TechLine
Information for Noxious Weed Control Professionals
January, 1991

Decay And Movement Of Tordon 22K Herbicide For Roadside Knapweed Control In Montana

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"False facts are highly injurious to the progress of science, for they often endure long; but false views, if supported by some evidence, do little harm, for everyone takes a salutary pleasure in proving their falseness."
... Charles Darwin

In western Montana a detailed study evaluated the environmental fate of Tordon* 22K herbicide used for roadside weed control. Tordon 22K is very effective for the control of spotted knapweed along roadsides in Montana. The effectiveness of Tordon 22K is partially due to its solubility in water and its relatively lengthy active period after being transported into the soil. Due to these traits, the study addressed the potential risk of the herbicide's movement into nearby ground or surface water after heavy rainstorms or cumulative precipitation over the active life of the herbicide.

The study included two test sites which depicted optimum and adverse conditions for the retention of Tordon 22K in the spray swath area while avoiding contamination of water supplies.

Best Case-Fort Missoula

The site chosen to represent the best case to retain Tordon 22K in the application zone with the minimum potential for water contamination was at Fort Missoula, just southwest of Missoula. The site was flat, valley bottom terrace located 1/3 mile from the Bitterroot River with loam topsoil and a 30-foot groundwater table. Applicators sprayed the area with 1 pt/acre of Tordon 22K. **(see Table 3)**

Worst Case-Elk Creek

The North Fork of Elk Creek, 35 miles east of Missoula, was chosen to represent worst case conditions for possible off-site movement of Tordon 22K while still being within label restrictions. This mountain watershed site has a logging road which follows a small stream for 2.5 miles.

The texture of the most abundant soil is a sandy loam consisting of 61% sand. The sandy texture and low organic matter content allow this soil to have a moderately rapid sustained infiltration rate. When this soil is dry the short term infiltration rate is much higher. Overland flow would only be expected on the compacted roadbed or the steepest slopes during intense rainfall events.

The water table between the road and the stream was as close to the

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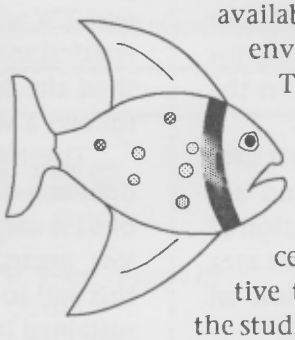
Tordon 22K And Fish

Although Tordon 22K herbicide exhibits effective herbicidal activity on broadleaf weeds and woody plants, it has low toxicity to aquatic organisms. However, as with any chemical in widespread use, questions may remain about the potential effects of Tordon 22K on fish if small amounts of the compound were to inadvertently enter surface water. To properly consider the effects of Tordon 22K in the environment we also need to consider what effect the environment has on Tordon 22K. Toxicity is not only a function of the **concentration** of the material to which an organism exposed but also is a function of the duration (**time**) of exposure. The environment dissipates and degrades Tordon 22K which limits the toxicity because the concentration decreases over time. This article summarizes several studies that answer these questions about the breakdown of Tordon 22K in lakes and streams and the effects on fish that may result if small quantities are introduced to aquatic environments.

"Toxicity is not only a function of the concentration of the material to which an organism is exposed but also a function of the duration (time) of exposure."



These studies show that if Tordon 22K is introduced into an aquatic system, physical and chemical forces will alter its availability to aquatic life. For example, it begins to decompose when exposed to sunlight. In flowing waters the initial concentration will be greatly reduced by dilution. The movement of Tordon 22K in the flowing water will effectively limit the duration of exposure of aquatic organisms.

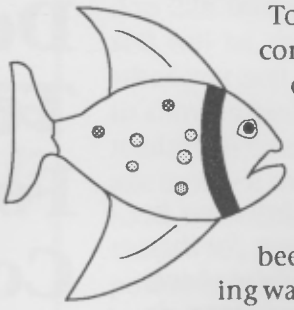
The potential for substantial quantities to enter the aquatic environment through normal use is minimal. After a review of literature, Mayes and Oliver **(1)** determined that under normal use conditions there is little concern for effects on fish from Tordon 22K because:

1. Small amounts of Tordon 22K were detected in run-off water.
2. The low levels that are present are rapidly dissipated thus reducing the time of exposure of susceptible organisms to potentially toxic concentrations.
3. The rapid break down by sun light (photodegradation) of Tordon 22K in aqueous solution.
4. Tordon 22K dilutes rapidly in running waters.

