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## APPENDIX 1

### A DISCUSSION OF SOME OF THE ACTIVE INGREDIENTS REGISTERED ON WATER HYACINTH IN SOUTH AFRICA AND FORMULATIONS USED IN THIS PROJECT

#### **Diquat**

(Group II: Moderately hazardous or harmful)

Diquat based Midstream®, was used in this study. It is a non-selective contact herbicide that results in rapid death of treated plants. This causes a rapid increase in rotting material, that may lead to de-oxygenation of water and high algal growth (Findlay & Jones 1996; Zeneca 1997). It may have a detrimental effect on bees, while water can be used for human consumption 24 hours after application (Zeneca 1997).

#### **Glyphosate (isopropylamine salt)**

(Group IV: Acute hazard unlikely in normal use)

Also called N-(phosphonomethyl)glycine, glyphosate-based herbicides are systemic (Grossbard & Atkinson 1985). Roundup® is a broad spectrum, non-selective, post-emergence herbicide used for control of annual and perennial weeds (Franz 1985). It is translocated from the foliage to the roots, rhizomes and apical meristems, and also kills the below-ground parts of the plant. Annual plants are visibly affected after two to four days, perennials in seven to ten days and woody species require one to two weeks (Humburg 1989). The other glyphosate formulations tested were Mamba®, Mon 52276, Rodeo®, Roundup®Ultra and Tumbleweed. It is expected that the surfactants will be responsible for changes in toxicity of these formulations as they contain the same active ingredient.

Glyphosate binds easily to soil particles and dissipates rapidly through microbial activity, photolytic activity or adsorption to sediment when deposited in river systems (Bronstad & Friestad 1985; Humburg 1989). Bound to suspended soils, it can be transported far from the site of application, and have unknown biological implications (Tooby 1985).

The effect of glyphosate on non-target organisms including some mammals, birds, fish, aquatic invertebrates, algae, terrestrial invertebrates and microflora have been determined (Sullivan 1988; Tooby 1985). Roundup is more toxic than glyphosate, as a result of the additives and surfactants incorporated in the formulation (Tooby 1985). High concentrations of the herbicide have an effect on invertebrates (Buikema *et al.* 1981 IN: Tooby 1985). It is generally accepted that glyphosate products have a relatively small effect on the environment (Findlay & Jones 1996; Franz 1985).

## APPENDIX 1 Continued

### **Glyphosate-trimesium**

(Group II: Moderately hazardous)

The products Muster® and Touchdown® were tested. These are non-selective systemic, post-emergence herbicides that control both annual and perennial weeds. They are absorbed by green foliage, causing localised damage or translocated to other parts of the plant where they cause damage. Visible damage appears within 7 to 10 days after application (Zeneca 1993).

### **2,4-D amine**

(Group II: Moderately hazardous)

2,4-D is considered relatively toxic to many animals and fish and has a long and persistent residual action (Findlay & Jones, 1996). It is not registered for aquatic use in South Africa and Zimbabwe, but is still used worldwide and in many of our neighbouring countries. It is a relatively cheap herbicide and controls water hyacinth successfully (Divakar & Manoharan 1979). 2,4-D amine has however been shown to enhance the germination of water hyacinth seeds on the banks of the Nile River, leading to almost immediate reinfestation (Pettet 1964).

## APPENDIX 2

### ARTHROPOD SPECIES RELEASED AGAINST WATER HYACINTH WORLD-WIDE (adapted from Julien & Griffiths 1998)

Species	Date	Country	Comments/Status
<i>Cercospora rodmanii</i> Conway (Hyphomycetes)	1991	RSA	Established
<i>Eccritotarsus catarinensis</i> Carvalho (Miridae)	1996 1996	Malawi RSA	Established at some sites
<i>Neochetina bruchi</i> Hustache (Curculionidae)	1972 1974 1977 1979 1984 1989 1990  1991 1992  1993  1994 1995  1996	Mozambique USA Panama Sudan India Honduras Australia RSA Zimbabwe Thailand Benin Malaysia Philippines Papua New Guinea Taiwan Uganda Ghana Cuba Kenya Malawi Mexico Nigeria Tanzania Indonesia China Vietnam	Established Established, contributes to control Established, but least effective agent Very effective Established Established well at some sites Established and redistributed Established, good control Excellent control Established but spreading slow Not effective yet Established and successful control Starting to have effect Established at low densities Established Established Widely established and spreading Established well Spreading naturally Established and spreading Established Established at some sites
<i>Neochetina eichhorniae</i> Warner (Curculionidae)	1970's 1971 1972 1974 1975 1977 1978 1979 1980 1982 1983	Mexico Zambia Zimbabwe Mozambique USA RSA Australia Fiji Sudan Indonesia Thailand Myanmar Solomon Islands India	Present since 1960's, well distributed Not established Established Spreading and contributing to control Established and spreading Widely established, good control Established and spreading Established, spread and successful control Established but low densities Established, widespread and excellent control Established and spreading Not established Established well, excellent control

## APPENDIX 2 Continued

Species	Date	Country	Comments/Status
<i>Neochetina eichhorniae</i> <i>continue...</i>	1983	Malaysia	Established and widely spread
	1984	Vietnam	
	1985	RSA (again)	Established, contributing to control
	1986	Papua New Guinea	Widespread, good control
	1988	Sri Lanka	Established
	1990	Honduras	Established
	1991	Benin	Established, good control
	1992	Philippines	
		Taiwan	
	1993	Kenya	Established
		Nigeria	Established and control in areas
		Uganda	Established and control
	1994	Ghana	Established
	1995	Malawi	Widely established and spreading
	1996	Tanzania	Established, may be spreading
	China	Established	
	RSA (again)		
<i>Niphograptia albiguttalis</i> Warren (Pylalidae)	1971	Zambia	Not established
	1977	Australia	Widely established, severe but temporary control
		Panama	
		USA	Established, spreading, and patchy but effective control
	1980	Sudan	Widely established and spreading
	1990	RSA	Widely established
	1993	Benin	Not established
	1994	Papua New Guinea	Not established after continued release
		Zimbabwe	
	1995	Thailand	Established at some sites
	1996	Ghana	
		Malawi	
		Malaysia	
<i>Orthogalumna terebrantis</i> Wallwork (Galumnidae)	1971	Zambia	Established well
	1986	India	Established
<i>Xubida infusellus</i> Walker (Pylalidae)	1981	Australia	Not established

## APPENDIX 3

### THE BIOLOGY OF ARTHROPOD SPECIES ESTABLISHED AS NATURAL ENEMIES OF WATER HYACINTH IN SOUTH AFRICA

#### (a) *Neochetina eichhorniae* Warner and *N. bruchi* Hustache (Coleoptera: Curculionidae)

*Neochetina eichhorniae* are 5 mm long, cryptic, dull-brown weevils that appear mottled when wet (Cilliers 1991). They are nocturnal, feeding and ovipositing at night and hiding among ligules or inside young, rolled leaves near the base of the plant at day time (DeLoach & Cordo 1976; Harley 1990). The adults feed on the upper epidermal layer of the upper third of the petiole, causing small circular scars (Harley 1990). A female can lay approximately seven to eight eggs per day in the exposed aerenchyma tissue of feeding scars (Harley 1990; Center 1994). *Neochetina eichhorniae* females place eggs individually just under the leaf epidermis, while *N. bruchi* females place eggs in the second or third layer of epidermis, singly or in groups of up to 25 (De Loach & Cordo 1976).

Newly hatched larvae start feeding and tunnel towards the base of petioles and into the crown of the plant. Third instar larvae can be found in pockets in the rhizome. The larval development takes 34 to 90 days (Center 1994). When full grown, larvae leave the plant and descend into the water, to attach onto the upper roots where they assemble old roots and form balls to pupate in. DeLoach and Cordo (1976) suggest that the pupa might receive oxygen through a hole made with their posterior spurs into the root. Emerged adults start to feed within 24 hours and begin to oviposit within the next six days (DeLoach & Cordo 1976). Generation time is 120 days for *N. eichhorniae* and 70 days for *N. bruchi*. Adults live for four to eight months depending on temperature and plant quality (DeLoach & Cordo 1976). Depending on temperature, females may stop reproducing during winter (Center 1994). Approximately three generations of weevils are produced per year in South Africa (Cilliers 1991).

#### (b) *Niphograptia albiguttalis* Warren (Lepidoptera: Pyralidae)

Adults moths are 6 – 10 mm in length and live for about four days (Center *et al.* 1982; Center 1981 In: Center 1994). Adult females lay an average of 370 eggs, usually within the first two days after emergence from the pupa (Center 1981 In: Center 1994). Eggs are placed singly in leaf tissue, scars or abrasions within the aerenchyma and incubate for between three to four days (DeLoach & Cordo 1978). Young larvae feed externally on the surface creating irregular shaped scars. Within the next day or two the larvae start to feed on parenchyma creating transparent areas in the leaf surface (Center 1994). Older larvae burrow to the central part of the plant, and preferably feed on the apical meristem and young leaves (Wright & Bourne 1986). When the larva is fully grown it burrows to a central part of the aerenchyma and prepares a chamber with a thin epidermis-window (Center 1994). The larva spins a cocoon, lining the exit with silk. The adult moth emerges seven days later by rupturing the thin hyaline epidermis-window (DeLoach & Cordo 1978; Center 1994).

## APPENDIX 3 Continued

The larvae require about 21 days for development, at an optimal water temperature of 30°C (DeLoach & Cordo 1978; Center 1981 In: Center 1994). The total generation time is about 27 and 34 days.

The species is difficult to breed as the mortality rate is high during the larval stages (Bennett 1972). The moth feeds exclusively on the Pontederiaceae and preferably on water hyacinth (Cordo & DeLoach 1978). The moth feeds mainly on young plants or growing tissue (Wright & Bourne 1986; Hill & Cilliers 1999). This may have implications for biological control, as the insect moves away before sufficient control of the infestations have been attained (Center & Durden 1981).

### (c) *Orthogalumna terebrantis* Wallwork (Acarina: Galumnidae)

This mite was already present in both the USA and South Africa before testing and introduction were considered in these countries (Bennett 1977). Emerged adults live or hide in galleries and are inactive during daytime (Delfosse *et al.* 1975). Although they prefer feeding on areas with broken epidermis, often made by *Neochetina* weevils, they are able to initiate feeding with their piercing rutella (mouthpart) (Cordo & DeLoach 1975; Delfosse *et al.* 1975). Eggs are laid singly inside a small hole in the leaf, created by mandibles of the female (Silveira-Guido *et al.* 1965). Six-legged larvae and eight-legged nymphs create and live in 3.5 mm long, darkly coloured feeding galleries (Delfosse *et al.* 1975; Cordo & DeLoach 1976). The generation time is approximately 115 days (Silveira-Guido *et al.* 1965). The mites can occur at high densities on the plants, but easily disperse and cause damage to all plants in the population and to all the leaves on a plant.

### (d) *Eccritotarsus catarinensis* Carvalho (Heteroptera: Miridae)

Adults tend to aggregate, often with nymphs, and are active and fly and run off easily when disturbed. Eggs are laid singly inside the abaxial surface of the leaves. Generation time is approximately 73 days (Hill *et al.* 1999). The four nymphal instars and the adult feed mainly on the abaxial surface of the leaves, leaving black frass marks as an indication of their presence (Hill *et al.* 1999). Their high reproductive rate, short life-cycle, mobility, gregarious tendencies and the intensity of their damage to the plant, suggest that they will be successful biological control agents of water hyacinth in South Africa. This species was released in 1996 for the first time in South Africa and is establishing well (Hill & Cilliers 1999).

