8-20-1970

Effects Of Las On Germination Of Seeds And Seedlings (Dicots And Monocot)

Nelson Patterson
Prairie View Agricultural and Mechanical College

EFFECTS OF LAS ON GERMINATION OF SEEDS AND SEEDLINGS (DICOTS AND MONOCOT)

EFFECTS OF LAS ON GERMINATION OF SEEDS AND SEEDLINGS (DICOTS AND MONOCOT)

A Thesis

Submitted to the Graduate Faculty

Of Prairie View Agricultural and Mechanical College

Prairie View, Texas

In Partial Fulfillment of the Requirements for the

Degree of

Master of Science

By

Nelson Patterson II

August 20, 1970

ACKNOWLEDGMENT

To Dr. T. P. Dooley for contributing the materials for this study, who not only critically analyzed and evaluated with me the preliminary plans, but gave his time freely throughout the semesters during which the study took place.

The author is also indebted to the Graduate School for providing a Graduate Research Assistantship that made this study possible.

I also wish to express my gratitude to my wife Betty, whose interest and support contributed greatly to its success.

In addition, I recognize the contribution of Dr. J. E. Berry and Dr. E. Martin who provided equipment to a specific phase of this study.

N. P.

TABLE OF CONTENTS

LIST OF TABLES

EFFECTS OF LAS ON GERMINATION OF SEEDS AND SEEDLINGS (DICOTS AND MONOCOT)

Bean seeds (Stringless Green Pod Landreth's Bush) soaked for 18 hours in 1.0%, 0.5% and 0.25% solution of Linear Alkylate Sulfonate (LAS) failed to germinate. The bean seed germination increased as the concentrations were lower and the soaking periods reduced.

Morning glory seeds (wild morning glory) soaked for 18, 12 and 6 hours in 1.0%, 0.5% and 0.25% solution of LAS and moistened with same fluid, or tap water showed less than 50% germination. The seeds that germinated and moistened with tap water recovered from the injurious effects while the seeds moistened in solution soaked in showed growth inhibition on the 4th day.

The corn seeds soaked for 18, 12 and 6 hours in 1.0%, 0.5% and 0.25% solutions of LAS showed an extremely high rate of germination which indicated no injurious effects.

All seeds soaked in tap water as control, showed germination. The greatest and quickest germination took place in those soaked for 12 hours.

INTRODUCTION

Dooley, (1968); the comparative effects of Alkylate Benzene Sulfonate (ABS) and LAS on the mosquito minnow was reported which revealed the toxicity of detergents on this fish. This report reveals the exposed time and concentration that killed fish. The survival time increased as the fish were exposed to lower

glory were used since the black seeds failed to germinate.

The LAS (Linear Alkylate Sulfonate) used in this study was furnished by Dr. Dooley of Prairie View A. and M. College. For composition see table 1 page 15.

Seeds were soaked in the following concentrations of LAS: (1) 1.0%, (2) 0.5%, (3) 0.25%. Tap water was used to make all concentrations of LAS solution. Fourty seeds for each experimental groups were placed in a 250 ml. beaker and soaked for three different periods so that the period for all end at the same time. Twenty seeds were soaked in tap water as the control for periods corresponding to those of LAS.

The following three different periods of soaking were used for each type of seed: (1) 18 hours, (2) 12 hours, (3) 6 hours for each concentration including water as the control. After the soaking periods, the seeds were separated into groups of (20) and placed in sterlized petri dishes which were lined with sterlized filter paper and grouped according to the type of seed, period of exposure and concentration of LAS.

For each group there were two petri dishes of 20 seeds in each, one was kept moistened with tap water and its corresponding experimental group was kept moistened with the concentration of solution in which they were soaked.

They were observed daily noting rate and degree of germination, the length of root and shoot. Other traits of the germinating seeds were recorded such as abnormal growth, mold infections and physical appearance.

Microscopic sectioned preparations of the roots were made of each groups.

The tissue was fixed in Navashin's Fluid and stained with Elrich's hematoxylin and counter stained with eosin. The sections were cut from 7-10 mu.

Photographs of the seeds and seedlings were taken at the end of 4 days.

OBSERVATION AND RESULTS

Morning glory: (dicot with endosperm)

The 18 hours soaked seeds in the control group showed 25% germination on the 1st day and at the end of 8 days 30%. The 12 hours soaked seeds in the control group showed 35% germination on the 1st day and at the end of 8 days 50%. The 6 hours soaked seeds in the control group showed 20% germination on the 2nd day and at the end of 8 days 35%. The growth and development of the seeds in each control petri dish were ideal, however the amount of germination was low. Germination of the seeds occured in each petri dish twelve hours after being transferred from the container in which they were soaked with tap water.

The 1.0% soaked seeds moistened with tap water for the 18 hours soaking period showed 5% germination on the 2nd day and at the end of 8 days 5% (table 2 page 16). The roots and shoots developed normal but growth rate decreased.

Seeds soaked for 18 hours in 1.0% concentration and moistened in it, showed 35% germination on the 2nd day and at the end of 8 days 45% (table 2 page 16). The roots and shoots failed to develop, radicles took on a brown color (table 4 and 5 page 17, 18). Germination and growth of seeds and seedlings terminated on the 4th day for the 1.0% experimental group for 18 hours soaked and moistened

in it.

