



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, DC 20460

JAN 24 1989

OFFICE OF
PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Terrachlor (PCNB). EPA Reg. No. 400-401.
Metabolism Study for Seed Treatment Uses.
DEB No. 4770. MRID Nos. 408629-00, -01.

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By letter of 10/21/88, Uniroyal Chemical Company, Inc. has a submitted pentachloronitrobenzene (PCNB) metabolism study for seed treatment uses. According to Uniroyal, since the primary purpose of the study was to determine the quantity of uptake, metabolite identification was not attempted. Metabolites will be identified in studies in progress on cabbage, potatoes and peanuts treated at planting.

Background

Interim tolerances of 0.1 ppm are in effect under 40 CFR 180.319 for residues of PCNB in or on bananas, beans, broccoli, brussels sprouts, cabbage, cauliflower, garlic, peppers, potatoes and tomatoes. The interim tolerance for peanuts is 1 ppm. A tolerance of 0.1 ppm has been established under §180.291 for negligible residues of PCNB in or on cottonseed. Tolerances of 0.2 ppm with regional registration (Georgia) have been established for residues of PCNB in or on kale and mustard greens. Tolerances are pending for a number of raw agricultural commodities (racs). These proposed tolerances include limitations on the impurity hexachlorobenzene.

Various formulations of PCNB are registered for seed treatment of barley, corn, oats, peas, rice, safflower, sorghum, soybeans, sugar beets and wheat. No tolerances have been established for PCNB residues in/on any crop for which PCNB is

registered exclusively for use in seed treatment because seed treatment uses have been considered to be "non food" uses, i.e., they do not result in measurable residues in food. However, the Registration Standard (Residue Chemistry Chapter, 6/20/86) observed that although no residues of PCNB, per se, were detected in/on the seed of sorghum or the seedlings, roots and foliage of sugar beets grown from PCNB-treated seed, residue accountability was not sufficient to demonstrate no uptake and translocation of PCNB metabolites and/or impurities. Also, no data were submitted for barley, corn, oats, peas, rice, safflower and wheat. In order for these uses to be considered non-food uses, the Registration Standard required that a radiolabeled study be submitted to determine whether uptake and translocation of radioactivity into corn, peas, rice, safflower, sugar beets and wheat occurs when seeds are treated with PCNB at the maximum use rate.

Residues of PCNB, per se, were observed in/on the leaves of soybeans from a crop treated at 0.7x the maximum label rate. The Registration Standard required additional field trials in which the use level reflected the maximum label rate.

In its 90-Day Response (5/3/87) to the Registration Standard, Uniroyal stated that it would conduct radiolabeled studies on corn, sugarbeets, wheat and soybeans. The registration for rice and safflower would be dropped. With respect to soybeans, Uniroyal claimed that the "maximum label rate" of 0.75 lb ai/bu was considerably higher than the rate on Gustafson seed treatment labels -- equivalent to 0.06 lb ai/bu. Because this use rate was much lower than the 0.7 x 0.75 lb ai/bu which resulted in measurable PCNB, Uniroyal proposed to conduct radiolabeled studies prior to additional field work.

Conclusions and Recommendations

1. Uniroyal's report does not indicate the source of the factor 14.1, used to calculate the minimum quantifiable limits (MQL's). There is an error in the subsequent MQL calculation. No raw data (CPM) have been reported.

For the present submission, this information is moot (see Conclusion 2); however, in future submissions of radiolabeled studies the raw data should be submitted along with a brief explanation, with references, of factors such as 14.1.

2. Although raw data are not present and we were unable to verify the MQL calculation, the data do show that uptake of radioactivity occurs in all treated plants in this study. Hence, we cannot conclude that seed treatment with PCNB is a "non food" use.

3. The nature of the residue in plants is not adequately understood. The metabolism studies in progress on cabbage, potatoes and peanuts must be submitted.

4a. Once the nature of the residue in plants has been satisfactorily elucidated, field trials must be conducted in the following states for the following crops:

Corn (grain, hay, forage): CO, GA, IA, IL, NE, TX.

Soybeans (grain, forage, fodder): IA, LA, MN, MI, OH, TN.

Peas (fresh and dried peas and vines): DE, ID, MN, NY, WA, WI.

Sugarbeets (roots, tops): CA, CO, ID, MI, MN, WA.

Wheat (grain, hay, forage): CA, CO, KS, OK, TX, WA.

4b. In one of the field trials on corn, seeds should be treated with PCNB at ≥ 28 times the maximum label treatment level. If no detectable residues are found in the resulting corn grain, a processing study will not be required. If detectable residues are present, corn grain obtained from the exaggerated treatment should be processed to starch, crude oil and refined oil and these commodities analyzed for PCNB residues. If it is not possible to treat seeds at 28x the maximum use level, the maximum feasible application level should be used and a processing study done.