Within the context of their review, Mayes and Oliver assessed the available data on the toxicity and environmental breakdown of Tordon 22K. Much of the data are from DowElanco and were generated over the past 20 years. The test methods conformed to procedures current to the respective time periods during which the studies were conducted. The test fish were purchased from commercial vendors and from federal and state hatcheries as either embryos or juveniles, or were obtained from brood fish (fathead minnows) maintained in the Dow Environmental Sciences Research Laboratory.

Aquatic Hazard Assessment

Review of the environmental chemistry data shows that in soil Tordon 22K is degraded by microorganisms and to a lesser extent by sunlight. Tordon 22K has a low affinity for soil and is relatively water soluble; therefore, some may move from certain treatment sites in run-off water. In the aquatic environment Tordon 22K is rapidly degraded by sunlight; however it is stable in the absence of sunlight.



Tordon 22K does not bioconcentrate in aquatic organisms or bind readily to suspended solids or sediment. Concentrations of Tordon 22K that have been determined in flowing waters adjacent to the application area following rainfall have approached 0.50 ppm, but within days the concentrations were greatly reduced because of degradation by sunlight and dilution. Concentrations of Tordon 22K found in flowing waters, as well as in water catchments, are well below levels found to be acutely toxic to the species tested.

Dissipation of Tordon 22K in Water

A study of aquatic environment dissipation of Tordon 22K shows the molecules are more susceptible to decomposition by sunlight than chemical decomposition in water. The results followed an application of 2 qt/acre of Tordon 22K to the surface of a 0.25 acre livestock pond. The initial loss of Tordon 22K occurred at the rate of 14% to 18% of the amount applied/day, and at 100 days the Tordon 22K concentration on the pond was less than 0.005 ppm. The loss rate was dependent on concentration and decreased to less than 1% per day after 100 days.

Another study followed the direct injection of Tordon 22K and 2,4-D at a rate of 6.26 ppm into a flowing stream in Arizona. The scientists detected 0.001 ppm of Tordon 22K a maximum of 4 miles downstream. The amount injected was greater than that normally found in run-off and does not necessarily represent a typical use situation. Soil and water

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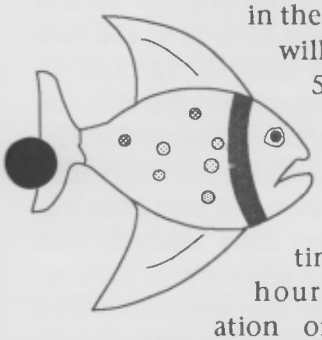
samples collected along the stream for a distance of 2 miles downstream of the injection point contained Tordon 22K concentrations of 0.50 ppm or less at one and two days after injection. The study included a test of stream water on the day of injection. After exposing the sample to sunlight for 8.8 hours, the water contained only 43% of the Tordon 22K found in unexposed stream water samples.

Short-Term Effects of Tordon 22K On Aquatic Organisms

Seven species of fish (representing five families) were tested for their short-term sensitivity to Tordon 22K. Examination of 68 short-term toxicity tests shows a wide range of sensitivity to Tordon 22K with a range of LC_{50} values. An LC_{50} is the concentration of a substance in air, water, or continuous exposure in the diet, which will be lethal to 50% of the organisms within a specified period of time (e.g. 96 hours). Evaluation of the data shows that salmon, trout, and the channel catfish, in general, are the most sensitive species tested.



A flow-through short term exposure study simulated exposure to Tordon 22K in a run-off situation. This study exposed rainbow trout to technical Tordon 22K that resulted in a 96-hour LC_{50} value of 15.5 ppm and a 192-hour LC_{50} of 13.9 ppm; the lowest measured concentration where no adverse effects were noted was 6.9 ppm.

