

Quality Assessment of the Main Water Source of Barangay Ambassador, Tublay, Benguet, Philippines using the *Allium cepa* Test

¹Doctor, T.R. ²Manuel, J.F. and ³Rivera, M.P

^{1,2}Department of Natural Sciences, College of Arts and Sciences, University of the Cordilleras, Governor Pack Road, Baguio City, Philippines 2600
³Philippine Science High School, Baguio City, Philippines 2600

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 Barangay 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

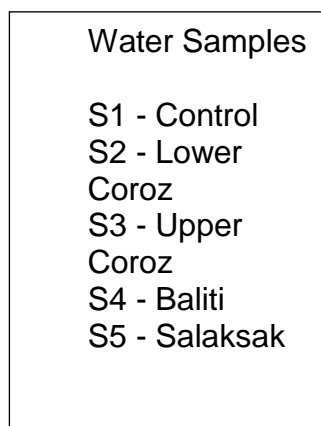
water source of Barangay Ambassador may be tapped as possible sources of potable water.

Index Terms- water quality, *Allium cepa* test, genotoxicity,

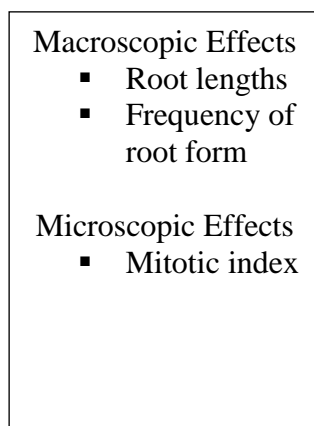
I. INTRODUCTION

Water is an essential commodity for every community. In the Philippines, Ambassador, Tublay, Benguet, is only one of the community that needs a good source of water. The local government wanted to find out the potability of the main water sources. This research tested the quality of the identified water sources. Specifically, this study aimed to:(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 Barangay 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 barangay; (4) create public awareness about the toxic effects of the river pollution to biological systems.

Independent Variable



Dependent Variable



Expected Outcome

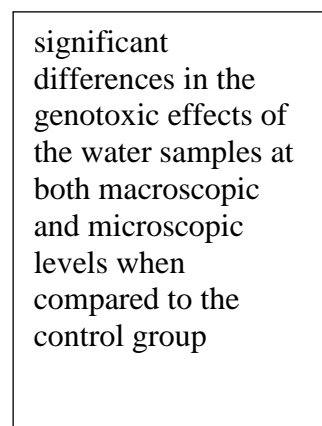


Figure 1. Paradigm of the Study

II. STATEMENT OF THE PROBLEM

This study was conducted to investigate the macroscopic and microscopic effects of the main water source of Ambassador, Tublay, Benguet on *Allium cepa*. Furthermore, this study sought to answer the following questions:

(1) What are the effects of the different water samples on the *Allium cepa* in terms of:

a) Macroscopic indicators such as (i) root lengths (longest and shortest roots) (ii). frequencies of root forms (bulbous and curved) b. Microscopic indicators (mitotic index)?

(2) Are there significant differences in the effect of the water samples on *Allium cepa* as to the macroscopic and microscopic indicators among the water samples and the control?

III. SCOPE AND DELIMITATION

This study was concerned in the determination of the possible genotoxicity of the different water samples from the main water source of Barangay 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: Root lengths (shortest and longest). 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* was the test organism used in this experiment since this kind of onion possesses a very advantageous characteristics, 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 barangay, microbiological and chemical analyses will be conducted after in collaboration with the Baguio Water District.

IV. 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: Steps to be undertaken to ensure potable water, such as reiteration of importance of proper waste management, among others;

identification of clusters of *sitios* that would share a communal water basin/tank; design of the communal water basin/tank and the appropriate system of distribution to the different household; Construction of the communal water basin/tank via the *bayanihan* system among the barangay officials, kagawads and community members of the clustered *sitios*.

V. MATERIALS AND METHODS

Research Design and Methodology

The study made use of 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 Barangay Ambassador. Surface water was collected from all the sources and distilled water was used as the control.

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.

