Online ISSN: 2249-4626
Print ISSN: 0975-5896

Global Journal of Science Frontier Research: D

Agriculture and Veterinary

Highlights

- Soil Thermal Properties
- Effect of Urea Treatment
- Agronomic and Quality Traits
- Genetic Diversity in Bread

Discovering Thoughts, Inventing Future

VOLUME 13 ISSUE 8 VERSION 1.0

© 2001-2013 by Global Journal of Science Frontier Research, USA

Global Journal of Science Frontier Research: D
Agriculture & Veterinary

Global Journal of Science Frontier Research: D
Agriculture & Veterinary
Volume 13 Issue 8 (Ver. 1.0)

Open Association of Research Society

© Global Journal of Science Frontier Research .2013.

All rights reserved.

This is a special issue published in version 1.0 of "Global Journal of Science Frontier Research." By Global Journals Inc.

All articles are open access articles distributed under "Global Journal of Science Frontier Research"

Reading License, which permits restricted use. Entire contents are copyright by of "Global Journal of Science Frontier Research" unless otherwise noted on specific articles.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without written permission.

The opinions and statements made in this book are those of the authors concerned. Ultraculture has not verified and neither confirms nor denies any of the foregoing and no warranty or fitness is implied.

Engage with the contents herein at your own risk.

The use of this journal, and the terms and conditions for our providing information, is governed by our Disclaimer, Terms and Conditions and Privacy Policy given on our website http://globaljournals.us/terms-and-condition/menu-id-1463/

By referring / using / reading / any type of association / referencing this journal, this signifies and you acknowledge that you have read them and that you accept and will be bound by the terms thereof.

All information, journals, this journal, activities undertaken, materials, services and our website, terms and conditions, privacy policy, and this journal is subject to change anytime without any prior notice.

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: Open Association of Research Society
Open Scientific Standards

Publisher's Headquarters office

Global Journals Inc., Headquarters Corporate Office, Cambridge Office Center, II Canal Park, Floor No. 5th, ***Cambridge (Massachusetts)***, Pin: MA 02141 United States
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Open Association of Research Society, Marsh Road, Rainham, Essex, London RM13 8EU United Kingdom.

Packaging & Continental Dispatching

Global Journals, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investers@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Including by Air Parcel Charges):

For Authors:
22 USD (B/W) & 50 USD (Color)
Yearly Subscription (Personal & Institutional):
200 USD (B/W) & 250 USD (Color)

Editorial Board Members (HON.)

John A. Hamilton,"Drew" Jr.,
Ph.D., Professor, Management
Computer Science and Software Engineering
Director, Information Assurance Laboratory
Auburn University

Dr. Henry Hexmoor
IEEE senior member since 2004
Ph.D. Computer Science, University at Buffalo
Department of Computer Science
Southern Illinois University at Carbondale

Dr. Osman Balci, Professor
Department of Computer Science
Virginia Tech, Virginia University
Ph.D.and M.S.Syracuse University, Syracuse, New York
M.S. and B.S. Bogazici University, Istanbul, Turkey

Yogita Bajpai
M.Sc. (Computer Science), FICCT
U.S.A.Email:
yogita@computerresearch.org

Dr. T. David A. Forbes
Associate Professor and Range Nutritionist
Ph.D. Edinburgh University - Animal Nutrition
M.S. Aberdeen University - Animal Nutrition
B.A. University of Dublin- Zoology

Dr. Wenying Feng
Professor, Department of Computing & Information Systems
Department of Mathematics
Trent University, Peterborough,
ON Canada K9J 7B8

Dr. Thomas Wischgoll
Computer Science and Engineering,
Wright State University, Dayton, Ohio
B.S., M.S., Ph.D.
(University of Kaiserslautern)

Dr. Abdurrahman Arslanyilmaz
Computer Science & Information Systems Department
Youngstown State University
Ph.D., Texas A&M University
University of Missouri, Columbia
Gazi University, Turkey

Dr. Xiaohong He
Professor of International Business
University of Quinnipiac
BS, Jilin Institute of Technology; MA, MS, PhD,. (University of Texas-Dallas)

Burcin Becerik-Gerber
University of Southern California
Ph.D. in Civil Engineering
DDes from Harvard University
M.S. from University of California, Berkeley & Istanbul University

Dr. Bart Lambrecht
Director of Research in Accounting and FinanceProfessor of Finance
Lancaster University Management School
BA (Antwerp); MPhil, MA, PhD (Cambridge)

Dr. Carlos García Pont
Associate Professor of Marketing
IESE Business School, University of Navarra
Doctor of Philosophy (Management), Massachusetts Institute of Technology (MIT)
Master in Business Administration, IESE, University of Navarra
Degree in Industrial Engineering, Universitat Politècnica de Catalunya

Dr. Fotini Labropulu
Mathematics - Luther College
University of ReginaPh.D., M.Sc. in Mathematics
B.A. (Honors) in Mathematics
University of Windso

Dr. Lynn Lim
Reader in Business and Marketing
Roehampton University, London
BCom, PGDip, MBA (Distinction), PhD, FHEA

Dr. Mihaly Mezei
ASSOCIATE PROFESSOR
Department of Structural and Chemical Biology, Mount Sinai School of Medical Center
Ph.D., Etvs Lornd University
Postdoctoral Training,
New York University

Dr. Söhnke M. Bartram
Department of Accounting and FinanceLancaster University Management SchoolPh.D. (WHU Koblenz)
MBA/BBA (University of Saarbrücken)

Dr. Miguel Angel Ariño
Professor of Decision Sciences
IESE Business School
Barcelona, Spain (Universidad de Navarra)
CEIBS (China Europe International Business School).
Beijing, Shanghai and Shenzhen
Ph.D. in Mathematics
University of Barcelona
BA in Mathematics (Licenciatura)
University of Barcelona

Philip G. Moscoso
Technology and Operations Management
IESE Business School, University of Navarra
Ph.D in Industrial Engineering and Management, ETH Zurich
M.Sc. in Chemical Engineering, ETH Zurich

Dr. Sanjay Dixit, M.D.
Director, EP Laboratories, Philadelphia VA Medical Center
Cardiovascular Medicine - Cardiac Arrhythmia
Univ of Penn School of Medicine

Dr. Han-Xiang Deng
MD., Ph.D
Associate Professor and Research Department Division of Neuromuscular Medicine
Davee Department of Neurology and Clinical NeuroscienceNorthwestern University Feinberg School of Medicine

Dr. Pina C. Sanelli
Associate Professor of Public Health
Weill Cornell Medical College
Associate Attending Radiologist
NewYork-Presbyterian Hospital
MRI, MRA, CT, and CTA
Neuroradiology and Diagnostic Radiology
M.D., State University of New York at Buffalo,School of Medicine and Biomedical Sciences

Dr. Roberto Sanchez
Associate Professor
Department of Structural and Chemical Biology
Mount Sinai School of Medicine
Ph.D., The Rockefeller University

Dr. Wen-Yih Sun
Professor of Earth and Atmospheric SciencesPurdue University Director National Center for Typhoon and Flooding Research, Taiwan University Chair Professor Department of Atmospheric Sciences, National Central University, Chung-Li, TaiwanUniversity Chair Professor Institute of Environmental Engineering, National Chiao Tung University, Hsin-chu, Taiwan.Ph.D., MS The University of Chicago, Geophysical Sciences
BS National Taiwan University, Atmospheric Sciences
Associate Professor of Radiology

Dr. Michael R. Rudnick
M.D., FACP
Associate Professor of Medicine
Chief, Renal Electrolyte and Hypertension Division (PMC)
Penn Medicine, University of Pennsylvania
Presbyterian Medical Center, Philadelphia
Nephrology and Internal Medicine
Certified by the American Board of Internal Medicine

Dr. Bassey Benjamin Esu
B.Sc. Marketing; MBA Marketing; Ph.D Marketing
Lecturer, Department of Marketing, University of Calabar
Tourism Consultant, Cross River State Tourism Development Department
Co-ordinator , Sustainable Tourism Initiative, Calabar, Nigeria

Dr. Aziz M. Barbar, Ph.D.
IEEE Senior Member
Chairperson, Department of Computer Science
AUST - American University of Science & Technology
Alfred Naccash Avenue – Ashrafieh

President Editor (HON.)

Dr. George Perry, (Neuroscientist)
Dean and Professor, College of Sciences
Denham Harman Research Award (American Aging Association)
ISI Highly Cited Researcher, Iberoamerican Molecular Biology Organization
AAAS Fellow, Correspondent Member of Spanish Royal Academy of Sciences
University of Texas at San Antonio
Postdoctoral Fellow (Department of Cell Biology)
Baylor College of Medicine
Houston, Texas, United States

Chief Author (HON.)

Dr. R.K. Dixit
M.Sc., Ph.D., FICCT
Chief Author, India
Email: authorind@computerresearch.org

Dean & Editor-in-Chief (HON.)

Vivek Dubey(HON.)
MS (Industrial Engineering),
MS (Mechanical Engineering)
University of Wisconsin, FICCT
Editor-in-Chief, USA
editorusa@computerresearch.org

Sangita Dixit
M.Sc., FICCT
Dean & Chancellor (Asia Pacific)
deanind@computerresearch.org

Suyash Dixit
(B.E., Computer Science Engineering), FICCTT
President, Web Administration and
Development , CEO at IOSRD
COO at GAOR & OSS

Er. Suyog Dixit
(M. Tech), BE (HONS. in CSE), FICCT
SAP Certified Consultant
CEO at IOSRD, GAOR & OSS
Technical Dean, Global Journals Inc. (US)
Website: www.suyogdixit.com
Email:suyog@suyogdixit.com

Pritesh Rajvaidya
(MS) Computer Science Department
California State University
BE (Computer Science), FICCT
Technical Dean, USA
Email: pritesh@computerresearch.org

Luis Galárraga
J!Research Project Leader
Saarbrücken, Germany

Contents of the Volume

i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Table of Contents
v. From the Chief Editor's Desk
vi. Research and Review Papers

1. Effect of Urea Treatment and Concentrate Proportions on Dry Matter Degradation of Different Roughages in the Rumen of Jersey Cows. *1-10*
2. Determination of Efficiency of Yield Components on Oil Yield Per Plant in Safflower Breeding by Different Statistical Methods. *11-20*
3. Determination of Genetic Diversity in Bread Wheat (*T.Aestivum* L.) by Agronomic and Quality Traits and SDS-PAGE Method. *21-29*
4. Nitrogen Management In Banana (*Musa Paradisica* L.) Cv. Basrai through Drip under Paired Row System. *31-34*
5. Comparison of Microbial Load Associated with Smoked Fish *(Chrysichthys Nigrodigitatus)* from Oyan Lake and Ogun Waterside in Ogun State, Nigeria. *35-39*
6. Variability of Soil Thermal Properties of a Seasonally Cultivated Agricultural Teaching and Research Farm, University of Ibadan, South - Western Nigeria. *41-64*

vii. Auxiliary Memberships
viii. Process of Submission of Research Paper
ix. Preferred Author Guidelines
x. Index

Global Journal of Science Frontier Research
Agriculture and Veterinary
Volume 13 Issue 8 Version 1.0 Year 2013
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Effect of Urea Treatment and Concentrate Proportions on Dry Matter Degradation of Different Roughages in the Rumen of Jersey Cows

By Tesfayohannes S. T., Nsahlai I. V. & Bengaly K
University of KwaZulu-Natal, South Africa

Abstract - A study was conducted to determine the interaction of roughage quality and urea-ammonization on the luminal degradation properties of low quality roughage diets. Four rumen fistulae Jersey cows were fed on a basal diet of either urea-treated or untreated *Eragrostis uvula* hay. These basal diets were supplemented with concentrate composed of maize meal (78%) and cotton seed cake (22%). The concentrates contributed 0, 25, 50 and 75% of the total ration and hay the rest. The experiment consisted of 6 periods. Each period lasted 19 days, comprising 12 days of adaptation to the experimental diet followed by 6 days degradability measurements and 1-day collection of rumen fluid. During each period the 4 cows were randomly allocated to 4 of the 8 dietary treatments, ensuring that each diet was fed to 3 animals during the entire experimental period.

Keywords : urea-ammonization, rumen ammonia, rumen pH, dry matter, fiber, roughage, degradability.

GJSFR-D Classification : FOR Code: 070205

EFFECT OF UREA TREATMENT AND CONCENTRATE PROPORTIONS ON DRY MATTER DEGRADATION OF DIFFERENT ROUGHAGES IN THE RUMEN OF JERSEY COWS

Strictly as per the compliance and regulations of :

© 2013. Tesfayohannes S. T., Nsahlai I. V. & Bengaly K. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Effect of Urea Treatment and Concentrate Proportions on Dry Matter Degradation of Different Roughages in the Rumen of Jersey Cows

Tesfayohannes S. T.[α], Nsahlai I. V.[σ] & Bengaly K [ρ]

Abstract - A study was conducted to determine the interaction of roughage quality and urea-ammonization on the luminal degradation properties of low quality roughage diets. Four rumen fistulae Jersey cows were fed on a basal diet of either urea-treated or untreated *Eragrostis uvula* hay. These basal diets were supplemented with concentrate composed of maize meal (78%) and cotton seed cake (22%). The concentrates contributed 0, 25, 50 and 75% of the total ration and hay the rest. The experiment consisted of 6 periods. Each period lasted 19 days, comprising 12 days of adaptation to the experimental diet followed by 6 days degradability measurements and 1-day collection of rumen fluid. During each period the 4 cows were randomly allocated to 4 of the 8 dietary treatments, ensuring that each diet was fed to 3 animals during the entire experimental period.

The pH of the rumen fluid ranged between 6.5 and 6.8 for all diets. Rumen ammonia (NH_3) concentration was higher ($P<0.002$) when the basal diet consisted of urea-treated hay. Increasing the concentrate proportion in the diet had the desired effect of increasing rumen NH_3 concentration without severely affecting the pH. Urea-ammonization increased ($P<0.0001$) the slowly degradable fraction (B), potential degradability (PD), effective degradability (ED) of dry matter (DM), decreased ($P>0.05$) lag time (LT) but had no effect on the rate of degradation (c) of DM. Maximum and minimum degradability values of the B-fraction, PD and ED of DM were obtained at the 25 and 75% concentrate levels, respectively for both urea-treated and untreated diets. Within urea-ammonization, roughage type increased ($P<0.001$) the B-fraction, PD and ED of DM. Ryegrass degraded almost three to four times faster than urea-treated oat or untreated wheat straw. Urea-ammonization was less effective in increasing DM degradation rate of ryegrass compared to wheat straw. Results show that low quality roughages such as wheat straw benefited relatively the most from urea-ammonization.