The concentration of 15.5 ppm for the duration of 96 hours is very unlikely to occur in the environment. For example, to achieve a 15.5 ppm concentration of Tordon 22K in water requires that a half-acre pond, 4-feet deep (estimated to contain 652,355 gallons of water), receive 40 gallons of undiluted Tordon 22K. For Tordon 22K to remain at that concentration for 96 hours, environmental conditions must remain unchanged, for instance no rainfall, run-off, or decomposition by sunlight. Since such a scenario is highly unlikely under natural conditions,

"...to achieve a 15.5 ppm concentration of Tordon 22K in water requires that a half-acre pond, 4-feet deep (estimated to contain 652,355 gallons of water), receive 40 gallons of undiluted Tordon 22K."

the alternative would be to add more Tordon 22K to the pond to keep the concentration at 15.5 ppm. **Toxicity is not only a function of the concentration of the material to which an organism is exposed but also a function of the duration of exposure.**

Conclusion

As shown in these studies, if Tordon 22K is inadvertently introduced into an aquatic system, physical and chemical forces will alter its availability to aquatic life. For example, it will be degraded by sunlight. And in flowing waters the initial concentration will be greatly reduced by dilution. The movement of Tordon 22K in the flowing water will effectively limit the duration of exposure to aquatic organisms. Study results conclude that under current label recommendations Tordon 22K is not expected to reach concentration levels high enough to constitute a hazard to aquatic organisms.

Reference:

(1) Mayes, M.A. and Oliver, G.R., "An Aquatic Hazard Assessment: Tordon 22K," Aquatic Toxicology and Hazard Assessment: Eighth Symposium, ASTM STP 891. R. C. Bahner and D. J. Hansen, Eds., American Society for Testing and Materials, Philadelphia, 1985, pp. 253-269. Mayes is an Aquatic Toxicologist in the Health and Environmental Sciences Dept. for DowElanco and Oliver is a Soil Physicist for DowElanco.
(2) Haas, Scifres, Merkle, and Hoffman, Weed Research, Vol. 11, '71, pp. 54-62. ◆

Organic Foods: A Choice - At A Price

In the debate over food safety, organically-grown fruits and vegetables play an important, dual role.

On one hand, they provide a wholesome alternative for people who feel pesticide residues pose too high a risk. On the other hand, they clearly demonstrate key benefits of pesticides.

A survey by the Consumer Alert organization reported in *USA Today* (Jun. 21, '89), shows a family of four that switched to organic foods could spend an extra $1,000 per year for groceries. Survey results, based on comparison shopping in 6 cities, show the weekly expenses from an organic food store were an average of $96.96. The same items from a traditional supermarket would cost $77.90 -- 24% less.

An informal survey conducted by *The Bottom Line* in Milwaukee, WI, brought similar results (see chart). Prices were compared for fruits and vegetables at a supermarket and at two stores with organic produce..

A few organic vegetables were priced the same as, or lower than, comparable items at the supermarket. But most items were priced significantly higher.

Some out-of-season items -- such as green grapes and tomatoes -- were not available at organic stores. The

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surface as 3 to 9 feet, depending on the location and time of year. The average distance from the road to the stream is 110 feet, but the road edge is within 3 feet of the stream at some points.

Applicators sprayed the location with 4 pt/acre of Tordon 22K. This is four to eight times higher than the rate necessary for control of spotted knapweed. This higher rate was used to strengthen the worst case assumption, and to increase the possibility of transporting detectable amounts of Tordon 22K into the groundwater or stream. **(see Table 1)**

The Elk Creek site is higher, cooler and receives more precipitation than Fort Missoula. The compacted road surface increases the water delivered to the roadside. This mountain soil allows more rapid infiltration of rainfall, but is not able to hold as much water as the valley bottom loam at Fort Missoula. The lower organic matter content of the sandy loam also reduces its capacity to adsorb Tordon 22K dissolved in the infiltrating water. The water table is much closer to the surface and the shallow soil covers impermeable bedrock so the groundwater flows almost directly into the small stream adjoining the road. The stream flow can increase rapidly after even a small rainfall. If Tordon 22K was transported into the groundwater or the small stream there is less dilution capacity available than the Bitterroot River system. The Elk Creek site clearly has a higher potential for water contamination than Fort Missoula, but the label restrictions for Tordon 22K allow the Elk Creek site to be sprayed.

