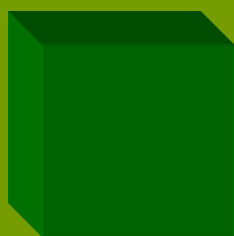
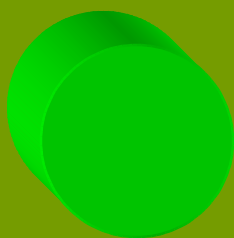
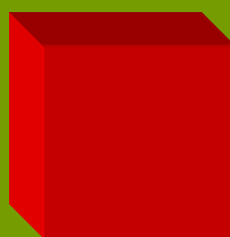


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## **SEA FOOD FLAVORED -TEA PRODUCT DEVELOPMENT**

**Rogelio M. Estacio**

Associate Professor,

Don Mariano Marcos Memorial State University,  
Bacnotan, La Union, Philippines

### **Abstract**

*The “Sea Food Flavored Tea” was an offshoot product of the project entitled “Sea Food Flavored Tea (energy drink) Product Development and Standardization”. The purpose of the study was to determine the possibility of preparing tea from seaweeds, sea urchin test (*Tripneustes gratilla*) and rice powder as the primary ingredients. The sea food flavored tea product, which is a mixture of the above resource, was brought to the Department of Science and Technology- Food and Nutrition Research Institute - Taguig Metro Manila for food analysis. After which, the product was sensory evaluated by 10 trained panelist of Don Mariano Marcos Memorial State University-Mid La Union Campus –Food Technology Department.*

*Result of the study revealed that the sea food flavored tea is rich in minerals such as calcium, iodine, iron, potassium, carbohydrate, energy and other important elements which are vital for good health and nutrition. Sensory evaluation of the product was found out to be acceptable for its overall quality attributes.*

*Microbial analysis showed no harmful microorganism detected e.g., salmonella. Mold and yeast counts were found to be an insignificant value hence, the tea is safe for human consumption.*

*Sea food flavored tea production and processing technology out of the sea urchin test can lead to generation of additional livelihood opportunities hence, source of income for fishermen families. The presence of macro and micronutrients of the processed product is a justification for continued development of the product.*

**Keywords:** *tea; sea food; sea urchin test utilization*

### **Introduction**

Sea food flavored tea is especially formulated from sea urchin test and selected species of seaweed. It contains a wealth of mineral elements. Its unique flavor spells the natural health benefits. Mostly it promotes good health and preventive medicine against bone loss considering its calcium contents. It contains high level of iodine that can prevent goiter. Sea food flavored tea is another avenue for optimizing the use of sea urchin test which at present generally considered “waste” in sea urchin farming.



Sea urchins are valuable fishery resources because of its local and global market potential. The gonads of both sexes are exotic food item and referred to as “roe or uni”. These are good source of vitamins and minerals such as glycogen, carotenoids, alamine, valine, glycine, methionine, glutamic acid, inosinic acid and gluanylic acid (Namisato, 1974). The roe or its gonad is the only component of the urchin used as food.

The total sea urchin production worldwide was estimated to be 119,647 metric tons in 1995. The major export markets are Japan, France and Korea. Annual Japanese import of sea urchin gonads rose from 6,835 metric tons in 1995 to 12,971 metric tons in 1999. The Philippine’s sea urchin fishery production was estimated to be approximately 1,100 metric tons of fresh weight gonad in 1972. However, gonad exports to Japan in 1996 was only 18.2 metric tons and comprised mainly of lower value products as paste (Juinio-Menez et.al., 2001)

The gonad is the only product that is utilized and processed into other food products leaving the sea urchin shell and other body parts as waste materials. These waste products could still be utilized as supplements or turned into better and nutritious food items. The sea urchin shell contains 28.09% calcium according to the analysis conducted by the Bureau of Animal Industry dated April 14-22, 2008; Laboratory Report No. 09-328-1008. (Appendix Table 4). Hence, it is a potential source of calcium food supplement for daily calcium need requirements for human.

Efforts to establish the dynamics of the sea urchin wild stock population and its performance in cage environment were conducted in Balaoan waters aimed at sustaining livelihood opportunities in the area (Prado and Tepait, 2006; Prado and Galvez 2008; Prado.et al.2008). On the other hand, Sargassum is a seaweed that are salt dwelling, attached to rocks and reefs, often in wave-swept areas. The color is dark brown with golden-brown tips. They are removed from the rocks or reef areas by waves and are found washed up on beaches in large amounts or floating around on the sea surface. These seaweed are found throughout the world’s ocean and seas and none is known to be poisonous ([seaweeds@safariseeds.com](mailto:seaweeds@safariseeds.com)).

This seaweed is edible, raw or cooked. The tips and whole parts can be sun dried for long term storage, or crisped and crumbled to make flavor flakes. Regular eating of even small amounts of brown algae can be an ongoing metal detoxification practice which can reduce the quenching of enzymes by heavy metals, in a way which avoids damaging the kidney (Yang Yifang, 2002).

Sargassum seaweeds contain high level of iodine, which prevent goiter. It also has algin, fucoidan and laminarin substances which act as a preventive medicine for heart disease and stroke. It also serve as antibacterial, anti tumor, controlling ascariasis, it has cooling and blood cleaning effect, and also regulate cholesterol level, with potency for normalizing blood pressure(Trono, Gavino Jr, 1989). Also, this seaweed draws an extraordinary wealth of mineral elements from the sea that can account for up to 36% of its dry mass. The minerals macronutrients include sodium, calcium, magnesium, potassium, chlorine, sulfur and phosphorous. The micronutrients include iodine, iron, zinc, copper, and vitamins from A to Z. (Hsu HY, et al, 1986)



Hence, this project aims to develop new product formulation from seaweeds and sea urchin shell or test, which are abundant and locally considered wastes in La Union and nearby provinces.

**Objectives:**

*General Objective:* To develop a tea product as food supplement from seaweeds and sea urchin test/shell.

*Specific Objectives:*

1. To determine the acceptability of the sea flavored tea; and
2. To establish nutritional facts, proximate and microbial load of the tea.

**Materials and Methods**

**Materials**

Preparation of supplies and materials- Cooking and processing materials/utensils were purchased, and were set up in the processing laboratory. Seaweed were gathered at the shoreline of Balaoan, La Union. Sea urchin shell/test were provided by the sea urchin fishermen, while other materials were bought locally.

A. Sea food flavored tea formulation procedure:

1. Collection, washing, soaking and drying of seaweeds and sea urchin test/shell. The gathered seaweed were immediately washed with running fresh water to remove oceanic odor and other unwanted debris. The seaweeds were soaked in fresh water and placed in stainless container for overnight. After which, the seaweeds were rinsed and dried under the sun until completely dried.

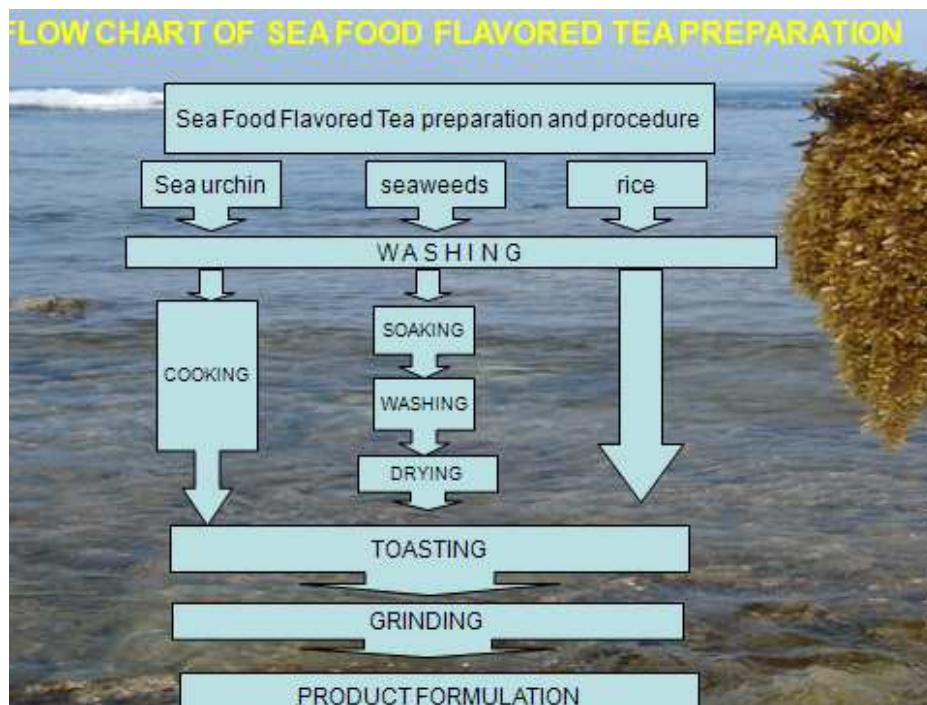


Plate 1. The process flowchart of the sea food flavored tea preparation.



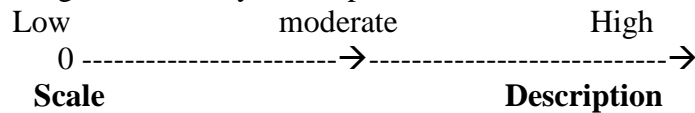
Also, the sea urchin test/shells were washed in clean water and boiled in stainless casserole for more than 1 hour. The boiled sea urchin test were washed in fresh water to remove its fishy odor, dehydrated and set aside for toasting.

2. Toasting- Dried seaweeds were toasted in oven for less than an hour while rice and sea urchin test/shell were cooked dry for more than an hour.
3. Pulverizing- A grinding machine was used in powdering toasted sea urchin test, seaweeds and rice.
4. Mixing of ingredients- Ingredients were mixed as follows; 20% sea urchin test, 20% seaweeds (*sargassum spp*) and 60% rice powder.
5. Packaging- The formulated sea food flavored tea were wrapped with tea bag.

**B. Test and Evaluation:**

1. Sensory evaluation- The formulated sea food flavored tea product were evaluated by 10 trained panelist of DMMMSU- MLUC- Food Technology Department.
2. Sampling tools and technique- The modified hedonic rating scale was used by the evaluators. The quality attributes or criteria for evaluation was adopted based on the recommendation of the Food Technology Department for “tea” product.

Below is the rating scale used by the 10 panelist. The scale of 0 -150 was used



Scale	Description
0 – 49	Low
50 – 99	Moderate
100 - 150	High

3. Data analysis- Data on the sensory evaluation results were analyzed using the Analysis of Variance (ANOVA). Significant differences among treatment means was further compared using Scheffe’s test, whenever possible.

- C. Proximate, nutrient, and microbial analysis of the product- Sea food flavored tea samples were brought to DOST-FNRI Taguig City for analysis.(Please refer to appendix tables 1 2, and 3).

**Results and Discussion**

**Acceptability of the sea food flavored tea**

Sensory evaluation result by the trained panelists is reflected in Table 1. Five (5) quality attributes of the tea were presented and served as basis for the acceptability test of the product.

Results indicated that the overall mean value of the product is 61.25 which suggests that the product is “acceptable”. Of the five (5) tea attributes, color, tea aroma and low seaweed flavor are indicative to a good tea quality attributes considering the “non traditional” materials used in developing a tea product. Hence, such utilization of sea urchin test which is considered waste by-product of sea urchin production, and sargassum as part of the preparation for tea production will pave a new area of developing alternative livelihood and resource utilization for the benefit of coastal communities.





Meanwhile, the other two quality attributes of the tea that may need to be improved are its “burned flavor” and “aftertaste”. Though the product is generally accepted by the trained panelist, such attributes must be “refined” for acceptance by the general public.

Table 1. Mean acceptability of the sea food flavored tea by the panelists on the quality attributes of the product.

Quality attributes	Mean	Descriptive equivalent
Over all	61.25	moderate
color	82.5	moderate
Tea Aroma	90	moderate
Seaweed flavor	50	moderate
Burned flavor	130	high
Aftertaste	120	high

Table 2. Analysis of variance (ANOVA) on the mean score of the panelists on the quality attributes of the product.

Quality attributes	P-value	Level of significance at .01
Color	1	ns
Overall flavor	0.99	ns
Tea Aroma	1	ns
Seaweed flavor	1	ns
Burned rice flavor	1	ns
After taste	1	ns
Overall	0.99	ns

Table 2 shows the mean responses of the panelist on the quality attributes of the sea food flavored tea product. The result indicated no significant differences at .01 level of significance reflecting similarities of response of the panelists with respect to any of the quality attributes of the tea product.

**Nutritional, proximate and microbial load of the sea food flavored tea**

Table 3 presents the analysis of DOST-FNRI on the formulated sea food flavored tea product. Results indicated that the tea product has various composition vital in nutrition and in maintaining good health.



Table 3 Nutrition information of the sea food flavored tea as per analysis conducted by Department of Science and Technology- Food and Nutrition Research Institute.

Serving Size 1Tbsp. (9g)/cup Serving per pack/number of serving 78	Amount per Serving	Amount per 100g
Energy (Calories)	30	340
Total Fat (g)	0	1
Total Carbohydrate (g)	7	76
Total dietary Fiber (g)	1	13
Total Protein (g)	1	8
Sodium (mg)	15	160
	Amount per Serving	%RENI
Calcium (mg)	374	50
Iron (mg)	<2	4
Potassium*(mg)	24	0
Zinc(mg)	<2	7
Iodine (ug)	86	58

The tea provides 30 kcalories of energy on a per serving basis (1tbsp (9g)/cup). An average man (154lbs) needs about 18 kcalories per pound of weight or approximately 2680 calories per day ([www.chestofbooks.com](http://www.chestofbooks.com)). Small quantities of carbohydrate (7g), fiber (1g) and protein (1g) were also traceable on the product. Accordingly, children and adults need a minimum of 130g of carbohydrates per day for proper brain function ([www.dietaryfiberfood.com](http://www.dietaryfiberfood.com)), and, a good amount of carbohydrates would provide energy vital for metabolic processes of the body ([www.diet-and-health.net](http://www.diet-and-health.net))

On the other hand, the tea constitutes a low value of Sodium (15mg), very much lower than a known energy drink available in the commercial market at present. The product by itself has a “zero” fat content - a significant findings for health-risk conscious individuals.

Among the micro nutrient content of the product, it is rich in calcium and iodine. Based on the DOST analysis, the tea could supply about 50% and 58% of calcium and iodine requirement (RENI) of a person 19years old and above (Appendix Table 2). Young and adult needs 1000mg/day and 1200mg/day of calcium daily respectively according to the National Osteoporosis Foundation ([www.weightlosscenter.net](http://www.weightlosscenter.net)), and iodine of 90ug (1-8 years old), 120ug (9-13 years old) 150ug (14-18 years old) and 150ug for men and women ([www.betterhealth.vic.gov.au](http://www.betterhealth.vic.gov.au)). Hence the tea product will add and considered a good source of supplemental RDA needs of a person at all ages in terms of calcium and iodine requirements. Additionally, iron, potassium and zinc were also found in the product though in small quantities. For instance, the RDA’s for adults which is 19 to 50 years old is 8mg for males and 18mg for females, and for 51 years and above is 8 mg for both male and female ([www.dietarysupplements.info.nih.gov/factsheets/iron.asp](http://www.dietarysupplements.info.nih.gov/factsheets/iron.asp)). The tea product has <2mg per serving size of 1tsp (9g)/cup which constitutes only about 4% of the required value for iron. Zinc micro nutrient is also <2mg, or only about 7% of the required. Potassium content which is only 24mg, is considered very low compared to the recommended daily intake of dietary potassium for 10 years old and above of 2,000mg. ([www.umm.edu/altmed/articles/potassium-000320.htm](http://www.umm.edu/altmed/articles/potassium-000320.htm)).



On the other hand, results of the microbial load of the tea indicated insignificant value in terms of mold/yeast.

## **Summary, Conclusions and Recommendations**

### **Summary**

The sea food flavored tea product was formulated out of sea urchin test/shell and seaweed combined with rice powder. The use of the sea urchin test/shell was generally considered waste product from sea urchin fisheries though at present effort to optimize the utilization of the test is underway (e.g. use of test/shell as décor), aimed at increasing, and adding value to the current effort of sea urchin fishermen.

A formulation protocol was developed in coming up with the sea food flavored tea product. The product was brought to DOST- Food and Nutrition Research Institute, Taguig, Metro Manila for analysis of its nutrient and microbial content. The product by itself was also sensory evaluated by 10 trained panelists of the DMMMSU- MLUC-Food Technology Department of the College of Technology, San Fernando City, La Union

Results indicated the following:

1. that the sea food flavored tea product was generally accepted as to its composition, though other factor attributes shall be improved.
2. that the proximate composition of the sea food flavored tea product made out of sea urchin test, seaweed and rice powder contain essential micronutrients that are needed to supplement deficiencies in daily nutritional requirement of a person.
3. that the results of the microbial analysis indicated insignificant value, such that it was considered safe for consumption.

### **Conclusions**

Based on the sensory and proximate analysis undertaken, the following were found:

1. that sea food flavored tea product out of sea urchin test/shell and seaweed combined with rice powder can be developed and accepted for consumption, and
2. that the tea is rich in micro nutrients especially calcium and iodine, and could serve as a supplementary product in sustaining the recommended energy and nutrient intake (RENI) of a person for good health and maintenance.

### **Recommendations**

In the light of the above findings, the following are recommended.

1. The sea food flavored tea must be sensory evaluated by a wider consumer group to serve as basis for further improvement of the quality attributes of the product; and
2. Shelf life and packaging studies must be undertaken for quality development and standardization prospect of the product.



**References:**

Juino-Menez, M.A., M.C.D. Malay and H.G.P.Bangi. Sea Urchin Grow-out Culture. Coastal Resource Management Tools, Marine Environment Resources Foundation, Inc. The Marine Science Institute, University of the Philippines, Diliman, Quezon City. 34p

Prado,V.V. and E. Tepait, 2006. An Analysis on the Growth of Sea Urchin (*T. gratilla*) in cages. R&E Journal. DMMMSU, Bacnotan, La Union pp92-102.

Prado, VV and G. Galvez 2008. Temporal Occurrence of Sea Urchin *Tripneustes gratilla* Along Balaoan Waters La Union. R & E Journal DMMMSU, Bacnotan, La Union. pp 21-30.

Prado V.V. I.C. Junio, E.V. Tepait, G.N. Galvez and L.P. Bisco. The “2in 1 plus” Mariculture Farming System: A Livelihood Development strategy for coastal families. R&E Journal, DMMMSU, Bacnotan, La Union. pp 96-106.

Trono, Gavino, 1989, Field Guide and Atlas of the Seaweed Resources of the Philippines

[www.herbs2000.com](http://www.herbs2000.com)

<http://exercise.about.com>

<http://www.madsci.org>

<http://circ.ahajournals.org/cgi/content/full/105/25/e197>

<http://chestofbooks.com>

[www.weight-loss-center.netseaweeds@safariseeds.com](http://www.weight-loss-center.netseaweeds@safariseeds.com)

[www.herbs.2000.com](http://www.herbs.2000.com)

[www.umm.edu/articles/potassium](http://www.umm.edu/articles/potassium)

<http://Chinese-school.netfirms.com>

<http://linkinghub.eslevier.com>

[www.madsci.org/2003-05](http://www.madsci.org/2003-05)

<http://allonhealth.com>

[www.diet-and-health.net](http://www.diet-and-health.net)

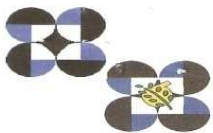
[www.annecollins.com](http://www.annecollins.com)

[www.weight-loss-center.net](http://www.weight-loss-center.net)




## Appendix Table

Appendix Table I- Report of analysis conducted by Food and Nutrition Research Institute-DOST Based at Taguig Metro Manila.



Republic of the Philippines  
 Department of Science and Technology  
**FOOD AND NUTRITION RESEARCH INSTITUTE**  
 Gen. Santos Ave., Bicutan, Taguig, Metro Manila, Philippines  
 Website: www.fnri.dost.gov.ph; E-mail: trpfnri@yahoo.com  
 Tel. Nos. 837-2934; 837-2071 to 82; Fax. No. (832) 837-3164



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"Fight Malnutrition with Accurate Data, Correct Information and Innovative Technologies"

**July 14, 2008**

**FASL Report No. 08-065**

**REPORT OF ANALYSIS**

Client Name : DMMMSU - NLUC  
 Address : Bacnotan, La Union  
 Date Submitted : June 12, 2008  
 Sample : Sea Flavored Tea  
 Lab. Ref. No. : NUT 08-042

ANALYTE Per 100g	Sea Flavored Tea	METHOD USED	DATE OF ANALYSIS	ANALYST
Moisture, g	2.1	AOAC 934.01	06-16-2008	J.S. Espolita
Ash, g	12.8	AOAC920.100	06-20-2008	P.M. Matibag
Energy*, Kcal	345	Computed using Atwater Factors	-	P.M. Matibag
Total Fat, g	1.0	Acid Hydrolysis (tecator)	06-24-2008	J.S. Espolita
Total Carbohydrate*, g	76.1	Computed by Difference	-	P.M. Matibag
Dietary Fiber, g	12.8	AOAC 991.43	06-20-2008	J.G. Ardena
Protein, g	8.0	Automated Kjeldahl Method (Buchi)	06-20-2008	P.M. Matibag
Sodium*, mg	164	AOAC 985.35 (Modified)	06-28-2008	D.P. Briones
Iron, mg	5.7	AOAC 985.35 (Modified)	07-03-2008	D.P. Briones
Calcium, mg	4151	AOAC 985.35	06-28-2008	D.P. Briones
Iodine*, ug	959	Tech. AAI Ind. Method 530-77A	07-04-2008	R.J. Dumag
Potassium*, mg	272.2	AOAC 985.35 (Modified)	06-28-2008	D.P. Briones
Zinc*, mg	5.1	AOAC 985.35 (Modified)	07-09-2008	D.P. Briones


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Checked by:  
  
**JULIANA G. ARDENA**  
 Senior Science Research Specialist  
 Chemist License No. 5288


Approved by:  
  
**TERESITA R. PORTUGAL**  
 Supervising Science Research Specialist  
 Chemist License No. 3308

Noted by:  
  
**MARIO V. CAPANZANA, Ph.D.**  
 Director


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Appendix Table 2 - Nutritional Information as reported by Food and Nutrition Research Institute-DOST based at Taguig Metro Manila.


 Republic of the Philippines  
 Department of Science and Technology  
**FOOD AND NUTRITION RESEARCH INSTITUTE**  
 Gen. Santos Ave., Alabang, Taguig, Metro Manila, Philippines  
 Website: www.fnri.dost.gov.ph; E-mail: fnri@fnri.dost.gov.ph  
 Tel. Nos. 837-2994; 837-2071 to 82; Fax No. (832) 837-3164

---

"Fight Malnutrition with Accurate Data, Correct Information and Innovative Technologies"

August 1, 2008 FASL NF 08- 047

Client Name Address Date Submitted Sample Lab Ref. No.	<b>NUTRITION INFORMATION</b> DMMMSLI - NLUC Bacnotan, La Union June 12, 2008 Sea Flavored Tea NUT 08-042 Package size: 700g
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**NUTRITION INFORMATION**

Serving Size 1Tbsp. (9g)/cup

Serving per pack/number of serving 78

	Amount per Serving	Amount per 100g
Energy (Calories)	30	340
Total Fat (g)	0	1
Total Carbohydrate (g)	7	76
Total dietary Fiber (g)	1	13
Total Protein (g)	1	8
Sodium (mg)	15	160
	Amount per Serving	%RENI
Calcium (mg)	374	50
Iron (mg)	<2	4
Potassium*(mg)	24	0
Zinc(mg)	<2	7
Iodine (ug)	86	58

Prepared by  
  
**JULITA G. ARDENA**  
 Sr. Science Research Specialist

Approved by  
  
**TERESITA R. PORTUGAL**  
 OIC, FSTD

Noted by  
  
**MARIO V. CAPANZANA, Ph.D.**  
 Director



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## **CARBON DIOXIDE (CO<sub>2</sub>) SEQUESTRATION CAPACITY OF TAMPILISAN FOREST**

C. Tagupa<sup>1</sup>, A. Lopez<sup>2</sup> and F. Caperida<sup>3</sup>, G. Pamunag<sup>4</sup>, A. Luzada<sup>5</sup>

### **Abstract**

*This study estimated the carbon dioxide sequestered and stored in the forest trees of Jose Rizal Memorial State University – Tampilisan Campus reservation. The study site contained the trees species Mohagany (*Swietenia macrophylla*), Gmelina (*Gmelina arborea*), Mangium (*acacia magium*) Rubber (*Hevea brasilliensis*) and natural forest trees (e.g. *Dipterocarp* species, etc). Results revealed that standard – sized trees have better CO<sub>2</sub> sequestration potential than the sapling and pole – sized. These trees have the biggest merchantable height, trunk diameter and wood density. Among the species considered, Gmelina had the highest amount of CO<sub>2</sub> sequestered and stored in stem followed by Mangium, Rubber and Mahogany at standard size. In addition, regression analysis indicated that the rate of CO<sub>2</sub> sequestered and stored on trees are related to the growth characteristics as trunk diameter (DBH) and total height, but not with wood density. Moreover, the forest stand of JRMSU – Tampilisan Campus reservation has a total sequestration capacity of 88.17 kT CO<sub>2</sub>.*

**Keywords:** *global warming, climate change, carbon dioxide sequestration, greenhouse gasses, forest and merchantable volume*

### **Introduction**

Global warming is the increase in the average temperature of the earth's surface resulting from the rise in the concentration of greenhouse gases (GHGs) like carbon dioxide CO<sub>2</sub>, methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and chlorofluorocarbons. The increased concentration of GHGs in the atmosphere attributes to the change in the world's climate. GHGs destroy the ozone layer allowing the ultra violet rays to pass towards the earth surface. The intense heat emitted in the earth surface through radiation has hazardous effect on plants, animals, human race, and its total environment. Forest trees are considered as an important factor in mitigating climate change because of their role in carbon sequestration – the process of removing carbon dioxide (CO<sub>2</sub>) from the atmosphere and 'storing' it in plants that use sunlight to turn CO<sub>2</sub> into biomass and oxygen (ACIAR, 2008).

---

<sup>1</sup> Department of Agroforestry, Jose Rizal Memorial State University-Tampilisan Campus

<sup>2</sup> Department of Plant Pathology, Jose Rizal Memorial State University-Tampilisan Campus

<sup>3</sup> Department of Animal Husbandry, Jose Rizal Memorial State University-Tampilisan Campus

<sup>4</sup> Jose Rizal Memorial State University-Tampilisan Campus

<sup>5</sup> Jose Rizal Memorial State University-Tampilisan Campus



Forest ecosystems play an important role in climate change because they can be both sources and sinks of CO<sub>2</sub> (Trexler and Haugen, 1994). Carbon in the form of carbon dioxide (CO<sub>2</sub>) is emitted by rotting vegetation and (collectively called ‘sources’), and CO<sub>2</sub> is sequestered or absorbed by trees (the so-called ‘sinks’). Likewise, where trees are cut, the stored carbons in them are again released into the atmosphere. Realizing the importance of trees in sequestering carbon dioxide in the atmosphere, the Jose Rizal Memorial State University – Tampilisan Campus – reforested a hilly portion of its reservation with different species of trees. The school, in collaboration with the OISCA International, also initiated the extension services in some schools in Zamboanga del Norte and Zamboanga Sibugay advocating children’s forest program. The school also established a rubber tree plantation. The planting of trees is anchored on the belief that carbon dioxide can be stored in trees. The present study is an important step towards quantifying the carbon sequestration properties of the trees planted in the forested area of the University. Various other research considerations were tackled head on when exact quantification of these properties were made available. Hence, the present study.

### **Research Method and Design**

***Location and Description of the Study Area.*** The study was conducted in the reservation area of JRMSU – Tampilisan Campus. It is located in barangay Znac, municipality of Tampilisan, Zamboanga del Norte (fig. 1). Specifically, the campus lies in the foothill of Mt. Gampoy, one of the tallest mountains in Zamboanga del Norte.

The amount of carbon dioxide sequestered by trees in JRMSU - Tampilisan Campus reservation were estimated based on allometrics, getting the relationships between tree height, stem diameter and wood density – to the amount of carbon stored in trees.

***Establishment of Sampling Sites and Sampling Plots.*** The study site covered the 40 hectares of reforested area, 550 hectares of rubber tree plantation and 200 hectares of natural forest. Sampling plots measuring 10 m x 20 m were established within the sampling sites. The plots were cordoned with a rope so that the perimeter of a plot can be seen. There were five sample plots (quadrats) established per hectares, and random sampling was used in the selection of sample areas in the study sites.

***Classification of Tree Stands and Data Collection.*** The different species of trees, regardless of age, were classified into sampling (< 10 cm), poles size (10 – 30 cm), and standards trees (> 30 cm), according to their diameter at least height (DBH). The number of trees found inside the perimeter of each classification, were tallied and recorded. Moreover, the merchantable height and the total height of trees were measured with the aid of a clinometers while the DBH and the top diameter of sample trees were determined using a calliper.

***Sampling for Wood Density.*** The wood density of each tree species was determined by taking wood samples from the trunk of ten trees. An approximately 1 inch, ½ inch, and 2 inches wood samples were bored through the main trunk of sampling, pole, and standard size sample trees, respectively. The holes of each trunk were then treated with coal tar to prevent from further damages, especially insect pest and disease – causing microorganisms. The woods were then shaped into cubes and then the fresh weight and the oven – dry weight of cubes were determined using a triple beam balance.





**Stand Volume of Sample Trees.** Volume (m<sup>3</sup>) of trees was estimated using data on DBH, merchantable height and total height of individual trees found inside the sample plots. The volume per tree was determined following Phillip (1994) as cited by Sales et al. (2004) using the general formula:  $0.7854 \cdot dbh^2 \cdot mh/th \cdot \text{form factor}$ . The form factor was computed as follows:

$$\text{Form factor} = \frac{V_m}{g_{bh}(th)}$$

where:  $V_m$  = merchantable volume over bark (OB), defined by a specific top diameter (m),  $g_{bh}$  is basal area at breast height (m), and  $th$  is total height (m).

The volume per hectare was estimated by the ratio of the average stand density of trees contained in sample plot areas (200 m<sup>2</sup>) to the area of one hectare (10,000m<sup>2</sup>).

**Biomass and Carbon Density of Sample Trees.** The fresh and dry weights as well as the density (g/cm<sup>3</sup>) of wood samples for each tree species were determined. The amount of carbon dioxide in stems of trees was computed using the formula:

$$\text{Amount of CO}_2 = \text{merchantable volume OB} * \text{wood density} * 45\% * 3.6663$$

where: 45% is a default value based on the overall estimate of carbon content of biomass of trees as proposed by IPCC (1996). 3.6663 is the ratio of CO<sub>2</sub> to C.

**Rate of Total CO<sub>2</sub> Accumulation in Trees.** The total amount of CO<sub>2</sub> accumulated in trees were approximated based from Huy et al. (2008) who reported the following relationship:

$$\begin{aligned} \text{Total CO}_2 \text{ accumulation in trees:} &= 62 \% \text{ in stem} \\ &= 26 \% \text{ in branches} \\ &= 10 \% \text{ in bark} \\ &= 2 \% \text{ in leaf} \end{aligned}$$

However, to avoid overestimation of the total CO<sub>2</sub> content, the amount of CO<sub>2</sub> in bark of trees was decided to be excluded, with the assumption that it was already incorporated in the stem part (as it considered merchantable volume over bark).