## APPENDIX 4

**Table A** LC<sub>50</sub> values expressed as herbicide concentration (%) for *Eccritotarsus catarinensis* using a normal regression program (R) and the Proban analysis program (P), with linear correlation coefficient values (r) where available

	24*			48			72			96			120		
	R	r	P	R	r	P	R	r	P	R	r	P	R	r	P
2,4-D amine	3.2	1.0	-	2.0	1.0	2.2	1.5	0.9	2.0	1.2	0.9	1.8	0.9	0.9	1.58
Add-2	0.6	0.9	0.7	0.4	0.9	0.5	0.4	0.9	0.6	0.4	0.9	0.6	0.3	0.8	-
Agral	0.3	0.9	0.5	0.3	0.9	0.3	0.2	0.6	0.4	4.0E-02	0.4	0.2	0.1	0.7	0.29
Mamba	8.0	1.0	9.1	7.7	1.0	9.3	6.9	1	8.7	6.9	1.0	8.8	6.9	1.0	9.02
Midstream	0.4	0.9	0.6	9.8E-07	0.6	0.0	4.8E-29	0.3	-	-	-	-	-	-	-
Mon 52276	6.8	1.0	7.6	5.1	1.0	5.7	4.5	1	5.6	4.2	1.0	5.2	3.9	1.0	5.17
Muster	1.0	0.9	1.8	0.6	0.9	1.6	0.2	0.9	1.6	0.4	0.9	1.4	0.3	0.9	1.78
Rodeo	723.4	0.8	-	6.0E+05	0.8	-	148.8	0.8	-	191.4	0.7	-	147.0	0.8	-
Roundup	61.0	0.7	51.1	2.3E+03	0.3	3.1E+03	195.6	0.5	337.5	521.8	0.3	707.0	-	-	-
Roundup Ultra	3.0	1.0	-	2.0	1.0	3.2	0.6	0.9	2.8	1.2	1.0	2.7	1.0	1.0	2.8
Touchdown	112.6	0.7	120.8	1.2E+05	0.1	1.3E+06	-	-	-	1.0E-03	0.4	0.1	0.0	0.5	0.2
Tumbleweed	6.2	1.0	8.3	5.1	1.0	6.6	3.1	1	5.8	3.0	1.0	5.6	2.2	1.0	4.6

**Table B** LC<sub>50</sub> values expressed as herbicide concentration (%) for *Neochetina eichhorniae* using a normal regression program (R) and the Proban analysis program (P), with linear correlation coefficient values (r) where available

	24*			48			72			96			120		
	R	r	P	R	r	P	R	r	P	R	r	P	R	r	P
Agral	0.72	0.92	-	0.62	0.97	-	0.59	0.96	-	0.59	0.96	-	0.59	0.96	-
Muster	8.57	0.97	7.96	7.27	0.96	5.96	7.11	0.97	5.96	7.11	0.97	5.96	6.92	0.96	5.94
Roundup Ultra	160	0.89	83.19	24.1	0.93	22.71	21.2	0.90	20.53	17.9	0.94	17.78	15.6	0.97	15.59

\* hours after application

## APPENDIX 5

Mortality of *Eccritotarsus catarinensis* (Figure 3.2)

BBB	Control
24	24 hours after exposure to herbicide
48	48 hours after exposure to herbicide
72	72 hours after exposure to herbicide
96	96 hours after exposure to herbicide
120	120 hours after exposure to herbicide

Anova: Single Factor

2,4-D amine

SUMMARY

Groups	Count	Sum	Average	Variance
DDD 24	3	2	0.666666667	1.333333333
DDD 48	3	4	1.333333333	2.333333333
DDD 72	3	7	2.333333333	5.333333333
DDD 96	3	9	3	7
DDD 120	3	10	3.333333333	5.333333333
EEE 24	3	13	4.333333333	10.333333333
EEE 48	3	18	6	3
EEE 72	3	20	6.666666667	2.333333333
EEE 96	3	20	6.666666667	2.333333333
EEE 120	3	21	7	1
PP 24	3	22	7.333333333	0.333333333
PP 48	3	23	7.666666667	0.333333333
PP 72	3	23	7.666666667	0.333333333
PP 96	3	23	7.666666667	0.333333333
PP 120	3	23	7.666666667	0.333333333
QQ 24	3	23	7.666666667	0.333333333
QQ 48	3	24	8	0
QQ 72	3	24	8	0
QQ 96	3	24	8	0
QQ 120	3	24	8	0
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

DDD	2,4-D 1%
EEE	2,4-D 3%
PP	2,4-D 9%
QQ	2,4-D 18%

ANOVA

Source of Variati	SS	df	MS	F	P-value	F crit
Between Gro	644.2133333	24	26.84222222	13.60247748	1.61E-14	1.73708
Within Group	98.66666667	50	1.973333333			
Total	742.88	74				

Anova: Single Factor

Add-2

SUMMARY

Groups	Count	Sum	Average	Variance
P 24	3	3	1	0
P 48	3	8	2.666666667	4.333333333
P 72	3	8	2.666666667	4.333333333
P 96	3	8	2.666666667	4.333333333
P 120	3	8	2.666666667	4.333333333
Q 24	3	10	3.333333333	5.333333333
Q 48	3	14	4.666666667	2.333333333
Q 72	3	14	4.666666667	2.333333333
Q 96	3	14	4.666666667	2.333333333
Q 120	3	16	5.333333333	4.333333333
R 24	3	9	3	4
R 48	3	11	3.666666667	4.333333333
R 72	3	11	3.666666667	4.333333333
R 96	3	12	4	3
R 120	3	12	4	3
S 24	3	14	4.666666667	0.333333333
S 48	3	16	5.333333333	2.333333333
S 72	3	16	5.333333333	2.333333333
S 96	3	16	5.333333333	2.333333333
S 120	3	16	5.333333333	2.333333333
T 24	3	22	7.333333333	0.333333333
T 48	3	22	7.333333333	0.333333333
T 72	3	22	7.333333333	0.333333333
T 96	3	22	7.333333333	0.333333333
T 120	3	22	7.333333333	0.333333333
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

P	0.2 % Add
Q	0.3 % Add
R	0.6 % Add
S	1 % Add
T	2 % Add

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	388.9888889	29	13.41340996	5.667638012	7.58184E-09	1.65838
Within Groups		142	2.366666667			
Total	530.9888889	89				

## APPENDIX 5 Continued

### Anova: Single Factor

### Agral

#### SUMMARY

Groups	Count	Sum	Average	Variance
HH 24	3	13	4.333333333	1.333333333
HH 48	3	14	4.666666667	2.333333333
HH 72	3	14	4.666666667	2.333333333
HH 96	3	16	5.333333333	6.333333333
HH 120	3	16	5.333333333	6.333333333
II 24	3	15	5	3
II 48	3	16	5.333333333	2.333333333
II 72	3	18	6	3
II 96	3	19	6.333333333	4.333333333
II 120	3	19	6.333333333	4.333333333
JJ 24	3	15	5	1
JJ 48	3	16	5.333333333	0.333333333
JJ 72	3	16	5.333333333	0.333333333
JJ 96	3	17	5.666666667	1.333333333
JJ 120	3	17	5.666666667	1.333333333
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

HH	0.5 % Ag
II	0.75 % Ag
JJ	1 % Ag

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	229.7333333	19	12.09122807	5.145203434	6.59937E-06	1.85289295
Within Groups	94	40	2.35			
Total	323.7333333	59				

### Anova: Single Factor

### Mamba

#### SUMMARY

Groups	Count	Sum	Average	Variance
FFF 24	3	2	0.666666667	0.333333333
FFF 48	3	3	1	1
FFF 72	3	4	1.333333333	2.333333333
FFF 96	3	4	1.333333333	2.333333333
FFF 120	3	4	1.333333333	2.333333333
GGG 24	3	4	1.333333333	2.333333333
GGG 48	3	5	1.666666667	4.333333333
GGG 72	3	6	2	4
GGG 96	3	6	2	4
GGG 120	3	6	2	4
HHH 24	3	17	5.666666667	6.333333333
HHH 48	3	17	5.666666667	6.333333333
HHH 72	3	20	6.666666667	2.333333333
HHH 96	3	20	6.666666667	2.333333333
HHH 120	3	20	6.666666667	2.333333333
III 24	3	23	7.666666667	0.333333333
III 48	3	23	7.666666667	0.333333333
III 72	3	23	7.666666667	0.333333333
III 96	3	23	7.666666667	0.333333333
III 120	3	23	7.666666667	0.333333333
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

FFF	Mamba 3 %
GGG	Mamba 4 %
HHH	Mamba 12 %
III	Mamba 24 %

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit	F crit
Between Groups	603.68	24	25.15333333	11.36445763	5.78087E-13	1.73708	1.964306051
Within Groups	110.6666667	50	2.213333333				
Total	714.3466667	74					

## APPENDIX 5 Continued

Anova: Single Factor

Mon 52276

SUMMARY

Groups	Count	Sum	Average	Variance
SS 24	3	6	2	1
SS 48	3	8	2.666666667	0.333333333
SS 72	3	8	2.666666667	0.333333333
SS 96	3	9	3	1
SS 120	3	9	3	1
TT 24	3	8	2.666666667	0.333333333
TT 48	3	10	3.333333333	0.333333333
TT 72	3	11	3.666666667	0.333333333
TT 96	3	12	4	0
TT 120	3	13	4.333333333	0.333333333
UU 24	3	15	5	7
UU 48	3	19	6.333333333	2.333333333
UU 72	3	21	7	3
UU 96	3	21	7	3
UU 120	3	21	7	3
VV 24	3	23	7.666666667	0.333333333
VV 48	3	24	8	0
Vv 72	3	24	8	0
VV 96	3	24	8	0
VV 120	3	24	8	0
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

SS	Mon 3%
TT	Mon 4%
UU	Mon 12%
VV	Mon 24%

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit	F crit
Between Groups	497.3333333	24	20.72222222	16.89311594	1.81921E-16	1.737078037	1.737078037
Within Groups	61.33333333	50	1.226666667				
Total	558.6666667	74					

Anova: Single Factor

Muster

SUMMARY

Groups	Count	Sum	Average	Variance
X 24	3	12	4	1
X 48	3	14	4.666666667	2.333333333
X 72	3	15	5	3
X 96	3	15	5	3
X 120	3	16	5.333333333	1.333333333
Y 24	3	20	6.666666667	0.333333333
Y 48	3	20	6.666666667	0.333333333
Y 72	3	20	6.666666667	0.333333333
Y 96	3	21	7	1
Y 120	3	21	7	1
Z 24	3	23	7.666666667	0.333333333
Z 48	3	23	7.666666667	0.333333333
Z 72	3	23	7.666666667	0.333333333
Z 96	3	23	7.666666667	0.333333333
Z 120	3	24	8	0
AA 24	3	0	0	0
AA 48	3	0	0	0
AA 72	3	0	0	0
AA 96	3	0	0	0
AA 120	3	0	0	0
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

X	Must 2%
Y	Must 3%
Z	Must 12%
AA	Must 24%

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	716.6666667	24	29.86111111	33.93308081	3.64698E-23	1.737078037
Within Groups	44	50	0.88			
Total	760.6666667	74				

## APPENDIX 5 Continued

### Anova: Single Factor

### Rodeo

#### SUMMARY

Groups	Count	Sum	Average	Variance
G 24	3	0	0	0
G 48	3	3	1	1
G 72	3	3	1	1
G 96	3	3	1	1
G 120	3	3	1	1
H 24	3	1	0.333333333	0.333333333
H 48	3	3	1	1
H 72	3	3	1	1
H 96	3	5	1.666666667	0.333333333
H 120	3	6	2	1
I 24	3	1	0.333333333	0.333333333
I 48	3	2	0.666666667	1.333333333
I 72	3	2	0.666666667	1.333333333
I 96	3	2	0.666666667	1.333333333
I 120	3	4	1.333333333	2.333333333
J 24	3	1	0.333333333	0.333333333
J 48	3	1	0.333333333	0.333333333
J 72	3	4	1.333333333	2.333333333
J 96	3	4	1.333333333	2.333333333
J 120	3	5	1.666666667	4.333333333
K 24	3	6	2	3
K 48	3	6	2	3
K 72	3	9	3	4
K 96	3	9	3	4
K 120	3	9	3	4
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	55.5555556	29	1.915708812	1.172882946	0.295543286	1.656381698
Within Groups	98	60	1.633333333			
Total	153.5555556	89				

G	Rodeo 1,5%
H	Rodeo 3%
I	Rodeo 4%
J	Rodeo 9%
K	Rodeo 18%

### Anova: Single Factor

### Roundup

#### SUMMARY

Groups	Count	Sum	Average	Variance
A 24hr	3	7	2.333333333	4.333333333
A 48hr	3	9	3	7
A 72hr	3	10	3.333333333	9.333333333
A 96hr	3	11	3.666666667	12.333333333
A 120hr	3	12	4	13
B 24	3	7	2.333333333	16.333333333
B 48	3	7	2.333333333	16.333333333
B 72	3	8	2.666666667	14.333333333
B 96	3	8	2.666666667	14.333333333
B 120	3	12	4	13
C 24	3	3	1	3
C 48	3	7	2.333333333	10.333333333
C 72	3	7	2.333333333	10.333333333
C 96	3	7	2.333333333	10.333333333
C 120	3	9	3	7
D 24	3	4	1.333333333	5.333333333
D 48	3	5	1.666666667	8.333333333
D 72	3	5	1.666666667	8.333333333
D 96	3	5	1.666666667	8.333333333
D 120	3	7	2.333333333	8.333333333
E 24	3	6	2	3
E 48	3	6	2	3
E 72	3	8	2.666666667	2.333333333
E 96	3	8	2.666666667	2.333333333
E 120	3	8	2.666666667	2.333333333
F 24	3	12	4	7
F 48	3	12	4	7
F 72	3	13	4.333333333	9.333333333
F 96	3	13	4.333333333	9.333333333
F 120	3	13	4.333333333	9.333333333
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

