UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM January 28, 1988

SUBJECT: Fish and Wildlife Risk Assessment for Disposal of Treated Seeds by Exaggerated Planting Rates

FROM: Henry Craven, Acting Chief
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TO: James Touhey
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The Ecological Effects Branch has been requested to assess potential risk to fish and wildlife from the disposal of corn seed treated with Captan, Methoxychlor and Malathion, and sorghum seed treated with Heptachlor. Disposal would be accomplished by planting the seeds at 15 or 30 times the normal planting rates as green-manure cover-crop on set-aside acreage.

Corn is assumed to weigh approximately 50-56 pounds per bushel. There are approximately 1200 seeds per pound. Sorghum weighs approximately 56 pounds per bushel with from 15,000 to 20,000 seeds per pound. Corn is typically planted from 2 to 4 inches deep and sorghum is planted from 1 to 2 inches deep. At least for this cover-crop planting, either the corn or sorghum seed may be broadcast and incorporated rather than planted (telephone conversation with Jack Christie, January 22, 1988).

Both corn and sorghum are assumed to be planted at the same rate, i.e. 9 to 15 lbs. of seed per acre. The 15X rate would be 200 lbs. or 4 bushels and the 30X rate would be 400 lbs. or 8 bushels of seed per acre.

## Summary

The planting of seed corn treated with Captan or Methoxychlor at a 15X or 30X rate is unlikely to result in adverse effects to either terrestrial or aquatic organisms.

If substantial amounts of Malathion treated seed were exposed on the surface, rates of either 15X or 30X may

occasionally cause acute effects to birds, but probably not mammals or aquatic organisms. This exposure to birds should be reduced by requiring that:

1. Malathion treated corn seed to be planted at maximum depth;
2. Field edges at the end of rows be monitored for exposed piles of seed; and
3. Exposed seed be covered thoroughly or collected and replanted.

Planting sorghum seed treated with Heptachlor at 15X or 30X is expected to cause bird and mammal mortality and reproductive effects to mammals. At the 30X rate, concentrations in aquatic habitats near treated fields are expected to cause mortality to aquatic invertebrates but not fish. At the 15X rate, adverse effects would be less likely but still expected. Given the extreme persistence of Heptachlor and its tendency to bioaccumulate, adverse effects would be expected to continue for several years after treatment. Such hazard should be avoided, if possible. However, the following restrictions must be enforced if planting sorghum seeds treated with Heptachlor is conducted:

1. Drill plant to maximum depth;
2. Apply to soil with $\leq$ 2% slope;
3. Do not apply within 100 feet of any natural water, including ponds, streams, rivers, marshes or swamps;
4. All plantings must be monitored for spills and exposed seeds; and
5. Any spills or exposed seeds must either be covered thoroughly or collected and replanted.

## Captan

Captan is applied to corn seed at 3 oz. active ingredient (ai) per 100 pounds.

| Planting Rate | Oz. AI/Acre |
|---|---|
| normal | 0.3 |
| 15X | 4.5 |
| 30X | 9.0 |

### Toxicological Information

Fish LC50's = 47 to 111 ppb for bluegill and
66 to 80 ppb for rainbow trout
Fish MATC >16<39 ppb for fathead minnows
Aquatic Invertebrate LC50 = 7 to 10 ppb for Daphnia magna

Mammal LD50 = 9000 mg/kg for rats
1-generation NOEL=12.5 mg/kg/day for rats
Bird LC50 > 2400 ppm for bobwhite quail
Bird LD50 > 2000 mg/kg for mallard
1-generation reproductive NOEL = 1000 ppm

Aquatic

If corn seed is planted at maximum depth, exposure to aquatic organisms will be very low since Captan would likely breakdown before it was available to transport by runoff to adjacent aquatic habitat.

If the seed is broadcast and incorporated, exposure is possible, since some of the Captan on seed would be near the surface. If the seed is incorporated to 2 inches, the ai on seed in the top 1 cm (1/5th) is available for runoff. Since captan is minimally soluble, only 1 percent of the available ai will transport by runoff.

