference is made to the information on skeleton weed being amassed by workers in the south-east of the continent.

The ecological and physiological approach is slow and unspectacular by comparison with chemical and mechanical methods. I am convinced, however, that such studies will become increasingly important, enabling (1) other research, including the evaluation of herbicides,to yield maximum results.

(2) the development of integrated farming and grazing systems for vegetation control problems.

Important though herbicides may become, their effects are temporary. They may enable the vegetation to be changed, even drastically. Especially in a grazing situation the principles of ecology alone will provide the permanent and profitable answer.

THE TOOLS OF WEED CONTROL.

Mechanical weed control - the hoe and the cultivator - has long been with us, but development was slow until the general acceptance of the tractor.

The scientific approach to weed control in Australia really began in the 1920's with the biological control of prickly pear (Opuntia spp.) and the use of ecological principles in the control of St. John's wort (Hypericum perforatum). Between the two wars, chemicals, mainly arsenicals, chlorates and common salt, had limited and special uses only.

The main stream of development for the past twenty years has been in herbicides, that remarkable group of pesticides which actually reduces the labour and machine requirements of crop production. The intensity of development is shown by the increase from under ten to about sixty herbicides in the last 25 years. The use of herbicides has increased far more than their numbers and is currently increasing at a greater rate than for other groups of pesticides.

We must admit that a great amount of ad hoc effort has been involved in the screening and evaluation of herbicides to achieve registration markets and official recommendations. This has been inevitable in a period of such rapid development.

The continuing application of chemical innovation in the control of vegetation will, I believe lead us to new, strange paths. In crops, I foreshadow increasing use of pre-emergence or early post-emergence treatments, mostly for the control of a broad-spectrum of weeds. The results obtained should be more reliable than at present, but may well be dependent on a more precise assessment of the environment. The sheer cost of developing a herbicide will ensure that such factors are well studied.

In straight weed-killing, the control of species with protected underground propagules - for instance bracken fern (Pteridium sp.) or skeleton weed - must be expected. But will it involve a highly translocated herbicide or some "sophisticated" system involving, say, use of a "dormancy breaker"?

It is in the agronomic implications of effective means of weed control by herbicides that I am particularly interested.

Already, herbicides have allowed the spread of broad acre production of vegetables, have been vital in the establishment of economic cotton production in New South Wales. I have already referred to the replacement of weed control by rotation by weed control by herbicides in parts of the United Kingdom. The Symposium of the British Ecological Society on Crop Production in a Weed Free Environment has given a valuable lead in this field.

Work is already in progress in this State on the effect of herbicides on cotton and potato culture while the classical citrus management research at Hanwood has demonstrated remarkable interactions between fertilizer requirements and chemical weed control.

The skills of weed control are increasing interest in the clearing of land and its preparations for sowing - the so-called chemical fallowing could have great significance for the wheat farmer - particularly on the looser and more erodable soils.

Crofts has to-day emphasised the tremendous potential for development on non-arable country possible through the use of the skills of weed science together with other appropriate steps. Campbell at Bathurst has already shown the way here with aerial spraying of inferior pasture followed by aerial seeding. Obviously, the weed scientist is moving out into a broader field which may well be termed vegetation control.

During the next decade, weed workers will become far more concerned with less direct effects of herbicide use. One of these is the fate of the chemical. We are already well aware of spray drift - research in the fields of engineering and physical chemistry has produced useful, but not yet adequate methods of drift control.

Unfortunately, the low cost of ultra-low volume spray techniques may aggravate this problem.

The impact of soil residues will be felt much more in future. The direct effect of residues of atrazine, trifluralin and picloram may influence crop rotations. Indirectly, very little is yet known of the interaction between herbicides and soil biology and soils themselves, and of the movement of the more persistent materials through soils, possibly into ground water.

Residues found in or on the crop are also particularly important whether for flavour, health or even political reasons.

All forms of lack of control over chemical dispersal are important in a modern society. We shall become increasingly concerned with them and shall call for aid from other disciplines, especially soil science and microbiology.

BIOLOGICAL CONTROL.

Because of an antagonism to chemicals in parts of the community, research into the biological control of weeds must increase. Studies are already under way on lantana (Lantana camara), skeleton weed (Chondrilla juncea), Noogoora burr (Xanthium pungens) and groundsel bush (Baccharis halimifolia). Quite a number of weeds found overseas are candidates for future study.

Unfortunately, many weeds have uses which makes such a control intolerable - barley grass has already been mentioned as valuable grazing, paspalum (Paspalum dilatatum), undoubtedly the worst weed of industrial and urban situations, is a valuable pasture.

Whether any unusual biological methods will be developed for weed control as for insect control remains to be seen. However, success to date has been limited (apart from prickly-pear control), the research involved is expensive and time-consuming while the results have proved unpredictable.

Biological control, by insects or pathogens, will become more important, but always of lesser importance than other methods.

Early in this paper I emphasised the importance of defining the problem. I have not yet done so as I hoped that the process of review would facilitate this task. A weed seems to be any plant which has some undesirable characteristics.

Weed science is concerned with preventing, controlling or modifying the growth of vegetation so as to minimise its ill-effects, it is increasingly concerned with the interactions of such action on all aspects of plant and animal production, as well as on the health and activities of humans. It is concerned with the application of its skills in opening the way for major developments in rural production. Its boundaries are indefinite as it contributes to, and calls on other biological disciplines.

Our papers to-day have demonstrated the serious economic and other effects of unwanted vegetation on man's production and pleasure. The need for a major contribution by weed science is obvious and the diversion of resources in this direction will pay handsome dividends.

References.

It has been impracticable to list the papers to which reference has been made. The works of the many authors concerned is gratefully acknowledged.

* * * * *