**Results**

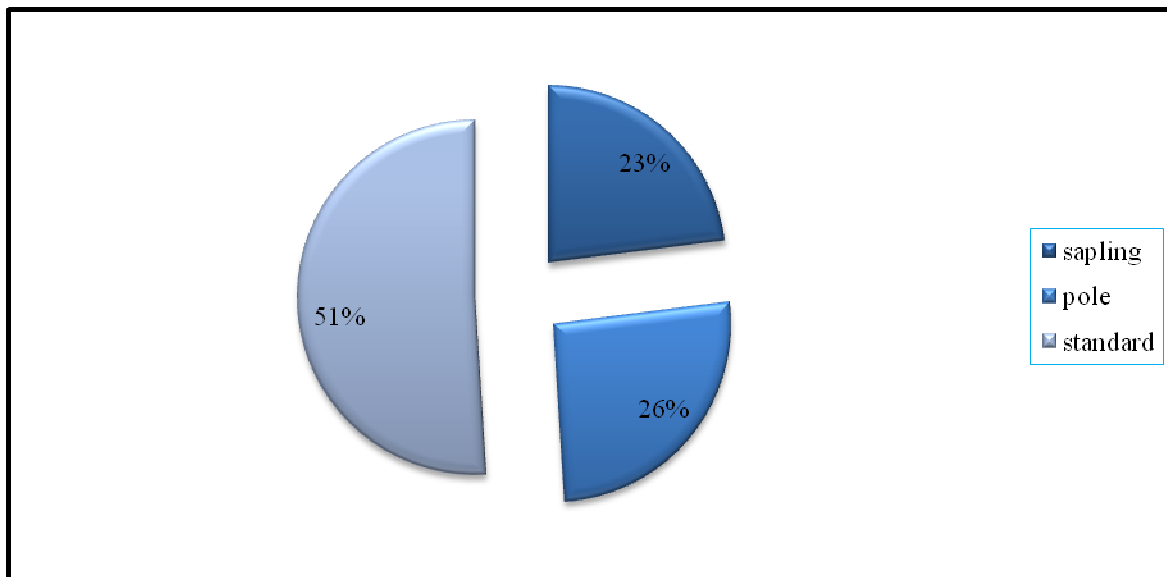
**Table 1: Tree Species Found in Sampling Area**

<b>Classification</b>	<b>Common Name</b>	<b>Scientific name</b>
Planted	Mohogany	<i>Swietenia macrophylla</i>
Planted	Gmelina	<i>Gmelina arborea</i>
Planted	Mangium	<i>Acacia mangium</i>
Planted	Rubber	<i>Hevea brasillensis</i>
Natural	Mangga Poso	<i>Hopea mindanensis</i>
	Anang	<i>Diospyrus pyrhcenpa</i>
	Yakal	<i>Shorea astylosa</i>
	Almon	<i>Shorea almon</i>
	Kaatoang bangkal	<i>Anthocephdus chinensis</i>
	Tagoang uwak	<i>Croton leiophyllus</i>
	Tabian	<i>Elaeocarpus moncera</i>
	Mindanao cinnamon	<i>Cinnamon mindanensis</i>
	Nato	<i>Balaguium luzoniense</i>
	Bagtikan	<i>Parashorea malaanonan</i>
	Palosapis	<i>Anisoptera thurifera</i>
	Pagsahingin	<i>Canarium asperum</i>
	Mayapis	<i>Shorea posapis</i>
	Kubi	<i>Artocarpus nitidus</i>
	Binuang	<i>Octomeles sumatrana</i>
	Narig	<i>Vatica mangachapoi</i>
	Hagakhak	<i>Dipterocarpus validus</i>
	Igyo	<i>Dysoxylum daeandrum</i>
	Basikong – Kalawang	<i>Alphonsea arborea</i>
	White lavan	<i>Ficus minahassae</i>
	Apanang	<i>Shorea contorta</i>
	Apitong	<i>Neotriwia cumingii</i>
	Malabayabas	<i>Dipterocarpus grandiflorous</i>
	Binunga	<i>Tristaniopsis dicorticata</i>
	Katmon	<i>Macaranga tanarius</i>
		<i>Dillenia philippenensis</i>



**Table 2. Species, classification and density (No. of trees per hectare) of sample trees in the study site.**

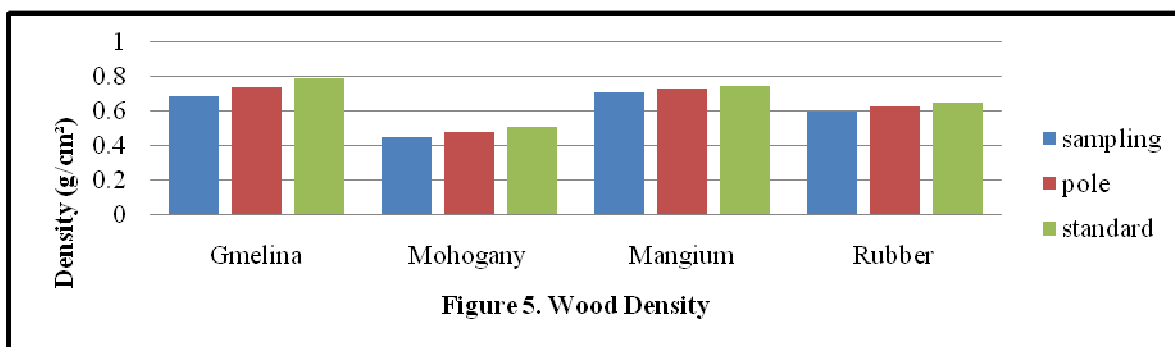
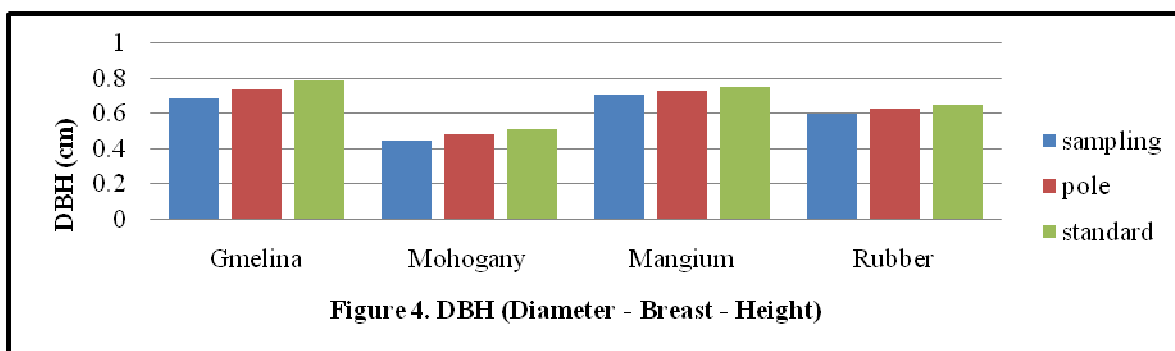
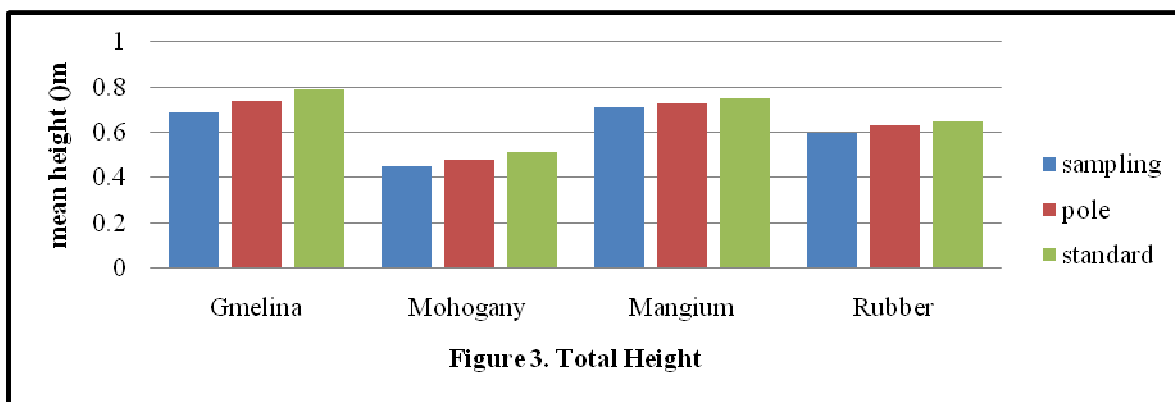
Species	Trees Classification	Stand density (Trees/ha.)	Total Area Covered (has.)
Mohogany ( <i>Swietenia macrophylla</i> )	Sapling	218.33	20
	Pole	435.01	
	standard	198.33	
<b>Total</b>		<b>851.67</b>	
Gmelina ( <i>Gmelina arborea</i> )	Sapling	206.67	10
	Pole	446.67	
	standard	46.67	
<b>Total</b>		<b>700.01</b>	
Mangium ( <i>Acacia mangium</i> )	Sapling	216.00	10
	Pole	452.00	
	standard	186.00	
<b>Total</b>		<b>854.00</b>	
Rubber ( <i>Hevea brasillensis</i> )	Sapling	125.71	550
	Pole	328.57	
	standard	144.29	
<b>Total</b>		<b>598.57</b>	
Dipterocarps, etc	Sapling	484.00	200
	Pole	442.00	
	standard	144.00	
<b>Total</b>		<b>1,070.00</b>	



**Figure 2. The distribution of sample trees in the study site.**



**Characteristic Data of Trees Sampled**



**Biomass and Carbon Density.** From the analysis, sapling generally have lesser biomass compared to pole – sized trees; and pole – sized trees have lesser biomass than standard – sized (Table 3). Thus, the biomass is expressed in the following order of magnitude: standard – sized > pole – sized > sapling. It also shows that the biomass and carbon density varies among tree species at these stages. The carbon density value of Mahogany, Gmelina, Mangium, and Rubber from sapling to standard – sizes ranged from 5 Mg/ha to 291 Mg/ha, 8.99 Mg/ha to 435 Mg/ha, 9.4 Mg/ha to 418.62 Mg/ha, and 12.89 Mg/ha to 411.88 Mg/ha, respectively.



**Table 3. Estimate of CO<sub>2</sub> Accumulation Based on Tree Species and Classification (Mg/ha)**

Species	Trees Classification	Predicted CO <sub>2</sub> Density (MG/ha)			
		Stem	branches	Leaves	total
Mohogany ( <i>Swietenia macrophylla</i> )	Sapling	3.60	1.30	0.10	5.00
	Pole	57.32	20.70	1.59	79.61
	standard	209.73	75.74	5.82	291.29
Gmelina ( <i>Gmelina arborea</i> )	Sapling	6.47	2.34	0.18	8.99
	Pole	40.28	14.55	1.12	55.94
	standard	313.86	113.33	8.71	435.92
Mangium ( <i>Acacia mangium</i> )	Sapling	6.77	2.44	0.19	9.40
	Pole	113.18	40.87	3.14	157.19
	standard	301.41	108.44	8.37	418.62
Rubber ( <i>Hevea brasillensis</i> )	Sapling	9.28	3.35	0.26	12.89
	Pole	90.99	32.86	2.53	126.38
	standard	295.65	107.09	8.24	411.88

**P = values:** Sapling = 0.028; Pole = 0.113; Standard = 0.190

Analysis of variance showed that on the average, the capacity of trees to sequester CO<sub>2</sub> varies among species at sapling stage (p = 0.028). However, as trees approached the pole and standard sizes, no significant variation exist in terms of their carbon sequestration capacity, p = 0.113 and 0.190, respectively.

**Table 4. Analysis of variance for Comparing CO<sub>2</sub> Sequestration of Terms**

Stage	Mahogany	Gmelina	Mangium	Rubber	F- value	P -value
Sapling	5.00	6.47	6.77	9.28	11.927*	0.028
Pole	79.01	55.94	157.19	123.38	3.984	0.113
Standard	291.29	435.92	418.12	411.12	2.755	0.190

Significant at 0.05 (p < .05)

**Relationship between Carbon Density and Growth Characteristics of Tree.** Linear regression analysis indicated that the rate of CO<sub>2</sub> Sequestered and stored is related to the trunk diameter (DBH) and total height of trees (TH). Wood density (WD), however, did not affect the rate of CO<sub>2</sub> Sequestered and stored (Table 5).



**Table 5. Relationship between the amount of CO<sub>2</sub> sequestered**

<b>Relative Equation</b>	<b>R<sup>2</sup></b>	<b>P</b>
$\ln(\text{CO}_2 \text{ stem}) = 8.3472489 + 1.3252205 * \ln(\text{DBH})$	0.916	< 0.05
$\ln(\text{CO}_2 \text{ stem}) = -3.333994 + 2.5263893 * \ln(\text{DBH})$	0.621	< 0.05
$\ln(\text{CO}_2 \text{ stem}) = 3.9733343 + 0.9055904 * \ln(\text{DBH})$	0.010	> 0.05

**Carbon Dioxide Sequestration Capacity of Tampilisan Forest.** The carbon dioxide (CO<sub>2</sub>) sequestration capacity of each of the forest trees in the reservation of JRMSU – Tampilisan campus is shown in Table 6. Among the trees, Rubber had sequestered the highest amount of CO<sub>2</sub> at 56.41 kT, followed by the natural forest trees, then Mahogany, Mangium and Gmelina at 27.91, 1.87, 1.51 and 0.47 kT, respectively. A total of 88.17 kT was observed to be the CO<sub>2</sub> sequestration capacity of the forest stand in the reservation area of JRMSU – Tampilisan campus. The variation in the amount of CO<sub>2</sub> sequestered and stored in the species within the forest stand was affected greatly by the stand density of trees of their total population and the area planted to these trees, aside from other their biomass. The wider the area occupied by Rubber, compared to Mangium, Mahogany and Gmelina which covered only 10, 20, and 10 hectares, respectively. Whereas, the natural forest trees were about 200 hectares.

**Table 6. CO<sub>2</sub> sequestration capacity of the forest stand JRMSU – Tampilisan Campus reservation.**

<b>Species</b>	<b>CO<sub>2</sub> Density (kT)</b>
Mohogany ( <i>Swietenia macrophylla</i> )	1.87
Gmelina ( <i>Gmelina arborea</i> )	0.47
Mangium ( <i>Acacia mangium</i> )	1.51
Rubber ( <i>Hevea brasillensis</i> )	56.41
Natural Forest Trees	27.91
<b>Total</b>	<b>88.17</b>

## **Discussion**

The data showed that the biomass and carbon density varies among tree species sampled when trees were at sapling stage, but as trees grew bigger and reached the pole and standard sizes, no more significant variation exist in terms of their carbon sequestration capacity. This implies that the four species of trees being considered have statistically comparable CO<sub>2</sub> sequestration capacity. The parameters considered as wood density, merchantable height, total height, and trunk or stem diameter may have interplayed, giving additional or compensatory effects. The lower wood density values may be compensated for by greater height and trunk diameter, vice versa. This can be further explained by the fact the Gmelina and Mangium numerically showed to have the higher amount of carbon sequestered at older stages compared to Rubber which



performed the best at sapling stage. The work of Huy et al. (2008) however, revealed that biomass and carbon density varies among tree species. This study may have been using a large number of sample trees with significantly varied morphological characteristics. We might also have observed this had we only have enough samples of the native tree species to be included in our analysis.

The carbon density values for Mahogany and Gmelina obtained from this experiment were comparable to that reported by Sales et al. (2005) who studied the carbon density values at various ages of these tree species in the Philippines.

Furthermore, CO<sub>2</sub> sequestration and storage were dependent on the amount of biomass of trees, specifically, on the variables trunk diameter and total height. This conforms to the findings of Terakunpisut et al. (2007) who mentioned that carbon sequestration potential in the different forest types tends to be correlated to DBH and tree height. Moreover, the wood density did not much differ from the four species considered so that it did not have a notable effective at removing carbon dioxide from the air, thus, it is considered as one of the variables in computing for carbon density.

The value 88.17 kT as the total CO<sub>2</sub> sequestration capacity of the forest stand in JRMSU – Tampilisan campus reservation area is sufficient enough to contribute to the mitigation of climate change. Nased from the findings of Denman et al. (2007) and as cited by Lasco (2009) it is estimated that about 60 Gt C is exchanged between terrestrial ecosystems and at atmosphere every year. Maintenance and expansion of this carbon sink in our area may even showcase for the adaptation of the smallholders to climate change.

### **Conclusions and Implications**

Based from this study, it is revealed that regardless of age, the bigger trees, particularly at their standard sizes, sequestered the greatest amount of CO<sub>2</sub>. Provide that the trees are allowed to grow and were not cut for any purpose at all, they continue to provide the safety net for the adverse effects of climate change. The significant amount of carbon sequestered at the Tampilisan campus of the University (with an area of 790 hectares) shows the potential and significant CO<sub>2</sub> sequestration by trees. If all the other agricultural state universities in the country were to dedicate a thousand hectares for this purpose e.g. Central Mindanao University, Central Luzon State University and others, then developing these areas can greatly increase the amount of CO<sub>2</sub> sequestered from the atmosphere. As it was noted, the sequestration capacity increases as the size of forest stand gets bigger. Any of the four species of trees (Rubber, Gmelina, Mahogany, Mangium) can be used in the reforestation program to help mitigate global warming, since it was also found out that there was no significant difference in terms of the rate of CO<sub>2</sub> sequestration capacity as these trees becomes mature.

### **Acknowledgement**

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**References**

Banaticla, R.N., Sales, R.F. and Lasco, R.D. (2004). Biomass equation for tropical tree plantation species using secondary data from the Philippines, a paper submitted for the ACIAR End of the project Workshop held in Ormoc City, Philippines.

Cacho, O.J., Hean, R.L., and Wise, R.M. Cacho, O., Hean, R., Ginoga, K., Wise, R., Djaenudin, D., Lugina, M., Wulan, Y., Subarudi, B., van Noordwijk, M. And Khasanah, N. (2008). Economic potential of land – used change and forestry for carbon sequestration and poverty reduction. ACIAR technical reports No. 68, 98 pp.

Devlin, R. (1981). Plant Physiology, 3<sup>rd</sup> ed., Litton educational Publishing, inc., New York, N.Y.

Huy, b. And Anh, T.A. (2008). Estimating CO<sub>2</sub> sequestration in natural broad- leaved evergreen forest in Vietnam, Asia – pacific Agroforestry newsletter, 7 – 10. Intergovernmental Panel on climate Change (1996). Revise Guidelines for GHG Inventory, Land Use and Forestry, sector, IPCC, London.

Lasco, R.D., Sales, J.S., Arnuevo, m.T., Guillermo, I.Q., de Jesus, A.C., Medrano, R., Bajar, O.F., and Mendoza, C.V. (2002), Carbon Dioxide (CO<sub>2</sub>) storage and sequestered of land cover in the Leyte Geothermal reservation, Renewable Energy, (25): 307 -315.

Lasco, R.D., Sales, R.F., Estrella, R., Saplaco, S.R., Castillo, A.S.A., Cruz, RV. O. And Pulhin, F.B. (2001) Carbon stock assessment of multistory agroforestry systems in a tropical forest reserve in the Philippines, The Philippines Agricultural Scientist, 84(4): pp. 401 – 407.

Philip, M.S. (1994). Measuring Trees and Forests, 2<sup>nd</sup> ed., CABI Publishing, Wallingford.  
Sales, R.D. and Banaticla, R.N. (2005). Carbon storage and sequestration potential of small holder tree farms on Leyte Island, ACAIR Smallholder Forestry Project, Philippines.

Taylor, R. (2008). Farm Forests as Carbon Sinks, Partners in Research for Development, Australian Center for International Agricultural Research (ACIAR), Coretext Pty Ltd., Canberra, Australia, 16 – 18.

Terakunpisut, J. Gaajaseni, N. And Ruankawe N. (2007). Carbon sequestration potential in aboveground biomass of Thong Pha Phum National Forest, Thailand. Applied Ecology and Environmental Research. 5(2): 93 – 102.

Trexler, M.C., and Haugen, C. (1994). Keeping it Green: Evaluating Tropical Forestry Strategies to Mitigate Global Warming, World Resources, University of the Philippines, Los Baños, College, Laguna.





## **STATUS OF JOSE RIZAL MEMORIAL STATE COLLEGE: BASIS FOR A UNIVERSITY PROPOSAL**

**Joseph Salvel R. Campiseño**  
Director, Linkages & Networking,  
JRMSC-Main Campus, Dapitan City, Philippines

### **Abstract**

*The study determines the status of Jose Rizal Memorial State College (JRMSC) as an institution of higher learning and the viability for the conversion of the college into a state university. The study revealed that generally, faculties are much competent in the performance of their functions. It favors and supports for the advantage of its clients – the students. There is exemplary leadership and management by the school leaders. The VGMO of the college is very relevant with its legal and educational development mandate and the thrust of the government. Curriculum and Instructional design are effective in the development of students to achieve holistic development. Researches conducted are focused on the institutions' research priority areas for development. The E-library and Library holdings are adequate for faculty and students use. There is adequate equipment in the institution for the faculty and students to use in the classroom. The laboratories are equipped adequately with computers, supplies and materials ready for use. Physical plant and facilities is adequate. This means that the College can accommodate the expected increase of enrolment and is prepared for future expansion.*

*Keywords: chartered colleges, universities, elevation to*

### **Introduction**

Since the establishment of the institution of higher education in the Philippines three centuries and seven decades ago, the demand for higher education has continued to increase. Enrolment has likewise been consistently on the rise owing to the natural growth of our population and increasing number of secondary graduates flowing into tertiary level institutions. The higher education enrolment in our colleges and universities for AY 2000-2001 has an aggregate of 2,399,268 (Higher Education 4<sup>th</sup> National Congress 2001).

Statistics also show that there has been increasing number of higher education institutions (HEIs). As of 2004, there are 1,710 private colleges and universities in the Philippines, in contrast to only 112 state universities and colleges (SUCs). There are 76 state colleges and 36 state universities. The public HEIs include 37 Local, CHED Supervised and Special Higher Education Institutions (Higher Education National Congress 2004).

The study on higher education, in which FAPE participated, shows the overwhelming economic orientation of the college students. Presently, the regional share in tertiary student enrollments is increasing; CHED Region IX reported a total enrollment of 77, 046 college students in the region. (Peace Works Vol. IV No 6 Special Issue: PASUC Gen. Assembly 2005)



A quick review reveals an uneven distribution of our state colleges and universities among the regions and provinces. In the Central Visayas region, for instance, there are only three state colleges and one university. In Western Visayas, three of the eight state colleges and universities are located in Iloilo. Northern Mindanao has five SUCs and two in CARAGA. In contrast, the National Capital Region (NCR) has eight state colleges and universities, not to mention that it is also the place where private institutions proliferate. The favored regions are; Region III (Central Luzon) which has ten, Region IV has thirteen and Region VIII, also has eleven. Region IX has six state colleges and only one university, the Western Mindanao State University in Zamboanga City.

There is a need for the government to spread increasingly institutions of higher learning all over the country. This undoubtedly reflects the fervent hope of parents and children that their dreams of economic security and social mobility would be realized.

These are the primary considerations of the writers in conducting this study. Certainly, the conversion of Jose Rizal Memorial State College into a State University fosters excellence in higher education in this part of Mindanao.

### **Conceptual Framework**

The Philippine experience in quality assurance, termed as “accreditation” provides the specific concept of the study. The government through the Presidential Commission on Educational Reform (PCER 2000) mandated the Commission on Higher Education (CHED) to take a stronger hand in the accreditation process and consider shifting from pure voluntary to prescribed accreditation for quality assurance, as it specifically required the provision of incentives.

By virtue of CHED Memorandum Order (CMO) number 48, Series of 1996 no college may be converted to a university or the corporate life of an existing university renewed after it has lapsed according to law, unless its undergraduate degree programs in liberal arts, in commerce, and in education where offered are accredited. The criteria which an institution (HEI), seeking an enhance status to the title of a university are to meet must have a level III accreditation for at least four (4) of its undergraduate programs, one (1) of which must be in the Arts and one (1) in the Sciences, and two (2) of its graduate programs.

The rise of Accrediting Agencies prompted The Philippine Association of State Universities and Colleges (PASUC) to sponsor the creation of the Accrediting Agency of Chartered Colleges and Universities (AACCUP). The ten (10) areas of AACCUP accreditation are considered by the researchers as criteria for determining the level of readiness of the conversion of JRMSC into a University, namely: (1) Vision, Mission, Goals and Objectives; (2) Faculty; (3) Curriculum and Instruction; (4) Support to Students; (5) Research; (6) Extension and Community Involvement; (7) Library; (8) Physical Plant and Facilities (9) Laboratories and (10) Administration.

Commission on Higher Education Requirements for a University Status



By virtue of CHED Memorandum Order (CMO) number 48, Series of 1996 the following are the updated standards and guidelines for the grant and /or retention of university status vis-à-vis Higher Education Institutions (HEI s). The HEI operates, among others, recognized and / or authorized tertiary level degree programs or course of studies;

- In addition, a minimum of three (3) other active and duly recognized professional courses ( a professional course in one which requires a special study towards a specific competence and a license to practice) ; and
- At least two (2) graduate-level courses leading to doctorate degrees.
- The HEI must have a level 111 accreditation (or the commission’s equivalent) for at least four (4) of its undergraduate programs
- The HEI must exhibit a continuing quest for excellence and a commitment to reasonably high standards of instruction through the quality of its education programs, outstanding achievements of its students, and excellent performance of its graduates particularly In government examinations.
- The HEI must demonstrate a track record of not less than three (3) years in attaining high research standards as evidenced by a dynamic research program manned by qualified and competent faculty members and supported by an adequate budgetary allocation. The result of these researches must have been published in preferred journals.
- The HEI must have a creditable community extension program which may take the form of continuing education, application of research results, community service and the like. Reports of these activities should be made readily available.
- The HEI faculty must be able to comply with the following initial conditions, to wit:
  - At least 50% of its faculty in the Arts and Sciences must be full-time;
  - Of its total faculty at least 20% must be doctoral degree holders in their respective areas of specialization, half of whom are on full-time, and at least 35% must be masters degree holders in their respective areas of specialization, at least 70% of whom are full- time;
  - There must be a provision to recognize the specialized skills of its faculty who are nationally and / or internationally renowned;
- The HEI must own its institutional site which should be at least five (5) hectares, at least three (3) of which are contiguous to the main campus. Its buildings should be made of permanent materials constructed in accordance with existing laws, rules and regulations.



- The library and laboratory facilities and equipment of the HEI must conform to the standard set by the commission. In addition and as far as possible, the HEI should also provide its students with access to other library resources and database through the Internet and other information technology facilities including CD – ROM devices.

## **Research Methodology**

The descriptive and normative methods were used utilizing official records and other documentary materials of Jose Rizal Memorial State College five years back (2000 – 2005) as the primary source of data. Data indicating the College status in the past and of the present were to be determined.

The researcher employed the normative survey method with the use of the Master Survey Instrument for the Accreditation of Programs of the Accrediting Agency of Chartered Colleges and Universities in the Philippines (AACUP) as the data gathering tool.

The respondents of the study were the campus administrators of the four campuses of Jose Rizal Memorial State College and all the two hundred ninety seven faculty members (297) of the JRMSC system. This is inclusive of the local AACUP Accreditation Task Force in each campus, who was trained in the completion of the AACUP instrument for program accreditation.

The researchers utilized observations, interviews, questionnaires and documentary analysis of available documents as sources of data of this study.

A frequency count, percentage computation and ranking were used to determine the profile of enrollment, curricular offerings and faculty members

## **Results and Discussion**

The level of readiness of Jose Rizal Memorial State College in her conversion into a university:

Vision, Mission, Goals and Objectives of the institution were found to be in accordance with its legal mandate and the thrust of the government, having a weighted mean of 3.71 described as much relevant. Base on the predictors, this implies that Jose Rizal Memorial State College was found to have already strengthened her Mission, Goals, and Objectives. The formulated mission, vision, goals and objectives expressed the philosophy and training that should pervade its operation. The Vision of the college clearly states what the institution hopes to become in the future. The Mission is in consonance to the mandate (RA 8193) of the whole state college. The Goals aims at the hierarchical structure below the state college, i.e. the academic college/ department; and the Objectives aims at the level of the program, i.e., what the program hopes to produce.

Aside from the State College mission statement, the different Departments or programs have defined their mission, goals and objectives. The mission covered the whole program. Goals and objectives are specific to each sub-program. The goals and objectives were defined within the



context of producing graduates equipped with competencies (both theoretical and technical/practical knowledge) required of the profession and geared towards educating students for careers as professionals who are employable locally and abroad.

The Faculty of JRMSC system was generally perceived as much competent with a weighted mean of 3.67 and highly qualified members in terms of academic qualification and professional performance. As of the first semester AY 2007 – 2008 the faculty profile of JRMSC system is as follows:

There were 49 or 16.90 percent Doctors of Education (Ed.D.), Doctors of Philosophy (Ph.D.), and Doctors of Public Administration (DPA); 51 or 17.59 percent Master's degree holder and were now pursuing in their doctoral degrees; 71 or 24.48 percent who were full- fledged M.A/ MS /MPA; 76 or 26.20 percent were Bachelors degree and were now taking units in the Masters degree. There are 43 or 14.82 percent who remain a Bachelors degree holder. Majority of the faculty, 230 or 77.44 percent were permanent and a few 11 or 3.70 percent were temporary. There were 56 or 18.86 percent who were part time instructors.

In totality, the curriculum and instruction content and design were perceived effective to enable the students to achieve intended learning outcomes, rated much relevant/ much ready with a weighted mean of 3.63. This is manifested in the result of the recent graduate tracer study conducted by the office of the Vice President for Research. It shows that curriculum and instruction is the topmost factor in the employability of graduates. Further, students' knowledge and skills were found to be highly relevant to the needs of industry in the 21<sup>st</sup> century.

The institution was found much competent in her support to the students, a weighted mean of 3.48. In support to the students, JRMSC strengthened the office of the students' affairs by designating a qualified dean who looks into the welfare of the students. A director for student organizations was designated with the student government adviser to assist the student officials in performing their functions at the same time monitor their activities geared towards the realization of the VGMO of the institution. In addition, the guidance office is also in full service to assist the school for students' holistic development. Students' consultation was made part of the faculty load where students may err their personal and school problems. Research has been institutionalized making it a part of faculty and students program for development; hence Wednesday is made a research day for both faculty and students to cope with the new trends and issues in education.

It was revealed that researches conducted by the institution were "much relevant" to the institutions research thrust & priorities geared towards the regional and national development agenda with a mean of 3.63. As of 2005 – 2007 the number of JRMSC's researches published in international, national, regional and local refereed publication is thirty one (31); Research outputs presented and disseminated in international, national, regional and local fora are twenty seven (27); Inventions utilized and commercialized (patent on application status) is four (4); and Research outputs cited by other researchers is six (6).

Extension and Community Involvement had a grand mean of 3.66 described as relevant. The indicators: priorities and relevance 3.84 "relevant"; planning, implementation, monitoring and evaluation 3.63 "relevant". In AY 2006 – 2007 JRMSC has 43 terminated extension programs



and services with more than 3,000 beneficiaries being served. This includes the two Gawad Kalinga community development programs with foreign funding of 3.8 million pesos excluding the LGU counterpart on the labor component. Community Extension program and Research were both rated outstanding in the latest 2007 DBM Agency Performance Review conducted by the regional office in Pagadian City.

The Library was found to be to cater to the needs of the faculty and students research activities. The indicators were: Library administration 3.39 adequate; Staff / Personnel 3.33 adequate; Collection, Development, Organization and Preservation 3.12; Services and Utilization 3.15 adequate; Physical Set –up and Facilities 3.35 adequate; and Financial Support 3.50 - adequate. The JRMSC library is one of the primary concerns of the administration. It has budget for operating expenditures, inclusive of salaries. The library fee of P200 per student per semester is spent solely for the growth and development of the library resources to support the institutions objectives. It has more or less 200 setting capacity with sufficient volumes of books. It is wired and connected to big national libraries in the country. It has established two E- libraries which could offset the needs of faculty and students in books for research.

Physical Plant - The Physical plant and facilities were “adequate” with a weighted mean of 3.36. The school is site big enough for future expansion. The main campus in Dapitan City is situated in a 7-hectare titled lot which is very conducive for learning. The Agricultural programs are offered in Katipunan and Tampilisan campuses with 116 hectares and more than 2,000 hectares of land respectively, very much adequate for the program. Buildings were made of permanent materials and constructed in accordance with existing rules and regulations. It provided adequate space and facilities for faculty and students use e.g. faculty room, function hall & students’ center, Let review center, students’ lounge, audio visual room, accreditation rooms, shops, showrooms etc.

The result shows that laboratories were generally “adequate” with a mean of 3.27. These laboratories includes: Natural Sciences laboratory, Mini - hospital for Nursing and Allied health courses, Speech laboratory, Computer laboratories, Criminology laboratory, and Laboratory for all Engineering courses.

All respondents were consistent in their perceptions that the administration was much competent / much ready with a grand mean of 3.62. JRMSC is fortunate to have a very supportive governing Board of Trustees, who formulates policies for the betterment of the institution; a well- established and well - defined organizational structure spearheaded by the qualified president, who runs JRMSC guided by the BOT approved College Code. The campus administrators and deans of departments are all academically qualified. The State College utilizes the income for part- time instructors to cope with faculty requirements; each curricular program is provided with the corresponding competent and qualified faculty to promote effective instruction.

### **Recommendations**

1. Encourage the non- tenured faculty to upgrade their educational qualifications in order for them to meet the entry qualification for a permanent status.
2. Offer more opportunities and privileges for the students to shape a brighter future.



3. The administration must build more strength towards one vision and common goals to serve as engine of the institution in the attainment of its VGMO.
4. Develop the other attributes of values desired to be acquired by the graduates of the program that would enable them to compete for employment, locally and abroad.
5. Design a curriculum that gears towards the pursuit of the mission of the institution and the attainment of the course objectives.
6. Collaborate with other SUCs online library through the internet. Motivate the faculty and students to utilize the references in the E-Library for research.
7. Collaborate with other agencies to avail equipment needed for instruction and research.
8. Apply cost saving measures for the acquisition of additional facilities. Seek donations from organizations like alumni and PTECA.
9. Synergize the JRMSC campuses by unifying effort towards centralized developments in all areas evaluated. Employ the “BIG Brother Principle” by helping those who are weak.

#### Development Strategies and Course of Actions

- Prepare university activities and schedules for the proposed conversion;
- Request approval of the budgetary allocation;
- Prepare the required documents for submission to CHED and the Technical Committee on Education in congress;
- Prepare a university bill, submit to the first district Legislator for submission in Congress;
- Seek the support of other Congressmen as co-authors of the bill;
- Follow-up the bill in the committee on technical education in congress;
- Keep track the university activities and schedule.



**References:**

**Books**

Covey, Stephen R. Principle-Centered Leadership. New York: Simon & Schuster, Inc., 1992

Franco, Ernesto A. ed. Educational Planning. Manila: National Bookstore, Inc., 1994

Grieco, Peter Jr. L. Total Quality Management Just In Time. Malaysia: S. Abdul Majeed & Company, 1995

Stoner, James A.F., Freeman, Edward R., Gilbert, D. R. Management, Prentice Hall Inc. Upper Saddle River, New Jersey. 2002

Pearce II, John and Robinson Jr., Richard. Strategic Management. Boston:

Richard D. Erwin, Inc., 1991

Sojor, Henry A., T. Valentino S. and Olis, Bernadette. Thesis/Dissertation Writing: A Guide. ISBN No. 971-93043-14-0, Copyright@2003.

Sterns, Harry L., Community Relations and the Public Schools. Englewood, New Jersey: Prentice Hall, Inc 1992

The New Webster English Dictionary of the English Language. International Edition, New York: Lexicon Publications, Inc. 1996

**Journals**

Padua, Roberto N. International Higher Education Quality Assurance Practices: Situating the Philippine System. Journal of Philippine Higher Education. Vol. 1, No. 1, 2003. ISSN-1655-8545

Preddy, J. et al. "ADB-PPTA on Normative Financing". (A Technical Report Submitted to CHED, 2002)

ENCARTA ENCYCLOPEDIA MUTIMEDIA LIBRARY 2005.

**Internet Sources/URL**

[http://www.google.com/search?q=cache:ofbRcY5jascJ:www.mdaszko.comtheoryoftransformat ion\\_final\\_to\\_short\\_article\\_apr05.pdf+transformation+theory&hl=en](http://www.google.com/search?q=cache:ofbRcY5jascJ:www.mdaszko.comtheoryoftransformat ion_final_to_short_article_apr05.pdf+transformation+theory&hl=en)





## **JOB PORTAL FOR DON MARIANO MARCOS MEMORIAL STATE UNIVERSITY**

**Kathrina Sison Tambot**

Don Mariano Marcos Memorial State University, ICS,  
Agoo, La Union, Philippines

### **Abstract**

*The study aimed to develop a Job Portal for Don Mariano Marcos Memorial State University that used the descriptive research method. Data gathering techniques used were 1) Interview with 21 respondents (DMMMSU Job placement services in-charge, students, alumni); 2) Analysis and review of existing job portals; and 3) Document analysis of job-related documents such as resumes. Findings were known that for every job portal users, relevant information needs to be included in the job portal. For job seekers, information were categorized according to account details, resume and cover letter details. For employers, information were categorized according to account details, company details and job posting details. For moderator, information for account details only. Findings on the features included in the job portal were categorized according to the features that can be accessed by job seekers and employers. Findings on the moderation measures implemented include those that will need approval from the moderator. All relevant information requirements should be considered since these serve as the foundation of the job portal. The features included were centered on job searching and job postings by job seekers and employers respectively. The moderation measures do away with unauthorized use of the restricted features of the job portal.*

**Keywords:** job advertisement, job hunting, job portal, job postings, job search, content management system, web-based system

### **Introduction**

Finding a job is what everyone attempts to do to earn a living. From local to national newspapers, job seekers look around the classified ads for job vacancies and try to apply. They give out their resume hoping for a positive response from a certain company. These are just some of the traditional ways of finding a job.

According to Dewar (2008), more and more businesses are recruiting their employees through agencies. Agencies are a valuable asset to any company looking for the best candidates for vacant positions.

In recruitment agencies, a job seeker visits a local branch for a short interview and an assessment before being placed on the agency's list of candidates. Recruitment consultants then work to match their list of candidates to their clients' open positions. Suitable candidates are short-listed and put forward for an interview with potential employers on a temporary or permanent basis.



A job fair is another traditional job hunting process. It is commonly known as a career fair or career exposition. It is a fair or exposition for employers, recruiters and schools to meet with prospective job seekers. Expositions usually include company or organization booths where resumes can be collected and business cards can be exchanged.