A	1 % RU
B	2 % RU
C	3 % RU
D	4 % RU
E	12 % RU
F	24 % RU

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	120.2285714	34	3.536134454	0.4760181	0.990377723	1.596292876
Within Groups	520	70	7.428571429			
Total	640.2285714	104				

## APPENDIX 5 Continued

### Anova: Single Factor

### Roundup Ultra

#### SUMMARY

Groups	Count	Sum	Average	Variance
WW 24	3	13	4.333333333	6.333333333
WW 48	3	14	4.666666667	6.333333333
WW 72	3	15	5	7
WW 96	3	15	5	7
WW 120	3	16	5.333333333	4.333333333
XX 24	3	12	4	4
XX 48	3	15	5	4
XX 72	3	17	5.666666667	2.333333333
XX 96	3	18	6	1
XX 120	3	18	6	1
ZZ 24	3	23	7.666666667	0.333333333
ZZ 48	3	23	7.666666667	0.333333333
ZZ 72	3	23	7.666666667	0.333333333
ZZ 96	3	23	7.666666667	0.333333333
ZZ 120	3	24	8	0
AAA 24	3	24	8	0
AAA 48	3	24	8	0
AAA 72	3	24	8	0
AAA 96	3	24	8	0
AAA 120	3	24	8	0
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

WW	RUU 3%
XX	RUU 4%
ZZ	RUU 12%
AAA	RUU 24%

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	490.4533333	24	20.43555556	9.888172043	8.33046E-12	1.737078037
Within Groups	103.3333333	50	2.066666667			
<b>Total</b>	<b>593.7866667</b>	<b>74</b>				

### Anova: Single Factor

### Tumbleweed

#### SUMMARY

Groups	Count	Sum	Average	Variance
KK 24	3	5	1.666666667	4.333333333
KK 48	3	7	2.333333333	6.333333333
KK 72	3	8	2.666666667	4.333333333
KK 96	3	8	2.666666667	4.333333333
KK 120	3	12	4	3
LL 24	3	7	2.333333333	0.333333333
LL 48	3	9	3	1
LL 72	3	11	3.666666667	2.333333333
LL 96	3	11	3.666666667	2.333333333
LL 120	3	12	4	4
MM 24	3	16	5.333333333	4.333333333
MM 48	3	17	5.666666667	2.333333333
MM 72	3	18	6	3
MM 96	3	19	6.333333333	4.333333333
MM 120	3	19	6.333333333	4.333333333
NN 24	3	19	6.333333333	0.333333333
NN 48	3	19	6.333333333	0.333333333
NN 72	3	22	7.333333333	0.333333333
NN 96	3	23	7.666666667	0.333333333
NN 120	3	23	7.666666667	0.333333333
OO 24	3	24	8	0
OO 48	3	24	8	0
OO 72	3	24	8	0
OO 96	3	24	8	0
OO 120	3	24	8	0
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

KK	TW 1%
LL	TW 4%
MM	TW 12%
NN	TW 24%
OO	TW 50%

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	589.3333333	29	20.32183908	10.27508718	3.21555E-14	1.856381698
Within Groups	118.6666667	60	1.977777778			
<b>Total</b>	<b>708</b>	<b>89</b>				

## APPENDIX 5 Continued

Anova: Single Factor

Midstream and Combinations

SUMMARY

Groups	Count	Sum	Average	Variance
BB 24	3	16	5.333333333	2.333333333
BB 48	3	23	7.666666667	0.333333333
BB 72	3	24	8	0
BB 96	3	24	8	0
BB 120	3	24	8	0
CCC 24	3	20	6.666666667	2.333333333
CCC 48	3	22	7.333333333	0.333333333
CCC 72	3	23	7.666666667	0.333333333
CCC 96	3	24	8	0
CCC 120	3	24	8	0
CC 24	3	20	6.666666667	2.333333333
CC 48	3	23	7.666666667	0.333333333
CC 72	3	24	8	0
CC 96	3	24	8	0
CC 120	3	24	8	0
DD 24	3	24	8	0
DD 48	3	24	8	0
DD 72	3	24	8	0
DD 96	3	24	8	0
DD 120	3	24	8	0
EE 24	3	20	6.666666667	1.333333333
EE 48	3	24	8	0
EE 72	3	24	8	0
EE 96	3	24	8	0
EE 120	3	24	8	0
FF 24	3	23	7.666666667	0.333333333
FF 48	3	24	8	0
FF 72	3	24	8	0
FF 96	3	24	8	0
FF 120	3	24	8	0
GG 24	3	24	8	0
GG 48	3	24	8	0
GG 72	3	24	8	0
GG 96	3	24	8	0
GG 120	3	24	8	0
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

BB	1 % MS
CCC	2 % MS
CC	3.75 % MS
DD	4 % MS
EE	5 % MS
FF	1.88MS&0.38Ag
GG	3.75MS&0.75Ag

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	633.8916667	39	16.25363248	38.24987431	5.7595E-38	1.549445
Within Groups	34	80	0.425			
Total	667.8916667	119				

Anova: Single Factor

Touchdown and Combinations

SUMMARY

Groups	Count	Sum	Average	Variance
L 24	3	1	0.333333333	0.333333333
L 48	3	7	2.333333333	1.333333333
L 72	3	12	4	3
L 96	3	15	5	9
L 120	3	15	5	9
M 24	3	7	2.333333333	16.33333333
M 48	3	12	4	13
M 72	3	14	4.666666667	9.333333332
M 96	3	18	6	4
M 120	3	18	6	4
N 24	3	4	1.333333333	1.333333333
N 48	3	5	1.666666667	2.333333333
N 72	3	10	3.333333333	5.333333333
N 96	3	16	5.333333333	9.333333333
N 120	3	17	5.666666667	10.33333333
O 24	3	8	2.666666667	0.333333333
O 48	3	10	3.333333333	0.333333333
O 72	3	15	5	3
O 96	3	17	5.666666667	4.333333333
O 120	3	17	5.666666667	4.333333333
U 24	3	5	1.666666667	2.333333333
U 48	3	6	2	3
U 72	3	11	3.666666667	5.333333333
U 96	3	11	3.666666667	5.333333333
U 120	3	11	3.666666667	5.333333333
V 24	3	8	2.666666667	6.333333333
V 48	3	10	3.333333333	9.333333333
V 72	3	12	4	7
V 96	3	12	4	7
V 120	3	12	4	7
W 24	3	13	4.333333333	10.33333333
W 48	3	16	5.333333333	9.333333333
W 72	3	19	6.333333333	2.333333332
W 96	3	20	6.666666667	1.333333333
W 120	3	21	7	1
BBB 24	3	2	0.666666667	1.333333333
BBB 48	3	2	0.666666667	1.333333333
BBB 72	3	3	1	1
BBB 96	3	3	1	1
BBB 120	3	5	1.666666667	2.333333333

L	2 % TD
M	4 % TD
N	8 % TD
O	20 % TD
U	2%TD&0.2%Add
V	2%TD&0.3%Add
W	4%TD&0.4%Add

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	397.3333333	39	10.18803419	2.041006518	0.003617277	1.549445
Within Groups	399.3333333	80	4.991666667			
Total	796.6666667	119				

## APPENDIX 6

Mortality of *Eccritotarsus catarinensis* (Table 3.3)

Anova: Single Factor

24 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
A 24hr	3	7	2.333333	4.333333
B 24	3	7	2.333333	16.333333
C 24	3	3	1	3
D 24	3	4	1.333333	5.333333
E 24	3	6	2	3
F 24	3	12	4	7
G 24	3	0	0	0
H 24	3	1	0.333333	0.333333
I 24	3	1	0.333333	0.333333
J 24	3	1	0.333333	0.333333
K 24	3	6	2	3
L 24	3	1	0.333333	0.333333
M 24	3	7	2.333333	16.333333
N 24	3	4	1.333333	1.333333
O 24	3	8	2.666667	0.333333
P 24	3	3	1	0
Q 24	3	10	3.333333	5.333333
R 24	3	9	3	4
S 24	3	14	4.666667	0.333333
T 24	3	22	7.333333	0.333333
U 24	3	5	1.666667	2.333333
V 24	3	8	2.666667	6.333333
W 24	3	13	4.333333	10.333333
X 24	3	12	4	1
Y 24	3	20	6.666667	0.333333
Z 24	3	23	7.666667	0.333333
AA 24	3	0	0	0
BB 24	3	16	5.333333	2.333333
CCC 24	3	20	6.666667	2.333333
CC 24	3	20	6.666667	2.333333
DD 24	3	24	8	0
EE 24	3	20	6.666667	1.333333

Anova: Single Factor

48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
A 48hr	3	9	3	7
B 48	3	7	2.333333	16.333333
C 48	3	7	2.333333	10.333333
D 48	3	5	1.666667	8.333333
E 48	3	6	2	3
F 48	3	12	4	7
G 48	3	3	1	1
H 48	3	3	1	1
I 48	3	2	0.666667	1.333333
J 48	3	1	0.333333	0.333333
K 48	3	6	2	3
L 48	3	7	2.333333	1.333333
M 48	3	12	4	13
N 48	3	5	1.666667	2.333333
O 48	3	10	3.333333	0.333333
P 48	3	8	2.666667	4.333333
Q 48	3	14	4.666667	2.333333
R 48	3	11	3.666667	4.333333
S 48	3	16	5.333333	2.333333
T 48	3	22	7.333333	0.333333
U 48	3	6	2	3
V 48	3	10	3.333333	9.333333
W 48	3	16	5.333333	9.333333
X 48	3	14	4.666667	2.333333
Y 48	3	20	6.666667	0.333333
Z 48	3	23	7.666667	0.333333
AA 48	3	0	0	0
BB 48	3	23	7.666667	0.333333
CCC 48	3	22	7.333333	0.333333
CC 48	3	23	7.666667	0.333333
DD 48	3	24	8	0
EE 48	3	24	8	0

24 hours cont...

FF 24	3	23	7.666667	0.333333
GG 24	3	24	8	0
HH 24	3	13	4.333333	1.333333
II 24	3	15	5	3
JJ 24	3	15	5	1
KK 24	3	5	1.666667	4.333333
LL 24	3	7	2.333333	0.333333
MM 24	3	16	5.333333	4.333333
NN 24	3	19	6.333333	0.333333
OO 24	3	24	8	0
DDD 24	3	2	0.666667	1.333333
EEE 24	3	13	4.333333	10.333333
PP 24	3	22	7.333333	0.333333
QQ 24	3	23	7.666667	0.333333
SS 24	3	6	2	1
TT 24	3	8	2.666667	0.333333
UU 24	3	15	5	7
VV 24	3	23	7.666667	0.333333
WW 24	3	13	4.333333	6.333333
XX 24	3	12	4	4
ZZ 24	3	23	7.666667	0.333333
AAA 24	3	24	8	0
BBB 24	3	2	0.666667	1.333333
FFF 24	3	2	0.666667	0.333333
GGG 24	3	4	1.333333	2.333333
HHH 24	3	17	5.666667	6.333333
III 24	3	23	7.666667	0.333333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1230.3051	58	21.21216	7.937741	1.8E-21	1.4357
Within Groups	315.33333	118	2.672316			
Total	1545.6384	176				
Total	1563.9111	179				

48 hours cont...

