WEED CONTROL ON NEW ZEALAND RAILWAYS

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New Zealand and American authorities agree that:-

"The elimination of weeds and other vegetation from the roadbed is essential to the economic maintenance of track In the track, the elimination of vegetation facilitates drainage, increases the life of sleepers, reduces the fouling of ballast and otherwise decreases the cost of track maintenance Weeds should be destroyed at that period in their growth that is most effective in preventing regrowth or reproduction. In general this is the early part of their seedling stage.

The greatest economy is effected by reducing to the minimum the amount of hand-weeding through the use of mechanical and chemical aids"

The effort required to obtain control of weed growth depends on such factors as soil fertility, temperature and humidity, length of growing season, and frequency and amount of rainfall.

On the track area the natural agencies of seed transportation are assisted by spillings from seed sacks and droppings from the floors of stock wagons etc.

Waterlogged and weedfoul ballast lacks the structural strength to transmit the heavy axle-loads from the rail via the sleepers and ballast evenly over the formation; a rough and uneven running-top will be the result.

Vegetation on the right-of-way and unoccupied lands generally has received much less attention than on the roadbed itself, and although the acreage is much greater the degree of control is quite different.

The track area should be kept continuously free from vegetation, and, if it were possible at reasonable cost, the ballast made sterile. Off the roadbed, grasses are desirable to prevent erosion, but brush and tall weeds must be controlled to prevent their damaging power and telephone lines and impairing the visibility of both road and rail traffic.

Weeds must also be controlled to avoid choked watercourses and culverts, to reduce fire hazards, and to assist inspection of vital structures.

It should be noted that wherever possible, land not immediately required is leased and the weeding responsibility transferred to the lessee.

The results obtained from early experiments were so promising that it was decided to design a completely mechanised spray train for chlorates and this unit came into operation in October, 1945. It can now be stated with the authority of considerable experience that on railway tracks arsenicals, chlorates and certain hormone mixtures, can give a satisfactory degree of control, showing great economy over the older manual methods.

RAILWAY WEED-CONTROL IN VARIOUS COUNTRIES (European and American Railways):

Most railway administrations of America and Europe use chlorates extensively for control of weeds on the roadbed. In 1939 the German production of chlorates was 15,000 tons of which 8,400 tons (or 56%) was used by the railway companies.

European railways use from 100 to 180 pounds of dry sodium chlorate dissolved in from 100 to 1000 gallons of water to each acre sprayed. The Victorian Railways use from 100 to 150 pounds of calcium chlorate dissolved in 140 to 200 gallons of water per acre.

For comparison, the N.Z.R. spray train applies two treatments per year of 118 gallons of solution containing atalacide equivalent to 71 pounds of sodium chlorate per acre, and it is proposed to reduce the volume sprayed (by more concentrated solution) to about 30 gallons per acre.

The American railroads have used chlorates, arsenicals, creosote and oils, and boron compounds for track weeding. More recently attention there has been directed to 2,4-D, 2,4,5-T, T-C-A, and pentachlorophenol, of which the two last named are most favoured for roadbed use. One authority suggests that 50 to 100 pounds of sodium T-C-A mixed with 8 to 12 pounds of pentachlorophenol in oil should give the required control over one acre of track. Such a mixture would be expensive (£12 to £20 per acre) but may, nevertheless, be efficient for control of perennials and grasses. Mixtures containing 2,4-D and 2,4,5-T appear to be more favoured for off-track work in control of susceptible and brush weeds on the right-of-way.

While both European and American authorities appear to place chlorates first and arsenicals second (because of poison hazards) for roadbed use, reports from U.S.A. indicate that considerable use is being made of the newer chemicals and hormone mixtures for both on- and off-track work, and particularly for grasses, brush weeds, and other special weeds.

DOSAGE:

The aim is simply to obtain the best results for the least cost, which, however, is not capable of a precise determination without some years of careful analysis of costs and results.

Chemical sprays become more selective as the dosage is reduced, and the results obtained from increasing or decreasing the optimum dosage tend to become either extravagant or ineffective. There is always a temptation to reduce the dosage where weeds are light and scattered, but such a practice is unsound as weeds, even if scattered, still require the standard effective dosage. Increase of dosage for heavy growths is, however, justified by the additional volume required to penetrate the thicker mantle.

Instances have been noticed where successive sprayings with the one chemical have changed the weed associations by the gradual elimination of the susceptible types and, although the bulk may be considerably reduced, the resistant types predominate. Perennials, brush weeds (blackberry, gorse and bracken), mature grasses, and true clovers, are resistant to the dosages used by the N.Z.R., and if not killed in the seedling stage, require to be controlled by heavier dosages, different chemicals, or by manual methods. Reports have been received that fennel, lupin, and some thistles are normally resistant to chlorates and susceptible to 2,4-D, and that sorrel is more susceptible to chlorates than to 2,4-D. Grasses and hard weeds seem slightly more susceptible to chlorates and arsenicals than to hormone mixtures, and heavy applications of arsenicals do give a measure of control over hard weeds.

