DATE: 7-28-78

To: Product Manager 25 (Taylor)
TS-767

Through: Dr. Gunter Zweig, Chief
Environmental Fate Branch

Through: Mr. James Conlon, Acting Director
Hazard Evaluation Division, TS-769

From: Review Section No. 1
Environmental Fate Branch

Attached please find the environmental fate review of:

Reg./File No.: 524-308

Chemical: Glyphosate

Type Product: Herbicide

Product Name: Roundup

Company Name: Monsanto

Submission Purpose: Data Review. Also nitroso information

Date in: 6-14-78

Date out: 6-30-78

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FEB BRANCH REVIEW

DATE: IN _____ OUT _____ IN 6/14/78 OUT 6/30/78 IN _____ OUT _____

FISH & WILDLIFE ENVIRONMENTAL CHEMISTRY EFFICACY

FILE OR REG. NO. 524-308

PETITION OR EXP. PERMIT NO. _____

DATE DIV. RECEIVED 6/12/78

DATE OF SUBMISSION _____

DATE SUBMISSION ACCEPTED 3CID-No

TYPE PRODUCT(S): I, D,(H) F, N, R, S _____

PRODUCT MGR. NO. Taylor (25)

PRODUCT NAME(S) Roundup

COMPANY NAME Monsanto

SUBMISSION PURPOSE data review

CHEMICAL & FORMULATION Glyphosate (N-phosphonomethylglycine) isopropylamine salt

2

1.0 Introduction

1.1 Applicant has submitted additional Environmental Chemistry studies for Glyphosate (Roundup). Report No. MSL-0207, 6/5/78, R.D. #181, Section J.

2.0 Solubility, Volatility, Adsoprtion and Partition Coefficients, Leaching and Aquatic Metabolism of MON0573 and MON0101. B. B. Brightwell and J. M. Malik. 2/78.

The following solubilities of parent compound (MON-0573) and the sodium salt (MON0101) were determined at different temperatures.

	MON-0101	MON-0573
15%	50.80%	1.34%
25%	49.16%	1.57
35%	54.12%	2.06

The vapor pressures of MON-0573 and MON-0101 determined by the gas saturation method at 45°C were 2.03 E +11 and 1.6 E+12, respectively. These values indicate that glyphosate and the sodium salt are non-volatile from soil.

Partition coefficients of MON-0573 and MON-0101 in octanol-water mixture at 100 ppm and 20 ppm are as follows:

	MON-0573	MON-0101
20 ppm	0.0017	0.0012
100 ppm	0.0006	0.0006

These values are extremely low and may be used to indicate a low degree of bio-accumulation.

Soil adsorption and desorption coefficients were determined by equilibrating four soils and two sediments with four concentrations of MON-0573 or MON-0101 (0.1, 1.0, 10, and 20 ppm) at 25°C. Controls were run and samples were anlayzed by LSC. Both adsorption

and desorption data were treated by the Freundlich isotherm which indicated that both compounds were nearly completely adsorbed at all concentrations by sediments.

Soil binding was dependent on organic content with the least adsorption and greatest desorption being observed with soils containing the least organic matter (sand). Freundlich adsorption coefficients varied from 90-22 for parent compound and from 115-30 for the sodium salt. The percent desorbed did not go above 11.5 for either compound on all soils.

Leaching of ^{14}C-MON-0573 (8 lbs/A equiv.) was studied on 30 cm soil columns (silt loam, silty clay loam, sandy loam, fine sand, lava and volcanic ash) which were eluted with 20 acre inches of water. The leachate and 2 cm soil segments were analyzed by LSC and TLC.

MON-0573 did not leach readily - the greatest mobility occurring in sandy soil (20% of applied ^{14}C-activity).

In an aged leaching study of MON-0573 and MON-0101 where soil columns were aged 30 days prior to eluting with ½ acre inch of water for 45 days, leaching of parent compound and degradation compound (MON-0573) was insignificant.

In soil TLC experiments MON-0573 and MON-0435 were classified as highly immobile.

Hydrolysis of ^{14}C-MON-0573 was determined in sterile water at pH values of 3.0, 6.0, and 9.0 at 25 and 250 ppm. The sterile solutions were incubated in the dark at 5°and 35°C for 32 days and samples taken at intervals of 0, 7, 14, 21, and 32 days were analyzed by LSC, TLC, and HPLC.

In addition three natural water samples, ranging from pH 4.23 to pH 7.30 were treated with 0.1 ppm ^{14}C-MON-0573. filter-sterilized,

incubated in the dark at 30°C and analyzed at 7, 21, 35 and 49 days by LSC, TLC, and HPLC.

Glyphosate was stable in the sterile buffer solutions with slow biodegradation occurring in natural waters (percent recovery varied from 113-98).

Aerobic aquatic metabolism was studied by measuring $^{14}CO_2$ evolution from 0.1 ppm ^{14}C-MON-0573. Duplicate water samples were analyzed by LSC, TLC, and HPLC with total recovery varying from 92-108%.

The most rapid degradation was observed in a Sphagnum Bog, pH 4.23 with a half-life of 7 weeks versus 9-10 weeks for the Cattail Swamp (pH 6.25) and pond water (pH 7.3).

In the anaerobic aquatic metabolism study 0.1 ppm ^{14}C-MON-0573 was applied to two water and sediment samples. Samples were incubated in the dark at 30°C and analyzed as before (aerobic study). The half-lives of MON-0573 was 5 and 7 weeks in the Cattail Swamp and bog, respectively. The major degradate in both studies was MON-0435 (aminomethylphosphonic acid).