15X rate = 4.5 oz. ai/acre;
4.5 / 5 = 0.9 oz. ai per acre available for runoff;
0.9 oz = 0.05625 lb. ai/acre

Using the scenario of a 10-acre field draining into a 1 acre pond 6 feet deep, the resulting EEC for the 15X rate is 0.34 ppb.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Calculation: | 0.05625 lb. ai/ acres | X | 10 acres planted | X | 0.01 1% | X | 61 ppb from 1 lb. | = | 0.34 ppb |

0.34 ppb is EEC after 15X planting by broadcast and incorporation
0.69 ppb is EEC after 30X, (2 X 0.34 ppb)

Both these concentrations are less than the fish chronic NOEL of 16 ppb. Captan is less toxic to aquatic invertebrates than to fish. No adverse acute or chronic effects are expected to aquatic organisms from planting of Captan treated corn seed at 15X or 30X the normal rate.

Terrestrial

Using the avian LD50 of >2000 mg/kg, a 1 kg bird (e.g. mallard or pheasant) would have to eat 2.33 lbs. of treated corn (approx. 2800 kernels) in one day to receive a dose of Captan equivalent to its LD50. This is unlikely, therefore, acute effects to birds are not expected. Chronic hazard is expected to be minimal since seed would germinate in a short time (2 weeks) and Captan is not expected to be available at concentrations exceeding the avian reproductive NOEL of 1000 ppm. Based on acute studies, Captan is less toxic to mammals than to birds.

Calculation: 3 oz. = 85.7 grams on 100 lbs of corn seed
The LD50 for a 1 kg bird is 2 grams, 2 grams is 2.33% of 85.7 grams and 2.33% of 100 lbs. is 2.33 lbs.

Adverse acute or chronic effects to terrestrial organisms are not expected.

## Methoxychlor

Corn seed is treated with Methoxychlor at 2 oz. ai per bushel or 4 oz. per 100 lbs.

| Planting Rate | Oz. AI/Acre |
|---|---|
| normal | 0.4 |
| 15X | 6.0 |
| 30X | 12.0 |

Toxicological Information

Fish LC50's = 29 ppb for bluegill and
52 ppb for rainbow trout
Aquatic Inv. LC50 = 3.6 ppb for Daphnia magna

Mammal LD50 = 5000 to 6000 mg/kg for rats
800 mg/kg for mice

Bird LD50 > 2000 mg/kg for mallards
LC50's > 5000 ppm for mallard and bobwhite

Aquatic

If corn seed is planted at maximum depth, exposure to aquatic organisms would be very low since Methoxychlor would likely breakdown before it was available for transport to adjacent aquatic habitat.

If seed is broadcast and incorporated, exposure is possible, since some of the Methoxychlor on seed would be near the surface. If the seed is incorporated to 2 inches, the ai on seed in the top 1 cm (1/5th) is available for runoff. Since methoxychlor is minimally soluble, only 1 percent of the available ai will transport via runoff.

15X rate = 6.0 oz. ai/acre;
6 / 5 = 1.2 oz. ai per acre available for runoff;
1.2 oz = 0.075 lb. ai/acre

Using the scenario of a 10-acre field draining into a 1 acre pond 6 feet deep, the resulting EEC for the 15X rate is 0.46 ppb.

| Calculation: | 0.075 lb. ai/ acres | X | 10 acres planted | X | 0.01 1% | X | 61 ppb from 1 lb. | = | 0.46 ppb |
|---|---|---|---|---|---|---|---|---|---|

0.46 ppb, EEC after 15X planting by broadcast and incorporation
0.92 ppb, EEC after 30X planting (2 X 0.46)

Both these concentrations are less 1/2 than the aquatic invertebrate LC50. Methoxychlor is less toxic to fish than to aquatic invertebrates. While chronic toxicity is unknown,

chronic exposure will be minimal since Methoxychlor degrades in natural water within 36 days. Considering the low initial estimated concentrations compared to the acute toxicity information and relatively low persistence in natural water, neither chronic nor acute effects are expected to aquatic organisms from this planting of Captan treated corn seed at either 15X or 30X.

