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# GROWTH CONTROL IN TREES

A comparative study of four growth retardents applied as foliar sprays.

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Abstract: A new philosophy is developing amongst Utility Companies toward new improved appearance rights-of-way. One of the methods utilized, to reduce the impact of rights-of-way is the increasing retention of existing plants and the planting of woody species on the power corridor. These plants will require extensive maintenance if their growth is uncontrolled. Three species of forest trees, White Ash, (Fraxinus americana L.), Silver maple, (Acer saccharinum L.) and Carolina poplar, (Populus canadensis Moench) were sprayed with four growth inhibitors each at three rates. MH30T (Diethanolamine salt of 1,2-dihydro-3,6-pyridazinedione) gave the most complete control with least foliar damage. NIA10637 (Ethyl hydrogen 1-propylphosphonate) gave adequate control at one rate. Increased bud formation was noted. CF125 (Methyl 2-chloro-9-hydroxyfluorene -9-carboxylate) did not indicate good control at the rates used. A new material DP1108, the structure of which is not known, gave promising results.

## INTRODUCTION

The sustained increase in electrical power demand and concomitant generation facilities is exerting a substantial pressure on the electrical utilities to purchase more property for generating plants and transmission rights-of-way. This latter demand is demonstrated graphically in Table I.

It is the view of many conservationists that electric power lines are one of the more significant despoilers of natural beauty wrought by the industrial revolution. Whether this view is right or wrong, much of the general public shares it, and the electric utilities are now under constant pressure to reduce the impact of transmission lines on the surrounding landscape.

Such attitudes are now reflected in reports sponsored by government authorities (29),(30),(31),(32). It is fully recognised that it is not technologically or economically feasible to place high voltage electric transmission lines underground for long distances.

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In view of this, the Electric Utility Industry Task Force has stated that "a special burden is justifiably placed on the Industry to do whatever is possible to alleviate the environmental problems caused by transmission lines." (30).

The problem, then, is how best to meet the mounting demand for electricity and to build the necessary additional transmission facilities while at the same time protecting environmental values.

The trend in many utilities by design or pressure has been away from a purely engineering approach to such environmental problem solving. Utility personnel with backgrounds in the biological sciences have published a number of papers on ways of moderating the impact of rights-of-way. A number of papers have been presented on this subject (9),(12),(14),(18),(20),(27).

The principal theme of such papers has involved the improvement of line location, the retention of woody shrubs and trees on new rights-of-way, screening, planting and the selective use of herbicides. Much of the plant material mentioned for planting does, or is assumed to have, inherently fastigiate growth characteristics. Such material is costly if purchased from commercial nurseries. In fact, the estimated cost by one utility for the creation of one 100 foot wide screen comprised of small growing trees and shrubs is some $550. (33).

Forest trees are perhaps significantly not mentioned although they offer a much less expensive method of obtaining the same, or in some cases, a substantially more natural and silviculturally more suitable effect. One author has noted that some trees will be planted that may eventually require trimming for maximum safety clearances but that such maintenance would not be extravagant (12).

With an interconnected grid system, all coupled systems require a high degree of security. Maintenance Departments must be extremely alert to system failure from whatever cause or potential cause. Such a potential is inherent in the current trend toward leaving woody growth in relatively close proximity to high tension conductors. Maintenance costs and methods for beautility plantings are an unknown. Such must not be the case.

The biological sciences are on the threshold of offering a possible key to reduced maintenance costs on growing plant material. If the plant physiologist can reliably contain the growth of plants by chemical, by genetic or by environmental factors, we will have transcended the era of the herbicides.

A number of papers have referred to the utility application of MH30 and MH30T, (1,2 dihydro-3,6-pyridazinedione) and the Diethanolamine salt to control the growth of woody plants (1),(2),(6),(10),(15),(19),(25),(28). Much of this information has been developed in conjunction with trimming practice on distribution lines. Such information has culminated in a commercial use of the material in California (7),(23) and in an experimental station publication (26).

Recently, the group of morphactin materials has been demonstrated as effective foliar growth retardents for woody plants (13),(16),(17). The most active of these materials is CF125, (Methyl 2 chloro-9-hydroxyfluorene-9-carboxylate). NIA10637, (Ethyl hydrogen 1-propylphosphonate) is a growth regulating material which Nethery has shown to have activity on a number of woody species (21),(22). A new growth regulating material has been developed by DuPont (3). It has been given the designation DP1108; however, the chemical structure has not been released.