Keywords : urea-ammonization, rumen ammonia, rumen pH, dry matter, fiber, roughage, degradability.

Authors α σ : Discipline of Animal and Poultry Science, School of Agriculture and Agribusiness, University of KwaZulu-Natal, Pietermaritzburg 3209, South Africa.

Author ρ : Université de Ségou, Centre d'Expertise et de Recherche Appliquée pour le Développement, Angoulème Avenue 2000, Ségou, Mali, West Africa. E-mail : konis6@gmail.com

I. Introduction

Other the last two or three decades there has been a lot of research conducted to determine the benefit of using low quality roughages in livestock feeding in the tropics, particularly during the dry season when green pasture resources area not available. These roughages contain 70-80% cell wall (CW) components, which represent potential energy for ruminant animals. Availability of this energy to the animal is generally limited by the low voluntary intake, the chemical association with lignin and CW carbohydrates, and physical limitation of the CW components to microbial fermentation. Despite the limiting features roughages have enormous potential and can be used as sole feed, if their feeding value is improved.

Considerable efforts have been made worldwide to find ways of modifying roughages to improve degradability and upgrade their nutritive value to feed ruminants. Some of the methods for improving the availability of energy in roughages for ruminants involve treatment with ammonia (Sandston and Cox worth, 1984), Noah (Dixon and Parra, 1984; Escobar *et al.*, 1984) and urea (Had jipanayiotou, 1982a; Colette and Kissinger, 1984; Dias-Ad-Silva and Sandston, 1986). Urea is one of the major chemical agents used to improve the nutritive value of cereal straws and other fibrous by-products (Ray *et al.*, 1989; Got *et al.*, 1991; Tune *et al.*, 1991; Ghana *et al.*, 1993). Treatment with urea can break the ester bonds between lignin, hemicelluloses and cellulose, and physically cause structural fiber to swell. It has been suggested (Mason *et al.*, 1988; Many chi *et al.*, 1992) that urea-ammonization affects CW composition and improves extent of rumen degradability.

Eragrostis uvula is a popular hay grass, produced in vast quantities in Natal, with a mean crude protein (CP) content of less than 6 g kg^{-1} (Galloway, 1980), which does not meet the minimum dietary CP concentration required for milk producing dairy cows (Flacon sky *et al.*, 1993). A large proportion of the potential hay crop is lost each year because difficulties are experienced with harvesting the hay at the correct

Global Journal of Science Frontier Research (D) Volume XIII Issue VIII Version I Year 2013

© 2013 Global Journals Inc. (US)

time. As a result a large proportion of the *E. uvula* hay produced is of little feed value. If urea has the same effect on *E. uvula* hay as on cereal straws then urea-ammonization of such low quality hay could increase its potential as a ruminant feedstuff. Concentrate supplementation for such low quality roughages also increase the rumen fermentation due to the supply of readily fermentable energy. However, it has been reported that high concentrate levels in the diet may reduce rumen fermentation and rumination time (Korsakov and Ryle, 1990). As a consequence, saliva production is low. It is not known; therefore, to what extent the changes in the rumen environment induced by feeding urea-treated roughages and concentrate supplements could affect fiber degradation.

The overall objective of this study was to determine how dietary manipulation and urea-ammonization affect degradation properties of roughage diets.

II. Materials and Methods

a) Study Area

The experiment was conducted at the University of Natal's Ukulinga Research Farm outside Pietermaritzburg, in the subtropical hinterland of KwaZulu-Natal Province, South Africa. It lies at 30°24'S, 29°24'E and approximately 700 m above sea level. The mean annual rainfall in the study site is 735 mm, falling mostly in summer, between October and April, and the maximum and minimum mean annual temperatures are 25.7 and 8.9°C, respectively (Camp, 1999). Light to moderate frost occurs occasionally in winter.

b) Animals

Four adult Jersey cows (average body weight of 425.5 ± SD 58.4), fitted with permanent rumen canola of 120 mm internal diameter were used in this study. They were kept in individual feedlot pens under a roofed shed with floor beddings. Cows were provided with clean water and a mineral block supplement at all time throughout the experiment.

c) Diet and Feeding

All rumen fistulae Jersey cows were fed on a basal diet composed of either urea-treated or untreated *Eragrostis uvula* hay. These basal diets were supplemented with a concentrate mixture composed of maize meal (78%) and cottonseed oilcake meal (22%). The concentrate was formulated to contain 15% crude protein (CP). Concentrate contributed 0, 25, 50 or 75% of the total ration and treated or untreated *E. uvula* hay the rest (22%). Thus 8 different dietary treatments were formed.

d) Experimental Design

The experiment comprised six periods. Each period lasted 19 days, comprising 12 days of adaptation to the experimental diet followed by 6-days of degradability measurements and 1-day of rumen fluid collection. During each period, the animals were randomly assigned to 4 of the 8 dietary treatments. It was however ensured that each diet was fed to 3 animals during the entire experiment (Table 1).

Before the initiation of the experiment, cows were allowed free access to diets to determine *ad labium* intake. Cows were then subsequently fed 80% of the *ad labium* intake to ensure complete consumption of feed so as to adhere to the roughage: concentrate ratio. Diets were fed twice a day, during morning (08:00) and afternoon (16:00).

e) Preparation of the urea ammoniated hay

Urea solution was prepared in a plastic container by adding 3 kg urea into 40 liters of water whilst stirring until all the urea was dissolved. The entire 40-litre solution was then sprayed onto 100 kg of hay (on a DM basis). Before the solution was made, a total of 240 bales of *E. uvula* hay were collected from Ukulinga Research Farm. One hundred and twenty of the 240 bales were ammoniated with urea and divided into 4 layer groups. The bottom layer, comprising 30 bales, was placed on the concrete floor. Using a 15-litre capacity plastic watering can fitted with a spray nozzle, the prepared urea solution was distributed evenly over the top surface of each layer of hay. The same procedures were applied until the fourth layer. The urea treated hay was covered with large plastic sheets and tightly sealed with tape at the four corners and round the edges with soils to exclude air. Immediately after sealing tightly, weights were strategically put on the top of the plastic sheet to hold it down. After 5 weeks, the treated hay was opened and aerated before feeding to the experimental animals. This treatment resulted in moisture content of approximately 35%, as calculated according to Chemist and Kaolin (1997). Representative samples of hay were taken for chemical analysis prior to and after treatment.

f) Preparation of roughages for rumen incubation study

Samples (2 kg) of 10 different roughages were chosen for this study. They were collected from different parts of South Africa. The experimental roughages were wheat (*Tritium sativa*) straw, barley (*Horde vulgar*) straw, coast cross (k_{11}) (*Condon* hybrid) hay, veldt hay (natural grass), oat (*Avenal sativa*) straw, oat (*Avenal sativa*) hay, maize (*Zeal Mays*) Stover, kikuyu (*Pennisetum clandestine*) grass, weeping love grass (*Eragrostis uvula*) hay and Italian ryegrass (*Folium multiform*).

The experimental barley, wheat and oat straws examined in this study originated from the Western Cape Province and oat hay from the Free State Province. The rest of the roughages were collected from Ukulinga Research Farm. Italian ryegrass was collected (cut) fresh and then sun-dried before use. Each sample was sub-divided into two equal portions. Each portion

© 2013 Global Journals Inc. (US)

was then treated with or without urea. The urea solution was wholly distributed over 1 kg of roughage. Addition of the urea solution would increase the moisture content of the roughages to 35%. Treated roughages were sealed tightly and stored at room temperature for 5 weeks in plastic bags. Immediately after opining, the different roughages, including the untreated ones, were sun-dried, chopped fine by hand and ground through a2-mm screen in a laboratory mill.

g) Nylon bag incubation procedure

About 3 g of each ground forage sample was weighed into labeled nylon bags (ANKOM Co, Fairport, New York, USA; internal dimensions: 5 cm x 9 cm; pore size 50 μm). The bags were tied to a stainless steel disc with 10 evenly spaced small holes drilled through the periphery of the disc serving as anchor points. The bags were incubated (in duplicate per time interval) in the rumen for 120, 96, 72, 48, 24, 12, 6 and 3 h sequentially. The treated samples were incubated in the rumen of animals fed treated hay, while untreated samples were incubated in animals given untreated hay. Immediately after removal from the rumen, the bags, including the zero hour ones, which had not been incubated but soaked in warm water for one hour, were washed in 6 cycles (each lasting 4 minutes) in a semi-automatic washing machine. The washed bags were then dried in a forced draught oven at 60°C for 48 hours, cooled in a dedicator and weighed.

h) Rumen pH and ammonia concentration

After each incubation period, animals were maintained on the same diets and rumen fluid was collected from each animal for determination of ammonia (NH_3) concentration and rumen pH during the following times after morning feeding: 2, 4, 6, 8, 10, 12 and 24 hours. Immediately after collection, the rumen fluid was strained through a double layer of cheesecloth. Rumen pH was measured using a Crimson portable pH model 507 (Crimson Instruments, SA. 08328 Allele, and Barcelona, Spain). Samples of about 100 ml were put in 250 ml containers to which 5 drops of concentrated sulfuric were added and stored in a freezer maintained at -20°C until they were needed for NH_3 analysis.

i) Chemical analysis of basal diet and concentrate

Dry matter, organic matter (OM) and ash were analyzed using the procedures described by the Association of Official Analytical Chemists (AOAC, 1990). Nitrogen (N) or crude protein (CP) [(6.25*N)] content in feeds was determined using an automatic protein determinate (LECO FP2000, LECO, Pretoria, South Africa). Rumen NH_3-N concentration was measured using an auto-analyzer with no sample preparation. Neutral detergent fiber and acid detergent fiber (ADF) contents in feeds were analyzed according to Van Sorest *et al.* (1991) and hemicelluloses were estimated as the difference between NDF and ADF.

j) Calculations and statistical analysis

The degradation of DM was estimated by fitting the non-linear model proposed by McDonald (1981) and modified by Hanoi (1988) to the degradation data of each component: variables were determined using the secant method (SAS, 1987).

$$P = A + B\,[1 - \exp^{-c\,(T - LT)}] \qquad (1)$$

Where P is the disappearance of DM or fibre fraction at time T, A = the water soluble fraction (washing losses) and is considered immediately degradable at time zero, B = the degradable part of the insoluble fraction, c = rate of disappearance of the degradable fraction "B", T = time of exposure and LT = the lag time. The PD was calculated as (A + B). A passage rate (k) of 0.03 h^{-1} was assumed in order to calculate ED of DM (Bonsai *et al.*, 1994; Nashua *et al.*, 1998a):

$$ED = A + B \times c/(k + c) \qquad (2)$$

The model used for statistical analysis of DM degradation parameters was:

$$Y_{ijklm} = \mu + A_i + P_j + U_k + C\,(U)_{kl} + F\,(U)_{km} + \epsilon_{ijkl} \qquad (3)$$

Where

Y = individual observation;

μ = overall mean;

A = animal effect;

P = period effect;

U = effect of urea-ammonization;

C (U) = effect of concentrate within urea-ammonization;

F (U) = effect of roughage within urea-ammonization; and

ϵ = random variation (assumed independent, identical and normally distributed).

The model used for the analysis of rumen NH_3 and rumen pH was:

$$Y_{ijklm} = \mu + T_i + TA_{ij} + TP_{ik} + TC_{il} + TU_{im} + TC\,(U)_{ilm} + \epsilon_{ijklm} \qquad (4)$$

Where

Y = individual observation;

μ = overall mean;

T = effect of time;

A = animal effect;

P = period effect;

C = effect of concentrate;

U = effect of urea-ammonization;

C(U)= effect of concentrate within urea- ammonization; and

© 2013 Global Journals Inc. (US)

ϵ = random variation (assumed independent, identical and normally distributed).

Time was introduced in the model as a repeated measure.

III. Results

a) Chemical composition of the feeds

The chemical composition of the urea-treated and untreated roughages is given in Table 2. Urea-ammonization resulted in marked increase in N content. There was a wide variation in the chemical composition of the treated and untreated roughage samples. Most of the roughages (Table 2) were characterized as high fibrous feedstuffs, with a high NDF value but low CP content. NDF and hemicelluloses contents of most feeds were decreased while ADF was increased due to urea-ammonization. Among the untreated roughages, ryegrass had the highest CP content, followed by coast cross hay, oat hay, maize Stover and the lowest was barley straw in descending order. The rest of the untreated roughages fell in between the two extremes.

b) Ammonia concentration and pH in the rumen

The least square means of the effects of urea-ammonization of dietary roughages and varying concentrate proportions on rumen NH_3 concentration and pH are given in Table 3. Urea-ammonization ($P<0.01$) and concentrate proportions ($P<0.001$) increased NH_3 concentration in the rumens of Jersey cows but concentrate proportions within urea-ammonization had no effect ($P>0.05$). The lowest and highest rumen NH_3 concentrations were observed at 2 and 4 hrs, respectively, after feeding for animals fed urea treated hay, while for those on the untreated hay the lowest and the highest were recorded at 24 and 4 hrs after morning feeding. The profile of rumen NH_3 concentration of the untreated diet was maintained at a lower level than for urea-treated diet throughout the period of measurement.

As shown in Table 3, the effect of urea-ammonization and concentrate proportions on rumen pH levels was not significant ($P>0.05$). There was, however, a tendency for increased ($P<0.098$) rumen pH in animals fed urea-treated diets. Concentrate levels within urea-ammonization had no effect on rumen pH.

c) Degradation of Dry Matter

i. Effect of roughage type

The effect of roughage type within urea-ammonization on DM degradability of incubated roughages (treated and untreated) is given in Table 4. Within urea-ammonization, roughage type affected ($P<0.0001$) all the degradability parameters of DM.