FF 48	3	24	8	0
GG 48	3	24	8	0
HH 48	3	14	4.666667	2.333333
II 48	3	16	5.333333	2.333333
JJ 48	3	16	5.333333	0.333333
KK 48	3	7	2.333333	6.333333
LL 48	3	9	3	1
MM 48	3	17	5.666667	2.333333
NN 48	3	19	6.333333	0.333333
OO 48	3	24	8	0
DDD 48	3	4	1.333333	2.333333
EEE 48	3	18	6	3
PP 48	3	23	7.666667	0.333333
QQ 48	3	24	8	0
SS 48	3	8	2.666667	0.333333
TT 48	3	10	3.333333	0.333333
UU 48	3	19	6.333333	2.333333
VV 48	3	24	8	0
WW 48	3	14	4.666667	6.333333
XX 48	3	15	5	4
ZZ 48	3	23	7.666667	0.333333
AAA 48	3	24	8	0
BBB 48	3	2	0.666667	1.333333
FFF 48	3	3	1	1
GGG 48	3	5	1.666667	4.333333
HHH 48	3	17	5.666667	6.333333
III 48	3	23	7.666667	0.333333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1156.91525	58	19.94681	7.23481	7.726E-20	1.4357
Within Groups	325.333333	118	2.757062			
Total	1482.24859	176				
Total	1518.32778	179				

## APPENDIX 6 Continued

Anova: Single Factor

72 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
A 72hr	3	10	3.33333	9.33333
B 72	3	8	2.66667	14.3333
C 72	3	7	2.33333	10.3333
D 72	3	5	1.66667	8.33333
E 72	3	8	2.66667	2.33333
F 72	3	13	4.33333	9.33333
G 72	3	3	1	1
H 72	3	3	1	1
I 72	3	2	0.66667	1.33333
J 72	3	4	1.33333	2.33333
K 72	3	9	3	4
L 72	3	12	4	3
M 72	3	14	4.66667	9.33333
N 72	3	10	3.33333	5.33333
O 72	3	15	5	3
P 72	3	8	2.66667	4.33333
Q 72	3	14	4.66667	2.33333
R 72	3	11	3.66667	4.33333
S 72	3	16	5.33333	2.33333
T 72	3	22	7.33333	0.33333
U 72	3	11	3.66667	5.33333
V 72	3	12	4	7
W 72	3	19	6.33333	2.33333
X 72	3	15	5	3
Y 72	3	20	6.66667	0.33333
Z 72	3	23	7.66667	0.33333
AA 72	3	0	0	0
BB 72	3	24	8	0
CCC 72	3	23	7.66667	0.33333
CC 72	3	24	8	0
DD 72	3	24	8	0
EE 72	3	24	8	0

Anova: Single Factor

96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
A 96hr	3	11	3.66667	12.3333
B 96	3	8	2.66667	14.3333
C 96	3	7	2.33333	10.3333
D 96	3	5	1.66667	8.33333
E 96	3	8	2.66667	2.33333
F 96	3	13	4.33333	9.33333
G 96	3	3	1	1
H 96	3	5	1.66667	0.33333
I 96	3	2	0.66667	1.33333
J 96	3	4	1.33333	2.33333
K 96	3	9	3	4
L 96	3	15	5	9
M 96	3	18	6	4
N 96	3	16	5.33333	9.33333
O 96	3	17	5.66667	4.33333
P 96	3	8	2.66667	4.33333
Q 96	3	14	4.66667	2.33333
R 96	3	12	4	3
S 96	3	16	5.33333	2.33333
T 96	3	22	7.33333	0.33333
U 96	3	11	3.66667	5.33333
V 96	3	12	4	7
W 96	3	20	6.66667	1.33333
X 96	3	15	5	3
Y 96	3	21	7	1
Z 96	3	23	7.66667	0.33333
AA 96	3	0	0	0
BB 96	3	24	8	0
CCC 96	3	24	8	0
CC 96	3	24	8	0
DD 96	3	24	8	0
EE 96	3	24	8	0

72 hours cont...

FF 72	3	24	8	0
GG 72	3	24	8	0
HH 72	3	14	4.66667	2.33333
II 72	3	18	6	3
JJ 72	3	16	5.33333	0.33333
KK 72	3	8	2.66667	4.33333
LL 72	3	11	3.66667	2.33333
MM 72	3	18	6	3
NN 72	3	22	7.33333	0.33333
OO 72	3	24	8	0
DDD 72	3	7	2.33333	5.33333
EEE 72	3	20	6.66667	2.33333
PP 72	3	23	7.66667	0.33333
QQ 72	3	24	8	0
SS 72	3	8	2.66667	0.33333
TT 72	3	11	3.66667	0.33333
UU 72	3	21	7	3
VV 72	3	24	8	0
WW 72	3	15	5	7
XX 72	3	17	5.66667	2.33333
ZZ 72	3	23	7.66667	0.33333
AAA 72	3	24	8	0
BBB 72	3	3	1	1
FFF 72	3	4	1.33333	2.33333
GGG 72	3	6	2	4
HHH 72	3	20	6.66667	2.33333
III 72	3	23	7.66667	0.33333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1056.4068	58	18.2139	6.56591	3.5E-18	1.43568
Within Groups	327.33333	118	2.77401			
Total	1383.7401	176				
Total	1412.3278	179				

96 hours cont...

FF 96	3	24	8	0
GG 96	3	24	8	0
HH 96	3	16	5.33333	6.33333
II 96	3	19	6.33333	4.33333
JJ 96	3	17	5.66667	1.33333
KK 96	3	8	2.66667	4.33333
LL 96	3	11	3.66667	2.33333
MM 96	3	19	6.33333	4.33333
NN 96	3	23	7.66667	0.33333
OO 96	3	24	8	0
DDD 96	3	9	3	7
EEE 96	3	20	6.66667	2.33333
PP 96	3	23	7.66667	0.33333
QQ 96	3	24	8	0
SS 96	3	9	3	1
TT 96	3	12	4	0
UU 96	3	21	7	3
VV 96	3	24	8	0
WW 96	3	15	5	7
XX 96	3	18	6	1
ZZ 96	3	23	7.66667	0.33333
AAA 96	3	24	8	0
BBB 96	3	3	1	1
FFF 96	3	4	1.33333	2.33333
GGG 96	3	6	2	4
HHH 96	3	20	6.66667	2.33333
III 96	3	23	7.66667	0.33333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1039.3785	58	17.92032	5.92878	1.66E-16	1.435676
Within Groups	356.66667	118	3.022599			
Total	1396.0452	176				
Total	1421.3111	179				

## APPENDIX 6 Continued

Anova: Single Factor

120 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
A 120hr	3	12	4	13
B 120	3	12	4	13
C 120	3	9	3	7
D 120	3	7	2.333333	6.333333
E 120	3	8	2.66667	2.333333
F 120	3	13	4.333333	9.333333
G 120	3	3	1	1
H 120	3	6	2	1
I 120	3	4	1.333333	2.333333
J 120	3	5	1.66667	4.333333
K 120	3	9	3	4
L 120	3	15	5	9
M 120	3	18	6	4
N 120	3	17	5.66667	10.33333
O 120	3	17	5.66667	4.333333
P 120	3	8	2.66667	4.333333
Q 120	3	16	5.33333	4.333333
R 120	3	12	4	3
S 120	3	16	5.33333	2.333333
T 120	3	22	7.33333	0.333333
U 120	3	11	3.66667	5.333333
V 120	3	12	4	7
W 120	3	21	7	1
X 120	3	16	5.33333	1.333333
Y 120	3	21	7	1
Z 120	3	24	8	0
AA 120	3	0	0	0
BB 120	3	24	8	0
CCC 120	3	24	8	0
CC 120	3	24	8	0
DD 120	3	24	8	0
EE 120	3	24	8	0

A	1 % RU
B	2 % RU
C	3 % RU
D	4 % RU
E	12 % RU
F	24 % RU
G	Rodeo 1,5%
H	Rodeo 3%
I	Rodeo 4%
J	Rodeo 9%
K	Rodeo 18%
L	2 % TD
M	4 % TD
N	8 % TD
O	20 % TD
P	0.2 % Add
Q	0.3 % Add
R	0.6 % Add
S	1 % Add
T	2 % Add
U	2%TD&0.2%Add
V	2%TD&0.3%Add
W	4%TD&0.4%Add
X	Must 2 %
Y	Must 3 %
Z	Must 12 %
AA	Must 24%
BB	1 % MS
CC	3,75 % MS
DD	4 % MS

EE	5 % MS
FF	1.88MS&0.38Ag
GG	3.75MS&0.75Ag
HH	0.5 % Ag
II	0.75% Ag
JJ	1 % Ag
KK	TW 1%
LL	TW 4%
MM	TW 12%
NN	TW 24%
OO	TW 50%
PP	2.4-D 9%
QQ	2.4-D 18%
SS	Mon 3%
TT	Mon 4%
UU	Mon 12%
VV	Mon 24%
WW	RUU 3%
XX	RUU 4%
ZZ	RUU 12%
AAA	RUU 24%
BBB	h2o
CCC	2 % MS
DDD	1 % 2,4-D
EEE	3 % 2,4-D
FFF	Mamba 3 %
GGG	Mamba 4 %
HHH	Mamba 12 %
III	Mamba 24 %

120 hours cont...

FF 120	3	24	8	0
GG 120	3	24	8	0
HH 120	3	16	5.333333	6.333333
IJ 120	3	19	6.333333	4.333333
JJ 120	3	17	5.666667	1.333333
KK 120	3	12	4	3
LL 120	3	12	4	4
MM 120	3	19	6.333333	4.333333
NN 120	3	23	7.666667	0.333333
OO 120	3	24	8	0
DDD 120	3	10	3.333333	5.333333
EEE 120	3	21	7	1
PP 120	3	23	7.666667	0.333333
QQ 120	3	24	8	0
SS 120	3	9	3	1
TT 120	3	13	4.333333	0.333333
UU 120	3	21	7	3
VV 120	3	24	8	0
WW 120	3	16	5.333333	4.333333
XX 120	3	18	6	1
ZZ 120	3	24	8	0
AAA 120	3	24	8	0
BBB 120	3	5	1.666667	2.333333
FFF 120	3	4	1.333333	2.333333
GGG 120	3	6	2	4
HHH 120	3	20	6.666667	2.333333
III 120	3	23	7.666667	0.333333

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	947.728814	58	16.3402	5.583411	1.48E-15	1.43568
Within Groups	345.333333	118	2.92655			
Total	1293.06215	176				
Total	1315.39444	179				

## APPENDIX 7

### Mortality *Eccritotarsus catarinensis* (Figure 3.4)

Anova: Single Factor 24 hours

#### SUMMARY

Groups	Count	Sum	Average	Variance
3.75 % MS	3	250	83.33333	364.5833
1.88MS&0.38Ag	3	287.5	95.83333	52.08333
3.75MS&0.75Ag	3	300	100	0
0.75 % Ag	3	187.5	62.5	468.75
Control	3	12.5	4.166667	52.08333

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	18395.8333	4	4598.958	24.52778	3.75E-05	3.478
Within Groups	1875	10	187.5			
Total	20270.8333	14				

Anova: Single Factor 120hours

#### SUMMARY

Groups	Count	Sum	Average	Variance
3.75 % MS	3	300	100	0
1.88MS&0.38Ag	3	300	100	0
3.75MS&0.75Ag	3	300	100	0
0.75 % Ag	3	237.5	79.16667	677.0833
Control	3	12.5	4.166667	52.08333

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	20687.5	4	5171.875	35.46429	7.02E-06	3.478
Within Groups	1458.33333	10	145.8333			
Total	22145.8333	14				

Anova: Single Factor 24 hours

#### SUMMARY

Groups	Count	Sum	Average	Variance
2 % TD	3	12.5	4.1666667	52.08333
0.2 % Add	3	37.5	12.5	0
2%TD&0.2%Add	3	62.5	20.833333	364.5833
4%TD&0.4%Add	3	162.5	54.166667	1614.583
Control	3	12.5	4.1666667	52.08333

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5166.667	4	1291.6667	3.1	0.06681	3.47805
Within Groups	4166.667	10	416.66667			
Total	9333.333	14				

Anova: Single Factor 120 hours

#### SUMMARY

Groups	Count	Sum	Average	Variance
2 % TD	3	187.5	62.5	1406.25
0.2 % Add	3	100	33.333333	677.0833
2%TD&0.2%Add	3	137.5	45.833333	833.3333
4%TD&0.4%Add	3	262.5	87.5	156.25
Control	3	12.5	4.1666667	52.08333

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	11708.33	4	2927.0833	4.683333	0.02175	3.47805
Within Groups	6250	10	625			
Total	17958.33	14				