Seeds soaked for 18 hours in 0.5% concentration and moistened with tap water showed 20% germination on the 1st day and at the end of 8 days 30% (table 2 page 16). The roots and shoots developed normal but shorter than the control. Germination of seeds occured twelve hours after the seeds were transferred from the soaked solution of LAS to the petri dish.

Seeds soaked for 18 hours in 0.5% concentration and moistened in it, showed 35% germination on the 1st day and at the end of 8 days 45%. The roots and shoots failed to develop and the radicles took on a brown color (table 4 and 5 page 17, 18). Germination of seeds occured twelve hours after being placed in the petri dish.

Seeds soaked for 18 hours in 0.25% concentration and moistened with tap water showed 10% germination on the 1st day and at the end of 8 days 15% (table 2 page 16). The roots and shoots developed normal and similar in appearance to the control groups (table 4 and 5 page 17, 18).

Seeds soaked for 18 hours in 0.25% concentration and moistened in it, showed 10% germination on the 1st day and at the end of 8 days 25%. The roots and shoots failed to develop but radicles appeared normal for the first 2 days. Germination of seeds occured 12 hours after being placed in the petri dish.

Seeds soaked for 12 hours in 1.0% concentration and moistened with tap water, showed 20% germination on the 2nd day and at the end of 8 days 25% (table 2 page 16). The roots and shoots developed normal but failed to equal the control in all aspects.

Seeds soaked for 12 hours in 1.0% concentration and moistened in it, showed 15% germination on the 2nd day and at the end of 8 days 25%. The roots and shoots failed to develop and the radicles took on a brown color (table 4 and 5 page 17, 18).

Seeds soaked for 12 hours in 0.5% concentration and moistened in it, showed 5% germination on the 1st day and at the end of 8 days 25%. The roots and shoots developed but growth remained less than 1 cm in the 12 hours soaked group moistened in 0.5% solution (table 4 and 5 page 17, 18).

Seeds soaked in 0.5% concentration for 12 hours and moistened with tap water showed 20% germination during the first 12 hours and at the end of 8 days 25%. The roots and shoots developed but were stunted compared to the 12 hour soaked control group.

Seeds soaked in 0.25% concentration for 12 hours and moistened in it, showed 5% germination and at the end of 8 days 5%. Germination of seeds occured 12 hours after being placed in the petri dish. The roots and shoots developed but appeared stunted as compared to the 12 hours control.

Seeds soaked for 12 hours in 0.25% concentration and moistened with tap water showed 15% germination on the 1st day and at the end of 8 days 20%. The roots and shoots grew similar to the 12 hour control which indicate continued growth without any serious effects from the 0.25% concentration after being kept moist with tap water.

Seeds soaked for 6 hours in 1.0% concentration and moistened in it, showed 10% germination on the 2nd day and 20% germination at the end of 8 days. The

shoots failed to develop, the radicles remained the same length for seven days and took on a brown color.

Seeds soaked for 6 hours in 1.0% concentration and moistened with tap water, showed 25% germination on the 2nd day, and 30% at the end of 8 days. The shoots and roots developed with being seriously effected, nevertheless the roots were shorter than the control group for 6 hours soaked (table 4 and 5 page 17, 18).

Seeds soaked in 0.5% concentration for 6 hours and moistened in it, showed 15% germination on the 2nd day and at the end of 8 days 20% (table 2 page 16). The shoots and roots failed to gain any appreciable growth that would sustain the life of the plant (table 4 and 5 page 17, 18).

Seeds soaked in 0.5% concentration for 6 hours and moistened with tap water showed 10% germination on the 2nd day and 15% at the end of 8 days. The shoots and roots developed, reaching 2/3 of the height of the 6 hours soaked control group (table 4 and 5 page 17, 18).

Seeds soaked in 0.25% concentration for 6 hours and moistened with tap water, showed 5% germination on the 1st day and at the end of 8 days 10%. The roots and shoots developed, reaching 2/3 of the height of the 6 hours control group (table 4 and 5 page 17, 18).

Seeds soaked in 0.25% concentration for 6 hours and moistened in it, showed 10% germination on the 3rd day and remained at that point through the following 5 days (table 2 page 16). The roots and shoots developed to a sustantial height and length (table 4 and 5 page 17, 18).

Corn: (monocot)

The 18 hours soaked seeds in the control group showed 75% germination on the 3rd day and at the end of 8 days 95%. The 12 hours soaked seeds in the control group showed 50% germination on the 3rd day and at the end of 8 days 100%. The 6 hours soaked seeds in the control group, showed 95% germination on the 3rd day and at the end of 8 days 95%. The growth and development of the seeds in each control petri dish were ideal.

Seeds soaked for 18 hours in 1.0% concentration and moistened in it, showed 40% germination on the 3rd day and at the end of 8 days 85% (table 6 page 19). The roots and shoots developed normal without noticeable effects other than mold growth and roots shorter than the control.