These four growth control chemicals have been compared in an experiment designed to evaluate the control of apical and lateral growth on three species of forest trees.

## MATERIAL AND METHODS

An experimental nursery for growth retardation experiments was established by Ontario Hydro in 1969. This nursery is situated on flat ground with a predominantly heavy clay soil, poor drainage and open exposure to easterly winds. The prevailing winds are however from the west. Average rainfall in this area is some 75 cm per year, the maximum and minimum temperatures +35C and -25C respectively. Micro-climate at this point is effected by a 0.8 kilometer proximity to Lake Ontario just below the 44th parallel.

White ash (Fraxinus americana L.) and silver maple (Acer saccharinum L.) were established in the spring of 1969. Carolina poplar (Populus canadensis, eugenei Moench) were planted in the early spring of 1970.

The stock originated from the Ontario Department of Lands and Forests nursery at Orno, Ontario. The ash and maple were grown from seed collected in zone 6E while the poplar were grown from 15 cm cuttings having Ontario clone origin.

The trees were planted in rows 3 meters apart with the individual trees 2.5 meters apart, seventy trees in each row. At time of treatment (June 10, 1970) the ash and maple had attained a height of 2 to 2.5 meters and the poplar 1.5 to 2 meters.

Trees were picked randomly for treatment, but trees exhibiting dieback or poor crown development were not included in the block used for random choice.

Each tree was numbered with a plastic tag attached to a major lateral. These self-tie tags were also attached with a plastic/wire tie which would fall into the crotch of that lateral if the tag were to break. A map of each row and specific placing of each proposed treatment was compiled.

The time of bud break was relatively uniform between species. The time of treatment was determined by the degree of leaf expansion of each species, however, some individuals had greater growth at time of treatment than did others. No treatment was attempted until all buds had produced leaves and these leaves had completed initial chlorophyl production.

One day prior to treatment each tree was measured at three points; the leader, the lateral with the tag and the immediate opposite lateral in the case of ash and maple and the next lateral down in the case of the poplar. The actual measurements were made from the seasonal growth collar to the end of the growing point of each branch. One hundred and five trees of each species were tagged to provide for four chemicals at three rates plus three controls, all replicated seven times. The large number of controls (21) and replications (7) were required for statistical analysis of the results of each treatment. Any dead laterals or small laterals with dead buds on the tree were removed with secateurs. The species treatment date, evaluation dates and weather conditions are given in Table II.

A hand operated Cooper Pegler CP3 pressure gauge backpack sprayer with a nozzle producing a broad flat spray pattern was used to apply the chemicals. These rates are given in Table III. Each was applied in an aqueous solution of nine liters which was sufficient to spray the leaf surfaces and stem of the seven replications of each of the three species. Specific care was taken to ensure complete coverage without contaminating a neighbouring treatment. No more than 1 kg per sq cm pressure was used. This gave good penetration into the crown with minimum drift. The controls were sprayed with the water (pH6.5) used in making up the treatment solution.

The median rate used was that suggested in the manufacturers literature (3), (34),(35),(36). The other two rates used above and below that rate are at a level which would control growth without severe foliage damage. A second experiment with greater spread of rates has been repeated with three replications to determine the toxic threshold of each species to the materials; however, the results in that experiment differ little from those reported here.

The use of surfactant combinations was considered, however a previous paper by Sachs (25), has noted little enhanced efficacy with a number of these agents and they were not incorporated in this experiment.

Measurements and observations were made approximately 40 and 140 days after treatment. Each evaluation remeasured the growth of the leader and laterals, the first lateral being identified by the previous attachment of the tag and wire tie. Measurement of growth alone was found to provide an inadequate picture of results. Therefore data sheets were compiled for each individual tree. Where at the first evaluation leaf necrosis, dieback, chlorosis, epinasty, bud damage, or bark damage were evident these were recorded. A subjective evaluation of leaf loss as a percentage of the total crown was made. At the second evaluation made after senescence, bud set, tissue dieback, bark damage and death were recorded.

The statistical analysis of the numerical data was undertaken by Punhani (24) using an Incomplete Latin (Youden) square design as described by Cox (5). This numerical data, given in Table IV, applies only to the evaluation made in August of 1970. There is little difference between these data and those collected in October of 1970. The growth on all species between these two periods was comparatively small.