## APPENDIX 3

### Mortality of *Neochetina eichhorniae* (Figure 3.5)

PP	Control
24	24 hours after exposure to herbicide
48	48 hours after exposure to herbicide
72	72 hours after exposure to herbicide
96	96 hours after exposure to herbicide
120	120 hours after exposure to herbicide

#### Anova: Single Factor

#### 2,4-D amine

##### SUMMARY

Groups	Count	Sum	Average	Variance
I 24	3	0	0	0
I 48	3	0	0	0
I 72	3	0	0	0
I 96	3	0	0	0
I 120	3	0	0	0
J 24	3	1	0.3333333	0.3333333
J 48	3	1	0.3333333	0.3333333
J 72	3	1	0.3333333	0.3333333
J 96	3	2	0.6666667	0.3333333
J 120	3	2	0.6666667	0.3333333
ZZ 24	3	0	0	0
ZZ 48	3	0	0	0
ZZ 72	3	0	0	0
ZZ 96	3	0	0	0
ZZ 120	3	0	0	0
K 24	3	0	0	0
K 48	3	0	0	0
K 72	3	0	0	0
K 96	3	0	0	0
K 120	3	0	0	0
AAA 24	3	0	0	0
AAA 48	3	0	0	0
AAA 72	3	0	0	0
AAA 96	3	0	0	0
AAA 120	3	0	0	0
L 24	3	0	0	0
L 48	3	0	0	0
L 72	3	0	0	0
L 96	3	0	0	0
L 120	3	0	0	0
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

I	1 % 2,4-D
J	3 % 2,4-D
ZZ	4 % 2,4-D
K	9 % 2,4-D
AAA	12 % 2,4-D
L	18 % 2,4-D

##### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3.2	34	0.0941176	1.9764706	0.008226	1.5962929
Within Groups	3.333333	70	0.047619			
Total	6.533333	104				

#### Anova: Single Factor

#### Add-2

##### SUMMARY

Groups	Count	Sum	Average	Variance
A 24hr	3	0	0	0
A 48hr	3	0	0	0
A 72hr	3	0	0	0
A 96hr	3	0	0	0
A 120hr	3	0	0	0
B 24	3	0	0	0
B 48	3	0	0	0
B 72	3	0	0	0
B 96	3	0	0	0
B 120	3	0	0	0
C 24	3	0	0	0
C 48	3	0	0	0
C 72	3	0	0	0
C 96	3	0	0	0
C 120	3	1	0.3333	0.333333
QQ 24	3	0	0	0
QQ 48	3	0	0	0
QQ 72	3	0	0	0
QQ 96	3	0	0	0
QQ 120	3	0	0	0
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

A	0.2 % Add
B	0.3 % Add
C	1 % Add
QQ	2.4 % Add

##### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.32	24	0.0133	1	0.483526491	1.737078
Within Groups	0.666666667	50	0.0133			
Total	0.986666667	74				

## APPENDIX 8 Continued

### Anova: Single Factor

### Agral

#### SUMMARY

Groups	Count	Sum	Average	Variance
BBB 24	3	0	0	0
BBB 48	3	0	0	0
BBB 72	3	0	0	0
BBB 96	3	0	0	0
BBB 120	3	0	0	0
D 24	3	3	1	3
D 48	3	4	1.33333333	5.33333333
D 72	3	5	1.66666667	8.33333333
D 96	3	5	1.66666667	8.33333333
D 120	3	5	1.66666667	8.33333333
E 24	3	11	3.66666667	1.33333333
E 48	3	12	4	1
E 72	3	13	4.33333333	2.33333333
E 96	3	13	4.33333333	2.33333333
E 120	3	13	4.33333333	2.33333333
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

BBB	0.25 % Ag
D	0.5 % Ag
E	0.75 % Ag

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	173.066667	19	9.1087193	4.2697368	5.501E-05	1.852893
Within Groups	85.3333333	40	2.13333333			
Total	258.4	59				

### Anova: Single Factor

### Mamba

#### SUMMARY

Groups	Count	Sum	Average	Variance
KKK 24	3	0	0	0
KKK 48	3	0	0	0
KKK 72	3	0	0	0
KKK 96	3	0	0	0
KKK 120	3	0	0	0
LLL 24	3	0	0	0
LLL 48	3	0	0	0
LLL 72	3	0	0	0
LLL 96	3	0	0	0
LLL 120	3	0	0	0
MMM 24	3	0	0	0
MMM 48	3	0	0	0
MMM 72	3	0	0	0
MMM 96	3	0	0	0
MMM 120	3	0	0	0
NNN 24	3	2	0.66666667	1.33333333
NNN 48	3	3	1	1
NNN 72	3	3	1	1
NNN 96	3	4	1.33333333	1.33333333
NNN 120	3	4	1.33333333	1.33333333
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

KKK	3 % Mamba
LLL	4 % Mamba
MMM	12 % Mamba
NNN	24 % Mamba

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	14.58666667	24	0.60777778	2.53240741	0.00279933	1.737078
Within Groups		12	50	0.24		
Total	26.58666667	74				

## APPENDIX 8 Continued

### Anova: Single Factor

### Midstream

SUMMARY					
Groups	Count	Sum	Average	Variance	
M 24	3	0	0	0	0
M 48	3	0	0	0	0
M 72	3	1	0.33333333	0.33333333	
M 96	3	4	1.33333333	5.33333333	
M 120	3	4	1.33333333	5.33333333	
N 24	3	0	0	0	0
N 48	3	1	0.33333333	0.33333333	
N 72	3	2	0.66666667	0.33333333	
N 96	3	2	0.66666667	0.33333333	
N 120	3	6	2	7	
O 24	3	0	0	0	0
O 48	3	0	0	0	0
O 72	3	1	0.33333333	0.33333333	
O 96	3	3	1	1	
O 120	3	5	1.66666667	4.33333333	
DDD 24	3	0	0	0	0
DDD 48	3	0	0	0	0
DDD 72	3	0	0	0	0
DDD 96	3	0	0	0	0
DDD 120	3	0	0	0	0
EEE 24	3	0	0	0	0
EEE 48	3	0	0	0	0
EEE 72	3	0	0	0	0
EEE 96	3	1	0.33333333	0.33333333	
EEE 120	3	1	0.33333333	0.33333333	
CCC 24	3	0	0	0	0
CCC 48	3	0	0	0	0
CCC 72	3	0	0	0	0
CCC 96	3	0	0	0	0
CCC 120	3	0	0	0	0
RR 24	3	6	2	3	
RR 48	3	11	3.66666667	2.33333333	
RR 72	3	12	4	3	
RR 96	3	12	4	3	
RR 120	3	14	4.66666667	0.33333333	
SS 24	3	9	3	7	
SS 48	3	11	3.66666667	4.33333333	
SS 72	3	12	4	3	
SS 96	3	16	5.33333333	1.33333333	
SS 120	3	17	5.66666667	0.33333333	
PP 24	3	0	0	0	0
PP 48	3	0	0	0	0
PP 72	3	0	0	0	0
PP 96	3	0	0	0	0
PP 120	3	0	0	0	0

  

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	380.103704	44	8.63872054	7.33476272	1.002E-15	1.511672565
Within Groups	106	90	1.17777778			
Total	486.103704	134				

M	2 % MS
N	4 % MS
O	5 % MS
DDD	12 % MS
EEE	24 % MS
CCC	0.0375 % & 0.1875 % Ag
RR	1.875 % MS & 0.375 % Ag
SS	3.75 % MS & 0.75 % Ag

### Anova: Single Factor

### Touchdown

SUMMARY				
Groups	Count	Sum	Average	Variance
F 24	3	0	0	0
F 48	3	0	0	0
F 72	3	0	0	0
F 96	3	0	0	0
F 120	3	1	0.33333333	0.33333333
G 24	3	0	0	0
G 48	3	0	0	0
G 72	3	0	0	0
G 96	3	0	0	0
G 120	3	0	0	0
H 24	3	0	0	0
H 48	3	0	0	0
H 72	3	0	0	0
H 96	3	0	0	0
H 120	3	0	0	0
XX 24	3	0	0	0
XX 48	3	0	0	0
XX 72	3	0	0	0
XX 96	3	0	0	0
XX 120	3	0	0	0
YY 24	3	0	0	0
YY 48	3	0	0	0
YY 72	3	0	0	0
YY 96	3	0	0	0
YY 120	3	0	0	0
TT 24	3	1	0.33333333	0.33333333
TT 48	3	1	0.33333333	0.33333333
TT 72	3	1	0.33333333	0.33333333
TT 96	3	1	0.33333333	0.33333333
TT 120	3	1	0.33333333	0.33333333
UU 24	3	0	0	0
UU 48	3	0	0	0
UU 72	3	0	0	0
UU 96	3	0	0	0
UU 120	3	0	0	0
GGG 24	3	0	0	0
GGG 48	3	0	0	0
GGG 72	3	0	0	0
GGG 96	3	0	0	0
GGG 120	3	0	0	0
OOO 24	3	0	0	0
OOO 48	3	0	0	0
OOO 72	3	0	0	0
OOO 96	3	0	0	0
OOO 120	3	0	0	0
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

  

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.76	49	0.035918	0.89795918	0.856877741	1.48042467
Within Groups	4	100	0.04			
Total	5.76	149				
Total	5.73333333	124				

F	2 % TD
G	4 % TD
H	8 % TD
XX	12 % TD
YY	24 % TD
TT	2 % TD & 0.2 % Add
UU	4 % TD & 0.2 % Add
GGG	4 % TD & 0.4 % Add 120
OOO	8 % TD & 0.8 % Add 120

## APPENDIX 8 Continued

### Anova: Single Factor

Mon 52276

#### SUMMARY

Groups	Count	Sum	Average	Variance
P 24	3	0	0	0
P 48	3	0	0	0
P 72	3	0	0	0
P 96	3	0	0	0
P 120	3	0	0	0
Q 24	3	0	0	0
Q 48	3	0	0	0
Q 72	3	0	0	0
Q 96	3	0	0	0
Q 120	3	0	0	0
24	3	0	0	0
48	3	0	0	0
72	3	0	0	0
96	3	0	0	0
120	3	0	0	0
S 24	3	0	0	0
S 48	3	0	0	0
S 72	3	0	0	0
S 96	3	0	0	0
S 120	3	0	0	0
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

P	3 % Mon
Q	4 % Mon
R	12 % Mon
S	24 % Mon

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0	24	0	65535	#NUM!	1.737078
Within Groups	0	50	0			
Total	0	74				

### Anova: Single Factor

Muster

#### SUMMARY

Groups	Count	Sum	Average	Variance
T 24	3	0	0	0
T 48	3	0	0	0
T 72	3	0	0	0
T 96	3	0	0	0
T 120	3	0	0	0
U 24	3	1	0.3333333	0.33333
U 48	3	1	0.3333333	0.33333
U 72	3	1	0.3333333	0.33333
U 96	3	1	0.3333333	0.33333
U 120	3	1	0.3333333	0.33333
FFF 24	3	0	0	0
FFF 48	3	0	0	0
FFF 72	3	1	0.3333333	0.33333
FFF 96	3	1	0.3333333	0.33333
FFF 120	3	1	0.3333333	0.33333
V 24	3	12	4	3
V 48	3	16	5.3333333	1.33333
V 72	3	16	5.3333333	1.33333
V 96	3	16	5.3333333	1.33333
V 120	3	17	5.6666667	0.33333
W 24	3	17	5.6666667	0.33333
W 48	3	18	6	0
W 72	3	18	6	0
W 96	3	18	6	0
W 120	3	18	6	0
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

T	2 % Must
U	3 % Must
FFF	4 % Must
V	12 % Must
W	24 % Must

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	594.9333333	29	20.514943	59.5595	2.5123E-34	1.656381698
Within Groups	20.66666667	60	0.3444444			
Total	615.6	89				

## APPENDIX 8 Continued

### Anova: Single Factor

### Rodeo

#### SUMMARY

Groups	Count	Sum	Average	Variance
HH 24	3	0	0	0
HH 48	3	0	0	0
HH 72	3	0	0	0
HH 96	3	0	0	0
HH 120	3	0	0	0
HHH 24	3	0	0	0
HHH 48	3	0	0	0
HHH 72	3	0	0	0
HHH 96	3	0	0	0
HHH 120	3	0	0	0
II 24	3	0	0	0
II 48	3	0	0	0
II 72	3	0	0	0
II 96	3	0	0	0
II 120	3	0	0	0
JJ 24	3	0	0	0
JJ 48	3	0	0	0
JJ 72	3	0	0	0
JJ 96	3	0	0	0
JJ 120	3	0	0	0
III 24	3	0	0	0
III 48	3	0	0	0
III 72	3	0	0	0
III 96	3	0	0	0
III 120	3	0	0	0
KK 24	3	0	0	0
KK 48	3	0	0	0
KK 72	3	0	0	0
KK 96	3	0	0	0
KK 120	3	0	0	0
JJJ 24	3	0	0	0
JJJ 48	3	0	0	0
JJJ 72	3	0	0	0
JJJ 96	3	0	0	0
JJJ 120	3	0	0	0
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

