Hydro Québec

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Objet : Entretien des emprises, valeur des terres agricoles et méthodes de travail en présence d'espèces floristiques rares

Madame Méthot,

Le mercredi 4 juin dernier, la Commission a demandé le dépôt de références concernant les études réalisées par divers organismes indépendants, démontrant que les phytocides ne sont pas nocifs pour la santé s'ils sont utilisés conformément aux prescriptions du fabricant et en conformité avec les normes d'Hydro-Québec (voir la réponse n° 45 dans le premier complément de l'étude d'impact publié en février 2008).

Les références en question sont annexées à la présente lettre. La plupart sont tirées d'une revue effectuée par M. Milo Mihajlovich en 2001 sur le triclopyr, le phytocide qui serait utilisé pour l'entretien de l'emprise de la ligne Chénier-Outaouais si une application de phytocide était éventuellement requise. Vous trouverez également quatre autres références sur le sujet.

L'analyse de cette revue de la littérature permet de conclure que s'il est appliqué conformément à la législation et en respectant les consignes d'Hydro-Québec, le triclopyr ne présente pas de risque d'atteinte à la santé de la population ni des travailleurs qui appliquent ce produit, ni de risque pour la faune.

Par ailleurs, la Commission s'est également intéressée à la valeur des terres agricoles. Après vérification, Hydro-Québec ne dispose pas d'études traitant de l'influence d'installations de transport sur la valeur des terres agricoles.

En ce qui a trait aux méthodes de travail en présence d'espèces floristiques rares, à la suite des inventaires qui seront effectués à l'été 2008 dans l'emprise de la ligne Chénier-Outaouais et advenant la découverte d'une espèce floristique à statut particulier, diverses mesures d'atténuation pourraient être mises en place. En voici quelques exemples :

- optimiser la localisation des pylônes ;
- optimiser la stratégie de circulation et de construction (déboisement en hiver) ;

- baliser les populations situées à proximité des aires de travail et des chemins de circulation ;
- conserver le plus intégralement possible l'habitat lors du déboisement (mode de déboisement de types B et C) ;
- transplanter des plants (ail des bois, par exemple).

Nous espérons que ces quelques renseignements répondent adéquatement à vos attentes et nous demeurons disponibles, madame Méthot, si tout renseignement supplémentaire était nécessaire.

Dany Duchesne
Chef de projets et porte-parole

ANNEXE

Références concernant les phytocides

Références tirées de la revue suivante :
MIHAJLOVICH, Milo, *Triclopyr Herbicide, A Technical Bibliography of Non-target Effects*, Incremental Forest Technologies Ltd, 2001, p. 122-129

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Baker, L., R. Tomin, and D. Fitzell. 1993. Air monitoring of herbicide applications. Proc. For., Veg. Manage. Conf., Redding. Calif. pp. 41-43.

Bush, P. B., D. G. Neary, C. K. McMahon, and J. W. Taylor, Jr. 1987. Suitability of hardwoods treated with phenoxy and pyridine herbicides for use as firewood. Arch. Environ. Contam. and Toxicol. 16: 333-342. Potential exposure to pesticide residues resulting from burning wood treated with phenoxy and pyridine herbicides was assessed. Wood samples from trees treated with 2,4-D (2,4-dichlorophenoxy acetic acid), dicamba (3,6-dichloro-oanisic acid), dichlorprop (2- (2,4-dichlorphenoxy) propionic acid), picloram (4-amino-3,5,6-trichloropicolinic acid), and triclopyr (3,5,6-trichloro-2-pyridinyl) oxy acetic acid contained variable amounts of parent compound residues at 4, 8, and 12 months after application. At the time of the latter sampling, residues of 2,4-D, dicamba, and picloram were 2.1 mg/kg on a fresh weight basis. Mean residue concentrations of triclopyr and dichlorprop were somewhat higher at 3.5 and 13.0 mg/kg, respectively. In a laboratory experiment, samples with known amounts of herbicide residue were subjected to either slow or rapidly burning conditions in a tube furnace. During slow combustion, relatively stable compounds such as 2,4-D, dicamba, and dichlorprop were released in significant amounts. Rapid combustion greatly enhanced decomposition of 2,4-D, dicamba, dichlorprop, picloram, and triclopyr. A welldeveloped fire in a wood stove or fireplace, with active flaming combustion, where temperatures commonly reach 800-1,000°C, should result in greater than 95% thermal decomposition of the herbicides examined in this study. Burning of herbicide-treated wood under smoldering conditions could result in very low levels of herbicide residue in ambient indoor air. However, the exposure levels are less than 0.3% of the threshold limit value for 2,4-D and triclopyr. The exposure is also more than 3 orders of magnitude lower than the established acceptable daily intakes for these products.