Terrestrial

As a dietary exposure, seeds treated with methoxychlor at 4 oz. ai / 100 lbs. (0.25% ai or 2500 ppm) would not exceed the dietary LC50 of >5000 ppm. Using the avian LD50 of >2000 mg/kg, a 1 kg bird (mallard or pheasant) would have to eat 1.75 lbs. of treated corn (approx. 2100 kernels) in one day to receive a dose of Methoxychlor equivalent to its LD50. This is unlikely, therefore, acute effects to birds are not expected.

Calculation: 4 oz. = 114.3 grams on 100 lbs of corn seed
The LD50 for a 1 kg bird is 2 grams, 2 grams is 1.75% of 114.3 grams and 1.75% of 100 lbs. is 1.75 lbs.

Based on a mouse LD50 of 800 mg/kg, a 1 kg mammal would have to eat 0.7 lb of corn in one day to receive a dose of Methoxychlor equivalent to its LD50. This is 32% of its weight. It is unlikely that a mammal would consume enough corn to experience an acute effect.

Calculation: 0.8 grams is 0.7% of 114.3 grams
0.7% of 100 lbs is 0.7 lb. or 320 grams

Chronic toxicity to both birds and mammals is unknown but chronic exposure is expected to be minimal since seed would germinate in a short time (2 weeks) and Methoxychlor, once leached into the soil, would not be available to terrestrial organisms in high concentrations, relative to its known toxicity. It does bioaccumulate, but has been shown to depurate within 2 weeks.

Adverse acute or chronic effects to terrestrial organisms are not expected.

## Malathion

Corn seed is treated with Malathion at 2 oz. ai per bushel or 4 oz. per 100 lbs.

| Planting Rate | Oz. AI/Acre |
|---|---|
| normal | 0.4 |
| 15X | 6.0 |
| 30X | 12.0 |

### Toxicological Information

Fish LC50's = 1.1 ppm for guppy and
2.3 ppm for chinook salmon
Aquatic Inv. LC50 = 1 ppm for Daphnia magna
0.5 ppm for Gammarus fasciatus
0.05 ppm for Pteronarcys calfornica

Mammal LD50 = 1000 mg/kg for rats

Bird LD50 = 167 mg/kg for ring-necked pheasant
403 mg/kg for horned lark
1485 mg/kg for mallard duck
LC50 = 3497 ppm for bobwhite and
> 5000 ppm for mallard

### Aquatic

If corn seed is planted at maximum depth, exposure to aquatic organisms would be very low since Malathion would likely breakdown before it was available for transport to adjacent aquatic habitat.

If seed is broadcast and incorporated, exposure is possible, since some of the Malathion on seed would be near the surface. If the seed is incorporated to 2 inches, the ai on seed in the top 1 cm (1/5th) is available for runoff. Since malathion is minimally soluble, only 1 percent of the available ai will transport via runoff.

15X rate = 6.0 oz. ai/acre;
6 / 5 = 1.2 oz. ai per acre available for runoff;
1.2 oz. = 0.075 lb. ai/acre

Using the scenario of a 10-acre field draining into a 1 acre pond 6 feet deep, the resulting EEC for the 15X rate is 0.46 ppb.

| Calculation: | 0.075 lb. ai/ acres | X | 10 acres planted | X | 0.01 1% | X | 61 ppb from 1 lb. | = | 0.46 |
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0.46 ppb, EEC after 15X planting by broadcast and incorporation
0.92 ppb, EEC after 30X planting (2 X 0.46)

Both these concentrations are substantially less than the fish and invertebrate LC50's. Chronic toxicity is unknown, and chronic exposure cannot be estimated with available information. Considering the low initial estimated concentrations relative to the acute toxicity chronic hazards are expected to be low if they occur. Neither chronic nor acute effects to aquatic organisms from this planting are expected to be unreasonable.