The correlation of the subjective evaluation of visible effects was undertaken by the author. Evaluation number one and two data sheets were compiled to give a composite picture of growth and or damage during 1970.

## RESULTS

The statistical analysis of the growth data for the White ash did not detect any significant difference among the treatments. Treatments 1, 4 and 7 appeared to have exerted some effect relative to the controls. All other treatments grew more than the controls. Sachs, Phillips and Corkins have noted fair to poor control of ash with MH30 (26),(23),(4). Further, ash is notably resistant to a number of herbicides. A combination of reasons may explain this resistance. Poor leaf absorption may be a characteristic of ash species. Each of the treatments mentioned above are the low rates of each material. Possibly high auxin levels in ash may cause auxin antagonism with synthetic growth regulators resulting in a diffusion blockage of the sprayed material.

The subjective analysis indicated severe and very severe leaf necrosis respectively for the two higher rates of MH30T at 40 days after treatment. This damage was not evident at the 140 day evaluations. The DP1108 did not cause noticeable formative effects. Some bark damage was evident at the 4 lb rate. NIA10637 at the 1 lb and 4 lb rates produced no foliage damage, however, the 8 lb rate produced severe necrosis at the 40 day evaluation on 40 per cent of the replicates. This did not affect bud set although slight bark damage was evident on some individuals. The CF125 produced slight necrosis at all rates at 40 days, however no effect carried through to fall. No disturbance of the controls was evident.

Growth of all the maples tested was relatively small despite favourable growing weather. This may be a reflection of the site quality which is not ideal for maple species. Lane has indicated that silver maple is not an ideal choice for experimental work if grown from commercial seed rather than one clone. Silver maple will cross-pollinate freely with other maple species thus producing variability in collected seed. Since genetic similarity of stock is required for reliable results of growth retardent response, silver maple will not be used in future experiments.

Treatments 1, 2, 3, 4, 5 and 12 controlled the growth of the leader and laterals uniformly. Treatments 8 and 9 promoted growth in comparison with the controls.

The subjective evaluation indicates that the 2 and 3 gal rates of MH30T caused no disturbance of the foliage during the growing season or of bud set in the fall. The 5 gal rate caused severe leaf necrosis and severe dieback of all 1970 tissue. The DuPont research material caused no evident damage other than slight lateral defoliation at the 40 day assessment with the 2-5 lb rate. NIA10637 caused little damage at the 1 and 4 lb rates however, 8 lb caused severe leaf necrosis noted at the 40 day assessment. This damage did not affect bud set at the 140 day evaluation.

CF125 produced small cupped leaves on growth produced after spraying. This epinasty was still noticeable 40 days after treatment at all rates. Some tissue dieback of 1970 growth was produced by the 300 ppm rate. No other adverse effects were evident. No undue disturbance of the controls was detected.

The poplar, although established in the year of treatment, produced greater growth than ash and maple. The statistical analysis of the numerical data provides more meaningful results. Further, the degree of damage was greater with high rates of the chemicals used, indicating a threshold of tolerance. Treatments 3, 4, 5, and 6 were significantly better in their control of both apical and lateral growth with the exception of treatment 4 on lateral #2. Treatments 8, 9, 10, 11 and 12 grew more than the controls. Treatments 10, 11 and 12 were significant in this respect.

The subjective analysis produced uniform results with respect to defoliation, necrosis, chlorostic effects, and bud damage. The 2 gallon rate of MH30T did not produce adverse effects either at the 40 day evaluation or after senescence. The 3 gal rate caused some defoliation of laterals when first evaluated. This effect resulted in incomplete fall bud formation on 60 per cent of the replicates. The 5 gal rate produced noticeable defoliation initially. This resulted in severe bud damage and tissue dieback by the time of the second assessment.

The 1 lb rate of DP1108 produced some initial defoliation, however, this did not result in incomplete bud set. The 2.5 lb rate caused severe defoliation at 40 days, causing 50 per cent of the replicates to die by fall. Those remaining alive had up to 80 per cent bud damage. The 4 lb rate produced even more severe defoliation resulting eventually in 70 per cent death.

NIA10637 at the 1 lb rate produced slight defoliation after treatment. This did not effect hardening off. Increased bud formation from auxiliary buds was noted on 30 per cent of the treatments. The 4 lb rate produced essentially the same results although increased bud formation was noted on 70 per cent of the trees. The 8 lb rate did not cause this effect, but severe bark lesions were noted at the base of the leader on 30 per cent of the specimens.