Carmichael, N. G. 1989. Assessment of hazards to workers applying pesticides. Food Addit. Contam. 6 Suppl 1, PS21-7. Exposure to pesticides as a result of their use in agriculture will vary according to the type of formulation, the method of application and the protective measures used. Quantitation of external exposure does not on its own predict the amount absorbed nor does it allow the toxic hazard to be assessed; information on skin penetration is also required. With the use of a suitable generic database for exposure, the assessment of many compounds would only require the measurement of skin penetration. With the knowledge of human dermal

pharmacokinetics a field study can be performed which measures the absorbed dose directly and avoids the need for exposure measurement.

Carmichael, N. G., R. J. Nolan, J. M. Perkins, R. Davies, and S. J. Warrington. 1989. Oral and dermal pharmacokinetics of triclopyr in human volunteers. Human Toxicol. 8: 431-438. Blood levels and urinary excretion of triclopyr, the active ingredient in Garlon herbicides, were followed in six volunteers given single doses of 0.1 and 0.5 mg/kg body weight. Five of these volunteers later received dermal applications of Garlon 4 herbicide formulation equivalent to 3.7 mg triclopyr/kg body weight applied to the forearm. Following oral administration blood levels peaked at 2-3 h and declined to undetectable levels within 48 h; more than 80% of the dose was found as unchanged triclopyr in the urine. A two-compartment pharmacokinetic model was used to describe the time-course of triclopyr clearance; half-lives for the rapid initial and slower terminal phases were 1.3 h and 5.1 h respectively, and were independent of dose. Due to the slow half-life for determal absorption (t1/2 = 16.8 h) the rapid initial elimination phase was obscured and the pharmacokinetics could be simplified by a one-compartment model. An average of 1.37% of the applied dose was recovered in the urine; when corrected for recovery after oral administration this was equivalent to an absorption of 1.65%. Triclopyr is slowly absorbed through skin and is rapidly eliminated. It has very low potential to accumulate in man or to be absorbed through the skin in acutely toxic amounts.

De'ath, M. R. 1988. Triclopyr - a review of its forestry and industrial weed control uses. Aspects Applied Biology. 16: 183-188. The toxicology, soil behaviour, mode of action and use of triclopyr for forest and industrial weed control is reviewed briefly.

Hotchkiss, S. A. M., P. Hewitt, J. Caldwell, W. L. Chen, and R. R. Rowe. 1992. Percutaneous absorption of nicotinic acid, phenol, benzoic acid and triclopyr butoxyethyl ester through rat and human skin *in vitro*: Further validation of an *in vitro* model by comparison with in vivo data. Food and Chem. Toxicol. 30: 891-899. The *in vivo* percutaneous absorption of three model compounds, nicotinic acid, phenol and benzoic acid, and the herbicide triclopyr butoxyethyl ester (triclopyr BEE) has been investigated in flowthrough diffusion cells using skin from male Fischer 344 rats and humans. After the application of four chemicals to the epidermal surface of unoccluded fullthickness rat skin, the absorption of each compound across the skin and into the receptor fluid at 72 hr reached 3.7 ± 0.3, 5.7 ± 0.6, 26.7 ± 3.7 and 48.3 ± 1.2% (mean ± SD, n = 2-7) of the applied dose for triclopyr BEE, nicotinic acid, phenol and benzoic acid, respectively. After the application of the four chemicals to the epidermal surface of unoccluded full-thickness human skin, the absorption of each compound across the skin and into the receptor fluid at 72 hr was significantly ($P < 0.05$) less than through rat skin, reaching 0.7 ± 0.1, 0.7 ± 0.2, 18.8 ± 1.3 and 37.8 ± 6.9% (mean ± SD, n = 2-7) of the applied dose for triclopyr BEE, nicotinic acid, phenol and benzoic acid, respectively. Occlusion of the skin surface with teflon caps often significantly ($P < 0.05$) enhanced the percutaneous absorption of the model compounds, although this effect was not uniform, varying with the compound under study and the skin (rat or human) used. When rat skin was occluded with teflon caps, the extent of absorption at 72 hr reached 8.6 ± 0.8, 36.2 ± 1.7 and 51.8 ± 3.3% (mean ± SD, n = 3-4) for nicotinic acid, phenol and benzoic acid, respectively.