Study Results

An objective of the study was to account for all the applied Tordon 22K as it moved through the ecosystem and decayed over time. The environmental compartments considered capable of holding significant amounts of Tordon 22K were the above ground vegetation, the soil at various depths, the groundwater, and the stream. The amount of Tordon 22K in each compartment changes over time because of photodecay, leaching, microbial decay, uptake of Tordon 22K from the soil by plant roots, and possible export from the system by groundwater or stream flow.

Seven days after application at the optimum site at Fort Missoula, researchers measured 44% photodecay due to lack of rain and high sunlight exposure. Low precipitation and soil adsorption restricted the herbicide to the upper 20 inches of the soil. Of the original Tordon 22K application 36%, 13%, and 10% still persisted after 3, 12, and 15 months. Researchers detected no movement of herbicide off the site.

At the worst case site the permeable, sandy loam soil along the logging road was fully charged with snowmelt and rainwater at the time of application. The second day after spraying a light rain carried the herbicide into the soil profile, so photode-

Table 1
Environmental Fate Of Tordon* 22K Herbicide As A Percentage Of The Initial Application At Elk Creek Site

	Day 0	Day 7	Day 90
Vegetation	46.9%	15.1%	7.1%
Soil Layer (inches)			
0-5	53.1%	41.0%	37.1%
5-10	ns	10.2%	14.2%
10-20	ns	7.5%	5.9%
20-30	ns	6.3%	6.6%
30-40	ns	5.4%	6.9%
Soil Totals	53.1%	70.4%	70.7%
Soil + Vegetation	100.0%	85.6%	77.9%
Inches of Cumulative Precipitation After Day	0	0.12	2.60

ns = not sampled, no herbicide anticipated
nd = Tordon 22K was not detected

Table 2
Concentrations of Tordon* 22K Herbicide as Parts Per Million in Environmental Compartments at Elk Creek Site and Typical Minimum Detection Limits for Sample Analyses

	Day 0	Day 7	Day 90	Detection Limit
Vegetation	166.000	54.400	27.900	0.010
Soil Layer (inches)				
0-5	0.366	0.284	0.205	0.005
5-10	ns	0.070	0.094	
10-20	ns	0.028	0.020	
20-30	ns	0.022	0.022	
30-40	ns	0.021	0.024	
Groundwater	ns	nd	nd	0.0005
Stream water	nd	nd	nd	0.0005

ns = not sampled, no herbicide anticipated
nd = Tordon 22K was not detected

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Table 3
Environmental Fate of Tordon 22K as a Percentage of the Initial Application at Fort Missoula Site

	Day 0	Day 7	Day 90	Day 365	Day 445
Vegetation	9.8%	3.1%	0.8%	0.8%	0.7%
Soil Layer (inches)					
0-5	90.2%	52.7%	13.7%	6.2%	5.9%
5-10	ns	ns	13.3	6.2	4.0
10-20	ns	ns	7.8	nd	nd
20-30	ns	ns	nd	nd	ns
30-40	ns	ns	nd	nd	ns
Soil Totals	90.2%	52.7%	34.8%	12.5%	9.9%
Soil & Vegetation	100%	55.8%	35.6%	13.3%	10.5%
Inches of cumulative precipitation after Day 0		trace	6.8	17.0	20.8

ns = not sampled, no herbicide anticipated
nd = Tordon 22K was not detected

cay by sunlight was insignificant. Tordon 22K was transported to a depth of 40 inches. After three months, 78% of the herbicide application was still present in the vegetation and the soil.

Tordon 22K was not detected in the groundwater nor the stream.

Sample Analysis

Appropriate samples were taken to evaluate each compartment. The samples were analyzed to determine Tordon 22K *concentrations in parts per million (ppm). The weight of vegetation and soil per acre were determined so the Tordon 22K concentrations could be converted back to the pounds per acre* of Tordon 22K in these compartments. The pounds per acre in each compartment was then expressed as a **percentage** persisting from the initial application. The volume of water discharged from the North Fork of Elk Creek was continuously recorded. If Tordon 22K was detected in the stream water samples the measured concentrations could be used to calculate the weight of Tordon 22K lost from the site into the stream.

When following label restrictions with roadside application rates of 1 pt/acre or less, any resultant Tordon 22K contamination of water is unlikely to exceed tolerence levels for human health and environmental effects. The weed control planner and licensed applicator should evaluate soil texture, depth, moisture, and topographic features pertaining to groundwater and surface water to recognize the exceptional conditions that might allow some water contamination by Tordon 22K.