The low rate of CF125 caused slight defoliation and chlorosis was noted on 20 per cent of the treatments. No effect was evident on bud formation at the 140 day assessment. Similarly, the 200 ppm rate caused little effect other than chlorosis on 40 per cent of the treatments. The 300 ppm rate produced noticeable epinasty on new growth 40 days after treatment. This did not effect fall bud set. One control died; the balance had produced a high degree of bud set at the time of the 140 day evaluation.

## DISCUSSION

The experiment was intended to screen the four growth retardents to establish efficacy, optimum rates of application and degree of undesirable side effects. Ash and maple did not show statistically significant results for linear growth control however, the order of these results is similar to the data collected on poplar. The subjective data are of value in comparing treatments even though growth differences in some treatments are not significant. Different species would appear to require separate rates to provide equal control. MH30T gave the most complete growth control with fewest side effects at the 2 and 3 gal rates. The low rate produced no adverse side effects but the 3 gal rate produced some defoliation especially in the ash 40 days after treatment. The only long term effect was on poplar where fall bud set was affected. The 5 gal rate produced severe defoliation after treatment, eventually resulting in severe tissue dieback and bud damage.

The DP 1108 gave good growth control at all rates. The 1 lb rate provided the most uniform control and produced no ill effects on any species. The 2.5 and 5 lb rates however, produced this control of growth on the poplar through very severe dieback resulting at the high rate in 70 per cent death. Maple and Ash did not exhibit this effect although some bark damage was caused by the high rate on Ash.

The NIA 10637 at the low rate produced better control than at higher rates. Increased bud formation was noted at this rate and at the 4 lb rate. Such was not the case at the 8 lb rate which caused some leaf damage after treatment and bark lesions on poplar. These two higher rates appeared to stimulate growth on ash and maple in comparison with the controls.

The three rates of CF125 used did not control growth except at 300 ppm on maple and in the case of poplar all rates appeared to stimulate growth. The material produces epinasty on new growth especially on maple. This effect does not persist as bud damage, however some leaf malformation in the second year has been observed by the author in other experiments. It would appear that the rates used were too low and that control may be effected at a 500 ppm concentration.

These experiments will be evaluated in June and October of 1971 to establish if the materials exert any carryover effect. In an effort to apply the information gained here toward field use of the more successful growth retardents, further trials will be undertaken in 1971. It is hoped that aerial application with a helicopter and Micro Foil spray equipment will be investigated on a new right-of-way which has been selectively cut.

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Table I.

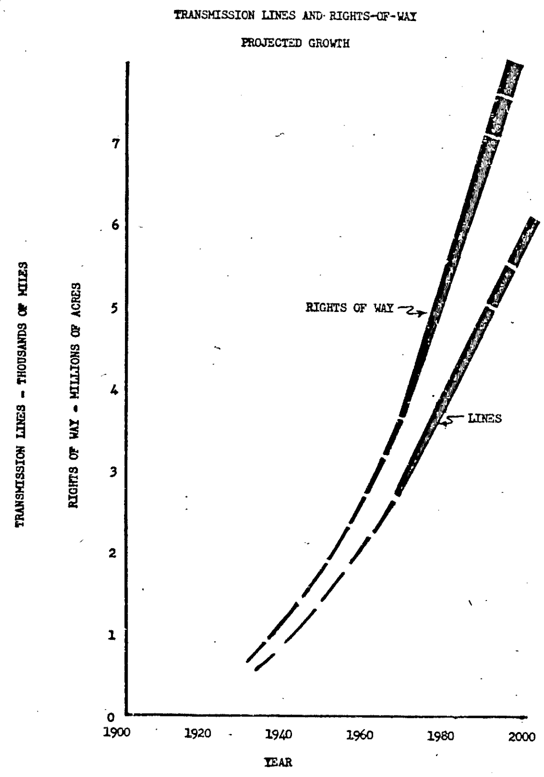



Table II.

| Species | Date of Treatment | Wind 12:00 pm | Temp. 12:00 pm | Humidity 12:00 pm | Date of Eval #1 | Date of Eval #2 |
|---|---|---|---|---|---|---|
| Ash W. | June 10 | W.S.W. | 27°C | 43% | July 21 | Oct. 27 |
| Maple S. | " | at | " | " | Aug. 8 | Oct. 28 |
| Poplar C. | " | 11 mph | " | " | July 22 | Oct. 29 |

