BOOMTEELT
PRAKTIJKONDERZOEK

APPLIED RESEARCH FOR NURSERY STOCK

PROJECT

Control of the black vine weevil (*Otiorhynchus sulcatus*)

REPORT (BPO)

TRIAL 4105-14

Registration research SusCon10 for control of larvae of the black vine weevil (*Otiorhynchus sulcatus*)

Boskoop, 1 October 1998

Author

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The data mentioned in this report are for purpose of registration in The Netherlands.

SUMMARY

Report number: 4105-14

Title: Registration research SusCon10 for control of larvae of the black vine weevil (*Otiorhynchus sulcatus*)

Author: ir. R.W.H.M. van Tol

Purpose of this research is to test the efficacy of the product SusCon10 at the registered application concentration for control of larvae of the black vine weevil. In The Netherlands this product is registered for use against this pest in potted plants in Nursery Stock.

Results at growers place and research outside of The Netherlands suggest that 375 kg/m^3 of the product SusCon10 is insufficient for acceptable control of this pest.

Two concentrations of SusCon10 are tested in a two-years trial. The registered concentration will be compared with a higher concentration. In this report the results of control after the first year in pots are shown.

Control of larvae of the black vine weevil (*Otiorhynchus sulcatus*) with SusCon10 at a dose of 375 kg/m^3 soil proved to be insufficient for complete control of this pest (79% control). The remaining larvae in this treatment caused a serious damage to the root-collar.

Application of SusCon10 at a dose of 750 kg/m^3 gave 99% control of black vine weevil larvae.

There were no phytotoxic symptoms found on the test plant *Thuja occidentalis* 'Frieslandia' at any of the tested application rates of SusCon10.

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1. PURPOSE

Purpose of this research is to test the efficacy of the product SusCon10 at the registered application concentration for control of larvae of the black vine weevil. In The Netherlands this product is registered for use against this pest in potted plants in Nursery Stock. For plants grown in pots during one year this product can be mixed in the soil at a concentration of 375 kg/m^3 soil. For plants growing two years in pots in the first year a concentration of 750 kg/m^{3}soil can be applied. In the second year plants can be repotted in bigger pots with soil containing 375 kg/m^{3}soil. Results at growers place and research outside of The Netherlands suggest that 375 kg/m^3 of the product SusCon10 is insufficient for acceptable control of this pest. In small containers a control of almost 100% is required to prevent serious damage. One or two remaining larvae per pot can completely destroy a plant when girdling the stem base of the young plants.

For possible adjustment of the registration two concentrations of SusCon10 are tested in a two-years trial. The registered concentration will be compared with a higher concentration. In this report the results of control after the first year in pots are shown.

2. MATERIALS AND METHODS

2.1 TRIAL SET UP

2.1.1 Trial schedule

The trial has been set up as a block trial, consisting of four blocks and nine treatments. Each treatment within a block consists of 8 trial plants and 4 border plants. The treatments are randomized within each block (**appendix 1**). The test treatments are coded with the capital letters A1, A2 and B. The standard treatments are coded S1 and S2. The control (untreated) treatments are coded resp. O1, O2, O3 and O4. O1 and O3 are control treatments not infested with vine weevil eggs and not treated with insecticides. O2 and O4 are the control treatments infested with vine weevil eggs but not with insecticides. O1 and O3 are performed to measure possible phytotoxic effects of the applied chemicals. O1, O2, S1 and A1 are harvested in 1998. The other treatments are not infested with vine weevil eggs and will be used for the second year trial after repotting in bigger pots in 1999. This report shows only the results of the treatments O1, O2, S1 and A1.

2.1.2 Crops

The tested crop is *Thuja occidentalis* 'Frieslandia'. This plant species has been used in the past to test many chemicals for controlling the larvae of the black vine weevil. Because these plants have one main stem the damage by larvae at a low infestation can be very high. It is therefore a good test plant to compare different concentrations of SusCon10 on the efficacy of control and the damage to the plants by the larvae.