Jolly (2009) mentioned in Job Fair Techniques that on the down side, it is often a zoo, particularly at larger job fairs, with hundreds or even thousands of others competing with you for a few minutes with a company representative. It is often very noisy, very distracting, and almost impossible to make a good lasting impression.

Aside from recruitment agencies, job fairs, and going straight to the job employer to submit resumes, are other traditional job hunting processes available and difficulties in these sorts of practices are not far behind. One of these difficulties is that, bulk of resumes of job seekers is being stocked.

In a study on job searching, Dixon (2003) mentioned that individuals looking for jobs have become part of a larger information superstructure which they may or may not be aware of.

In traditional job hunting processes, another difficulty is distance. A job seeker needs to go from one place to another to look for job vacancies. But, because of the advances in technology, distance is no longer a problem.

Technology is now sinking in our lives and beginning to reshape our standard way of living. From simple cellular phones to multimedia gadgets to super computers, that enables a person to make traditional processes become automated.

Advances in technology such as the World Wide Web, also known as the collection of huge information, is one of the media used by people nowadays to access information resources via the Internet. People save a lot of time and money and get an instant edge with only little effort in the comfort of home.

According to the Bureau of Labor and Statistics in the United States (2009), finding a job can take months of time and effort. But you can speed the process by using many methods to find job openings, and one of these methods is the Internet resources. The Internet includes many job hunting Web sites with job listings. Some job boards provide national listings of all kinds while others are local. To find good prospects, begin with an Internet search using keywords related to the prospective job.

Boyd (2009) said in his article that the Internet is a great resource to find jobs. People can find anything they want if they know how to look for it correctly. He emphasized that people will not get a job over the Internet because it is still up to them on how they would advertise themselves.

According to Galvan (2008), the advancement of the Internet has changed many of our lives. One particular area in which Internet is utilized is the access to the job market.



Dixon (2003) said that in a mere decade, job searching has evolved from primarily a paper and file-cabinet affair to an arena that is nearly completely digitized. Based on statistics by Boyce (2002) of Pew Internet and American Life Project, 52,000,000 Americans have looked online for information about jobs, and more than 4 million do so on a typical day. Overall, these figures represent a more than 60% jump in the number of online job hunters from March 2000. It is found then that 32 million had used the Internet to check out jobs. Moreover, there has been about a 33% hike in the daily traffic related to job searching. On a typical day in March 2000, about 3 million Internet users were searching for job information.

According to Nielsen (2005), there were over 202 million internet users as of December 2005 and 30% of the internet users in the U.S. regularly visited job related websites.

According to the National Statistics Office, Labor Force Survey, in the year 2008, a total of 1,317 unemployed persons looking for work by job search method here in the Philippines are divided accordingly: 586 or 44.50% seek help from employment agencies, 482 or 36.60% approached employers directly, 440 or 33.41% approached relatives/friends, 85 or 6.45% placed or answered advertisements and 18 or 1.37% falls to others.

Job portal is a website that facilitates online job hunting. It gives support to job seekers allowing them to post personal information and work experiences relevant to their application and make them noticed by different employers. It also gives the employers the chance to have their job vacancies posted for job seekers to see.

The traditional job hunting process involves strategies such as looking in the classified ads, searching through bulletin boards, going to employment agencies, and applying for jobs in the personnel office of companies. All these traditional methods involve a person reacting to a job that has already been publicly offered. Unlike in job portals, you can look for a job advertised in the comfort of home with the use of the Internet.

Boswell (2009) talked about how job seekers can narrow their search by location, keywords, and employers in using job portals, plus, the extra features of it such as networking boards, job search alerts, and online resume posting.

Based on an article entitled Active Versus Traditional Job Search Methods (2009), only less than 30% of job seekers find jobs when they apply for a job in a traditional manner, while more than 70% of job seekers who use the Internet find jobs. When it comes to looking for the perfect job, the World Wide Web is the easiest resource to use because of its accessibility and massive options of job postings.

Jobstreet, JobsDB and Trabaho are some of the job portals available in the World Wide Web that provide easy-to-use interface in seeking for a job. Jobstreet, JobsDB and Trabaho are web sites that offer features that are related to job hunting, such as viewing of job ads, searching for job vacancies, resume writing and posting, career guides and the like. These web sites are open to all people, allowing them to view job ads and vacancies. For people who are registered to their web site, they have username and password giving them full-access to all the features of the web site such as the resume posting.



Designing the Job Portal for DMMMSU shall serve as a tool for job seekers in making their job search effective and for employers to have list of possible applicants for their vacant positions. The job portal can be accessed by both job seekers and employers to view necessary information. For job seekers, they can easily update their information relevant to their application. On the other hand, a moderator will be the authorized person who could periodically update information about job vacancies submitted by the employers.

Specifically, this study sought answers to the following questions:

1. What are the information requirements needed for the development of the Job Portal for DMMMSU?
2. What features are to be incorporated in the proposed Job Portal for DMMMSU?
3. What moderation measures are to be implemented in the Job Portal for DMMMSU?

## **Materials and Methods**

This study entitled “Job Portal for Don Mariano Marcos Memorial State University” was intended to design and develop a job portal for students and alumni of DMMMSU.

The Agile Web Engineering (AWE) Process Life-Cycle was used in the design and development of the system. AWE is an iterative and incremental process that has been developed to deal with the problems associated with the development of web-based applications and make it easy to identify the criteria that will be used to select what problems are to be addressed first. The benefit of this kind of process is that lessons learned from the previous iterations will be applied in the succeeding phases.

The AWE identifies all the major stages that need to be addressed during Web application development that includes business analysis, requirements, design, implementation, testing and evaluation.

In the development of the system, the Unified Modeling Language (UML) was used as a guide in creating a well-built web application. Joomla was used to develop the system.

Interviews with appropriate respondents, analysis and reviews of existing job portals and analysis of job related documents were done by the researcher to determine the suitable requirements needed to design and develop the Job Portal for DMMMSU.

## **Results**

Based on the research problems, the following were the findings of this study:

1. The information requirements needed for the development of the Job Portal for DMMMSU are as follows:

For the Job Seekers. It is summarized mainly on the: a) account details that includes the name, username, password and a valid e-mail address; b) resume details that is categorized according to personal information, education, employer history, skills, reference; and c) cover letter details that includes a title and description.

For the Employers. It is summarized mainly on the: a) account details that includes the name, username, password and a valid e-mail address; b) company details that includes the company



name, category, contact name, contact details and description; and c) job posting details that consists mainly of the job title, company, category, job type, salary range, work hours, highest education attained, number of available jobs for a particular job posting, years of experience needed, description, qualifications and preferred skills of potential applicants.

For the Moderator. It consists of the username, password and a valid e-mail address.

2. The features incorporated in the Job Portal for DMMMSU are as follows:

For the Job Seekers. a) online registration; b) control panel; c) searching and viewing of job postings; d) creating, updating and viewing of resumes and cover letters; e) online application to job postings; f) viewing of applied jobs; g) updating of account details; h) posting of topics via forum; i) sending of private messages to moderator; j) retrieval of forgotten username and/or password; k) viewing of articles; and l) links to other job portals.

For the Employers. a) control panel; b) creating, updating and viewing of company and job posting details; c) viewing of resumes and cover letters of applicants; d) updating of account details; e) posting of topics via forum; f) sending of private messages to moderator; g) retrieval of forgotten username and/or password; and h) viewing of articles; and i) links to other job portals.

3. The moderation measures implemented in the Job Portal for DMMMSU are as follows: a) CAPTCHA; b) job seeker account approval; c) giving of employer account; d) new company approval; e) job posting approval; f) updated company and job posting approval; g) posting of announcements; and h) posting of articles.

## **Discussion**

1. Job seekers' and employers' relevant information requirements need to be given emphasis since these serve as the foundation of the Job Portal for DMMMSU.
2. The features incorporated in the Job Portal for DMMMSU is centered on the job hunting of job seekers and job advertising of employers. Addition to this, security of the job portal system is also implemented by means of a login account. Other extra features such as posting of announcements and articles related to job hunting are also helpful to both job seekers and employers giving them essential facts. Links to other existing job portals is also a useful tool in helping job seekers find job vacancies.
3. The moderation measures implemented in the Job Portal for DMMMSU do away with unauthorized use of the restricted features of the job portal system which can only be done by the moderator.



## **References:**

### **Books**

Conallen, J. (2003). Building Web Applications with UML. Pearson Education, Inc.

Firth, R. (2005). High Powered CVs. How to Books Publishing.

Maier, M. & Rechtin, E. (2000). The Art of Systems Architecting 2<sup>nd</sup> Edition. CRC Press.

Schmuller, J. (2004). Sams Teach Yourself UML in 24 Hours, Third Edition. Sams Publishing.

### **Articles/Journals**

Boyce, A. (2002). Online Job Hunting: A Pew Internet Project Data Memo. Pew Internet and American Life Project. Published: July 17, 2002.

Dewar, J. (2008). Using an Employment Agency to Best Effect. Success @ Work. Published: January 2008.

Dorn, J. & Naz, T. (2007). Meta-Search in Human Resource Management. International Journal of Social Sciences.

Kuhn, P. & Skuterud, M. (2000). Job Search Methods: Internet versus Traditional. Monthly Labor Review. Published: October 2000.

### **Electronic Articles/Journals**

Boswell, W. The Top Ten Job Search Engines on the Web. Retrieved on July 26, 2009 from <http://websearch.about.com/od/enginesanddirectories/tp/jobsearchengine.htm>.

Boyd, S. Finding Jobs on the Internet. Retrieved on July 27, 2009 from [www.jobseekersadvice.com/job\\_seeker/articles/finding\\_jobs\\_on\\_the\\_internet.htm](http://www.jobseekersadvice.com/job_seeker/articles/finding_jobs_on_the_internet.htm).

Jolly, P. Job Fair Techniques. Retrieved on July 26, 2009 from <http://www.countyofnapa.org/Pages/Search.aspx?keywords=job%20fairs>.

Murphy, M. Recharge Your Resume: Review, Revise, Revive. Retrieved on July 26, 2009 from [http://www.jacobson-associates.com/uploadfiles/Recharge %20your%20resume-revise,%20revise,%20revise.pdf](http://www.jacobson-associates.com/uploadfiles/Recharge%20your%20resume-revise,%20revise,%20revise.pdf).

### **Unpublished Materials**

Dilan, R. (2008). Job Portal: Online Recruitment System. [Project Study]. University of the Cordilleras, Baguio City.

Dixon, P. (2003). Job Searching in the Networked Environment: Consumer Privacy Benchmarks. 2003 Job Search Privacy Study.

Galvan, M. (2008). Online Job Portal of the University of Luzon. [Project Study]. University of the Cordilleras, Baguio City.



McDonald, A. & Welland, R. (2001). Agile Web Engineering (AWE) Process. University of Glasgow, Glasgow, Scotland.

Internet Recruiting Power: Opportunities and Effectiveness

**Web Sites**

<http://www.bestjobs.ph>

<http://www.gopinoy.com>

<http://www.jobsdb.com.ph>

<http://www.jobsonline.com.ph>

<http://www.jobstreet.com.ph>

<http://www.phil-job.net>

<http://www.workabroad.ph>

<http://www.kckcc.edu/services/studentServices/careerPlanningAndPlacement/generalInformation/activeVsTraditionalJobSearchMethods.aspx>

<http://www.bls.gov/oco/oco20042.htm>

<http://www.bles.dole.gov.ph/2009%20Publications/2009%20Yearbook%20of%20Labor%20Statistics/statistical%20tables/Chapter%2005/Tab5-3.pdf>



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## **PREDICTION OF INTERSPECIES RELATIONSHIP AND ANTIGENICITY OF SEGMENT 1 PROTEIN OF INFLUENZA A VIRUS FROM INDIA.**

**Gaikwad Vishnu J., Bhosale S. S., Patel S. S., Kadam D.S., Dodamani G. O.**

Dept. of Biotechnology Engineering,  
Tatyasaheb Kore Institute of Engineering and Technology, Warananagar,  
Dist- Kolhapur, MS, INDIA-416113.  
Email: vishnu.gaikwad@gmail.com

### **Abstract:**

*The ancestral information related to h1n1 swine flu segment 1 from India has the similarity with the h1n1 segment 1 from Chile.*

*The ambition of this research work includes analyzing the gene sequence of segment 1 from H1N1 (INDIA), to find out interspecific relationship between them by using advanced tools and techniques, for prediction of vaccine candidate we have predicted hydrophilic, antigenic peptides and plots.*

*The nucleic acid sequence of H1N1 segment 1 has 2282 base-pairs. By using Bio-Edit we have predicted the sequence similarity interspecifically in between 20 species for evaluating the relationship between them, also calculated the entropy of the segment1.*

*Predicted sites are 21- VDHMAIK-32, 88- RVMISPLAV-96, 105-VTSTVHYPKIYKTYFEKVER-124, 129- TFGPVHFRNQVKI-141, 158- EAQDVIMEVVFPN-170. These are the antigenic sequences from which in future we can design a drug or vaccine against it.*

**Keywords:** h1n1 swine flu segment 1, interspecies relationship, antigenic sequences

### **Introduction**

**Swine influenza virus (SIV)** is any strain of the influenza family of viruses that is endemic in pigs (Eccles, R (2005)). As of 2009, the known SIV strains include influenza C and the subtypes of influenza A known as H1N1, H1N2, H3N1, H3N2, and H2N3. Influenza viruses belong to the family of Orthomyxoviridae; viruses with segmented RNA genomes that are negative sense and single-stranded (Baltimore 1971). Influenza remains an important cause of morbidity and death in Man, principally because of the ability of the surface haemagglutinin to undergo extensive antigenic variation (Stuart-Harris, C. (1979)).

A comparative sequence analysis of series of antigenically drifted strains of the H3 haemagglutinin subtype (G.W., Sleight, et al., (1983)) clearly shows that variation occurs by the gradual accumulation of point mutations causing single amino acid substitutions. It appears that these cluster in 4 antigenic sites on the surface of the globular head of the haemagglutinin (Wiley, D.C., et al., (1981), Webster, R.G., Laver, et al., (1982)) but amino acid substitutions are by no means confined solely to these relatively discrete sites.

#### **Influenza A**

Swine influenza is known to be caused by influenza A subtypes H1N1 (Villegas, P (1998)), H1N2 (Villegas, P (1998)), H2N3 (Horwood F, Macfarlane J (2002)), H3N1 (Kawaoka Y





(2006)), and H3N2(Villegas, P (1998)). In pigs, three influenza A virus subtypes (H1N1, H1N2, and H3N2) are the most common strains worldwide (Vainionpää R, Hyypiä T (April 1994)). In the United States, the H1N1 subtype was exclusively prevalent among swine populations before 1998; however, since late August 1998, H3N2 subtypes have been isolated from pigs. As of 2004, H3N2 virus isolates in US swine and turkey stocks were triple reassortants, containing genes from human (HA, NA, and PB1), swine (NS, NP, and M), and avian (PB2 and PA) lineages (Hall CB (June 2001)).

### **Surveillance**

Although there is no formal national surveillance system in the United States to determine what viruses are circulating in pigs (Klenk et al. (2008)), there is an informal surveillance network in the United States that is part of a world surveillance network.

Swine flu has been reported numerous times as a zoonosis in humans, usually with limited distribution, rarely with a widespread distribution. Outbreaks in swine are common and cause significant economic losses in industry, primarily by causing stunting and extended time to market. For example, this disease costs the British meat industry about £65 million every year (Taubenberger JK, Morens DM (2008)).

### **Transmission**

#### **Transmission between pigs**

Influenza is quite common in pigs, with about half of breeding pigs having been exposed to the virus in the US (Carrat F, et al., (2006)). Antibodies to the virus are also common in pigs in other countries ((Carrat F, et al., (2006))).

#### **Transmission to humans**

People who work with poultry and swine, especially people with intense exposures, are at increased risk of zoonotic infection with influenza virus endemic in these animals, and constitute a population of human hosts in which zoonosis and reassortment can co-occur(Hall CB ( 2007). Vaccination of these workers against influenza and surveillance for new influenza strains among this population may therefore be an important public health measure (Tellier R (November 2006)). Transmission of influenza from swine to humans who work with swine was documented in a small surveillance study performed in 2004 at the University of Iowa (Brankston G, et al., (2007)). This study among others forms the basis of a recommendation that people whose jobs involve handling poultry and swine be the focus of increased public health surveillance (Hall CB ( 2007). Other professions at particular risk of infection are veterinarians and meat processing workers, although the risk of infection for both of these groups is lower than that of farm workers (Cole E, Cook C (1998)).

#### **Vaccination**

Vaccines are available for different kinds of swine flu. Although the current trivalent influenza vaccine is unlikely to provide protection against the new 2009 H1N1 strain (MacIntyre CR, Cauchemez S, Dwyer DE, *et al.* (2009)), vaccines against the new strain are being developed and could be ready as early as November 2009 (Bridges CB, Kuehnert MJ, Hall CB ( 2003)).



## **Treatment**

### **In humans**

The U.S. Centers for Disease Control and Prevention recommends the use of Tamiflu (oseltamivir) or Relenza (zanamivir) for the treatment and/or prevention of infection with swine influenza viruses; however, the majority of people infected with the virus make a full recovery without requiring medical attention or antiviral drugs (CCID, August 8, 2005). The virus isolates in the 2009 outbreak have been found resistant to amantadine and rimantadine (Bridges CB, Kuehnert MJ, Hall CB (2003)).

In the U.S., on April 27, 2009, the Food and Drug Administration (FDA) issued Emergency Use Authorizations to make available Relenza and Tamiflu antiviral drugs to treat the swine influenza virus in cases for which they are currently unapproved. The agency issued these EUAs to allow treatment of patients younger than the current approval allows and to allow the widespread distribution of the drugs, including by non-licensed volunteers (McDonnell G, Russell A (1999)).

The epidemic properties of individual virus strains are likely to result from a combination of factors affecting the different stages of virus replication. Nonetheless, it is widely accepted that structural changes in the haemagglutinin play a key role in the development of epidemics of influenza in man ((Stuart-Harris, C. (1979))).

The important relationship between influenza in pig and human populations is due to the relative ease of transmission of viruses between the two species and is rejected in the prevalent subtypes. Influenza A viruses of the H1N1 and H3N2 subtypes have co-circulated and caused outbreaks of

disease among pigs in Europe since the mid 1970s. The initial H3N2 viruses were antigenically related to contemporary human H3N2 viruses, such as Port Chalmers1}73 (Tumova *et al.*, 1980; Ottis *et al.*, 1982).

The ambition of this project includes analyzing the gene sequence of segment 1 from H1N1 (INDIA), to find out interspecific relationship between them by using advanced tools and techniques, for prediction of vaccine candidate we have predicted hydrophilic, antigenic peptides and plots.

## **Materials and Methods:**

### **Data Collection and Analysis:**

The sequence of Influenza A virus-segment 1 originated from India in 2009 (A/India/6263/1980(H1N1), gene index number is 133754167 by which we accessed it from National Centre for Biotechnology Information. This gene information we had applied for various software through which derives desired results.

We had translated this sequence from nucleic acid to amino acid and this sequence applied for modeling and antigenic fragments prediction as vaccine and or drug candidate.

### **Sequence analysis:**

The programme used in sequence analysis was BioEdit VERSION 7.0.0, Tom Hall, Ibis Therapeutics, a division of Isis Pharmaceuticals, Inc. BioEdit is a biological sequence editor that runs in Windows 95/98/NT/2000 and is intended to provide basic functions for protein and nucleic sequence editing, alignment, manipulation and analysis.

We have also predicted Entropy (Hx) plot from the BioEdit programme.



### **Prediction of Protein Secondary Structure**

The important concepts in secondary structure prediction are identified as: residue conformational propensities, sequence edge effects, moments of hydrophobicity, position of insertions and Deletions in aligned homologous sequence, moments of conservation, auto-correlation, residue ratios, secondary structure feedback effects, and filtering (Garnier, 1978; and Robson and Garnier, 1993).

The GOR method is based on information theory and was developed by J.Garnier, D.Osguthorpe and B.Robson (J.Mol.Biol. 120,97, 1978). The present version, GOR IV, uses all possible pair frequencies within a window of 17 amino acid residues and is reported by J. Garnier, J.F. Gibrat and B.Robson in *Methods in Enzymology*, vol 266, p 540-553 (1996). After cross validation on a data base of 267 proteins, the version IV of GOR has a mean accuracy of 64.4% for a three state prediction (Q3). The program gives two outputs, one eye-friendly giving the sequence and the predicted secondary structure in rows, H=helix, E=extended or beta strand and C=coil ;the second output gives the probability values for each secondary structure at each amino acid position. The predicted secondary structure is the one of highest probability compatible with a predicted helix segment of at least four residues and a predicted extended segment of at least two residues. This program was written by Jean-Francois Gibrat and was modified by Stephen Pheiffer in order to increase it's efficiency.

We have got the secondary structure information about alpha-helices, turns and coils by using GOR-IV.

### **Phylogenetic Analysis:**

Evolutionary relationship predictions are the most commonly used to derive ancestral relations amongst the species. We have predicted the relationship among 19 species with our H1N1 segment 1 from India.

### **Prediction of hydrophobicity:**

Hydrophobic interactions are the most important non-covalent forces that are responsible for different phenomena such as structure stabilization of proteins binding of enzymes to substrates and folding of proteins (Dill, 1990). This kind of interaction appears when non-polar compounds are put into water, and it is an entropy-driven process. The protein separation technique based on hydrophobic interactions, *Hydrophobic Interaction Chromatography* (HIC) is an important technique which exploits the reversible interaction between the hydrophobic patches on a protein's surface and the hydrophobic ligands of a chromatographic medium at moderately high concentrations of an antichaotropic salt.

A protein coming in contact with the hydrophobic ligands in the column suffers a spatial reorientation, and the hydrophobic ligands interact with the hydrophobic zones on the protein surface to reversibly bind the protein to the column (Mahn and Asenjo, 2005). HIC has been used for purifying a variety of biomolecules, such as membrane proteins (McNair and Kenny, 1979), nuclear proteins (Comings et al., 1979), receptors (Kuehn et al., 1980), recombinant proteins (Lienqueo et al., 2003) and serum proteins (Mahn, Andrea 2008).

These predicted surface sites or, in other words, the hydrophilic, accessible, or mobile regions were then correlated to the known antigenic sites from immunological studies and accessible sites determined by X-ray crystallographic data for several proteins (Parker JM, Guo D, Hodges RS. 1986). A semi-empirical method which makes use of physicochemical properties of amino acid residues and their frequencies of occurrence in experimentally known segmental epitopes was developed to predict antigenic determinants on proteins (Kolaskar AS, Tongaonkar PC. 1990).



### Prediction of Antigenic Fragments-Peptides:

Identification of epitopes on proteins would be useful for diagnostic purposes and also in the development of peptide vaccines (Schmidt, A.M. (1989)). To aid experimental workers, Hopp and Woods have developed a method for prediction of antigenic determinants (Hopp, T.P. and Woods, K.R. (1981)).

The approach of Hopp and Woods has been modified to take into account the fact that antigenic sites are on the surface of the protein and most surface residues are antigenic.

### Results and Discussion:

The nucleic acid sequence of H1N1 segment 1 has 2282 base-pairs. By using Bio-Edit we have predicted the sequence similarity interspecifically in between 20 species for evaluating the relationship between them, also calculated the entropy of the segment1. (Fig.1)

#### Alignment of 20 species by using BioEdit.

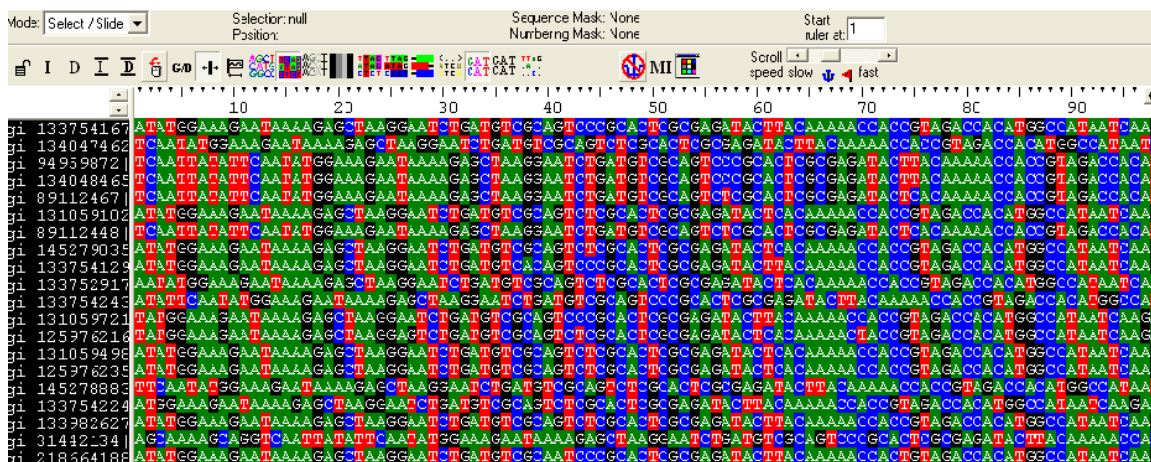


Fig.1: The figure shows the interspecies sequence alignment of 19 species with H1N1 segment 1 from INDIA.



**Phylogenetic Analysis:**

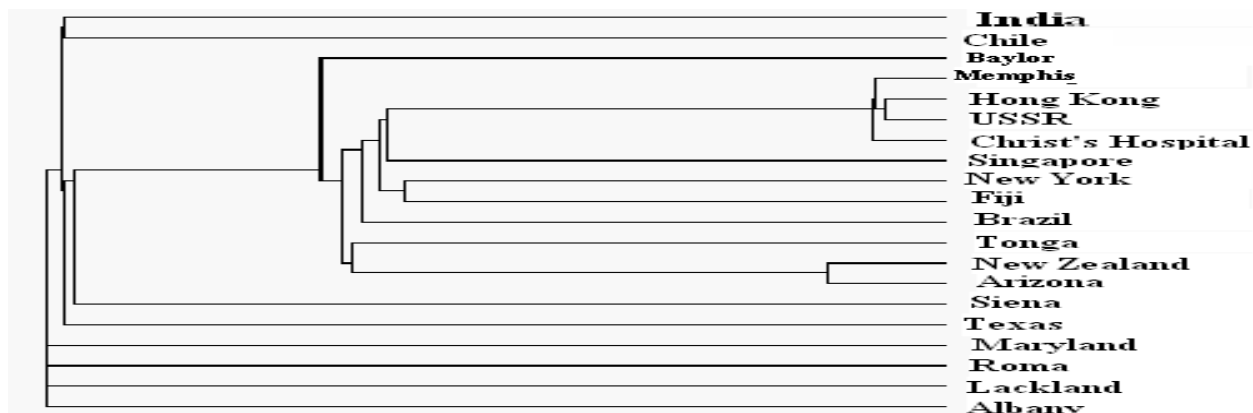


Fig.4: Phylogenetic Analysis Indian H1N1 segment 1 with 19 species around the world.

Above phylogenetic results shows that, the segment 1 from H1N1 India having homology in common ancestor with H1N1 of Chile rather than other continentals.

We had predicted some hypothesis that, the drug molecules and or vaccine candidates present to prevent the H1N1 virus in Chile should have same results about H1N1 virus in India

**Hydrophobicity**

Since the main feature of most globular protein domains is the hydrophobic core, the distributions of hydrophobic amino acids along the sequences of remote homologues and analogues ought to be similar. But is this pattern recognition already achieved by standard alignment techniques using log-odds matrices derived from observed substitutions in sequence alignments[Dayhoff *et al.*, 1978,]Most of these matrices cluster polar and nonpolar amino acids separately.

Analyses of conservation in multiple sequence alignments [Han & Baker, 1995,Fiser *et al.*, 1996,Ladunga & Smith, 1997] have also identified the amino acids which commonly substitute with each other and rationalise them in terms of structure and/or amino acid properties. Han and Bakerhan:sequence found that the most common clusters of single column amino acid profiles were predominantly hydrophobic or polar in nature. Consecutive segments of up to 13 residues were also often best explained in terms of hydrophobicity. Fiser *et al.*fiser:conservation looked at the conservation of amino acids with respect to structure and concluded that hydrophobicity was well conserved in the core. Ladunga and Smithladunga:substitution employed a robust all-or-nothing binary profile analysis on a number of large sequence databases and also reported common substitutions between hydrophobic or polar residues.



**Antigenic Fragments Prediction of H1N1:**

**Your sequence is 759 residues long**

**Average antigenic propensity for this protein is 1.0151**

**Antigenic plot for sequence**

Sr. No.	Start Position	Sequence	End Position
1.	21	VDHMAIK	32
2.	88	RVMISPLAV	96
3.	105	VTSTVHYPKIYKTYFEKVER	124
4.	129	TFGPVHFRNQVKI	141
5.	158	EAQDVIMEVVFVN	170
6.	173	GARILTS	179
7.	192	ELQNCKISPLMVAY	205
8.	207	LERELVRK	214
9.	216	RFLPVAGGTSSVYIEVLHLTQ	236
10.	255	VDQSLIIAAR	264
11.	267	RFLPVAGGTSSVYIEVLHLTQ	286
12.	306	QAVDICKA	313
13.	349	LQTLKLVHE	358
14.	378	TRRLIQLIVS	387
15.	391	EQSIVEAIVVAMVFSQEDCMIKAVRGDLNF	420
16.	430	PMHQLLRH	437
17.	439	QKDAKVLVQ	447
18.	476	RGVRVSK	482
19.	490	NAERVVVSIDRFLRV	504
20.	508	RGNVLLSPE	516
21.	541	RGNVLLSPE	552
22.	579	PFQSLVPK	586
23.	592	YSGFVRT	598
24.	614	QIIKLLPFAAAPP	626
25.	632	QFSSLTVNV	640
26.	645	MRILVRGN	652
27.	663	KRLTVLG	669
28.	685	GVESAVLRGFLIL	697
29.	704	YGPALSI	710
30.	721	KANVLIGQGDVVLVM	735
31.	740	DSSILTD	746



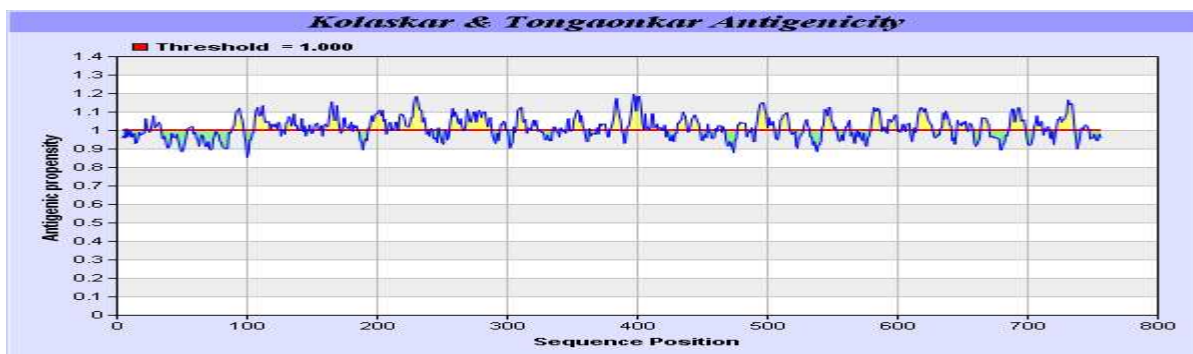
ALLELE: DRB1\_0101

Threshold for 3 % with score: 0.14, Highest Score achievable by any peptide: 6

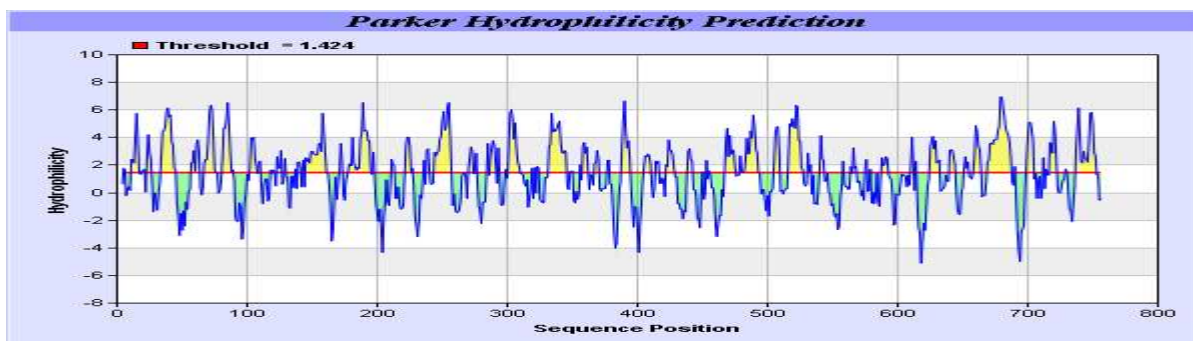
Rank	Sequence	At Position	Score	% of Highest Score
1.	FQSLVPKAI	535	2.6000	43.33
2.	WNRNGPVTS	54	1.7400	29.00
3.	WMMAMKYPI	4	1.7000	28.33
4.	LRISSEFSF	272	1.3000	21.67
5.	WEINGPESV	492	1.1400	19.00
6.	IHKLLPFAA	570	1.1000	18.33
7.	VRGNPVSFN	604	0.7400	12.33
8.	LEMCHSTQI	236	0.6900	11.50
9.	FKRTSGSSV	285	0.6000	10.00
10.	MRILVRGNS	600	0.4000	6.67
11.	IVRRAAVSA	221	0.4000	6.67
12.	FRNQVKIRR	90	0.4000	6.67
13.	VRDQRGNVL	459	0.3000	5.00
14.	VMGMIGILP	412	0.3000	5.00
15.	VKIQWSQNP	515	0.2000	3.33
16.	LIIAARNIV	214	0.2000	3.33
17.	LRKATRRLI	329	0.2000	3.17
18.	LVRGNPVSF	603	0.1700	2.83
19.	MRGVRVSKM	430	0.1300	2.17
20.	IRGQYSGFV	543	0.1000	1.67
21.	IRNWETVKI	509	0.1000	1.67
22.	FVNRAHQRL	375	0.1000	1.67



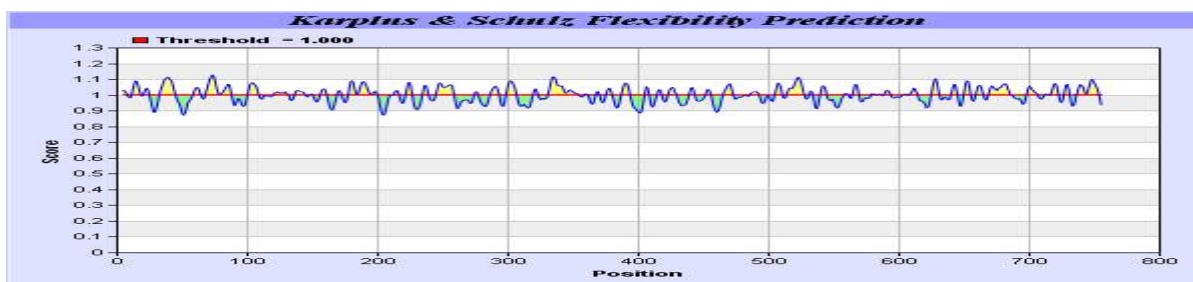
**Kolaskar & Tongaonkar Antigenicity:** Average: **1.016** Minimum: **0.856** Maximum: **1.195** Threshold: **1.000**



**Parker Hydrophilicity Prediction:** Average: **1.424** Minimum: **-5.114** Maximum: **6.943** Threshold: **1.424**



**Karplus & Schulz Flexibility Prediction:** Average: **1.002** Minimum: **0.872** Maximum: **1.126** Threshold: **1.000**

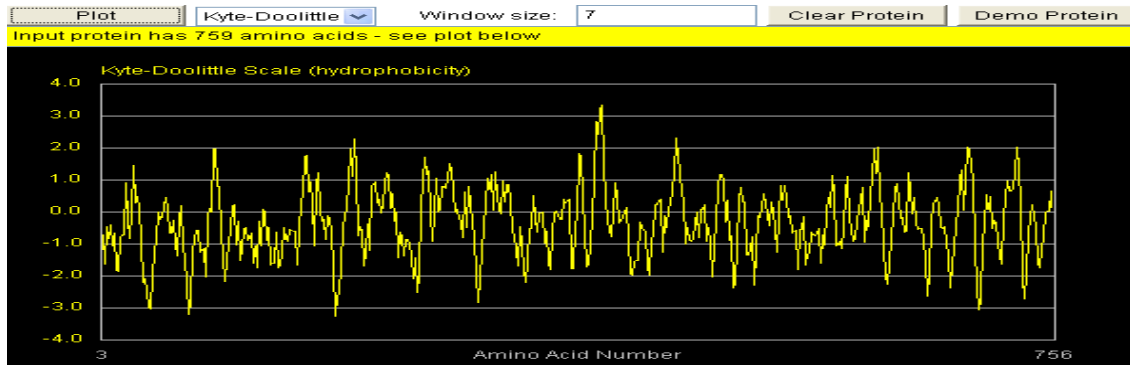


Bepipred linear epitope prediction: Average: **-0.024** Minimum: **-2.007** Maximum: **2.367** Threshold: **0.350**





## Hydrophobicity plot: 1. Kyte-Doolittle Method



## Conclusion and Future Scope:

**We have predicted that the sequence of h1n1 of swine virus is similar to h1n1 segment 1 from Chile.**

With prediction of antigenicity we got the sequences that has the antigenic sites by using that we can predict the vaccine and or drug formulations against that.



