Soil Technologies Corp.
Research and Development Department

Research Report

Title: Controlling Late Blight, Downy Mildew, and Leaf Spot Diseases

Location: Japan

Principal Investigators: Satoshi Yamanaka PhD, Section Manager at SDS BioTech K.K. Tsukuba Technology Center and Research and Development Biocontrol

Crop: Cucumber, Tomato, Chinese Cabbage

Date: 2001

Abstract: This comprehensive study, conducted at the SDS Biotech K.K. Tsukuba Technology Center in Japan, assessed the efficacy of Fungastop™ and Armorex™, proprietary formulations from Soil Technologies Corporation, against a range of plant pathogens. Over a series of in vitro assays and greenhouse trials, the research evaluated the products' abilities to combat various diseases, including powdery mildew on cucumber, late blight on tomato, downy mildew on cucumber, and Alternaria leaf spot on Chinese cabbage. Through observation and quantitative analysis, the study revealed significant reductions in disease severity and pathogen growth rates following the application of both Fungastop™ and Armorex™, indicating their efficacy as potent fungicidal and nematicidal agents for crop protection in agricultural settings.

[1]Armorex is a minimum risk pesticide manufactured by Soil Technologies Corp. in Fairfield, IA USA
[2]Fungastop is an EPA 25(b) list antifungal and antibacterial product manufactured by Soil Technologies Corp. in Fairfield, IA USA

Preliminary Evaluation of Armorex (TM) and Fungastop (TM) of Soil Technologies Corporation

SDS Biotech K.K. Tsukuba Technology Center
Biocontrol Research and Development

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Fungicidal Evaluation

[1] powdery mildew on cucumber (*Sphaerotheca fuliginea*)

Materials and Methods

Host : cucumber (Variety Hikari-3-gou-P, 3.5 true leaf stage cut third leaf)

Treatment method: 40ml / 2 pots by handsprayer

Conditions : greenhouse condition (dry), with vinyl cover condition (high humidity)

Inoculation : One day after treatment (low disease pressure condition)

Evaluation : Observed diseased area of first and second leaves

Test materials : FungaStop (dilution rate: 100, 200, 400 and 800 times)

: Armorex (15%, 7.5%, 3.8% and 1.9%)

Reference :quinomethionate 25%WP (21 ppm, 10.5ppm, 5.3 ppm and 2.7 ppm)

Results

Material	Concentration	Disease Severity (%)	Protective Value (%)	Phytotoxicity
FungaStop	100(times)	22.50	25.00	–
	200	30.00	0.00	–
	400	30.00	0.00	–
	800	32.50	0.00	–
Armorex	15(%)	1.50	95.00	++
	7.5	2.00	93.33	++
	3.75	2.00	93.33	–
	1.88	5.50	81.67	–
quinomethionate	21 (ppm)	6.25	79.17	–
	10.5	6.75	77.50	–
	5.3	13.75	54.17	–
	2.7	30.00	0.00	–
control	-	30.00	-	–

[2] late blight on tomato (*Phytophthora infestans*)

Materials and Methods

Host : tomato (Variety mini-tomato, 5 true leaf stage)

Treatment method: 40 ml/2 pots by handsprayer

Conditions : greenhouse condition

Inoculation : One day after treatment (10^4 spores/ ml)

Evaluation : observed diseased area of the third, fourth and fifth leaves (four days after inoculation)

Test materials : FungaStop (dilution rate: 100, 200, 400 and 800 times)

: Armorex (15%, 7.5%, 3.8% and 1.9%)

Reference : chlorothalonil 40%WP (16.7 ppm, 8.4 ppm, 4.2 ppm and 2.1 ppm)

Results

Material	Concentration	Disease Severity (%)	Protective Value (%)	Phytotoxicity
FungaStop	100 (times)	6.07	93.89	–
	200	9.42	90.51	–
	400	22.58	77.26	–
	800	46.45	53.22	–
Armorex	15 (%)	0.00	100.00	++
	7.5	1.50	98.49	–
	3.75	1.79	98.20	–
	1.88	1.57	98.42	–
chrolothalonil	16.5(ppm)	0.00	100.00	–
	8.4	0.00	100.00	–
	4.2	0.67	99.33	–
	2.1	22.50	77.34	–
control	-	99.30	-	–