Seeds soaked for 18 hours in 1.0% solution and moistened with tap water, showed 5% germination on the 3rd day and 55% germination at the end of 8 days (table 6 page 19). The shoots and roots developed normal but length and height were shorter than the control group (table 8 and 9 page 20, 21).

Seeds soaked for 18 hours in 0.5% concentration and moistened in it, showed 100% germination on the 3rd day without any injurious effects from LAS. The roots and shoots grew normal but not as long as the control.

Seeds soaked for 18 hours in 0.5% concentration and moistened with water, showed 20% germination on the 3rd day and at the end of 8 days 100%. The roots and shoots developed normal compared to the control group (table 8 and 9 page 20, 21).

Seeds soaked for 18 hours in 0.25% concentration and moistened in it,

showed 60% germination on the 3rd day and at the end of 8 days 100%. The roots and shoots developed normal.

Seeds soaked for 18 hours in 0.25% concentration and moistened with tap water, showed 100% germination on the 3rd day without any apparent damage resulting from the LAS exposure. The roots and shoots developed normal but shorter in length compared to the control group (table 8 and 9 page 20, 21).

Seeds soaked for 12 hours in 1.0% concentration and moistened in it, showed 75% germination on the 3rd day and at the end of 8 days 95% (table 6 page 19). The roots and shoots developed without any abnormality than being stunted compared to the control.

Seeds soaked for 12 hours in 1.0% concentration and moistened with tap water, showed 20% germination on the 3rd day and at the end of 8 days 95% (table 6 page 19). The roots and shoots developed but growth never equal the control seedlings.

Seeds soaked for 12 hours in 0.5% concentration and moistened in it, showed 95% germination on the 3rd day and 100% on the 4th day (table 6 page 19). The shoots and roots grew longer than the previously indicated 1.0% soaked seeds.

Seeds soaked for 12 hours in 0.5% concentration and moistened with tap water, showed 45% germination and at the end of 8 days 100% (table 6 page 19). The roots and shoots developed to a normal height and length (table 8 and 9 page 20, 21).

Seeds soaked for 12 hours in 0.25% concentration and moistened in it, showed 80% germination on the 3rd day and at the end of 8 days 100% (table 6 page 19).

The roots and shoots developed but were shorter than the control group (table 8 and 9 page 20, 21).

Seeds soaked for 6 hours in 1.0% concentration and moistened in it, showed 20% germination (3rd day) and at the end of 8 days 85% (table 6 page 19). The roots and shoots appeared normal but shorter than the control group for 6 hours.

Seeds soaked for 6 hours in 1.0% concentration and moistened with tap water showed 15% germination on the 3rd day and at the end of 8 days 95%. The roots and shoots developed without any apparent effects from LAS.

Seeds soaked for 6 hours in 0.5% concentration and moistened in it, showed 65% germination on the 3rd day and 100% at the end of 8 days (table 6 page 19). The shoots and roots developed without any apparent effects from LAS exposure. A small amount of mold growth occured on the 5th day.

Seeds soaked for 6 hours in 0.5% concentration and moistened with tap water, showed 40% germination on the 3rd day and 100% at the end of 8 days (table 6 page 19). The roots and shoots developed without any apparent effects from the LAS.

Seeds soaked for 6 hours in 0.25% concentration and moistened in it, showed 65% germination on the 3rd day and 95% at the end of 8 days (table 6 page 19). The roots and shoots developed without any apparent effects from the exposure of LAS.

Seeds soaked for 6 hours in 0.25% concentration and moistened with tap water on the 3rd day showed 90% and also at the end of 8 days (table 6 page 19). The roots and shoots developed without LAS causing any injurious effects (table 8 and 9 page 20, 21).

Bean: (dicot without endosperm)

Bean seeds soaked for 18 hours in tap water, as the control, showed 95% germination at the end of 8 days, the 12 hour soaked seeds in the control group showed 95% germination at the end of 8 days, the 6 hour soaked seeds in the control group showed 95% germination at the end of 8 days. The roots and shoots growth were ideal.

The bean seeds soaked in tap water (1) 18 hours, (2) 12 hours and (3) 6 hours enlarged tremendously indicating a great degree of absorption occured.

Seeds soaked in (1) 1.0%, (2) 0.5% and (3) 0.25% concentration for 18 hours, and moistened with LAS and those moistened with tap water showed no germination (table 10 page 22). At the end of the 4th day the 18 hours soaked experimental seeds groups showed mold growth and an offensive odor.

Seeds soaked in 1.0% concentration for 12 hours and moistened in it, and the group moistened in tap water showed no germination, and the petri dishes contained mold growth.

Seeds soaked for 12 hours in 0.5% concentration and moistened in it, showed 20% germination at the end of 8 days. The roots and shoots failed to develop. The radicles turned pale with mold growth present.

Seeds soaked in 0.5% concentration for 12 hours and moistened in tap water, showed 20% germination on the 3rd day and remained unchanged at the end of 8 days (table 10 page 22). The roots and shoots failed to develop due to apparent effects of LAS exposure.