## References:

Baltimore, D. 1971. Expression of animal virus genome. *Bacteriol. Rev.* 35:235-241.

Brankston G, Gitterman L, Hirji Z, Lemieux C, Gardam M (April 2007). "Transmission of influenza A in human beings". *Lancet Infect Dis* 7 (4): 257–65. doi:10.1016/S1473-3099(07)70029-4. PMID 17376383.

Both, G.W., Sleight, M.J., Cox, N.J. and Kendal, A.P. (1983) in press.

Carrat F, Luong J, Lao H, Sallé A, Lajaunie C, Wackernagel H (2006). "A 'small-world-like' model for comparing interventions aimed at preventing and controlling influenza pandemics". *BMC Med* 4: 26. doi:10.1186/1741-7015-4-26. PMID 17059593.

Chou PY, Fasman GD. 1978. Prediction of the secondary structure of proteins from their amino acid sequence. *Adv Enzymol Relat Areas Mol Biol* 47:45-148. PMID: 364941

Cole E, Cook C (1998). "Characterization of infectious aerosols in health care facilities: an aid to effective engineering controls and preventive strategies". *Am J Infect Control* 26 (4): 453–64. doi:10.1016/S0196-6553(98)70046-X. PMID 9721404.

Dayhoff, M. O., Schwartz, R. M. & Orcutt, B. C., (1978). A model of evolutionary change in proteins. In *Atlas of Protein Sequence and Structure* (Dayhoff, M. O., ed.), volume 5, Suppl. 3, pp. 345-352. National Biomedical Research Foundation, Silver Spring, Washington D.C.

Dill KA. Dominant forces in protein folding. *Biochemistry.* 1990;29:7133–55. [PubMed]

Eccles, R (2005). "Understanding the symptoms of the common cold and influenza". *Lancet Infect Dis* 5 (11): 718–25. doi:10.1016/S1473-3099(05)70270-X. PMID 16253889

Emini EA, Hughes JV, Perlow DS, Boger J. 1985. Induction of hepatitis A virus-neutralizing antibody by a virus-specific synthetic peptide. *J Virol* 55:836-839. PMID: 2991600

Fischer, D., Elofsson, A., Rice, D. & Eisenberg, D., (1996). Assessing the performance of fold recognition methods by means of a comprehensive benchmark. In *Pacific Symposium on Biocomputing, Hawaii.*, pp. 300-318.

Garnier J, Gibrat J-F, Robson B (1996). GOR secondary structure prediction method version IV. *Meth Enzymol*, 266:540-553

Hall CB (June 2001). "Respiratory syncytial virus and parainfluenza virus". *N. Engl. J. Med.* 344 (25):1917–28. PMID:11419430.  
<http://content.nejm.org/cgi/pmidlookup?view=short&pmid=11419430&promo=ONFLNS19>.



Hall CB (August 2007). "The spread of influenza and other respiratory viruses: complexities and conjectures". *Clin. Infect. Dis.* **45** (3): 353–9. doi:10.1086/519433. PMID 17599315. <http://www.journals.uchicago.edu/doi/full/10.1086/519433>.

Han, K. F. & Baker, D. (1995). Recurring local sequence motifs in proteins. *J. Mol. Biol.* **251**, 176-187.

Haste Andersen P, Nielsen M, Lund O. 2006. Prediction of residues in discontinuous B-cell epitopes using protein 3D structures. *Protein Sci* **15**:2558-2567. PMID: 17001032

Hillisch, A. et al. (2004) Utility of homology models in the drug discovery process. *Drug Discov. Today*, 9, 659–669. Hopp, T.P. and Woods, K.R. (1981) *Proc. Natl. Acad. Sci. USA* 78, 3824-3828.

Hopp, T.P. and Woods, K.R. (1981). Prediction of protein antigenic determinants from amino acid sequences. *Proceedings of the National Academy of Sciences USA*, 78: 3824-3828.

Horwood F, Macfarlane J (October 2002). "Pneumococcal and influenza vaccination: current situation and future prospects". *Thorax* 57 (Suppl 2): II24–II30. PMID 12364707. PMC: 1766003. <http://thorax.bmj.com/cgi/pmidlookup?view=long&pmid=12364707>.

Karplus PA, Schulz GE. 1985. Prediction of chain flexibility in proteins. *Naturwissenschaften* 72:212-213.  
PMID:

Kawaoka Y (editor). (2006). *Influenza Virology: Current Topics*. Caister Academic Press. ISBN 978-1-904455-06-6. <http://www.horizonpress.com/flu>.

Kolaskar AS, Tongaonkar PC. 1990. A semi-empirical method for prediction of antigenic determinants on protein antigens. *FEBS Lett* 276:172-174. PMID: 1702393

Kopp, J. and Schwede, T. (2004a) Automated protein structure homology modeling: a progress report. *Pharmacogenomics*, 5, 405–416.

Ladunga, I. & Smith, R. F. (1997). Amino acid substitutions preserve protein folding by conserving steric and hydrophobicity properties. *Protein Eng.* 10, 187-196.

Larsen JE, Lund O, Nielsen M. 2006. Improved method for predicting linear B-cell epitopes. *Immunome Res* 2:2. PMID: 16635264

Parker JM, Guo D, Hodges RS. 1986. New hydrophilicity scale derived from high-performance liquid chromatography peptide retention data: correlation of predicted surface residues with antigenicity and X-ray-derived accessible sites. *Biochemistry* 25:5425-5432. PMID: 2430611

Ponomarenko JV, Bourne PE. 2007. Antibody-protein interactions: benchmark datasets and prediction tools evaluation. *BMC Struct Biol* 7:64. PMID: 17910770



Stuart-Harris, C. (1979) *Brit.Med.Bull.*, 35, 3-8.

Schmidt, A.M. (1989) *Biotect. Adv.* 7, 187-213.

Tellier R (November 2006). "Review of aerosol transmission of influenza A virus". *Emerging Infect. Dis.* 12 (11): 1657–62. PMID 17283614.  
<http://www.cdc.gov/ncidod/EID/vol12no11/06-0426.htm>.

Tumova, B., Veznikova, D., Mensik, J. & Stumpa, A. (1980). Surveillance of influenza in pig herds in Czechoslovakia in 1974±1979. I. Introduction of influenza epidemic A (H3N2) viruses in pig herds. *Zentralblatt für Veterinärmedizin Beiheft Reihe B* 27, 517±523.

UMN CIDRAP Avian Influenza (Bird Flu): Implications for Human Disease. Physical characteristics of influenza A viruses..

Vainionpää R, Hyypiä T (April 1994). "Biology of parainfluenza viruses". *Clin. Microbiol. Rev.* 7 (2): 265–75. PMID 8055470. PMC: 358320.  
<http://cmr.asm.org/cgi/pmidlookup?view=long&pmid=8055470>.

Villegas, P (1998). "Viral diseases of the respiratory system". *Poult Sci* 77 (8): 1143–5. PMID 9706079.

Webster, R.G., Laver, W.G., Air, G.M. and Schild, G.C. (1982) *Nature* 296, 115-121.

Wiley, D.C., Wilson, I.A. and Skehel, J.J. (1981) *Nature* 289, 373-378.



## **EXTENT OF USE OF QUALITATIVE AND QUANTITATIVE MANAGEMENT TECHNIQUES IN ADMINISTRATIVE AND ACADEMIC DECISION-MAKING AMONG ELEMENTARY AND HIGH SCHOOL PRINCIPALS/HEAD TEACHERS AND TEACHERS-IN-CHARGE IN ZAMBOANGA DEL NORTE SCHOOL DIVISIONS IN REGION IX**

Leonardo D. Cainta, E. M. D.  
JRMSC-Main Campus, Dapitan City, Philippines

### **Abstract**

*The study aimed to examine the extent to which elementary and high school administrators used the qualitative and quantitative techniques of decision – making along the four managerial functions: Planning, Controlling, Leading and Organizing to enhance their administrative and academic decision –making capability.*

*The descriptive- co relational method was used with a questionnaires- checklist to gather the data. Three hundred three principals/ head teachers/ teachers-in-charge from both elementary and high schools in the Divisions of Zamboanga del Norte and the twin cities of Dipolog and Dapitan were utilized. Statistical tools include percentage, weighted mean, Chi- square and contingency coefficient. The results of the study revealed that school principals/ head teachers were familiar and used the qualitative technique but were not acquainted with the quantitative techniques while teachers-in-charge were not well- versed in both techniques. But all school administrators found so much benefits in using these techniques in the four managerial function. School principals/ head teachers encountered less serious obstacles both in the use of these two techniques but not the teachers- in- charge who encountered serious obstacles. There was a significant difference in the use of qualitative techniques along four managerial functions. A significant difference in the use of quantitative technique along leading, organizing and planning but no significant difference along controlling function. No significant relationship was revealed between benefits derived from use of the techniques and the course completed and seminars attended by the administrators.*

*Therefore, teachers-in-charge must attend seminars /conferences on qualitative and quantitative techniques in decision-making along the four managerial functions. However, school principals/head teachers should continue to apply and use the techniques to strengthen their ability to make good and wise decisions in terms of improving the school programs and students learning.*

**Key Words & Phrase :** Qualitative and Quantitative techniques, decision making, four Managerial functions: Planning, Organizing, Leading and Controlling.



## **Introduction**

The ability to deal effectively with other people and accomplish tasks through others has and will remain a fundamental ingredient in the management process. This is true among management groups faced with complicated problems. However, human relations skills are insufficient for managing complex educational organizations. Technical competencies also required numerous and various tasks. The use of simple models can identify and evaluate effective alternatives. Management techniques is needed to process the information needed for effective planning, leading. organizing and controlling.

According to Dunn (994) most organizational problems are interdependent, subjective, artificial and dynamic. They are systems with purposive properties such that the quality of the whole different from the quantitative sum of the parts. If this reasoning is factored into the decision-making process, then administrators will be able to discern multitudinous alternatives. Since decision- making according to Morris is psyche- technical, the psychological use of information must be combined with practical and technical analysis. Qualitative and quantitative methods are productive tools in solving organizational problems. They are behavioral and mathematical techniques respectively that can provide a diversity of knowledge base.

Qualitative analysis requires the administrators' judgment experience, conceptual and interpersonal skills and behavioral techniques to make good and sound decision. On the other hand, quantitative analysis concentrates on facts, data and numerical aspects associated with the problem. The emphasis is on the development of mathematical expression to describe the objectives and constraints connected with the problem. Thus, the administrator's quantitative knowledge can help enhance the decision- making process.

In Zamboanga del Norte, many elementary and high school teachers are dissatisfied with the decision-making process of their administrators. This lead them to react with indifference to management decisions. The study was conceived to complement the administrators' capacity to deal with problematic organizational environments.

## **Theoretical/Conceptual Framework**

The study was premised in the concept that man could be programmed to be an efficient machine. This management movement was the result of Frederick Taylor's writings, who believed on scientific management and efficiency in the workplace, seeking ways to use man effectively in industry. His theory focused more on physical production and man's physical limit.

It found support on Taylor's administrative theory which includes broader problems of departmental decision of work and coordination. As administrative science developed, human relations recognized. It was seen that the fundamental problem of all organization was the development and maintenance of a dynamic and harmonious relationship. It stressed that conflict was not a necessary and wasteful outbreak in incompatibilities but a normal process by which socially valuable differences register themselves for the enrichment of all concerned.



These theories paved the birth of administration whereby the rational decision-making influence the behavior of the members of the organization. In return the organization resolves questions through satisfying rather than optimizing actions. Educational administrators must then realize that to enhance their decision-making capabilities, they need to learn about quantitative methodologies. Knowledge of the quantitative techniques facilitates the comparison and evaluation of the sources of information and the combination of data to formulate the best decision. Moreover, the administrators must be able to recognize, adjust to and accommodate various behavioral situations that are present in any organization. Most problems requiring management intervention are focused on individual groups, staff work, task forces, subordinates other administrators, support groups and public officials. This is where the qualitative skills of administrators come in.

### **Statement of the Problem**

The study aimed to examine the status and extent to which the elementary and the high school principals/head teachers and the teachers-in-charge used the qualitative and the quantitative techniques of management in planning, organizing, leading and controlling activities for enhancing their administrative and academic decision-making capability.

Specifically the study sought to answer the following questions:

1. What managerial methodologies in the qualitative and the quantitative techniques are more familiar to the elementary and the high school principals/head teachers and the teachers-in-charge in their decision-making?
2. To what extent are these school principals/head teachers and teachers-in-charge of the elementary and high school using the qualitative and the quantitative techniques of decision-making in carrying out their managerial functions of planning, organizing, leading and controlling?
3. What benefits do these principals/head teachers and teachers-in-charge of both levels obtain from using qualitative and quantitative techniques in their decision-making process?
4. What obstacles or constraints do the elementary and the high school principals/head teachers and teachers-in-charge commonly encounter in implementing the qualitative and the quantitative techniques in their decision-making?
5. Is there a significant difference in the extent of use of the qualitative and the quantitative techniques in decision-making between the elementary and the high school principals and the teachers-in-charge?
6. Is there significant relationship between the benefits perceived by the elementary and the high school principals/head teachers and the teachers-in-charge using the qualitative and the quantitative techniques in decision-making based on course finished and seminars attended?

### **Literature Review**

The science of educational administration is still a very young school of thought. The classical organizational thought of administration had a management theory that started with scientific



analysis of work and efficiency as Taylor believed in. Later management dealt with concepts and principles of bureaucratic theory such as hierarchical structures, authority, procedures and rationally. These concepts were integrated into the administrative functions of planning, organizing, leading and controlling.

The scientific management revolution of early 1900 provided the foundation for a behavioral science approach which resulted to the qualitative studies in organizations. The quantitative studies of management had its origin during World war II when operation research teams were formed to deal with strategic and tactical problems faced by the military. After the war, many of these teams continued their research on quantitative approach to decision-making as applied to manufacturing, health care, communication, business, engineering project, and educational administration.

Though administrators and managers used some managerial functions, none do it with efficiency, that is, they have not used optional outputs to produce maximum outputs or with effectiveness to attain goals which can bring impact on their clientele, beneficiaries, or with efficiency to increase morale on the subordinates, This is so because the administrators role is just to balance and coordinate the interest of the organization members and work together within the limits set by the organization's not so clear goals and resources. Most administrators recognize the politics within the organization and readily accepts their roles as agents and arbitrators of conflicts.

Many educational administrators realized that to increase administrative capability is to seek more rational ways of making decisions and more structured methods in solving problems. Thus, administrators, in carrying out their managerial functions, should be assisted by modern management techniques which are the qualitative and quantitative techniques to making decision. The manager used the quantitative techniques to be explicit about the objectives of the organization, to identify and record the types of decision variables that will influence the objectives, identify and record pertinent interactions and trade-offs between decision variable and to record constraints on the values that the variable may assume.

Another technique employed in management to solve problems is the qualitative technique which has a humanizing effect on stakeholders. They found out that brainstorming and nominal group technique were qualitative tools for comprehensive planning and implementation. There is also the management by objectives which minimizes the subjective or personal prejudices elements since the appraisal was based on agreed objectives previously set. This gave executives and managers better decision-making processes because each manager discussed with the subordinates, the goals and objectives of his department. This technique was participatory in nature because the managerial level was carried below to include the rank and file employees. This was to help the user learn through guided experience the skills and procedures needed to become effective agent of change. It is evident that these behavioral tools, because of their artistic nature require administrative ability and creativity for a successful application.

## **Methodology**

The study employed descriptive- co relational method. A questionnaire- checklist served as the main instrument for data gathering. The respondents were the 303 principals/head teachers and





teachers-in-charge of the elementary and high school in the Divisions of Zamboanga del Norte, Dipolog city and Dapitan City. The study was conducted during the second semester, School Year 2007-2008. Statistical tools used include percentage, weighted mean, Chi- square, Pearson chi-square, and contingency coefficient.

**Findings / Result and Discussions**

**TABLE 1**

The Principals’ Extent of Use of the Qualitative and Quantitative Management Techniques in Managerial Functions  
N = 168

Managerial Functions	Qualitative Techniques		Quantitative Techniques	
	Average Weighted Mean	Interpretation	Average Weighted Mean	Interpretation
1. Planning	3.33	Always Used	3.16	Frequently Used
2. Organizing	3.18	Frequently Used	3.07	Frequently Used
3. Leading	3.25	Always Used	3.09	Frequently Used
4. Controlling	3.14	Frequently Used	2.99	Frequently Used
<b>GRAND MEAN</b>	<b>3.23</b>	<b>Frequently Used</b>	<b>3.08</b>	<b>Frequently Used</b>

**TABLE 2**

The Teachers - in - Charges’ Extent of Use of the Qualitative and Quantitative Management Techniques in Managerial Functions  
N = 135

Managerial Functions	Qualitative Techniques		Quantitative Techniques	
	Average Weighted Mean	Interpretation	Average Weighted Mean	Interpretation
1. Planning	2.98	Frequently Used	2.82	Frequently Used
2. Organizing	2.90	Frequently Used	2.78	Frequently Used
3. Leading	2.96	Frequently Used	2.79	Frequently Used
4. Controlling	2.92	Frequently Used	2.82	Frequently Used
<b>GRAND MEAN</b>	<b>2.94</b>	<b>Frequently Used</b>	<b>2.80</b>	<b>Frequently Used</b>

3.25 – 4.00 *Always Used*

2.50 – 3.24 *Frequently Used*

1.75 – 2.24

1.00 – 1.74

*Occasionally Used*

*Never Used*



**TABLE 3**  
 The Principals' and Teachers – in – charges' Benefits and Obstacles in Using  
 Qualitative and Quantitative Techniques  
 N = 303

Respondents	Qualitative Techniques		Quantitative Techniques	
	Benefits	Obstacles	Benefits	Obstacles
Principal	3.39 Much Beneficial	2.39 Less Serious	3.40 Much Beneficial	2.35 Less Serious
Teachers – in – charge	3.30 Much Beneficial	2.52 Serious	3.19 Beneficial	2.54 Serious

3.25 – 4.00	<i>Much Beneficial</i>	3.25 – 4.00	<i>Very Serious</i>
2.50 – 3.24	<i>Beneficial</i>	2.50 – 3.24	<i>Serious</i>
1.75 – 2.49	<i>Less Beneficial</i>	1.75 – 2.49	<i>Less Serious</i>
1.00 – 1.74	<i>Not Beneficial</i>	1.00 – 1.74	<i>Not Serious</i>

**TABLE 4**  
 The Comparison of the Principals and The Teachers – in – Charge's Extent of Using the  
 Qualitative and Quantitative Techniques Along Managerial Functions  
 N = 303

Managerial Function	Qualitative Techniques		Quantitative Techniques	
	Mean Square	Interpretation	Mean Square	Interpretation
1. Planning	18.42	Significant	15.66	Significant
2. Organizing	11.75	Significant	14.47	Significant
3. Leading	14.78	Significant	12.71	Significant
4. Controlling	8.52	Significant	6.20	Not significant

\*df : 3.0

\* TV: 7.82

\* $\alpha$  = 0.05



**TABLE 5**

The Relationship of the Principals and the Teachers – in –charge’s Benefits on Qualitative and Quantitative Techniques based on Course Finished and Seminars Attended  
 N = 303

	Qualitative Techniques		Quantitative Techniques	
	Mean Square	Interpretation	Mean Square	Interpretation
Course Finished	5.92	Not Significant	7.87	Not Significant
Seminar Attended	15.98	Not Significant	14.69	Not Significant

Course Finished                      \*df = 6.0                      \*TV: 12.59                      \*α = 0.05  
 Seminar Attended                      \*df = 15                      \*TV: 25.00                      \*α = 0.05

1. On familiarity of elementary and high school administrators with the qualitative and quantitative techniques, a weighted mean of 3.31 showed that these administrators were indeed using the qualitative decision-making techniques but not always with the quantitative technique in their administration, with a weighted mean of 2.97. On the other hand, a weighted means of 2.85 and 2.77 showed that teachers-in-charge often used only the qualitative and quantitative decision-making techniques in their administration and in the process of making themselves well-versed with its application.

2. On extent of use of techniques in decision-making.

**Planning.** A weighted mean of 3.33 showed principals/ head teachers were always using the qualitative technique in planning, while the teachers-in-charge were frequently using the technique with weighted mean of 2.98. In the quantitative technique, principal/head teachers and teachers-in-charge were frequently using with weighted mean of 3.16 and 2.82 respectively.

**Organizing.** Principals/ head teachers and teachers-in-charge frequently used both qualitative and quantitative techniques in their decision-making with weighted means of 3.18, 2.90, 3.07 and 2.78 respectively.

**Leading.** A weighted mean of 3.25 showed that principals/ head teachers always used the qualitative techniques, while teachers-in-charge frequently use the qualitative with a weighted mean of 2.96 on the quantitative technique of decision-making, principals/ head teachers and teachers-in-charge were frequently using the method with weighted mean of 3.09 and 2.79 respectively.

**Controlling.** On the qualitative and quantitative techniques, all school administrators were found to frequently use the method with weighted means of 3.14 and 2.92 for qualitative and 2.99 and 2.82 for the quantitative techniques.



3. Benefits obtained by administrators in using the qualitative and quantitative techniques in their decision-making. It was found out that principals/ head teachers were much benefited in using qualitative techniques with weighted mean of 3.39 and 3.30 respectively. On the quantitative technique only the principals/head teachers were much benefited, while the teachers-in-charge were benefited only.

4. Obstacles encountered by administrators in implementing the qualitative and quantitative techniques. The weighted mean of 2.39 and 2.35 showed that principals /head teachers encountered less serious obstacles in the use of both techniques while teachers-in-charge encountered serious problems in the use of the qualitative techniques.

5. In the test of difference, results showed that there was a significant difference in the administrators' extent of using qualitative and quantitative methods along planning, organizing, leading and controlling. However there was no significant difference in the extent of using the qualitative method in controlling which accepted the null hypothesis only on this aspect.

6. In the test of relationship between the benefits derived from the use of qualitative and quantitative techniques and course completed and seminars attended, no significant relationships were shown.

## **Conclusions and Recommendations**

### **Conclusions**

Based on the findings of the study, the following conclusions are drawn:

1. The high school and elementary principals/head teachers were familiar with the use of qualitative technique in decision-making but were not well-acquainted with the quantitative techniques. The teachers-in-charge were not so well-versed in the use of qualitative and quantitative techniques in decision-making.

2. The principals/head teachers were always using qualitative techniques in planning and leading and they often applied qualitative method in organizing and controlling, while the teachers-in-charge often applied qualitative and quantitative techniques in all four managerial functions: Planning, Organizing, Leading and Controlling.

3. The principals/ head teachers were very much benefited by both the qualitative and quantitative techniques in decision-making but the teachers-in-charge were benefited only in their use of quantitative techniques in decision-making.

4. The principals/ head teachers encountered less serious obstacles in the application of both qualitative and quantitative techniques in decision-making, while the teachers-in-charge encountered serious obstacles.

5. There was a significant difference in the use of qualitative decision-making techniques between the principals/head teachers and the teachers-in-charge along the four managerial functions. The null hypothesis of no significant difference was rejected along the qualitative.



There was a significant difference in the use of quantitative decision-making technique between the principal/head teachers and the teachers-in-charge both in the elementary and the high school on the three factors of leading, organizing and planning which rejected the null hypothesis. However there was no significant difference in the extent of using the quantitative method in controlling which accepted the null hypothesis only on this aspect.

6. There was no significant relationship between the benefits derived from the use of qualitative and quantitative techniques and the course completed and seminars attended by school administrators, the null hypotheses were accepted.

### **Recommendations**

In the light of the findings and conclusions of this study, the following recommendations are proposed.

1. The teachers-in-charge must attend seminars and conference on the use of the qualitative and quantitative techniques in decision-making along the four managerial functions.
2. The principals/ head teachers should always use the qualitative method along organizing and controlling to develop mastery in its application.
3. The principals/ head teachers should always use the quantitative method along the four managerial functions to become experts in its application.
4. The teachers-in-charge must be resourceful in the use of qualitative and quantitative techniques in the discharge of their managerial functions especially in handling difficult situations.
5. Elementary and high school administrators should always apply both qualitative quantitative methods to strengthen their ability to make good decisions in terms of improving school programs and students' learning.



**References:**

**BOOKS**

Dunn W. N. ( 1994) *Public Policy Analysis: An Instruction*. Eaglewood Cliffs, N. J. Printice Hall.

Fayol, Henri ( 1987) *General and Industrial Management*,Belmont California; Lake Books.

Morris, W.T. (1986) *Organization Behavior in Action: Skills Building Experience*, New York; West Publishing

Taylor, F. W. ( 1990). *The Principle of Scientific Management*, New York: Harper and Row, 1964.

**UNPUBLISHED THESIS/ DISSERTATIONS**

Valerio, Carlos ( 1997) “ *Application of Qualitative and Quantitative Techniques of Management in Administrative Decision-making.*” Unpublished Dissertation. Baguio City.

Swangpol, Ratee. “ *Leadership Qualities Decision- Making Structures of Administrators as Related to Teaching Performance of the Faculty Members Of Sri- Ayudhaya United Colleges, Thailand.*” Unpublished Dissertation: University Of Northern Philippines.



## **DIGITAL LIBRARY FOR THE GRADUATE SCHOOL OF DMMMSU-SLUC, AGOO, LA UNION**

**Darwin C. Llavore**

Don Mariano Marcos Memorial State University

### **Abstract**

*The library is considered as the depot of general knowledge. It had been established as an imperative support system to provide incessantly for the reading needs of students, faculty and the community. Effective utilization of the library facilities and services will help the students succeed in their academic life.*

**Key words:** digital library, wiki journal, e-journal, e-library, content management systems, theses compendium, virtual library

### **Introduction**

With the growth and the popularity of the Internet, World Wide Web, adoption of these technologies in libraries has led to the development of “digital library”. Digital libraries aim at a continuous and speedy access to contents over computer and communication networks, thus justify the need for shifting into a digital library setup for useful information resources.

This project study entitled Digital Library for Graduate School of DMMMSU-SLUC, Agoo, La Union was intended to design and develop a digital library and fully utilize the potentials of available technology. It attempted to answer the following questions:

1. What are the problems encountered by a user in accessing the Graduate School Library holdings of DMMMSU-SLUC?
2. What are the attributes of the thesis manuscript to be included in the proposed Digital Library for Graduate School of DMMMSU-SLUC, Agoo, La Union?
3. What are the advantages of the proposed Digital Library?
4. What are the security measures to be implemented in the proposed Digital Library?

### **Materials and Methods**

The study focused primarily on the design and development of a digital library for the Graduate School of DMMMSU Agoo Campus that provides an alternative means for student researchers in their conduct of literature review for their studies. The RAD (Rapid Application Development) model was adopted to develop the system. Frequency and percentage was used to determine respondents’ perception on the problems encountered and the advantages of a digital library. The study included 133 students of the graduate school of DMMMSU Agoo campus as respondents in the study.



Data are gathered primarily from the Graduate School Library of DMMMSU-SLUC. People of particular importance in providing information needed are the faculty members, Graduate School Librarian, library assistants and students who are conducting researches. They are the people who provided necessary information about the existing setup of the Graduate School Library.

Interviews and observation with actual gathering of available CDs containing softcopies of the theses manuscripts are also important sources of facts and served as the primary tool in gathering needed data.

## **Results**

Based on the research problems, the following are the findings of the researcher:

1. Users are encountering problems in accessing the Graduate School Library holdings of DMMMSU-SLUC. Eighty percent (80%) of the respondents considered documents are for inside researching only, 81% on time constraints in browsing collections, 80% on the seating capacity of the library is not enough, 76% on the duplication of manuscripts is limited, 74% on working space is limited, 75% on time constraints in locating theses manuscripts, 63% on information of theses manuscript is not always updated, 69% on documents are not allowed to be photocopied, 63% on not every time, the library is opened, 62% on library is always crowded.

2. With regard to the attributes of the manuscripts to be included, the following are adopted:

a) The theses manuscripts are organized with the following attributes considered: title, author, abstract and date/year. The abstract contents are converted to Post Script (PS) and Microsoft Word (MS-Word) document files and the full text contents are converted to Portable Document Format (PDF).

b) The contents of the digital library are stored in the database with the following attributes of the manuscript: title, author, abstract, date and year. MYSQL was used as database engine. The converted PDF, PS and MS-Word format files are uploaded to the digital library which serves as the main collection of the digital library.

c) The contents of the digital library can be accessed using different search categories such as the title, author, subject and date and the abstract attribute of the manuscripts. Abstract can be downloaded in PS or MS-Word document format. Full text content can be downloaded in PDF file.

3. There are advantages of the proposed digital library as perceived by the respondents. Ninety-four percent (94%) perceived that it brings information to the user at work or home and user never needs to go and visit a library building, 95% on support full text searching, 97% on information can be shared more easily, 92% on easier to keep information current and updated, 89% on materials are never checked out or mis-shelved, 89% on materials will never be stolen, 92% on efficient locating and searching of manuscript, 94% on more users can simultaneously access a collection, 95% on researcher can do research anytime, 92% on user can easily copy and print the abstract of a research without an error.





4. In terms of the system's access levels, there are two primary account types namely, the administrator and the member account. Administrator account has a full privilege to access all modules of the system as well as in the management of the system's database. The member of the site is authorized to search and view the full contents of the abstract collections in the digital library. He or she can upload a PDF or MS-Word document file containing the abstract of his or her study as part of the digital library. The registered member of the site has also the option to download the PDF or MS-Word document file containing the full abstract of the study.

## **Discussion**

1. The problems encountered by the users in accessing the Graduate School Library holdings of DMMMSU-SLUC are attributed to traditional setup where manual processes are used.
2. Copying of the information in a manuscript is limited to some attributes or parts of the manuscripts only.
3. Digital library addresses the problems that are identified. The library will be brought to the user and users never need to go and visit the physical library building. Information can easily be accessed and shared by users. Digital library is expensive but with the declining costs of technology, digital library may eventually prove to be less expensive.
4. The security measures adopted is indeed prohibiting unauthorized access to the system and allow only the registered member of the site.



## References:

### Published Materials

Eden, B.L.(2008). Content management systems in libraries, A case study. Retrieved April 8, 2009, from

<https://www.scarecrowpress.com/Catalog/SingleBook.shtml?command=Search&db=^DB/CATALOG.db&eqSKUdata=0810856921>.

Greenstein, D., & Thorin, S.E.(2002). The Digital library: A biography. Washington,DC: Digital Library Federation Council on Library and Information Resources.

### Web Resources

*(Definition and Purposes of a Digital Library, 2009)*. Retrieved April 8, 2009, from <http://d.scribd.com/docs/wrkyukydiibazo4n9bg.pdf>.

Eden, B.L.(2008). Content Management Systems in Libraries, A Case Study. Retrieved April 8, 2009, from

<https://www.scarecrowpress.com/Catalog/SingleBook.shtml?command=Search&db=^DB/CATALOG.db&eqSKUdata=0810856921>.

Goncalves, M. A., & Fox, E. A., & Watson, L. T., & Kipp, N. A. (2009) Streams, Structures, Spaces, Scenarios, Societies (5S): A Formal Model for Digital Libraries. Retrieved April 14, 2009, from <http://www.dlib.vt.edu/projects/5S-Model/5s6.pdf>.

Jeevan, V.K.J.(2004). Digital library development: identifying sources of content for developing countries with special reference to India. Retrieved April 6, 2009, from <http://d.scribd.com/docs/23j19lg139qhj50224ru.pdf>.

Krowne,A.(2003). *Building a Digital Library the Commons-based Peer Production Way*. D-Lib Magazine, Vol.9. Retrieved April 6, 2009, from <http://www.dlib.org/dlib/october03/krowne/10krowne.html>.

Lynch, C., & Garcia-Molina, H. (2009). Interoperability, scaling, and the digital libraries research agenda: A report on the May18–19, 1995, IITA digital libraries workshop, August 22, 1995. Retrieved on April 6, 2009, from <http://www.itrd.gov/pubs/iita-dlw/main.html>.

McMartin F., et.al.(2008). The use of online digital resources and educational digital libraries in higher education. Retrieved April 6, 2009, from <http://d.scribd.com/docs/2h2iuhbzwnbd46djwram.pdf>.

Mintzer, F., Lotspiech, J., Morimoto, N.(2009). *Safeguarding Digital Library Contents and Users*. D-Lib Magazine. Retrieved April 7, 2009, from <http://dlib.org/dlib/december97/ibm/12lotspiech.html>.

Noerr, P. (2009). The digital library toolkit (pp. 148–174). Retrieved on April 6, 2009, from <http://www.sun.com/products-n-solutions/edu/libraries/digitaltoolkit.html>.



Obermier, T. R.(2006). Accreditation Self-Study using a Website Content Management System. Journal of Industrial Technology, Vol. 24, Number 4. Retrieved April 6, 2009, from <http://www.nait.org>.