[3] downy mildew on cucumber (*Pseudoperonospora cubensis)*

Materials and methods

Host : cucumber (Variety: Hikari-3-gou-P, 3.5L true leaf stage cut third leaf)

Treatment method: 40 ml / 2 pots by handsprayer

Conditions : greenhouse condition (incubation in 100% humidity at 22℃ for 16h after inoculation)

Inoculation : One day after treatment (10^3spores /ml)

Evaluation : Observed diseased area of the first and second leaves (four days after inoculation)

Test materials : FungaStop (dilution rate: 100, 200, 400 and 800 times)

: Armorex (15%, 7.5%, 3.8% and 1.9%)

Reference : chlorothalonil 40%WP(16.7ppm, 8.4ppm, 4.2ppm and 2.1ppm)

Results

Material	Concentration	Disease Severity (%)	Protective Value (%)	Phytotoxicity
FungaStop	100 (times)	6.25	92.42	–
	200	12.50	84.85	–
	400	12.50	84.85	–
	800	17.50	78.79	–
Armorex	15 (%)	2.50	96.97	++
	7.5	2.50	96.97	++
	3.75	8.75	89.39	–
	1.88	18.75	77.27	–
chrolothalonil	16.7 (ppm)	0.00	100.00	–
	8.4	0.00	100.00	–
	4.2	0.00	100.00	–
	2.1	2.50	96.97	–
control	-	82.50	-	–

[4] Alternaria leaf spot on Chinese cabbage (*Alternaria brassicora*)

Materials and methods

Host : Chinese cabbage (Variety: Nozaki-2-gou)

Treatment method:

Conditions : incubation under 20 ℃, 100% humidity condition after inoculation

Inoculation : 5×10^4 spores /ml, handsprayer

Evaluation : disease index (0 to 4) (three days after inoculation)

(Disease index) : no disease (0), 1←low←disease severity→high→4

Test materials : FungaStop (dilution rate: 100, 200, 400 and 800 times)

: Armorex (15%, 7.5%, 3.8% and 1.9%)

Reference : iprodione 50%WP (2ppm, 1ppm, 0.5ppm and 0.25ppm)

Results

Material	Concentration	Disease Severity (%)	Protective Value (%)	Phytotoxicity
FungaStop	100 (times)	44.05	20.29	–
	200	39.52	28.49	–
	400	36.18	34.54	–
	800	36.49	33.97	–
Armorex	15 (%)	49.93	9.65	–
	7.5	45.07	18.46	–
	3.75	58.88	0.00	–
	1.88	63.43	0.00	–
iprodione	2 (ppm)	1.48	97.33	–
	1	5.55	89.96	–
	0.5	10.70	80.64	–
	0.25	11.38	79.40	–
control	-	55.27	-	–

Nematicidal Evaluation of Armorex

[1] Check Optimum Concentration

Host : Cucumber (Variety: Sagami-Hanjiro)

Treatment method:

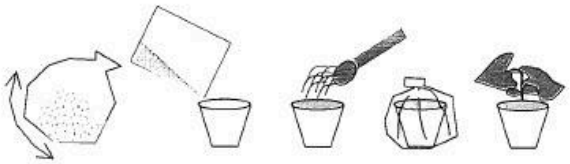
Test Soil: Cray Loam with 99.6 of Meloidogyne and 111.7 of other free-living nematodes per 10 g of dry soil.

(1) Soil Incorporation

① 1,000 cm^3 of the soil were put into a vinyl bag with the indicated concentrations and volumes of Armorex and shook thoroughly.

② The soil was transferred to pot (15cm diameter, 1.1L)and irrigated with 100ml of water. The pot was put into a large vinyl bag and placed in a grass house for two days (automatically maintained at 25-30 ℃).