Table III.

| Research Designation | Trade Name | Chemical Name | Rate | |
|---|---|---|---|---|
| 1 | MH30T | Diethanolamine salt of 1,2- dihydro | 2 | gal p |
| 2 | (Royal Slo-Gro) | -3,6-pyridazinedione plus | 3 | in 80 |
| 3 | | adjuvant | 5 | imp gal |
| 4 | DP1108 | Not known | 1 | lb p |
| 5 | | | 2.5 | in 100 |
| 6 | | | 4 | US gal |
| 7 | NIA10637 | Ethyl hydrogen 1-propyl- | 1 | lb ai |
| 8 | | phosphonate | 4 | in 100 |
| 9 | | | 8 | US gal |
| 10 | CF125 | Methyl 2-chloro-9-hydroxy- | 100 | |
| 11 | | fluorene-9-carboxylate | 200 | ppm |
| 12 | | | 300 | |

## Table IV.

### ASH: Mean Linear Growth in cm for each Treatment

Leader

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 12 | 10 | 11 | 3 | 6 | 2 | 8 | 5 | C* | 4 | 7 | 1 |
| 1.27 | 0.70 | 0.62 | 0.59 | 0.58 | 0.56 | 0.55 | 0.43 | 0.42 | 0.40 | 0.34 | 0.32 | 0.23 |

Lateral #1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 12 | 5 | 6 | 9 | 2 | 11 | 3 | 10 | C* | 7 | 1 | 4 |
| 1.04 | 0.78 | 0.56 | 0.56 | 0.46 | 0.40 | 0.39 | 0.37 | 0.34 | 0.33 | 0.32 | 0.24 | 0.23 |

Lateral #2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 11 | 12 | 9 | 3 | 6 | 5 | 4 | 2 | 7 | 1 | 10 | C* |
| 1.14 | 0.76 | 0.63 | 0.54 | 0.50 | 0.49 | 0.44 | 0.41 | 0.34 | 0.26 | 0.23 | 0.21 | 0.14 |

### MAPLE: Mean Linear Growth in cm for each Treatment

Leader

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | C* | 7 | 6 | 10 | 9 | 11 | 5 | 12 | 1 | 3 | 4 | 2 |
| 0.54 | 0.45 | 0.43 | 0.36 | 0.36 | 0.34 | 0.31 | 0.30 | 0.30 | 0.30 | 0.19 | 0.10 | 0.07 |

Lateral #1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 9 | C* | 10 | 11 | 7 | 5 | 6 | 4 | 3 | 12 | 1 | 2 |
| 0.54 | 0.54 | 0.35 | 0.34 | 0.34 | 0.33 | 0.26 | 0.23 | 0.21 | 0.19 | 0.19 | 0.14 | 0.10 |

Lateral #2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 6 | C* | 11 | 8 | 4 | 7 | 10 | 12 | 5 | 1 | 2 | 3 |
| 0.49 | 0.44 | 0.43 | 0.34 | 0.33 | 0.33 | 0.31 | 0.31 | 0.26 | 0.23 | 0.21 | 0.19 | 0.06 |

### POPLAR: Mean Linear Growth in cm for each Treatment

Leader

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 10 | 12 | 1 | 8 | C* | 2 | 9 | 7 | 4 | 3 | 5 | 6 |
| 8.20 | 7.82 | 7.17 | 5.90 | 4.50 | 4.44 | 4.17 | 3.94 | 3.59 | 2.20 | 2.11 | 1.59 | 0.79 |

Lateral #1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 12 | 10 | 8 | 1 | 9 | 2 | C* | 7 | 6 | 5 | 3 | 4 |
| 4.61 | 4.13 | 3.86 | 3.83 | 3.63 | 3.30 | 2.84 | 2.82 | 2.36 | 1.79 | 1.51 | 1.16 | 0.90 |