Corresponding values for human skin occluded with teflon caps were 3.3 ± 1.6, 47.1 ± 0.5 and 65.5 ± 7.1% (mean ± SD, n = 3-4). The experiments on the absorption of each model compound through rat and human skin were repeated and there was generally good agreement between the results from the two sets of experiments. The *in vitro* data reported compare favorably with data obtained by other workers using both *in vitro* and *in vivo* methodologies. The *in vitro:in vivo* correlation supports the use of the flow-through diffusion cell system as a model for the prediction of percutaneous absorption *in vivo* in the rat and in humans.

Johnson, E. M. 1987. A tier system for developmental toxicity evaluations based on considerations of exposure and effect relationships. Teratology 35:405- 427.

Kale, P. G., B. T. Petty, Jr., W. Walker, J. B. Ford, N. Dehkordi, S. Tarasia, B. O. Tasie, R. Kale, and Y. R. Sohni. 1995. Mutagenicity testing of nine herbicides and pesticides currently used in agriculture. Environ. And Molecular Mutagenesis. 25: 148-153. Nine pesticides (permethrin, trifluralin, acifluorfen[-sodium], glyphosate as either Roundup or Pondmaster, 2,4-D, Crossbow [triclopyr], chlordimeform and prometon) were tested for their mutagenicity using the *Drosophila* sex-linked recessive lethal mutation assay. Unlike adult feeding and injection assays, the larvae were allowed to grow in medium with the test chemical, thereby providing long and chronic exposure to the sensitive and dividing diploid cells, i.e., mitotically active spermatogonia and sensitive spermatocytes. All chemicals induced significant numbers of mutations in at least one of the cell types tested. As some of these compounds gave negative results in earlier studies, an explanation for the difference in results is provided. It is probable that different germ cell stages and treatment regimes are suitable for different types of chemicals. It is concluded that larval treatment may still be valuable and can complement adult treatment in environmental mutagen testing.

Leveille, P., J. Legris, G. Couture, and R. Langevine. 1995. Evaluation of the effects of triclopyr used in forestry. Pub. No. RN95-3084; Ministère des Ressources Naturelles; Québec; Canada. 18 p. An account is given of the chemical composition, biological action, toxicology, degradation and decomposition in air, soil, water, flora and fauna (including human), and effects on vegetation, fauna and humans, of the herbicide triclopyr.

McMahon, C. K. and P. B. Bush. 1992. Forest worker exposure to airborne herbicide residues in smoke from prescribed fires in the southern United States. Amer. Indus. Hygiene Assoc. J. 53: 265-272. Occupational safety and health concerns have been raised in a number of southern states by workers conducting prescribed burns on forest lands treated with herbicides. Modeling assessments coupled with laboratory experiments have shown that the risk of airborne herbicide residues to workers is insignificant, even if the fire occurs immediately after herbicide application. However, no field studies had been conducted to confirm these findings. To bridge that gap, a field validation study was conducted in Georgia to measure breathing zone concentrations of smoke suspended particulate matter (SPM), herbicide residues, and carbon monoxide (CO) on 14 operational prescribed fires. Smoke was monitored on sites treated with labeled rates of forestry herbicides containing the

active ingredients imazapyr, triclopyr, hexazinone, and picloram. The sites were burned within 30-169 days after herbicide application. Tract size ranged from 2.4 to 154 hectares. Personal monitors and area monitors employing glass fiber filters and polyurethane foam collection media were used. No herbicide residues were detected in the 140 smoke samples from the 14 fires conducted in this study. The sensitivity of the monitoring methods was in the 0.1 to 4.0 µg/m3 range, which is several hundred to several thousand times less than any established occupational exposure limit for herbicides. The SPM and CO monitored on these fires is the first time breathing zone concentrations of these smoke constituents have been measured in the South. As expected, concentrations were highly variable depending on fire conditions and the location of personnel. Worker respirable (2.3 µ particle cut point) SPM concentrations ranged between 0.2 and 3.7 mg/m3.

