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Water Quality of the Main Water Source of Village Ambassador, Tublay, Benguet using the *Allium cepa* Test

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Abstract - In view of the ecological hazards of chemicals, in vitro experiments were conducted to determine the probable toxicity of the different water samples from the main water source of Village Ambassador, Tublay, Benguet employing the classical *Allium cepa* test prior to the establishment of communal water catch basins/tanks. In this study, experimental *Allium cepa* were grown in the different water samples from Lower and Upper Coroz, Baliti, and Salaksak. The different parameters that were utilized in the study (i.e. macroscopic and microscopic) served as indicators of the genotoxicity of the water samples to the test organisms. This laboratory experiment of the genotoxic effect of the water samples revealed insignificant differences among the different water samples and the control group for all the following observations: macroscopic level in terms of root length

and frequencies of root forms and the mitotic index values scored at microscopic level. This interaction implies that the different water samples inhibited the growth of the onions, may have caused some morphological abnormalities and possible genotoxic effect on the onions in all the treatment groups. However, the level of toxicity did not vary significantly among the treatment groups and the control group. Taken together, results of the study showed that the selected water samples from the main water source of Village Ambassador may be tapped as possible sources of potable water.

Keywords - water quality, *Allium cepa, ecological hazard*

INTRODUCTION

This study was concerned with the determination of the possible genotoxicity of the different water samples from the main water source of Village Ambassador, Tublay, Benguet on the roots of *Allium cepa* var. *aggregatum*. The classical *Allium cepa* test was used to gather and quantify data on the macroscopic and microscopic parameters. The influences of water samples on macroscopic (root length, form and color) and microscopic (root tip mitotic index) parameters were examined. The water samples were gathered from Ambassador, Tublay, Benguet on July 2009.

For the macroscopic effects, parameters were limited to the following:

1. Root lengths (shortest and longest)
2. Frequencies of root forms (curved and bulbous)

The microscopic parameter was also limited to measuring the mitotic index values of the root tips of the onions (*Allium cepa* var. *aggregatum*).

Allium cepa var. *aggregatum* was the test organism used in this experiment since this kind of onion possesses a very advantageous characteristic, i.e. highly sensitive to toxicants, and is readily available in the market. Moreover, *Allium cepa* test offers possibility to investigate samples not requiring any previous extraction, concentration or isolation procedure. Owing to qualities such as low cost, easy application, and good correlation with mammalian genotoxicity test systems (Fiskesjo 1985, Plavica et al. 1991).

As to the effects of the water samples on microscopic level, determining the frequency of chromosome aberrations should also be of importance as to further investigate the potentiality of the water samples tested of their genotoxicity. Furthermore, since this only a preliminary study on the assessment of the water quality of the said Village, microbiological and chemical analyses will be conducted after in collaboration with the Baguio Water District.

SIGNIFICANCE OF THE STUDY

Through the *Allium cepa* test to be conducted on the water samples from the main source of the stream tributaries, UC Project HELEN through its area on environment will be able to offer the appropriate recommendations as to the following:

1. Steps to be undertaken to ensure potable water, such as reiteration of importance of proper waste management, among others;
2. Identification of clusters of sitios that would share a communal water basin/tank;
3. Design of the communal water basin/tank and the appropriate system of distribution to the different household;
4. Construction of the communal water basin/tank via the *bayanihan* system among the Village officials, kagawads and community members of the clustered sitios.

OBJECTIVES OF THE STUDY

1. compare the effect of the different water samples on the roots produced,
   root lengths and frequencies of root forms of *Allium cepa* var. *aggregatum* to the control sample;
2. find out if the water in the main source of Village Ambassador has genotoxic effect on *Allium cepa* var. *aggregatum*;
3. determine if the sites where water samples were collected can be possible sources of potable water for the Village;
4. create public awareness about the toxic effects of the river pollution to biological systems.

MATERIALS AND METHODS

Research Design and Methodology

The study used the experimental method of research because of the need to observe and examine the genotoxic effects of the different water samples on the root growth of *Allium cepa* var. *aggregatum*. Descriptive analysis was employed for the interpretation and discussion of the obtained results.

The experimental design utilized in this study was Complete Randomized Design where the macroscopic and microscopic effects of the water samples to the onion roots were observed with the applied subsequent treatments to determine the effect. The experimental set-up employed replication, control, and treatments.