Observed Tordon 22K Dissipation

The target application rate at Elk Creek was 4.0 pt/acre. The measured rate on day 0 was 4.01275 pt/acre. The dense vegetation canopy along the Elk Creek roadside intercepted 47% of the application and 53% was deposited on the ground surface **(Table 1).**

The first post-application rainstorm came on day 2. The 0.12 inches of rain caused leaf drip to wash Tordon 22K off the vegetation, puddles to form on the roadbed, and infiltration of rainwater into the uncompacted soil on the roadside. This storm increased stream flow, but Tordon 22K was not detected in the groundwater nor the stream.

A measured 86% of the applied Tordon 22K was still present at the Elk Creek site on day 7. Shading from the heavy vegetative cover, including the tree overstory, reduced the photodecomposition rate on the soil surface and understory leaves. The vegetation still retained 15% of the original application, but the early storm washed as much as 70% of the Tordon 22K into the soil where it was protected from sunlight. Tordon 22K in the soil was mostly adsorbed in the top 5 inches, but 5.4% travelled as far down as 40 inches into the deepest sampled soil layer. The rapid deep leaching was caused by the day 2 rainstorm having fallen on soil already charged to near field capacity with water. Still, neither the ground-

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Table 4
Concentrations of Tordon 22K as Parts Per Million in Environmental Compartments at Fort Missoula

	Day 0	Day 7	Day 90	Day 365	Day 445
Vegetation	32.300	9.610	5.040	1.310	0.882
Soil Layer (inches)					
0-5	0.151	0.088	0.023	0.012	0.011
5-10	ns	ns	0.022	0.011	0.008
10-20	ns	ns	0.007	nd	nd
20-30	ns	ns	nd	nd	ns
30-40	ns	ns	nd	nd	ns

ns = not sampled, no herbicide anticipated
nd = Tordon 22K was not detected

"Roadside"

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water nor the stream had detectable amounts of Tordon 22K through day 7.

There were seven precipitation events that caused increases in stream flow after the day 2 storm, but Tordon 22K was never detected in the stream nor in the groundwater. These stream flow increases were caused by direct channel precipitation and recharge at higher elevations. There was no recharge of the groundwater nor the stream from infiltration in the spray swaths. The soil moisture wetting front along the roadside never advanced deeper than 10 inches between day 7 and day 90.

The Tordon 22K content of the Elk Creek site only declined to 78% of the initial application when final measurements were made on day 90. Cumulative rainfall after day 2 was only 2.48 inches. The low rainfall and the rapid withdrawal of available water from the sandy loam soil by vegetation during the summer months restricted leaching and limited microbial breakdown of Tordon 22K. The Tordon 22K content of the vegetation dropped to 7.1% because of photodecay, leafdrop, and washoff, but the soil still held 71% of the application. Most of the Tordon 22K in the soil was near the surface, but 6.9% was between 30- and 40-inches deep.

Environmental Concentrations and Tolerance Limits for Tordon 22K

The concentrations of Tordon 22K in parts per million (ppm) measured in the various environmental compartments are summarized in **Table 2** for the Elk Creek site and **Table 4** for Fort Missoula. **Table 2** also contains the minimum detection limits for Tordon 22K. The environmental concentrations can be compared to the tolerance limits established to protect people and other non-target species from possible herbicide injury, and the soil concentration necessary for controlling the target weeds.

The day 0 concentrations at Elk Creek are much higher than those at Fort Missoula primarily because the application rate at Elk Creek was four times that used at Fort Missoula. The Tordon 22K concentration on the Elk Creek vegetation immediately after spraying was 166 ppm. Data from other studies indicate that forage concentrations of 25 to 50 ppm are to be expected following application rates of 1 pt/acre and 100 to 200 ppm after spraying 4 pt/ac. The initial herbicidal effect on the plants is caused by absorption through the leaves and stems. Longer term knapweed control is obtained by the roots extracting Tordon 22K residues from the soil. Tordon 22K concentrations in the soil are much lower than those in vegetation because the herbicide sprayed per unit area is dispersed in a much greater mass of soil than vegetation.