McMahon, C. K., P. B. Bush, and T. G. Rials. 1994. Evaluation of worker respiratory exposure to herbicide residues in prescribed fire smoke: A preliminary report. Symposium on current research in the chemical sciences. Third Annual Southern Station Chemical Sciences Meeting, Alexandria, Louisiana, 7-8 February 1990. General Technical Report, Southern Forest Experiment Station, USDA Forest Service, No. SO-101. pp. 37-41. Concentrations of smoke particles, herbicide residues and carbon monoxide were measured during 14 operational site-preparation prescribed fires on forest sites in Georgia which had been treated with labelled rates of imazapyr, triclopyr, hexazinone or picloram 30-169 days before burning.

Middendorf, P., C. Timchalk, B. Kropscott, and D. Rick. 1992. Forest worker exposures to triclopyr butoxyethyl ester during directed foliar applications of Garlon 4 herbicide. Proc. 45th Annual Meeting Southern Weed Sci. Soc. pp. 177-185. Exposure of forest workers to triclopyr over 1 working day while mixing and applying a directed 3% foliar spray by backpack sprayer was assessed for teams of workers at 4 sites by monitoring inhalation and dermal exposures over 1 test day and urine triclopyr levels over 5 days. The overall geometric mean of the biomonitored dose of triclopyr was 1106 µg, with the dermal route giving 86.2% of the total estimated dose; 6 of 21 workers had doses >1% of the no-observed-effect level. An analysis of factors contributing to higher doses included consideration of weather, site conditions, gloves, training and experience, equipment, mixing, adjuvant and tobacco use; it was concluded that vegetation density and height, training and experience, gloves, mixing procedures and equipment maintenance influence exposure to triclopyr.

Moriya, M. T. Ohta, K. Watanabe, T. Miyazawa, K. Kato, and Y. Shirasu. 1983. Further mutagenicity studies on pesticides in bacterial reversion assay systems. Mutat. Res. 116:185-216.

Samuel, O., L. Houde, and D. Phaneuf. 1994. Evaluation of risks to human health attributable to the use of triclopyr in a forest environment. An assessment was made of the potential risks to human health associated with the use of the phytocide Release® in forest regeneration maintenance operations (basal bark application). In general, worker exposure to triclopyr is low if the recommended safety measures are

complied with. However, further information is required before firm conclusions can be drawn as to health risks associated with the use of triclopyr. The amounts of triclopyr used should not constitute a risk to public health.

Sassaman, J. F., R. Pienta, M. Jacobs, and J. Cioffi. 1984. Pesticide background statements. Vol. 1. Herbicides. 909 pp. The individual Herbicide Background Statements have been compiled to provide a comprehensive review of the available information concerning the use, chemistry, toxicology, environmental fate, and comparative hazard of the herbicides in forest applications. References to the published literature at the end of each background statement are provided for those individuals who wish to independently evaluate the toxicological data and environmental fate information that is presented in summary form. In many instances, secondary sources, such as review articles, handbooks, and company technical data sheets, were used. Wherever possible in these instances, the primary source was also indicated and referenced, although it may not have been examined. Herbicides included in the document are: amitrole, atrazine, 2,4-D, 2,4-DP, dalapon, dicamba, fosamine ammonium, glyphosate, hexazinone, picloram, simazine, and triclopyr.

Segawa, R., A. Bradley, P. Lee, D. Tran, J. Hsu, J. White, and K.S. Goh. 1997. Residues of forestry herbicides in plants of importance to California native Americans. Bulletin of Environmental Contamination and Toxicology. 59: 556-563. The monitoring results are reported for herbicide residues in 13 plant species collected from inside and outside treatment areas in 4 National Forests in California following ground applications of 1.0-1.5 lbs/acre glyphosate and 3.0-3.5 lbs triclopyr and aerial or ground applications of 1.0-1.5 lbs hexazinone. From within the treatment area, 45 out of 92 samples contained detectable residues while the figure for outside this area was 4 out of 119. Glyphosate, hexazinone and triclopyr residues were found in 52, 47 and 50%, and 5, 2 and 3% of samples inside and outside the treatment areas, respectively. However, residues were found in 94 and 15% of samples taken from plots subjected to aerial (broadcast over the entire plot) and ground (direct on individual trees) treatment with hexazinone, respectively.

