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Preliminary Registration Review of P.P. No. 1F1105 for Endothall (Dimethylalkylamine, potassium or sodium salts of 7-oxabicyclo-(2.2.1) heptane-2,3-dicarboxylic acid) in sugar beets

Submitted by: Pennwalt Corporation
Filed: March 25, ~~1970~~ 1971

I. Introduction:

A separate evaluation is done for aquatic use. Same petition number.

1. Petitioner is proposing establishment of a tolerance for negligible residues of endothall in or on the raw agricultural commodities sugar beets (roots and tops) and in water at 0.2 part per million from the application of its dimethylalkylamine, potassium, or sodium salts as herbicides. Residues would be expressed as endothall.

IV Directions for Use:

1. Sugar Beets (Roots and Tops)

The following formulations are currently registered ~~with the~~ on a "no-residue" basis:

Endothal Weed Killer	Reg no. 4581-93
Herbicide 273	Reg no 4581-223
Herbicide 283	Reg no. 4581-243
Endothal-TCA Herbicide	Reg no. 4581-170

The directions for use for each formulation will be listed separately.

Note - Recommended dosage rates may depend on soil type. See label for complete directions

Endothall Weed Killer

Pre-emergence — spray onto the seed bed during or just after planting.

(A) Broadcast Treatment - 2 to 4½ gallons (2.9 to 6.55 lbs A) per Acre.

(B) Band Treatment :— Equivalent dosage rates — note: for light sandy soils use lower rates (See table on label)

Post emergence - apply only after weeds have emerged. The sugar beets should normally be in the 4-6 leaf stage. Do not apply later than 45 days after emergence

(A) Broadcast Treatment — 2 to 4 quarts (0.73 - 1.46 lbs A) per acre in 10-30 gallons of water

(B) Band Treatment - Equivalent dosage rates (See table on label)

Herbicide 273

Pre-emergence

(A) Broadcast treatment - 1 to 2.2 gallons (3.0 to 6.6 lbs A) per acre with sufficient water to give good coverage.

(B) Band treatment - Equivalent dosage (See table on ~~this label~~ label) - Use lower rates for sandy soils.

Post-emergence

(A) Broadcast treatment - 1 - 2 quarts (0.75 - 1.5 lbs A) per acre in 10 - 30 gallons of water

(B) Band Treatment - Equivalent dosage - (See table on label)

Herbicide 283

Pre-plant – imbed to a shallow depth not exceeding 1 or 1½ inches (No dosage rate given)

Pre-emergence – Apply at time of planting or shortly thereafter, but before beets emerge from soil.

(A) Broadcast Treatment – 1 to 2½ gallons (2 to 5 lbs A) per acre – Do not use on high organic soils.

(B) Band Treatment – Equivalent dosage – See table on label – Do not use on high organic soils

Endothal - TCA Herbicide

Pre-emergence - Spray onto seed bed during or just after planting.

(A) Broadcast treatment - 5½ to 8 gallons (3 to 4.4 lbs A) per acre

(B) Band treatment - Equivalent dosage (See table on label) in sufficient water to give good coverage. Apply before beets emerge from soil.

II

Analytical Method: GLC method microcoulometric nitrogen detection system (model T-400-H cell) Sample is extracted with acidified methanol. Clean-up is by treatment with activated charcoal and a cation exchange resin. The N-chloroethylimide derivative is formed by reaction with 2-chloroethylamine hydrochloride The derivative is determined by G.L.C. using the nitrogen specific detector.

Analysis of fortified samples indicates a limit of sensitivity of 0.2 P.P.M at an average recovery efficiency of 64%.

Discussion of Data

Included in Section D are 18 'exhibits' dealing generally with the metabolism of Endothall. They are summarized individually below.

(1.) Endothall solutions up to 2% concentration may support bacterial growth.

(2) Endothal is leached in soil to a depth of at least five inches with more than one inch of rain. ~~More~~ movement was greater in sandy soils than in a clay type.

Endothal breaks down to at least half of its activity in four weeks (in moist soils) as compared with no breakdown on absolutely dry soils. Degradation seems to be microbiological.

(3) It is possible to move Endothal down or up in soil by using surface & subirrigation respectively. Leaching and ~~volatization~~ of Endothall depends on soil textures and types.
Inactivation of Endothall in soil depends on soil moisture. No inactivation was measurable 8 weeks after treatment in air-dry soil.
The rate of inactivation in soil was significantly less at temperatures below 20°C than at temperatures of 20° to 30°C.

(4) 33% of Endothal was decomposed after 133 to 162 hours exposure to ultraviolet light.
The rate of decomposition and extent of adsorption of Endothal in different soil types varies widely. There is a general inverse relationship between rate of decomposition and adsorption. However, in the studies conducted no consideration was given to the micro-organism populations in the different soils.

((4) continued) In duplicate samples 13 % and 20 % of Endothal was degraded when exposed to sunlight for 7 days.

Inhibition of soil microorganism activity by application of pentachlorophenol will decrease the rate of breakdown of endothal measured by $C^{14}O_2$ evolution from the soil.

Endothal can be made more persistent in the soil by the addition of bactericides and anti-oxidants to the formulation.