Seeds soaked for 12 hours in 0.25% concentration and moistened in it, seed

coat color faded. Germination on the 3rd day showed 10%, and at the end of 8 days 15%. The roots and shoots failed to develop and the petri dish contained mold growth.

Seeds soaked for 12 hours in 0.25% concentration and moistened with tap water failed to show any germination which indicated that this exposure time as being lethal. During the soaking period the seed coat began decolorizing.

Seeds soaked for 6 hours in 1.0% concentration and moistened in it, began germinating on the 5th day showing 10% and at the end of 8 days 30% (table 10 page 22). The roots and shoots failed to develop to any appreciable degree to sustain life. The petri dish possessed an (offensive) odor.

Seeds soaked for 6 hours in 1.0% concentration and moistened with tap water began germinating on the 4th day showing 25% and at the end of 8 days 60%. The roots and shoots failed to gain any appreciable amount of growth that would sustain life.

Seeds soaked for 6 hours in 0.5% concentration and moistened in it, began germinating on the 5th day, showing 35% and at the end of 8 days 55%. The roots and shoots failed to develop to any measurable degree (table 10 page 22) mold growth occured in the petri dish.

Seeds soaked for 6 hours in 0.5% concentration and moistened with tap water, began germinating on the 4th day, showing 45% and at the end of 8 days 55%. The roots and shoots growth failed to develop to equal the control but could sustain life with a degree of success.

Seeds soaked for 6 hours in 0.25% concentration of LAS and moistened in it, began germinating on the 3rd day showing 45% and at the end of 8 days 75%.

The roots and shoots developed with little or no effects from LAS.

Seeds soaked for 6 hours in 0.25% concentration and moistened with tap water, showed 50% germination, beginning on the 3rd day and at the end of 8 days 60%. The roots and shoots developed with little or no effects from LAS exposure.

Histological preparations of the root tips of the control and those subjected to LAS were made following the procedure of Kendall, (1964). The root tips were 2 mm long, taken from the seedlings and preserved in a 40% formaldehyde for 18-25 hours and washed in running tap water for 24 hours. The root tips were dehydrated in several changes of dioxan. The dioxan was removed from the root tips by infilteration with parafin. The root tips were then placed in boats in such a manner, that longitudinal sections were made. Sectioned root tips were affixed on a lx3 inch glass slide. A series of coplin jars large enough to hold the slides were labeled for each reagent where needed and the estimated time for soaking each slide. The root tip sections on the glass slides were then carried through the staining procedure in the following manner: (l) Xylol for 3 minutes; (2) 95% alcohol for 2 minutes; (3) 70% alcohol for 2 minutes; (4) 50% alcohol for 2 minutes; (5) tap water for 2 minutes; (6) Elrich's hematoxylin stain for 3 minutes; (7) water for 2 minutes and examined under the microscope; (8) 50% alcohol for 2 minutes; (9) 70% alcohol for 2 minutes; (10) eosin in 70% alcohol for 4 minutes; (ll) 95% alcohol for 2 minutes and examined under the microscope; (12) Xylol for 2 minutes, slides removed and placed on filter paper. One or two drops of gum dammar was placed over the section which were not permitted to dry at any point of the procedure. A cover glass was lifted with

the forceps and carefully lowered over the section.

Microscopic examinations were made of the root tips of control and those subjected to LAS under high dry and oil immersions objectives which showed no mitosis. Therefore the chromosomal alterations, if any, could not be determined from the preparations of the sections on the slide.

APPENDIX

A

Table 1

Chemical composition of LAS

LAS	60.8%
Sodium sulfate	36.1%
Free oil	0.4%
Water	2.7%

Table 2

Daily germination of morning glory seeds

Date	Hours soaked	Control		1% T.W*		1% S**		.5% T.W*		.5% S**		.25% T.W*		.25% S**	
	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
6-14-70	18	5	25	N	0	N	0	4	20	7	35	2	10	2	10
	12	7	35	N	0	N	0	4	20	1	5	3	15	1	5
	6	N	0	N	0	N	0	N	0	N	0	1	5	N	0
6-15-70	18	6	30	1	5	7	35	4	20	9	45	3	15	4	20
	12	10	50	4	20	3	15	5	25	2	10	4	20	1	5
	5	4	20	5	25	2	10	2	10	3	15	2	10	2	10
6-16-70	18	6	30	1	5	8	40	5	25	9	45	3	15	4	20
	12	10	50	4	20	4	20	5	25	2	10	4	20	1	5
	6	6	30	6	30	4	20	3	15	4	20	2	10	2	10
6-17-70	18	6	30	1	5	9	45	6	30	9	45	3	15	4	20
	12	10	50	4	20	5	25	5	25	2	10	4	20	1	5
	6	7	35	6	30	4	20	3	15	4	20	2	10	2	10
6-18-70	18	6	30	1	5	9	45	6	30	9	45	3	15	5	25
	12	10	50	5	25	5	25	5	25	2	10	4	20	1	5
	6	7	35	6	30	4	20	3	15	4	20	2	10	2	10
6-19-70	18	6	30	1	5	9	45	6	30	9	45	3	15	5	25
	12	10	50	5	25	5	25	5	25	2	10	4	20	1	5
	6	7	35	6	30	4	20	3	15	4	20	2	10	2	10
6-20-70	18	6	30	1	5	9	45	6	30	9	45	3	15	5	25
	12	10	50	5	25	5	25	5	25	2	10	4	20	1	5
	6	7	35	6	30	4	20	3	15	4	20	2	10	2	10
6-21-70	18	6	30	1	5	9	45	6	30	9	45	3	15	5	25
	12	10	50	5	25	5	25	5	25	2	10	4	20	1	5
	6	7	35	6	30	4	20	3	15	4	20	2	10	2	10

T.W* = moistened with tap water, S** = solution moistened with, N = no germination.