The slowly degradable fraction of untreated roughages varied from 442 g kg^{-1} of wheat straw to 650 g kg^{-1} of veldt hay with a mean value of 527 g kg^{-1}, while for urea-treated roughages it varied from 483 g kg^{-1} of oat hay to 742 g kg^{-1} of veldt hay with a mean value of 599 g kg^{-1}. The rate of degradation of DM of untreated roughages varied from 0.022 h^{-1} for wheat straw to 0.087 h^{-1} for ryegrass, while for urea-treated roughages it varied from 0.022 h^{-1} for oat straw to 0.082 h^{-1} for ryegrass. Ryegrass degraded almost three to four times faster than urea-treated oat straw. The potential degradability ranged from 625 g kg^{-1} of untreated wheat straw to 950 g kg^{-1} of ryegrass, and from 733 g kg^{-1} of treated wheat straw to 964 g kg^{-1} of treated ryegrass. The effective degradability was lowest in untreated wheat straw (370 g kg^{-1}) and highest in ryegrass (799 g kg^{-1}), while in treated roughages wheat straw had the lowest (434 g kg^{-1}) and ryegrass the highest (797 g kg^{-1}) effective degradability. For the untreated feeds the lag time ranged from 0.6 h in *E. uvula* hay to 3.2 h in veldt hay, and from 0.3 h in treated oat straw to 3.0 h in treated veldt hay.

ii. Effect of urea-ammonization

The main effect of urea and concentrate proportions within urea-ammonization nod degradability of treated and untreated roughages is given in Table 5. Urea-ammonization increased ($P<0.0001$) the B-fraction, PD and ED, decreased ($P>0.05$) the lag time that precedes the onset of degradation of DM but had no effect on rate of degradation of DM.

iii. Effect of concentrate proportion

Concentrate proportion affected ($P<0.05$) the B-fraction, PD, LT and ED but had no effect ($P>0.05$) on the rate of degradation of DM. For both urea-treated and untreated roughages, the B-fraction, the PD and the ED of DM increased to their maximum at 25% concentrate levels. Beyond this level, they decreased with increasing concentrate level, reaching a mini mum at 75% concentrate level (Table 5). The pattern of decrease of each of these parameters was gentle for treated but rapid for untreated ones.

d) Relationships Among Variables

i. Correlation of chemical constituents with degradation of roughages

The degradability parameters: c, PD and ED were highly correlated ($P<0.0001$) with the concentration of CP, ash, ADF and NDF (Table 6). The degradability of DM as measured by the above parameters increased with increasing CP and ash contents but decreased in the direction of increasing concentration of either NDF or ADF.

IV. Discussion

a) Chemical composition

Urea-treated diets had higher N content than untreated ones due to urea-ammonization, as was reported previously (Colette and Kissinger, 1984; Brand *et al.,* 1991). Urea-ammonization generally caused a reduction in the NDF and hemicelluloses contents of the

© 2013 Global Journals Inc. (US)

low quality roughages. It was the reverse for the high quality roughages especially ryegrass and oat hay. Similar results regarding NDF and hemicelluloses contents of low quality roughages have been reported before (Colette and Kissinger, 1984) due to soul bilization of hemicelluloses (Van Sorest *et al.,* 1983/84; Mason *et al.,* 1988). Urea-ammonization may have removed some linkages within hemicelluloses and thus enhanced their solubility in detergent solution.

b) Rumen Environment

Rumen-NH_3 ammonia concentration steadily increased with increasing concentrate proportion in the diet. The highest DM degradation was observed when the mean value for rumen-NH_3 was close to 50 mg/l recommended by Setter and Slyer (1974). Ammonia is the preferred source of N for a large proportion of rumen microbes (Bryant and Robinson, 1963). The results of the present study indicate that the urea-treated hay, compared to the untreated diets, caused an increase in the DM degradation of the roughages. This might be attributed to the fact that urea treatment of basal diets provided more fermentable energy and N to the rumen microbes than untreated diets (Van Sorest *et al.,* 1983/84; Got *et al.,* 1991; Tune *et al.,* 1991). Although the concentrate level had no effect ($P>0,05$) on the luminal pH of cows, it tended to be lower in cows receiving 50 and 75% concentrate than in cows receiving 25% concentrate. This might have reduced the extent of DM degradability in the rumen of cows.

c) Effect of roughage type on dry matter degradability

The difference observed between the degradable parts of the insoluble fraction, the potential degradability and the effective degradability of DM of untreated and urea-treated materials might be related to the quality of the roughages before the treatment. Roughages such as barley, wheat and oat straw, coast cross hay, *E. uvula* hay and maize Stover, unlike ryegrass and oat hay, consist of cell walls that have undergone secondary thickening (Adebowale and Nakashima, 1992; Jung and Allen, 1995; Wilson and Martens, 1995) consequently they are very slowly degraded. This may explain why the washing losses of ryegrass and oat hay were almost two times higher than for the rest of the roughages. The high potential degradability values for ryegrass followed by oat hay resulted partly from very high washing losses of these roughages. This could be linked to their low NDF concentrations since the potential degradability of the roughages was found to be negatively correlated ($r = -0.797$, $P<0.0001$) to NDF. This observation confirms a report that DM digestibility was positively correlated to crude protein content and negatively correlated to crude fiber, NDF and ADF (Manson, 1982b). This may also explain why wheat, oat and barley straws had low effective DM degradability values. The low potential degradability of wheat, oat and barley straws, veldt, Kikuyu and *E. uvula* hays are closely linked to their low values of washing losses. The high effective degradability of DM for the ryegrass and oat hay before urea-ammonization could be linked to their low NDF concentrations.

Mature plants (straws) like barley, wheat and oat straw, *E. uvula* hay, coasters, hay and maize Stover are more lignified than the young grasses (ryegrass and oat hay). The deposition of lignin polymer commences with the initiation of secondary wall thickening (Trachoma *et al.,* 1993). In addition to deposition of lignin in these plants during secondary wall thickening, there is apparently an incorporation of some of the arabinoxylan ferulae esters of the primary wall into cross-linkages of the xylems to lignin (Imam *et al.,* 1990) and p-comedic acid (Lam *et al.,* 1992). The phenol nature of lignin developed during the secondary wall thickening may act as an enzyme inhibitor and interfere with the digestion of cell wall components (Van Sorest, 1994). Thus, the high slowly degradable fraction, PD and ED values of NDF (not reported) observed in this experiment, in ryegrass and oat hay may be attributed to the low levels of soluble phenol compounds as compared to wheat, barley and oat straws. These compounds are present in most mature grasses (Hartley *et al.,* 1985) and were reported to be linked to lignin, consequently limiting the degradability of cell walls (Thunder, 1985). Non-lignified tissues may also be poorly degraded due to binding with low molecular weight phenol compounds (Vadiveloo and Fidel, 1992).

d) Effect of urea-ammonization on the degradability of dry matter

Significantly higher rumen-NH_3 concentration may partly be responsible for a better rumen environment for roughage degradation in the animals fed urea-treated diets. The improvements observed in the degradability parameters of DM following urea treatment of the roughages could in part be attributed to the increased availability of carbohydrates in the dietary fiber fractions for microbes. According to Akin (1989), it is likely that any change in the degradation of the basal diet as a result of an increase in microbial activity may depend on the number of available sites for microbial attachment.

Treatment with urea increases the B-fraction. The mathematical procedure used to derive degradation parameters shows that an estimate of "B" is negatively correlated with the rate of degradation. Consequently, an increase in the B-fraction following urea-ammonization might reduce the possible effect of treatment on the rate of degradation.

The effect of urea-ammonization might have been more pronounced on the degradability of low quality roughages, such as wheat straw, relative to good quality roughage like ryegrass because urea-ammonization works best on low quality roughages. It

© 2013 Global Journals Inc. (US)

has been observed (Got *et al.,* 1991) that the extent of improvement in degradability following ammonia treatment of Golden Promise (a variety of wheat straw which had a DM degradability of 41.0% before treatment and 53.5% after treatment) was about four times higher than the corresponding value in Doublet (a variety of wheat straw which had a DM degradability value of 57% before ammonia treatment and 59% after treatment), indicating that the effect of ammonization was more pronounced for materials of lower inherent degradability. Utah et *al.* (1986) reported that the poorest quality straw benefited the most from urea-ammonization.

e) Effect of concentrate proportions on the degradation of dry matter

Although the highest rumen-NH_3 concentration was recorded in animals fed urea-treated *E. uvula* hay supplemented with 75% concentrate, its failure to improve the dry matter degradability of the incubated roughages may relate the fact that higher concentrate proportions in a diet may lower the cellulolytic activity of rumen microbes. Gal yean and Goatish (1993) proposed that the inclusion rates of concentrate in a diet for dairy and beef cattle should be less than 40 a d 20% of the total ration, respectively. In the experiment reported here, however, addition of concentrate up to 25% to urea-treated and untreated hay resulted in positive associative effects on dry matter degradation. Similar results were reported in another study (Niangua *et al.,* 1993) after goats and sheep were offered urea-treated sorghum stover with less than 25% concentrate supplementation. Beyond the 25% concentrate level, there was a negative associative effect on dry matter degradation. The pattern of negative effect was less pronounced in the urea-ammoniated diets. This might be due to the fact that urea is alkaline, which can neutralize the acidity caused by adding higher amount of concentrate in the diets of cows. Flacon sky *et al.,* (1993) also reported that dry matter degradability of ammonia-treated and untreated straw decreased when dietary straw was replaced by concentrate and that the extent of depression was higher for the untreated straw.

V. Conclusion

The results of this study have shown that urea-ammonization increased CP content as well as decreased NDF and hemicellulose contents of roughages. Addition of 25% concentrate in either urea-ammoniated or untreated *E. uvula* hay diets increased DM degradation. Increasing concentrate level beyond 25% of the diet was associated with decreased *in Sacco* DM degradation. It was observed that urea-ammonization tended to reduce the negative effect of feeding high concentrate compared to untreated diets. Therefore, this study suggests that there is much to gain by treating low quality roughages.

References References References

1. Adebowale, E. A. and Nakashima, Y., 1992. Rumen degradation of some *Leguminosae* and *Germaine* roughages: effect of chemical pre-treatment with or without cellulose preparation on dry matter and cell wall disappearance. Anim. Feed Sci. Technol. 38, 219-235.
2. Akin, D. E., 1989. Histological and physical factors affecting digestibility of forages. J. Agron.81, 17-25.
3. Association of Official Analytical Chemists, 1990. Official Methods of Analysis, 15th end. AOAC, Arlington, VA, Pp 45-50, and 237-238.
4. Bonsai, M. L. K., Ouija, P. O., Nashua, I. V. and Utah, A. K., 1994. Graded levels of sesbania and leucaena leucocephala as supplements to tiff straw given to Ethiopian Men sheep. Anim. Prod. 59, 235-244.
5. Brand, A. A., Colette, S. W. P. and Franck, F., 1991. The effect of supplementing untreated, urea supplemented and urea-ammoniated wheat straw with maize meal and/or fish meal in sheep. S. Afr. J. Anim. Sci. 21, 48-54.
6. Bryant, M. P. and Robinson, I. M., 1963. Apparent incorporation of ammonia and amino acid carbon during growth of selected species of luminal bacteria. J. Dairy Sci. 46, 150-154.
7. Camp, K., 1999. Guide to the use of bore source programmed. Celera Report N°N/A/99/11, KwaZulu-Natal Department of Agriculture, Celera, South Africa. Pp 1-59.
8. Chemist, M. and Kaolin, C., 1997. Roughage utilization in warm climates. FAO Animal Production and Health Paper N°135. FAO, Rome. Pp 41-62.
9. Colette, S. W. P. and Kissinger, N. M., 1984. Urea ammonization compared to urea supplementation as a method of improving the nutritive value of wheat straw for sheep. S. Afr. J. Anim. Sci. 14, 59-63.
10. Hanoi, M. S., 1988. On the analysis of Deacon Bag data for low degradability feeds. Grass For. Sci. 43, 441-444.
11. Dias-Ad-Silva, A. A. and Sandston, F., 1986. Urea as a source of ammonia for improving the nutritive value of wheat straw. Anim. Feed Sci. Technol. 14, 67-79.
12. Dixon, R. M. and Parra, R., 1984. Effects of alkali treatment of forage and concentrate supplementation on rumen digestion and fermentation. Trop. Anim. Prod. 9, 68-80.
13. Escobar, A., Para, R. and de para, O., 1984. Effect of alkali treatment on digestibility fermentation rate and intake of maize cobs. Trop. Anim. Prod. 9, 45-52.
14. Flachowsky, G., Koch, H., Triode, K. and Matthey, M., 1993. Influence of the ration between wheat straw and ground barley, ground corn or dried

© 2013 Global Journals Inc. (US)