Strategic sampling stations were along the main water source of Village Ambassador. Surface water was collected from all the sources and distilled water was used as the control.

Analysis of Statistical Data

Data on both the macroscopic and microscopic indicators were analyzed by analysis of variance (ANOVA), with the calculations of the F-statistic and respective P values. The P values were compared with the calculation of the minimum significant difference for P=0.05%. Mean was used as a measure of central tendency. Analysis of variance (ANOVA) of the data was performed with the SPSS Statistical Package.

RESULTS AND DISCUSSION

The data that were analyzed were focused on the effects of the water samples on the root growth of *Allium cepa.* var. *aggregatum* in terms of the macroscopic parameter (as manifested by the presence of bulbous or curved roots, shortest and the longest roots) and the microscopic parameter in terms of the mitotic index values.

Effects on the macroscopic parameters

A. Root Length

1. Longest Roots

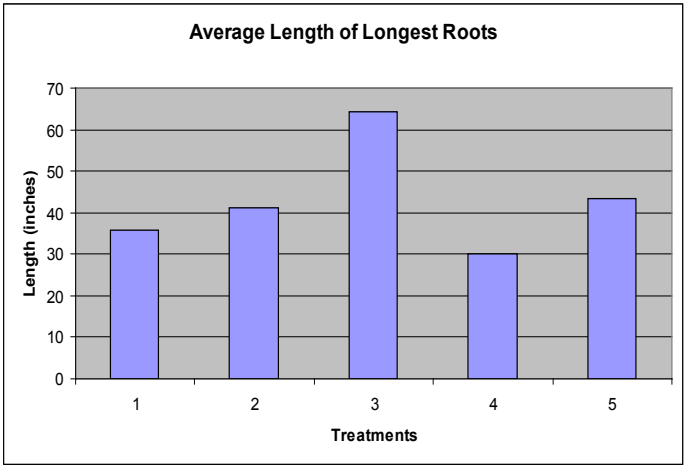

Figure1. Mean Length of the Longest Roots

Legend : T1 - Control
T2 – Lower Coroz
T3 – Upper Coroz
T4 – Baliti
T5 - Salaksak

Table 1. Analysis of Variance (ANOVA) in CRD and LSD of the macroscopic effect of the water samples in terms of the presence of longest roots.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2042.267	4	510.567	2.163	.147[ns]
Within Groups	2360.667	10	236.067		
Total	4402.933	14			

[ns] - The mean difference is not significant (p>0.05)

2. Shortest Roots

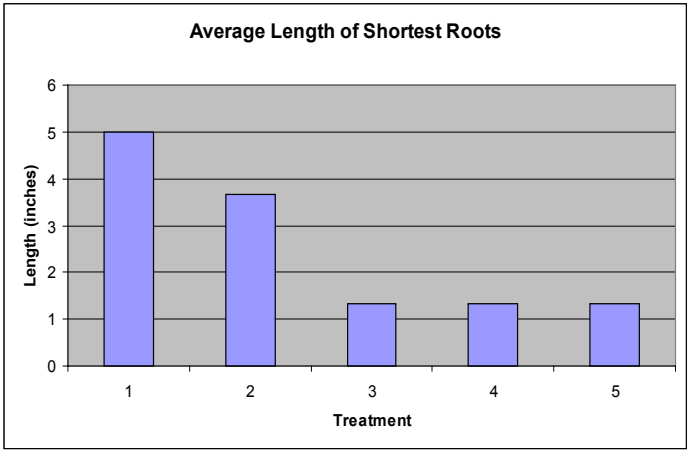

Figure2. Mean Length of the Shortest Roots.