Shackelford, D.D., D.L. Young, C.A. Mihaliak, B.A. Shurdut, and J.A. Itak. 1999.Practical immunochemical method for determination of 3,5,6-trichloro-2-pyridinol in human urine: applications and considerations for exposure assessment. Journal of Agricultural and Food Chemistry. 47: 177-182. An analytical method is described for the quantitative determination of 3,5,6- trichloro-2-pyridinol (3,5,6-TCP), the primary analyte found in urine as a result of exposure to chlorpyrifos, chlorpyrifos-methyl and triclopyr. Conjugates of 3,5,6-TCP are released from urine by acid hydrolysis. Free 3,5,6-TCP is then purified using C18 solid-phase extraction, eluting the analyte with 1- chlorobutane. An aliquot of 1-chlorobutane is placed in a vial containing Trichloropyridinol Sample Diluent and evaporated, leaving 3,5,6-TCP in the aqueous sample diluent. The samples are assayed using the Trichloropyridinol RaPID Assay immunoassay test kit. Final results are calculated using a standard curve constructed by linear regression after a ln/Logit data transformation is performed of the concentration and the absorbance readings, respectively. The calculated lower limit of quantitation for 3,5,6-TCP in fortified control urine samples is 2.96 ng/ml (2.96 ppb). The overall recovery level over the

range of 2.00 to 200.00 ng/ml 3,5,6-TCP was 92%. A comparative study found that residues of 3,5,6-TCP determined using both immunochemical and gas chromatography with mass spectrometric detection correlated well.

Shirasu, Y., M. Moriya, H. Tezuka, S. Teramoto, T. Ohta, and T. Inoue. 1982. Knowledge gained from the testing of large numbers of chemicals in a multi-laboratory, multi-system mutagenicity testing program. Environ. Mutagen. Carcinog., Proc. 3rd International Conf., pp. 331-335.

Siltanen, H., C. Rosenberg, M. Raatikainen, and T. Raatikainen. 1981. Triclopyr, glyphosate and phenoxy herbicide residues in cowberries, bilberries and lichen. Bull. Environ. Contam. and Toxicol. 27: 731-737. Investigations were carried out in Finland into herbicide residues in wild berries in forests which had been subjected to foliar spraying for brush control. Residues of triclopyr were analyzed in cowberries and bilberries after treatment with 0.25, 0.75 and 2.25 kg/ha of the herbicide. Effect of date of treatment on glyphosate (applied at the rate of 0.75 kg/ha) and triclopyr residues was investigated. Results are tabulated. These showed that the residues in the berries were of the same order of magnitude when the same amount of any of the herbicides was used. In aerial spraying the application rate was lowest for glyphosate and highest for phenoxy herbicides. As a result residues in the berries from aerially sprayed forests can be expected to the highest after phenoxy herbicide application and lowest after glyphosate application.

Timchalk, C. and R.J. Nolan. 1997. Pharmacokinetics of triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid) in the beagle dog and rhesus monkey: perspective on the reduced capacity of dogs to excrete this organic acid relative to the rat, monkey, and human. Toxicology and Applied Pharmacology. 144: 268-278. The pharmacokinetics of triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid) were measured in the beagle dog and rhesus monkey and compared with the kinetics observed in rats and humans. In addition, studies were conducted in anesthetized dogs to better understand the mechanism by which (14C)triclopyr is eliminated in this species. Triclopyr was dissolved in distilled water, and administered as a single oral dose of 0.5, 5, or 20 mg/kg to three male dogs. A single male rhesus monkey was given an intravenous dose of 30 mg (14C)triclopyr/kg body wt on two occasions separated by 10 days. Anesthetized male dogs, were implanted with venous, arterial, and urethral catheters and given increasing amounts of triclopyr to produce plasma triclopyr levels ranging from 0.3 to 27 mu-g eq/mL. In the monkey, triclopyr was rapidly eliminated from the plasma (t-1/2 = 6.3 hr) with gt 95% of the urinary 14C activity excreted within 24 hr postdosing. In the dog, orally administered triclopyr was rapidly and effectively absorbed at every dose level with virtually all of it excreted in the urine by 72 hr postdosing. However, the kinetics were slightly nonlinear, and the fraction of the dose excreted in the urine decreased with increasing dose. Several nonlinear processes may collectively contribute to the modest nonlinear pharmacokinetics in the dog. Plasma protein binding of triclopyr in the dog ranged from 94 to 99%, was nonlinear, and was an important determinant in the renal clearance of triclopyr. The nonlinear plasma protein binding indicates that glomerular filtration became disproportionately more important as plasma triclopyr concentration increased. There was good evidence for a high-affinity low-capacity activesecretory

process that was saturated by low plasma triclopyr concentrations. As plasma triclopyr concentrations increased, tubular reabsorption begins to exceed secretion, resulting in decreased renal clearance. The volume of distribution, normalized for body weight, was constant across all species. While clearance and half-life could be allometrically scaled to body weight for the rat, monkey, and human, the dog had a much slower clearance and longer half-life for triclopyr elimination than predicted allometrically. These data demonstrate that the pharmacokinetics of triclopyr in the dog are markedly different than in rat, monkey, and human.