sugar beet pulp on in Sacco dry matter degradation of ryegrass and wheat straw, rumen fermentation and apparent digestibility in sheep. Arch. Anim. Nut. 43, 157-167.
15. Galloway, M. L., 1980. The nutritive value of *Eragrostis uvula* hay treated with sodium hydroxide. Mac thesis, University of Natal, Pietermaritzburg, South Africa.
16. Gal yeans, M. L. and Goatish, A. L., 1993. Utilization of forage fiber by ruminants. In H. G.
17. Jung, D. R. Buxton, R. D. Hatfield and J. Ralph (eds.) Forage cell wall structure and digestibility. Segue R. D., Madison, USA. Pp 33-71.
18. Got, M., Gordon, A. H. and Chess on, A., 1991. Effect of gaseous ammonia on barley straws showing different rumen degradability. J. Sci. Food Agric. 56, 141-153.
19. Had jipanayiotou, M., 1982a. The effect of ammonization using urea on the intake and nutritive value of chopped barley straw. Grass For. Sci. 37, 89-93.
20. Hartley, R. D., Discard G. and Keene, A. S., 1985. Effect of ammonia on the phenol and other chemical constituents of cell walls of cereal straws in relation to wall biodegradability and digestion by ruminants. In: R. D. Hill and L. Monck (eds.) New approaches to research on cereal on cereal carbohydrates. Elsevier Appl. Sci. Publ. B. V., Amsterdam, the Netherlands. Pp 319-322.
21. Iiyama, K., Lam, T. B. T. and Stone, B. A., 1990. Phenol acid bridges between polysaccharides and lignin in wheat internodes. Photochemistry (Oxf.) 29, 733.
22. Jung, H. G. and Allen, M. S., 1995. Characteristics of plant cell walls affecting intake and digestibility of forages by ruminants. J. Anim. Sci. 73, 2774-2790.
23. Lam, T. B. T., Iiyama, K. and Stone, B. A., 1992. Cinnamon acid bridges between cell wall polymers in wheat and Palmaris internodes. Photochemistry (Oxf.) 31, 1179-1194.
24. Many chi, B., Korsakov, E. R. and Kay, R. N. B., 1992. Effects of feeding small amounts of ammonia treated straw on degradation and intake of untreated straw. Anim. Feed Sci. Technol. 38, 293-304.
25. Mason, V. C., Hartley, R. D., Keene, A. S. and Cabby, J. M., 1988. The effect of ammonization on the nutritive value of wheat, barley and oat straw. 1. Changes en chemical composition in relation to digestibility *in vitro* and cell wall degradability. Anim. Feed Sci. Technol. 19, 159-171.
26. McDonald, I., 1981. A review model for estimation of protein degradability in the rumen. J. Agric. Sci. Comb. 96, 251-252.
27. Ghana, D. M., Kim ambo, A. E., Sandston, F. and Madsen, J., 1993. Influence of urea treatment or supplementation on degradation, intake and growth performance of goats fed rice straw diets. 209-220.
28. Manson, D. J., 1982b. Effect of chemical composition on digestibility and metabolizable energy. Nut. Abs. Rev. 52, 592-615.
29. Niangua, A. J., Louis, S. L., Suleiman, S., Our dragoon, C. L. and Seaway, A., 1993. Effect of urea treatment on digestibility and utilization of sorghum straw. Biotechnology. Argon. Environ. 3, 78-85.
30. Nashua, I. V., Bryant, M. J. and Manna, N. N., 1998. Utilization of barley straw by steers:
31. The effect of quantity and source of nitrogen on the degradation of straw fractions, particle outflow and intake. J. Anim. Res. 14, 33-50.
32. Korsakov, E. R. and Ryle, M., 1990. Energy nutrition in ruminants. Elsevier Appl. Sci. Publ., New York. Pp 16-42.
33. Ray, S. N., Wally, T. K. and Gupta, B. N., 1989. The chemical composition and nutritive value of rice straw after treatment with urea or coronus fematrius in a solid state fermentation system. Anim. Feed Sci. Technol. 26, 81-92.
34. Setter, L. D. and Slyer, L. L., 1974. Effect of ammonia concentration on rumen microbial or protein production *in vitro.* Br. J. Nut. 32, 191-196.
35. SAS, 1987. Procedures Guide for Personal Computers (version 6 Ed.) Statistical Analysis System Institute Inc., Cary, NC, USA.
36. Sandston, F. and Cox worth, E. M., 1984. Ammonia treatment. In: F. Sandston and E. Owen (eds.) Straw and other fibrous by-products as feed. Elsevier Appl. Sci. Publ. Amsterdam, the Netherlands. Pp 196-239.
37. Trachoma, N., Fukushima, M., He, L. F. and Taka be, K., 1993. Comprehensive model of the lignified plant cell wall. In: H. G. Jung, D. R. Buxton, R. D. Hatfield and J. Ralph (eds.) Forage cell wall structure and digestibility. Segno R. D., Madison, USA. Pp 247-264.
38. Thunder, O., 1985. Review of straw carbohydrate research. In: New approaches to research on cereal carbohydrates. Hill, R. D. and Monck, L. (eds), Elsevier Appl. Sci. Publ. B. V., Amsterdam, The Netherlands. Pp 217-230.
39. Tuah, R. D., Loaf déjà, E., Korsakov, E. R. and Blackest, G. A., 1986. Rumen degradation of straw. 1. Untreated and ammonia treated barley, oat and wheat straw varieties and triticale straw. Anim. Prod. 43, 261-269.
40. Tune, A. A., Dayan, M. M., Young, B. A. and Vijchulata, P., 1991. Intake and digestion of urea treated, urea supplemented and untreated rice straw by goats. Anim. Feed Sci. Technol. 32, 333-340.
41. Valdiveloo, J. and Fidel, J. G., 1992. Compositional analysis and rumen degradability of selected

© 2013 Global Journals Inc. (US)

tropical feeds. Anim. Feed Sci. Technol. 37, 265-279.
42. Van Sorest, P. J., 1994. Nutritional ecology of the ruminant. 2nd edn. Cornell University Press, Ithaca, OR, Pp 476.
43. Van Sorest, P. J., Ferreira, A. M. and Hartley, R. D., 1984. Chemical properties of fiber in relation to nutritive quality of ammonia treated forages. Anim. Feed Sci. Technol. 10, 155-164.
44. Van Sorest, P. J., Robertson, J. B. and Lewis, B. A., 1991. Methods of dietary fiber, neutral detergent fiber and non-starch monosaccharide's in relation to animal production. J. Dairy Sci. 74, 3583-3597.
45. Wilson, J. R. and Martens, D. R., 1995. Cell wall accessibility and cell structure limitations to microbial digestion of forages. Crop Sci. 35, 251-259.

Table 1 : Experimental design of feeding program (regime) in different periods

Periods	Treated : Concentrate ratio (T : C)**				Untreated : Concentrate ratio (UT : C)**			
	100 : 0	75 : 25	50 : 50	25 : 75	100 : 0	75 : 25	50 : 50	25 : 75
P_1	1***			4	3	2		
P_2		1	4				3	2
P_3	2	3	1				4	
P_4			2	1		4		3
P_5	3	2			1			4
P_6				3	4	1	2	

*$P_1, P_2, P_3, \ldots P_6$ = Period.
**T : C = Urea-ammoniated hay : Concentrate ratio; UT : C = Untreated : Concentrate ratio.
****1 – 4 = Animal number.

Table 2 : Chemical composition (g kg^{-1} DM) of feed ingredients and incubated sample of feeds

Items	Urea	DM	CP	Ash	NDF	ADF	HEM
Feed ingredients							
E. curvula hay	1	937	88.3	56.1	754	431	234
E. curvula hay	0	938	64.2	59.2	752	420	332
Maize meal		897	80.4	11.1	85	24	61
Cotton seed cake		895	363.5	56.7	287	234	544
Incubated roughages							
Barley straw	1	938	79.4	52.7	739	523	217
E. curvula hay	1	923	10.1	59.2	772	432	340
Coastcross hay	1	924	153.2	69.8	758	419	339
Kikuyu hay	1	909	117.6	78.9	659	381	279
Maize stover	1	912	124.3	46.9	720	434	287
Oat hay	1	887	177.5	105.4	479	318	162
Oat straw	1	938	80.4	68.5	724	516	208
Ryegrass	1	913	348.6	139.4	495	247	248
Veld hay	1	924	106.0	60.6	721	492	230
Wheat straw	1	932	76.0	48.3	727	518	209
Barley straw	0	930	37.0	54.5	795	541	254
E. curvula hay	0	936	71.2	58.1	765	426	339
Coastcross hay	0	951	118.3	70.2	764	398	369
Kikuyu hay	0	930	75.7	77.2	692	365	327
Maize stover	0	929	85.9	46.3	720	448	272

© 2013 Global Journals Inc. (US)

Oat hay	0	905	97.0	107.9	487	302	185
Oat straw	0	937	43.4	69.2	769	531	239
Ryegrass	0	924	302.7	136.2	438	233	206
Veld hay	0	945	64.7	79.3	698	454	245
Wheat straw	0	935	45.4	56.9	752	521	230

1, Urea-ammoniated; 0, Untreated; HEM, hemicelluloses (HEM = NDF – ADF).

Table 3 : Least square means of the main effects of urea-ammonization of dietary roughages and variation in dietary concentrate proportion on the rumen ammonia concentration and rumen pH in Jersey cows

Parameters	Urea		SED	P value	Concentrate (%)				SED	P value
	0	1			0	25	50	75		
NH_3 mgl^{-1}	49.9	66.9	2.54	0.002	38.2	46.8	71.5	77.0	3.59	0.000
pH	6.6	6.5	0.03	0.098	6.7	6.6	6.5	6.5	0.05	0.169

0, untreated; 1, urea-ammoniated.

Table 4 : Effect of roughage type within urea - ammonization on dry matter degradability of treated and untreated roughages incubated in the rumens of cows fed either treated or untreated hay with or without concentrate

Feed type	Urea	Degradation parameters				
		B (g kg^{-1})	c (h^{-1})	PD (g kg^{-1})	ED (g kg^{-1})	LT (h)
Barley straw	1	603	0.026	812	479	2.2
E. curvula hay	1	728	0.031	853	467	1.9
Kikuyu grass	1	551	0.043	755	517	0.9
Coastcross hay	1	622	0.032	808	498	2.7
Maize stover	1	593	0.032	799	504	1.5
Oat hay	1	483	0.050	912	723	0.6
Oat straw	1	578	0.022	788	439	0.3
Ryegrass	1	572	0.082	964	797	1.8
Veld hay	1	742	0.027	882	476	3.0
Wheat straw	1	517	0.023	733	434	1.6
Barley straw	0	559	0.027	719	423	2.2
E. curvula hay	0	629	0.025	787	442	0.6
Kikuyu grass	0	447	0.032	665	448	3.2
Coastcross hay	0	578	0.029	730	435	1.5
Maize stover	0	485	0.026	711	448	0.7
Oat hay	0	455	0.066	881	731	1.4
Oat straw	0	464	0.029	635	397	2.1
Ryegrass	0	565	0.087	950	799	1.5
Veld hay	0	650	0.026	808	453	3.2
Wheat straw	0	442	0.022	625	370	1.9
SED		46.3	0.011	46.3	26.9	1.2
Effect feed type (urea)		0.0001	0.0001	0.0001	0.0001	0.0001

1, Urea-ammoniated; 0, Untreated; c, rate of degradation of slowly degradable fraction; B, slowly degradable fraction; h, hour; PD, potential degradability; ED, effective degradability; LT, lag time.

© 2013 Global Journals Inc. (US)

Table 5 : Effect of urea-ammonization and concentrate proportions on dry matter degradability of treated and untreated roughages incubated in the rumen of Jersey cows

Concentrate (%)	Urea	Degradation parameters				
		B (g kg^{-1})	c (h^{-1})	PD (g kg^{-1})	ED (g kg^{-1})	LT (h)
0	1	596	0.036	827	534	1.4
25	1	614	0.040	846	548	1.6
50	1	592	0.038	823	541	2.3
75	1	594	0.033	826	511	1.3
0	0	529	0.039	753	507	2.3
25	0	553	0.039	776	511	1.8
50	0	525	0.036	749	488	1.9
75	0	503	0.034	727	473	1.4
Main effect of Urea						
	1	599	0.037	831	533	1.6
	0	527	0.037	751	495	1.8
SED (conc level)		32.8	0.0075	32.8	19.0	0.81
SED (urea)		16.4	0.0038	16.4	9.5	0.41
Effect of conc (urea)		0.0353	0.2589	0.0353	0.0001	0.0256
Urea		0.0001	0.9706	0.0001	0.0001	0.2804

1, Urea-ammoniated; 0, Untreated; c, rate of degradation of slowly degradable fraction; B, slowly degradable fraction; h, hour; PD, potential degradability; ED, effective degradability; LT, lag time

Table 6 : Correlation between the chemical composition of roughages and the degradability parameters of dry matter

Chemical constituents	c(h^{-1})		PD (g kg^{-1})		ED (g kg^{-1})	
	1	0	1	0	1	0
Crude protein	0.88**	0.83**	0.67**	0.72**	0.81**	0.80**
Ash	0.85**	0.93**	0.75**	0.78**	0.89**	0.91**
NDF	-0.86**	-0.94**	-0.74**	-0.80**	-0.95**	-0.97**
ADF	-0.86**	-0.84**	-0.67**	-0.77**	-0.88**	-0.87**

1, urea treated; 0, untreated; NDF, neutral detergent fiber; ADF, acid detergent fiber; c, rate of degradation of slowly degradable fraction; h, hour; PD, potential degradability; ED, effective degradability.

© 2013 Global Journals Inc. (US)

Global Journal of Science Frontier Research
Agriculture and Veterinary
Volume 13 Issue 8 Version 1.0 Year 2013
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Determination of Efficiency of Yield Components on Oil Yield Per Plant in Safflower Breeding by Different Statistical Methods

By Duran Katar
Eskişehir Osmangazi University, Turkey

Abstract - The aim of this study was to determine relationship oil yield and yield components and to show efficiency of components on oil yield by using statistical procedures under rainfed conditions in safflower (Carthamus tinctures L.). Data of oil yield and yield components over the two years in the study were evaluated by statistical procedures; correlation and path analysis, regression analysis (multiple linear regression and best subsets regression), factor analysis, principal component analysis and cluster analysis. Results in this study revealed that hhigh yielding new cultivars are evaluated, selected by using various yield components such as seed yield per capitalism, thousand kernel weight, oil content, yield per plant are getting used more and more for high grain/oil yield and for resistance to drought conditions.

Keywords : safflower (carthamus tinctures l.), oil content, seed yield, oil yield per plant.

GJSFR-D Classification : FOR Code: 820403, 820302, 070602

DETERMINATION OF EFFICIENCY OF YIELD COMPONENTS ON OIL YIELD PER PLANT IN SAFFLOWER BREEDING BY DIFFERENT STATISTICAL METHODS

Strictly as per the compliance and regulations of :

© 2013. Duran Katar. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Determination of Efficiency of Yield Components on Oil Yield Per Plant in Safflower Breeding by Different Statistical Methods

Duran Katar

Abstract - The aim of this study was to determine relationship oil yield and yield components and to show efficiency of components on oil yield by using statistical procedures under rainfed conditions in safflower (Carthamus tinctures L.). Data of oil yield and yield components over the two years in the study were evaluated by statistical procedures; correlation and path analysis, regression analysis (multiple linear regression and best subsets regression), factor analysis, principal component analysis and cluster analysis. Results in this study revealed that hhigh yielding new cultivars are evaluated, selected by using various yield components such as seed yield per capitalism, thousand kernel weight, oil content, yield per plant are getting used more and more for high grain/oil yield and for resistance to drought conditions.

Keywords : safflower (carthamus tinctures l.), oil content, seed yield, oil yield per plant.

I. Introduction

Being an oil seed crop, safflower *(Carthamus tinctures L.)* is known as drought tolerant plant and is grown wide semiarid climates in the world (Christos and Seoul's, 2008). Due to deeper roots, this crop could be tolerant to water stress could join rotation with other crops and these phenomena make this crop drought tolerant (Usual et al., 2006). Safflower has been cultivated in the world for its oil content that is rich in polyunsaturated fatty acids playing important role to decrease blood cholesterol level (Bayar and Turgot, 1999). Moreover, this crop has about 75% linoleum acid, higher than corn, soybean, cottonseed, peanut or olive oils. This crop is therefore used first of all for edible oil products such as salad oils and soft margarines. High-quality oil feature makes safflower an important crop for vegetable oil (Conge et al., 2007).

The need of new cultivars having higher oil quality/content of oil leads to the objective of safflower breeding programs to develop new cultivars having higher oil quality/content, greater yielding ability and eventually resistance to drought and diseases (Volkmann and Raj can, 2009). Grain yield and oil quality/content are important characters and subject to many variables affecting plant growth. Increasing genetic association between agronomic and quality characters could improve the efficiency of breeding programs by determining and effectively using markers in selection of safflower genotypes (Volkmann and Raj can, 2009).