HH	1,5 % Rodeo
HHH	3 % Rodeo
II	4 % Rodeo
JJ	9 % Rodeo
III	12 % Rodeo
KK	18 % Rodeo
JJJ	24 % Rodeo

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0	39	0	65535	#NUM!	1,549445
Within Groups	0	80	0			
Total	0	119				

### Anova: Single Factor

### Roundup

#### SUMMARY

Groups	Count	Sum	Average	Variance
X 24	3	0	0	0
X 48	3	0	0	0
X 72	3	0	0	0
X 96	3	0	0	0
X 120	3	0	0	0
Y 24	3	0	0	0
Y 48	3	1	0,33333333	0,33333333
Y 72	3	1	0,33333333	0,33333333
Y 96	3	1	0,33333333	0,33333333
Y 120	3	1	0,33333333	0,33333333
Z 24	3	0	0	0
Z 48	3	0	0	0
Z 72	3	0	0	0
Z 96	3	0	0	0
Z 120	3	0	0	0
AA 24	3	1	0,33333333	0,33333333
AA 48	3	1	0,33333333	0,33333333
AA 72	3	1	0,33333333	0,33333333
AA 96	3	1	0,33333333	0,33333333
AA 120	3	2	0,66666667	0,33333333
BB 24	3	0	0	0
BB 48	3	0	0	0
BB 72	3	0	0	0
BB 96	3	0	0	0
BB 120	3	1	0,33333333	0,33333333
CC 24	3	0	0	0
CC 48	3	0	0	0
CC 72	3	0	0	0
CC 96	3	0	0	0
CC 120	3	1	0,33333333	0,33333333
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

X	1 % RU
Y	2 % RU
Z	3 % RU
AA	4 % RU
BB	12 % RU
CC	24 % RU

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3,2952381	34	0,0969188	0,92513369	0,5895855	1,5962929
Within Groups	7,3333333	70	0,1047619			
Total	10,628571	104				

## APPENDIX 8 Continued

### Anova: Single Factor

### Roundup Ultra

#### SUMMARY

Groups	Count	Sum	Average	Variance
DD 24	3	1	0.33333333	0.33333333
DD 48	3	1	0.33333333	0.33333333
DD 72	3	1	0.33333333	0.33333333
DD 96	3	1	0.33333333	0.33333333
DD 120	3	1	0.33333333	0.33333333
EE 24	3	3	1	1
EE 48	3	4	1.33333333	2.33333333
EE 72	3	4	1.33333333	2.33333333
EE 96	3	4	1.33333333	2.33333333
EE 120	3	4	1.33333333	2.33333333
FF 24	3	3	1	1
FF 48	3	8	2.66666667	8.33333333
FF 72	3	9	3	7
FF 96	3	9	3	7
FF 120	3	9	3	7
GG 24	3	6	2	4
GG 48	3	8	2.66666667	6.33333333
GG 72	3	8	2.66666667	6.33333333
GG 96	3	9	3	7
GG 120	3	10	3.33333333	8.33333333
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

DD	3 % RUU
EE	4 % RUU
FF	12 % RUU
GG	24 % RUU

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	104.88	24	4.37	1.4697309	0.124691714	1.737078
Within Groups	148.6666667	50	2.97333333			
Total	253.5466667	74				

### Anova: Single Factor

### Tumbleweed

#### SUMMARY

Groups	Count	Sum	Average	Variance
LL 24	3	0	0	0
LL 48	3	0	0	0
LL 72	3	0	0	0
LL 96	3	0	0	0
LL 120	3	0	0	0
MM 24	3	1	0.33333333	0.33333333
MM 48	3	1	0.33333333	0.33333333
MM 72	3	1	0.33333333	0.33333333
MM 96	3	1	0.33333333	0.33333333
MM 120	3	1	0.33333333	0.33333333
NN 24	3	0	0	0
NN 48	3	0	0	0
NN 72	3	0	0	0
NN 96	3	0	0	0
NN 120	3	0	0	0
OO 24	3	0	0	0
OO 48	3	1	0.33333333	0.33333333
OO 72	3	1	0.33333333	0.33333333
OO 96	3	1	0.33333333	0.33333333
OO 120	3	1	0.33333333	0.33333333
PP 24	3	0	0	0
PP 48	3	0	0	0
PP 72	3	0	0	0
PP 96	3	0	0	0
PP 120	3	0	0	0

LL	1 % TW
MM	4 % TW
NN	12 % TW
OO	24 % TW

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.92	24	0.08	0.666667	0.8589	1.737078
Within Groups	6	50	0.12			
Total	7.92	74				



## APPENDIX 9

### Mortality of *Neochetina eichhorniae* (Table 3.5)

Anova: Single Factor

24 hours

#### SUMMARY

Groups	Count	Sum	Average	Variance
A 24	3	0	0	0
AA 24	3	1	0.333333333	0.333333333
AAA 24	3	0	0	0
B 24	3	0	0	0
BB 24	3	0	0	0
BBB 24	3	0	0	0
C 24	3	0	0	0
CC 24	3	0	0	0
CCC 24	3	0	0	0
D 24	3	3	1	3
DD 24	3	1	0.333333333	0.333333333
DDD 24	3	0	0	0
E 24	3	11	3.666666667	1.333333333
EE 24	3	3	1	1
EEE 24	3	0	0	0
F 24	3	0	0	0
FF 24	3	3	1	1
FFF 24	3	0	0	0
G 24	3	0	0	0
GG 24	3	6	2	4
GGG 24	3	0	0	0
H 24	3	0	0	0
HH 24	3	0	0	0
HHH 24	3	0	0	0
I 24	3	0	0	0
II 24	3	0	0	0
III 24	3	0	0	0
J 24	3	1	0.333333333	0.333333333
JJ 24	3	0	0	0
JJJ 24	3	0	0	0
K 24	3	0	0	0
KK 24	3	0	0	0
KKK 24	3	0	0	0
L 24	3	0	0	0
LL 24	3	0	0	0
LLL 24	3	0	0	0
M 24	3	0	0	0
MM 24	3	1	0.333333333	0.333333333
MMM 24	3	0	0	0
N 24	3	0	0	0
NN 24	3	0	0	0
NNN 24	3	2	0.666666667	1.333333333
O 24	3	0	0	0
OO 24	3	0	0	0
OOO 24	3	0	0	0
P 24	3	0	0	0
PP 24	3	0	0	0
Q 24	3	0	0	0
QQ 24	3	0	0	0
R 24	3	0	0	0
RR 24	3	6	2	3
S 24	3	0	0	0
SS 24	3	9	3	7
T 24	3	0	0	0
TT 24	3	1	0.333333333	0.333333333
U 24	3	1	0.333333333	0.333333333
UU 24	3	0	0	0
V 24	3	12	4	3
W 24	3	17	5.666666667	0.333333333
X 24	3	0	0	0
XX 24	3	0	0	0
Y 24	3	0	0	0
YY 24	3	0	0	0
Z 24	3	0	0	0
ZZ 24	3	0	0	0

A	0.2 % Add
AA	4 % RU
AAA	12 % 2,4-D
B	0.3 % Add
BB	12 % RU
BBB	0.25 % Ag
C	1 % Add
CC	24 % RU
CCC	0.9375 % MS & 0.1875 % Ag
D	0.5 % Ag
DD	3 % RUU
DDD	12 % MS
E	0.75 % Ag
EE	4 % RUU
EEE	24 % MS
F	2 % TD
FF	12 % RUU
FFF	4 % Must
G	4 % TD
GG	24 % RUU
H	8 % TD
HH	1.5 % Rodeo
HHH	3 % Rodeo
I	1 % 2,4-D
II	4 % Rodeo
III	12 % Rodeo
J	3 % 2,4-D
JJ	9 % Rodeo
JJJ	24 % Rodeo
K	9 % 2,4-D
KK	18 % Rodeo
KKK	3 % Mamba
L	18 % 2,4-D
LL	1 % TW
LLL	4 % Mamba
M	2 % MS
MM	4 % TW
MMM	12 % Mamba
N	4 % MS
NN	12 % TW
NNN	24 % Mamba
O	5 % MS
OO	24 % TW
P	3 % Mon
PP	h2o
Q	4 % Mon
QQ	2.4 % Add
R	12 % Mon
RR	1.875 % MS & 0.375 % Ag
S	24 % Mon
SS	3.75 % MS & 0.75 % Ag
T	2 % Must
TT	2 % TD & 0.2 % Add
U	3 % Must
UU	4 % TD & 0.2 % Add
V	12 % Must
W	24 % Must
X	1 % RU
XX	12 % TD
Y	2 % RU
YY	24 % TD
Z	3 % RU
ZZ	4 % 2,4-D

#### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	216.8	64	3.3875	8.155092593	5.10346E-24	1.411713
Within Groups	54	130	0.415384615			
Total	270.8	194				



## Appendix 9 Continued

Anova: Single Factor

48 hours

SUMMARY

Groups	Count	Sum	Average	Variance
A 48	3	0	0	0
AA 48	3	1	0.333333333	0.333333333
AAA 48	3	0	0	0
B 48	3	0	0	0
BS 48	3	0	0	0
BBB 48	3	0	0	0
C 48	3	0	0	0
CC 48	3	0	0	0
CCC 48	3	0	0	0
D 48	3	4	1.333333333	5.333333333
DD 48	3	1	0.333333333	0.333333333
DDD 48	3	0	0	0
E 48	3	12	4	1
EE 48	3	4	1.333333333	2.333333333
EEE 48	3	0	0	0
F 48	3	0	0	0
FF 48	3	8	2.666666667	8.333333333
FFF 48	3	0	0	0
G 48	3	0	0	0
GG 48	3	8	2.666666667	6.333333333
GGG 48	3	0	0	0
H 48	3	0	0	0
HH 48	3	0	0	0
HHH 48	3	0	0	0
I 48	3	0	0	0
II 48	3	0	0	0
III 48	3	0	0	0
J 48	3	1	0.333333333	0.333333333
JJ 48	3	0	0	0
JJJ 48	3	0	0	0
K 48	3	0	0	0
KK 48	3	0	0	0
KKK 48	3	0	0	0
L 48	3	0	0	0
LL 48	3	0	0	0
LLL 48	3	0	0	0
M 48	3	0	0	0
MM 48	3	1	0.333333333	0.333333333
MMM 48	3	0	0	0
N 48	3	1	0.333333333	0.333333333
NN 48	3	0	0	0
NNN 48	3	3	1	1
O 48	3	0	0	0
OO 48	3	1	0.333333333	0.333333333
OOO 48	3	0	0	0
P 48	3	0	0	0
PP 48	3	0	0	0
Q 48	3	0	0	0
QQ 48	3	0	0	0
R 48	3	0	0	0
RR 48	3	11	3.666666667	2.333333333
S 48	3	0	0	0
SS 48	3	11	3.666666667	4.333333333
T 48	3	0	0	0
TT 48	3	1	0.333333333	0.333333333
U 48	3	1	0.333333333	0.333333333
UU 48	3	0	0	0
V 48	3	16	5.333333333	1.333333333
W 48	3	18	6	0
X 48	3	0	0	0
XX 48	3	0	0	0
Y 48	3	1	0.333333333	0.333333333
YY 48	3	0	0	0
Z 48	3	0	0	0
ZZ 48	3	0	0	0

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	325.8666667	64	5.091666667	9.366745283	7.58145E-27	1.411713413
Within Groups	70.86666667	130	0.543589744			
Total	396.5333333	194				