Timchalk, C., D. R. Finco, and J. F. Quast. 1997. Evaluation of renal function in rhesus monkeys and comparison to beagle dogs following oral administration of the organic acid triclopyr (3,5,6-trichloro-2- pyridinyloxyacetic acid). Fundamental and Applied Toxicol. 36: 47-53. The current study evaluated the effects of triclopyr (3,5,6- trichloro-2- pyridinyloxyacetic acid) on renal function following oral administration in the beagle dog and Rhesus monkey. Male rhesus monkeys were orally administered triclopyr by gavage at a dose of 5 mg/kg/day, 7 days/week for 28 days, after which the dosage was increased to 20 mg/kg/day for 102 consecutive days. Groups of male dogs were administered either a single oral dose of 5 mg/ kg triclopyr or were fed a diet spiked with triclopyr at a dose of 5 mg/kg/day for 47 consecutive days. The following functional and clinical chemistry parameters were evaluated: exogenous phenolsulfonphthalein (PSP) excretion, inulin and para-aminohippurate (PAH) clearance (monkeys only), endogenous serum creatinine, and blood urea nitrogen (BUN) at multiple time points during the study. Creatinine, BUN, and inulin clearance were within the normal range from both species following triclopyr administration which indicates that repeated administration of triclopyr in the dog and monkey had no effect on glomerular filtration rate (GFR). In monkeys, the percentage excretion of PSP and PAH appeared to increase following triclopyr administration (20 mg/kg/day), suggesting that these weak organic acids may be competing for the same plasma protein-binding site enhancing their clearance. More importantly, these data strongly suggest that triclopyr is not competing with PSP or PAH for the active secretory site within the monkey kidney proximal tubules. In contrast, PSP clearance studies in dogs clearly demonstrated that triclopyr administration (5 mg/kg) can significantly decrease the percentage PSP excretion even following a single dose administration. The decrease in percentage PSP was reversible and inversely related to the plasma triclopyr concentration. Overall, these data clearly indicate that triclopyr effectively competes with PSP for the active secretory site within the dog kidney proximal tubules. In contrast, the monkey was insensitive to the effects of triclopyr on the active secretory process even at doses fourfold higher (20 mg/kg/day) than the effective dose in the dog (5 mg/kg/day). These findings suggest that the effect observed on PSP and PAH excretion in the dog represent a physiological competition for excretion and not toxicity.

World Health Organization Geneva, Switzerland 1996. Maximum residue limit of triclopyr - Canada. International Digest Health Legislation 47 (2) 199. Food and Drug Regulations, Schedule No. 990, SOR/96-87. Amends the Canada Food and Drugs Act by establishing a maximum residue limit of 0.5 ppm for triclopyr, including its metabolite, in animals intended for human consumption.

Autres références

Carney, E. W., Billington, R., and Barlow, S. M. (2007). **Developmental toxicity evaluation of triclopyr butoxyethyl ester and triclopyr triethylamine salt in the CD rat**. *Reprod Toxicol* **23**, 165-174.

Gosselin, N. H., Brunet, R. C., Carrier, G., and Dosso, A. (2005). **Worker exposures to triclopyr: risk assessment through measurements in urine samples**. *Ann Occup Hyg* **49**, 415-422.

Hanley, T. R., Jr., Thompson, D. J., Palmer, A. K., Beliles, R. P., and Schwetz, B. A. (1984). **Teratology and reproduction studies with triclopyr in the rat and rabbit**. *Fundam Appl Toxicol* **4**, 872-882.

Timchalk, C., Dryzga, M. D., and Kastl, P. E. (1990). **Pharmacokinetics and metabolism of triclopyr 3,5,6-trichloro-2-pyridinyloxyacetic acid) in Fischer 344 rats**. *Toxicology* **62**, 71-87.