On the roadbed itself, regular spraying (spring and autumn) gives control of easy weeds and of many potential difficult weeds in the seedling stage. A big problem lies near the edges of the ballast where the perennials and grasses of the right-of-way are constantly invading. Apart from some special local weeds, grasses are probably the most serious problem yet to be solved on the roadbed, and the T-C-A mixtures will, if as effective as reported, be very welcome to the Railway Department.

TIME TO SPRAY:

Annual weeds should be sprayed from the early seedling stage to before seeding, but effective kills can be made at any stage that there is sufficient vulnerable leaf area exposed.

The Railway Department has decided to adopt two treatments per year, the first in October-November at the full vigour of spring growth, and the second in April when the increasing rainfall had brought about the "Autumn recovery". Very satisfactory control has resulted from these two treatments with chlorates, arsenicals, or hormone mixtures, and the roadbed is kept cleaner at much less cost than was ever possible with handweeding.

WEED SPRAY TRAIN:

The weed spray train consists of a locomotive, staff car, wagons for transport of chemicals etc., a tank wagon, a pumping wagon, and a mechanical loading and mixing wagon. The capacity of the tank wagon is nominally 6000 gallons, and is sufficient to spray a strip 14 to 15 feet wide and over 20 miles long.

The train is manned by the train crew, 2 fitters and a cook, under the supervision of a member of the Civil Engineer's staff. The staff car, converted from an obsolete sleeping car, provides eating and sleeping accommodation for seven men.

The chemical used is atlacide (60% sod. chlorate and 40% calcium chloride) dissolved one pound to the gallon and applied at the rate of 200 gallons to the mile (118 gallons to the acre). The solution is drawn from the tank wagon through filters and forced through nozzles by a rotary displacement pump driven from an axle, so that the rate of discharge per mile or acre is uniform and independent of the speed of travel. Safety valves, pressure gauges and self-cleaning filters are also fitted.

The loading and mixing equipment consists essentially of a powerful pump discharging through a nozzle under a hopper. The intense agitation of the jet breaks up lumps and, dissolving the chemical very rapidly, carries the solution by momentum from under the hopper into the top of the tank. The tank can be loaded and the chemical mixed in less than $\frac{1}{2}$ hour.

LOW VOLUME SPRAYING:

The spray train was designed as a high-volume set-up, discharging some 118 gallons per acre, but tests made at rates as low as 30 gallons per acre are encouraging. It is hoped that medium to low-volume spraying will permit the use of semi-portable units which may be operated at the most favourable times in all districts.

It can be appreciated that the timetabling of the spray train is quite complex without considering the best time for spraying in individual districts, nor the cancelling or readjusting of the programme because of high winds or wet weather.

Even at the loss of some efficiency, the advantages of the smaller units are preferred.

COSTS:

In New Zealand there are some 3526 miles of main lines and over 1000 miles of sidings.

Last year the Railways spent more than £ $\frac{1}{4}$ million on weeding, and this represents almost 20% of the cost of track maintenance. Thus it will be seen that, if hand weeded, this task would demand one day a week of the line gang's time and this at the expense of lining, packing and fettling the permanent way to withstand the hammering from heavy axle-loads.

Nearly £10,000 was spent on chemical weeding in the North Island in 1949, and the savings already made are estimated at more than £50,000 per annum. It is expected that when these operations are extended to the South Island, the savings will be more than £100,000 per annum.

The increasing hourly wage rates are reflected in the weeding costs of both Islands, but the check and reduction of costs by the introduction of extensive mechanised operations in the North Island from 1945 onwards is remarkable. That costs rise or fall with decrease or increase of the mileage sprayed shows why the Railway Department is so anxious to secure a reliable source of supply of chemicals.

It is estimated that the hand-hoeing of weeds on the track area costs roughly £40 per acre per annum, and that two sprayings of arsenicals,

chlorates, or hormone mixtures, would achieve the same result for about £10.

CONCLUSION:

The railway roadbed problem differs from the agricultural problem in that a non-selective kill is required. Weeds on the roadbed have been controlled by hand-hoeing, harrowing, or discing with horses, or by burning or scorching with flame jets, but chemical spraying seems likely to supersede all these methods. It is proposed to replace the pit-run shingle covering all sleepers with a partially crushed and screened ballast leaving the sleeper tops exposed. Hoeing, harrowing and discing will then be very expensive, if possible at all, and the only economical alternatives will be scorching and chemical spraying. The present indications are that chemical spraying meets the needs of the N.Z. Railways best and will be extended.

The future of chemical spraying depends on the development of new chemicals and techniques, and the extension of knowledge of the chemicals now in use. The Railway Department is interested in the use of T-C-A for the control of grasses on the roadbed and in watercourses, and the use of 2,4-D and 2,4,5-T for special problems on the right-of-way.

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QUESTIONS AND DISCUSSION

DR. YEATES: Have any of the weed-killers had any harmful corrosive effect on the metal of the track?

MR. LOVATT: We have not noticed any excessive corrosion in the areas where we have sprayed with chlorates. The tank wagon on the spray train is of mild steel and no excessive corrosion has been noticed in five years.

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