Tordon 22K was never detected in the water at the Elk Creek site. It is possible that some Tordon 22K at a concentration below the detection limit may have reached the groundwater or even the stream. Some herbicide travelled to the maximum sampling depth of 40 inches during the first week and there were spots between the spray swath and the stream where the groundwater was within 36 inches of the surface during late spring. The detection limit for Tordon 22K in water was 0.0005 ppm or 0.5 parts per billion.

The Health Advisory limit the EPA established for Tordon 22K in drinking water is 0.49 ppm. Cutthroat trout fingerlings are considered the fish most sensitive to Tordon 22K. The suggested tolerance limit in stream water for these fish is 0.290 ppm for 24 hours of exposure. Some crop plants, such as alfalfa, are very sensitive to Tordon 22K. Production could be reduced by irrigating with water containing 0.010 ppm Tordon 22K or repeated irrigation with water containing 0.001 to 0.004 ppm Tordon 22K.

If any Tordon 22K did reach the water at the Elk Creek site, it would have been at concentrations well below those causing adverse effects.

Contrasting Characteristics of the Elk Creek and Fort Missoula Study Sites

Name	Best Case Fort Missoula	Worst Case Elk Creek (N. Fork)
Land-type	Valley bottom old field	Mountain watershed w/ logging road by stream
Dominant veg.	Spotted Knapweed	Spotted Knapweed
Elevation	3,150 ft.	4,150-4,700 ft.
Precipitation	13.3 inches/yr	16 inches/yr
Ave. temp.	44 degrees F	41 degrees F
Soil texture	loam	sandy loam
Percent sand	33%	61%
Organic matter	2-4%	0.8-2%
Rate of water infiltration	moderate 0.6-2.0 inches/hr	moderately rapid 2.0-6.0 inches/hr
Depth to groundwater	30 ft.	3-9 ft.
Slope	less than 1%	4.5 to 15%
Distance to stream	1/3 mile	shortest dist. 3 ft. ave. dist. 110 ft.
Streamflow	500-20,000 cfs	1-8 cfs
Spray date	June 18, 1985	June 6, 1986
Herbicide rate	1 pt/acre	2 qt/acre
Soil moisture at spraying	2 to 5%	approx. 25% (field capacity)
Days to 1st rainfall	45	3
Total rain in first 30 days	trace	1.44 inches

Conclusions

Tordon 22K was not detected in groundwater nor in stream flow at the Elk Creek site. The roadside application was made at a rate four

times greater than the 1 pt/acre typically recommended to control spotted knapweed. The site was representative of a worst case scenario for ter contamination at a location which could be legally sprayed according to label restrictions.

At Fort Missoula, a site with topographic and soil characteristics more favorable for holding Tordon 22K in the soil and receiving the recommended application rate of 1 pt/acre, the herbicide did not travel deeper than 20 inches.

Special consideration should be given before spraying sites with shallow soils of moderately rapid permeability where groundwater is close to the surface if the soil has been saturated to near field capacity because of snow melt or recent heavy rains. Tordon 22K at the Elk Creek site was quickly transported to a depth approaching the groundwater table by a storm that delivered only 0.12 inches of rain. Heavier rainfall would carry more Tordon 22K to greater depths and possibly into the groundwater. Applicators should spray alternative sites with better retention capacities and deeper groundwater tables on days following soil saturating rains or snowmelt.

Tordon 22K applied at 1 pt/acre was very effective in converting the knapweed dominated Fort Missoula site to a grass-dominated site despite the large intial losses of Tordon 22K to the photodecay mechanism. A soil residue of 0.012 ppm was adequate to kill knapweed seedlings during the second growing season. Knapweed seedling reestablishment began in the third year.

It is unlikely that spraying within label restrictions for roadside weed control in Montana at 1 pt/acre will result in Tordon 22K contamination that would exceed published thresholds for effects on beneficial uses of water. The limited depth of the advance of the soil moisture wetting

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How Small Is Small? How Safe Is Safe?

Crop protection chemicals are poisons. How can even tiny amounts of crop protection chemicals be safe to drink?

That is an understandable concern. Common sense says we do not want poisonous substances in our water. An important concept to note is that everything is safe and everything is poisonous at some level or concentration. The tiny amounts of crop protection chemicals occasionally present in ground water would not have any effect on weeds or insects, let alone humans.