Terrestrial

As a dietary exposure, seeds treated with malathion at 4 oz. ai / 100 lbs. (0.25% ai or 2500 ppm) would not exceed the dietary LC50 of 3497 ppm. Using the avian LD50 of 167 mg/kg, a 1 kg bird (e.g. mallard or pheasant) would have to eat 0.146 lb. of treated corn (approx. 175 kernels) in one day to receive a dose of Malathion equivalent to its LD50. This is considered possible, therefore, acute effects to birds are expected.

Calculation: 4 oz. = 114.3 grams on 100 lbs of corn seed
The LD50 for a 1 kg bird is 0.167 gram
0.167 gram is 0.146% of 114.3 grams
0.146% of 100 lbs. is 0.146 lb.

Based on a rat LD50 of 1000 mg/kg, a 1 kg mammal would have to eat 0.875 lb of corn in one day to receive a dose of Malathion equivalent to its LD50. This is 40% of its weight. It is unlikely that a mammal would consume enough corn to experience an acute effect.

Calculation: 1 gram is 0.875% of 114.3 grams
0.875% of 100 lbs is 0.875 lb. or 399.9 grams

Chronic toxicity to both birds and mammals is unknown but chronic exposure is expected to be minimal since seed would germinate in a short time (2 weeks) and Malathion, once leached into the soil, would not be available to terrestrial organisms in high concentrations, relative to its known toxicity.

Adverse effects to mammals are not expected. Adverse acute effects to birds are expected if the corn seed is broadcast and incorporated. Such birds as turkey, mourning dove, ring-necked pheasant, blackbirds, crows, duck and geese may feed on areas planted with corn. This exposure could be reduced if the corn was planted to maximum depth and spills and exposed kernels thoroughly covered or collected for replanting. It is recommended that all disposal by planting of Malathion treated corn seed be according to the following:

1. Do not broadcast, plant only with corn planter to maximum depth that will allow germination; and

2. Monitor each planting for exposed seed, which must be covered thoroughly or collected for replanting.

## Heptachlor

Heptachlor is applied to sorghum at 2 oz. per bushel (56 lbs.)

| Planting Rate | Oz. AI/Acre |
|---|---|
| normal | 0.4 |
| 15X | 6.0 |
| 30X | 12.0 |

Toxicological Information

Fish LC50's = 7.4 to 10 ppb for rainbow trout and
3 ppb for stripped bass
Fish Rep. MATC > 0.86 < 1.84 ppb for fathead minnow
Aquatic Inv. LC50 < 1 ppb for stonefly and
up to 78 ppb for Daphnia magna

Mammal LD50's = 147 to 220 mg/kg
mouse reproduction study, rep. stopped at 50 ppm
effects minimal at 5 ppm

Bird LD50 $\geq$ 2080 mg/kg for mallard duck
LC50 = 50 ppm for starling after 9-day exposure,
92 ppm for bobwhite quail and
480 ppm for mallard

Aquatic

If sorghum was broadcast and incorporated to 2 inches, the ai on seeds near the surface (within 1 cm and therefore 1/5th the total) would be available for transport via runoff.

15X rate = 6.0 oz. ai/acre;
6 / 5 = 1.2 oz. ai per acre available for runoff;
1.2 oz = 0.075 lb. ai/acre

Using the scenario of a 10-acre field draining into a 1 acre pond 6 feet deep, the resulting EEC for the 15X rate is 0.46 ppb. It is assumed that 1% of the available Heptachlor would transport via runoff.

| Calculation: | 0.075 lb. ai/ acres | X | 10 acres planted | X | 0.01 1% | X | 61 ppb from 1 lb. | = | 0.46 ppb |
|---|---|---|---|---|---|---|---|---|---|

0.46 ppb, EEC after 15X planting by broadcast and incorporation
0.92 ppb, EEC after 30X planting (2 X 0.46)

These concentrations do not exceed the aquatic organism LC50's, but they do exceed 1/2 the aquatic invertebrate LC50's and the 30X rate approaches 1/2 the lowest fish LC50. Considering the variability in sensitivity of different untested

organisms, and cases where transport via runoff would be greater than estimated, acute effects are considered possible. The 30X rate exceeds the fish chronic NOEL. This, and the fact that Heptachlor persists and bioaccumulates makes it likely that chronic effects would occur.

