

제초제가 줄지렁이 치사에 미치는 영향평가

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Assessment of the Effects of Some Herbicides on Mortality of Earthworm (*Eisenia fetida*)

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The toxic effects of 9 commercially available herbicides on the earthworm, *Eisenia fetida* (Savigny) were evaluated with recommended dose, 2-fold and 4-fold dose using soil surface spray, immersion and contact filter tests in order to find out whether herbicides actually influence the life of earthworm in the soil or not. In the surface sprayed soil test, the earthworm mortality to nine herbicides were not significantly different from the comparison with the control regardless of level of dose. In the immersion test, the mortality of 4-fold dose was 34% in the napropamide and 64% in the alachlor. In contact filter test, the mortality appeared 80% in alachlor, 37% in napropamide, and 10% in triclopyr at 2-fold dose level and those of 4-fold dose were as follows: napropamide 96%, alachlor 80%, glyphosate 47%, triclopyr 37%, paraquatdichloride 37%; glufosinate ammonium 33%, pyributicarb 10%. As a result of these tests by three methods, the mortality of earthworm in terms of the recommended dose level was no observation about eight herbicides while the napropamide appeared 33% in contact filter test.

Key words: Earthworm, *Eisenia fetida*, Herbicides, Toxicity

서 언

잡초를 방제하는 제초제가 지렁이 생존에 미치는 악영향 여부는 논란의 여지가 많이 있어 왔다. Edwards(1989)는 지렁이에게 독성이 적은 제초제는 직접적으로 지렁이에 대해 독성을 보이지 않지만 살포된 제초제로 인해 고사된 잡초를 유기물원으로 지렁이들이 이용하기 때문에 간접적으로 영향을 미칠 수 있다고 하였으며, 독성이 강한 제초제는 토양에 직접적으로 지렁이에게 독성을 일으킨다고 보고하였다. 또한 제초제중에서 DNOC, chlorpropham, propham, dinoseb, simazine과 같은 triazine계 제초제가 지렁이에게 보통독성(moderately toxic)을 나타낸다고 기술하였다(Edwards and Thompson, 1973).

제초제란 잡초를 대상으로 처리함으로써 잡초의 발아나 생육을 억제·고사시키는 화학물질을 뜻하고, 잡초의 체내에서 비정상적 상태를 유발시켜 세포나 기관을 교란·파괴하고 생리활동체계를 방해하는 기능

을 지니고 있어, 잡초를 방제하여 농업생산성의 향상에 눈부시게 공헌해 왔다. 이런 제초제가 토양에 이로운 역할을 하는 대표적인 토양생물이라고 볼 수 있는 지렁이에 악영향을 주게 되면, 이로 인하여 유기물 분해, 토양 비옥도 증가, 토양 물리성 개선 등에 영향을 미치고 있다.

따라서 이 연구는 현재 농경지에 사용 중인 9종의 제초제를 대상으로 제초제가 실제 농경지에 뿌려지는 사용량을 기준으로 침지법, 표토처리법, 여지접촉법으로 줄지렁이의 치사율을 비교 평가하여 제초제가 토양 중 줄지렁이의 생존에 어느 정도 영향을 주는 지를 구명하고자 하였다.

재료 및 방법

실험생물과 실험에 사용된 제초제 종류 이 실험에 사용된 지렁이 종류는 줄지렁이(*Eisenia fetida*)이며 비닐하우스에서 우분을 먹이로 사육되었으며 비닐하우스의 크기와 환경조건은 Na *et al.* (2000)이 개발한 방법으로 설치되었으며 20~28°C가 유지되도록 하였

