

Toxics from the Agricultural and Wastewater Sectors in the Chesapeake Bay



1. **CONSERVATION TILLAGE AND HERBICIDES**
2. **ANTIBIOTICS AND BIOGENIC HORMONES D**



1. Conservation Tillage and Herbicides



- How the profound shift to conservation tillage as a cornerstone BMP for corn and soybeans in the Bay watershed has changed herbicide use and impacts over the last 3 decades



Trends in Herbicides Applied to Corn and Soybeans



ERA	1970's -1980's	1990-2000	2001 to present
Most Common Herbicides Detected	<ul style="list-style-type: none"> • Atrazine 	<ul style="list-style-type: none"> • Atrazine • Metoachlor • Acetochlor • Alachlor 	<ul style="list-style-type: none"> • Glyphosate • AMPA • Some Atrazine
Tillage Practices	>25% of crops use conservation till	Climbs to about 50 to 60% of crop acres	Climbs to nearly 90% of row crops
Genetically Engineered Crops	None	GE corn and soybeans enter market in mid to late 1990's	GE seeds comprise 92 to 94% share of crop acres

Changes in Herbicide Impacts Over Time



ERA	1970's -1980's	1990-2000	2001 to present
Most Frequently Detected	<ul style="list-style-type: none"> • Atrazine 	<ul style="list-style-type: none"> • Atrazine • Metoachlor • Acetochlor • Alachlor 	<ul style="list-style-type: none"> • Glyphosate • AMPA • Some Atrazine
Water Quality Risks	Atrazine suspected in SAV loss, but later exonerated	Aquatic life criteria frequently exceeded for metoachlor and atrazine. Possible Endocrine disruptor	Routinely detected in surface waters, but aquatic life criteria not exceeded
Groundwater Concerns	Major concern for rural drinking water wells	Declining levels measured toward end of the era	Rarely detected in groundwater or soil water at this time

Herbicide	Groundwater Advisory ?	Exceeds Aquatic Life Benchmarks ?	MCL	Half-life in Soils	Half-life in Water
			(ug/l)	Days	
Atrazine	Yes	Yes	3	146	742
Simazine	Yes	Yes	4	91	32
Metoachlor	Yes	Yes	100	26	410
Alachlor	Yes	Yes	2	21	640
Glyphosate *	No	No	700	35	96
AMPA*	No	No	nd	7-14	76-240



6. Antibiotics and Biogenic Hormones are Removed But then Re-emerge



Biogenic Hormones



- Biogenic hormones include estrogen, testosterone, estrone, estradiol and progesterone
- Concern about their potential endocrine disrupting properties.
- Concentrations of biogenic hormones in the part per trillion range can negatively impact aquatic life and possibly cause intersex fish.
- Discharged from animal feeding operations and wastewater treatment plants.
- Higher concentration w/ high watershed density of either animal feeding operations or sewage effluent

More on Biogenic Hormones



- Vegetated buffers, constructed wetlands and lagoons are highly effective in removing biogenic hormones in runoff from AFOs
- BNR upgrades are very effective in removing biogenic hormones in wastewater effluent
- Hormones concentrate in animal manure and municipal biosolids.
- When treatment residuals are applied to crops, they can potentially migrate back into the watershed.

More on Biogenic Hormones



- Sustainable strategy to keep unnecessary hormones out of the food supply chain.
- Livestock producers, groceries and restaurant chains are rapidly phasing them out
- Reminder about the power of social and economic forces advocating for food quality and safety



Antibiotics



- Antibiotics detected in streams and groundwater in the Chesapeake Bay include tetracycline, oxy-tetracycline and sulfamethoxazole.
- Concern about increased bacterial resistance that could reduce the therapeutic effect of these medicines
- Can degrade soil microbial community and reduce denitrification rate
- Half of human antibiotic use, and most livestock use "is unnecessary, inappropriate, and makes everyone less safe" (CDC, 2013).

More on Antibiotics



- Same 4 watershed sources as biogenic hormones
- Antibiotics are persistent, hydrophilic and very soluble -- may not be effectively removed by conventional WWTPS or BMPs
- Recent trend to phase out of antibiotics used in poultry, swine and cattle feeding operations.

Better Treatment, More Residuals



- Improved manure management at AFOs and the shift to BNR at WWTPs has increased removal of antibiotics and biogenic hormones from effluent, but the residuals are concentrated in animal manure and municipal biosolids that are applied back to croplands.
- Poor data quality make it difficult to fully assess this risk
- The phase out of antibiotics and hormones from livestock production and better antibiotic stewardship are the long term solution

Sustainable Solutions



- Continue the phase out of antibiotics and hormones from livestock production
- Better antibiotic “stewardship”