4c. In one of the field trials on soybeans, seeds should be treated with PCNB at ≥ 5.4 times the maximum label treatment level. If no detectable residues are found in soybean grain, a processing study will not be required. If detectable residues are present, the soybean grain obtained from the exaggerated treatment should be processed to meal, hulls, soapstock, crude oil and refined oil and these commodities analyzed for PCNB residues.

5a. The nature of the residue in animals is not adequately understood. The Registration Standard required metabolism studies in ruminants and poultry. Until the nature of the residue in animals has been satisfactorily elucidated, we will not know whether existing feeding studies are adequate.

5b. Because the nature of the residue in plants and animals is not understood and because field trial data are lacking, at this time we will make no attempt to estimate PCNB residues in animal products resulting from seed treatment uses.

Detailed Considerations

The following study has been submitted: F. Selman, E. Fentz, T. Leak, "Determining the Uptake and Translocation of [^{14}C]PCNB Used in the Seed Treatment of Corn (Zea mays), Wheat (Triticum aestivum), Soybean (Glycine max), Peas (Pisum sativum), and Sugarbeets (Beta vulgaris)", 3/28/88. The study was done at Analytical Bio-Chemistry Laboratories, Inc., Columbia, Missouri. The laboratory project ID no. is 35972. The study has been assigned MRID No. 408629-01.

Seeds were dosed with a mixture of Terraclor (PCNB-2EC) and [^{14}C]-PCNB Primary Stock Solution, an acetone solution of [^{14}C]-PCNB. The purity of the [^{14}C]-PCNB in the solution was determined to be 96% by TLC. Treated seeds were tumbled overnight in bottles to facilitate homogeneous coating. After tumbling and prior to planting, ten individual seeds from each seed type were separately combusted on a Packard Tri-Carb Sample Oxidizer and then analyzed by liquid scintillation counting (LSC). The reported treatment level for each seed type is the mean of the 10 individual seed concentrations. Treatment levels and label treatment levels (Registration Standard, pp. 95-96) are given in Table 1.

Table 1

Seed Type	Nominal Treatment Level (mg/g)	Measured Treatment Level (mg/g)	Max. Label Level (mg/g)
Corn*	0.523	0.39	0.46
Peas*	1.25	0.41	1.0
Sugarbeets	1.87	1.7	1.9
Wheat	0.523	0.42	0.5
Soybeans	1.045	0.72	0.5

* Uniroyal speculates that the peas, having a wrinkled surface, may not have been coated uniformly. Although there is a significant difference between nominal and measured treatment levels, this difference should be maintained when real samples are treated.

Controls and treated seeds were planted in greenhouse plots. Due to poor emergence, the control and treated sugarbeets and treated peas were replanted. Plant parts were usually frozen immediately after harvest (dried peas were frozen after 7 days), then ground and placed in frozen storage. Samples were analyzed 13-27 days after harvest.

Concentrations of [^{14}C]-PCNB were determined by duplicate or triplicate analyses of each sample using sample combustion followed by LSC. Recoveries were determined by spiking control plant tissue with [^{14}C]-PCNB at two levels. The lower level --

70.74 dpm [^{14}C]-PCNB-- corresponded to a concentration of about 200 ppb. The higher level -- from 416,274 dpm to 693,760 dpm, depending on the crop -- reflected 100% uptake into tissue. Percent low spike recoveries averaged $100.8 \pm 8.3\%$. Percent high spike recoveries averaged $97.6 \pm 1.8\%$.

Minimum quantifiable limits (MQL) were determined for each set of samples based upon radiochemical statistics of the replicate controls. In future submissions of this type, Uniroyal should submit a brief explanation with reference of how the factor 14.1 in the equation to calculate the MQL was derived. There is an error in the subsequent sample calculation (page 25). Raw data (CPM) for samples and background are not present and should be submitted in future submissions. For the present submission, this information is moot, for field trial data will be necessary (see below). MQL's varied from 0.0143 ppm (soybean grain) to 0.0879 ppm (wheat forage).

PCNB concentrations are given in Table 2.

Table 2

	PHI (days)	Mean Measured Concentration (ppm)	Mean Measured Conc. as a Percent of Measured Treatment Level (Table 1)
Corn			
Haylage ¹	48	<0.075*	-----
Silage	90	<0.045*	-----
Grain	125	<0.014*	-----
Stover	125	0.024	0.0062
Peas			
Fresh Peas	48	<0.070*	-----
Pea Vines	48	0.567	0.14
Dry Peas	48	<0.017*	-----
Dry Pea Vines	68, 76	1.81	0.44
Sugarbeets			
Roots	125	0.457	
Tops	125	<0.064*	0.027
Soybeans			
Hay	48	0.74	
Grain	102	<0.014*	0.10
Stalk	102	1.47	-----
			0.20

Wheat

Forage	33	0.536	0.13
Hay	63	<0.078*	-----
Grain	125	<0.015*	-----
Straw	125	0.056	0.013

¹ "Haylage" is essentially a grass silage wilted to 35-50% moisture.
 * MQL

Comment

With one exception, the results of the radiolabeled study are consistent with earlier residue analyses. Residues of [¹⁴C]-PCNB were not measured at concentrations greater than the MQL in corn grain, peas, wheat grain and soybeans when grown from treated seed. Significant residues were found in sugarbeets, the only human food item in which residues were detected. (There are no tolerances -- interim or pending -- for sugarbeets.) However, the fact that measurable uptake does occur in all plants tested strongly suggests that the seed treatment uses of PCNB cannot be considered "non food" uses, for residues in animal products are a definite possibility. Therefore, field trials will be necessary so that appropriate tolerances may be set. In addition, processing studies will be necessary for corn and soybeans, if exaggerated treatment levels show measurable residues.