Years of laboratory toxicological studies are conducted for each potential product before it reaches the marketplace. These studies and others have proven that risks to health depend on both:

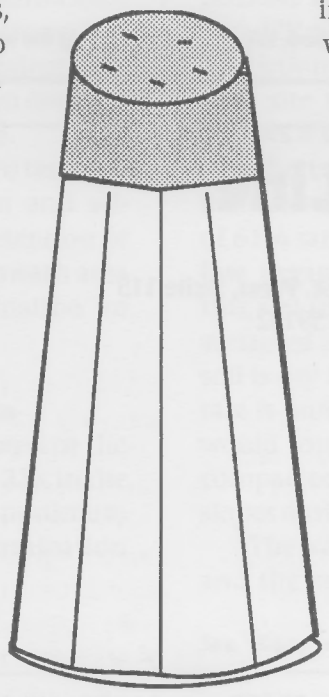
1) The toxicity of the material, and
2) The level of exposure.

Thus, the presence of a trace of the product in our water does not itself indicate a health risk.

Many substances at low levels are essential to our well- being but they can harm us or even kill us if we get too much of them. For instance...

- Chlorine and fluorine are toxic chemicals in even modest quantities. Yet, added to our municipal water supplies in minute quantities, they protect us from harmful microorganisms and protect our teeth from cavities.
- Every dining room table has a salt shaker on it, yet few people stop to think that we can hold enough salt in our hands to kill us.
- Lack of vitamin A causes night blindness, hair loss, and skin disorders, yet, too much is toxic and can cause birth defects. Clearly, the dose makes the poison.

We accept some extreme risks everyday, without nearly the concern we give to crop protection chemicals. Hundreds of thousands of Americans die each year from various accidents and diseases, many of which are partially or completely preventable. However, there is no evidence that anyone has ever died as a result of crop protection residues in food or water.



In addition, there are risks from toxic chemicals which nature introduces into the environment. The regulatory process is wisely designed to protect us from these excesses of nature as well as the mistakes of man. In spite of the presence of these natural toxic chemicals and occasional residues of man-made chemicals in our water supply, our water is safe.

The concerns about our water supply are understandable. But we must keep in mind that anything taken to excess can be harmful and that almost every compound known to man can be safely ingested if the level is small enough. *Source: ACRE - Alliance for a Clean Rural Environment* ◆

"Organic Prices"

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reason? Some organic foods have too short a "shelf life" to survive cross-country transport.

Organic foods carry one caveat. According to Consumer Alert, there is no guarantee that produce sold in natural foods stores is truly organic. States have different rules, and where rules are clear, enforcement is not very strict.

Some states are moving to adopt new standards to certify organic procedures and the organic farms. In the meantime, organic foods remain as a legitimate choice for careful consumers -- if they're willing to pay the price.

Comparing Prices

Item (by the lb.)	Supermarket	Organic Store #1	Organic Store #2
Cauliflower	$.68	$.79	$.89
Cucumbers (each)	.40	.69	.49
Celery (bunch)	.98	.69	1.99
Carrots	.79	.78	.78
Lettuce	.72	.69	.79
Green Peppers	.89	1.89	1.99
Tomatoes	2.68	n/a*	n/a
Onions	.30	.99	.89
MacIntosh Apples	.89	1.29	1.49
Navel Oranges	.20	.29	.49
Bananas	.29	.49	.49
Green Grapes	1.18	n/a	1.89
Pineapple (each)	2.48	3.39	2.49

* Not Available

(Survey conducted at three Milwaukee, WI, food stores during the week of Feb. 5-10, 1990)

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front does not allow the herbicide to reach the groundwater table. Tordon 22K incorporated into the topsoil will be decomposed over time whenever soil moisture is available to allow microbial activity. When a roadside is treated, the sprayed acreage is only a small proportion of the total watershed, usually much less than 1%. Any Tordon 22K transported into a stream by a storm will be further diluted by the increase in stream flow resulting from precipitation over the larger area of the drainage basin.

Footnote: A complete version of this study by V. J. Watson, P. M. Rice & E. C. Monnig was published in the *Journal of Environmental Quality*, Vol. 18, no. 2, April-June '89, p. 198-205.

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