2.1.3 Treatments/ insecticides

Table 1. Treatments and applied amounts

code	insecticide	active ingredient	dose '98	dose '99@	eggs#
O1	untreated	-	0	X	-
O2	untreated	-	0	X	2x20
O3	untreated	-	0	0	-
O4	untreated	-	0	0	2x20
S1	SusCon10	chlorpyrifos	750 kg/m^3	X	2x20
S2	SusCon10	chlorpyrifos	750 kg/m^3	375 kg/m^3	2x20
A1	SusCon10	chlorpyrifos	375 kg/m^3	X	2x20
A2	SusCon10	chlorpyrifos	375 kg/m^3	375 kg/m^3	2x20
B	SusCon10	chlorpyrifos	750 kg/m^3	750 kg/m^3	2x20

@ treatments marked with X are harvested in 1998

double inoculation (two times 20 eggs) with black vine weevil eggs. Treatments O4, S2, A2 and B inoculated in 1999, not in 1998.

2.1.4 Sprayings and inoculations

SusCon10 granules were weighed and mixed through the soil before plants were potted in this soil/insecticide mixture. The plants were planted in this soil with bare roots (no adhering soil). Each plant was potted in a 1-litre pot.

The plants of treatment O2, S1 and A1 were twice inoculated with 20 eggs of black vine weevils each time on resp. 16 June and 30 June 1998.

2.1.5 Statistics

The data are statistically processed using ANOVA (GENSTAT program) with a 95% confidence limit (p=0.05). The results were analysed after square root transformation of the data.

The data and ANOVA tables are shown in **appendix 2 and 3.**

3. OBSERVATIONS

3.1 PEST INDEX

Plants were harvested on 21 September 1998. In each pot the number of larvae were counted as well as the developmental stages of the larvae. For the developmental stages we used an index based on the lenght of the larval body and the transparency of the larvae (between brackets).

larval development index:

stage 1: 0-1 mm (transparent)

stage 2: 2-3 mm (transparent)

stage 3: 4-6 mm (transparent)

stage 4: 7-10 mm (transparent)

stage 5: 7-10 mm (milky white)

For the pest index we also used the degree of damage to the root-collar (see index below) and the root growth (index see 3.2).

root-collar damage index:

0 = no damage

1 = <25% girdling of the root collar

2 = 25 - 50% girdling of the root collar

3 = 50 - 75% girdling of the root collar

4 = 75 - 100% girdling of the root collar

5 = 100% girdling of the root collar

3.2 PHYTOTOXICITY

For phytotoxicity of the green plant parts we looked at the discoloration and/or necrosis of these parts (see index below) and the growth (lenght) of the plants. Phytotoxicity on root growth was determined by using a rooting index (see below). Growth and rooting index were also used for measuring the damage on the plants by the larvae. For phytotoxicity the control treatment O1 (no larvae, no chemical) is compared with the chemical treatments (S1 and A1).

phytotox. index green plant parts:

0 = no necrosis/discoloration

1 = little necrosis (<10%)/discoloration

2 = moderate necrosis (10-25%)/discoloration

3 = large necrosis (>25%)/discoloration

4 = plant dead

rooting index:
1 = 100% of pot volume rooted
2 = 75 - 100% of pot volume rooted
3 = 50 - 75% of pot volume rooted
4 = 25 - 50% of pot volume rooted
5 = <25% of pot volume rooted

3.3 CROP GROWTH AND DEVELOPMENT

For crop growth we measured the length of the plants.

4. RESULTS AND DISCUSSION

4.1 PEST INDEX

Table 2. Mean number of larvae per plant (n) and percentage reduction compared to the control treatment O2.

code	treatment	n	total%#	L2%#	L3%#	L4%#	L5%#
O1	untreated	0.0	-	-	-	-	-
O2	untreated	7.6@	0 a	0 a	0 a	0 a	0 a
S1	SusCon10 (750)	0.1	99 c	97 b	98 c	98 b	100 b
A1	SusCon10 (375)	2.1	79 b	94 b	80 b	50 a	93 b

percentage reduction based on number of larvae. Statistical results (letters behind figures) are based on square root transformation of number of larvae.
@ The population in the control (O2) consisted for 13% of L2-larvae, 48% of L3-larvae, 33% of L4-larvae and 6% of L5-larvae.
Figures in the same column followed by the same letter are not statistically significantly different, with a 95% confidence limit.