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Item name	Common name	Chemical name	Recommended dose	Class
Phamid WP, 50%	Napropamide	(RS)-N, N-diethyl-2-(1-maphthyloxy) propionamide	33 g/20	Amide
Alra EC, 43,7%	Alachlor	2-Chloro-2', 6'-diethy-N-(methoxy methyl) acetanilide	24 M/20	Chloroacetanilide
Sethoxydim EC, 20%	Sethoxydim	(±)-(ZE)-2-(1-ethoxy iminobutyl)-5-[2-(ethylthio)propyl]-3-hydroxy cyclohex-2-enone	25 M/20	Amide
Triclopyr EC, 61.6%	Triclopyr	(3, 5, 6-Trichloro-2-pyridyl-oxyacetic acid) butoxyethyl ester	43 M/20	Others
Glyphosate SL, 41.0%	Glyphosate	Isopropylamine salt of N-(phosphono methyl) glycine	75 M/20	Organophosphate
Paraco SL, 24.5%	Paraquatdichloride	1, 1'-Dimethyl-4, 4'-bipyridyldiylum dichloride	50 M/20	Bipyridilium
Simane WP, 50%	Simazine	2-Chloro-4, 6-bis(ethylamino)-1, 3, 5-triazine	33 g/20	Triazine
Pyributicarb WP, 47%	Pyributicarb	O-3-tert-Butylphenyl 6-methoxy-2-pyridyl(methyl)thiocarbamate	75 M/20	Carbamate
Glufosinate- ammonium SL, 18%	Glufosinate ammonium	Ammonium 4-[hydroxy(methyl) phosphinoyl]-DL-homoalanine	60 M/20	Others

Table 1. List of herbicides to be tested.

Item name	Common name	Chemical name	Recommended dose	Class
Phamid WP, 50%	Napropamide	(RS)-N, N-diethyl-2-(1-maphthyloxy) propionamide	33 g/20	Amide
Alra EC, 43,7%	Alachlor	2-Chloro-2', 6'-diethy-N-(methoxy methyl) acetanilide	24 M/20	Chloroacetanilide
Sethoxydim EC, 20%	Sethoxydim	(±)-(ZE)-2-(1-ethoxy iminobutyl)-5-[2-(ethylthio)propyl]-3-hydroxy cyclohex-2-enone	25 M/20	Amide
Triclopyr EC, 61.6%	Triclopyr	(3, 5, 6-Trichloro-2-pyridyl-oxyacetic acid) butoxyethyl ester	43 M/20	Others
Glyphosate SL, 41.0%	Glyphosate	Isopropylamine salt of N-(phosphono methyl) glycine	75 M/20	Organophosphate
Paraco SL, 24.5%	Paraquatdichloride	1, 1'-Dimethyl-4, 4'-bipyridyldiylum dichloride	50 M/20	Bipyridilium
Simane WP, 50%	Simazine	2-Chloro-4, 6-bis(ethylamino)-1, 3, 5-triazine	33 g/20	Triazine
Pyributicarb WP, 47%	Pyributicarb	O-3-tert-Butylphenyl 6-methoxy-2-pyridyl(methyl)thiocarbamate	75 M/20	Carbamate
Glufosinate- ammonium SL, 18%	Glufosinate ammonium	Ammonium 4-[hydroxy(methyl) phosphinoyl]-DL-homoalanine	60 M/20	Others

WP, wettable powder; EC, emulsifiable concentrate; and SL, soluble concentrate.

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가
glyphosate SL 4%, simane WP 4%,
4
6%, alra EC 6%, sethoxydim EC 4%, triclopyr EC 4%, glyphosate SL 4%, paraco SL 4%, pyributicarb WP 4%, glufosinate-ammonium SL 6%

(Table 2).

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가
2, 4
(Table 3).
0.5
4%, alra EC 4%, sethoxydim EC 6%, paraco SL 4%,
phamid WP 10%, sethoxydim EC 4%,

0.5,

triclopyr EC 10%, paraco SL 4%, simane WP 4%

가

4

phamid WP 34%, alra EC 64%

가

phamid WP 33%

2
phamid
WP 37%, alra EC 80%, triclopyr EC 10%

4
phamid
WP 96%, alra EC 80%, triclopyr EC 37%,
glyphosate SL 47%, paraco SL 37%,
pyributicarb WP 10%, glufosinate-ammonium SL 33%
(Table 4).

가

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3가

Table 2. Toxicity of herbicides to *E. fetida* using the surface sprayed soil test.