VI. RESULTS AND DISCUSSIONS

This portion of the study presents the data gathered from the experiment that were tabulated, analyzed and interpreted. 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.

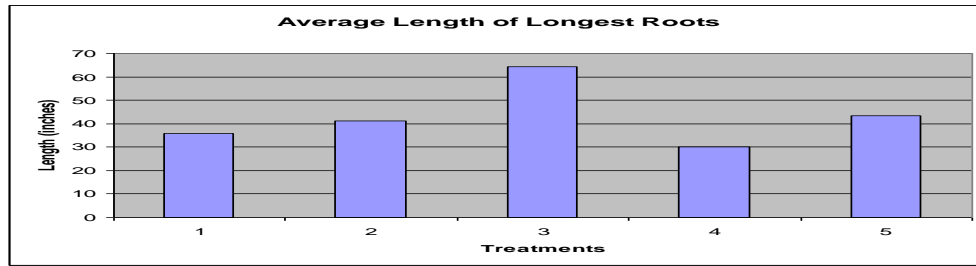
Effects on the macroscopic parameters

A. Root Length

1. Longest Roots

Table 1 presents the ANOVA of the mean number of longest roots. The computed F value of .147 is not significant at .05 level of significance. This means that the water samples do not have significant effect on the onion roots in terms of longest roots.

Figure1. Mean Length of the Longest Roots



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

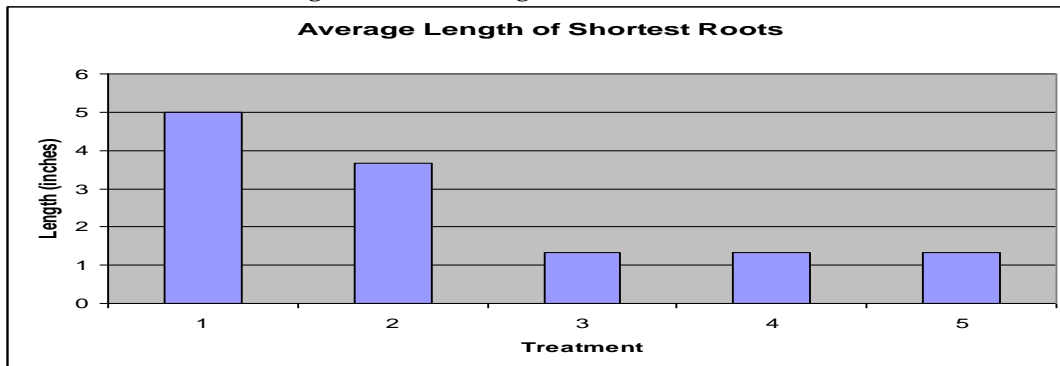
Table1. Analysis of Variance (ANOVA) in CRD and LSD of the macroscopic effect of the water samples in terms of the presence longest roots.

	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)

Shortest Roots

Figure 2. Mean Length of the Shortest roots.



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

Table 2 shows that there is significant difference in the effect in terms of shortest roots. This means that the water samples have differed in effect in terms of the shortest roots. Upper Coros, Baliti and Salaksak differed with lower Coroz and the control.

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
Within Groups	10.667	10	1.067		
Total	45.733	14			

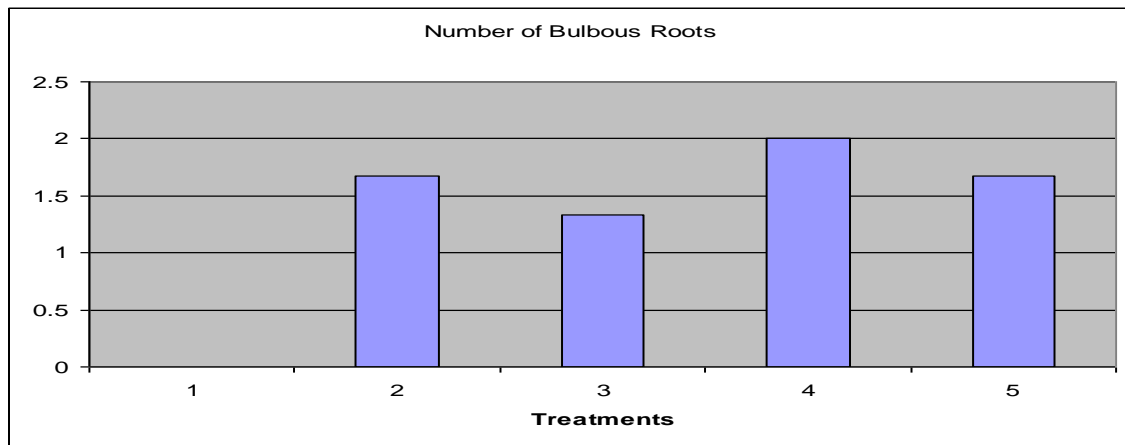
^{ns} - The mean difference is not significant (p>0.05)