Legend : T1 - Control
T2 – Lower Coroz
T3 – Upper Coroz
T4 – Baliti
T5 - Salaksak

Table 2. Analysis of Variance (ANOVA) in CRD and LSD of the macroscopic effect of the water samples in terms of the presence of shortest roots.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	35.067	4	8.767	8.219	.003[ns]
Within Groups	10.667	10	1.067		
Total	45.733	14			

[ns] - The mean difference is not significant (p>0.05)

B. Frequencies of Root Forms

1. Bulbous or Curved Roots

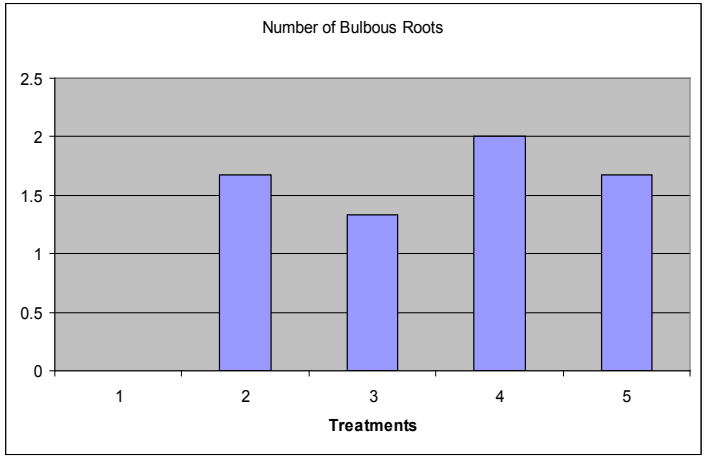

Figure 3 Mean of Bulbous or Curved Roots.

Legend : T1 - Control
T2 – Lower Coroz
T3 – Upper Coroz
T4 – Baliti
T5 - Salaksak

Table 3. Analysis of Variance (ANOVA) in CRD and LSD of the macroscopic effect of the water samples in terms of the presence of bulbous roots.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7.333	4	1.833	1.528	.267^{ns}
Within Groups	12.000	10	1.200		
Total	19.333	14			

^{ns} - The mean difference is not significant (p>0.05)

C. Effect on the microscopic parameter in terms of the mitotic index (MI)

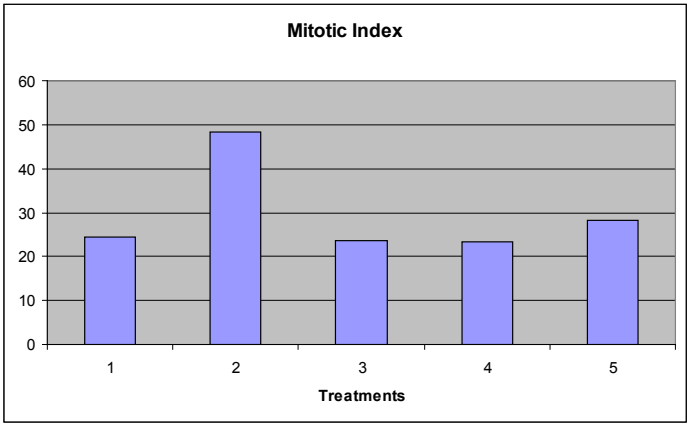

Figure 4. Mean of the Mitotic Index Values

Legend : T1 - Control
T2 – Lower Coroz
T3 – Upper Coroz
T4 – Baliti
T5 - Salaksak

Table 4. Analysis of Variance (ANOVA) in CRD and LSD of the microscopic effect of the water samples in terms of the mitotic index (MI).

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1370.083	4	342.521	2.782	.086^{ns}
Within Groups	1231.249	10	123.125		
Total	2601.332	14			

^{ns} - The mean difference is not significant (p>0.05)

CONCLUSIONS

Based on the initial findings, some conclusions are drawn.

Even though water samples obtained from the main water source of Village Ambassador showed growth inhibition of the onion roots and other morphological effects such as bulbous and curved roots, all of which yielded insignificant difference as compared with the control. Furthermore, based on the results that were obtained from the microscopic indicator, the samples were found to produce insignificant genotoxic effect. Therefore, the different sources of water from the main water source of Ambassador could be tapped as sources of potable water.

RECOMMENDATIONS

This project also recommends that there should be an over-all assessment of the water quality prior to the establishment of a water source that will provide the community with potable water. Over all assessment of water quality such as bacteriological tests and other available water potability test should be done by the local government. The local government should find ways to implement the elimination of discharge pollutants into the rivers of Village

Ambassador. Significantly, it must also set guidelines in prohibiting the discharge of wastes that might adversely affect the rivers of the Village. In addition, implementation of programs which highlight the importance of protecting the river in the locality and proper waste management must be set.