Herbicides	Mortality (mean±SE, %) [†]			
	0.5-fold Appl.	Recommended dose Appl.	2-fold Appl.	4-fold Appl.
Phamid WP, 50%	0 a	0 a	0 a	6±2 a
Alra EC, 43.7%	0 a	0 a	6±2 a	6±2 a
Sethoxydim EC, 20%	0 a	0 a	0 a	4±2 a
Triclopyr EC, 61.6%	4±2 a	4±2 a	4±2 a	4±2 a
Glyphosate SL, 41.0%	4±2 a	4±2 a	4±2 a	4±2 a
Paraco SL, 24.5%	0 a	0 a	4±2 a	4±2 a
Simane WP, 50%	0 a	4±2 a	0 a	0 a
Pyributicarb WP, 47%	0 a	0 a	4±2 a	4±2 a
Glufosinate-ammonium SL, 18%	4±2 a	0 a	4±2 a	6±2 a
Control	0 a	0 a	0 a	0 a

[†]Mean followed by the same letter in column are not significantly different ($P = 0.05$; Scheffe's test [SAS Institute 1986]).

Table 3. Toxicity of herbicides to *E. fetida* using the immersion test.

Herbicides	Mortality (mean±SE, %) [†]			
	0.5-fold Appl.	Recommended dose Appl.	2-fold Appl.	4-fold Appl.
Phamid WP, 50%	4±2 a	10±3 a	4±2 a	34±2 ab
Alra EC, 43.7%	4±2 a	0 a	0 a	64±10 a
Sethoxydim EC, 20%	6±2 a	4±2 a	0 a	6±2 b
Triclopyr EC, 61.6%	0 a	10±4 a	4±2 a	10±3 b
Glyphosate SL, 41.0%	0 a	0 a	0 a	0 b
Paraco SL, 24.5%	4±2 a	4±2 a	0 a	6±2 b
Simane WP, 50%	0 a	4±2 a	0 a	6±2 b
Pyributicarb WP, 47%	0 a	0 a	0 a	0 b
Glufosinate-ammonium SL, 18%	0 a	0 a	0 a	0 b
Control	0 a	0 a	0 a	0 b

[†]Mean followed by the same letter in column is not significantly different ($P = 0.05$; Scheffe's test [SAS Institute 1986]).

Table 4. Toxicity of herbicides to *E. fetida* using the direct contact-filter paper application.

Herbicides	Mortality (mean±SE, %) [†]			
	0.5-fold Appl.	Recommended dose Appl.	2-fold Appl.	4-fold Appl.
Phamid WP, 50%	0 a	33±3 b	37±3 b	96± a
Alra EC, 43,7%	0 a	0 a	80±6 a	80±6 b
Sethoxydim EC, 20%	0 a	0 a	0 d	0 g
Triclopyr EC, 61.6%	0 a	0 a	10±0 c	37±3 d
Glyphosate SL, 41.0%	0 a	0 a	0 d	47±3 c
Paraco SL, 24.5%	0 a	0 a	0 d	37±3 d
Simane WP, 50%	0 a	0 a	0 d	0 g
Pyributicarb WP, 47%	0 a	0 a	0 d	10±0 f
Glufosinate-ammonium SL, 18%	0 a	0 a	0 d	33±3 e
Control	0 a	0 a	0 d	0 g

[†]Mean followed by the same letter in column is not significantly different ($P = 0.05$; Scheffe's test [SAS Institute 1986]).

, 2 4
 ,
 4 phamid WP
 34%, alra EC 64%
 phamid WP 33%, 2
 phamid WP 37%, alra EC 80%, triclopyr EC
 10%, 4 phamid WP 96%, alra EC 80%,
 triclopyr EC 37%, glyphosate SL 47%, Paraco
 SL 37%, pyributicarb WP 10%, Glufosinate-
 ammonium SL 33%
 Stauffer Chemical
 (acylamide) , 가
 가
 2 ~ 3 cm , 50 ~ 60
 simane WP
 (moderately toxic) 가
 (Atlavinyte et al, 1977; Edwards,
 1970; Martin, 1982).
 phamid WP simane WP가
 가 가
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