## Appendix 9 Continued

Anova: Single Factor

72 hours

SUMMARY

Groups	Count	Sum	Average	Variance
A 72	3	0	0	0
AA 72	3	1	0.333333333	0.333333333
AAA 72	3	0	0	0
B 72	3	0	0	0
BB 72	3	0	0	0
BBB 72	3	0	0	0
C 72	3	0	0	0
CC 72	3	0	0	0
CCC 72	3	0	0	0
D 72	3	5	1.666666667	8.333333333
DD 72	3	1	0.333333333	0.333333333
DDD 72	3	0	0	0
E 72	3	13	4.333333333	2.333333333
EE 72	3	4	1.333333333	2.333333333
EEE 72	3	0	0	0
F 72	3	0	0	0
FF 72	3	9	3	7
FFF 72	3	1	0.333333333	0.333333333
G 72	3	0	0	0
GG 72	3	8	2.666666667	6.333333333
GGG 72	3	0	0	0
H 72	3	0	0	0
HH 72	3	0	0	0
HHH 72	3	0	0	0
I 72	3	0	0	0
II 72	3	0	0	0
III 72	3	0	0	0
J 72	3	1	0.333333333	0.333333333
JJ 72	3	0	0	0
JJJ 72	3	0	0	0
K 72	3	0	0	0
KK 72	3	0	0	0
KKK 72	3	0	0	0
L 72	3	0	0	0
LL 72	3	0	0	0
LLL 72	3	0	0	0
M 72	3	1	0.333333333	0.333333333
MM 72	3	1	0.333333333	0.333333333
MMM 72	3	0	0	0
N 72	3	2	0.666666667	0.333333333
NN 72	3	0	0	0
NNN 72	3	3	1	1
O 72	3	1	0.333333333	0.333333333
OO 72	3	1	0.333333333	0.333333333
OOO 72	3	0	0	0
P 72	3	0	0	0
PP 72	3	0	0	0
Q 72	3	0	0	0
QQ 72	3	0	0	0
R 72	3	0	0	0
RR 72	3	12	4	3
S 72	3	0	0	0
SS 72	3	12	4	3
T 72	3	0	0	0
TT 72	3	1	0.333333333	0.333333333
U 72	3	1	0.333333333	0.333333333
UU 72	3	0	0	0
V 72	3	16	5.333333333	1.333333333
W 72	3	18	6	0
X 72	3	0	0	0
XX 72	3	0	0	0
Y 72	3	1	0.333333333	0.333333333
YY 72	3	0	0	0
Z 72	3	0	0	0
ZZ 72	3	0	0	0

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	350.1846154	64	5.471634615	9.198006466	1.81025E-26	1.411713413
Within Groups	77.33333333	130	0.594871795			
Total	427.5179487	194				

## Appendix 9 Continued

Anova: Single Factor

96 hours

SUMMARY

Groups	Count	Sum	Average	Variance
A 96	3	0	0	0
AA 96	3	1	0.333333333	0.333333333
AAA 96	3	0	0	0
B 96	3	0	0	0
BB 96	3	0	0	0
BBB 96	3	0	0	0
C 96	3	0	0	0
CC 96	3	0	0	0
CCC 96	3	0	0	0
D 96	3	5	1.666666667	8.333333333
DD 96	3	1	0.333333333	0.333333333
DDD 96	3	0	0	0
E 96	3	13	4.333333333	2.333333333
EE 96	3	4	1.333333333	2.333333333
EEE 96	3	1	0.333333333	0.333333333
F 96	3	0	0	0
FF 96	3	9	3	7
FFF 96	3	1	0.333333333	0.333333333
G 96	3	0	0	0
GG 96	3	9	3	7
GGG 96	3	0	0	0
H 96	3	0	0	0
HH 96	3	0	0	0
HHH 96	3	0	0	0
I 96	3	0	0	0
II 96	3	0	0	0
III 96	3	0	0	0
J 96	3	2	0.666666667	0.333333333
JJ 96	3	0	0	0
JJJ 96	3	0	0	0
K 96	3	0	0	0
KK 96	3	0	0	0
KKK 96	3	0	0	0
L 96	3	0	0	0
LL 96	3	0	0	0
LLL 96	3	0	0	0
M 96	3	4	1.333333333	5.333333333
MM 96	3	1	0.333333333	0.333333333
MMM 96	3	0	0	0
N 96	3	2	0.666666667	0.333333333
NN 96	3	0	0	0
NNN 96	3	4	1.333333333	1.333333333
O 96	3	3	1	1
OO 96	3	1	0.333333333	0.333333333
OOO 96	3	0	0	0
P 96	3	0	0	0
PP 96	3	0	0	0
Q 96	3	0	0	0
QQ 96	3	0	0	0
R 96	3	0	0	0
RR 96	3	12	4	3
S 96	3	0	0	0
SS 96	3	16	5.333333333	1.333333333
T 96	3	0	0	0
TT 96	3	1	0.333333333	0.333333333
U 96	3	1	0.333333333	0.333333333
UU 96	3	0	0	0
V 96	3	16	5.333333333	1.333333333
W 96	3	18	6	0
X 96	3	0	0	0
XX 96	3	0	0	0
Y 96	3	1	0.333333333	0.333333333
YY 96	3	0	0	0
Z 96	3	0	0	0
ZZ 96	3	0	0	0

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	388.5846154	64	6.071634615	8.969460227	5.99188E-26	1.411713413
Within Groups	88	130	0.676923077			
Total	476.5846154	194				



## Appendix 9 Continued

Anova: Single Factor

120 hours

SUMMARY

Groups	Count	Sum	Average	Variance
A 120	3	0	0	0
AA 120	3	2	0.666666667	0.333333333
AAA 120	3	0	0	0
B 120	3	0	0	0
BB 120	3	1	0.333333333	0.333333333
BBB 120	3	0	0	0
C 120	3	1	0.333333333	0.333333333
CC 120	3	1	0.333333333	0.333333333
CCC 120	3	0	0	0
D 120	3	5	1.666666667	8.333333333
DD 120	3	1	0.333333333	0.333333333
DDD 120	3	0	0	0
E 120	3	13	4.333333333	2.333333333
EE 120	3	4	1.333333333	2.333333333
EEE 120	3	1	0.333333333	0.333333333
F 120	3	1	0.333333333	0.333333333
FF 120	3	9	3	7
FFF 120	3	1	0.333333333	0.333333333
G 120	3	0	0	0
GG 120	3	10	3.333333333	8.333333333
GGG 120	3	0	0	0
H 120	3	0	0	0
HH 120	3	0	0	0
HHH 120	3	0	0	0
I 120	3	0	0	0
II 120	3	0	0	0
III 120	3	0	0	0
J 120	3	2	0.666666667	0.333333333
JJ 120	3	0	0	0
JJJ 120	3	0	0	0
K 120	3	0	0	0
KK 120	3	0	0	0
KKK 120	3	0	0	0
L 120	3	0	0	0
LL 120	3	0	0	0
LLL 120	3	0	0	0
M 120	3	4	1.333333333	5.333333333
MM 120	3	1	0.333333333	0.333333333
MMM 120	3	0	0	0
N 120	3	6	2	7
NN 120	3	0	0	0
NNN 120	3	4	1.333333333	1.333333333
O 120	3	5	1.666666667	4.333333333
OO 120	3	1	0.333333333	0.333333333
OOO 120	3	0	0	0
P 120	3	0	0	0
PP 120	3	0	0	0
Q 120	3	0	0	0
QQ 120	3	0	0	0
R 120	3	0	0	0
RR 120	3	14	4.666666667	0.333333333
S 120	3	0	0	0
SS 120	3	17	5.666666667	0.333333333
T 120	3	0	0	0
TT 120	3	1	0.333333333	0.333333333
U 120	3	1	0.333333333	0.333333333
UU 120	3	0	0	0
V 120	3	17	5.666666667	0.333333333
W 120	3	18	6	0
X 120	3	0	0	0
XX 120	3	0	0	0
Y 120	3	1	0.333333333	0.333333333
YY 120	3	0	0	0
Z 120	3	0	0	0
ZZ 120	3	0	0	0

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	430.5948718	64	6.728044872	8.41005609	1.23001E-24	1.411713413
Within Groups	104	130	0.8			
Total	534.5948718	194				

## APPENDIX 10

### Mortality of *Neochetina eichhorniae* (Figure 3.6)

Anova: Single Factor

24 hours

SUMMARY

Groups	Count	Sum	Average	Variance
4 % MS	3	0	0	0
0.94%MS&0.19%Ag	3	0	0	0
1.875%MS&0.375%Ag	3	100	33.333333	833.333333
3.75%MS&0.75%Ag	3	150	50	1944.44444
0.75 % Ag	3	183.333333	61.111111	370.37037
h2o	3	16.66666667	5.5555556	92.5925926

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10879.62963	5	2175.9259	4.02857143	0.0223	3.105875
Within Groups	6481.481481	12	540.12346			
Total	17361.11111	17				

Anova: Single Factor

120 hours

SUMMARY

Groups	Count	Sum	Average	Variance
4 % MS	3	100	33.333333	1944.44444
0.94%MS&0.19%Ag	3	0	0	0
1.875%MS&0.375%Ag	3	233.333333	77.777778	92.5925926
3.75%MS&0.75%Ag	3	283.333333	94.444444	92.5925926
0.75 % Ag	3	216.666667	72.222222	648.148148
h2o	3	16.66666667	5.5555556	92.5925926

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	23842.59259	5	4768.5185	9.96774194	0.000596	3.105875
Within Groups	5740.740741	12	478.39506			
Total	29583.33333	17				

Anova: Single Factor

24 hours

SUMMARY

Groups	Count	Sum	Average	Variance
2 % TD	3	0	0	0
2 %TD & 0.2 % Add	3	16.66667	5.555556	92.592593
4 %TD & 0.4 % Add	3	0	0	0
0.2 % Add	3	0	0	0
2.4 % Add	3	0	0	0
h2o	3	0	0	0

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	77.1604938	5	15.4321	1	0.458197	3.105875
Within Groups	185.185185	12	15.4321			
Total	262.345679	17				

Anova: Single Factor

120 hours

SUMMARY

Groups	Count	Sum	Average	Variance
2 % TD	3	16.66667	5.555556	92.592593
2 %TD & 0.2 % Add	3	16.66667	5.555556	92.592593
4 %TD & 0.4 % Add	3	0	0	0
0.2 % Add	3	0	0	0
2.4 % Add	3	0	0	0
h2o	3	0	0	0

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	123.45679	5	24.69136	0.8	0.570523	3.105875
Within Groups	370.37037	12	30.8642			
Total	493.82716	17				

## APPENDIX 11

Anova: Single Factor

4% Herbicides at 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
4%MS	3	302	100.6667	2214.333
3.75%MS&0.75%Ag	3	29	9.666667	82.33333
4%TD	3	361	120.3333	857.3333
4%TD&0.2%Add	3	195	65	127
4%TD&0.4%Add	3	253	84.33333	142.3333
4%Rodeo	3	368	122.6667	3425.333
4%Mon	3	366	122	907
4%Mamba	3	134	44.66667	212.3333
4%Must	3	225	75	351
4%RUU	3	127	42.33333	1070.333
4%2,4-D	3	209	69.66667	142.3333
4%TW	3	328	109.3333	2408.333
4%RU	3	130	43.33333	120.3333
Control	3	252	84	756

LSD<sub>(0.05)</sub> = 89.9  
LSD<sub>(0.01)</sub> = 106.2

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	47390.12	13	3645.394	3.982068	0.001061	2.088932
Within Groups	25632.67	28	915.4524			
Total	73022.79	41				

Anova: Single Factor

12% Herbicides at 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
12%MS	3	155	51.66667	72.33333
12%TD	3	177	59	211
12%Rodeo	3	237	79	112
12%Mamba	3	77	25.66667	154.3333
12%TW	3	269	89.66667	380.3333
12%Mon	3	381	127	2869
12%Must	3	20	6.666667	133.3333
12%RUU	3	151	50.33333	2242.333
12%2,4-D	3	207	69	673
12%RU	3	111	37	601
Control	3	252	84	756

LSD<sub>(0.05)</sub> = 79.8  
LSD<sub>(0.01)</sub> = 96.2

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	33211.21	10	3321.121	4.452629	0.001679	2.293694
Within Groups	16409.33	22	745.8788			
Total	49620.55	32				



## APPENDIX 11 Continued

Anova: Single Factor

4% Herbicides at 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
4%MS	3	122	40.66667	954.3333
3.75%MS&0.75%Ag	3	3	1	1
4%TD	3	315	105	225
4%TD&0.2%Add	3	225	75	21
4%TD&0.4%Add	3	235	78.33333	32.33333
4%Rodeo	3	290	96.66667	40.33333
4%Mon	3	235	78.33333	82.33333
4%Mamba	3	230	76.66667	152.3333
4%Must	3	307	102.3333	604.3333
4%RUU	3	182	60.66667	81.33333
4%2,4-D	3	201	67	849
4%TW	3	210	70	237
4%RU	3	177	59	844
Control	3	209.01	69.67	702.0667