Grain yield and naturally oil yield per plant in safflower are in general under effect of some components (the number of capitulate per plant, seed yield per capitalism, 1000 seed yield and seed yield per plant) that seem to be important elements for breeding programs (Aslant et al., 2008; Bonham et al., 2011). Usual (2006) stated that under rained conditions some components (seed yield per plant, oil content and 1000 seed weight) have been evaluated by several researchers and are considered as important measures for oil yield per plant. Several researchers evaluated components affecting oil yield per plant and plant adaptations for semi arid climatic conditions and drought stress may cause a reduction in certain components but particularly in seed yield per plant and seed oil content (Yılmazlar, 2008, Sade et al., 2012).

In addition, there are various statistical techniques covering correlation and path analysis, multiple linear regression, Factor Analysis, Principal component analysis, Best subsets regression and cluster analysis to evaluate yield and yield components for breeding programs (Massmart et al., 1997; Oldsmar, 1999; Slavonic et al., 2004; Skis et al., 2006). Correlation and path analyses are important procedures to examine dependent variable, and direct and indirect contribution of components and both correlation and path analyses could successfully be used in breeding programs (Massmart et al., 1997; Oldsmar, 1999; Hilt runner et al., 2007). Regression analyses, including multiple linear regression, best subsets regression are efficiently used in modeling crop yield analyses (Oldsmar, 1999; Skis et al., 2006). Principal component and factor analyses are multivariate statistical techniques for analyzing and making simplification in complex plant data sets (Slavonic et al., 2004).The characteristic of this statistical technique is to transform variables correlated in to simplified variables and to show features of components (Oldsmar, 1999). Cluster analysis is often used to reveal characteristics of components and classify components in to distinct groups and subgroups in the characteristics of similarity and dissimilarity levels (Otto, 1999; Beltane and Ojai, 2007). This study was carried

Author : Eskişehir Osmangazi University, Faculty of Agriculture, Bağlar Campus, Ziraat Street, Eskişehir-Turkey.
E-mail : durankatar6060@gmail.com

© 2013 Global Journals Inc. (US)

out to help breeders, researching to reveal main components and their influences on oil yield per plant and plant productivity. The aim of this study was to determine relationship oil yield per plant and yield components and to show efficiency of components on oil yield per plant by using statistical procedures under rained conditions.

II. Materials and Methods

This study was carried out in research area of Central Research Institute for Field Crops in Hayman-Ankara (32^0 51 E; 39^0 57 N; 860 m above sea level)/Turkey in 2010 and 2011 years. Soil characteristics in research area had lime-loamy soil structure, having 7.19 pH, 0.037 % salt, 1.30 % organic matter and 2.48 % lime. Hayman-Ankara/turkey where the trials were performed has a typical steppe climate with high temperature differences between day and night. Summers are dry and winters are relatively rainy. Total rainfall in 2010 and 2011 (379,9 mm and 401,5 mm, respectively) were lower than long-term years rainfall (402,1 mm). In 2010 period, total rainfall (March-September) was 176 mm so doing 213.2 mm in 2011 period. Rainfall in tailoring stage (in May), important for yield, was 22 mm in 2010 and 86 mm in 2011 period. Besides, mean temperatures in 2010 and 2011 (11.8°C and 10,5°C, respectively) were lower than long-term-years temperature (12.0°C).

Dancer (spineless), Remzibey (spiny), Yen ice and Shiva (spineless) cultivars and TAEK-sulk line (spiny) were used in trial as plant materials. Yen ice, Dancer and Remzibey cultivars were developed at Translational Zone Agricultural Research Institute in Turkey. Shiva cultivar was obtained from Tajikistan. TAEK-sulk pure line was developed at The Turkish Atomic Energy Authority by mutation. Field experiments in 2010 and 2011 growing seasons were conducted with four replications as 'Randomized Complete Block Design' in Ankara-Turkey ecological conditions. The cultivars and pure line (Dancer, Remzibey, Yenice, Shiva and pure line TAEK-sulk) were randomized into plots. Seeds were sown with 30 cm row spacing on plots of 6 m^2 harvest area (1.20 m width x 5 m length) on 25 March 2010 and 28 March 2011. After intra-row spacing was stabilized at 10 cm by thinning in both first and second years (Kızıl vet ark. 1999). Weed controls were made by means of manual weeding in rows. A total of 50 kg $ha^{-1}$of P_2O_5 and 40 kg $ha^{-1}$of nitrogen were applied with sowing and 20 kg $ha^{-1}$of nitrogen was applied as a top dressing at the beginning of stem elongation. On 10 September and 17 September at full maturity of the seeds plant harvests were made in 2010 and 2011, respectively. Thirty plants per plot were selected as randomly and made by hand. Seeds obtained from these plants were used for experiments. For all statistical analyses, SAS and Minitab 15 package programs were used. Means of data taken from oil yield per plant and yield components during crop growing periods of 2010 and 2011 years are given in Table 1.

Data of oil yield per plant and yield components for the two years in the study were evaluated by statistical procedures; correlation and path analysis, regression analysis (multiple linear regression and best subsets regression), factor analysis, principal component analysis and cluster analysis.

III. Result and Discussion

Minimum, maximum, mean and standard deviation of all characters in safflower (Carthamus tinctures L.) cultivars is shown in Table 2.

Correlation and path analyses between oil yield per plant and yield components and relationship between oil yield per plant and yield components are given Table 3 and Figure 1. Correlations close to 1 denotes that almost positive/similar results are taken from two variables and value close to -1 show that results in two characters are so opposite/dissimilar. Value close to zero also assign that two characters are so independent from each other (Ozdamar, 1999).

Table 3 and Figure 1 show that significant and positive relationship between oil yield per plant and capitalism yield, thousand kernel weight, yield per plant; significant and negative relationship between oil yield per plant and hull content. Path analysis is also a useful analysis to understand formation dependent variable and the effect of independent variables on dependent variable (Kang, 1990). In path analysis, direct and indirect effects of components having significant correlation in oil yield per plant per plant were considered (Table 3). Results revealed that capitalism yield (-0.1186 and 8.0866%) and thousand kernel weight (-0.2983 and 14.2114%) had negative direct effects, positive direct effects were taken from hull content (0.1151 and 8.7204%) and (0.1194 and 6.9851%). Nevertheless, the highest indirect effects were determined via capitalism number, capitalism yield, thousand kernel weight, yield per plant and hull content and these can considered as important characters. Studies emphasized that owing significant and positive relationship with oil or plant grain yield; capitalism number, capitalism yield, thousand kernel weights, could safely be used breeding programs (Badoglio et al., 2006). Sandal (1988) pointed out that oil yield per plant under rained climatic conditions was determined by capitalism number, capitalism yield, thousand kernel weight.

Multiple linear regression analysis, given in Table 4, explains the regression coefficients, the probability of the variables on estimation of oil yield per plant in safflower (Carthamus tinctures L.).

T-test showed that capitalism yield and seed yield per plant had significant effect in oil yield per plant.

© 2013 Global Journals Inc. (US)

This formula show 95.8 variation in variables and the remaining 4.2 % assign residual effects. Yield estimation Formula is also shown below:

Oil yield per Plant ($\hat{Y}$) = - 2.71 - 0.00615 Plant Height + 0.0055 Branch Number - 0.0478 Capitalism Number + 0.068 Capitalism Yield - 0.0183 Thousand Kernel Weight + 0.400 Yield per Plant + 0.0309 Hull Content + 0.0598 Oil Content

These results show that capitalism yield and yield per plant are important variables and should be used in bread wheat breeding programs. Regression analysis is the better way to make crop yield/oil yield per plant prediction (Bonham et al., 2011) and linear regression model is one of best method to determine crop yield/oil yield per plant in safflower (Carthamus tinctures L.) (Badoglio et al., 2006).

Best subsets regression determines the best-fitting regression models, constructed with the predictor characters specified. Best subsets regression is an important analysis to clarify models achieving targets with as less predictors as possible. Subset models could easily guess the regression coefficients and predict future responses with smaller variance than the full model using all predictors (Press and Wilson, 1978). The model with the highest adjusted R, low Mallows' value and the lowest S value is assumed as the best model for determination of best characters (Bonham et al., 2011).

Table 6 shows best subset regression explaining the best predictor characters. With 99.7 adjusted R^2, 3.2 Mallows' values variable 5 including plant height, capitalism yield, thousand kernel weight, and yield per plant, hull content and oil content appeared the best predictors and could be used for in safflower (*Carthamus tinctures* L.) breeding programs. Best subset regression is widely used to determine best subsets and to describe dependent variables (Press and Wilson, 1978; Sachem et al., 2007) such as oil yield per plant.

Principal component analysis is so common procedure to alter observed and correlated variables to linearly uncorrelated variables by using orthogonal transformation. This analysis is a linear transformation, shifting the data to a new coordinate system that the greatest variance (called the first principal component), the second greatest variance on the second coordinate, then so. (Crosse et al., 1991; Potgieter et al., 2002).

Principal component analysis in Table 7 and relatively ballot analysis of safflower *(Carthamus tinctures L.)* show that decrease in Eigen values is associated with increase of component numbers and maximum component number is determined at three factors.

According to results, variables could be grouped in three components and these components account for 93.6% of the total variation of oil yield per plant of safflower (Carthamus tinctures L.). PC_1 correlated with capitalism yield, thousand kernel weight, and oil content. Besides, PC_2 correlated with yield per plant. PC_3 correlated with plant height. PC1, PC2 and PC3 account for 53.8%, 80.9 and 93.6% of the variation in oil yield per plant (Table 7 and Figure 2). So, capitalism yield, thousand kernel weight, oil content, yield per plant and plant height showed up to be important characters for oil yield of safflower (*Carthamus tinctures* L.). Studies revealed that correlation between oil yield per plant and capitalism yield, thousand kernel weight, oil content, yield per plant and plant height (Badoglio et al., 2006).

Factor analysis describes variance among observed, correlated variables for potentially lower number of unobserved variables. Factor analysis seeks joint variations related to unobserved latent variables. The observed variables are modeled as linear combinations of the potential factors, plus "error" terms (Harmon, 1976; Joreskog, 1977; Anderson, 1984). Factor analysis of characters in safflower (*Carthamus tinctures* L.) is given in Table 8. Factor analysis revealed that factor variances in Factor I, Factor II Factor III and Communality were 45.00, 27.30, 12.60 and 84.90%, respectively. According to results, yield per plant in Factor I, thousand kernel weight in Factor II and plant height in Factor III seemed important characters on oil yield per plant. As a result of factor analysis yield per plant, thousand kernel weight and plant height are important components in oil yield per plant. Oil yield per plant is important character and should be taken into consideration on selection of genotypes in breeding programs (Knowles, 1982). Besides seed yield and oil content are both efficient characters for oil yield per plant (Volkmann and Raj can, 2009). It was stressed that capitalism yield, yield per plant, thousand kernel weight and oil content had significant correlation with oil yield per plant (Golparvar, 2011, Behnam et al., 2011).

Cluster technique is an agglomerative hierarchical method that begins with all variables separate, each forming its own cluster (Milligan, 1980; Murphy et al., 1986; Martin et al., 1995). In this study cluster analysis and den do gram are given in Table 9 and Figure 3. In cluster analysis, distance of each variable related to the others are calculated and groups observed are established by agglomeration process in which all variables start individually in one's group. Groups closed to each other gradually merged until all variables come to a single group. Repeated splitting of groups result in all evaluated variables being in groups of their own. For quantitative characters, cluster numbers are chosen from hierarchical analysis (Martin et al., 1995). Table 9 and Figure 3 denotes that both similarity level and cluster number increase. In distance of 70.1 % and similarity level of 88.33 %, all variables could be agglomerated in four clusters.

Cluster I includes plant height, while branch number and capitalism number belonged to Cluster II.

© 2013 Global Journals Inc. (US)

Cluster III constituted of oil yield per plant, capitalism yield, thousand kernel yield, oil content and yield per plant; hull content appeared in Cluster IV.

Cluster analysis showed that, capitalism yield, thousand kernel yield, oil content and yield per plant could be considered as important characters for high oil yielding genotypes in safflower (*Carthamus tinctures* L.) breeding programs.

Results of explained the effect of oil yield components are given in Table 10. Results in this study revealed that capitalism yield, thousand kernel weight, yield per plant and oil content are most important characteristics and they are highly effective in grain yield (Table 10). Safflower (*Carthamus tinctures* L.) breeding programs have been carried out all around the world. High yielding new cultivars are evaluated, selected by using various yield components such as capitalism yield, thousand kernel weight, oil content, yield per plant are getting used more and more for high grain/oil yield and for resistance to drought conditions.