B. Frequencies of Root Forms is

1. Bulbous Curved Roots

Table 3 showed that ANOVA of the bulbous or curved roots. The value of .267 means that there is no significant difference in the effect of the water samples and the control in terms of curved or bulbous 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.

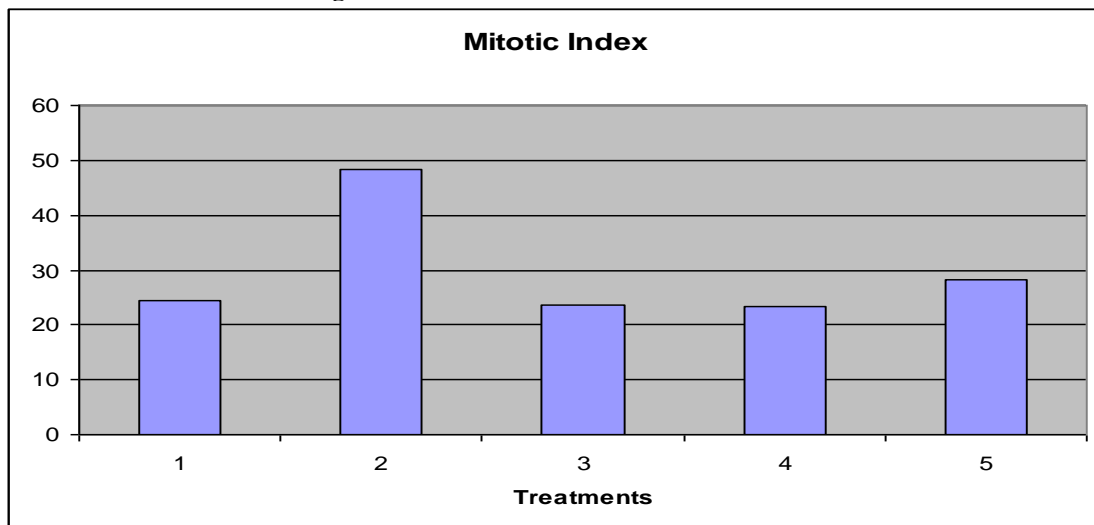
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	7.333	4	1.833	1.528	.267 ^{ns}
Within Groups	12.000	10	1.200		
Total	19.333	14			

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

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

In terms of terms of mitotic index ANOVA, this shows no significant difference in the effect of the water samples on the onion roots. This means that the water samples and pure water are not different in effect in terms of mitotic index.

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	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)

VII. CONCLUSIONS

Based on the aforementioned discussions and the initial findings obtained from this scientific study, some conclusions may be drawn. Even though water samples obtained from the main water source of Barangay 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.

VIII. RECOMMENDATIONS

This project also recommends that there should be an overall 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 Barangay Ambassador. Significantly, it must also set guidelines in prohibiting the discharge of wastes that might adversely affect the rivers of the barangay. 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 Barangay 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.

REFERENCES

Journal Articles

- [1] Baker, AJM & Walker, P.L .Physiological Responses of Plants to Heavy Metals and the Quantification of Tolerance and Toxicity. *Chem Speciation and Bioavail* (1989) 1: 7-17
- [2] Doctor, TR.; Pedling, MC; Manuel, JF; Kebasen, CB; Bulayungan; FL; Ballada, KA; and Ngalob, JD. Effects of Selected Water Samples from the Stream Tributaries of Barangay Ambassador, Tublay, Benguet on the Root

Growth of *Allium cepa* var. *aggregatum*. University of the Cordilleras Research Journal. Baguio City, Philippines (May 2008) Vol 01, No 2, pp 01-17.