Table 3

Germination of morning glory seeds at the end of 8 days

Hours soaked	Control	1% T.W*	1% S**	.5% T.W*	.5% S**	.25% T.W*	.25% S**
18	6	1	9	6	9	3	5
12	10	5	5	5	2	4	1
6	7	6	4	3	4	2	2

T.W* = moistened with tap water, S** = solution moistened with.

Table 4

Morning glory seeds average growth of shoot in cm at the end of 8 days

Hours soaked	Control	1% T.W*	1% S**	.5% T.W*	.5% S**	.25% T.W*	.25% S**
18	2.5 cm	1.5 cm		1.2 cm	0.3 cm	2.0 cm	
12	2.7	0.7		1.2 cm	0.3 cm	2.5 cm	
6	2.5 cm	2.0 cm		1.5 cm	0.3 cm	0.8 cm	

T.W* = moistened with tap water, S** = solution moistened with,

cm = centimeters.

Table 5

Morning glory seeds average growth of roots in cm at the end of 8 days

Hours soaked	Control	1% T.W*	1% S**	.5% T.W*	.5% S**	.25% T.W*	.25% S**
18	7 cm	4.5 cm	0.2 cm	4.8 cm	0.8 cm	5.5 cm	2.5 cm
12	7 cm	4.5 cm	0.2 cm	4.8 cm	0.8 cm	5.5 cm	2.5 cm
6	7 cm	4.5 cm	0.2 cm	4.8 cm	0.8 cm	5.5 cm	2.5 cm

T.W* = moistened with tap water, S** = solution moistened with, cm = centimeters.

Table 6

Daily germination of corn seeds

Date	Hours soaked	Control		1% T.W*		1% S**		.5% T.W*		.5% S**		.25% T.W*		.25% S**	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
6-14-70	18	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	12	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	6	N	0	N	0	N	0	N	0	N	0	N	0	N	0
6-15-70	18	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	12	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	6	N	0	N	0	N	0	N	0	N	0	N	0	N	0
6-16-70	18	15	75	1	5	8	40	4	20	20	100	20	100	12	60
	12	10	50	4	20	15	75	9	45	19	95	20	100	18	90
	6	7	35	3	15	4	20	8	40	3	15	13	65	13	65
6-17-70	18	19	95	6	30	17	85	17	85	20	100	20	100	17	85
	12	20	100	11	55	18	90	15	75	20	100	20	100	20	100
	6	16	80	9	45	10	50	17	85	19	95	14	70	14	70
6-18-70	18	19	95	7	35	17	85	20	100	20	100	20	100	20	100
	12	20	100	18	90	19	95	18	90	20	100	20	100	20	100
	6	18	90	18	90	17	85	19	95	20	100	17	85	18	90
6-19-70	18	19	95	11	55	17	85	20	100	20	100	20	100	20	100
	12	20	100	19	95	19	95	20	100	20	100	20	100	20	100
	6	19	95	19	95	17	85	20	100	20	100	18	90	19	95
6-20-70	18	19	95	11	55	17	85	20	100	20	100	20	100	20	100
	12	20	100	19	95	19	95	20	100	20	100	20	100	20	100
	6	19	95	19	95	19	95	20	100	20	100	18	90	19	95

T.W* = moistened with tap water, S** = solution moistened with, N = no germination.

Table 7

Germination of corn seeds at the end of 8 days

Hours soaked	Control	1% T.W*	1% S**	.5% T.W*	.5% S**	.25% T.W*	.25% S**
18	19	11	17	20	20	20	20
12	20	19	19	20	20	20	20
6	19	19	17	20	20	18	19

T.W* = moistened with tap water, S** = solution moistened with.

Table 8

Corn seeds average growth of shoot in cm at the end of 8 days

Hours soaked	Control	1% T.W*	1% S**	.5% T.W*	.5% S**	.25% T.W*	.25% S**
18	2.4 cm	1.4 cm	.9 cm	2.7 cm	1.8 cm	2.4 cm	1 cm
12	3.6 cm	2.9 cm	1.2 cm	2.6 cm	1.2 cm	3.3 cm	2.2 cm
6	3.4 cm	2.6 cm	.7 cm	2.9 cm		3.0 cm	2.1 cm

T.W* = moistened with tap water, S** = solution moistened with,

cm = centimeters.