③ After two days, cucumber seedling was transplanted to the pot. Three pots were subjected to each treatment.

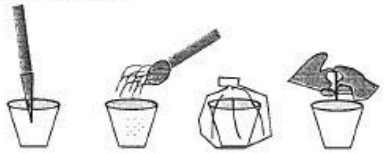


(2) Soil Injection

① 1,000 cm^3 of the soil were put into the pot (15cm diameter, 1.1L) and the indicated concentrations and volumes of Armorex was injected by using pipette to the soil.

④ After irrigating with 100ml of water, the pot was put into a large vinyl bag and placed in a grass house for two days (automatically maintained at 25-30 ℃).

②After two days, cucumber seedling was transplanted to the pot. Three pots were subjected to each treatment.



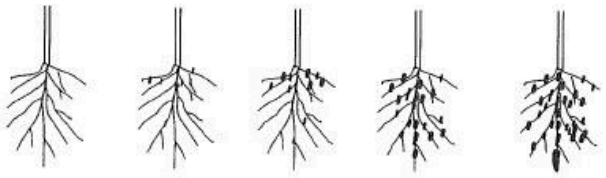
Conc. and Vol. For Check Optimum Concentration Tests

	Concentration (%)	Volume (ml)
Soil Incorporation	15	0.5
	1.5	5
	0.15	170
	0.15	50
Soil Injection	15	0.5
	15	3
	15	5

(3) Judgement of efficacy

① Four weeks after treatment, Gall index of each cucumber root was determined based on the following root-knot ranks. Then protected ratio was calculated.

② As for the plat growth rating, fresh plant weight without root and dry root weight were determined.



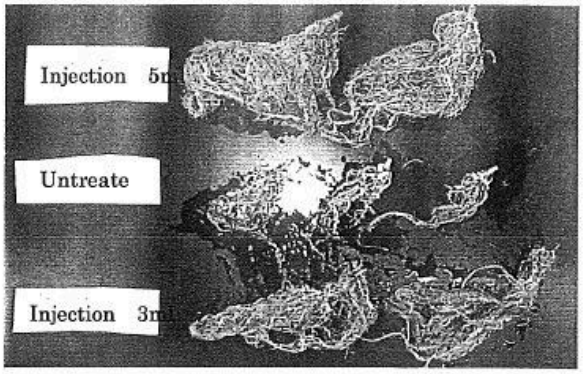
Root-knot Ranks 0 1 2 3 4

Results:

Treatment	Conc.	Vol.	Gall Index			GI	Protection	Plant Weight	
	(%)	(ml)	Rep1	Rep2	Rep3	(%)	(%)	Wet Plant(g)	Dry Root(mg)
Soil	15	0.5	4	2	4	83.3	16.7	6.5	354.0
Incorpo-	1.5	5	4	4	NC	100	0	8.3	612.0
ration	0.15	170	4	4	4	100	0	7.6	672.0
	0.15	50	4	4	4	100	0	4.4	242.3
Injection	15	0.5	3	3	4	83.3	16.7	4.5	298.0
	15	3	0	1	-	12.5*	87.5*	19.6*	1321.5*
	15	5	0	0	-	0*	100.0*	17.2*	1671.0*
Untreated	-	-	4	4	4	100	0	3.6	326.7

NC: Not counted by plant disease of dumping off.

* : There are significant differences between treated and untreated ($P<0.005$).



[2] Check Optimum Volume with 15% solution

Host : Cucumber (Variety: Sagami-Hanjiro)

Treatment method:

Test Soil: Cray Loam with 50.2 of Meloidogyne and 43.3 of other free-living nematodes per 10 g of dry soil.

(1) Soil Incorporation

Same treatment as of [1] with the indicated treatment volume of Armorex.

(2) Soil Injection

Same treatment as of [1] with the indicated treatment volume of Armorex.