Rajashekar, T.B.(2008), Digital Library and Information Services.Retrieved on June 11, 2009, from <http://www.ncsi.iisc.ernet.in/raja/is214/is214-2006-01-04/topic-1.htm>.

Sridhar, M.S.(2007). Information Management in Digital Environment: A Librarian's Perspective. Retrieved April 6, 2009, from <http://d.scribd.com/docs/1afewrcysbpvgf3x7fd4.pdf>.

“What is a Library anyway?”,2009.<http://www.lib.sk.ca/aboutlibraries/what.html>.

### **Unpublished Materials**

Marzan, C.S.,& Verceles, R. T. et. al(2009). Computerized Certification, Authentication and Verification System for Commission on Higher Education of Region I. Don Mariano Marcos Memorial State University, La Union, Philippines.

Mendoza, C.D.(2008). Wiki Journal System of Lyceum-Northwestern University.Masteral Thesis. University of Cordilleras, Baguio, Philippines.

Palaoag, T.D.(2005). Digital Library of Information Technology Projects and Computer Science Theses for Colegio De Dagupan.Masteral Thesis. University of Cordilleras, Baguio, Philippines.



## **COMMUNITY EXTENSION SERVICES OF SUCs IN REGION IX: BASIS FOR A SUSTAINABLE COMMUNITY ENHANCEMENT PROGRAM**

**Clarita D. Bidad<sup>1</sup>**  
**Evelyn R. Campiseño<sup>2</sup>**

<sup>1</sup> Faculty Member, JRMSC-Dipolog Campus, Dipolog City, Zambo. del Norte

<sup>2</sup> Vice President for Planning, Research, Extension and Special Concerns, JRMSC System

### **Abstract**

*This study aimed to assess SUCs community extension services in Region IX along education, livelihood generation, health and nutrition, good governance and environmental awareness during the School Year 2008-2009 as basis for sustainable community enhancement program.*

*The descriptive method was used with a questionnaire aided by an unstructured interview utilized in gathering data. The statistical tools used were mean, computation, percentage, frequency and t-test of difference. There were 90 implementers and 175 beneficiaries who were utilized as respondents in the study. The results of the study revealed that the extension program of SUCs was well implemented. And, faculty and students were well involved. There was no significant difference on the ratings of the implementers and beneficiaries along education, livelihood generation, health and nutrition, good governance and environmental awareness implementation. No significant difference also existed on the perceptions of the implementers and beneficiaries in their involvement of the extension programs on education, livelihood generation and good governance. However, there was significant difference in their involvement on the program on health and nutrition and environmental management.*

*Therefore, the extension programs should continue to move on and reach out for the sustainable development of the community.*

**Keywords :** *Extension services, sustainable, enhancement program*

### **Introduction**

Republic Act 7722, otherwise known as The Commission on Higher Education mandates institutions of higher learning like State Universities and Colleges (SUCs) to respond to the call for societal transformation. The aim is to serve the poorest of the poor, the less privileged, the deprived and the oppressed. (Elman1998)

Among SUCs most extension programs are demand driven and accreditation driven. Demand driven is community-based that encompass basic functional needs and demands designed to establish and promote the general well-being of the rural and urban populace. Usually this is requested by the Local Government Unit concerned upon identification of the specific needs of their constituents. On the other hand, the accreditation driven extension programs are implemented in response to the requirements by an accrediting body. Although, they emerged differently, yet the implementation complements the curricular offerings of the institution.



Both kinds of programs provide opportunities for the target clientele to improve their standard of living and uplift the quality of life of the clientele.

In order to serve and improve community life, SUCs offer a wide variety of extension programs and services. These are designed primarily to increase the security of livelihood, alleviate poverty, reduce illiteracy, improve health and nutrition, create a system of governance that promotes supports and sustains human development and protecting and preserving the environment. For the poor to benefit, they must be empowered in mind, body and resources. To augment their voice and make government responsive to their needs and aspiration, good governance demands for their greater participation. Hence, good governance increases their opportunity to participate in decision making, institution building and social life.

As an extension coordinator of JRMSC-Dipolog Campus, this research study was undertaken to assess the extension programs and services of SUCs in Region IX covering formidable tasks such as poverty, illiteracy, health and nutrition, sustain programs and activities through its good governance, and achieving sustainable development among the marginalized people.

### **Conceptual Framework**

The study is premised on the concept that State Universities and Colleges (SUCs) in the Philippines are mandated by law to serve the communities. This mandate is fulfilled by exercising the functions of the school. One of the functions is to meet social needs or to provide the social services needed to combat social and economic ills of society. Therefore, SUCs have to move ideas along the road to action, to develop knowledge needed, and to apply useful knowledge in the solution of society's major problems. This is carried on through the establishment of the extension programs and services.

In response to the mandate and the strong emphasis to sustain community development, SUCs of Region IX extended its programs and services to the different communities. These services are focused on capability building through education, the conduct of livelihood skills training to adults who are unemployed, underemployed or who wanted to upgrade their skills, out-of-school youth, technical assistance to support programs of government, and the transfer of technology to the depressed barangays where resources were available. In view of the mandate, SUCs extended the following programs and services to the community and which looked into this study namely: education, livelihood generation, health and nutrition, good governance, and environmental awareness.

### **Research Method**

This study used the descriptive method of research with the aid of the questionnaire checklist and unstructured interview to assess SUCs extension services in Region IX along education, livelihood generation, health and nutrition, good governance and environmental .

### **Research Respondents**

The respondents of the study were the implementers of the SUCs extension programs and services in Region IX composed of the extension directors, extension coordinators, faculty



members who extended their expertise, visiting lecturers and community organizers. The other group of respondents was the 20 beneficiaries of the extension programs and services of the College/University. They were the recipients of the five extended areas considered in this study. These beneficiaries were chosen based on the record of the extension workers who knew well on their participation, attendance as well as their performance during the conduct of the classes and trainings.

### **Research Instrument**

The study employed questionnaires and unstructured interview as the instruments for data gathering. There were two sets of questionnaires: one for the implementers and the other for the beneficiaries. Questionnaires for the beneficiaries were stated in the vernacular or Cebuano for ease in understanding.

The questionnaire consisted of two parts. Part 1 was the profile of the implementers and the beneficiaries such as age, sex, civil status, educational attainment, occupation, number of dependents and monthly family income. Part II, solicited the perceptions of the implementers and respondents on the implementation and involvement of the extension programs and services of SUCs .

The researcher used 5-point scale parameters and the data obtained were interpreted as to the extent of implementation and involvement of the implementers and beneficiaries on the extension programs and services of SUCs in Region 1X.

### **SCALE PARAMETERS:**

#### **A. Extent of implementation**

<i>Scale</i>	<i>Range</i>	<i>Description</i>	
5	4.21 – 5.00	Very well implemented	Priority is always shown and and is highly implemented
4	3.41 – 4.20	Well implemented	Priority is always shown and is always implemented
3	2.61 – 3.40	Implemented	Priority is often shown and is implemented
2	1.81 – 2.60	Less implemented	Priority is often shown but not implemented
1	1.00 – 1.80	Never implemented	Priority is seldom shown and not implemented

#### **B. Extent of involvement**

<i>Scale</i>	<i>Range</i>	<i>Description</i>	
5	4.21 – 5.00	Very well involved	Interest is always shown and is highly attended
4	3.41 – 4.20	Well involved	Interest is always shown and is always attended
3	2.61 – 3.40	Involved	Interest is often shown and is attended



2	1.81 – 2.60	Less involved	Interest is often shown but not attended
1	1.0 – 1.80	Never involved	Interest is seldom shown and not attended

**Data Gathering Procedure**

The researcher asked permission from the President of each College/University to allow her to distribute the questionnaire to the respondents and to direct her to the in-charged of the extension programs of the school. In as much as the implementers and the beneficiaries were not yet available, the researcher requested the Director/Coordinator to distribute the questionnaires in her favor. In consideration of the distance between the school respondents and the researcher’s home, further request was made to send the collected instruments through mail. However, some questionnaires were collected personally by the researcher a week after the distribution through the extension coordinator in the nearby schools, particularly in JRMSC system except Siocon Campus which is many kilometers from Dipolog City.

**Statistical Treatment of Data**

The statistical tools employed in the analyses of data were frequency count, percentage, mean, ranking and t-test. All statistical tests were set at 0.05 levels of significance.

Frequency Count, Percentage, and Mean – These were used to describe the profile variables, such as age, gender, civil status, educational attainment, occupation monthly family income and number of dependents.

Ranking – This was used to describe the predominant problems encountered by the implementers and beneficiaries on the implementation and their involvement of the extended services.

Weighted Mean – This was used to assess the extent of the implementation and involvement of implementers and beneficiaries.

t-Test– This was employed to determine the significant difference in the ratings of implementers and beneficiaries in the implementation and their involvement of SUCs extension programs.

**Results and Discussions**

Table 1 reflects the Summary Table of the extent of implementation of the extension programs and services of SUCs in Region 1X. All indicators were rated by both respondents as “well-implemented”. This was supported by the computed general means of 3.674 and 3.694 respectively.

Table 1. Extent of Implementation of the Extension Programs and Services of SUCs in Region IX.

Indicators	Implementers	Beneficiaries
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	Mean	D	Mean	D
Education	3.82	WI	3.64	WI
Livelihood Generation	3.73	WI	3.74	WI
Health and Nutrition	3.73	WI	3.70	WI
Good Governance	3.68	WI	3.71	WI
Environmental Management	3.41	WI	3.68	WI
General Mean	3.674	WI	3.694	WI

Table 2 reflects the summary of the extent of involvement of the implementers and beneficiaries on the extension programs and services of SUCs in Region 1X. It can be gleaned in the table that only one indicator was rated by implementers as “involved” with the mean of 3.34. This means that the respondent implementers perceive good governance as one of the extension programs where they are obliged to be involved. The rest of the indicators were rated as well-involved.

The beneficiaries rated education and livelihood generation as well-involved while health and nutrition, good governance and environmental management were rated involved. However, the general mean of 3.42 falls on the well involved category.

Table 2. Extent of Involvement of the Implementers and Beneficiaries on the Extension Programs and Services of SUCs in Region IX.

Services/Programs	Implementers		Beneficiaries	
	AWV	D	AWV	D
Education	3.91	WI	3.82	WI
Livelihood generation	3.96	WI	3.73	WI
Health and nutrition	3.56	WI	3.26	I
Good governance	3.34	I	3.11	I
Environmental management	3.62	WI	3.16	I
General Mean	3.68	WI	3.42	WI

Legend:

4.21 – 5.00 - Very well involved    1.81 \_ 2.60 - Less involved  
 3.41 – 4.20 - Well involved        1.00 \_ 1.80 - Not involved  
 2.61 – 3.80 - Involved

Meanwhile, problems were met by both respondents in the implementation and their involvement of the extension programs and services of SUCs and data are presented in Table 3. The table shows that the two groups of respondents did not identify the same item as their top most encountered problems. The implementers considered item 5 which is “transportation is not available all the time” as their number one problem. Unanimously, the beneficiaries





claimed that the “period of classes is too short for the training” which is item number 6 as their first problem. However, other items ranked almost the same in both respondents.

It can be deduced that the extension workers/faculty are sincere enough in performing their responsibility as agent of change. In spite of the problems encountered during the conduct of the extension programs and services yet they manifest no indication of losing their enthusiasm to share their expertise to the clientele. Thus, the program is well implemented. Indeed, this is a respond to the mandate that SUCs must actively involve in the four-fold functions: instruction, research, extension and production. Geronimo (2001) stressed out that in the process of effecting community development, many difficulties arise as these are inevitable. Therefore, teachers who get involved in this endeavor must not only equip themselves with knowledge, skills, attitudes and technology but also the values of being patient, understanding and the sincere intention of sharing whatever resources they have to the constituents.

On the other hand, beneficiaries felt the needs of lengthening the period of time of the training. To them, the transfer and acquisition of knowledge and the development of skills cannot be done just within the span of few days, otherwise certificate of completion maybe awarded to half-baked trainees.

Table 3. Problems Met by the Implementers and Beneficiaries in the Implementation of the Extension Programs and Services.

Items	Implementers		Beneficiaries	
	Frequency	Rank	Frequency	Rank
There is no action program to guide the project.	24	8	78	9.5
There are no sufficient materials and tools for better learning process.	37	3	108	2.5
The extension workers are incompetent and unprepared.	13	11	22	12
Trainers are not coming regularly for the extension activities.	15	10	78	9.5
Transportation is not available all the time.	42	1	96	5
Period of classes is too short for the training.	27	7	133	1
Extension workers/faculty are not given incentives.	39	2	96	5
Training time coincides with work at home, sea or farm.	31	6	108	2.5
Participants are always absent from the class.	2	12	51	11
Participants use their own materials for the return demonstration.	32	5	87	7
Linkage partners are not doing their responsibilities as stipulated in the MOA.	35	4	80	8
There is no proper monitoring and evaluation of the services conducted.	17	9	96	5



Table 4. Significant Difference in the Ratings of Implementers and Beneficiaries on the Implementation of Extension Programs and Services of SUC’s in Region IX.

Indicators	Implementers	Beneficiaries	$\bar{X}D$	t-Value
Education	3.82	3.64	0.18	1.31ns
Livelihood Generation	3.73	3.74	0.01	0.014 ns
Health and Nutrition	3.73	3.70	0.03	0.23 ns
Good Governance	3.68	3.71	0.03	0.23 ns
Environmental Management	3.41	3.68	0.27	1.56 ns

Legend :

\* - significant    T.V. - 1.96    df - 263  
 ns - not significant    α - 0.05

Tabular values reveal that the implementers and beneficiaries obtained almost similar ratings on the extent of implementation of SUCs extension programs and services. When the data were subjected to t-test, the computed t- result was less than the tabled value of 1.96 with 263 degree of freedom at 0.05 level of confidence. Hence, there is no significant difference in the ratings of both respondents on the implementation of extension services and programs of SUCs in Region IX.

Table 5 . Significant Difference in the Perceptions of the Implementers and Beneficiaries on their Involvement of the Extension Programs and Services of SUCs in Region IX.

Indicators	Implementers	Beneficiaries	$\bar{X}D$	t- Value
Education	3.91	3.82	0.09	1.11 ns
Livelihood Generation	3.96	3.73	0.23	1.72 ns
Health and Nutrition	3.56	3.26	0.30	1.99 *
Good Governance	3.34	3.11	0.23	1.72 ns
Environmental Management	3.62	3.16	0.46	2.32 *

Legend:

\* \_ significant    α \_ 0.05    t-v – 1.96  
 ns \_ not significant    df \_ 263

Table 5 reveals that there were two extension services perceived by both respondents as “well implemented” and the beneficiaries were also benefited. These were supported by the means of 3.56 and 3.62 for the implementers and 3.26 and 3.16 for beneficiaries. The mean differences of the two indicators were 0.30 and 0.46, it resulted to t-test values of 1.99 and 2.32 which exceeded the tabled value of 1.96 with 263 degree of freedom at 0.05 level of significance.



It is safe to say, that there is significant difference in the perceptions of both implementers and beneficiaries on their involvement in the extension services and programs on the health and nutrition services and environmental management.

However, in the interview conducted to the beneficiaries revealed that the barangay has mandated its constituents to maintain cleanliness as they believe would redound to better health. Planting vegetables or backyard gardening was also encouraged to increase food availability at the household level. Furthermore, it was emphasized that proper way of preparing nutritious foods and the application of the basics for keeping good health can dramatically reduce the risk for many common health problems.

Education, livelihood generation and good governance with the t-results of 1.11, 1.72 and 1.72 did not exceed the critical value of 1.96 with same degree of freedom and level of significance. The t-values indicated no significant difference in the perceptions of both implementers and beneficiaries on their involvement on extension services and programs. Therefore, both respondents have similar perceptions regarding the extension services on education, livelihood generation and good governance.

## **Conclusions**

In view to the findings of this study, the following conclusions were derived:

1. The extension services along education, livelihood generation, health and nutrition, good governance and environmental management are perceived by both implementers and beneficiaries as well- implemented.
2. The implementers and the beneficiaries perceive the extended program on education, livelihood generation, health and nutrition, good governance and environmental management as well involved.
3. There is no significant difference in the ratings given by both respondents on the implementation of the extension programs and services of SUCs in Region IX along education, livelihood generation, health and nutrition, good governance and environmental management.
4. There is no significant difference in the perceptions of the implementers and beneficiaries on their involvement in the extension services along education, livelihood generation and good governance. However, there is significant difference in their perceptions on their involvement in the extension program on health and nutrition and environmental management.

## **Recommendations**

Based on the findings and conclusions, the following recommendations are hereby offered:

1. Each SUC should exert more effort to get the people involve in the extension program.
2. A vehicle should be provided by each SUC to be used for the extension activities.



3. The school must provide incentives to faculty/teachers involved in the extension services in order to boost their morale.
4. Lengthen the period of time for the training on skills enhancement and development.
5. A regular schedule be made by the Extension Director for a dialogue reminding the linkage partner especially the LGU of its responsibility based on the MOA.
6. A study be made on the impact of extension programs and services of SUCs in Region IX.
7. Each SUC should conduct proper monitoring and evaluation of the extended program to identify the strengths and weaknesses and likewise the impact of the program to the community.

## **References**

Campiseño, Salvador Y. (2004) “The Partnership Initiatives of Government and Non-Government Organizations In Zamboanga del Norte, Mindanao, Philippines: Basis For A Development Program”. Central Visayas Polytechnic College, Dumaguete City.

Geronimo, Marites C. (2006). “ The Involvement of Teacher Education Graduates in Community Development Activities”. Philippine Normal University, Alicia, Isabela.

Elman, Nichol.(1998). “The Commission on Higher Education State of Extension Service in Philippine Institutions of Higher Learning”.

<http://en.Wikipedia.org/wik/sustainable dev.>

<http://www.unisctf.Or/huset/gg/governance>



## **ANTIFUNGAL PROPERTIES OF NEEM (*AZARDIRACHTA INDICA*) LEAVES EXTRACT TO TREAT HAIR DANDRUFF**

**Anand Niharika<sup>1</sup>, Johnson M. Aquicio<sup>2</sup>, Arulsamy Anand<sup>3</sup>**

<sup>1&2</sup>Small World Christian School Foundation, Baguio City, Philippines

<sup>3</sup>Professor, Graduate School, University of the Cordilleras, Baguio City, Philippines

### **Abstract**

*Dandruff due to fungus is extremely common, affecting close to 50% of the world's population and it also most prevalent between ages 15 and 50. Thus, this study has been conducted to come up with Neem leaves extract that has high antifungal properties.*

*Neem is an attractive broad-leaved, evergreen tree which can grow up to 30m tall and 2.5m in girth. Its trunk usually straight is 30-80 cm in diameter. Its spreading branches form a rounded crown of deep-green leaves and honey-scented flowers as much as 20m across. Neem is native of India, Pakistan, Thailand and Burma. Its actual origin is still debatable, but it is for sure that it originated in the Indian subcontinent and from there it spread to different parts of the world.*

*The Neem leaves were macerated in 400 mL ethanol and covered with parafilm. It was allowed to stand in room temperature for 48 hours then it was filtered. To get 100% extract, an amount of the extract was placed in an evaporating dish to be subjected to water-bath. The extract looked dark brown in its liquid form.*

*The fungi (*P. ovale*) was cultured in the Laboratory. Various levels of Neem extract concentration (25%, 50%, 75%, and 100%) were prepared. The inhibiting capacity of each level on fungus that causes dandruff was tested using agar cup method. To establish a firmer and more solid foundation of the contention that high antifungal properties is present, experiment was conducted in three treatments. The 100% extract of Neem leaves produced the widest zone of inhibition which was found statistically highest than the other concentration levels.*

**Key Words:** Neem Leaf, *Azadirachta indica*, Anti-fungal, *Pityrosporum ovale*

### **Introduction**

The researcher chose this investigatory project because of its feasibility, availability, antifungal properties, and practicality. This study will help us find a potential product in nature. It is also environmental friendly as the process does not need expensive factory equipment and the substances do not leave environmental residue.

### **Neem**

Neem is native of India, Pakistan, Thailand and Burma. Its actual origin is still debatable, but it is for sure that it originated in the Indian subcontinent and from there it spread to different



parts of the world. As Neem is considered in India as a very important part of the household and is very much respected for its medicinal value, it spread with the migration of people. It is said that when people from India were taken as slave to the Fiji islands, with them they took the seeds, kernels of Neem. As Neem can grow in various temperatures, it flourished in tropical and warmer climates of Fiji and from there is spread to the south Pacific islands. Now Neem is cultivated in central and south America, West Indies and Australia. (Refer Appendix-I)

Neem or Margosa is a botanical cousin of mahogany. It belongs to the family Meliaceae. The Latinized name of Neem - *Azadirachta indica* - is derived from the Persian:

Azad = Free, dirakht = Tree, i - Hind = of Indian Origin

This literally means: 'The Free Tree of India'

Neem is an attractive broad-leaved, evergreen tree which can grow up to 30m tall and 2.5m in girth. Its trunk usually straight is 30-80 cm in diameter. Its spreading branches form a rounded crown of deep-green leaves and honey-scented flowers as much as 20m across.

This amazing tree has been a help to human race since 4,500 years ago. One of the immediately perceivable impact of this antifungal, antibacterial and, perhaps, even antiviral king of the arboretums on the human body is its guaranteed ability to heal or cure many, if not all, skin diseases or epidermal problems ranging from dandruff, acne, psoriasis, ringworm, athlete's foot, warts, chicken pox, small pox and malaria. Further, Neem produces pain-relieving, anti-inflammatory and fever-reducing compounds that can aid in the healing of cuts, burns, sprains, earaches, headaches, as well as fevers, possibly dengue. On the other hand, Neem tree encompasses the treatment of a variety of physical ailments such as heart disease, diabetes, blood disorders, digestive and nervous disorders, parasites and, possibly, cancer. Moreover, Neem may also be used as spermicidal as well as mouthwash.

## **Dandruff**

Scalp skin is unique on the body due to the density of hair follicles and high rate of sebum production. These features make it susceptible to superficial mycotic conditions (dandruff, seborrheic dermatitis, and tinea capitis), parasitic infestation (epiclerosis capitis), and inflammatory conditions (psoriasis). These scalp conditions share similar clinical manifestations of scaling, inflammation, hair loss, and pruritus.

## **Causes of Dandruff**

### **Internal causes of dandruff:**

1. Hormonal imbalance
2. Allergic Hypersensitive
3. Lack of rest and fatigue



4. Improper nutrition and intake of fried foods and aerated drinks, fats, sugars, salts, chocolates, sea food, Peanuts and lastly dairy products

5. Stress, anxiety and tension.

### **External causes of dandruff**

1. Frequent use of hair sprays and gels

2. Use of mousse, hairspray and instruments such as heated hair straighteners

3. Infrequent shampooing of the hair or inadequate rinsing of the scalp can cause dandruff problems.

4. Cold weather and dry indoor heating.

5. Tight fitting hats and scarves.

6. Extreme weather, oily skin and use of lotions that contain alcohol may increase the chances of dandruff

### ***Main Cause of Dandruff***

The cause of dandruff is usually a fungus called *Pityrosporum ovale* (P.ovale) which is a naturally occurring yeast-like organism found on the scalp and other parts of human skin. The fungus is found most on skin areas with plenty of sebaceous glands: on the scalp, face and upper part of the body and gradually P.ovale fungus tends to concentrate on the scalp where a large number of sebaceous glands can be found. These are the glands that produce your skin's natural oil, called sebum, which contributes to the growth of the P. ovale fungus.

As the fungus grows in size and numbers, it results in dandruff.

### **Statement of the Problem with Hypotheses**

This research aims to answer the following queries:

- a) Does Neem leaves extract have antifungal properties?
- b) Does Neem leaves extract have high antifungal properties?

### **Significance of the Study**

Why use Neem?

The common treatment for the dandruff is antifungal and anti-inflammatory.

- a) The **antifungal** is treated with antifungal drugs. To treat the antifungal, the drug has to be specifically designed to treat the fungi. However the fungal and human cells are similar at the molecular level. This makes it more difficult to find or design drugs that target fungi without



affecting human cells. Consequently, many antifungal drugs cause side-effects. Some of these side-effects can be life-threatening if the drugs are not used properly.

b) The **anti inflammatory** is treated with cortisone which belongs to group of steroids. Excessive use of cortisone will help reduce excess inflammation however it may cause damage to the spine.

Neem produces antifungal, antibacterial, pain-relieving, and anti- compounds that would treat dandruff.

## **Methodology**

### **Antifungal Extraction from Neem Leaves**

Cut a hand full of semi-dry Neem leaves in to small pieces. Macerate the leaves in 400ml ethanol and cover it with Parafilm. Let it stand in room temperature for 48 hours. Filter it. To get 100% extract, place an amount of the extract in an evaporating dish to be subjected to water-bath.

### **Determining High Antifungal Properties of Neem Leaves Extract**

The fungi (*P. ovale*) were cultured in the Laboratory. Various levels of Neem extract concentration (25%, 50%, 75%, and 100%) were prepared. The inhibiting capacity of each level on fungus that causes dandruff was tested using agar cup method. To establish a firmer and more solid foundation of the contention that high antifungal properties is present, experiment was conducted in three treatments:

## **Results and Discussion**

### **Determining High Antifungal Properties of Neem Leaves Extract**

#### Antimicrobial Susceptibility Test with Neem Leaves Extract

**Table 1: Zone of Inhibition of the organism from dandruff as affected by Neem leaves using agar disc method**

Sample Concentration	Replication		
	1	2	3
100%	15mm	18mm	19mm
75%	10mm	11mm	13mm
50%	10mm	9mm	9mm
25%	7mm	6mm	7mm

The results show that 50% and above level of concentration has optimal level of inhibition on the dandruff growth. The higher the concentration, the higher is the inhibition on the growth of dandruff. The various measurement seen in the table refers to the zone of inhibition (diameter)





in millimeters. The extract is said to be effective if the zone of inhibition is 10 mm and above. The fungus is susceptible to the Neem leaves extract.

**Table 2: Statistical Analysis of the Effect of Neem Leaves Extract**

Concentration of Neem Leaves Extract (%)	Mean of the Zone of Inhibition (mm)
100%	17.33 a
75%	11.33 b
50%	9.33 bc
25%	6.67 c

Means with the same letters are not significantly different, (Bonferroni, 5%).

Presented in Table 2 are the zones of inhibition produced by the different concentration of Neem extract. The 100% extract of Neem leaves produced the widest zone of inhibition which was found statistically highest than the other concentration levels. The sample treated with 75% Neem extract showed the second widest zone of inhibition (11.33 mm) but was found at par with the 50% concentration, which produced about 9.33 mm zone of inhibition. The sample treated with the lowest concentration of 25% extract produced the smallest diameter of 6.67 mm, which was found not significantly different from the 50% extract. Thus, the sample treated with 100% extract was the most effective.

## **Summary, Conclusion, and Recommendation**

Even though Neem tree has been existing for more than 4500 years and known for its medicinal properties, there are hardly any studies conducted in Philippines to understand its uses in treatment of dandruff. This study is one of its kinds in Philippines. The main objective of this research is to determine its high antifungal property, which is less harmful to the normal cells. Secondly, the study intends to prove that Neem leaves extracts can inhibit the growth of *P. ovale* fungus, which is the main cause of dandruff.

### **Summary of the Findings**

The study aimed to determine whether antifungal extracts can be taken out from Neem leaves and if this contains high antifungal properties. Based from the observations and results, the following were the salient findings of the study:

The 100% extract of Neem leaves produced the widest zone of inhibition which was found statistically highest than the other concentration levels.

### **Conclusions**

The following conclusions were drawn based from the findings of the study:

1. Antifungal extracts can be taken from Neem leaves extracts.
2. Neem leaves extracts have high antifungal content.



### **Recommendations**

Based from the findings and conclusions of the research, further studies must be conducted to validate the statements:

Since Neem leaves extracts have high antifungal content, it can turned into antidandruff shampoo.

Further experiments could be done to understand the effect of the Neem leaves extract on human beings.

There could also be a study to find out how much does the Neem leaves extracts affect the normal cells when used as antidandruff shampoo.



## **References**

Amelia C. Bulmer<sup>1</sup> and Glenn S. Bulmer<sup>1</sup> The antifungal action of dandruff shampoos, *Mycopathologia*, Volume 147, Number 2 / August, 1999, 63-65

Boekhout T, Kamp M, Gueho E. Molecular typing of *Malassezia* species with PFGE and RAPD. *Med Mycol* 1998;36:365-72.

Boni E. Elewski, 2005, Clinical Diagnosis of Common Scalp Disorders, *J Investig Dermatol Symp Proc* 10:190 –193,

Gueho E, Boekhout T, Ashbee HR, Guillot J, Van Belkum A, Faergemann J. The role of *Malassezia* species in the ecology of human skin and as pathogens. *Med Mycol* 1998;36:220-9

Gueho E, Leclerc MC, de Hoog GS, Dupont B. Molecular taxonomy and epidemiology of *Blastomyces* and *Histoplasma* species. *Mycoses* 1997;40:69-81.

Gueho E, Midgley G, Guillot J. The genus *Malassezia* with description of four new species. *Antonie Van Leeuwenhoek* 1996;69:337-55.

Hay RJ, Graham-Brown RA. Dandruff and seborrheic dermatitis: causes and management. *Clin Exp Dermatol* 1997;22:3-6.

Leyden JJ, McGinley KJ, Kligman AM. Role of microorganisms in dandruff. *Arch Dermatol* 1976;112:333-8.

Malassez, L. Note sur le champignon du pityriasis simple. *Arch Physiologie* 1874;1:451.  
Robert Baran, Howard I. Maibach., 2005 Text book of cosmetic dermatology Taylor and Francis Publishers, p 259.

Pierard-Franchimont C, Hermanns JF, Degreef H, Pierard G. From axioms to new insights into dandruff. *Dermatology* 2000;200:93-8.

Shuster S. The aetiology of dandruff and the mode of action of therapeutic agents. *Br J Dermatol* 1984;111:235-42.

Saint-Leger D, Kligman AM, Stoudemayer TJ. The role of resident microflora in the pathogenesis of dandruff. *J Soc Cosmet Chem* 1989;40:109-17.