Table 9

Corn seeds average root growth in cm at the end of 8 days

Hours soaked	Control	1% T.W*	1% S**	.5% T.W*	.5% S**	.25% T.W*	.25% S**
18	11 cm	11 cm	2 cm	8 cm	4 cm	6 cm	6 cm
12	11 cm	11 cm	2 cm	8 cm	4 cm	6 cm	6 cm
6	11 cm	11 cm	2 cm	8 cm	4 cm	6 cm	6 cm

T.W* = moistened with tap water, S** = solution moistened with,

cm = centimeters.

Table 10

Daily germination of bean seeds

Date	Hours soaked	Control		1% T.W*		1% S**		.5% T.W*		.5% S**		.25% T.W*		.25% S**	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
6-14-70	18	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	12	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	6	N	0	N	0	N	0	N	0	N	0	N	0	N	0
6-15-70	18	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	12	N	0	N	0	N	0	N	0	N	0	N	0	N	0
	6	N	0	N	0	N	0	N	0	N	0	N	0	N	0
6-16-70	18	6	30	N	0	N	0	N	0	N	0	N	0	N	0
	12	15	75	N	0	N	0	1	5	N	0	N	0	N	0
	6	16	80	N	0	N	0	N	0	N	0	N	0	N	0
6-17-70	18	13	65	N	0	N	0	N	0	N	0	N	0	N	0
	12	18	90	N	0	N	0	1	5	N	0	N	0	2	10
	6	18	90	5	30	N	0	9	45	N	0	10	50	9	45
6-18-70	18	16	80	N	0	N	0	N	0	N	0	N	0	N	0
	12	19	95	N	0	N	0	1	5	4	20	N	0	2	10
	6	19	95	6	30	2	10	11	55	7	35	11	50	15	75
6-19-70	18	18	90	N	0	N	0	N	0	N	0	N	0	N	0
	12	19	95	N	0	N	0	1	5	4	20	N	0	2	10
	6	19	95	12	60	4	20	11	55	10	50	11	55	15	75
6-20-70	18	19	95	N	0	N	0	N	0	N	0	N	0	N	0
	12	19	95	N	0	N	0	1	5	4	20	N	0	3	15
	6	19	95	12	60	6	30	11	55	11	55	12	60	15	75
6-21-70	18	19	95	N	0	N	0	N	0	N	0	N	0	N	0
	12	19	95	N	0	N	0	1	5	4	20	N	0	3	15
	6	19	95	12	60	6	30	11	55	11	55	12	60	15	75

T.W* = moistened with tap water, S** - solution moistened with, N = no germination.

Table 11

Germination of bean seeds at the end of 8 days

Hours soaked	Control	1% T.W*	1% S**	.5% T.W*	.5% S**	.25% T.W*	.25% S**
18	19	N	N	N	N	N	N
12	19	N	N	1	4	N	3
6	19	12	6	11	11	12	15

T.W* = moistened with tap water, S** = solution moistened with,

N = no germination.

DISCUSSION AND RESULTS

Dooley and Cavil (1964), found that fish subjected to a 1.0% concentration of 15 different detergents were always killed. Dooley in (1968) used the basic components of detergents Alkylate Benzene Sulfonate and Linear Alkylate Sulfonate in various concentrations appeared to be less toxic than the additives. ABS (nondegradable) is being replaced in detergents by the LAS (biodegradable) therefore, LAS was only used in the present study.

Roots of germinating morning glory seeds soaked in 1.0% concentration and moistened in it, took on a brown color. This is probably due to the absorption of LAS by the morning glory seeds.

The total germination of the morning glory seeds in the experimental group exposed to 1.0% and 0.5% solutions and moistened with them for 18 hours was 45% compared to the bean seeds having no germination for the 18 hours soaking periods as in the 1.0% and 0.5% solution. The corn seeds similarily treated had approximately 100% germination. It appears that possibly the presence of an endosperm was one of the factors responsible for this difference as the morning glory and corn seeds had an endosperm (plate I, III, and V page).

In previous experiments with black seeds and light brown seeds mixed, only the light brown seeds germinated. The black seed coat was hard and impermeable to water. It was suggested that all black seeds should be filed and soaked in tepid water in order to make seed coat permeable. However due to the scarcity of seeds a mixture of dark brown and light brown ones were used in this

experiment. It appears that the dark brown germinated less than the light colored seeds which may in part be another factor accounting for the small amount of germination of morning glory seeds as a whole.

Roots of germinating morning glory seeds soaked in 1.0% concentration and moistened with tap water took on a white appearance. This is probably an indication of normal condition being returned to the seedlings.

The greatest amount of germination occured in the 12 hours soaked seeds in the control group which was 50% (plate II, figure 14, page). The experimental group of seeds soaked for 18, 12, and 6 hours whether moistened with tap water or the solution soaked in had maximum germination of 45% (plate I group page). Here again it is probably due to dark brown seeds coats prevented absorption and limited germination.

The experimental group of seeds and seedlings soaked in 1.0%, 0.5% and 0.25% concentrations for 6 hours and moistened with tap water showed appreciable growth and the roots had a white appearance. The white appearance of the roots indicated the normal condition was returning to the seedlings (plate I, figure 1 page).