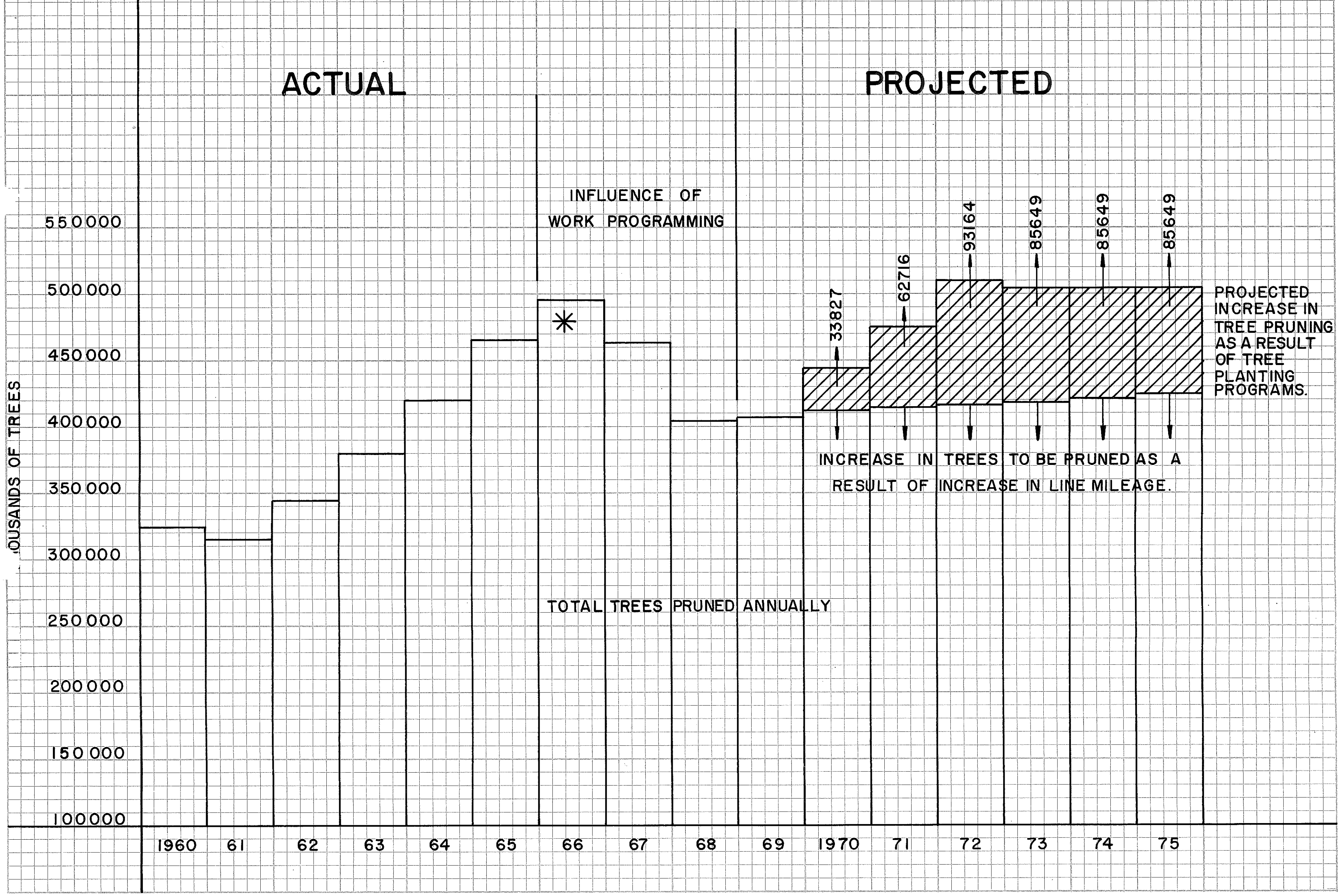
Lateral #2

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 12 | 10 | 8 | 7 | 9 | 1 | 4 | C* | 2 | 3 | 5 | 6 |
| 4.87 | 3.93 | 3.91 | 3.37 | 2.69 | 2.59 | 2.52 | 1.91 | 1.79 | 1.11 | 1.10 | 1.03 | 0.51 |

Treatments which do not differ significantly have been underlined by a bar, the significance level being 5%.

C* - Control

# PROJECTED INFLUENCE ON RURAL LINE CLEARING WORK LOAD OF TREE PLANTING BEGUN IN * 1966



G9-5DG
10 X 10 TO THE INCH
MADE IN CANADA

CC&S MICROGRAPH

# PROJECTED BENEFITS FROM USING GROWTH INHIBITING CHEMICALS