Table 3. Root-collar damage and root growth expressed as percentage damage resp. root growth reduction compared to the control treatment O1 (n = mean number of larvae per plant).

code	treatment	n	%damage#	% growth reduction@
O1	untreated	0.0	0 a	0 a
O2	untreated	7.6	82 c	43 b
S1	SusCon10 (750)	0.1	2 a	-4 a
A1	SusCon10 (375)	2.1	18 b	3 a

percentage root-collar damage based on index numbers (see Chapter 3.1).
@ percentage reduction in root growth based on index numbers (see Chapter 3.2).
Statistical results (letters behind figures) are based on index results.
Figures in the same column followed by the same letter are not statistically significantly different, with a 95% confidence limit.

From the results in table 2 it can be concluded that the application rate of 375 kg/m^3 of SusCon10 to the soil in pots is insufficient for a complete control of the larvae. Compared to the rate of 750 kg/m^3 there is 20% less control. The application rate of 750 kg/m^3 is giving almost complete control of this pest.
The relative damage caused to the plant root-collar by the larvae at the application rate of 375 kg/m^3 is 18%. There is no damage found in the treatment with the high application rate (750 kg/m^3). The control treatment with vine weevils but without a chemical applied shows a relative damage of 82%. There is only a significant root growth reduction found in the control treatment O2 (table 3).

4.2 PHYTOTOXICITY

There were no symptoms of phytotoxicity found on any of the green plant parts (see appendix 2). The results of the root growth (table 2) and plant length (table 4) gave no indications for phytotoxic effects of SusCon10 in any of the tested concentrations on this plant species.

4.3 CROP GROWTH AND DEVELOPMENT

Table 4. Total average length (in cm) of *Thuja occidentalis* 'Frieslandia' (n = mean number of larvae per plant).

code	treatment	n	plant length (% growth reduction)#	
O1	untreated	0.0	56.8 (0)	b
O2	untreated	7.6	49.6 (13)	a
S1	SusCon10 (750)	0.1	55.4 (2)	b
A1	SusCon10 (375)	2.1	56.3 (0)	b

growth reduction expressed as percentage length difference compared to O1.
Statistical results (letters behind figures) are based on results of length measured.
Figures in the same column followed by the same letter are not statistically significantly different, with a 95% confidence limit.

There was only significant reduction in growth of the control treatment O2. This does not mean that the larval infection in the treatment A1 has no influence on the final growth results. The main damage to the root-collar occurs in autumn, winter and spring. This damage will therefore most likely affect the growth of the plants in the year after the larval infection.

5. CONCLUSIONS

Control of larvae of the black vine weevil (*Otiorhynchus sulcatus*) with SusCon10 at a dosage of 375 kg/m^3 soil is not sufficient for complete control of this pest. The remaining larvae in this treatment cause a serious damage to the root-collar.

Application of SusCon10 at a dose of 750 kg/m^3 is giving almost complete control of black vine weevil larvae.

There are no phytotoxic symptoms found on the test plant *Thuja occidentalis* 'Frieslandia' at any of the tested application rates of SusCon10.

APPENDIX

Appendix 1. Trial form and field schedule

PROEFFORMULIER ACTIVITEIT NR. 4105-14

projectleider	:	Rob van Tol
proefleider	:	Rob van Tol
datum opstellen proefformulier	:	31 maart 1998
titel projectplan	:	Bestrijding van de gegroefde lapsnuitkever (Otiorhynchus sulcatus)
nummer projectplan	:	4105
titel activiteit	:	Registration research SusCon10 for control of larvae of the black vine weevil
nummer activiteit	:	14
locatie activiteit	:	Proefstation voor de Boomkwekerij Boskoop
type proef	:	potten
periode proef	:	april 1998 tm. november 1999
EPPO-nummer	:	111
PD-richtlijn	:	ww8adv16.doc
proefoppervlak	:	10 m^2
-per bruto exp. eenheid	:	0,24 m^2
-per netto exp. eenheid	:	0,16 m^2
vorm van proefveld	:	3,6 m x 2,4 m
-per bruto exp. eenheid	:	0,4 m x 0,6 m
-per netto exp. eenheid	:	0,27 m x 0,6 m
aantal planten	:	432 Thuja
-per soort	:	432
-per bruto exp. eenheid	:	12
-per netto exp. eenheid	:	8
potmaat	:	1 liter
voorvrucht	:	nvt
grondsoort	:	veenmosveen
-textuur	:	40% Fins veemosveen + 60% korrelmolm + 5% Vulka korrels
-structuur	:	nvt
-% org.stof	:	85
-pH-KCl	:	5
-bemesting	:	standaard
watergeefsysteem	:	overhead beregening
aantal bufferrijen	:	1
plantensoort(en)	:	*Thuja occidentalis* 'Frieslandia'
aantal herhalingen	:	4 (blokkenproef)
ziekten/plagen	:	*Otiorhynchus sulcatus*