Check Optimum Volume with 15% Solution Test

	Concentration (%)	Volume (ml)
Soil Incorporation	15	0.5
	15	1.0
	15	2.0
	15	3.0
Injection	15	0.5
	15	1.0
	15	2.0
	15	3.0

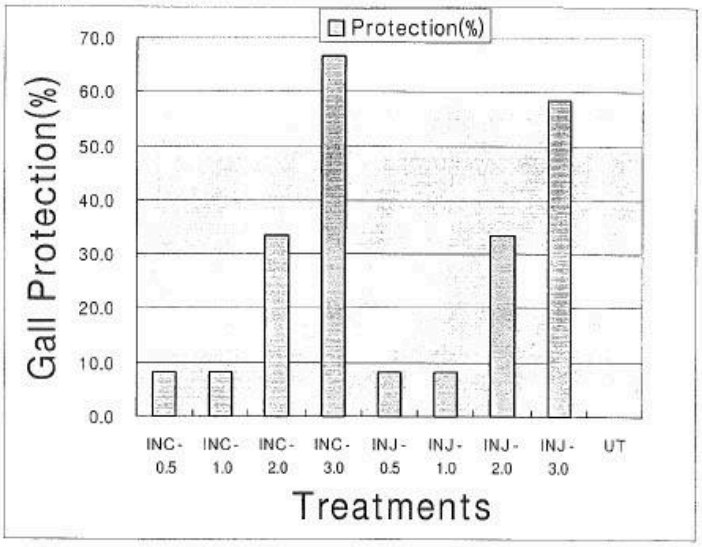
(3) Judgement of efficacy

Same procedure as of [1]

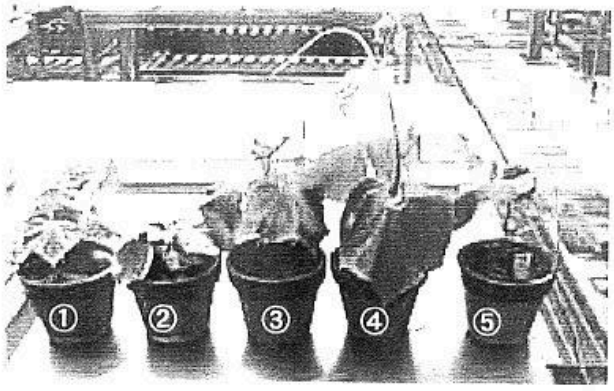
Results:

Treatment	Conc. (%)	Vol. (ml)	Gall Index Rep1	Rep2	Rep3	GI (%)	Protection (%)	Plant Weight Wet Plant (g)	Dry Root (mg)
Soil	15	0.5	4	3	4	91.7	8.3	6.6	411.3
Incorpo-		1	4	4	4	91.7	8.3	7.3	856.3
ration		2	3	4	4	66.7	33.3*	22.9	2095.7*
		3	3	1	1	33.3	66.7*	29.9	2644.0*
Injection	15	0.5	4	3	4	91.7	8.3	13.7	841.0
		1	4	4	4	91.7	8.3	12.0	883.0
		2	4	4	3	66.7	33.3*	17.5*	1435.0*
		3	2	3	3	41.7	58.3*	20.3*	1514.3*
Untreated	-	-	4	4	4	100.0	0.0	15.9	1216.3

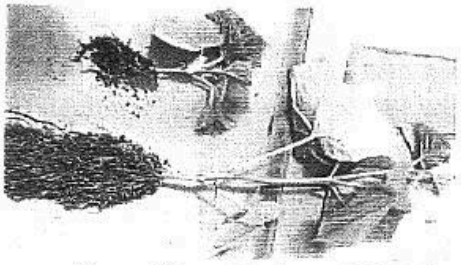
* : There are significant differences between treated and untreated (P<0.005).



INC: Soil Incorporation, INJ: Soil Injection, UT: Untreated



①: INC-0.5ml、②:INC-1.0ml、③: INC-2ml、④INC-3ml、⑤Untreated.



Upper: Untreated、 Lower: INC-3ml.