This study can also lead towards an investigation of the effects of water pollution on human health and the different sources of pollution of water of Village Ambassador.

This project also is meant to create an environmental awareness among the community residents about the possible effect on their health and provide them with an opportunity, as the concerned individuals, to become aware and actively participate in the protection, preservation and conservation of the water resource that they have at present.

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Post Hoc Tests

Multiple Comparisons

Dependent Variable: shortest

	(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
Scheffe	control	LC	1.33333	.84327	.655	-1.8120	4.4787
		UC	3.66667(*)	.84327	.021	.5213	6.8120
		BLBL	3.66667(*)	.84327	.021	.5213	6.8120
		SLK	3.66667(*)	.84327	.021	.5213	6.8120
	LC	control	-1.33333	.84327	.655	-4.4787	1.8120
		UC	2.33333	.84327	.185	-.8120	5.4787
		BLBL	2.33333	.84327	.185	-.8120	5.4787
		SLK	2.33333	.84327	.185	-.8120	5.4787
	UC	control	-3.66667(*)	.84327	.021	-6.8120	-.5213
		LC	-2.33333	.84327	.185	-5.4787	.8120
		BLBL	.00000	.84327	1.000	-3.1453	3.1453
		SLK	.00000	.84327	1.000	-3.1453	3.1453
	BLBL	control	-3.66667(*)	.84327	.021	-6.8120	-.5213
		LC	-2.33333	.84327	.185	-5.4787	.8120
		UC	.00000	.84327	1.000	-3.1453	3.1453
		SLK	.00000	.84327	1.000	-3.1453	3.1453
	SLK	control	-3.66667(*)	.84327	.021	-6.8120	-.5213
		LC	-2.33333	.84327	.185	-5.4787	.8120
		UC	.00000	.84327	1.000	-3.1453	3.1453
		BLBL	.00000	.84327	1.000	-3.1453	3.1453

Dependent Variable: shortest continued

LSD	control	LC	1.33333	.84327	.145	-.5456	3.2123
		UC	3.66667(*)	.84327	.001	1.7877	5.5456
		BLBL	3.66667(*)	.84327	.001	1.7877	5.5456
		SLK	3.66667(*)	.84327	.001	1.7877	5.5456
	LC	control	-1.33333	.84327	.145	-3.2123	.5456
		UC	2.33333(*)	.84327	.020	.4544	4.2123
		BLBL	2.33333(*)	.84327	.020	.4544	4.2123
		SLK	2.33333(*)	.84327	.020	.4544	4.2123
	UC	control	-3.66667(*)	.84327	.001	-5.5456	-1.7877
		LC	-2.33333(*)	.84327	.020	-4.2123	-.4544
		BLBL	.00000	.84327	1.000	-1.8789	1.8789
		SLK	.00000	.84327	1.000	-1.8789	1.8789
	BLBL	control	-3.66667(*)	.84327	.001	-5.5456	-1.7877
		LC	-2.33333(*)	.84327	.020	-4.2123	-.4544
		UC	.00000	.84327	1.000	-1.8789	1.8789
		SLK	.00000	.84327	1.000	-1.8789	1.8789
	SLK	control	-3.66667(*)	.84327	.001	-5.5456	-1.7877
		LC	-2.33333(*)	.84327	.020	-4.2123	-.4544
		UC	.00000	.84327	1.000	-1.8789	1.8789
		BLBL	.00000	.84327	1.000	-1.8789	1.8789

* The mean difference is significant at the .05 level.

DESCRIPTIVES

Mitotic Index

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
Control	3	24.3333	1.52753	.88192	20.5388	28.1279	23.00	26.00
LC	3	48.4000	19.97298	11.53141	-1.2156	98.0156	30.60	70.00
UC	3	23.7533	5.66679	3.27172	9.6762	37.8304	17.26	27.70
BLBL	3	23.2900	5.41805	3.12811	9.8308	36.7492	17.77	28.60
SLK	3	28.3667	12.36541	7.13917	-2.3507	59.0840	14.10	36.00
Total	15	29.6287	13.63119	3.51956	22.0800	37.1774	14.10	70.00

ANOVA

Mitotic Index

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1370.083	4	342.521	2.782	.086
Within Groups	1231.249	10	123.125		
Total	2601.332	14			

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