bestrijdingsmiddelen : granulaat SusCon10 wordt afgewogen en door grond gemengd voor oppotten; x = niet aanwezig

code	middel	actieve stof	dosering 1998	dosering 1999	afwegen
O1	onbehandeld	nvt	0	x	nvt
O2	onbehandeld	nvt	0	x	nvt
O3	onbehandeld	nvt	0	0	nvt
O4	onbehandeld	nvt	0	0	nvt
S1	SusCon10	chloorpyrifos	750 g/m^3 grond	x	30 g (40 liter grond)
S2	SusCon10	chloorpyrifos	750 g/m^3 grond	375 g/m^3 grond	30 g (40 liter grond)
A1	SusCon10	chloorpyrifos	375 g/m^3 grond	x	15 g (40 liter grond)
A2	SusCon10	chloorpyrifos	375 g/m^3 grond	375 g/m^3 grond	15 g (40 liter grond)
B1	SusCon10	chloorpyrifos	750 g/m^3 grond	750 g/m^3 grond	30 g (40 liter grond)

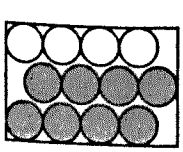
applicatiewijze : doormengen door potgrond
standaardmiddel (code S) : SusCon10
referentiemiddel (code R) : nvt
start bespuitingen : april 1998
aantal bespuitingen : S1 en A1 1x in1998; S2, A2 en B1 2x in resp. 1998 en 1999 bij verpotten
interval bespuitingen : 1 jaar bij 2^e maal toedienen
spuitapparatuur : nvt
spuitvolume (per ha) : nvt
spuitvolume (per exp. eenheid) : nvt
spuitdruk : nvt
spuitdoppen : nvt
bereidingswijze middelen : afwegen
snelheid spuiten : nvt
weersomstandigheden tijdens spuiten (min/max eisen):
-temperatuur : geen limiet
-RV : geen limiet
-windsnelheid : geen limiet
-neerslag : geen limiet
waarnemingen:
-aantal planten per herhaling : 8
-aantal larven per herhaling : 2x20 eitjes/pot toegediend
-sterfte larven : ja
-wortelhals aantasting : ja
-uitval/aantasting % planten : indien nodig
-fytotoxiciteit : lengte gewas, wortelgroei, verkleuring, necroses
-opbrengst gewas vers/droog : nee
-lengte : ja, bij controle behandelingen (zie fytotox)
-LAI : nee
-stamdikte : nee
-bloei : nee
-kleur gewas/blad : ja (zie fytotox.)
-interval waarnemingen : 1x oogst per jaar in november
-klimaat : nvt

PROEFVELDSCHEMA PROEF NR. 4105-14 (1998)

Titel : Registration research SusCon10 for control of larvae of the black vine weevil
Proefleider : ir. R.W.H.M. van Tol
Plaats : PB-Boskoop; containerveld
Bed nr. : A10
Plantafstand : geen (veenmanskist)
Planten per veld : 12
Vorm veldjes : 0,4 x 0,6 meter

O1 I	S2 I	A2 I	O3 I
B I	A1 I	O2 I	S1 I
O4 I	S2 II	O3 II	A1 II
S1 II	O1 II	A2 II	B II
O2 II	O4 II	B III	O2 III
S1 III	A1 III	O3 III	O4 III
S2 III	A2 III	O1 III	S2 IV
O2 IV	O4 IV	O3 IV	B IV
A2 IV	S1 IV	A1 IV	O1 IV

I = blok 1 (rode etiketten)
II = blok 2 (blauwe etiketten)
III = blok 3 (gele etiketten)
IV = blok 4 (groene etiketten