Studies using C^{14} endothal show the immediate breakdown products to be nearly all present as organic acids with greater than 60 % of the radioactivity present in the form of amphoteric compounds containing both acidic and basic functional groups.

(5) The sodium salt of radioendothal decomposes more rapidly in laboratory soil-water, and soil-water-sucrose systems than in distilled water. Decomposition was shown by TLC analysis and was attributed to microorganisms. Loss of ~~activity was~~ ppm radioactivity is probably due to CO_2 evolution.

(6) Sugar beets were treated pre-emergence + post-emergence with radioendothal. Fractionation and analysis of the plants showed no detectable level of endothal at harvest. Paper chromatography showed radioactive products significantly different from endothal. Sugar beets appear to have the ability to rapidly absorb and metabolize endothal.

(7) Endothal was shown to be very unstable in ~~the~~ ~~Ontario~~ soil. 70% disappeared as CO_2 in 7 days in Ontario soil. There is essentially no detectable residue of endothal in red beets or spinach at harvest after pre-emergence treatment with endothal.

(8) An aquatic weed, Anacharis, was exposed to 12 p.p.m. radio endothal over a period of five and one-half days in an aquaria with goldfish. The plant was dried, ~~fractionated and analyzed~~ fractionated and analyzed. Only 4% of the activity was found in that fraction that would contain parent endothal.

(9) Goldfish and Silver Salmon were exposed to the sodium salt of radioendothal under different conditions of temperature and time. Dried fish were extracted and the different fractions analyzed. The behaviour of the different fractions indicates that they are normal constituents of the organism, such as carbohydrates, organic acids, amino acids, and proteins, as well as fats and oils. ~~For~~ Goldfish exposed to endothal at 12 P.P.M., the highest concentration tested, for 5.5 days were found to contain only 0.07 P.P.M of endothal. For the normal use range of 6 P.P.M ~~endothal~~ only 0.002 P.P.M endothal were found in goldfish and 0.003 PPM in silver salmon fingerlings after 5.5 days. Extensive breakdown and metabolism of endothal in fish is indicated.

(10) The residual activity of endothal persists considerably longer on dry soil than on moist soil. No measureable inactivation of endothal occurred on air-dry soil 8 weeks after application. Soil type was (12.5% sand, 20.0% silt, 67.5% clay, 2.6% organic matter), on moist soil ~~~~ residual activity had almost disappeared after 14 days. Inactivation is temperature dependent being much more rapid at 20-30°C than at 5°C

Repeated applications of endothal to soil appear to be more rapidly deactivated due to microbiological enrichment.

(11.) In a preliminary study in the laboratory, microbial effects on endothal were shown to be reduced when endothal is applied in mixtures with sodium orthophenylphenate or sodium pentachlorophenate..

(12) Ten strains of soil bacteria capable of decomposing ~~the herbicide~~ endothal could be identified as belonging to the genus Arthrobacter. The organisms utilized a wide range of carbon sources but not including phthalate.

(13) Endothal stimulates nitrification in soil by microorganisms.

(14) Endothal blocks transport of ^{32}P in detached bean leaves.

(15) Endothal is an effective fruit tree defoliant. The physiological effect is a pronounced weakening of the synthetic activity of leaves and intensification of the disintegration processes in them.

(16) In a respiration study ^{14}C labelled endothal was sprayed on mature cotton plants. During a period of 10 days only about 1% of the original sprayed activity was evolved as $^{14}CO_2$. Loss of ^{14}C endothal from the leaves indicated that a high percentage was no longer present in extractable form.

(17) In a Colorado experiment, sugar beets were treated with the mono and di dimethyltridecylamine salts of endothall. Treatments were pre-plant in the soil at rates up to 5.0 lbs/acre (endothall acid equivalent). Apparent residues of dimethyltridecylamine in roots and tops of mature sugar beets showed no significant difference from untreated samples.

(18) The manufacture of beet sugar is described.

Discussion of Data

Roots — Sugar Beets

lbs/A	PHI	Treatment	PPM
1.5	36	H-273 Post	0.1
1.5	46	"	0.1
2.0	170	End-TCA-Pre	0.1
3.0	113	H283-Post	0.1
4.5	121	H273-Pre	0.1
5.35	108	End-TCA-Pre	0.1
6.0	96	EWK Pre	0.1

Tops

6.0	140	EWK Pre	0.1
3.0	76	H-273-Post	0.1

~~Def~~

Treatment

Post is post-emergence to the beets
Pre is treatment when seeded
H-273 is dipotassium endothall
End-TCA is disodium endothall-TCA
H-283 is dimethyltridecylamine mono salt of endothall
EWK is disodium endothall

V Conclusion

Data appears to support the Proposed use ~~Tolerance of 2 ppm~~

VI Recommendation

~~A favorable opinion is given to registration~~

We should RL Registration for the following reasons:

1. The fish studies are inadequate
2. Soil persistence data are incomplete, ~~and not well documented~~ and
3. Soil metabolism studies are insufficient in light of modern analytical technology

~~1. Hydrolysis Half life studies in water at pH 5, 7 and 9 are needed the half life of endothall should be determined~~

3. ~~4.~~ Photodegradation study in water are needed.