LSD<sub>(0.05)</sub> = 55.2

LSD<sub>(0.01)</sub> = 65.2

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	27085.64	13	2083.51	6.043665	3.45E-05	2.088932
Within Groups	9652.8	28	344.7429			
Total	36738.44	41				

Anova: Single Factor

12% Herbicides at 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
12%MS	3	155	51.66667	160.3333
12%TD	3	224	74.66667	617.3333
12%Rodeo	3	259	86.33333	212.3333
12%Mamba	3	200	66.66667	1776.333
12%TW	3	265	88.33333	833.3333
12%Mon	3	270	90	199
12%Must	3	60	20	444
12%RUU	3	43	14.33333	616.3333
12%2,4-D	3	192	64	1708
12%RU	3	110	36.66667	102.3333
Control	3	209.01	69.67	702.0667

LSD<sub>(0.05)</sub> = 75.6

LSD<sub>(0.01)</sub> = 91.2

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	21192.37	10	2119.237	3.16244	0.011648	2.296694
Within Groups	14742.8	22	670.1273			
Total	35935.17	32				

## APPENDIX 12

Anova: Single Factor

Figure 4.3a 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
2%MS	3	212	70.6667	346.3333
4%MS	3	302	100.667	2214.333
5%MS	3	215	71.6667	184.3333
12%MS	3	155	51.6667	72.33333
24%MS	3	163	54.3333	42.33333
h2o	3	252	84	756

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5079.2	5	1015.83	1.68572	0.212398	3.1059
Within Groups	7231.3	12	602.611			
Total	12311	17				

Anova: Single Factor

Figure 4.3a 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
2%MS	3	122	40.6667	1126.333
4%MS	3	122	40.6667	954.3333
5%MS	3	110	36.6667	54.33333
12%MS	3	155	51.6667	160.3333
24%MS	3	158	52.6667	250.3333
h2o	3	209	69.67	702.0667

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2214.4	5	442.884	0.818203	0.559469	3.1059
Within Groups	6495.5	12	541.289			
Total	8709.9	17				

Anova: Single Factor

Figure 4.3b 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
0.938%MS&0.188%A	3	167	55.667	204.3333
1.875%MS&0.375%A	3	36	12	31
3.75%MS&0.75%Ag	3	29	9.6667	82.33333
h2o	3	252	84	756

LSD<sub>(0.05)</sub>=42.8  
LSD<sub>(0.01)</sub>=58.7

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	11655	3	3885.1	14.47418	0.001349	4.0662
Within Groups	2147	8	268.42			
Total	13803	11				

Anova: Single Factor

Figure 4.3b 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
0.938%MS&0.188%A	3	176	58.667	82.33333
1.875%MS&0.375%A	3	42	14	73
3.75%MS&0.75%Ag	3	3	1	1
h2o	3	209	69.67	702.0667

LSD<sub>(0.05)</sub>=38.3  
LSD<sub>(0.01)</sub>=52.5

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10069	3	3356.3	15.63997	0.001041	4.0662
Within Groups	1717	8	214.6			
Total	11786	11				

## APPENDIX 12 Continued

Anova: Single Factor

Figure 4.3c 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
2%Must	3	345	115	457
3%Must	3	299	99.6667	102.3333
4%Must	3	225	75	351
8%Must	3	224	74.6667	750.3333
12%Must	3	20	6.66667	133.3333
24%Must	3	0	0	0
h2o	3	252	84	756

LSD<sub>(0.05)</sub>=53.2  
 LSD<sub>(0.01)</sub>=67.1

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	35652	6	5942	16.31137	1.37E-05	2.8477
Within Groups	5100	14	364.286			
Total	40752	20				

Anova: Single Factor

Figure 4.3c 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
2%Must	3	218	72.6667	265.3333
3%Must	3	185	61.6667	308.3333
4%Must	3	307	102.333	604.3333
8%Must	3	254	84.6667	24.33333
12%Must	3	60	20	444
24%Must	3	88	29.3333	2581.333
h2o	3	209	69.67	702.0667

LSD<sub>(0.05)</sub>=74.0  
 LSD<sub>(0.01)</sub>=93.2

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	15416	6	2569.32	3.648325	0.021557	2.8477
Within Groups	9859.5	14	704.248			
Total	25275	20				

Anova: Single Factor

Figure 4.3d 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
3%Mamba	3	166	55.333	754.3333
4%Mamba	3	134	44.667	212.3333
12%Mamba	3	77	25.667	154.3333
24%Mamba	3	141	47	819
h2o	3	252	84	756

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5415	4	1353.8	2.510818	0.108366	3.478
Within Groups	5392	10	539.2			
Total	10807	14				

Anova: Single Factor

Figure 4.3d 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
3%Mamba	3	239	79.667	1802.333
4%Mamba	3	230	76.667	152.3333
12%Mamba	3	200	66.667	1776.333
24%Mamba	3	179	59.667	1185.333
h2o	3	209	69.67	702.0667

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	764.4	4	191.1	0.170063	0.948769	3.478
Within Groups	11237	10	1123.7			
Total	12001	14				

## APPENDIX 12 Continued

Anova: Single Factor

Figure 4.3e 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
1%RU	3	167	55.6667	120.3333
2%RU	3	170	56.6667	12.33333
3%RU	3	142	47.33333	2.333333
4%RU	3	130	43.33333	120.3333
12%RU	3	111	37	601
24%RU	3	74	24.6667	156.3333
h2o	3	252	84	756

LSD<sub>(0.05)</sub>=44.3  
LSD<sub>(0.01)</sub>=55.8

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6283.9	6	1047.32	4.145056	0.01332	2.8477
Within Groups	3537.3	14	252.667			
Total	9821.2	20				

Anova: Single Factor

Figure 4.3e 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
1%RU	3	210	70	400
2%RU	3	153	51	112
3%RU	3	142	47.33333	660.3333
4%RU	3	177	59	844
12%RU	3	110	36.6667	102.3333
24%RU	3	75	25	76
h2o	3	209	69.67	702.0667

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5004.2	6	834.03	2.015445	0.131322	2.8477
Within Groups	5793.5	14	413.819			
Total	10798	20				

Anova: Single Factor

Figure 4.3f 48 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
3%RUU	3	206	68.667	366.3333
4%RUU	3	127	42.333	1070.333
12%RUU	3	151	50.333	2242.333
24%RUU	3	220	73.333	2836.333
h2o	3	252	84	756

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	3494	4	873.57	0.600692	0.67077	3.478
Within Groups	14543	10	1454.3			
Total	18037	14				

Anova: Single Factor

Figure 4.3f 96 hours

### SUMMARY

Groups	Count	Sum	Average	Variance
3%RUU	3	148	49.333	104.3333
4%RUU	3	182	60.667	81.33333
12%RUU	3	43	14.333	616.3333
24%RUU	3	37	12.333	102.3333
h2o	3	209	69.67	702.0667

LSD<sub>(0.05)</sub>=48.2  
LSD<sub>(0.01)</sub>=63.5

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	8432	4	2108	6.561386	0.007386	3.478
Within Groups	3213	10	321.28			
Total	11645	14				

## APPENDIX 13

(Figure 5.1)

- Treatment 1 = 6 % Roundup  
 2 = 6 % 2,4-D amine  
 3 = 6 % Midstream  
 4 = Control

**Accumulative mortality at 120 hours:**

**Kruskal-Wallis ANOVA by ranks and Dunn's multiple comparison test**

N 24      H = 18.64751 p = 0.0003

Treatment	1	a
	2	ab
	3	b
	4	a

1 & 3 \*\*  
 3 & 4 \*\*

**Accumulative mortality at 144 hours:**

**Kruskal-Wallis ANOVA by ranks and Dunn's multiple comparison test**

N 24      H = 19.48244 p=0.0002

Treatment	1	a
	2	ab
	3	b
	5	a

1 & 3 \*\*  
 3 & 4 \*\*

## APPENDIX 14

Figure 5.2 & 5.3

Anova: Single Factor

0 Hours

### SUMMARY

Groups	Count	Sum	Average	Variance
6%RU	6	349	58.166667	487.7667
6%2,4-D	6	315	52.5	344.7
6%MS	6	305	50.833333	66.56667
H2O	6	396	66	178

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	843.458	3	281.15278	1.044175	0.39464	3.098393
Within Groups	5385.17	20	269.25833			
Total	6228.63	23				

Anova: Single Factor

24 Hours

### SUMMARY

Groups	Count	Sum	Average	Variance
6%RU	6	348	58	304
6%2,4-D	6	160	26.666667	50.66667
6%MS	6	162	27	72
H2O	6	404	67.333333	299.0667

LSD<sub>0.05</sub>=30.8  
LSD<sub>0.01</sub>=39.0

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7965.83	3	2655.2778	14.63501	2.8E-05	3.098393
Within Groups	3628.67	20	181.43333			
Total	11594.5	23				

Anova: Single Factor

48 Hours

### SUMMARY

Groups	Count	Sum	Average	Variance
6%RU	6	317	52.83333	414.567
6%2,4-D	6	188	31.33333	127.467
6%MS	6	107	17.83333	70.1667
H2O	6	440	73.33333	89.4667

LSD<sub>0.05</sub>=30.3  
LSD<sub>0.01</sub>=38.4

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10701	3	3567	20.3344	2.74E-06	3.09839
Within Groups	3508.33	20	175.417			
Total	14209.3	23				

Anova: Single Factor

72 Hours

### SUMMARY

Groups	Count	Sum	Average	Variance
6%RU	6	235	39.1667	178.967
6%2,4-D	6	150	25	126
6%MS	6	63	10.5	8.3
H2O	6	377	62.8333	763.767

LSD<sub>0.05</sub>=37.5  
LSD<sub>0.01</sub>=47.5

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	8944.46	3	2981.49	11.073	0.000169	3.09839
Within Groups	5385.17	20	269.258			
Total	14329.6	23				

## APPENDIX 14 Continued

Anova: Single Factor

96 Hours

### SUMMARY

Groups	Count	Sum	Average	Variance
6%RU	6	193	32.166667	35.76667
6%2,4-D	6	93	15.5	77.9
6%MS	6	65	10.833333	111.3667
H2O	6	336	56	560.4

LSD<sub>0.05</sub>=32.0  
LSD<sub>0.01</sub>=40.6

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7504.46	3	2501.4861	12.73939	7E-05	3.098393
Within Groups	3927.17	20	196.35833			
Total	11431.6	23				

Anova: Single Factor

120 Hours

### SUMMARY

Groups	Count	Sum	Average	Variance
6%RU	6	163	27.166667	191.3667
6%2,4-D	6	91	15.166667	32.16667
6%MS	6	34	5.666667	23.46667
H2O	6	248	41.333333	441.0667

LSD<sub>0.05</sub>=30.0  
LSD<sub>0.01</sub>=38.0

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	4281	3	1427	8.295708	0.00088	3.098393
Within Groups	3440.33	20	172.01667			
Total	7721.33	23				

Anova: Single Factor

144 Hours

### SUMMARY

Groups	Count	Sum	Average	Variance
6%RU	6	228	38	106
6%2,4-D	6	107	17.83333	112.567
6%MS	6	25	4.16667	94.5667
H2O	6	310	51.6667	482.667

LSD<sub>0.05</sub>=32.2  
LSD<sub>0.01</sub>=40.9

### ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7988.83	3	2662.94	13.385	5.1E-05	3.09839
Within Groups	3979	20	198.95			
Total	11967.8	23				

## APPENDIX 15

Anova: Single Factor

Figure 6.2

### SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Roundup Sprayed	4	39.52	9.88	20.244
Roundup Unsprayed	4	160.8	40.2	24.37733
Midstream Sprayed	4	34.42	8.605	4.731567
Midstream Unsprayed	4	146.4	36.6	12.14267
Control Sprayed	2	69.98	34.99	108.6338
Control Unsprayed	2	70.98	35.49	78.125

$LSD_{(0.05)} = 15.3$ $LSD_{(0.01)} = 19.5$
--

### ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	3847.302	5	769.4603	29.01704	6.45E-07	2.958245
Within Groups	371.2455	14	26.51754			
Total	4218.547	19				