12 planten in een kist; waarvan 8 behandeling en 4 randplanten

Behandelde plant

Randplant

Appendix 2. Ruwe data

4105-14: DATA LARVENPROEF TAXUSKEVER 1998
(1e jaar van 2-jarige proef)

oogstdatum:
september 1998

O1 = onbehandeld, niet geinoculeerd
O2 = onbehandeld, wel geinoculeerd
S1 = SusCon10, 750 g/m3, wel geinoculeerd
A1 = SusCon10, 375 g/m3, wel geinoculeerd

blok	behandeling	plant nr.	larven totaal	larven stad.1	larven stad.2	larven stad.3	larven stad.4	larven stad.5	lengte plant	wortel groei	schade wortels	fytotox.
1	O1	1	0	0	0	0	0	0	41	2	0	0
1	O1	2	0	0	0	0	0	0	50	3	0	0
1	O1	3	0	0	0	0	0	0	31	3	0	0
1	O1	4	0	0	0	0	0	0	47	2	0	0
1	O1	5	0	0	0	0	0	0	39	3	0	0
1	O1	6	0	0	0	0	0	0	58	1	0	0
1	O1	7	0	0	0	0	0	0	52	4	0	0
1	O1	8	0	0	0	0	0	0	44	2	0	0
1	O2	1	12	0	1	10	1	0	47	4	4	0
1	O2	2	5	0	0	5	0	0	54	4	5	0
1	O2	3	18	0	1	6	10	1	58	4	4	0
1	O2	4	1	0	0	1	0	0	38	4	5	0
1	O2	5	17	0	1	3	9	4	60	4	4	0
1	O2	6	13	0	2	9	2	0	55	4	5	0
1	O2	7	2	0	1	1	0	0	51	4	4	0
1	O2	8	0	0	0	0	0	0	28	5	5	0
1	S1	1	0	0	0	0	0	0	61	2	0	0
1	S1	2	0	0	0	1	0	0	57	2	1	0
1	S1	3	0	0	0	0	0	0	61	1	0	0
1	S1	4	0	0	0	0	0	0	67	1	0	0
1	S1	5	0	0	0	0	0	0	64	1	0	0
1	S1	6	1	0	0	0	1	0	36	5	2	0
1	S1	7	0	0	0	0	0	0	49	4	0	0
1	S1	8	0	0	0	0	0	0	59	2	0	0
1	A1	1	0	0	0	0	0	0	50	3	2	0
1	A1	2	5	0	0	1	3	1	65	2	1	0
1	A1	3	3	0	0	0	3	0	57	3	2	0
1	A1	4	4	0	0	1	3	0	49	2	2	0
1	A1	5	0	0	0	0	0	0	59	2	0	0
1	A1	6	0	0	0	0	0	0	57	1	1	0
1	A1	7	1	0	0	0	1	0	50	3	1	0
1	A1	8	0	0	0	0	0	0	55	2	0	0
2	O1	1	0	0	0	0	0	0	61	3	1	0
2	O1	2	0	0	0	0	0	0	63	2	0	0
2	O1	3	0	0	0	0	0	0	54	2	0	0
2	O1	4	0	0	0	0	0	0	62	3	0	0
2	O1	5	0	0	0	0	0	0	47	5	0	0
2	O1	6	0	0	0	0	0	0	55	4	0	0
2	O1	7	0	0	0	0	0	0	70	2	0	0