References References References

1. Anderson, T.W., 1984. An Introduction to Multivariate Statistical Analysis, Second Edition. John Wiley and Sons.
2. Arslan, B., Esendal, E. and Paşa, C., 2008. The economically important traits of safflower (*Carthamus tinctorius* L.) cultivars and lines cultivated in Tekirdag, Turkey. VIIth International Safflower Conference, Wagga Wagga, Australian Journal of Agronomy 6 (3): 415-420.
3. Baydar, H.ve Turgut, İ., 1999. Yağlı tohumlu bitkilerde yağ asitleri kompozisyonununbazı morfolojik ve fizyolojik özelliklere ve ekolojik bölgelere göre değişimi. Turkish Journal of Agriculture and Forestry, 23(suppl.1):81-86.
4. Behnam, T., Said, A., Mohamadreza, S., Alireza, B.B. and Gafari, G., 2011. Path analysis of seed and oil yield in safflower (*Carthamus tinctorius* L.). International Journal of Agriculture and Crop Sciences (IJACS), 3-4/114-122.
5. Behnam, T., Said, A., Mohamadreza, S., Alireza, B.B. and Gafari, G., 2011. Path analysis of seed and oil yield in safflower (*Carthamus tinctorius* L.). International Journal of Agriculture and Crop Sciences (IJACS), 3-4/114-122.
6. Bidgoli, A.M., Akbari, G.A., Mirhadi, M.J., Zand, E., Soufizadeh, S., 2006. Path analysis of the relationships between seed yield and some morphological and phenological traits in safflower (Carthamus tinctorius L.). Euphytica Volume 148, Issue 3, pp 261-268.
7. Biljana, S., Onjia, A., 2007, Multivariate analyses of microelement contents in wheat cultivated in Serbia. Food Control, 18, 338–345.
8. Coşge, B., Gürbüz, B. ve Kıralan, M., 2007. Oil Content and Fatty Acid Composition of Some Safflower (*Carthamus tinctorius* L.) Varieties Sown in Spring and Winter. International Journal of Natural and Engineering Sciences 1 (3): 11-15.
9. Crossa, J., Fox, P.N., Pfeiffer, W.H., Rajaram,S., Gauch, H.G., 1991, AMMI adjustment for statistical analysis of an international wheat yield trial. 81(1): 27-37.
10. Esendal, E., 1988. Aspir (*Carthamus* sps.) Türleri Üzerine Bir Monografi I. *Carthamus tinctorius* L. Üzerindeki Islah Çalışmaları. Ondokuz Mayıs Ünv. Zir. Fak. Derg. 3 (1): 139-150.
11. Golparvar, A. R., 2011. Genetic Improvement of Oil Yield in Spring Safflower Cultivars under Drought and Non-drought Stress Conditions. Electronic Journal of Biology, Vol. 7(2):40-43.
12. Harmon, H., 1976. *Modern Factor Analysis*, Third Edition. University of Chicago Press.
13. Hiltbrunner, J., Streit, B., Liedgens, M., 2007, Are graining densities an opportunity to increase grain yield of winter wheat in a living mulch of white clover? Field Crops Research 102, 163–171.
14. İkiz, F., Puskulcu, H., Eren S., 2006, Introduction to Statistics, Barıs Press, Bornova, Izmir, pp 548.
15. Joreskog, K., 1977. "Factor Analysis by Least Squares and Maximum Likelihood Methods," *Statistical Methods for Digital Computers,* ed. K. Ensley, A. Ralston and H. Wolf, John Wiley & Sons.
16. Kang, M.S., 1990, Genotype-By-Environment Interaction and Plant Breeding, Louisiana State University Press, Louisiana, pp 392.
17. Massart, D. L., Vandeginste, B. G. M., Buydens, L. M. C., de Jong, S., Lewi, P. J., Smeyers-Verbeke, J., 1997, Straight line regression and calibration. In Handbook of chemometrics and qualimetrics, Part A, pp 171–231, Amsterdam, The Netherlands: Elsevier.
18. Milligan, G.W., 1980, An Examination of the Effect of Six Types of Error Pertubation on Fifteen Clustering Algorithms. Psychometrika, 45, 325-342.
19. Murphy, J.P., Cox, T.S., Rodgers, D.M., 1986, Cluster analysis of red winter wheat cultivars based upon coefficients of parentage. Crop Science, 26, 672-676.
20. Otto, M., 1999, Chemometrics statistics and computer application in analytical chemistry. Weinheim, Germany: Wiley-VCH.
21. Ozdamar, K., 1999, Statistical Data Analysis with Computer Programs, Vol: I-II, Kaan Press, 2nd Edition, Eskisehir, pp: 548.
22. Potgieter,A.B., Hammer, G.L.,Butler, D., 2002, Spatial and temporal patterns in Australian wheat yield and their relationship with ENSO *Australian Journal of Agricultural Research* 53(1) 77–89.
23. Press, S.J. and Wilson, S., 1978, Choosing Between Logistic Regression and Discriminate Analysis. Journal of the American Statistical Association, 73, 699-705.

© 2013 Global Journals Inc. (US)

24. Shacham, M., Brauner, N., Shore, H., 2007, A new procedure to identify linear and quadratic regression models based on signal-to-noise-ratio indicators. Mathematical and Computer Modelling, 46, 235–250.
25. Slavkovic, L., Skrbic, B., Miljevic, N., Onjia, A., 2004, Principal component analysis of trace elements in industrial soils. Environmental Chemistry Letters, 2, 105–108. Martin, J.M., Talbert, L.E., Lining, S.P., Blake, N.K., 1995, Hybrid performance in wheat as related to parental diversity. Crop Science, 35, 104-108.
26. Uysal N. H. Baydar ve S. Erbaş, 2006. Isparta populasyonundan geliştirilen aspir (*Carthamus tinctorius* L.) hatlarının tarımsal ve teknolojik özelliklerinin belirlenmesi. Süleyman Demirel Üniversitesi Ziraat Fakültesi Dergisi, 1(1): 52-63.
27. Vollmann, J. and Raj can,I., 2009. Oil Crops. In. Vollmann, J. and Raj can, I. (Ed.), Oil Crop Breeding and Genetics. Chapter 1,Volume 4 pp: 1-30, ISBN 978-0-387-77593-7 e-ISBN 978-0-387-77594-4 DOI 10.1007/978-0- 387-77594-4 Springer Dordrecht Heidelberg London New York.
28. Yılmazlar, B., 2008. Konya Şartlarında Farklı Ekim Zamanlarının Bazı Aspir Çeşitlerinde Önemli Tarımsal Karakterler Üzerine ve Verime Etkisi. Ankara Üniversitesi Fen Bilimleri Enstitüsü. Doktora Tezi.
29. Zadeh, K. N., Naseri, R., Mirzaei and Soleymanifard, A., 2012. Effect of Planting Pattern on Yield, Its Components, Oil Contain and Some İmportant Agronomic Traits of Safflower (*Carthamus tinctorius* L.) in Dry Land Conditions. International Journal of Agriculture and Crop Sciences (IJACS/4-2), pp: 86-91.

Table 1 : Means of data from oil yield per plant and yield components during on safflower (*Carthamus tinctures* L.) in crop growing periods of 2010 and 2011 years

	Pl.He.	Br.Num.	Cp.Num.	Cp. Yld.	Th.Ke.W.	Yi.per Pl.	Hull Co.	Oil Co.	Oil Yld.
Yenice	100,75	5,85	11,70	0,68	35,92	7,95	56,82	25,00	1,98
Remzibey	78,40	6,60	12,90	0,80	37,95	10,30	51,52	29,20	3,01
Dinçer	84,90	5,45	9,60	0,92	41,46	8,50	54,05	28,85	2,46
Shifa	103,10	5,20	7,45	1,59	44,98	11,50	47,00	30,45	3,50
Taek	80,00	6,55	12,85	0,80	38,45	10,25	49,54	28,85	2,96
Mean	89,43± 11,69	5,93± 1,44	10,90± 2,78	0,95± 0,36	39,75± 3,54	9,70± 1,63	51,78± 3,66	28,47± 2,01	2,77± 0,61

Pl. He : plant height, Br. Num.: number of branch per plant, Cp. Num.: number of capitalism per plant, Cp. Old.: seed yield per capitalism, Th. Key. W.: thousand kernel weight, Yi. per Pl.: seed yield per plant, Hull Co.: hull content, Oil Co.: oil content and Oil Old.: oil yield.

Table 2 : Minimum, maximum, mean and standard deviation of all characters in safflover (*Carthamus tinctorius* L.) cultivars

Traits	Minimum	Maximum	Mean
Plant Height	76,73	109,10	89,43±11,09
Branch Number	4,10	8,10	5,93±1,37
Capitulum Number	6,10	14,30	10,90±2,63
Capitulum Yield	0,65	1,79	0,96±0,35
Thousand Kernel Weight	35,12	46,85	39,70±3,35
Yield per Plant	7,30	12,10	9,70±1,55
Hull Content	46,80	57,01	51,78±3,48
Oil Content	0,00	30,80	28,43±2,01

© 2013 Global Journals Inc. (US)

Table 3 : Correlation matrix and path analysis for characters in safflower (*Carthamus tinctures* L.) cultivars

Traits	Oil yield per plant	Plant Height	Branch Number	Capitulum Number	Capitulum Yield	Thou. Ker.We.	Yieldper Plant	Hull content
Plant Height	0,055							
BranchNumber	0,343	-0,031						
Capit.Num.	-0,024	-0,317	0,827**					
Capit. Yield	0,705*	0,367	-0,448	-0,811**				
Thsnd. Ke.We.	0,778**	0,218	-0,387	-0,760**	0,921**			
Yield per Plant	0,976**	0,141	0,488	0,115	0,456	0,440		
Hull Content	-0,905**	0,020	0,001	0,273	-0,703*	-0,679	-0,837**	
Oil Content	0,005	0,245	-0,491	-0,422	0,307	0,415	-0,066	-0,217

Capitulum Yield			Correlation Coefficient
Direct Effect	Path Coefficient	%	
	-0.1186	8.0866	
Indirect Effect			
	Path Coefficient	%	
Plant Height	0.1909	13.0184	
Branch Number	-0.0053	0.3605	0,705*
Capit. Number	-0.2669	18.1973	
Thsnd. Ke.We.	-0.2106	14.3573	
Yield per Plant	0.0288	1.9619	
Hull Content	-0.0539	3.6745	
Oil Content	0.5917	40.3435	

Thsnd. Ke.We.			Correlation Coefficient
Direct Effect	Path Coefficient	%	
	-0.2983	14.2114	
Indirect Effect			
	Path Coefficient	%	
Plant Height	0.1797	8.5610	
Branch Number	-0.0052	0.2480	0,778**
Capit. Number	-0.3209	15.2856	
Capitulum Yield	-0.0837	3.9884	
Yield per Plant	0.0457	2.1771	
Hull Content	-0.0797	3.7944	
Oil Content	1.0860	51.7340	

Hull Content			Correlation Coefficient
Direct Effect	Path Coefficient	%	
	0.1151	8.7204	
Indirect Effect			
	Path Coefficient	%	
Plant Height	0.0716	5.4250	
Branch Number	0.0051	0.3875	0,976**
Capit. Number	0.0792	6.0033	
Capitulum Yield	-0.0297	2.2466	
Thsnd. Ke.We.	-0.1185	8.9744	
Yield per Plant	-0.1019	7.7199	
Oil Content	0.7989	60.5228	

© 2013 Global Journals Inc. (US)

Yield per Plant			Correlation Coefficient
Direct Effect	Path Coefficient	%	
	0.1194	6.9851	-0,905**
Indirect Effect			
	Path Coefficient	%	
Plant Height	0.0194	1.1349	
Branch Number	0.0004	0.0248	
Capit. Number	0.0970	5.6736	
Capitulum Yield	0.0535	3.1332	
Thsnd. Ke.We.	0.1991	11.6473	
Hull Content	-0.0982	5.7486	
Oil Content	-1.1220	65.6524	

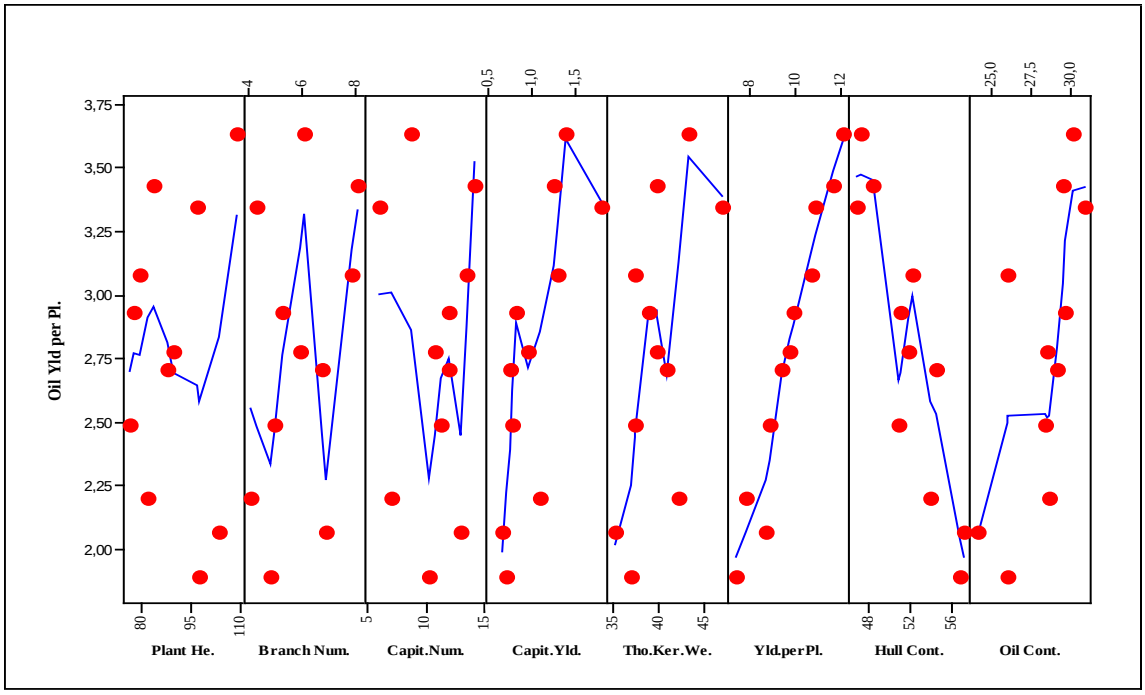


Figure 1 : Relationship between oil yield per plant and yield components in safflower (Carthamus tinctures L.)

Table 4 : The regression coefficient (*b*), standard error (SE), *T*-value and probability of the characters in estimation of oil yield per plant in safflower (*Carthamus tinctures* L.)

Source	Deg. of Freedom	M.S.	F_{auve}
Regression	8	0.414	80.97**
$Error_{Resudial}$	2	0.005	
Total	10		
R^2: 95,8%			

Traits	D.F.	Coef. of Regr.(B)	Std. Error (S_E)	T	P value
Plant Height	1	-0.0061	0.0036	-1.69	0.233ns
Branch Number	1	0.0054	0.0877	0.06	0.956ns
Capitulum Number	1	-0.0047	0.0633	-0.75	0.529ns
Capitulum Yield	1	0.1670	0.1673	2.57	0.042*

© 2013 Global Journals Inc. (US)

Thsnd Kernel Weight	1	-0.0182	0.0480	-0.38	0.740ns
Yield per Plant	1	0.3999	0.0874	4.57	0.017*
Hull Content	1	0.0309	0.0350	0.88	0.470ns
Oil Content	1	0.059	0.0472	1.27	0.333ns

Oil yield per Plant ($\hat{Y}$) = - 2.71 - 0.00615 Plant Height + 0.0055 Branch Number - 0.0478 Capitalism Number + 0.068 Capitalism Yield - 0.0183 Thousand Kernel Weight + 0.400 Yield per Plant + 0.0309 Hull Content + 0.0598 Oil Content

* And **: r is significant at 5% and 1%, ns: not significant

Table 5 : Coefficient of determination (R^2 and Adjusted R^2), measure of goodness of prediction (Mallows') and estimating the best characters by the best subsets regression analysis in safflower (*Carthamus tinctures* L.)