<http://www.discoverneem.com/neem-tree.html>

<http://www.nature.com/jidsp/journal/v10/n3/full/5640201a.html>

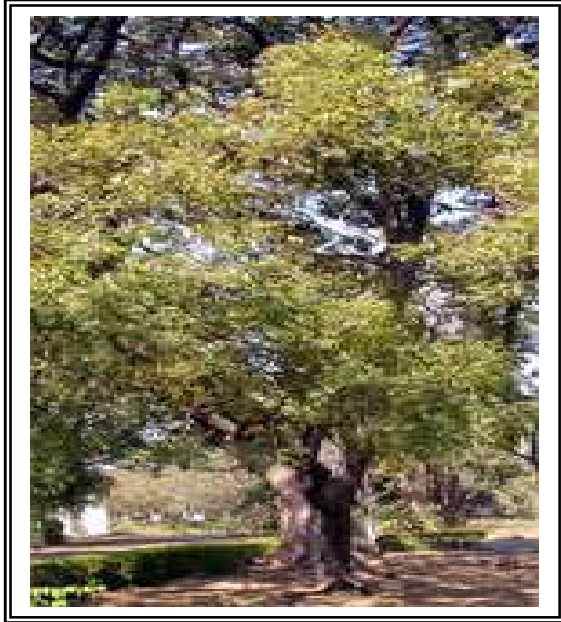
<http://www.innvista.com/health/herbs/castorop.htm>

<http://www.stuartxchange.org/TanganTangan.html>

<http://www.crescentbloom.com/>



## APPENDIX- I



**NEEM TREE**



**NEEM LEAVES, FRUIT  
& STEM**

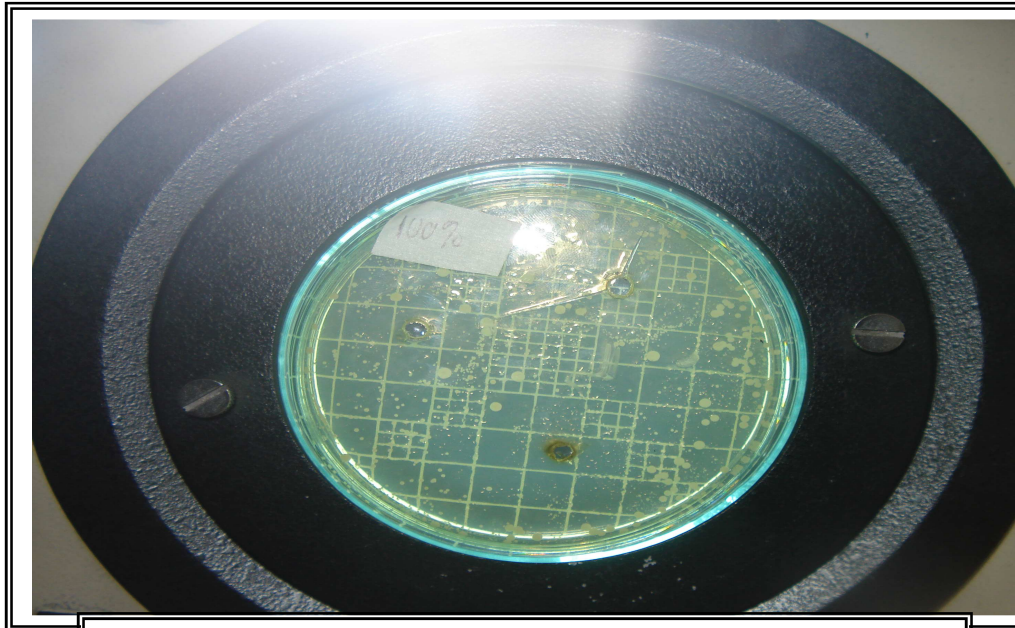


**NEEM LEAVES AND FRUITS**

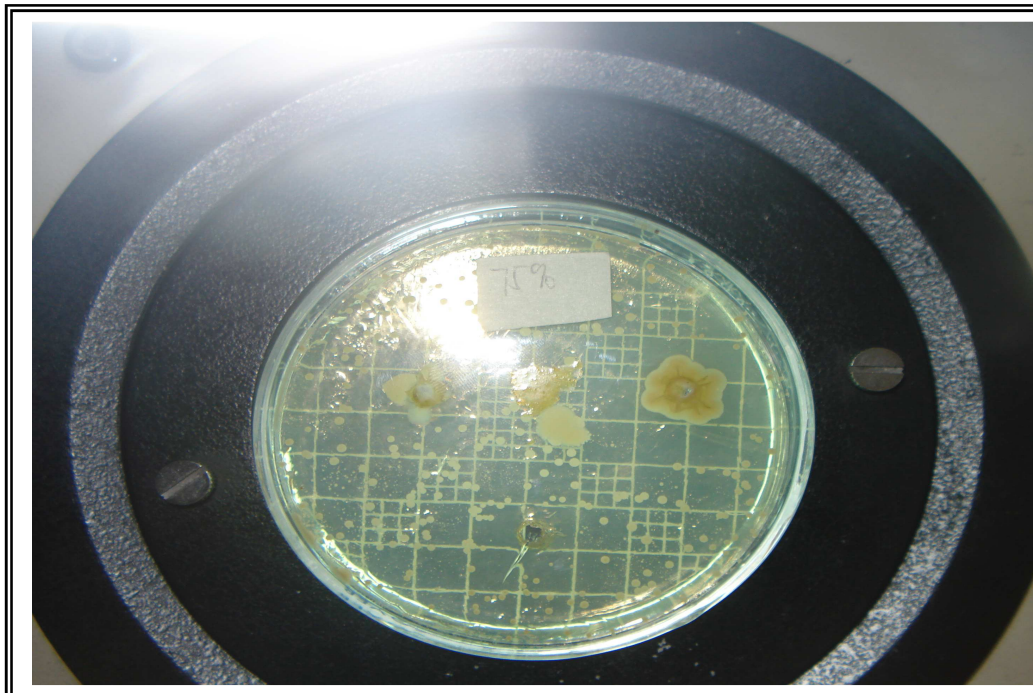


## **APPENDIX- II**

**Zone of inhibition of the unknown organism from Dandruff as affected by Neem leaves using agar disc method**



**100% Sample Concentration –Showing 18 To 19 Mm  
Inhibition on the Growth of the Dandruff**



**75% Sample Concentration –Showing 11 To 13mm  
Inhibition on the Growth of the Dandruff**



## **KNOWLEDGE, ATTITUDES, AND EXPERIENCES OF GRADE SIX PUPILS OF SAINT LOUIS UNIVERSITY - LABORATORY ELEMENTARY SCHOOL ON MEDICATION USE**

**Carl Froilan D. Leochico, Samantha S. Bartolo, Shiela B. Candelario, Amichelle A. Ebes, Ralph Christopher S. Manaois, Maria Luisa V. Pasahol, Leo Emmanuel R. Bunag, MD, FPSECP, John Anthony A. Domantay, MD, FPSP, PhD**  
Department of Pharmacology, College of Medicine  
Saint Louis University, Baguio City, Philippines

### **Abstract**

*The objective of the study was to establish local baseline information on adolescents' current level of knowledge, attitudes, and experiences with medication use. A Cross-sectional study design was used to study all grade six pupils enrolled in Saint Louis University – Laboratory Elementary School (SLU-LES), Baguio City, Philippines, during school year 2009-2010.*

***Results** Out of 431 grade six pupils, only 419 respondents completed the questionnaire. The mean score on the knowledge subpart was  $5.1169 \pm 1.6276$  out of 10, interpreted as low level of knowledge. They showed favorable attitudes ( $8.1456 \pm 1.3749$  out of 10), and extensive experiences ( $5.6110 \pm 1.4556$ ). Significant differences were found between the general average range and knowledge (95% C.I.). Attitudes were influenced by both general average and ethnic background ( $p$ -value  $< 0.05$ ). A significant association was found between knowledge and experiences on post-hoc analysis.*

***Conclusions** Low level of knowledge may put adolescents at risk for health-related problems, and poor transition from childhood to adulthood. Educational efforts are warranted to correct misconceptions, and to improve pupils' medication practices.*

**Key words:** knowledge, Attitude, Medication Use

### **Introduction**

The adolescent years mark a period of transition towards independence in a lot of activities, including the development of appropriate healthcare behaviors, which are, at this time, becoming less relied on parents or caregivers. Such is reflected in a recent study, which stated, "The transition from childhood, with parental control of medication administration, to independent adulthood is linked by a period of adolescence, when most individuals first begin to take responsibility for self-medicating minor illnesses and become more involved with managing chronic conditions."<sup>1</sup>

Before adolescents can formally assume such new responsibilities, it is imperative that they possess three prerequisites, namely, (1) adequate knowledge of common medications, (2)



positive attitudes towards medication use, and (3) various experiences with medicines that provide them practical learning. These prerequisites can assist them towards their gradual shift to independence that can guarantee safe and effective outcomes in terms of healthcare behavior.<sup>2</sup>

In the United States, self-medication begins in early adolescence, often during the middle school years, so that by the age of 16, almost all young adults have been taking medicines on their own, as reported by Buck. The degree of independent medication use in the adolescent age group is confirmed in several other studies with results similar in terms of both over-the-counter (OTC) and prescription medications. An evaluation of 392 families of children with asthma participating in an urban school-based education program revealed that more than 50% of the children, at least 9 years of age, were responsible for their own medication administration.<sup>3</sup>

However, there are reports about considerable doubts in the age at which independent, proper, and reliable self-care is achieved, and in the accuracy of medication and dosage selection among adolescents.<sup>4</sup> When Stoelben and colleagues assessed the level of medication frequency and knowledge among 53 adolescents in Dresden, Germany, they concluded that despite the relative frequency of medication use, the students had little understanding of common medication information.<sup>5</sup> On the area of knowledge, the test results yielded a mean score as low as  $5.74 \pm 1.89$  out of 13. Forty-seven percent knew the correct definition of an antibiotic, but only 6% could define accurately what an analgesic is for, despite figures that showed analgesics and antipyretics as their most frequently used drugs. Indeed, while self-medication is prevalent among adolescents, they remain to have significant knowledge deficits, which may predispose them to medication misuse and/or adverse effects. Bozoni added that early self-administration of OTC medicines that are often without an adult being informed or consulted poses significant risks against sound health maintenance worldwide, even in countries with advanced prevention programs.<sup>6</sup> The results of similar studies emphasize the need for further research on the way children perceive medicines.

In the Philippines, baseline information is lacking with regards to medication use among adolescents. Although it is well documented that patterns of general health behavior are shaped early in life, the concrete level of the aforementioned prerequisites to independent medication use among adolescents has received sporadic attention over the years. Therefore, the present study wanted to establish baseline information to serve as future references in the development of appropriate educational methods aimed “at producing measurable and favorable shifts in the knowledge about, the attitude towards, and the use of medicines.”<sup>7</sup>

## **Methods**

Cross-sectional study.

### **Research Design**

#### **Population & Locale**

The target population was the whole batch of grade 6 pupils enrolled in SLU-LES during the school year 2009-2010. By virtue of total enumeration, all of them were supposed to be included in the study for a total number of 431 pupils. Thus, no inclusion or exclusion criteria were necessary.



## **Research Material**

An original questionnaire was used to gather necessary data. It was formulated from various readings of related literatures modified to suit in the local setting. It was also a product of the researchers' keen observation of current trends (e.g., as conveyed by the media), and informal interviews with medical and paramedical professionals (e.g., pharmacist, pediatrician, Dean of the College of Medicine (SLU-COM), and psychologist), and younger adolescent siblings and relatives.

The questionnaire consisted of two major parts. The 1st part was meant to obtain demographic data in line with moderator variables (gender, general average range, and ethnicity). The 2nd part, the questionnaire proper, consisted of three subparts, namely, (1) knowledge, (2) attitudes, and (3) experiences. Content validity of the research instrument was established when the questionnaire was subjected to expert scrutiny and critique by the Dean of SLU-School of Medicine.

## **Procedure**

Prior to floating the questionnaires, permissions were sought from the Principal of Phases Learning Center (PLC) and SLU-LES, where the pre-test and actual study were conducted, respectively. A pre-test was necessary to check if all items in the questionnaire could be easily understood by grade six pupils, and to establish reliability of the instrument. The questionnaires were administered personally by the researchers in order to facilitate the session and accommodate any clarifications.

A script was prepared to standardize the administration of the questionnaire. It contained the purpose and benefits of the study that served as part of the introduction to the activity. The questionnaires were handed out only after proper instructions were given and pupils' clarifications were answered. There was no time limit in the completion of the questionnaire to encourage truthful and accurate responses. Completed questionnaires were returned immediately to the researcher-in-charge to ensure 100% return-rate. They were then skimmed in order to check for unclear or missing information and make necessary clarifications through informal interviews to prevent having gaps of information.

## **Statistical Analyses**

After all questionnaires have been checked and given corresponding scores, all data were encoded and analyzed statistically using Epi Info 3.5.1 for Windows. Statistical significance was defined with 95% confidence interval. Descriptive statistics were calculated for all study variables.

The associations among different variables were determined using either t-test or f-test, where appropriate. The weighted mean scores were computed and interpreted to determine the target population's level of knowledge, attitudes, and extent of experiences (dependent variables), as reflected in Table 1.





## **Results**

During the conduct of the pre-test, the pupils did not have any difficulty in understanding all the items in the questionnaire since they raised no questions or clarifications despite frequent prodding from the researchers. The results of the pre-test revealed a value of 0.23 on odds ratio, indicating that even correlations as small as such may have a predictive value, especially with a small sample population.<sup>8</sup>

For the study proper, out of 431 grade six pupils from SLU-LES, only 419 respondents completed and returned the questionnaire because a total of 12 pupils from different sections were absent on the day of the administration of questionnaire. Table 2 summarizes the demographic characteristics of the respondents. Majority of the respondents were males (51%). Most of the pupils indicated that their general average during the second quarter of the same school year ranged from 81-85 (54.7%). Meanwhile, 53.7% of the pupil-respondents were predominantly Tagalog.

The mean score on the knowledge subpart was  $5.1169 \pm 1.6276$  out of 10, interpreted as low level of knowledge. (Table 1) The rates of correctness for all knowledge items were extremely diverse, ranging from 22.7% to 86.6%. The minimum score was 1/10, while there was one pupil who got a perfect score of 10. Questions related to the side effects of medicines, such as mefenamic acid (K6), had the lowest numbers of correct responses among the ten items. (Table 3) Knowledge on the appropriate duration and frequency of use of mucolytic agents (K7) and antibiotics (K10) also had low numbers of correct answers. Only 43.7% of the pupils were knowledgeable on specific brand names of pain relievers, specifically paracetamol (K8). However, the highest numbers of correct responses were found among items that reflected their knowledge on the indications of medicines (K1, K9, K3).

Mean scores from the different groups of general average range in the knowledge subpart were significantly different ( $p < 0.05$ ). Pupils, whose general average ranged from 91-95, had a mean score of 5.7555 out of 10, interpreted as high level of knowledge. In contrast, pupils with a general average range of  $< 75$  got a low mean score of 4/10 for knowledge. For other variables on knowledge, such as gender and ethnicity, there were no significant differences found. Both males and females, and all ethnic groups had low mean scores on knowledge when data were treated separately according to gender and ethnicity, respectively.

Overall, the pupils showed favorable attitudes ( $8.1456 \pm 1.3749$  out of 10) towards medication use. Items regarding their compliance with antibiotic treatment (A2), and appropriate actions on the emergence of adverse drug reactions (A10) had the lowest numbers of favorable responses. (Table 4) In contrast, the highest number of pupils who agreed to the statements was found in items regarding compliance despite poor palatability (A7). Significant differences were found in the general average range and ethnicity in the attitudes subpart. Pupils with a general average range of 91-95 showed positive or very favorable attitudes (9.2222). In contrast, pupils with a general average range of 75-80 had a mean score of 7.093. In terms of ethnicity, pupils, who were from Pampanga, had the most favorable attitudes (9.000) among ethnic groups.

The mean score on the experiences subpart was  $5.6110 \pm 1.4556$  out of 10, indicating an extensive level of experiences with medication use among grade six pupils. (Table 1) The



lowest percentage, only 14.6%, indicated that they have experienced self-medicating (E4). (Table 5) The highest percentage claimed they experienced the positive effects brought about by intake of medicines. However, more than 50% of the pupils indicated that they also remembered not getting well even after intake of a certain medicine. Pain relievers (65.6%) were more commonly used than antibiotics among the pupil-respondents, as reflected by item E3. No significant differences were found among the variables (gender, general average range, and ethnicity) and the extent of experiences.

After performing Scheffe's method, significant associations between pairs of dependent variables were revealed between knowledge and experiences only.

## **Discussion**

The data demonstrate that the grade six pupils of SLU-LES have favorable attitudes and extensive experiences, but still lack appropriate knowledge on medication use. Studies have established that knowledge and attitudes influence the pediatric patients' behaviors and outcomes. Enrichments in knowledge are often correlated with better health practices.<sup>9</sup> Thus, there is a need to improve grade six pupils' knowledge on medication use to decrease the risk of medication misuse.

The primary school setting is ideal for imparting information on basic medication use as children begin to develop attitudes and beliefs early in their school years.<sup>10</sup> Beginning formal education with children on medicines will lead them to develop rational and safe use as they make their transition to adulthood. In the Philippines, inappropriate use of antibiotics remains an unsolved, serious problem, which is complex and multi-factorial.<sup>11</sup> One major factor cited is the obvious lack of appropriate knowledge on medicines among adults, from whom children base their early foundations of knowledge for their own medication practice and behavior.

A similar study that surveyed the knowledge of children on medicines stated that most of the responses were based on the children's personal observations and experiences, rather than on sound knowledge or formal information imparted to them.<sup>10</sup> Such conclusion was attributed to the lack of uniformity in responses and the high percentage of incorrect responses to certain queries.

### **Knowledge**

Results from the present study strongly indicate that the pupils' knowledge was less than satisfactory, as reflected by a low mean score of  $5.1169 \pm 1.6276$  out of the highest possible score of 10. More than half (54.9%) of all respondents thought it was correct to discontinue antibiotics when one felt better already. The prevalence of misconceptions on antibiotic use among adolescents was confirmed in several studies. For instance, Stoelben showed that 53% of surveyed students did not know the correct definition of an antibiotic.<sup>5</sup> The results of the present study bear a significant implication on the growing rates of antibiotic resistance due to non-compliance. In addition, most children did not know the correct dosages of commonly used medications, such as antibiotics and mucolytics, which may increase the risk of either underdosage (ineffectiveness) or overdosage (toxicities). However, a great majority already knew that dosages should be different between older and younger age groups, as reflected by the result for K9. (Table 3)



Although the pupils knew the correct indications of certain medicines, such as paracetamol as both anti-pyretic and analgesic, majority of them were still unaware of the occurrence of common side effects. The highest percentage of incorrect answers (77.3%) corresponded to the item on the most common side effect of mefenamic acid. These pupils thought that such medicine would not cause gastric irritation, possibly predisposing them to wrong intake of mefenamic acid with an empty stomach. Similarly, many also thought that vitamin C is not best taken with food.

Lastly, the data show that children lack awareness on the common brand names of certain medicines. Only 43.7% knew that Tempra and Biogesic, the more frequently used drugs among grade six pupils of SLU-LES (as reflected by E3), are of the same generic name. As a possible consequence, a scenario of toxicity may arise when a child takes in two medicines of the same generic name at the same time, causing an additive effect from both drugs.

### **Attitudes**

The respondents had a mean score of  $8.1456 \pm 1.3749$ , interpreted as having favorable attitudes towards the use of medicines in general. Specifically, attitudes were measured in terms of the children's interest, motivation, and compliance, which are all interrelated.

### **Interest**

The attitude of a patient towards a specific treatment was theorized by Bastiaens to be influenced by the patient's interest in the therapy.<sup>2</sup> The patient that shows enthusiasm in the treatment regimen may be manifested by his initiative in inquiring about the purpose of medicines he is advised to take. Majority of the pupils (92.6%) implied this particular enthusiasm (A1), a positive attitude needed by any pediatrician, who has the goal of improving compliance to the prescribed regimen and actual clinical outcome of the treatment.<sup>2</sup> (Table 4) However, children's relatively favorable initiative and interest in the therapy have yet to reflect or show correspondence to their current level of knowledge, which was relatively low. The disparity may be attributed to the types of questions the children ask their elders, and the kinds of answers the latter give. The pediatric patients draw their knowledge of medication use from their parents or caregivers, and doctors. They may also acquire health habits by observing family members' health behaviors at home. Therefore, if the health messages imparted to them were erroneous, the child would possibly develop wrong beliefs and attitudes. However, this is in disagreement to the study of Bozoni, who argued that a child is not simply a passive recipient of adult care and knowledge, but rather shows considerable autonomy in formulating specific health decisions.<sup>6</sup> In fact, he added that children at times "challenge the decision making skills of the parents concerning the use of medicines, insist on a treatment and reject another, or object to the use of pharmaceuticals" due to common complaints or side effects they experience.

### **Motivation**

The health-related behavior of children is especially influenced by various motivations, which may either be positive or negative. The present study found out that a minority of children are moved to action (A4) or non-action (A8) by wrong motivations, such as fear of being scolded or reprimanded, and fear of being teased in school, respectively. Data also suggested that greater compliance can be achieved in exchange of a reward (A9), which also motivates the child in a wrong way in that they fail to recognize the sole essence of taking medicines – to improve one's health.



### **Compliance**

Adolescents perceived medicines as useful, yet harmful. More than 87% thought that benefits outweighed the burden of medication compliance. Poor palatability of certain medicines did not hinder children from complying with their medications (A7). Yet, current issues on pediatric medication adherence still pressed the importance of palatability, acceptability, and formulations of medications prescribed for young children.<sup>12, 13</sup> However, the present study does not discount the fact that using simplified regimens of better-tasting medicines and age-appropriate delivery mechanisms may indeed improve adherence to drug therapy among pediatric patients. On another item, although many felt it was wise to stop taking the medicine that caused hypersensitivity reaction (A10), still a relatively high percentage thought otherwise, which suggests their lack of awareness on appropriate actions in the face of adverse drug reactions (ADRs). Lack of awareness on ADRs was explained in a prospective study that found low frequency of ADRs in the pediatric age group. The reason ADRs among ambulatory pediatric patients are rare, mild, and transient is that unlike adults, children are more often treated with fewer drugs (usually with few adverse effects, such as with antibiotics), for only one condition, and most do not have impaired renal or hepatic function.<sup>14</sup> Thus, children may have reduced risk of toxicities to begin with.

Lastly, majority of the children felt it was right to stop complying with antibiotics once symptoms were relieved (A2). The result coincided with their lack of knowledge on antibiotic dosage and risk of increasing antibiotic resistance.

### **Experiences**

A mean score of  $5.6110 \pm 1.4556$  for experiences correlated with the level of knowledge ( $5.1169 \pm 1.6276$ ) of children on medication use. Knowledge assimilation can indeed take the form of practical learning, wherein the adolescent gradually gains a bank of information about medicines from his active engagement and actual experiences with them, including either positive or negative effects.

Children who had positive experiences with medicines, such as having benefited from their therapeutic effects, most likely remembered the indications of medicines for which they were treated. Although antipyretics and analgesics were the more commonly used drugs than antibiotics (E3), the children had significant knowledge deficits on the former as to side effects and brand names. However, the present study was not able to identify their level of knowledge on the correct dosages of paracetamol. Nevertheless, the results of the study at hand were in concordance with the conclusion of Stoelben and colleagues.<sup>5</sup> Despite relative frequency of medication use, pupils remain to have significant knowledge deficits.

### **Other Significant Findings**

Significant differences ( $p < 0.05$ ) in the general average range were found in the knowledge and attitudes subparts. (Table 6) There was a direct relationship among the intelligence quotient, as reflected by the general average range, and the two independent variables, knowledge and attitudes.

In a survey done among hospitalized children & adolescents regarding psychopharmacological treatment, it was concluded that a child's knowledge and attitudes about pharmacotherapy correlated positively with mental age rather than chronological age. However, the study added



that the prescribing psychiatrists seemed to be highly influenced by chronological age in estimating a child's knowledge and perception about medication treatment. Consequently, clinicians may be prone to underestimating or overestimating pediatric patients' knowledge of pharmacotherapy and healthcare-related attitudes by "relying on the child's looks rather than the child's smarts."<sup>2</sup> However, the present study failed to verify and determine the accuracy of the general average range the pupils indicated due to inevitable reasons, such as unavailability of the people in charge, and lack of time.

There were also significant differences between the ethnic backgrounds of the pupils and the level of attitudes towards medication use. (Table 6) Liptak discovered that education and culture could strongly influence children's perceptions towards health-related practices.<sup>15</sup> Disparities in the adoption and maintenance of healthy lifestyles and adherence to medical regimens were attributed to disparities in cultural, ethnic, and socioeconomic factors. Although the present study did not consider the socioeconomic status of the pupils since eliciting such information may be difficult to verify, it presumed that such variable is relatively controlled in that the pupils mostly, if not all, belong to the same social class accounting for their enrollment in a private school. Nonetheless, to bridge the potential gap brought by various ethnic origins, the pediatrician needs to assess the patient's level of knowledge and attitudes, and determine whether misinformation or wrong perspectives influence the patient and the family.<sup>13</sup>

## **Conclusion**

The study showed that grade six pupils of SLU-LES have favorable attitudes and extensive experiences with medication use, but significant lack knowledge about proper use of medications and drug safety. Low level of knowledge may put adolescents at risk for health-related problems, and poor transition from childhood to adulthood, when they are expected to have responsible and safe healthcare behaviors and practices. Educational efforts are warranted to correct misconceptions, and to improve pupils' medication practices. Future studies are needed to initiate the formulation of appropriate educational strategies to augment the increasing gap in knowledge.

With the formal awareness of the current level of knowledge, attitudes, and extent of experiences regarding medication use among grade six SLU-LES pupils, similar studies can be done including a larger and broader spectrum of population also aimed at improving healthcare behaviors among Filipino adolescents.

## **Tables**

Table 1: Mean Scores, Range of Weighted Means (Intervals), & Corresponding Interpretations.

<b>Mean Scores</b>	<b>Intervals</b>	<b>Knowledge</b>	<b>Attitudes</b>	<b>Experiences</b>
9 – 10	3.25 – 4.00	Very high	Positive or very favorable	Very extensive
6 – 8	2.50 – 3.24	High	Favorable	Extensive
3 – 5	1.75 – 2.49	Low	Unfavorable	Limited
0 – 2	1.00 – 1.74	Very low	Negative or very unfavorable	Very limited



Table 2: Demographic Characteristics of Respondents. (N=419)

<b>Variable</b>	<b>No. (%)</b>
<b><i>Gender</i></b>	
Male	214 (51)
Female	205 (49)
<b><i>General Average Range</i></b>	
<75	6 (1.4)
75-80	43 (10.3)
81-85	229 (54.7)
86-90	132 (31.5)
91-95	9 (2.1)
>95	0 (0)
<b><i>Ethnicity</i></b>	
Igorot	67 (16)
Ilocano	86 (20.5)
Kapampangan	13 (3.1)
Pangasinense	19 (4.5)
Tagalog	225 (53.7)
Others:	
Batangueño	2 (0.5)
Bicolano	2 (0.5)
Bisaya	3 (0.7)
Chinese	2 (0.5)



Table 3: SLU-LES Grade Six Pupils' Knowledge On Medication Use  
In Descending Order. (N = 419)

<b>CODE</b>	<b>QUESTIONS</b>	<b>CORRECT ANSWER</b>	<b>CORRECT No. (%)</b>	<b>INCORRECT No. (%)</b>
K1	Paracetamol is used for fever, and it can also be given for headache.	True	363 (86.6)	56 (13.4)
K9	A 500 mg tablet of Biogesic is safe for use of 4 year-old children.	False	341 (81.4)	78 (18.6)
K3	Only sick people should take medications.	False	289 (69)	130 (31)
K4	Ascorbic Acid (such as Ceelin) is best taken with food.	True	201 (48)	218 (52)
K2	In taking antibiotics, such as Amoxicillin, one should complete the prescribed duration of treatment even when he feels better already.	True	189 (45.1)	230 (54.9)
K10	Usually, Amoxicillin is taken every 6 hours.	True	188 (44.9)	237 (50.1)
K8	Tempra produces similar effects as Biogesic.	True	183 (43.7)	236 (56.3)
K7	Solmux, used to treat cough, is taken only once a day.	False	155 (37)	264 (63)
K5	All medicines have side effects.	True	146 (34.8)	273 (65.1)
K6	One of the possible side effects of Mefenamic Acid (Dolfenal) is stomach irritation.	True	95 (22.7)	324 (77.3)



Table 4: SLU-LES Grade Six Pupils' Attitudes Towards Medication Use. (N = 419)

CODE	QUESTIONS	FAVORABLE ANSWER	AGREE No. (%)	DISAGREE No. (%)
A1	I feel I should always inquire first about the purpose of medications I am asked to take.	Agree	388 (92.6)	31 (7.4)
A2	I feel I can stop my intake of antibiotics (e.g., Amoxicillin) as soon as I feel better.	Disagree	231 (55.1)	188 (44.9)
A3	I feel happier & better when I take my medications, for there are more good things about it than the bad things.	Agree	366 (87.4)	53 (12.6)
A3	I feel happier & better when I take my medications, for there are more good things about it than the bad things.	Agree	366 (87.4)	53 (12.6)
A4	Only because I feel afraid to get scolded or punished that I take my medicines.	Disagree	37 (8.8)	382 (91.2)
A5	I don't feel that it is a must for medicines to be taken punctually or on time because taking it later has no difference.	Disagree	101 (24.1)	318 (75.9)
A6	I would rather be ill than to drink my medicine.	Disagree	32 (7.6)	387 (92.4)
A7	I feel I should take my medications even if they taste bad.	Agree	398 (95.0)	21 (5.0)
A8	I feel ashamed drinking my medicines in school because my classmates might tease me and call me " <i>lampayatot</i> ."	Disagree	28 (6.7)	391 (93.3)
A9	I feel like drinking my medicines only when there is a reward in store for me.	Disagree	35 (8.4)	384 (91.6)
A10	It feels wise to stop taking my medication as soon as I develop rashes or allergies.	Agree	219 (52.3)	200 (47.7)





Table 5: SLU-LES Grade Six Pupils' Experiences With Medication Use. (N = 419)

<b>CODE</b>	<b>QUESTIONS</b>	<b>YES No. (%)</b>	<b>NO No. (%)</b>
E1	I experienced feeling better after taking a medicine.	393 (93.8)	26 (6.2)
E2	I have experienced undesirable effects after intake of a certain medicine.	156 (37.2)	263 (62.8)
E3	I use pain relievers (Paracetamol) more often than antibiotics (Amoxicillin).	275 (65.6)	144 (34.4)
E4	I have tried taking medicines without orders from a doctor or from my parents.	61 (14.6)	358 (85.4)
E5	I was able to buy a drug from the pharmacy by myself.	169 (40.3)	250 (59.7)
E6	I had to take a medicine that tasted terrible.	388 (92.6)	31 (7.4)
E7	I have completed doctor-prescribed medications (e.g., I took antibiotics 3 times a day for 1 week).	372 (88.8)	47 (11.2)
E8	I was punished or scolded when I did not take my medicine.	124 (29.6)	295 (70.4)
E9	I remember not getting well even after I took a medicine.	224 (53.5)	195 (46.5)
E10	I experienced vomiting from intake of a bad-tasting medicine.	181 (43.2)	238 (56.8)



Table 6: Associations Among Variables.

VARIABLES	STATISTICAL VALUE	p-VALUE
<i>Knowledge</i>		
Gender	t= 0.3615	0.7179
General Average Range	f= 2.7089	0.0299
Ethnicity	f= 1.2022	0.3067
<i>Attitudes</i>		
Gender	t= 0.1530	0.8785
General Average Range	f= 10.7622	0.0000
Ethnicity	f= 2.8589	0.0150
<i>Experiences</i>		
Gender	t= 0.3185	0.7502
General Average Range	f= 0.7874	0.5338
Ethnicity	f= 0.6890	0.6320



## References

- Bastiaens, L: Knowledge, expectations, and attitudes of hospitalized children and adolescents in psychopharmacological treatment. *Journal of child and adolescent psychopharmacology*. 2009; 2(3), 157-171. Available at: [www.biomedsearch.com/.../Knowledge-expectations-attitudes-hospitalized-children/19630627.html](http://www.biomedsearch.com/.../Knowledge-expectations-attitudes-hospitalized-children/19630627.html)
- Buck, M: Self-medication by adolescents. *Pediatric Pharmacotherapy*. 2007; 13(5). Available at: [www.healthsystem.virginia.edu/alive/pediatrics/PharmNews/200705.pdf](http://www.healthsystem.virginia.edu/alive/pediatrics/PharmNews/200705.pdf)
- Bozoni, K., et al: Perception and knowledge of medicines of primary schoolchildren: the influence of age and socioeconomic status. *European Journal of Pediatrics*. 2006; 165(1), 42-49. Available at: [www.ncbi.nlm.nih.gov/pubmed/16222526](http://www.ncbi.nlm.nih.gov/pubmed/16222526)
- Chambers, C., et al: Self-administration of over-the-counter medication for pain among adolescents. *Arch Pediatr Adolesc Med*, 1997; 151, 449-455. Available at: [www.ncbi.nlm.nih.gov/pubmed/915845](http://www.ncbi.nlm.nih.gov/pubmed/915845)
- Desai et al. Knowledge and Awareness about Medicines among Primary Schoolchildren in Ahmedabad, India. *Regional Health Forum*, 2005; Volume 9
- Dy, E. Inappropriate Antibiotic Use in the Philippines. *Phil J Microbiol Infect Dis*. 1997; 26(2):77-87
- Fraenkel, J., and Wallen, N. (2007). *How to design and evaluate research in education*, 6<sup>th</sup> ed. Boston: McGraw Hill.
- Hsiao, F., et al: Survey of medication knowledge and behaviors among college students in Taiwan. *American Journal of Pharmaceutical Education*, Article 30, 2006; 70(2)
- Jonville-Bera et al. Frequency of adverse drug reactions in children: A prospective study. *Br J Clin Pharmacol*. 2002; 53(2): 207-210. Available at <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1874283>
- Liptak GS. Enhancing patient compliance in pediatrics. *Pediatr Rev*. 1996; 17:128-134
- Matsui, D. Current Issues in Pediatric Medication Adherence. *Pediatr Drugs*, 2007; 9 (5): 283-288
- Stoelben S., et al: Adolescents' drug use and drug knowledge. *Eur J Pediatr*. 2000; 159, 608-614. Available at: [cat.inist.fr/?aModele=afficheN&cpsidt=1429593](http://cat.inist.fr/?aModele=afficheN&cpsidt=1429593)
- Swadi, H., et al: Drug education to school children: does it really work? *British Journal of Addiction*. 1987; 82, 741-746. Available at: [doi.wiley.com/10.1111/j.1360-0443.1987.tb01540](http://doi.wiley.com/10.1111/j.1360-0443.1987.tb01540)
- Winnick S. How Do You Improve Compliance? *American Academy of Pediatrics*, 2005. Available at <http://www.pediatrics.org/cgi/content/full/115/6/e718>



## MYCORRHIZAL ASSOCIATION, N FERTILIZATION AND BIOCIDE APPLICATION ON THE EFFICACY OF BIO-N ON CORN (*ZEA MAYS L.*) GROWTH AND PRODUCTIVITY

Abercio V. Rotor<sup>1</sup>, Precila Catabian Delima<sup>1,2</sup>

<sup>1</sup>University of Santo Tomas Graduate School, España, Manila, Philippines

<sup>2</sup>Isabela State University- Cauayan City Campus, Isabela, Philippines

### Abstract

*The maximum benefits of Biological Nitrogen Fixation (BNF) may not be achieved if constraints are placed on the system. One of the most important and potentially limiting factors to BNF is the use of chemical treatments such as N Fertilizers and Biocides. Obtaining maximum benefits on farms from diazotrophic and vesicular-arbuscular mycorrhiza plant growth promoting biofertilizers will require a systematic strategy designed to fully utilize these beneficial factors, allowing crop yields to be maintained or even increased while fertilizer applications are reduced. The effect of VAMF, N Fertilizer and Biocides on the efficacy of Bio-N on Corn growth and productivity was studied under field conditions. Results showed potential benefits of this microbial biofertilizers with their combination with suboptimal and optimal amount of N Fertilizer. Significant findings were elucidated in terms of growth and yield. The effect of biocides is not straightforward.*

*Keywords: biofertilizer, BioN, diazotrophic, mycorrhiza, VAMF*

### RATIONALE

Recent concerns about cost increases, food safety and quality and environmental protection have prompted plant scientist to re- evaluate the current practices in chemical agriculture. Synthetic N fertilizer is known to cause: soil acidification and fertility degradation; pollution of the soil, air and groundwater; and generation of greenhouse gases such as N<sub>2</sub>O because of their inefficient utilization by crops --- but these may be reduced by biofertilizers. Alternative production methods have been in horticulture and agriculture to reduce production costs, improve food safety and quality and reduce environmental degradation. The alternatives are production of biofertilizers. Inoculant biofertilizers are more environmentally sound and their introduction in agricultural production systems could be one of the means to mitigate the onset of global warming as well as the reduction in fertilizer input costs of farmers (Kennedy *et al*, 2004).

This is the compelling reason to improve our understanding of Biological Nitrogen Fixation (BNF) application to agriculture and forestry production worldwide. In addition, the projected doubling in population over the next 50 years will put increasing pressure on food production, the environment, and the need for fixed N. Growing concerns about the environment, energy, nutrition, and agricultural sustainability make the need for BNF research even more compelling. Concerns about the cost and supply of fossil-based energy were major reasons for



the expansion of BNF research in the 1970s. Environmental quality and sustainability are equally compelling concerns beyond the 1990s.

The long term goal of BNF research is to improve the well-being of people worldwide. This suggests that the net effect of BNF is positive on society and on most sectors of the economy. BNF is in competition with industrially fixed N. Currently, the immediate economic advantage to the farmer often lies with the industrial product. However, the finite limit of resources needed, environmental concerns, and research progress in BNF is shifting the balance --- And research is crucially needed to quantify these aspects.

Reducing the dependence of corn farming on these important inorganic nitrogen sources will ultimately minimize dollar drain for the country. The impact of biofertilizer technologies can only be appreciated if these have been fully developed, adopted, and integrated with the farming systems. Product improvement through field experiment is an important activity to undertake before the said technologies could ultimately become economically feasible.

Regional performance test on Corn hybrids (Cornworld 801) with Biofertilizers, their combinations as well as interaction with chemical treatments have not been conducted yet (Aquino, DA-CVIARC, personal communication).

This study will generate information that could lead to better understanding of the technology. Experiments on the agronomic effects of associative and symbiotic microorganisms as biofertilizers on crops will provide useful model systems for rhizosphere studies and plant-microbe communication for the enhancement of the technology in improving agricultural production.

For the farmers who do not want to compromise their yields by doing validation studies on biofertilizers, the data from the study can guide them on which cultural practices are to be chosen in combination with biofertilizers to enhance their crop yield and eventually increase their net returns. This study therefore is to determine the effects of VAMF and biocides, their interactions at different levels of the recommended rate of inorganic fertilizer on the growth and yield of hybrid corn treated with Bio-N.