Conclusion. The applicant has submitted acceptable hydrolysis, adsorption/desorption, leaching, aerobic and anaerobic aquatic metabolism studies.

2.1 Herbicide Applicator Exposure to N-Nitroso-glyphosate during application of Roundup Herbicide and Field Re-entry. R. M. Kramer 4/78.

Exposure of pesticide operators during and after (re-entry) application of glyphosate to N-nitroso-glyphosate was measured. Results reported include tank filling, spraying with boom, handgun and backpack sprayers and re-entry at 1, 3 and 7 days post-application. Measurements were made to determine exposure by both inhalation and dermal routes plus measurement of the spray solutions

and treated foliage.

N-nitrosoglyphosate was not detected by HPLC in or on any of the intercept samples. It should be noted that the Ames test showed that N-nitroso-glyphosate was not mutogenic. Metabolism studies of 22 different crops did not show the presence of this compound and environmental studies demonstrated that it is readily degraded in the soil ($t_{1/2}$ = 9 minutes when exposed to light).

2.2 Metabolism of CP67575 in Representative Vegetables and Rotational Crops. L. A. Suba 4-76. In Vol. 1 of 2 Section DII Acces. No. 096398 10-25-77. Report No. 406.

A sandy loam soil and a silt loam soil planted with carrots, cabbage, peas, and string beans were treated at the rate of 4 lbs./A with N-phosphono-^{14}C-methyl glycine (glyphosate-^{14}C, CP67573-^{14}C) 16-60 days after planting and harvested 4-11 weeks after treatment. Rotational crops (cabbage, string beans, peas, carrots and sweet corn) were planted 1-23 days after harvesting the main crops. For controls, similar crops were planted to check $^{14}CO_2$ fixation from soil metabolism.

Plant and soil samples were lyophilized, extracted and analyzed by LSC and GLC/MS.
Results. The half-life of glyphosate in the sandy loam was about 17-19 weeks versus 3 weeks in the silt loam soil. Rotational crops in the sandy loam showed an uptake of 0-0.26% of the applied activity from edible parts while uptake in the silt loam was 0.59% of applied activity in carrots. The major degradate was aminomethylphosphonic acid.

After 31 weeks carrots showed residues of 0.37 ppm, while after 17 ½ weeks pea pods had residues of 0.248 ppm.

Table 7. Analysis of the Water Extractable ^{14}C-Activity from Vegetable Crops

Crops		Extractable	Neutrals	CP 67573	CP 50435	Others	Indeter-minate	FIM Data Total Uptake	Extractable	As CP 67573	As CP 50435
NORFOLK - ROTATION CROPS											
Carrots 18 wks	(I)	41.4	30.1	47.3	13.5	9.1	0	.094	[illegible]	.016	.005
Carrot Leaves	(I)	45.7	30.6	47.1	5.1	10.0	7.2	.086	.039	[illegible]	.002
Cabbage 18 wks	(I)	91.8	17.3	50.5	4.9	9.1	18.2	.056	.051	.028	.0[illegible]
Corn 16½ wks	(II)	48.0	26.6	25.1	23.2	25.1	0	.04	.020	.01[illegible]	.00[illegible]
Corn 2nd Harvest	(II)	59.4	39.3	9.4	15.0	12.8	23.5	.09	.053	[illegible]	.008
Kernel	(II)	39.9	44.2					.09			
Cob	(II)	51.5	51.6	6.3	17.5	21.0	3.6	.05	.026	.003	.005
Pea Leaves 17½ wks	(IV)	83.7	15.3	45.5	12.5	6.2	20.5	.19	16[illegible]	.07[illegible]	.021
Pea Pods	(IV)	88.5	10.2	52.3	17.6	5.4	15.0	.2[illegible]	.2[illegible]	.12[illegible]	.044
Carrots 31 wks	(IV)	73.4	58.9	9.4	10.3	11.6	9.8	.05	.037	.00[illegible]	.004
Carrot Leaves	(IV)	51.6	34.7	14.9	5.6	16.7	28.1	.05	.042	.00[illegible]	.002
String Bean Leaves	(III)	66.2	21.7	35.9	5.3	7.5	29.6	.09	.053	.019	.003
String Bean Pod 13½ wks	(III)	90.3	22.1	44.4	8.3	9.9	14.8	.04	.036	.016	.003
Cabbage 27 wks	(III)	57.5	41.7	14.5	11.6	16.1	16.1	.045	.02[illegible]	.00[illegible]	003
BAY - ROTATION CROPS											
Cabbage		55.7	36.5	-	15.1	24.0	24.4	.051	.028		.004
Carrots		65.9	73.1	-	13.7	13.2	0	.039	.020		.003
Carrot Leaves		35.8	62.9	-	6.7	30.4	0	.061	.018		.001

Conclusion. Since residues were found in these studies, a field study using formulated product should be undertaken to determine when residues would or could appear in subsequent crops under actual use conditions. From these studies we cannot be sure that the one-year restriction currently on the label will be entirely adequate. The applicant should examine uptake for intervals up to 18 months.

3.0 Recommendations

3.1 Applicant has submitted acceptable hydrolysis, adsorption/desorption, leaching, aerobic and anaerobic aquatic metabolism studies.

3.2 Applicant has submitted sufficient information concerning the formation of nitroso compounds in the environment.

RLCook 7-28-78

Ronald E. Ney
Karen Sampson
EC, EEE
June 30, 1978

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