Vars	R^2	Mallows Cp	Plant Height	Branch Number	Capit. Number	Capit. Yield	Thousand Ker. We.	Yield per Plant	Hull Content	Oil Content
1	95,2	24,1						X		
1	82,0	110,1							X	X
2	99,1	1,1					X	X		
2	97,9	8,5						X		
3	99,2	2,0					X	X		
3	99,2	2,0	X			X		X		X
4	99,5	2,0	X		X			X		X
4	99,5	2,3	X				X	X		X
5	**99,7**	**3,2**	**X**			**X**	**X**	**X**	**X**	**X**
5	99,6	99,1	X	X	X	X	X	X		X
6	99,7	99,2	X		X	X	X	X	X	X
6	99,7	99,2	X	X	X	X		X	X	X
7	99,7	99,0	X		X	X	X	X	X	X
7	99,7	98,9	X	X	X	X	X	X	X	X
8	99,7	98,5		X	X	X	X	X	X	X

Table 6 : Eigen value of the correlation matrix for the characters in safflower (Carthamus tinctures L.) by the principal component analysis

	PC_1	PC_2	PC_3	PC_4	PC_5	PC_6	PC_7	PC_8	PC_9
Plant He.	0,033	0,323	**0,908**	-0,067	-0,060	-0,375	-0,061	-0,009	-0,082
Branch Num.	-0,036	-0,407	0,162	0,374	-0,302	0,244	-0,397	-0,394	0,006
Capit.Num.	-0,197	-0,358	-0,133	-0,092	-0,188	-0,453	0,002	0,595	-0,168
Capit.Yield	**0,411**	-0,010	-0,153	0,647	0,332	-0,518	0,044	-0,090	0,025
Thd. Ke.We.	**0,391**	0,269	0,086	0,353	-0,379	0,358	-0,149	0,582	-0,098
Yld per Pl.	0,358	**0,463**	0,191	-0,149	0,142	0,169	0,294	0,173	0,718
Hull Cont.	-0,354	0,096	0,060	0,417	-0,392	-0,014	0,669	-0,067	0,156
Oil Content	**0,403**	0,116	-0,234	-0,301	-0,664	-0,357	-0,010	-0,297	0,149
Eigenbalue	4,8404	2,4400	1,1437	0,2619	0,1889	0,0928	0,0232	0,0078	0,0013
Proportion	0,538	0,271	0,127	0,029	0,021	0,010	0,003	0,001	0,000
Cumulative	0,538	0,809	0,936	0,965	0,986	0,996	0,999	1,000	1,00

© 2013 Global Journals Inc. (US)

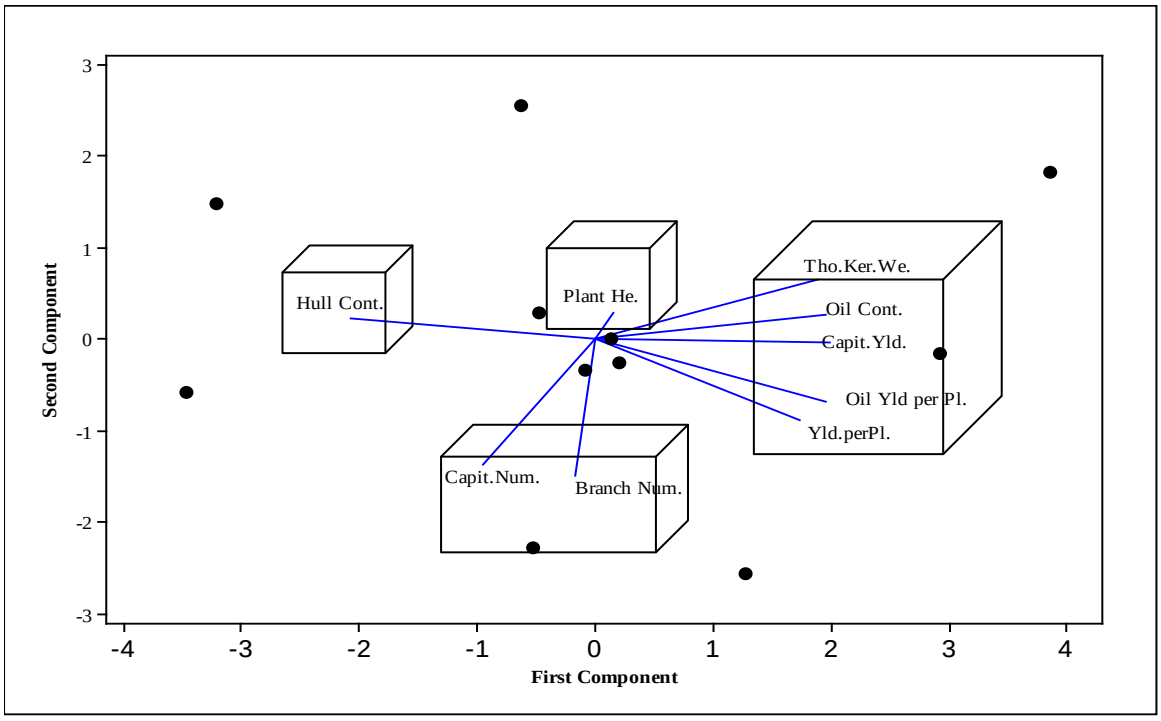


Figure 2 : Biplot analyses of safflower (*Carthamus tinctures* L.)

Table 7 : Relationships of characters in safflower (*Carthamus tinctures* L.) by the factor analysis

Characters	Factor I	Factor II	Factor III	Communality
Plant Height	0,024	0,106	0,993	0,58
Branch Number	0,205	0,301	0,060	0,65
Capitulum Number	-0,094	-0,239	-0,220	0,87
Capitulum Yield	0,726	0,217	0,456	0,77
Thousand Kernel Weight	0,543	0,569	0,158	0,79
Yield per Plant	0,935	0,287	0,651	0,88
Hull Content	-0,253	-0,199	0,056	0,62
Oil Content	0,674	0,389	-0,156	0,74
Latent Root	2,760	1,431	1,998	6,789
Factor Variance (%)	45,00	27,30	12,60	84,90

Characters	Loading	% Total Community	Suggested Factor
Factor I		45,00	Yield per Plant
Branch Number	0,205		
Capitulum Yield	0,726		
Thousand Kernel Weight	0,543		
Yield per Plant	0,935		
Hull Content	0,246		
Factor II		27,30	Thousand Kernel Weight
Branch Number	0,301		
Thousand Kernel Weight	0,569		
Yield per Plant	0,287		
Oil Content	0,389		
Factor III		12,60	Plant Height
Plant Height	0,993		
Yield per Plant	0,651		

© 2013 Global Journals Inc. (US)

Table 8 : Similarity and distance level of characters

Step	Clusters (No.)	Similarity Level	Distance Level
1	8	98,788	0,024
2	7	91,325	0,173
3	6	91,082	0,178
4	5	88,728	0,225
5	**4**	**88,336**	**0,701**
6	3	74,420	0,712
7	2	63,661	0,727
8	1	60,894	0,782

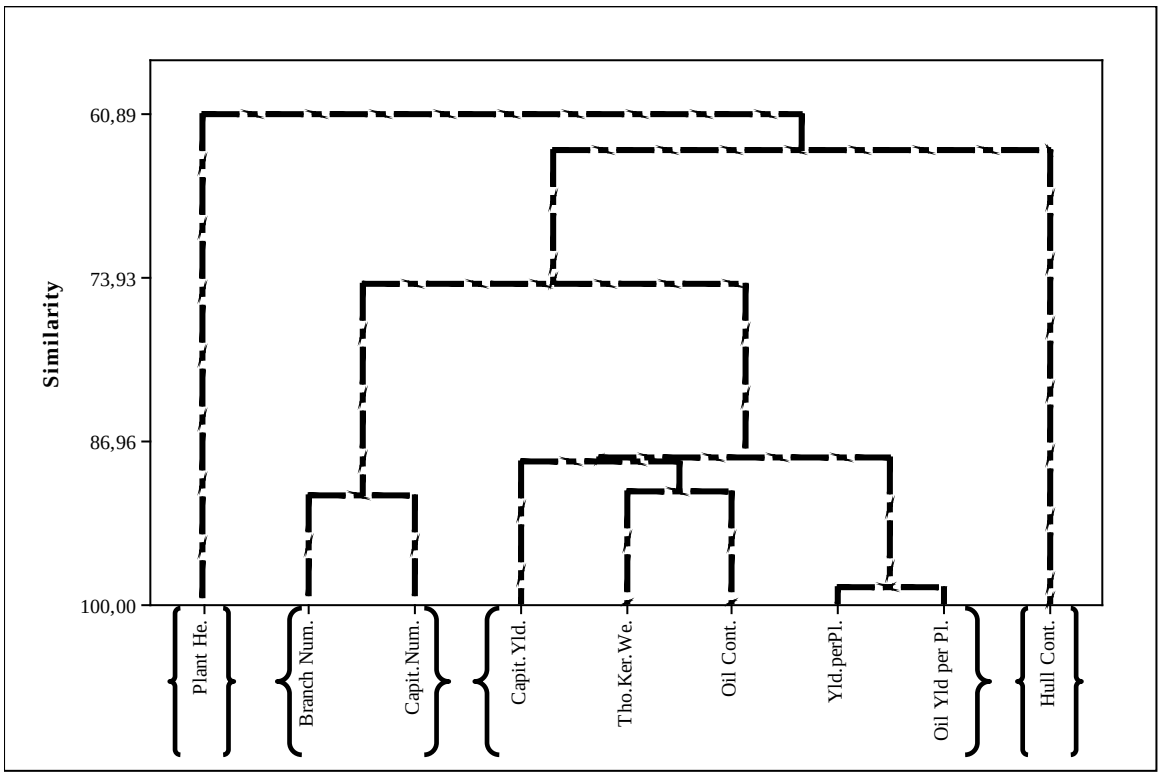


Figure 3 : Similarity levels of the variables

Table 9 : Essential variables effective on grain yield in safflover (*Carthamus tinctorius* L.)

	1	2	3	4	5	6
Plant Height			☺		☺	
Branch Number						
Capitulum Number	☺					
Capitulum Yield	☺	☺		☺	☺	☺
Thsnd Kernel Weight	☺		☺	☺	☺	☺
Yield per Plant	☺	☺	☺	☺	☺	☺
Hull Content	☺				☺	
Oil Content				☺	☺	☺

1: Correlation and path analysis, 2: multiple linear regression, 3: Factor Analysis, 4: Principal component analysis 5. Best subsets regression, 6: Cluster analysis.

© 2013 Global Journals Inc. (US)

Global Journal of Science Frontier Research
Agriculture and Veterinary
Volume 13 Issue 8 Version 1.0 Year 2013
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Determination of Genetic Diversity in Bread Wheat (*T.Aestivum* L.) by Agronomic and Quality Traits and SDS-PAGE Method

By Murat Olgun, Imren Kutlu, N. Gözde Ayter, Özcan Yorgancilar & Zekiye Başçiftçi

Osmangazi University, Turkey

Abstract - The aim of this study was examine genetic diversities in bread wheat based on Agronomic and Quality Traits and SDS-PAGE Method. Bread wheat genotypes are Prostor, Eser, Daphan, Kınacı 97, Bağcı 2002, Tosunbey, Karahan 99, Katea 1, Nenehatun, Lancer, Karasu 90, Alparslan, Palandöken 97, Konya 2002 and Doğu 88 were used. Results revealed that Prostor wheat genotype differed from the other genoypes in three traits (gliadin subunits, agronomic and quality traits); Eser, Tosunbey and Kınacı 97 genotypes showed similarities in agronomic traits and gliadin subunits. Some genotypes presented similarities in each analysis and these similarities in terms of genotypes was different for each traits. Determination of genetic characteristic of genotypes in breeding programs provides genotype classification, genetic purity, similarities and dissimilarities early material selection. Gliadin pattern of wheat genotypes are free from environment, they are easy and forceful method in evaluation of genetic materials, breeding programs, pure seed productions in hexaploid wheat.

Keywords : agronomic and quality traits, bread wheat, cluster analysis, correlation, SDS-PAGE method.

GJSFR-D Classification : FOR Code: 820507

DETERMINATION OF GENETIC DIVERSITY IN BREAD WHEAT T.AESTIVUM L. BY AGRONOMIC AND QUALITY TRAITS AND SDS-PAGE METHOD

Strictly as per the compliance and regulations of :

© 2013. Murat Olgun, Imren Kutlu, N. Gözde Ayter, Özcan Yorgancilar & Zekiye Başçiftçi. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Determination of Genetic Diversity in Bread Wheat (*T.Aestivum* L.) by Agronomic and Quality Traits and SDS-PAGE Method

Murat Olgun [α], Imren Kutlu [σ], N. Gözde Ayter [ρ], Özcan Yorgancilar [ω] & Zekiye Başçiftçi [¥]

Abstract - The aim of this study was examine genetic diversities in bread wheat based on Agronomic and Quality Traits and SDS-PAGE Method. Bread wheat genotypes are Prostor, Eser, Daphan, Kınacı 97, Bağcı 2002, Tosunbey, Karahan 99, Katea 1, Nenehatun, Lancer, Karasu 90, Alparslan, Palandöken 97, Konya 2002 and Doğu 88 were used. Results revealed that Prostor wheat genotype differed from the other genoypes in three traits (gliadin subunits, agronomic and quality traits); Eser, Tosunbey and Kınacı 97 genotypes showed similarities in agronomic traits and gliadin subunits. Some genotypes presented similarities in each analysis and these similarities in terms of genotypes was different for each traits. Determination of genetic characteristic of genotypes in breeding programs provides genotype classification, genetic purity, similarities and dissimilarities early material selection. Gliadin pattern of wheat genotypes are free from environment, they are easy and forceful method in evaluation of genetic materials, breeding programs, pure seed productions in hexaploid wheat.

Keywords : agronomic and quality traits, bread wheat, cluster analysis, correlation, SDS-PAGE method.