If sorghum is planted at maximum depth, exposure to aquatic organisms would be low initially, since little of the ai would be available for transport via runoff. However, Heptachlor is extremely persistent with a half-life of from 2 to 14 years so with time and tillage, Heptachlor would be moved to the surface and be available for runoff. Based on this, it is expected that Heptachlor would transport from the treated sites for years after the planting. Furthermore, Heptachlor tends to bioaccumulate in aquatic organisms up to 21,379X (Heptachlor) and 37,000X (for Heptachlor and HE[1] combined).

The concentration from runoff of field where sorghum seed had been drilled would be less, approximately 50% of values calculated for broadcast application. This is assumed since Heptachlor would not transport until the next year, and, through tillage the ai would be mixed to depths greater than 2 inches. Occasionally, this could cause adverse effects, but they would not be considered unreasonable if adequate measures are taken to avoid exposure. Such measures include drilling the seed to maximum depths that still allow germination, avoiding sloping land and avoiding planting near aquatic habitats.

Terrestrial

The 5-day dietary LC50 is 92 ppm for bobwhite quail and the 9-day LC50 is 50 ppm for starlings. For other bird species, a diet containing 50 ppm took longer to kill 50%, up to 24 days. However, for all species tested, 50 ppm was shown to be an incipient LC50.

When treated with 2 oz. ai per bushel, sorghum would contain 0.22% ai, which is 2200 ppm. If 4.2% of a birds diet consisted of treated sorghum seeds, it would be ingesting a lethal concentration of Heptachlor.

Calculation: 92 / 2200 = 4.2%

Even after the sorghum seed had germinated, the persistent ai would associate with other avian food items and thus be available to birds for several years after the planting occurred.

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[1] HE is Heptachlor Epoxide which is the most commonly found degradation product of Heptachlor. It is "not more toxic than heptachlor itself." This is according to the EPA Ambient Water Quality Criteria for Heptachlor.

Based on the mammalian LD50, acute hazards are possible. A 1 kg mammal requires 0.144 lb. of sorghum seeds for its LD50 equivalent.

Calculation: 2 oz. / 56 lbs.
57,142 mg / 56 lbs.
147 mg is 0.26% of 57142 mg
0.26% of 56 lbs. is 0.144 lb.

A 100 gram mammal would have to eat only 0.014 lb. of sorghum seed, or 252 seeds. A 46 gram meadow vole would receive the equivalent of its LC50 if it ate 115 seeds.

A dietary concentration of 50 ppm would be expected to have a severe impact. Such exposure is considered likely after sorghum seed had been planted at either the 15X or 30X rate.

Drilling seeds would initially reduce hazard, but over the years, as the soil was tilled, the ai would be moved to the surface and be available to various birds or mammals as it associated to terrestrial food items. Exposure to a broad range of organisms including insectivores, herbivores and omnivores would occur.

It is likely that the planting of sorghum seeds treated with Heptachlor at 15X or 30X the normal rates would cause acute and chronic effects to both birds and mammals. The risk to terrestrial organisms is unreasonably high.

Based on this assessment, disposal of sorghum seeds treated with Heptachlor by planting should only be done as a last resort. If it is still considered necessary, the following precautions are strongly recommended:

1. Drill plant to maximum depth, (at least 2 inches);

2. Apply only to soil with $\leq$ 2% slope;

3. Avoid planting within 100 feet of any natural water body including ponds, streams, rivers, swamps or marshes;

4. Field edges must be monitored for spills and exposed seeds; and

5. All exposed seeds must be covered thoroughly with 2 inches of soil or be collected and replanted.

If you have questions please contact Dan Rieder, 557-1451.