## **MATERIALS AND METHODS**

Field experiment was conducted in 2007 at the Cagayan Valley Integrated and Agricultural Research Center Experimental Station, Department of Agriculture (CVIARC-DA), San Felipe, Ilagan, Isabela. The study was performed on maize (*Zea mays*) which was selected on its ability to create associative relation with diazotrophs and vesicular arbuscular mycorrhizal fungi (VAMF). In the experiment performed in Randomized Block Design in three replications, the following factors were considered: inoculation with active strain of *Azospirillum* (Bio-N, B) and soil-based biofertilizer containing mycorrhizal fungi (Mykovam, M) originating from BIOTECH, UPLB, Laguna, three levels of Nitrogen Fertilizers, and absence or presence of biocides such as fungicidal seed dressing (Captan) and pre-herbicide treatment (Atrazine). Soil analyses were done at the Soils Laboratory of CVIARC before and after the experiment. Twenty treatments were considered in the study as follows: T<sub>1</sub> – Control A (Seeds not treated with Captan) ; T<sub>2</sub> - Control B (Seeds treated with Captan) ; T<sub>3</sub> - BioN ; T<sub>4</sub>- Mykovam; T<sub>5</sub>- Full RR + B ; T<sub>6</sub>- ¾ RR + B ; T<sub>7</sub> - ½ RR + B ; T<sub>8</sub> – Full RR + M ; T<sub>9</sub> - ¾ RR + M ; T<sub>10</sub> - ½ RR + M ; T<sub>11</sub> – Full RR ; T<sub>12</sub> - ¾ RR ; T<sub>13</sub> - ½ RR ; T<sub>14</sub> – B + M ; T<sub>15</sub> – FRR + B + M ; T<sub>16</sub> - ¾

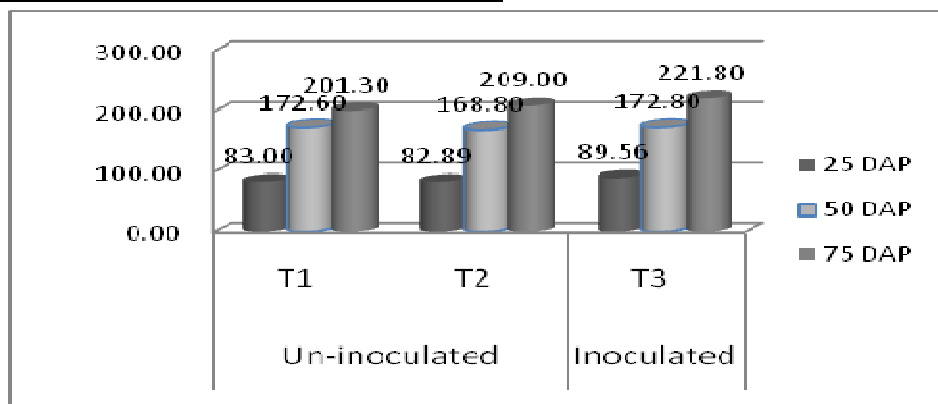


RR B + M ; T<sub>17</sub> – ½ RR B + M ; T<sub>18</sub> – B without Herbicide Application ; T<sub>19</sub>- ½ RR +B without Herbicide Application ; and T<sub>20</sub> – ¾ RR + B without Herbicide Application.

Treatments 3-17 were treated with Captan and sprayed with atrazine. Cultural management practices were applied. Morpho-physiological parameters were measured at 25, 50, 75 DAP and at physiological maturity. Root development and Morphology such as root length and root hair diameter of a 1- week old corn seedling were noted. Agronomic parameters such as yield and yield components were determined at physiological maturity. Plant height was determined on a weekly basis. Days to flowering, silking, and harvest were noted. Agro -meteorological data such as temperature, rainfall, relative humidity, solar radiation in the duration of the study were taken to support results of the experiment. Statistical analysis was done. Analysis of variance was used to detect any significant difference among treatments.

**DISCUSSION OF RESULTS**

A. Un- inoculated and Inoculated with Bio-N

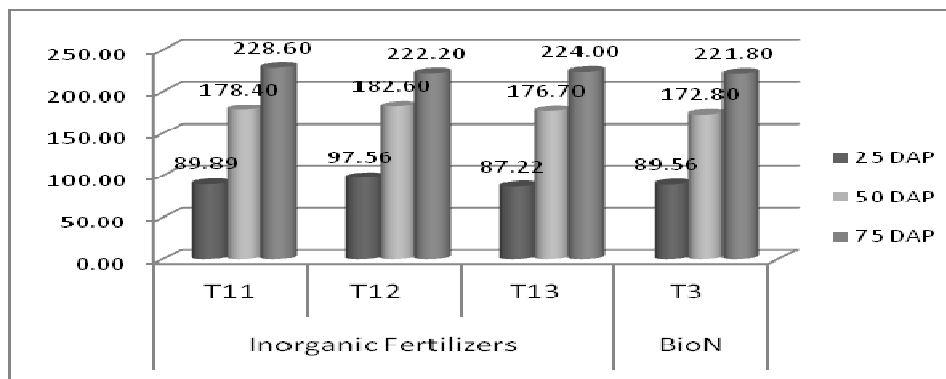


**FIGURE 1. Effect of inoculation with Bio-N on corn height at different growth stages (cm)**

Results presented in Table 1 show that plant height is lower in un-inoculated corn plants (T<sub>1</sub> and T<sub>2</sub>) compared to those inoculated with Bio-N (T<sub>3</sub> and T<sub>18</sub>). Inoculation of maize with *Azospirillum* bacteria (Bio-N) contributed to an increase of plant vigour (Sawicka, 2000). Plants were taller with inoculation of *Azospirillum*. These bacteria provide host plants with fixed N, hormones, signal molecules, vitamins, iron, etc (Zuberer, 1998; Bashan, 1999; Bashan and de-Bashan, 2002 a & b; Romero *et al.*, 2003) needed in plant growth.



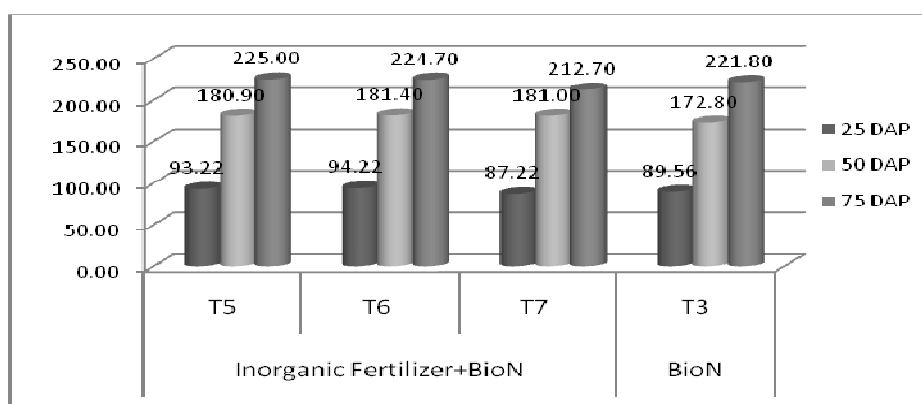
**B. Inorganic Fertilizers and Bio-N**



**FIGURE 2. Corn Height of Treatments (cm) with Inorganic Fertilizers and BioN**

Corn treated with biofertilizers alone (T<sub>3</sub>) was lower in plant height than those treated with different levels of inorganic fertilizers (T<sub>11</sub>, T<sub>12</sub> and T<sub>13</sub>). Biofertilizers alone cannot provide the nutrients needed by the plants during the early stage of its growth. This also explains the inadequacy of soil N for nutrition. Plant growth in the vegetative stage and reproductive stage depends on the immediate availability of plant nutrients offered by inorganic fertilizers. Compared to other organic fertilizers which are low cost but were ineffective at economically viable application rates, inorganic fertilizers can sustain adequate plant growth (Eastham and Morald, 2006). The positive response of the crops to fertilizer nitrogen indicates that the nitrogen demand of the crop is not being completely met by N<sub>2</sub> fixation or Bio-N and, therefore, symbiotic N<sub>2</sub> fixation could be limiting.

**C. Combination of Inorganic Fertilizers with Bio-N**



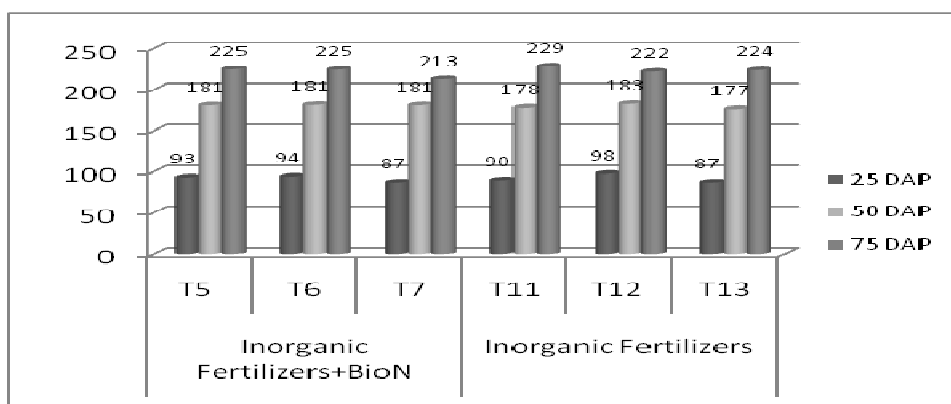
**FIGURE 3. Corn Height of Treatments (cm) with Inorganic Fertilizers + BioN and BioN alone**



It can be observed that plants treated with combination of full recommended rate and  $\frac{3}{4}$  recommended rate of Inorganic fertilizers and biofertilizers (T<sub>5</sub>,T<sub>6</sub>,) registered higher plant height than those treated with Biofertilizers alone (T<sub>3</sub>). This may be because of the supplemental effect of the biofertilizers on the inorganic fertilizers. This may be attributed to the ability of the diazotrophs in biofertilizers ,that apart from fixing N<sub>2</sub> it can affect plant growth directly by the synthesis of phytohormones and vitamins, improved nutrient uptake, solubilization of inorganic phosphate and mineralization of organic phosphate that are available in inorganic fertilizers.(Dobbelaere et al, 2003).

However,T<sub>3</sub> were taller than plants treated with  $\frac{1}{2}$  recommended rate of inorganic fertilizer(T<sub>7</sub>).

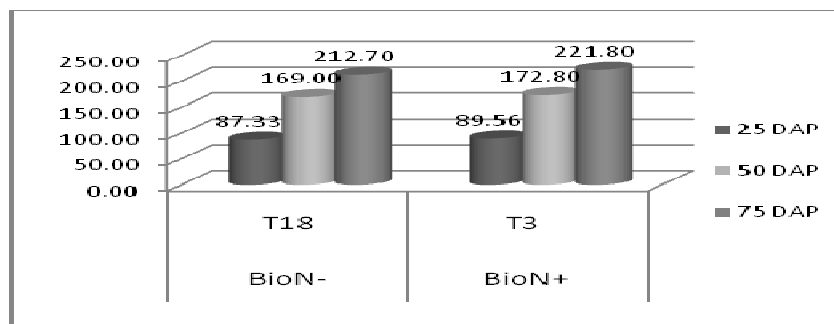
**D. Inorganic Fertilizers + Bio-N and Inorganic Fertilizers**



**FIGURE 4. Corn Height of Treatments (cm) with Inorganic Fertilizers with and without BioN.**

Full recommended rate of Inorganic fertilizer(T11) recorded the highest in plant height among the treatments in Figure 4. The growth is sustained if the N requirement of maize is normally met by fertilization at a rate depending on soil fertility with N fertilizer (Scharf, 2001).

**E. Biocides and Bio-N**



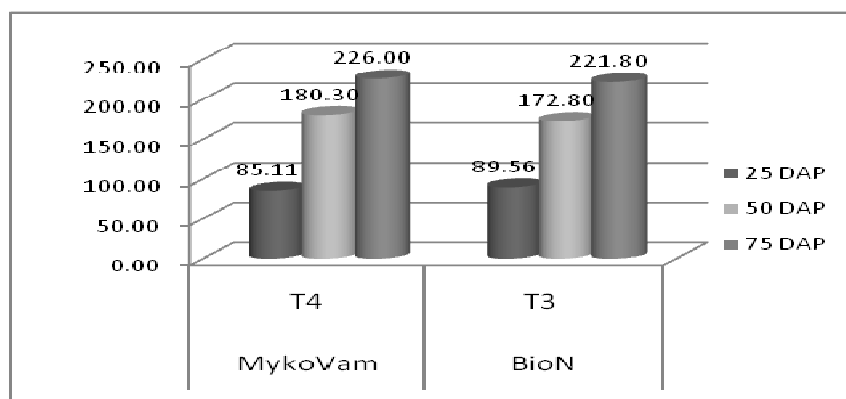
**FIGURE 5. Corn Height of Treatments (cm) with and without Biocides**





Plant height of T<sub>3</sub> (B<sup>++</sup>) was higher than those in T<sub>18</sub> (B<sup>-</sup>). Microbial degradation of the herbicide is evident as the presence of biocides did not affect plant height. Lars Prade (1998) explained that all aerobic organisms which include corn and *Azospirillum* contains detoxifying enzymes known as Gluthathione S- transferases (GST), which is responsible in the hastening of degradation of the biocides atrazine and captan. GSTs in maize are able to detoxify several classes of herbicides. GST-I from maize is known to have a significant activity towards atrazine. The primary microbial degradation pathway is N-dealkylation of the side chains to produce deethylatrazine and deisopropylatrazine (Neumann et al., 2004, Radosevich and Tuovinen, 2004) while the primary mechanism of chemical (abiotic) degradation is hydrolysis to produce hydroxyatrazine (Prosen and Zupancic-Krajc, 2005).

F. Mykovam and BioN

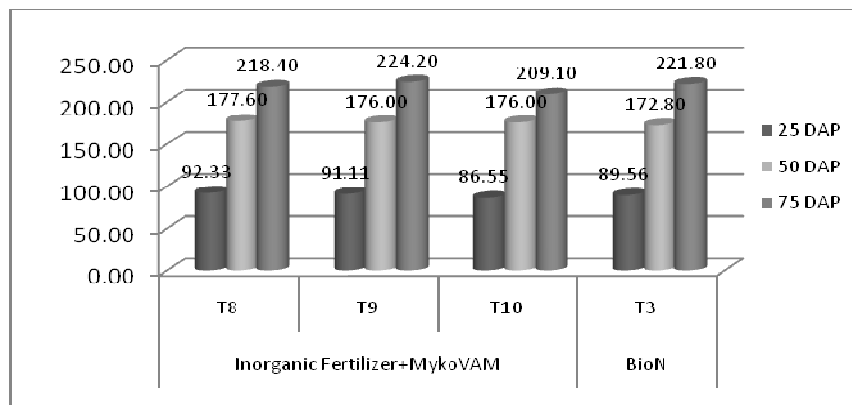


**FIGURE 6. Differences in Plant Height (cm) Between Corn Treated with MykoVam and BioN**

Plants treated with Bio-N<sup>+</sup>(T<sub>3</sub>) had higher plant height compared to plants treated with Mykovam (T<sub>4</sub>) during the vegetative stage. This may be attributed to the ability of the Bio-N as Plant Growth Promoting Rhizobacteria (PGPR) to convert atmospheric nitrogen into a form usable by plants in its vegetative stage of growth (Dobbelaere, 2003). However, in the reproductive stage, corn treated with Mykovam (T<sub>4</sub>) had a higher plant height than those treated with Bio-N<sup>+</sup> (T<sub>3</sub>). Vesicular Arbuscular Mycorrhizal fungi (VAMF) is a soil-based biofertilizer which functions for better absorption of nutrients and water. This may be attributed to the ability of the VAM fungi to form an extramatrical hyphae in the roots to better absorb water, solubilized phosphates and other nutrients needed for the intermediate and later growth stages of plant (Gosling et al., 2005). Vesicular–arbuscular mycorrhizae had been shown to enhance the transfer of soil nutrients to plant roots through their extramatrical hyphae that extend beyond root depletion zone. (Kehri and Chandra, 2001).



G. Combination of Inorganic Fertilizers plus Mykovam and BioN



**FIGURE 7. Corn Height of Treatments (cm) with Inorganic Fertilizers plus Mykovam and BioN**

The height of Bio-N treated plants (T<sub>3</sub>) was higher than those treated with Full Recommended Rate of inorganic fertilizer +M (T<sub>8</sub>) and ½ Recommended Rate of inorganic fertilizer +M (T<sub>10</sub>) but is lower than plants treated with ¾ RR +M (T<sub>9</sub>).

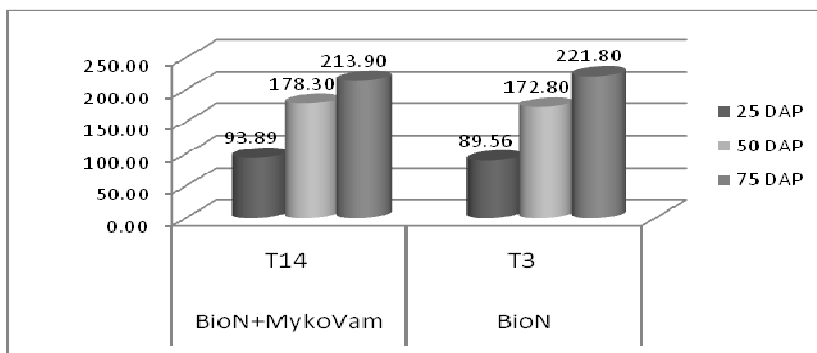
Usage of full and half recommended rate of readily soluble fertilizer, particularly N fertilizers, did not significantly affect the height of corn. As cited by Gosling in 2005, it can be attributed to the negative impact of N fertilizers on AM colonization which dictates growth (Miller and Jackson,1998,Liu et al. 2000,Burrows and Pflieger,2002 ), though not in others (Ryan and Ash,1999 and Jumponen et al.,2005).

The higher plant height registered by T<sub>9</sub> (¾ RR +M<sup>++</sup>), shows the versatility of AMF. Mycorrhiza can increase the uptake of macronutrients other than P including N,K provided by the inorganic fertilizer and Mg (Clark and Zeto,2000 and Hodge et al.,2001) as well as uptake of micronutrients. Enhanced uptake of P is generally regarded as the most important benefit that AMF provide to their host plant, and plant P status is often the main controlling factor in the plant–fungal relationship (Thompson, 1987, Smith and Read, 1997 and Graham, 2000). AMF can play a significant role in crop P nutrition, increasing total uptake and in some cases P use efficiency (Koide et al., 2000). This may be associated with increased growth and yield (Vosatka, 1995, Ibibijen et al., 1996 and Koide et al., 2000).



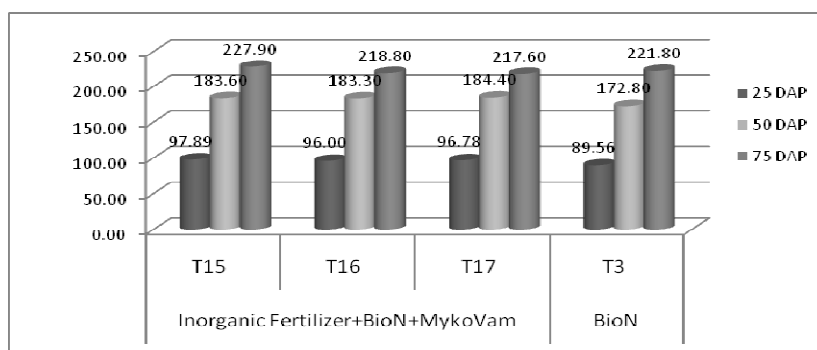
H. Combination of Bio-N and Mykovam and Bio-N alone

**FIGURE 8. Corn Height of Treatments (cm) with Combination of BioN+ MykoVam and BioN alone**



T<sub>3</sub> plants (Bio-N<sup>++</sup>) were taller than T<sub>14</sub> plants (BioN +M<sup>++</sup>). Bio-N is more effective as a single inoculant than in combination with AM fungi. The presence of mykovam decreased or did not significantly affect plant growth. This finding is similar to the study of Raimam et al., (2006) on rice where in mycorrhiza had no influence on the plant growth in the presence of N-fixing bacteria.

I. Combination of Inorganic Fertilizers and Biofertilizers and Bio-N alone



**FIGURE 9. Corn Height of Treatments (cm) with Combination of Inorganic Fertilizer + BioN+ Mykovam and BioN alone and BioN alone.**

Figure 9 shows that treatments with Full Recommended Rate of inorganic fertilizer plus BioN and Mykovam (T<sub>15</sub>) were taller than T<sub>3</sub> (BioN<sup>++</sup>) and T<sub>18</sub> (BioN<sup>-</sup>).

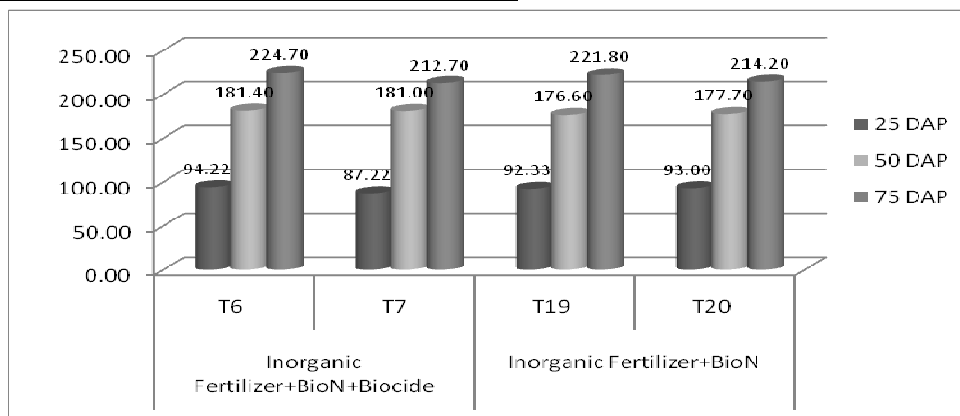
It implies that plant growth is dependent on the following factors such as the availability of nutrients provided by the inorganic fertilizer, Nitrogen supplement provided by Bio-N, and the complimentary function of the mykovam for better absorption of nutrients and water. It may be credited on the symbiotic interaction or relationship of N-fixing bacteria with AMF. This possibility may not be remote since bacterial communities and specific bacterial strains



promote germination of AM fungal spores and can increase the rate and extent of root colonization by AM (Johansson et al., 2004). Once the arbuscular symbiosis has developed, AM hyphae influence the surrounding soil, which has been termed the mycorrhizosphere (Linderman, 1988), resulting in the development of distinct microbial communities relative to the rhizosphere and bulk soil (Andrade et al., 1997). Within the mycorrhizosphere AMF interact with beneficial rhizosphere microorganisms including free living N fixing bacteria and general plant growth promoting rhizobacteria (PGPR) like Bio-N (Arias et al., 1991, Requena et al., 1997, Galleguillos et al., 2000, Tsimilli-Michael et al., 2000 and Biro et al., 2000).

As cited by Kennedy (2004). the possible effects of *Azospirillum* on maize growth are mainly derived from physiological changes of the inoculated roots which enhance water and mineral water uptake. Gosling (2004) cited Koide et al., (2000) study that AMF are significant in crop P nutrition, increasing total uptake and in some cases P use efficiency ; and studies of Vosatka (1995); Ibibijen et al., (1996); and Koide et al., (2000) that this may be associated with increased growth and yield.

J. Combination of Inorganic Fertilizers with Bio-N with Biocides and Combination of Inorganic Fertilizers with Bio-N without Biocides



**FIGURE 10. Corn Height of Treatments (cm) with Combination of Inorganic Fertilizer and BioN with and without Biocide**

Plants with  $\frac{3}{4}$  recommended rate of inorganic fertilizer with BioN plus biocides (T<sub>6</sub>) were taller than plants with  $\frac{3}{4}$  recommended rate of inorganic fertilizer without biocides(T<sub>20</sub>). Biocides like herbicide did not have negative impact on N fixation activity of the Bio-N. This is similar to the findings of Rennie and Dubetz (1984) on soybean where herbicides showed no effect on soybean nodulation and N Fixation. Herbicide when added at the recommended rate for weed control did not have detrimental effects on N -fixation (Kucey et al.,1988). It also shows that the findings agree with the findings of Umali-Garcia et al. that Bio-N is effective when it is combined with  $\frac{3}{4}$  of the RR of fertilizer. The biocides atrazine and captan were not detrimental to the *azospirillum* in Bio-N, This may be attributed to the presence of Glutathione



S-transferases (GSTs). All aerobic organisms which include maize and the bacteria azospirillum contains the detoxifying enzyme GST. This enzyme acts on the biodegradation of herbicides like atrazine, thus playing an important role in herbicide tolerance(Lars Prade,1998,Nemat Alla et al.,2008).

In contrast, the studies of Isoi and Yoshida in 1990 on soybean and Schnelle and Hensley (1990) on beans reported that herbicides induce reduction in nodulation and N<sub>2</sub> Fixation.

**1. Ear weight /Yield**

**Table 2. Yield of Corn (CW 801)**

Treatments	YIELD		RANK
	Kg/ha <sup>-1</sup>		
T1 – Control A (Seeds not treated with Captan)	6279.000	BCDEF	14
T2 – Control B (Seeds treated with Captan)	5695.000	EF	19
T3 – Bio-N	5696.000	EF	18
T4 – Mykovam	6507.000	BCDEF	12
T5 – Full RR + Bio-N	7198.000	ABCD	6
T6 – ¾ RR + Bio-N	7134.000	ABCD	7
T7 – ½ RR + Bio-N	6256.000	BCDEF	15
T8 – Full RR + M	6060.000	DEF	17
T9 – ¾ RR + M	7895.000	A	1
T10 – ½ RR + M	6763.000	ABCDEF	10
T11 – Full RR	7550.000	AB	3
T12 – ¾ RR	6953.000	ABCDE	9
T13 – ½ RR	6689.000	ABCDEF	11
T14 – B + M	5519.000	F	20
T15 – Full RR + B + M	7378.000	ABC	4
T16 – ¾ RR + B + M	7100.000	ABCD	8
T17 – ½ RR + B + M	6199.000	CDEF	16
T18 – B without herbicide Application	6450.000	BCDEF	13
T19 – ½ RR + B without herbicide application	7571.000	AB	2
T20 – ¾ RR + B w/o Herbicide application	7248.000	ABCD	5
Result	*		
C.V. (%)	11.88		
LSD	1317		

Table 2 shows the ear weight in kilogram/hectare (kg/ha) of the different treatments. As gleaned in the table, the different treatments significantly affected the corn ear weight /yield. T<sub>9</sub>( ¾ RR +M<sup>++</sup>) had the highest yield with 7895 kgha<sup>-1</sup> followed by the other treatments in descending order: T<sub>19</sub>( ½ RR B<sup>-</sup>) with 7571 kgha<sup>-1</sup>, T<sub>11</sub>(FRR<sup>++</sup>) with 7550 kgha<sup>-1</sup>, T<sub>15</sub> ( FRR +B+M<sup>++</sup>) with 7378 kgha<sup>-1</sup>, T<sub>20</sub> (¾ RR+B<sup>-</sup>) with 7248 kgha<sup>-1</sup>, T<sub>5</sub> (Full RR +B<sup>++</sup>) with 7198 kgha<sup>-1</sup>, T<sub>6</sub> ( ¾ RR+B<sup>++</sup>)with 7134 kgha<sup>-1</sup>, T<sub>16</sub>( ¾ RR+B+M<sup>++</sup>) with 7100 kgha<sup>-1</sup>, T<sub>12</sub>( ¾ RR<sup>++</sup>) with 6953 kgha<sup>-1</sup>, T<sub>10</sub> ( ½ RR +M<sup>++</sup>) with 6763 kgha<sup>-1</sup>, T<sub>13</sub> ( ½ RR<sup>++</sup>) with 6689 kgha<sup>-1</sup>, T<sub>4</sub> ( M<sup>++</sup>) with 6507 kgha<sup>-1</sup>, T<sub>18</sub> (B<sup>-</sup>) with 6450 kgha<sup>-1</sup>, T<sub>1</sub> (Control A) with 6279 kgha<sup>-1</sup>, T<sub>7</sub>( ½ RR+B<sup>++</sup>) with 6256 kgha<sup>-1</sup>, T<sub>17</sub> ( ½ RR +B+M<sup>++</sup>) with 6199 kgha<sup>-1</sup>, T<sub>8</sub>(FRR +M<sup>++</sup>)with 6060



$T_3(B^{++})$  with 5696  $kg\ ha^{-1}$ ,  $T_2$  (Control B) with 5695  $kg\ ha^{-1}$  and  $T_{14}(B+M^{++})$  with 5519  $kg\ ha^{-1}$ .

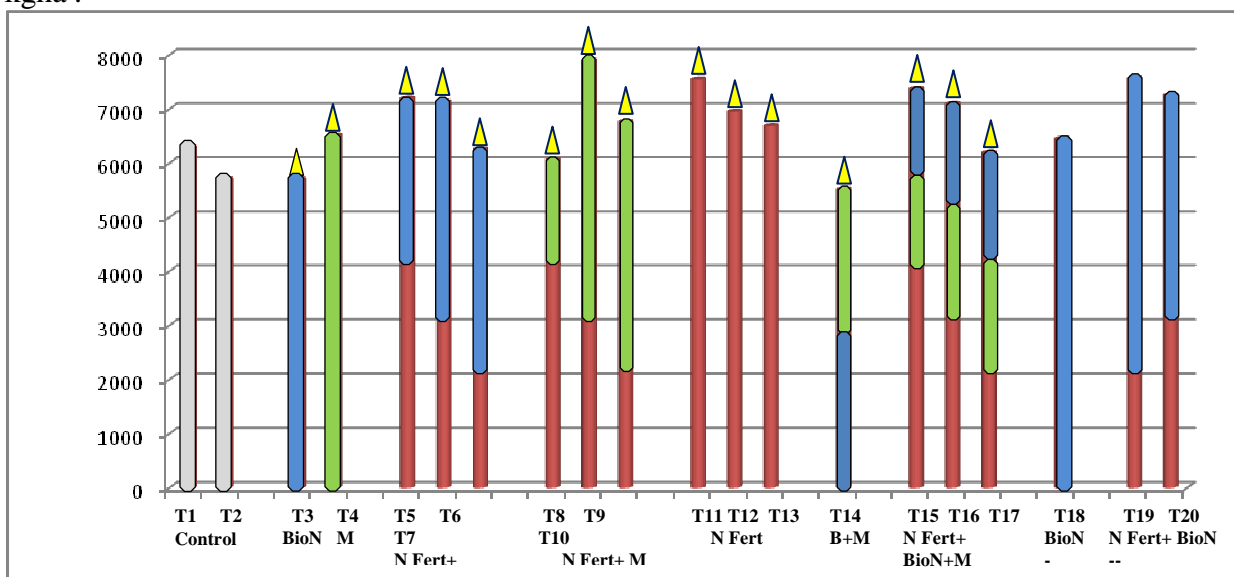


FIGURE 11. Corn Yield of the Different Treatments in Kilogram per Hectare (Kgha<sup>-1</sup>)

Leged

- Treated with biocide
- BioN
- Inorganic Fertilizer
- MykoVam
- Control

T1 – Control A (Seeds not treated with Captan)

T2 – Control B (Seeds treated with Captan)

T3 – Bio-N

T4 – Mykovam

T5 – Full RR + Bio-N

T6 – 3/4 RR + Bio-N

T7 – 1/2 RR + Bio-N

T8 – Full RR + M

T9 – 3/4 RR + M

T10 – 1/2 RR + M

T11 – Full RR

T12 – 3/4 RR

T13 – 1/2 RR

T14 – B + M

T15 – Full RR + B + M

T16 – 3/4 RR + B + M

T17 – 1/2 RR + B + M

T18 – B without herbicide Application

T19 – 1/2 RR + B without herbicide application

T20 – 3/4 RR + B w/o Herbicide application

A. Un-inoculated and Inoculated with Bio-N

$T_3$  (Bio-N<sup>++</sup>) registered a lower yield than  $T_1$  (Control A) but is higher than (Control B). However,  $T_{18}$ (Bio-N<sup>-</sup>) is higher in yield than  $T_1$  and  $T_2$ ). Biofertilizers are able to stimulate



growth and increase the yield of non-legumes like corn both in greenhouse and field experiments (Biswas *et al.*,2000,Yanni *et al.*, 2001). The lower yield in T<sub>3</sub> may be ascribed to the presence of captan, a fungicide which have a negative impact on N-fixation. Although, the effect of herbicide is complex and not easily predictable in the findings of Schreinen & Bethlenfalvay (1997).

**B. Chemical Treatments and Bio-N**

Grain yield was numerically higher in the three levels of inorganic fertilizers (T<sub>11</sub>,T<sub>12</sub> andT<sub>13</sub>) with ranks of 3<sup>rd</sup>,9<sup>th</sup> and 11<sup>th</sup> respectively than T<sub>3</sub> which ranked 18<sup>th</sup> . Inorganic Fertilizers provided the N-requirement of plants being more soluble and provided the nutrients which is readily available Biofertilizers alone on the other hand is not that sufficient to increase the grain yield comparable to the recommended rate of inorganic fertilizer. It only supplies half of the N requirement of plants.

**C. Combination of Inorganic Fertilizers with Bio-N and Bio-N alone**

The influence of Bio-N and its combination with Inorganic Fertilizers (T<sub>5</sub>,T<sub>6</sub> and T<sub>7</sub>) gave a higher yield than B<sup>++</sup> alone (T<sub>3</sub>) . The results show that Biofertilizers alone couldn't meet the nutrient requirement for corn . As cited by Garcia and Luis *et al.*(2003),the inorganic fertilizers provided nutrients readily available to the plants and Bio-N aid in the slow but gradual release of nutrients for the growing crop. In a similar study, Dobbelaere *et al.* (2001) found that *A. brasilense* increased grain yield of maize by 0.7-1.0 t ha<sup>-1</sup> (50–95% increase) depending on soil conditions when N was applied at low to medium (18-46 kg ha<sup>-1</sup>).

**D. Biocides and Bio-N**

T<sub>3</sub> (BioN<sup>++</sup>) did not significantly affect grain yield as it recorded lower grain

yield with a rank of 18<sup>th</sup> than T<sub>18</sub>(BioN<sup>-</sup>) with a rank of 13<sup>th</sup> . The presence of Biocide did not positively influence grain yield. This may be supported by the findings of Diciocco in 1997 that herbicide and fungicide have a negative effect on the nitrogenase activity of the bacteria *Azospirillum* affecting the yield of maize. In a similar study made by Sawicka in 2000, he reported that maize inoculated with *Azospirillum* but without fungicide increases yield.

**E. Bio-N and Mykovam**

T<sub>4</sub>(M<sup>++</sup>)which ranked 12<sup>th</sup> registered a higher yield than T<sub>3</sub>( B<sup>++</sup>) which

rank 18<sup>th</sup> among the 20 treatments . Bio-N as a single inoculant did not sustain the N requirement of plants necessary for growth thus yield is influenced. This result is parallel to the study of Nguyen *et al.*( 2002a) that not all of such trials were successful and there are cases where declines in yield were associated with inoculation . This was attributed to possible incompatibilities between bacterial strains and plant cultivars, as well as inadequate soil N for nutrition and inappropriate cultivation conditions Dobbelaere et al.(2001).