Corn: (monocot)

The corn seeds germination apparently was not affected by either concentration of LAS or the soaking periods 18, 12 and 6 hours. (plate III page). The length of roots and height of the shoots of seeds soaked in 1.0%, 0.5% and 0.25% for 18, 12, and 6 hours was apparently effected since their lengths were less than those of

the controls.

The corn seeds appeared to absorb less solution than the bean and morning glory seeds which may account for the corn tremendous growth and germination. This may be accounted for by the fact that the corn seed coat is covered by the ovary wall as well as seed coats formed from the integuments. The LAS solutions seemed to act as a stimulant to germination of the corn seeds as evidenced from the amount of germination in the control with the experimental groups. There is no plausable explanation. It seems to act inversely to the action of ethyl alcohol where a 95% alcohol is not effective but 70% solution is in it bacterial growth inhibition.

Bean: (dicot without endosperm)

Seeds soaked in 1.0%, 0.5% and 0.25% concentration for 18, 12 and 6 hours showed considerable swelling (plate V, figure 1 page). There was comparable swelling of seeds in each of the three control group also. This may be accounted for by the permeability of the bean seed coats and the two large cotyledons.

Seeds soaked in 1.0%, 0.5% and 0.25% concentration for 18 hours and 12 hours showed no germination which indicated that LAS produced toxic effects, thereby inhibiting germination (plate V, figures 1, 2, 3, 4, 5, 6, 7 page). The mold growth probably resulted from the removal of the petri dish tops to moistened the bean seeds and the fact that cotyledons, which contains large amount of carbohydrate (CHO), served as a suitable culture medium (plate VI figures 12, 13 page).

Seeds soaked in 0.5% concentration for 12 hours and moistened with tap water germinated but failed to grow due to the toxic effects of LAS concentration during absorption (plate VI figure II page).

Seeds soaked in 0.5% concentration for 12 hours and moistened in it, showed germination but failed to grow due to the quantity of LAS solution absorbed by embryo plant causing toxic effects. (plate VI figure 10 page).

Seeds soaked in 0.25% concentration for 12 hours and moistened in it, showed 15% germination which is probably due to the amount of LAS solution absorbed by the bean seeds being near the threshold of toxic and non-toxic due to the fact that some of these were able to sustain life (plate VI figure 8 page).

Seeds soaked in 0.25% concentration for 12 hours and moistened with tap water showed no germination which was contradictive to the previous experimental data of bean seeds leaving no logical explanation to account for the results (plate VI figure 9 page).

Seeds soaked in 1.0% concentration for 6 hours and moistened with tap water or the solution soaked in, showed an increase in the amount of germination, as compared with other concentrations and period soaked. This was probably due to the reduced soaking period prevented the bean seeds from absorbing the quantity of solution that will cause toxic effects (plate VI figure 19, 20 page).

Seeds soaked in 0.5% concentration for 6 hours whether moistened with tap water or the solution soaked in, showed 55% germination. This may be accounted for by the short soaking period and the lower concentration. Mold grew in each of these petri dish since bean seeds cotyledons contains large

amount CHO, served as a suitable culture medium (plate VI figure 17, 18 page).

Seeds soaked in 0.25% concentration for 6 hours and moistened with tap water or the solution soaked in, showed 60-75% germination with normal development of roots, shoots, and cotyledons which looked like the control group in comparison. The low concentration of LAS and short soaking period indicated the growth conditions of the seeds were not affected (plate VI figures 15, 16, 21 page). In the bean seeds one observes that as the concentration of LAS and the soaking period are reduced there is an increase in germination and growth of seedlings.

The histological picture of the root tip cells showed no mitosis. Therefore the chromosomal alterations, if any, could not be determined from the sectioned preparation of the slides. However the cell wall was well displayed but no signs of effects resulting from the LAS solution. To account for the apical growth region not being revealed was probably due to the piece of tissue removed from the roots were too far from the tip.

A certain quantity of LAS is necessary to be effective in being toxic and reducing germination and growth is shown by the fact that lower the concentration and shorter the period of exposure results in a greater degree of germination and growth.

SUMMARY

All seeds soaked in tap water, as control, showed germination; with the greatest amount of germination occured with the 12 hours soaked seeds:

(1) corn seeds, showed 100% (2) for bean 95% (3) for morning glory seeds 50%. Only seeds soaked for 6 hours in following concentrations showed germination.

Bean seeds (Stringless Green Pod Landreth's Bush) soaked for 18 hours in 1.0%, 0.5% and 0.25% solutions of LAS failed to germinate. The bean seeds germination increased as the concentrations were lower and the soaking periods reduced.

Morning glory seeds (wild morning glory) soaked for 18, 12 and 6 hours in 1.0% and 0.5% solution of LAS and moistened with solution soaked in, or tap water showed less than 50% germination. The seeds that germinated and moistened with tap water recovered from the injurious effects while the seeds moistened in solution soaked in, showed growth inhibition on the fourth day. The morning glory seeds soaked in .25% concentrations for 18, 12 and 6 hours and moistened in it, or tap water only showed a maximum of 25% germination.