- [3] Evandri, Maria Grazia Paolo Tucci and Paola Bolle. Food Additives and Contaminants, Dipartimento di Farmacologia delle Sostanze Naturali e Fisiologia Generale, University of Rome 'La Sapienza' P. le Aldo Moro, 5 - 00185 Rome, Italy (2000) Vol. 17, No. 12, 1037-1045
- [4] Feretti, D. Genotoxic Extracts of Pesticide Treated Vegetables and Grapes.
- [5] Food Additives & Contaminants, Department of Experimental and Applied Medicine, University of Brescia. Brescia. Italy (2007) Vol. 24, Issue 6, 561-572
- [6] Fiskejo, G. The Allium Test as Standard Environment Monitoring. *Hereditas*. (1985) 102: 99-112.
- [7] Fiskejo, G. The Allium Test - An Alternative in Environmental Studies: The Relative Toxicity of Metal Ions. *Mutations Research* (1988) 197: 243-260.
- [8] Greger, M. Metal Availability and Bioconcentration in Plants. M.N.V. Prasad and J. Hagemeyer (ed.) *Heavy Metal Stress in Plants. From Molecules to Ecosystem*. Springer-Verlag. Heidelberg, Germany (1999) 1-27
- [9] Gothberg, A; Greger, M; Holm, K; and Bengtsson, B. Influence of Nutrient Levels on Uptake and Effects of Mercury, Cadmium, and Lead in Water Spinach. *J. Environ. Qual.* (2004) 33: 1247-1255
- [10] Levan, A. The Effect of Colchicines on Root Mitoses in *Allium*. *Hereditas*, (1938) 24: 471-486
- [11] Medina, F.I.S. III. The Macroscopic Effect of Potassium Bromate on Multiplier Onions *Allium cepa* var. *aggregatum*. Philippine environmental Mutagen Society U.P. Diliman, Quezon City (1992)
- [12] Medina, F.I.S. III. Water Quality Assessment. (1994)
- [13] Oladiji, AT; Adeyemi O; and Abiola, O. Toxicological Evaluation of the Surface Water of Amilegbe River using Rats. *Biokemistri* (2004) Vol. 16, No. 2, 94-101
- [14] Poschenrieder C and Barcelo, J. Water Relations in Heavy Metal Stressed Plants. Springer 2nd ed. (2004) 249-270
- [15] Rank, J. and Nielsen M. H. Evaluation of the Allium Anaphase-Telophase Test in Relation to Genotoxicity Screening of Industrial Wastewater. Department of Environment, Technology and Social Studies, Roskilde University, Box 260, DK-4000, Roskilde, Denmark (1993)
- [16] Shaw, B.P. Heavy Metal Induced Oxidative Damage in Terrestrial Plants. Berlin, Heidelberg, Springer, 2nd ed. (2004) 84-126.

Newspaper Publication

- [17] Rafanan, J. and Almo, A. Effects of Water Samples From Selected Sites Along the Abra River on Root Growth of the *Allium fistulosum*. In Kim Quitsasol: Lepanto Mining Firm Not Environmentally-Friendly – UP Baguio, SLU scholars. *Bulatlat: Alipato Pub.*, Quezon City, Phil. August 28-September 3, 2005 Vol V. No. 29

Others

- [18] SWOT Analysis of Barangay Ambassador, Tublay

AUTHORS

First Author – Doctor, T.R, Department of Natural Sciences,
College of Arts and Sciences, University of the Cordilleras,
Governor Pack Road, Baguio City, Philippines 2600, Email:
tessdoctor@gmail.com

Second Author – Manuel, J.F, Department of Natural Sciences,
College of Arts and Sciences, University of the Cordilleras,
Governor Pack Road, Baguio City, Philippines 2600
Third Author – Rivera, M.P., Philippine Science High School,
Baguio City, Philippines 2600