Recent residue studies on crops treated with PCNB have included analytical results for PCNB; the metabolites pentachloroaniline (PCA), methylpentachlorophenyl sulfide (MPS); and the impurities pentachlorobenzene (PCB) and hexachlorobenzene (HCB). However, the Registration Standard concluded that the nature of the residue in plants was not adequately defined and required metabolism studies using cabbage, potatoes and peanuts treated at planting. In its 10/21/88 cover letter, Uniroyal states that these studies are in progress. Metabolites will be identified. (Metabolite identification was not attempted in the present study because of the low levels expected.) It would not be advisable for Uniroyal to conduct additional residue trails until these metabolism studies have been completed and reviewed.

The following residue studies will eventually be necessary:

Corn. Field trials should be conducted in Colorado, Georgia, Iowa, Illinois, Nebraska and Texas.. In 1983, these states accounted for 47% of the U.S. corn production (Agricultural Statistics, 1985). PCNB should be applied at the maximum label use level. Grain, forage and fodder should be analyzed. In one study seeds should be treated at 28x the maximum level. (This is the theoretical concentration factor used in DEB in going from grain, which has a minimum of 3.6% oil, to oil. If no detectable residues are found in the resulting

corn grain, a processing study will not be required. If detectable residues are present, corn grain obtained from the exaggerated treatment should be processed to starch, crude oil and refined oil and these commodities analyzed for PCNB residues. If it is not possible to treat seeds at 28x the maximum use rate, the maximum feasible application level should be used and a processing study done.

Soybeans. Field trials should be conducted in Iowa, Louisiana, Minnesota, Missouri, Ohio and Tennessee. In 1983, these states accounted for 28% of the total U.S. crop production (Ag. Statistics, 1985). Grain, hay and forage should be analyzed for PCNB residues. In one of these studies, seed should be treated at $\geq 5.4x$ the maximum use rate. (This is the theoretical concentration factor in going from grain to oil.) If no detectable residues are found in soybean grain, a processing study will not be required. If detectable residues are present, the soybean grain obtained from the exaggerated treatment should be processed to meal, hulls, soapstock, crude oil and refined oil and these commodities analyzed for PCNB residues.

Peas. Field trials should be conducted in Delaware, Idaho, Minnesota, New York, Washington and Wisconsin. Washington and Idaho account for over 95% of the U.S. dry pea production (Foods and Food Production Encyclopedia, 1982). The six states accounted for about 75% of the green pea production (for processing) in 1983 (Ag. Statistics, 1985). Fresh and dried peas and vines should be analyzed for residues of PCNB.

Sugarbeets. Field trials should be conducted in California, Colorado, Idaho, Michigan, Minnesota and Washington. These states account for over 70% of the U.S. crop production (Foods and Food Production Encyclopedia, 1982). Roots and tops should be analyzed for residues of PCNB. Because concentration of residues is not expected in non-fatty products, a processing study will not be required.

Wheat. Field trials should be conducted in California, Colorado, Kansas, Oklahoma, Texas and Washington. In 1983, these states accounted for 45% of the U.S. crop production (Ag. Statistics, 1985). Grain, hay and forage should be analyzed for residues of PCNB.

Residues in Meat, Milk, Poultry and Eggs

Tolerances of 0.15 ppm, of which no more than 0.05 ppm may be HCB, have been proposed for the combined residues of PCNB and its metabolites/impurities in the fat of cattle, goats, hogs, sheep and poultry. Tolerances of 0.05 ppm, of which no more than 0.02 ppm may be HCB, have been proposed for the same residues in meat, meat by-products, milk and eggs. The results given in Table 2 suggest that a measurable residue in animal products due

to consumption of seed-treated crops is a definite possibility. The Registration Standard stated that the nature of the residue in animals is not adequately understood and has requested metabolism studies in ruminants and poultry. Because the nature of the residue in plants and animals is not understood and adequate residue data from field trials are lacking, we make no estimate at this time of possible levels of PCNB residues expected in animal products from consumption of seed treated crops.

cc: RF., Circu., PCNB SF, PCNB Reg. Std. File, PMSD/ISB(Eldredge)
Reviewer(Mike Flood).
RDI:SectionHead:ARRathman:1/23/89:DeputyChief:RDSchmitt:1/23/89.
TS-769C:DEB:557-4362:MTF:mtf:CM#2:Rm810:1/24/89.