2	O1	8	0	0	0	0	0	0	75	1	0	0
2	O2	1	8	0	1	7	0	0	52	5	4	0
2	O2	2	3	0	0	3	0	0	44	5	5	0
2	O2	3	2	0	1	0	1	0	42	5	5	0
2	O2	4	15	0	2	9	4	0	53	5	5	0
2	O2	5	9	0	1	8	0	0	49	5	5	0
2	O2	6	7	0	0	3	4	0	49	5	3	0
2	O2	7	7	0	1	5	1	0	55	5	5	0
2	O2	8	14	0	1	1	7	5	58	4	4	0
2	S1	1	1	0	0	1	0	0	65	3	0	0
2	S1	2	0	0	0	0	0	0	52	3	0	0
2	S1	3	0	0	0	0	0	0	71	1	0	0
2	S1	4	0	0	0	0	0	0	51	2	0	0
2	S1	5	0	0	0	0	0	0	68	1	0	0
2	S1	6	0	0	0	0	0	0	61	1	0	0
2	S1	7	0	0	0	0	0	0	44	1	0	0
2	S1	8	0	0	0	0	0	0	57	1	1	0
2	A1	1	0	0	0	0	0	0	64	1	0	0
2	A1	2	2	0	0	0	2	0	64	1	1	0
2	A1	3	2	0	0	1	1	0	43	5	1	0
2	A1	4	2	0	0	1	1	0	56	2	2	0
2	A1	5	0	0	0	0	0	0	47	2	0	0
2	A1	6	0	0	0	0	0	0	70	1	0	0
2	A1	7	3	0	0	0	3	0	78	2	0	0
2	A1	8	2	0	0	0	2	0	58	4	0	0
3	O1	1	0	0	0	0	0	0	80	1	0	0
3	O1	2	0	0	0	0	0	0	48	3	0	0
3	O1	3	0	0	0	0	0	0	70	1	0	0
3	O1	4	0	0	0	0	0	0	69	1	0	0
3	O1	5	0	0	0	0	0	0	49	4	0	0
3	O1	6	0	0	0	0	0	0	63	2	0	0
3	O1	7	0	0	0	0	0	0	57	2	0	0
3	O1	8	0	0	0	0	0	0	55	3	0	0
3	O2	1	2	0	0	2	0	0	54	4	2	0
3	O2	2	11	0	0	5	6	0	50	4	1	0
3	O2	3	2	0	1	1	0	0	54	4	3	0
3	O2	4	19	0	3	15	1	0	63	4	4	0
3	O2	5	7	0	0	3	4	0	57	4	2	0
3	O2	6	6	0	4	2	0	0	48	4	4	0
3	O2	7	7	0	3	2	2	0	52	4	3	0
3	O2	8	10	0	1	3	6	0	49	4	2	0
3	S1	1	0	0	0	0	0	0	45	2	0	0
3	S1	2	0	0	0	0	0	0	53	2	0	0
3	S1	3	0	0	0	0	0	0	49	2	0	0
3	S1	4	0	0	0	0	0	0	42	4	0	0
3	S1	5	0	0	0	0	0	0	50	4	0	0
3	S1	6	0	0	0	0	0	0	47	2	0	0
3	S1	7	0	0	0	0	0	0	56	1	0	0
3	S1	8	0	0	0	0	0	0	65	2	0	0
3	A1	1	5	0	0	5	0	0	51	2	3	0
3	A1	2	0	0	0	0	0	0	47	2	1	0
3	A1	3	0	0	0	0	0	0	57	2	0	0
3	A1	4	7	0	2	4	1	0	54	2	4	0
3	A1	5	2	0	0	0	2	0	59	1	0	0
3	A1	6	4	0	0	3	1	0	32	5	0	0
3	A1	7	1	0	0	1	0	0	57	2	1	0
3	A1	8	3	0	0	2	1	0	53	4	1	0
4	O1	1	0	0	0	0	0	0	66	1	0	0
4	O1	2	0	0	0	0	0	0	55	1	0	0
4	O1	3	0	0	0	0	0	0	59	4	0	0
4	O1	4	0	0	0	0	0	0	60	2	0	0

4	O1	5	0	0	0	0	0	0	48	4	0	0
4	O1	6	0	0	0	0	0	0	62	2	0	0
4	O1	7	0	0	0	0	0	0	76	1	0	0
4	O1	8	0	0	0	0	0	0	52	1	0	0
4	O2	1	2	0	0	1	1	0	52	5	4	0
4	O2	2	2	0	0	2	0	0	43	5	5	0
4	O2	3	0	0	0	0	0	0	46	5	5	0
4	O2	4	3	0	3	0	0	0	49	5	5	0
4	O2	5	7	0	0	3	2	2	52	5	5	0
4	O2	6	2	0	2	0	0	0	45	5	5	0
4	O2	7	3	0	0	0	3	0	39	5	5	0
4	O2	8	28	0	2	8	16	2	42	5	5	0
4	S1	1	0	0	0	0	0	0	62	2	0	0
4	S1	2	0	0	0	0	0	0	56	2	0	0
4	S1	3	0	0	0	0	0	0	54	3	0	0
4	S1	4	0	0	0	0	0	0	53	2	0	0
4	S1	5	1	0	0	0	1	0	48	3	0	0
4	S1	6	0	0	0	0	0	0	60	1	0	0
4	S1	7	1	0	1	0	0	0	54	3	0	0
4	S1	8	0	0	0	0	0	0	57	3	0	0
4	A1	1	2	0	0	0	2	0	68	1	0	0
4	A1	2	3	0	0	2	1	0	69	2	0	0
4	A1	3	2	0	0	0	2	0	50	3	0	0
4	A1	4	4	0	0	0	4	0	70	2	0	0
4	A1	5	4	0	0	2	2	0	43	5	4	0
4	A1	6	1	0	0	0	1	0	60	2	0	0
4	A1	7	3	0	0	0	3	0	58	4	1	0
4	A1	8	1	0	0	0	1	0	50	5	2	0