The quickest germination occured in the morning glory seeds soaked for 18, and 12 hours in 0.5% and 0.25% concentration and moistened with tap water and moistened with the solution soaked in, showed germination 12 hours after being placed in the petri dishes.

The corn seeds soaked for 18, 12 and 6 hours in 1.0%, 0.5% and 0.25% concentration of LAS were not affected. The average germination of the exposed group was 95-100% whereas the control showed an average of 95%.

Seeds with no endosperm were effective most (bean); as shown by the lack of germination at the higher concentration for long periods of soaking morning glory seeds were small and had a small amount of endosperm were effected

less as shown in the degree of germination in the experimental group; however the corn with more endosperm appeared to be affected least as germination occured in all groups exposed to LAS.

The histological picture of the root tip cells showed no mitosis. Therefore the chromosomal alterations, if any, could not be determined from the preparations of sections on the slides. However the cell wall was well displayed but no signs of effects resulting from the LAS solutions.

Photographic pictures were taken at the end of four days of the corn, bean and morning glory seeds and seedlings to show the effects of LAS concentration, if any, upon germination and growth.

BIBLIOGRAPHY

Bruns, W. and H. F. Zipf, 1964- The effects of non ionic detergents on Bacteria. Arch Exp pathol pharmokol (naunyn-Schiedbergs) 274 (4): 388-389.

Cabejszek, I., J. Just J. Luzak and J. Maleszewska, 1963- Influence of Sulfpol-50 on physico- chemical properties and brocenosis of water. Gaz Woda Tech. sonit, 37, 53-57.

Cairns, J. Jr., A. Scheier and N. E. Hess, 1964- The effects of Alkyl Benzene Sulfonate on aquatic organism. Ind. water and wastes 9, 22-28 Pub. Health Eng. Abs., 44, 1587.

Cooke, W. B. and G. S. Matsuura, 1963- Removal of ABS from solutions by a common fungus of sewage. Mycopathologia et Mycologia Applicata, 19, 287. Pub. Health Eng. Abs., XLIII, 2414.

Dooley, T. P. and J. Cavil, 1964- Minimal lethal concentration of 15 common detergents on the mosquito minnow (Gambusia affinis). Tex. Jour. Sci. 16 (2): 202-209.

Dooley, T. P., 1968- Comparative effects of ABS and LAS on the mosquito minnow (Gambusia affinis). Tex. Jour. Sci., 20 (2): 147-155.

Ewing, B. B., Lefke, L. W., and Banerji, S. K., 1961- Retention of Alkylbenzesulfonates on soil and biological slimes. Robert A. Taft San. Eng. Center, Tech. Report W61-5.

Hettche, H. O., 1960- Biological Effects of detergents. Arch. Hgg., Berl., 144, 467 (1960) WPW 35, 2068.

Hind, Geoffery, 1968- The site of action of plastocynin in chloroplast treated with detergents (spinach). BIOCHIM BIOPHYS ACTA 153 (1): 235-240. Triton concentrations of about 0.01% uncouple photosynthetic process and speed the light induced reduction of cytochrome b_6 and oxidation of cytochrome b_{559}.

Hynes, N. B., and F. W. Roberts, 1962- The biological effects of synthetic detergents in the river Lee, Hertford shire. Ann. Appl. Bio., 50, 779.

Kendall, James, 1949- Microscopic Anatomy of Vertebrates. 3rd. edition, Lea A. Fedigher Co. Boston. Page 322.

Klien, S. A., Jenkins D. and McGauchey, P. H., 1963- The fate of ABS in soils and plants. J. WAT. POLLUT. CONTR. FED. 35, 636.

Klust, G., and Mann, H., 1960- Further investigation on the influence of detergents on the decomposition of Cellulose. Vom Wasser (Germany) 27, 99. WPA 36, 525.

Krajian, Aram A., 1940- Histological Technique. The C. V. Mosey Co. St. Louis.

Lichenstein, E. P., T. W. Fuhremann, K. R. Schulz and R. F. Skrenty, 1967- Translocation of insecticides from soil into pea plants. Effects of the detergent LAS on translocation and plant growth, J. Agr. Food Chem. 15 (5): 864-869.

Maehler, Claude Z., James M. Cripps, and Arnold E. Greenberg, 1967- Differentiation of LAS (Linear Alkylate Sulfonate). J. Water Pollut Contr Fed 39 (10 part 2): r^{92} r^{98}. Illus.

Manganelli, R. and Crosby, E. S., 1953- Effects of detergents on sewage microorganism. Sewage Industr. waste, 25: 260.

Matulova, D., 1965- The effects of detergents on water algae. Chem. Abs. 62, 10210h.

Okobayaski, T. 1954- Decomposition of nonionic detergents by the action of fungi. Bull J. Fermentation Technol, (Japan) 32, 484.

Payne, W. J., 1963- Pure culture studies of the (bacterial) Biotechnol and Eng. 5, (4): 355-365.

Smith, H. F., 1955- Toxicity of detergents, Bull. 2, Dept. of Civ. Eng., King College, Univ. of Durham.

Stedronsky, E., and M. A. Truelle, 1964- Harmful effects of detergents on aquatic plants. Water Poll. Abs., (Brit) 37, 1521.