**F. Bio-N and Combination of Inorganic Fertilizers and Mykovam**

The combination of  $\frac{3}{4}$  RR of Inorganic fertilizer + Mykovam (T<sub>9</sub>) registered the highest yield in corn which supports the findings of Ryan and Ash (1999) and Jumpponen et al., (2005) that soluble fertilizer, particularly N fertilizers does not have a negative impact on AMF colonization. However, the combination of Full recommended rate of inorganic fertilizer + Mykovam (T<sub>8</sub>) registered low in terms of yield. This may be attributed to the high concentration of N which has a negative impact on AMF colonization as reported by Treseder and Allen, 2002,

**G. Combination of Bio-N and Mykovam and Bio-N alone**

T<sub>14</sub> (B+M<sup>++</sup>) did not influence yield as shown by its lowest value among the treatments. Inoculation with Mykovam (M<sup>++</sup>) had no additive effect on Bio-N. Though the AMF association can offer multiple benefits to the host plant it may not be obviously mutualistic at all points in time, and it is possible under some conditions that the AMF may cheat their host plant into supplying C with no apparent benefit to the plant. In some cases, this can cause a decline in growth and yield (Lerat et al., 2003). However, proving that AMF are actually cheating is difficult (Fitter, 2001) not least because of the wide range of benefits to the host, which may only become obvious at specific times or under certain environmental conditions or stresses.

**H. Combination of Inorganic Fertilizers and Biofertilizers and Bio-N alone**

Yield was higher with the different levels of Inorganic fertilizers combined with biofertilizers, Bio-N and Mykovam (T<sub>15</sub>, T<sub>16</sub>, T<sub>17</sub>) as shown in their rank of 4<sup>th</sup>, 8<sup>th</sup> and 16<sup>th</sup> than Bio-N alone (T<sub>3</sub>). Yield was significantly affected by the treatments primarily by the influence of inorganic fertilizer and supplemental effect of biofertilizers. Kennedy (2004) in his review, stressed the potential of biofertilizers as Plant Growth Promoting Rhizobacteria (PGPR) that may promote crop yield increase by modifying soil-plant processes so that N and other nutrients from inorganic source are more completely retained in the plant soil system.

**I. Combination of Inorganic Fertilizers with Bio-N with and without Biocides**

As gleaned in Table 2, T<sub>19</sub> and T<sub>20</sub> ranked higher in yield than T<sub>6</sub> and T<sub>7</sub>. Treatment combinations of Inorganic Fertilizers with Bio-N minus the herbicide ranked 2<sup>nd</sup> and 5<sup>th</sup> while the combination of Inorganic Fertilizers plus herbicide ranked 7<sup>th</sup> and 15<sup>th</sup> respectively. The absence of herbicide did not affect yield as shown by its ranking. However, there are cases in which herbicides influence growth and yield positively (Thavaprakash et al., 2007) and that it is compatible with *Azospirillum* (Pereyra et al., 2009).

There are findings that Triazines have favorable effect on crop plants at sub lethal doses. Atrazine increased total nitrogen, protein content and yield of sweet corn (Reddy and Reddi, 1999) and physiological process in sorghum (Sairam et al., 1988).

## **CONCLUSION**

1. Bio-N in combination with mycorrhizal inoculum and half or  $\frac{3}{4}$  of the recommended inorganic fertilizer is sufficient to supply the nutrient requirements of corn.





2. Diazotrophic and Mycorrhizal Association can offer considerable benefits in terms of growth and yield. Bio-N and AMF are potential substitute for fertilisers and biocides.
3. The effect of Biocides like herbicide on Bio-N is not that straightforward/clear –cut.
4. Bio-N and Mykovam as single inoculants are not sufficient for crop growth.
5. High amount of N has a negative impact on the AMF resulting in low yield.
6. The activity of mycorrhizal fungi in agroecosystems is neither easily predictable nor always beneficial.

## **RECOMMENDATIONS**

1. Technology adoption of microbial biofertilizers at the local level should be strengthened to fully utilized its potential. With the declining availability of fossil fuels and the price for chemical fertilizers increasing, it is essential for farmers to have greater access to the cheaper inoculants biofertiliser technology.
2. There should be a concerted action to encourage biofertilizer production associated with BNF to become a significant feature of agriculture not only in the national level but in the local level. This would help to overcome chronic problems such as low farm productivity and poor returns on labor.
3. Level of Biocides should also be considered as a determinant to the effectiveness of biofertilizers.
4. The different biofertilizers should be used in combination with 50 to 75% of the recommended fertilizer rates.
5. If we are to achieve efficient use and manipulation of AMF for long-term agricultural stability and productivity in any form of agriculture, our understanding of their physiology and function and their interactions with crops during their vegetative growth and environmental conditions needs to be improved.
6. Studies on Rhizosphere is recommended to properly understood the behavior of these PGPR. Identification of the native rhizobial community should also be undertaken to prevent incompatibilities between the rhizobial community and the inoculants as well as the plant cultivar.
7. Utilization of environmentally sound inoculant biofertilizers should be enhanced since their use could help mitigate the onset of global warming as well as reduce the fertilizer input of farmers.
8. Conduct parallel studies applying low input systems such as organic farming to determine which is more favorable to diazotrophic and AMF communities.
9. Diversified Farm Management which are location- specific should still be tested to fully realized the potentials of these biofertilizers.
10. Another study should be conducted to test if re-inoculation with PGPR or Biofertilizers is needed for successive crops/ cropping to know if there is a residual effect of the inoculation.



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### **References:**

- Andrade, G., Mihara, K.L., Linderman, R.G., Bethlenfalvay, G.J., 1997. Bacteria from rhizosphere and hydrosphere soils of different arbuscularmycorrhizal fungi. *Plant Soil* 192, 71–79.
- Arias, I., Koomen, I., Dodd, J.C., White, R.P., Hayman, D.S., 1991. Growth responses of mycorrhizal and nonmycorrhizal tropical forage species to different levels of soil phosphate. *Plant Soil* 132, 253–260.
- Auge, R.M., 2001. Water relations, drought and vesicular-arbuscular
- Balandreau, J., 2002. The spermosphere model to select for plant growth promoting rhizobacteria. In: Kennedy, I.R. and Choudhury, A.T.M.A., Editors, *Biofertilizers in Action*, Rural Industries Research and Development Corporation, Canberra, pp. 55–63.
- Bashan, Y. and Holguin, G. 1997. Azospirillum-plant relationships: environmental and physiological advances (1990-1996). *Can J Microbiol* 43: 103-121.
- Bashan, Y., 1998. Azospirillum plant growth-promoting strains are non-pathogenic on tomato, pepper, cotton, and wheat. *Canadian Journal of Microbiology* 44, pp. 168–174.
- Bashan, Y., de-Bashan, L.E. 2002. Protection of tomato seedlings against *Pseudomonas syringae* pv. tomato by using plant growth promoting bacterium *Azospirillum brasilense*. *Appl Environ Microbiol* 68, 2637-2643
- Bashan, Y. 1999. Interaction of *Azospirillum* spp. in soils: a review. *Biol Fertil Soils* 29, 246-256
- Becana M, Sprent J I. 1987. Nitrogen fixation and nitrate reduction in the root nodules of legumes. *Physiol Plant.* 70:757–765
- Blume, E., Bischoff, M., Moorman, T.B., and Turco, R. E. 2004. Degradation and binding of atrazine in surface and subsurface soils. *J. Agricul. Food Chem.* 52, 7382- 7388.
- Boddey, R.M., de Oliveira, O.C., Urquiaga, S., Reis, V.M., de Olivares, F.L., Baldani, V.L.D., and Döbereiner, J. 1995. Biological nitrogen fixation associated with sugar cane and rice: contributions and prospects for improvement. *Plant Soil* 174: 195–209.
- Borie, F.R., Rubio, R., Morales, A., Castillo, C., 2000. Relationships between arbuscular mycorrhizal hyphal density and glomalin production with physical and chemical characteristics of soils under no-tillage. *Rev. Chil. Hist. Nat.* 73, 749–756.



Breux, E.J. 1987. Initial metabolism of alachlor in tolerant and susceptible seedlings. *Weed Sci.* **35**, 63-468.

Buetler, T.M. & Eaton, D.L. 1992. Glutathione S-transferases: amino acid sequence comparison, classification and phylogenetic *Environ. Carcino. Rev.* **C10**, 181-203.

Burrows, R.L., Pflieger, F.L., 2002. Arbuscular mycorrhizal fungi respond to increasing plant diversity. *Can. J. Bot.* **80**, 120–130.

Chelius, M.K. and Triplett, E.W. 2000. Diazotrophic endophytes associated with maize. In: Triplett, E.W., Editor. *Prokaryotic Nitrogen Fixation: A Model System for the Analysis of a Biological Process*, Horizon Scientific Press, Wymondham, pp. 779–791.

Choudhury, A.T.M.A. and Khanif, Y.M., 2001. Evaluation of the effects of nitrogen and magnesium fertilization on rice yield and fertilizer nitrogen efficiency using <sup>15</sup>N tracer technique. *Journal of Plant Nutrition* **24**, pp. 855–871.

Clark, R.B., Zeto, S.K., 2000. Mineral acquisition by arbuscular mycorrhizal plants. *J. Plant Nutr.* **23**, 867–902.

Cocking, E.C., 2002. Concerted action for cereal and other non-legume crop nitrogen fixation, enhanced growth and yield. In: Kennedy, I.R. and Choudhury, A.T.M.A., Editors. *Biofertilizers in Action*, Rural Industries Research and Development Corporation, Canberra, pp. 1–3.

Deaker, R. and Kennedy, I.R., 2001. Improved potential for nitrogen fixation in *Azospirillum brasilense* Sp7-S associated with wheat nifH expression as a function of oxygen pressure. *Acta Biotechnologica* **21**, pp. 3–17. transferases. *Eur. J. Biochem.* **220**, 645-661.

Diedhiou, P.M., Oerke, E.C., Dehne, H.W., 2004. Effects of the strobilurin fungicides azoxystrobin and kresoxim-methyl on arbuscular mycorrhiza. *Z. Pflanzenk. Pflanzen.* **111**, 545–556.

Dobbelaere, S., Croonenborghs, A., Thys, A., Ptacek, D., Vanderleyden, J., Dutto, P., Labandera-Gonzalez, C., Caballero-Mellado, J., Aguirre, J.F., Kapulnik, Y., Brener, S., Burdman, S., Kadouri, D., Sarig, S. and Okon, Y., 2001. Responses of agronomically important crops to inoculation with *Azospirillum*. *Australian Journal of Plant Physiology* **28**, pp. 871–879.

Döbereiner, J., Baldani, V.L.D., and Reis, V.M. 1995. Endophytic occurrence of diazotrophic bacteria in nonleguminous crops. In: *Azospirillum VI and Related Microorganisms*, pp. 3–14. Fendrik, I., del Gallo, M., Vanderleyden, J., and de Zamaroczy, M., Eds., Springer-Verlag, Berlin.

Dorado, J., Tinoco, P. Almendros, G. 2003. Soil parameters related with the sorption of 2,4-D and atrazine, *Comm. Soil. Sci. Plant Anal.* **24**, 1119- 1133.



Eastham, J. and Morald T. 2006. Effective Nutrient for Plant Growth on Bauxite residue 1. Comparing Organic and Inorganic Fertilizers. *Water, Air, Soil Pollut DOI* **10.1007/s11270-005-8870-7**

El-Komy, H.M.A., Moharram, T.M.M. and Safwat, M.S.A. 1998. Effect of *Azospirillum* inoculation on growth and N<sub>2</sub> fixation of maize subjected to different levels of FYM using 15N-dilution method. In: Malik, K.A., Mirza, M.S. and Ladha, J.K., Editors, 1998. Nitrogen Fixation with Non-Legumes, Kluwer Academic Publishers, Dordrecht, pp. 49–59.

El-Mohandes, M.A.O., 1999. The use of associative diazotrophs with different rates of nitrogen fertilization and compost to enhance growth and N<sub>2</sub>-fixation of wheat. *Bulletin of Faculty of Agriculture, University of Cairo* **50**, pp. 729–753.

Estrada, P., Mavingui, P., Cournoyer, B., Fontaine, F., Balandreau, J. and Caballero-Mellado, J., 2002. A N<sub>2</sub>-fixing endophytic *Burkholderia* sp. associated with maize plants cultivated in Mexico. *Canadian Journal of Microbiology* **48**, pp. 285–294.

Estrada-de los Santos, P., Bustillos-Cristales, R. and Caballero-Mellado, J., 2001. *Burkholderia*, a genus rich in plant-associated nitrogen fixers with wide environmental and geographic distribution. *Applied Environmental Microbiology* **67**, pp. 2790–2798.

Fallik, E., Okon, Y. and Fischer, M. 1988. Growth response of maize roots to *Azospirillum* inoculation: effect of soil organic matter content, number of rhizosphere bacteria and timing of inoculation, *Soil Biol. Biochem.* **20**, 45.

Fayez, M. and Daw, Z.Y., 1987. Effect of inoculation with different strains of *Azospirillum brasilense* on cotton (*Gossypium barbadense*). *Biology and Fertility of Soils* **4**, pp. 91–95. Jarma (eds) *Methods in Microbiology*. Vol. 24. Academic Press, N.Y. 339- 357. Pp

Fitter, A.H., 2001. Specificity links and networks in the control of diversity in plant and microbial communities. In: Press, M.C., Huntly, N.J., Levin, S. (Eds.), *Ecology, Achievement and Challenge*. Blackwell, Oxford, UK, pp. 95–114.

Fuerst, E.P. & Gronwald, J.W. 1986. Induction of rapid metabolism of metolachlor in sorghum (*Sorghum bicolor*) shoots by CGA-92194 and other antidotes. *Weed Sci.* **34**, 354-361.

Gadkari, D. 1988. Influence of herbicides on growth and nitrogenase activity of *Azospirillum*. *W: Azospirillum* IV. Genetics, physiology, ecology (Ed. W. klinmuller). Springer- Verlag, Berlin, Heidelberg, pp. 141,- 149

Galal, Y.G.M., El-Ghandour, I.A., Aly, S.S., Soliman, S. and Gadalla, A., 2000. Non- isotopic method for the quantification of biological nitrogen fixation and wheat production under field conditions. *Biology and Fertility of Soils* **32**, pp. 47–51.

Galleguillos, C., Aguirre, C., Barea, J.M., Azcon, R., 2000. Growth promoting effect of two *Sinorhizobium meliloti* strains (a wild type and its genetically modified derivative) on a non-legume plant species inspecific interaction with two arbuscular mycorrhizal fungi. *Plant Sci.* **159**, 57–63.



Garcia, M.U., San Jose T.S. 1982. Nitrogen Fixing Bacteria associated with grass roots. IN: productivity Of Soil Ecosystem pp.262-275. Nodai Research Institute, Japan

Gosling, P., Hodge, A., Goodlass G., and Bending, G.D. 2005. Arbuscular Mycorrhizal fungi and Organic farming. *Agriculture, Ecosystems and Environment*. Volume 113, Issues 1-4, April 2006. pages 17-35

Gosling, P., Shepherd, M., 2005. Long-term changes in soil fertility in organic arable farming systems in England, with particular reference to phosphorus and potassium. *Agric. Ecosyst. Environ.* 105, 425–432.

Graham, J.H., 2000. Assessing cost of arbuscular mycorrhizal symbiosis in agroecosystems. In: Podila, G.K., Douds, Jr., D.D. (Eds.), *Current Advances in Mycorrhizal Research*. APS Press, St. Paul, NM, pp. 127–140.

Graham P H, Ocampo G C, Ruiz L D, Duque A. 1980. Survival of *Rhizobium phaseoli* in contact with chemical seed protection. *Agron J.* 1980;72:625–627.

Gutiérrez-Zamora, M.L. and Martínez-Romero, E., 2001. Natural endophytic association between *Rhizobium etli* and maize (*Zea mays* L.). *Journal of Biotechnology* 91, pp. 117–126.

Han, S.O. and New, P.B., 1998. Variation in nitrogen fixing ability among natural isolates of *Azospirillum*. *Microbial Ecology* 36, pp. 193–201.

Hancock T L C, Costello A M, Lidstrom M E, Oremland R S. Strain IMB-1, a novel bacterium for the removal of methyl bromide in fumigated agricultural soils. *Appl Environ Microbiol.* 1998;64:2899–2905.

Haney, R.L., S.A. Senseman, F.M. Hons, and D.A. Zuberer. 2000. Effect of Roundup on soil microbial activity and biomass. *Weed Sci.* 48:89–93

Haney, R.L., S.A. Senseman, F.M. Hons. 2002. *Journal of Environ. Qual* 1: 730-735

Haque, S. A. 2002 Urea super granule point placement on potato: a new concept. In proceedings of the 17th World Congress of Soil Science. 14- 21 August, 2002. Thailand, Symposium No. 14 2030, pp 1-6.

Hegazi, N.A., Fayed, M., Amin, G., Hamza, M.A., Abbas, M., Youssef, H. and Monib, M., 1998. Diazotrophs associated with non-legumes grown in sandy soils. In: Malik, K.A., Mirza, M.S. and Ladha, J.K., Editors, 1998. *Nitrogen Fixation with Non-Legumes*, Kluwer Academic Publishers, Dordrecht, pp. 209–222.

Hodge, A., 2000. Microbial ecology of the arbuscular mycorrhiza. *FEMS Microbiol. Ecol.* 32, 91–96.

Hodge, A., Campbell, C.D., Fitter, A.H., 2001. An arbuscular mycorrhizal fungus accelerates decomposition and acquires nitrogen directly from organic material. *Nature* 413, 297–299.



Ibibijen, J., Urquiaga, S., Ismaili, M., Alves, B.J., Boddey, R.M., 1996. Effect of arbuscular mycorrhizal fungi on growth, mineral nutrition and nitrogen fixation of three varieties of common beans (*Phaseolus vulgaris*). *New Phytol.* 134, 353–360.

Islam, N. and Bora, L.C., 1998. Biological management of bacterial leaf blight of rice (*Oryza sativa*) with plant growth promoting rhizobacteria. *Indian Journal of Agricultural Science* **68**, pp. 798–800.

Islam, N., Rao, C.V.S. and Kennedy, I.R. 2002. Facilitating a N<sub>2</sub>-fixing symbiosis between diazotrophs and wheat. In: Kennedy, I.R. and Choudhury, A.T.M.A., Editors, 2002. *Biofertilisers in Action*, Rural Industries Research and Development Corporation, Canberra, pp. 84–93.

Johannesen, H and Aamand, J. 2003. Mineralization of aged atrazine, terbuthylazine, 2,4- D and mecoprop in soil and aquifer sediment, *Environ. Toxicol. Chem.* **22**, 722- 729.

Johansson, J., Paul, L.R., Finlay, R.D., 2004. Microbial interactions in the mycorrhizosphere and their significance for sustainable agriculture. *FEMS Microbiol. Ecol.* 48, 1–13.. Tillage or no-tillage:

Jones, T.W., Kemp, W.M., Stevenson, J.C. and Means, J.C. 1982. Degradation of atrazine in estuarine water/ sediments systems and soils, *J. Environ. Qual.* **11**, 632- 638.

Jumpponen, A., Trowbridge, J., Mandyam, K., Johnson, L., 2005. Nitrogen enrichment causes minimal changes in arbuscular mycorrhizal colonization but shifts community composition—evidence from rDNA data. *Biol. Fertil. Soil* 41, 217–224.

Kahiluoto, H., Ketoja, E., Vestberg, M., 2000. Creation of a non-mycorrhizal control for a bioassay of AM effectiveness. 1. Comparison of methods. *Mycorrhiza* 9, 241–258.

Kahiluoto, H., Ketoja, E., Vestberg, M., Saarela, I., 2001. Promotion of AM utilization through reduced P fertilization. 2. Field studies. *Plant Soil*

Kennedy, I. R. , Choudhury A.T.M.A., Kecskés M.L. 2004. Non-symbiotic bacterial diazotrophs in crop-farming systems: can their potential for plant growth promotion be better exploited? *Soil Biology an Biochemistry*, **36**: 8, pp 1229- 1224.

Kehri HK, S. Chandra.(2001), Performance of Black Gram with VAM Inoculation and Phosphate Fertilization *Philippine Journal of Science.* Volume 130 No.1 June 2001

Khalil, M.I., Rosenani, A.B., Van Cleemput, O., Fauziah, C.I. & Shamshuddin, J 2002. Nitrous oxide emission from maize- groundnut crop rotation supplied with different nitrogen sources in the humid tropics. *Journal of Environ Quality*, **31**, 1071- 1078.

Khalil, M.L., Schmidhalter, U., Gutser R. 2006. N<sub>2</sub>O, NH<sub>3</sub>, No<sub>x</sub> Emissions as a function of Urea Granule size and soil type under aerobic conditions. *Water, Air and Soil Pollution* **175**:127-148



Koide, R.T., Goff, M.D., Dickie, I.A., 2000. Component growth efficiencies of mycorrhizal and nonmycorrhizal plants. *New Phytol.* 148, 163– 168.

Kulinka, D., Drozdowicz, A. 1983. Occurrence of microorganisms antagonic to *Azospirillum* spp. *Zbl. Microbiol.*, **138**, 585.

Ladha, J.K., Baraquio, W.L. and Watanabe, I., 1982. Immunological techniques to identify *Azospirillum* associated with rice. *Canadian Journal of Microbiology* **28**, pp. 478–485.

Ladha, J.K., So, R.B. and Watanabe, I., 1987. Composition of *Azospirillum* species associated with wetland rice plant grown in different soils. *Plant and Soil* **102**, pp. 127–129.

Lauer, J. 2005. Corn Seed Survival: The importance of seed fungicide and insecticide. *Wisconsin Crop Manager*, **12 (11)**: 75- 76

Lerat, S., Lapointe, L., Piche´, Y., Vierheilig, H., 2003. Variable carbon-sink strength of different *Glomus mosseae* strains colonizing barley roots. *Can. J. Bot.* 81, 886–889.

Li, X.L., Marschner, H., George, E., 1991. Acquisition of phosphorus and  
Lerat, S., Lapointe, L., Piche´, Y., Vierheilig, H., 2003. Variable carbon-sink strength of different *Glomus mosseae* strains colonizing barley roots. *Can. J. Bot.* 81, 886–889.

Lesan, H.M. and Bhandari, A. 2004. Contact- time dependent atrazine residue formation in surface soils. *Wat. Res.* **38**, 4435- 4445.

Liljeroth, E., Baath, E., Mathiasson, I. and Lundborg, T. 1990. Root exudation and rhizosphere bacterial abundance of barley (*Hordeum vulgare* L.) in relation to nitrogen fertilization and root growth. *Plant and Soil*, **127**, 81.

Lin, W., Okon, Y., and Hardy, R. W. F. 1983. Enhanced mineral uptake by *Zea mays* and *Sorghum bicolor* roots inoculated with *Azospirillum brasilense*. *Appl. Environ. Microbiol.* **45**: 1775–1779.

Linderman, R.G., 1994. Role of VAM in biocontrol. In: Pflieger, F.L., Linderman, R.G. (Eds.), *Mycorrhizae and Plant Health*. APS Press, St. Paul, NM, USA, pp. 1–26.

Liu, A., Hamel, C., Hamilton, R.I., Ma, B.L., Smith, D.L., 2000. Acquisition of Cu, Zn, Mn and Fe by mycorrhizal maize (*Zea mays* L.) grown in soil at different P and micronutrient levels. *Mycorrhiza* **9**, 331–336.

Malik, K.A., Bilal, R., Mehnaz, S., Rasul, G., Mirza, M.S., and Ali, S. 1997. Association of nitrogen-fixing plant growth promoting rhizobacteria (PGPR) with kallar grass and rice. *Plant Soil* **194**: 37–44.

Malik, K.A., Mirza, M.S., Hassan, U., Mehnaz, S., Rasul, G., Haurat, J., Bally, R. and Normand, P., 2002. The role of plant-associated beneficial bacteria in rice–wheat cropping system. In: Kennedy, I.R. and Choudhury, A.T.M.A., Editors, 2002. *Biofertilizers in Action*, Rural Industries Research and Development Corporation, Canberra, pp. 73–83.



Mallik M A B, Tesfai K. 1993. Compatibility of *Rhizobium japonicum* with commercial pesticides in vitro. *Bull Environ Contam Toxicol.* 1993;**31**:432–437.

Mannervik, B., et al., & Jörnvall, H. 1985. Identification of three classes of cytosolic glutathione S-transferases common to several mammalian species: correlation between structural data and enzymatic properties. *Proc. Natl Acad. Sci. USA* **82**, 7202-7206.

Mehnaz,S.,Lazarovits G.,2006.Inoculation Effects of *Pseudomonas putida*, *Gluconacetobacter aazotocaptans*,*Azospirillum lipoferum* on Corn plant Growth Under Greehouse conditions.*Microb.Ecology*,**45**: 197-115

Miller, R.M., Reinhardt, D.R., Jastrow, J.D., 1995. External hyphal production of vesicular-arbuscular mycorrhizal fungi in pasture and tallgrass prairie communities. *Oecologia* 103, 17–23.

Mosse. B. 1981. Vesicular- arbuscular mycorrhiza research for tropical agriculture. Res. Bull. Hawaii. Agric. Exp. Stn. 194

Muller S H, Pereira P A A. 1995.Nitrogen fixation of common bean (*Phaseolus vulgaris* L.) as affected by mineral nitrogen supply at different growth stages. *Plant Soil.* **177**:55–61.

Mulvaney, R. L., Khan, S.A., & Mulvaney, C. S.1997. Nitrogen fertilizers promote identification. *Biological Fertility of Soils*,24, 211- 220

Murty, M.G. and Ladha, J.K., 1988. Influence of *Azospirillum* inoculation on the mineral uptake and growth of rice under hydroponic conditions. *Plant and Soil* **108**, pp. 281–285.

Muthukumarasamy, R., Revathi, G. and Lakshminarasimhan, C., 1999. Diazotrophic associations in sugar cane cultivation in South India. *Tropical Agriculture* **76**, pp. 171–178.

Nemat Alla M. M. , A. M. Badawi, N. M. Hassan, Z. M. El- Bastawisy,E. G. Badran.2008 Herbicide tolerance in maize is related to increased levels of glutathione and glutathione-associated enzymes.*Acta Phy. Plantarum*.30:371-379

Neumann, G., Teras, R., Monson, L., Kivisaar, M., Schauer, E and Heipieper, H.J. 2004. Simultaneous degradation of atrazine and phenol by *Pseudomonas* sp strain ADP. Effects of toxicity and adapataion, *Appl. Environ. Microbiol.* **70**, 1907- 1912.

Nguyen, T.H., Kennedy, I.R. and Roughley, R.J., 2002. The response of field-grown rice to inoculation with a multi-strain biofertiliser in the Hanoi district, Vietnam. In: Kennedy, I.R. and Choudhury, A.T.M.A., Editors, *Biofertilisers in Action*, Rural Industries Research and Development Corporation, Canberra, pp. 37–44.

O’Connell, K.M., Breux, E.J. & Fraley, R.T. 1988. Different rates of metabolism of two chloroacetanilide herbicides in Pioneer 3320 corn.*Plant Physiol.* **86**, 359-363.

Okon,Y.,Itzigsohn R. 1995. The development of *Azospirillum* as a commercial inoculant for improving crop yields.*BiotechnolAdv* **13**,415-424





Pandey, A. and Kumar, S., 1989. Potential of *Azotobacters* and *Azospirilla* as biofertilizers for upland agriculture: a review. *Journal of Scientific and Industrial Research* **48**, pp. 134–144.

Pang, L.P., Close, M and Flintoft, M. 2005. Degradation and sorption of atrazine, hexazinone and procymidone in coastal sand aquifer media, *Pest Manage. Sci.* **61**, 133- 143.

Panwar, J.D.S. and Singh, O., 2000. Response of *Azospirillum* and *Bacillus* on growth and yield of wheat under field conditions. *Indian Journal of Plant Physiology* **5**, pp. 108–110.

Pereira, J.A.R., Cavalcante, V.A., Baldani, J.I. and Döbereiner, J., 1988. Field inoculation of sorghum and rice with *Azospirillum* spp. and *Herbaspirillum seropedicae*. *Plant and Soil* **110**, pp. 269–274.

Prosen, H. and Zupancic- Krajl, L. 2005. Evaluation of photolysis and hydrolysis of atrazine and its first degradation products in the presence of humic acids, *Environ. Poll.* **133**, 517- 529.

Radosevich M, Traina S J, Hao Y L, Tuovinen O H. 1995. Degradation and mineralization of atrazine by a soil bacterial isolate. *Appl Environ Microbiol.* **61**:297–302

Radosevich, M. and Tuovinen, O. H. 2004. Microbial degradation of atrazine in soils, sediments and surface water, *Pesticide Decontamination and Detoxification: ACS Symposium Series*, 863, 129- 139.

Reeves, T.G., Waddington, S.R., Ortiz-Monasterio, I., Bänziger, M. and Cassaday, K., 2002. Removing nutritional limits to maize and wheat production: a developing country perspective. In: Kennedy, I.R. and Choudhury, A.T.M.A., Editors, 2002. *Biofertilizers in Action*, Rural Industries Research and Development Corporation, Canberra, pp. 11–36.

Reinemer, P., et al., & Bieseler, B. 1996. Three-dimensional structure of glutathione S-transferase from *Arabidopsis thaliana* at 2.2. Å resolution: structural characterization of herbicide-conjugating plant glutathione S-transferases and a novel active site architecture. *J. Mol. Biol.* **255**, 289-309.

Rennie R J, Howard R J, Swanson T A, Flores G H A. 1985. The effect of seed applied pesticides on growth and N<sub>2</sub> fixation in pea, lentil and faba bean. *Can J Plant Sci.* **65**:555–562.

Requena, N., Jimenez, I., Toro, M., Barea, J.M., 1997. Interactions between plant- growth-promoting rhizobacteria (PGPR), arbuscular mycorrhizal fungi and *Rhizobium* spp. in the rhizosphere of *Anthyllis cytisoides*, a model legume for revegetation in Mediterranean semi-arid ecosystems. *New Phytol.* **136**, 667–677. Rew, L.J., Froud-Williams, R.J., Boatman,

Riggs, P.J., Chelius, M.K., Iniguez, A.L., Kaeppler, S.M. and Triplett, E.W., 2001. Enhanced maize productivity by inoculation with diazotrophic bacteria. *Australian Journal of Plant Physiology* **28**, pp. 829–836.

Romero, A.M., Correa, O.S., Moccia, S., Rivas J., G. 2003. Effects of *Azospirillum*-mediated plant growth promotion on the development of bacterial diseases on fresh market and cherry tomato. *J Appl microbiol* **95**, 832-838.



Saubidet, M.I. and Barneix, A.J., 1998. Growth stimulation and nitrogen supply to wheat plants inoculated with *Azospirillum brasilense*. *Journal of Plant Nutrition* **21**, pp. 2565–2577.

Savant, S.K., & Stangel, P.J. 1990. Deep placement of urea super granules in transplanted rice principles and practices. *Fertilizer Research*. **25**, 1- 83.

Scharf, P.C., 2001. Soil and plant tests to predict optimum nitrogen rates for corn. *Journal of Plant Nutrition* **24**, pp. 805–826.

Shankariah, C. and Hunsigi, G. 2001. Field responses of sugarcane to associative N<sub>2</sub> fixers and P solubilisers. In: Hogarth, D.M., Editor, , Proceedings of the 24th International Society of Sugarcane Technologists Congress, 17–21 September 2001, The Australian Society of Sugarcane Technologists, Brisbane, pp. 40–45.

Shimabukuro, R.J., Swanson, H.R. and Walsh, W.C. 1970. Glutathione conjugation: atrazine detoxification mechanism in corn. *Plant Physiol*. **46**, 103-107.

Smith, A.E. and Walker, A. 1989. Prediction of persistence of the triazine herbicides *atrazine, cyanazine and metribuzin* in Regina heavy clay, *Can. J. Soil Sci.* **69**, 587- 595.

Smith, S.E., Read, D.J., 1997. Mycorrhizal Symbiosis. Academic Press, London.

Sommer, S.G., Sejoerring, J.K., and Denmead, O.T 2004. Ammonia emission from mineral fertilizers and fertilized crops. *Advances in Agronomy*, **82**, 557- 622.

Sonon, L.S. and Schwab, A.P. 2004. Transport and persistence of nitrate atrazine and alachlor in large intact soil columns under two levels of moisture content, *Soil Sci.* **169**, 541- 553.

Steenhoudt, O. and Vanderleyden, J. 2000. *Azospirillum*, a free-living nitrogen- fixing bacterium closely associated with grasses: genetic, biochemical and ecological aspects. *FEMS Microbiol Rev* **24**: 487-506.

Swedrzyńska, D., Sawicka, A. 2001. *Polish Journal of Environmental Studies.* **10:1**, 21- 25.

Thavaprakash, N., K. Velayudham and L. Gurusamy, 2007. Influence of herbicides as growth regulators on growth and yield of baby corn (*Zea mays* L.). *Int. J. Agric. Res.*, 2: 731-735.

Thompson, J.P., 1987. Decline of vesicular-arbuscular mycorrhizae in long fallow disorder of field crops and its expression in phosphorus deficiency of sunflower. *Aust. J. Agric. Res.* **38**, 847–867

Tomlin, C. 1994. The pesticide manual, 10th ed. British Crop Protection Council, Farnham, United Kingdom.

Treseder, K.K., Allen, M.F., 2002. Direct nitrogen and phosphorus limitation of arbuscular mycorrhizal fungi, a model and field test. *New Phytol.* **155**, 507–515. Troeh, Z.I., Loynachan



Tsagou, V., Aggelis, G. 2005. Growth Dynamics of *Azospirillum lipoferum* at steady and transitory states in the presence of  $\text{NH}_4^+$ . *Journal of Applied Microbiology* doi:10.1111/j.1365-2672.

Tsimilli-Michael, M., Eggenberg, P., Biro, B., Koves-Pechy, K., Voros, I., Strasser, J.S., 2000. Synergistic and antagonistic effects of arbuscular mycorrhizal fungi and *Azospirillum* and *Rhizobium* nitrogen-fixers on the photosynthetic activity of alfalfa, probed by the polyphasic chlorophylla fluorescence transient O-J-I-P. *Appl. Soil Ecol.* 15, 169–182.

Vosatka, M., 1995. Influence of inoculation with arbuscular mycorrhizal fungi on the growth and mycorrhizal infection of transplanted onion. *Agric. Ecosyst. Environ.* 53, 151–159.

Wairiu, M. and Lal, R., 2003. Soil organic carbon in relation to cultivation and topsoil removal on sloping lands of Kolombangara, Solon Islands. *Soil and Tillage Research* 70, pp. 19–27.

Weber, J.B., J.A. Best, and J.U. Gonese. 1993. Bioavailability and bioactivity of sorbed organic chemicals. p. 153–196. In D.M. Linn et al. (ed.) Sorption and degradation of pesticides and organic chemicals in soil. ASA and SSSA, Madison, WI.

Winkelman, D.A and Klaine, S.J. 1991. Degradation and bound residue formation of atrazine in a western Tennessee soil, *Environ. Toxicol. Chem.* 10, 335- 345.

Zhang, L., Fang P., Zhu R. 2004. Recent Advances in research and application of associated nitrogen fixation with graminaceous plants. *Ying Yong Sheng Tai Xue Bao*. Sep 15(9) 1650-4

Zuberer, D.A. 1998. Biological Dinitrogen Fixation: introduction and nonsymbiotic. In Principles and Applications of Soil Microbiology, ed. Sylvia, D.M., pp. 295-321. New Jersey: Prentice Hall