M:\mijndocumenten\project4105
\datagen14.xls

Appendix 3. Anova

```
103 JOB '4105-14; bestrijding keverlarven in potten 1998'

******** End of job. Maximum of 419 data units used at line 103 (88825 left)
Genstat 5 Release 3.2 (PC/Windows 95)          29 September 1998 11:27:05
Copyright 1995, Lawes Agricultural Trust (Rothamsted Experimental Station)

104 OUTPUT[WIDTH=80] 1
105 UNITS [NVALUES = 128]
106 FACTOR [LABELS = !T(O1, O2, S1, A1)] beh
107 FACTOR [LEVELS = !(1...4)] blok
108 factor[lev=8]plant
109 OPEN '4105-14.txt'; CHANNEL = 2; width=132
110 "SKIP [CHANNEL = 2] 21"
111 READ [CHANNEL = 2] blok, beh, plant, larv, sta1, sta2, sta3,\
112              sta4, sta5, lengpl, groeiwrt, schadewrt, fytotox;\
113               FREP = levels, labels, levels, *, *, *, *, *, *, *, *, *, *
```

Identifier	Minimum	Mean	Maximum	Values	Missing	
larv	0.000	2.453	28.000	128	0	Skew
sta1	0	0	0	128	0	
sta2	0.0000	0.2734	4.0000	128	0	Skew
sta3	0.000	1.117	15.000	128	0	Skew
sta4	0.0000	0.9531	16.0000	128	0	Skew
sta5	0.0000	0.1172	5.0000	128	0	Skew
lengpl	28.00	54.53	80.00	128	0	
groeiwrt	1.000	2.875	5.000	128	0	
schadewr	0.000	1.305	5.000	128	0	
fytotox	0	0	0	128	0	

Identifier	Values	Missing	Levels
blok	128	0	4
beh	128	0	4
plant	128	0	8

```
114 close 2
115 CALC Wlarv = SQRT(larv)
116 CALC WL1 = SQRT (sta1)
117 CALC WL2 = SQRT (sta2)
118 CALC WL3 = SQRT (sta3)
119 CALC WL4 = SQRT (sta4)
120 CALC WL5 = SQRT (sta5)
121
142 ANOVA [FPROB = yes] Wlarv

142.....................................................................

***** Analysis of variance *****

Variate: Wlarv
```

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	0.3023	0.1008	0.17	
blok.*Units* stratum					
beh	3	126.1739	42.0580	69.04	<.001
Residual	121	73.7162	0.6092		
Total	127	200.1924			

***** Tables of means *****

Variate: Wlarv

Grand mean 0.943

beh	O1	O2	S1	A1
	0.000	2.469	0.125	1.177

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	0.1951
l.s.d.	0.3863

143 ANOVA [FPROB = yes] WL1

143.....

***** Analysis of variance *****

Variate: WL1

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	0.	0.		
blok.*Units* stratum					
beh	3	0.	0.		
Residual	121	0.	0.		
Total	127	0.			

***** Tables of means *****

Variate: WL1

Grand mean 0.00

beh	O1	O2	S1	A1
	0.00	0.00	0.00	0.00

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	*
s.e.d.	0.000
l.s.d.	0

144 ANOVA [FPROB = yes] WL2

144.....

***** Analysis of variance *****

Variate: WL2

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	0.2409	0.0803	0.58	
blok.*Units* stratum					
beh	3	12.4836	4.1612	29.82	<.001
Residual	121	16.8852	0.1395		
Total	127	29.6096			

***** Tables of means *****

Variate: WL2

Grand mean 0.205

beh	O1	O2	S1	A1
	0.000	0.745	0.031	0.044

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	0.0934
l.s.d.	0.1849

145 ANOVA [FPROB = yes] WL3

145.....

***** Analysis of variance *****

Variate: WL3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	2.8683	0.9561	2.33	
blok.*Units* stratum					
beh	3	53.4499	17.8166	43.33	<.001
Residual	121	49.7497	0.4112		
Total	127	106.0678			

***** Tables of means *****

Variate: WL3

Grand mean 0.537

beh	O1	O2	S1	A1
	0.000	1.611	0.062	0.475

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	0.1603
l.s.d.	0.3174

146 ANOVA [FPROB = yes] WL4

146.....

***** Analysis of variance *****

Variate: WL4

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	0.7081	0.2360	0.49	
blok.*Units* stratum					
beh	3	29.6359	9.8786	20.32	<.001
Residual	121	58.8235	0.4861		
Total	127	89.1674			

***** Tables of means *****

Variate: WL4

Grand mean 0.506

beh	O1	O2	S1	A1
	0.000	1.084	0.063	0.880

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	0.1743
l.s.d.	0.3451

147 ANOVA [FPROB = yes] WL5

147.....

***** Analysis of variance *****

Variate: WL5

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	0.2643	0.0881	0.84	
blok.*Units* stratum					
beh	3	1.4217	0.4739	4.53	0.005
Residual	121	12.6720	0.1047		
Total	127	14.3581			

***** Tables of means *****

Variate: WL5

Grand mean 0.071

beh	O1	O2	S1	A1
	0.000	0.252	0.000	0.031

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	0.0809
l.s.d.	0.1602

148 ANOVA [FPROB = yes] lengpl

148.....

***** Analysis of variance *****

Variate: lengpl

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	566.69	188.90	2.35	
blok.*Units* stratum					
beh	3	1057.63	352.54	4.39	0.006
Residual	121	9719.56	80.33		
Total	127	11343.87			

***** Tables of means *****

Variate: lengpl

Grand mean 54.53

beh	O1	O2	S1	A1
	56.81	49.63	55.44	56.25

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	2.241
l.s.d.	4.437

149 ANOVA [FPROB = yes] groeiwrt

149.....

***** Analysis of variance *****

Variate: groeiwrt

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	2.313	0.771	0.70	
blok.*Units* stratum					
beh	3	114.563	38.188	34.71	<.001
Residual	121	133.125	1.100		
Total	127	250.000			

***** Tables of means *****

Variate: groeiwrt

Grand mean 2.875

beh	O1	O2	S1	A1
	2.344	4.500	2.156	2.500

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	0.2622
l.s.d.	0.5192

150 ANOVA [FPROB = yes] schadewrt

150.....

***** Analysis of variance *****

Variate: schadewr

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	5.3984	1.7995	2.64	
blok.*Units* stratum					
beh	3	355.2734	118.4245	173.80	<.001
Residual	121	82.4453	0.6814		
Total	127	443.1172			

***** Tables of means *****

Variate: schadewr

Grand mean 1.305

beh	O1	O2	S1	A1
	0.031	4.125	0.125	0.937

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	121
s.e.d.	0.2064
l.s.d.	0.4087

151 ANOVA [FPROB = yes] fytotox

151.....

***** Analysis of variance *****

Variate: fytotox

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
blok stratum	3	0.	0.		
blok.*Units* stratum					
beh	3	0.	0.		
Residual	121	0.	0.		
Total	127	0.			

***** Tables of means *****

Variate: fytotox

Grand mean 0.00

beh	O1	O2	S1	A1
	0.00	0.00	0.00	0.00

*** Standard errors of differences of means ***

Table	beh
rep.	32
d.f.	*
s.e.d.	0.000

152 STOP

******** End of 4105-14; bestrijding keverlarven in potten 1998. Maximum of 8036 data units used at line 152 (81208 left)
Genstat 5 Release 3.2 (PC/Windows 95) 29 September 1998 11:27:07
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