I. Introduction

Wheat is the cultivated crop in the world. With the purpose of meet the increasing demand of food in tremendously increasing human population, aim in breeding programs is to develop high yielding cultivars possessing high quality, resistant to cold, drought and heat stress (Blum, 1988; Wilson, 1984). Success to overcome these troubles is not sufficient, sustainability in these properties of is also important, a number of studies have been made to increase for this purpose (Metakovsky and Branlard, 1998). Success in breeding programs is closely related to opulence in number of breeding materials affecting released cultivars. Reductions in the number of germplasm materials by using limited number of parents in breeding programs and diminish variation in new characters. Besides, keeping genetic purity in cultivars, in other words sustaining production pure seed production will create opportunity to address different market's demands, consequently, classification certain physiological, physiological and quality traits vital (Akcura, 2006). Certain traits have been used to classify wheat genotypes such as physiological and quality traits and gliadin subunits (Weegels et al., 1996; Metakovsky et al., 1997; Metakovsky and Branlard, 1998; Ojaghi and Akhundova, 2010). Combinations for each trait create opportunity to distinguish genotypes each other (Ojaghi and Akhundova, 2010). Orth et al. (1996) stressed that many of physical and chemical tests could make the assessment of wheat genotypes for quality and these measurements strongly depend upon physical and chemical composition of wheat seed. Once physiological, physiological and quality traits are under genotype x environment interactions and a trait could be showed variations in different year or locations (Nevo et al., 1988). But gliadin sequence for each genotype is not affected by environment to identify genotypes (Zillman and Bushuk, 1979). Gliadins are the important seed proteins, evaluating and identifing genetic differences of genotypes could be safely made by them (Bushuk and Zillman 1978; Nevo and Payne 1987; Pfluger et al.2001). Reductions in the number of germplasm materials by using limited number of parents in breeding programs and diminish variation in new characters (Porceddu et al., 1988). Even tough morphometric characters (yield, yield components ect.) have been intensively used studies related to genetically diversity headed for protein bands such as gliadins (Metakovsky and Branlard, 1988). Gliadin (dissolved in etile alcohol, 70%) important part of wheat protein having high level of proline its named as prolamine (Zillman and Bushuk 1979). Gliadins as monomeric proteins could be classified to ω, γ, β, α groups (Jones et al.,1959). Most gliadin genes placed at first (Gli-1) and sixth (Gli-2) homology groups (Payne, 1987) and Gli-4 and Gli-5 groups in short arm of D chromosome (Rodrigve and Carrillo, 1996). Quality and agronomic traits have been commonly used in breeding programs, but determining quality and agronomic traits in genotypes needs long-term measurements to reach reliable results, since they are widely affected from environmental conditions (Metakovsky and Branlard, 1998; Ojaghi and Akhundova, 2010). Gliadin pattern of wheat genotypes are free from environment, they are easy and forceful method in evaluation of genetic materials, breeding programs, pure seed productions in hexaploid wheat.

Authors α σ ρ ¥ : Osmangazi University, Faculty of Agriculture, Department of Field Crops, ESKİŞEHİR/ TURKEY.
E-mail : ikutlu@ogu.edu.tr
Author ω : Transitional Zone Agricultural Research Institute, ESKİŞEHİR/ TURKEY. E-mail : burakolg@hotmail.com

© 2013 Global Journals Inc. (US)

The aim of this study was to reveal genetic diversity by examining agronomic and quality traits, and gliadin patterns in bread wheat.

II. Materials and Methods

Study was conducted in experimental station Osmangazi University Agricultural Faculty during 2009-2010 seasons. Long-term annual precipitation in Eskişehir province is 411.1 mm. Precipitation was 286.9 mm in 2009-2010 and 384.0 mm in 2010-2011 growing seasons. The soil had loamy-clay texture; 2.85 dS/m electrical conductivity, 7.21 pH (H_2O), 0.38% $CaCO_3$, 42,24 kg P_2O_5/ha available phosphorus, 3342 kg K_2O ha^{-1} and 1.70% organic matter. In the study, ammonium sulphate (21%N) and triple super phosphate (46%) were used as fertilizers. Experimental design was randomised completed block design with three replication. Plot size was 6 m x 1.2 m (7.2m^2). Seed were sown in 15 October and seed rate was 500 seed/m^2. 60 kg N/ ha (½ at sowing stage and ½ at tillering stage) and 60 kg P_2O_5/ha (at sowing) were applied. Wheat was sown in 1-15 September at the rate of 475 seed/m^2. Plot size was 6 m x 1.2 m (7.2m^2) at sowing. No K fertilization was made. Plots received (2000 cc/ha) applications of 2,4-D ester [(2,4-dichlorophenoxy)acetic acid] in early spring to control winter annual broadleaf weeds. Plot size at harvest for determining grain yield was 0.80 m x 5 m (5.0 m^2). Plots were harvested in 15th of July in 2009-2010 and 14th of July in 2010-2011. Bread wheat genotypes are Prostor, Eser, Daphan, Kınacı 97, Bağcı 2002, Tosunbey, Karahan 99, Katea 1, Nenehatun, Lancer, Karasu 90, Alparslan, Palandöken 97, Konya 2002 and Doğu 88 were used. Pedigree of wheat genotypes are given in Table 1. Agronomic characters; seed yield and plant height, seed number/spike, seed weight/spike, spikelet number, harvest index and 1000 grain weight (Slafer and Miralles, 1992) were evaluated. Quality characters; protein and gluten contents (Poehlman, 1987), zeleny sedimentation (Zeleny, 1947), farinograph, water absorbtion (Lehmensiek et al., 2006), alveograph, W_{energy} (Bettge et al., 1989), test weight (Sade et al., 1999), 1000 seed weight (Uluöz 1965) and PSI (Hruskova and Svec, 2009) were evaluated. Cluster analyses were made by MINITAB 16 Pocket Program. For gliadin subunits, sodium dodecylsulfate polyacrylamide gel electrophoresis (SDS-PAGE) analysis was used. Gliadin proteins were performed on vertical slab (Rashed et al., 2007). Relative mobility measures were used to evaluate gliadin band models. Relative motilities of bands were measured by formula (Keskin et al., 1996).

Rm=distance of bands measured from origin/ distance of reference band from origin x 45,5.

Table 1 : Pedigree of wheat genotypes

GENOTYPE	PEDIGRREE	Releas. Year
Prostor	Russalka imp./Nadadores63	1999
Eser	AGRI/NAC//LIRA	2003
Daphan	JUP/4/CLLF/3/II4.53/ODIN//CI14431/WA00477	2002
Kınacı 97	YAMHILL/TOBARI-66//MCDERMID/3/LIRA	1997
Bağcı 2002	HN7/OROFEN//BJN8/3/SERI82/4/74CB462/TAPPER/VONA	2002
Tosunbey	EÇVD-12/KRÇ-66//CROW"S"	2004
Karahan 99	C-126-15/COLLAFEN/3/NORIN-10-BREVOR/P-14//PULLMAN-101/4/KIRAÇ-66	1999
Kate a 1	Hebros/Bez-1	1998
Nenehatun	ND//P101/BLUEBOY SWM584	2001
Lancer	TK/CNO//NE-451406	1977
Karasu 90	LOM11/B12973//MİR264	1990
Alparslan	TX69A509-2//BBY2/FOX	2001
Palandöken 97	AU//YT54*2/N10B/3/II8260/5/PNC/CM//NB6977/3/CC/INIA//BB/4/MXP//KR/FUNO	1997
Konya 2002	KANRED/TENMARG//P211-6/3/2183/CO652643/LANCER	2002
Doğu 88	Bez/Dane//CO725052	1990

III. Results and Discussion

Genotypic/phenotypic diversity or classification in bread wheat genotypes are successfully made by using physiological, quality traits and gliadin subunits (Clarke et al., 1991; Yang et al., 1991; Metaovsky et al., 1990; Vaquero et al., 1990). Although physiological and quality traits are substantially connected to the environmental conditions, gliadin subunits are not affected by environmental conditions (Zillman and Bushluk, 1979; Metakovsky and Branlard, 1998). Maximum, minimum values and means in agronomic and quality traits and relative mobility of gliadin subunits, are given Table 2. Introduction and selection are milestones in wheat breeding. To obtain information about genotypes are commonly revealing characteristics of genotypes by agronomic and quality and electrophoresis methods including protein analysis

© 2013 Global Journals Inc. (US)

(Soizow and Poperelya, 1980; Metakovsky and Branlard, 1998). Once gliadin structure remains unchanged through generations, agronomic and quality traits are under genotype x environment interactions, and electrophoresis is therefore safe method to describe protein characteristics of genotypes (Bushuk and Zillman, 1978; Metakovsky and Branlard, 1998). Table 1 sows that relative mobility of gliadin subunits were varied from 20,33 to 76,47 (20,33-25,29 in ω, 44,33-49,49,08 in γ, 54,33-62,35 in β and 71,00-76,47 in α). Depending upon increasing mobility, gliadin protein fractions are grouped in four main groups ω, γ, β, α gliadin subunits (Bietz and Wall, 1973; Kharebian et al., 2008). Gepts (1990) stressed that genotypes can be successfully grouped or evaluated according to relative mobility of different gliadin groups.

Researchers stated that gliadin structures (Nevo and Payne, 1987; Bushuk and Zillman, 1978), agronomic and quality traits of genotypes are differed (Lee and Ronalds, 1967; Wrigley, 1970). Whole three traits could safely be used in genotype classification (Metakovsky and Branlard, 1998; Ojaghi and Akhundova, 2010), but the safest method is gliadin electrophoresis method (Zillman and Bushuk, 1979). A number of researches demonstrated the relationship of gliadin polymorphism with genetic diversity (Nevo and Payne, 1987). In our study each gliadin band fractions are evaluated in subgroups, ω, γ, β and α and are shown in Figure 1.

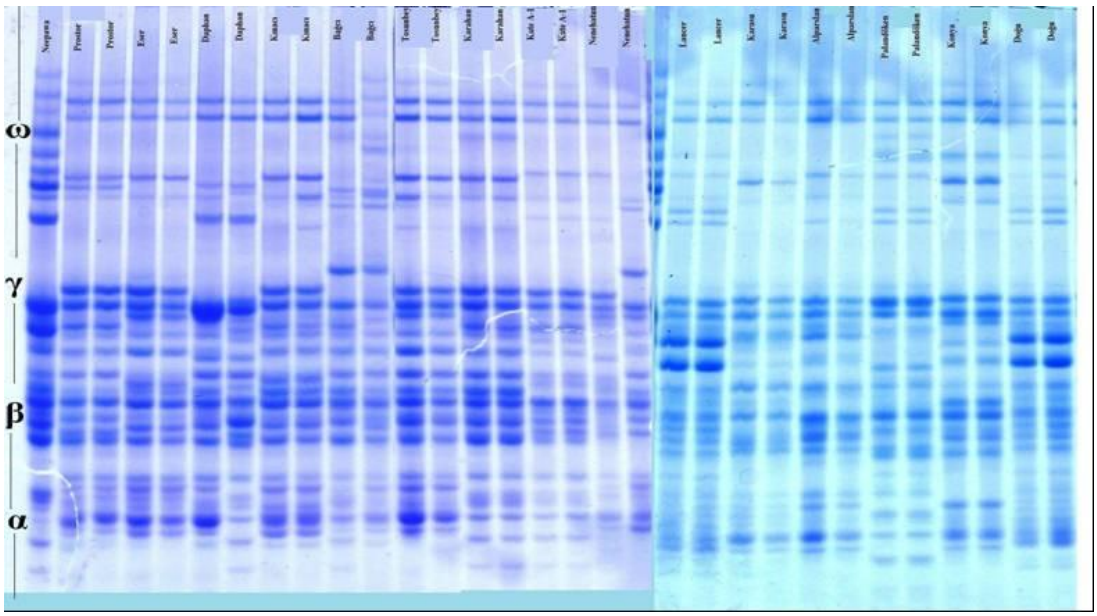


Figure 1 : Gliadin band subunits, ω, γ, β and α in bread wheat genotypes

Table 2 : Maximum, minimum values and means in agronomic and quality traits and relative mobility of gliadin subunits in bread wheat genotypes

Traits	Minimum	Maximum	Mean
Rm of Gliadin subunits			
ω	20,33	25,29	22,87±1,60
γ	44,33	49,08	46,19±1,96
β	54,33	62,35	63,38±1,40
α	71,00	76,47	73,45±1,59
Agronomic Traits			
Plant Height	85,40	142,47	109,12±14,83
Spike Heigh	7,73	11,35	9,61±1,02
Spikelet Number	14,40	18,67	16,38±1,27
Seed Number per Spike	28,47	57,87	38,92±8,36
Seed Weight per Spike	1,23	2,23	1,73±0,30
Harvest Index	42,34	56,67	25,08±7,21
Grain Yield	218,11	582,67	362,30±100,13

© 2013 Global Journals Inc. (US)

Quality Traits			
PSI	54,34	75,33	67,99±6,31
Thousand Seed Weight	38,02	55,04	44,94±5,38
Test Weight	72,49	79,28	76,88±1,65
Protein Content	10,81	13,36	12,17±0,62
Zeleny Sedimentation	27,66	43,80	35,23±4,96
Alveograph W_{Energy}	96,01	263,42	161,72±44,25
Farihograph Water Absorbtion	53,40	62,70	57,37±2,63
Gluten Content	23,00	38,00	28,00±3,87

We found notable polymorphisms among bread wheat genotypes on ω, γ, β and α gliadin subunits where γ and β have the heaviest molecular weights in Figure 1. Spectrum and density of molecular changed among ω, γ, β and α gliadin subunits in genotypes (Bietz and Wall, 1973; Nevo and Payne, 1987; Keskin et al.,1999). Kharabian et al. (2008) focused that ω has heaviest molecular weights. In our study, heavier molecular weights on γ, β gliadin subunits in Eser, Daphan, Kınacı 97, Tosunbey and Karahan 99 were found than that of the other genotypes. Moreover, differences in gliadin subunits assign differences of wheat genotypes, and ω, γ, β and α gliadin subunits are mostly located in Gli-A_1 and Gli-B_1 locus (Lafiandra and Kasarda, 1985; Kharabian et al., 2008), new giladin genes in Gli-D_4 Gli-D_5 (Rodriquez and Carrillo, 1996). Rashed et al. (2007) focused that ω region were so rich in the number of bands. The dendogram tree showed the similarity index of wheat cultivars detected by Rm of gliadin pattern (Figure 2).

The dendogram divided wheat genotypes in seven clusters. Prostor, Konya 2002, Palandöken 97 and Karasu 90 placed in separate groups. Once Eser, Tosunbey, Karahan 99, Kınacı 97 and Daphan genotypes placed one group; Lancer, Alparslan, Doğu88 and Bağcı 2002 another group. Nevertheless, Katea 1 and Nenehatun genotypes showed similar characteristics and placed same group (Figure 2). Gepts (1990) stressed that genotypes can be successfully grouped or evaluated according to relative mobility of different gliadin groups. According to Tanaka et al. (2003) wheat genotypes in Japan mainly different from other countries for gliadin pattern. Being main protein fragment in storage proteins, gliadins are important for bread making quality in hexaploid wheats (Kasarda et al., 1984). Nizar (2002) stated that determining gliadin pattern of wheat genotypes is safe method to classify cultivars and he successfully classified *T. durum* cultivars. Until recently, morphometric characters had been used in genetic diversities of wheat genotypes. Now, electrophoresis based techniques have been used for the determination and description of genotypes in cereals (Persson and Von Bothmer, 2000).

Genotypes segregate their own gliadin fraction; band pattern are characteristic of the genotype and aren't affected from environmental conditions (Bushuk and Zillman, 1978). Gliadin proteins having ω, γ, β, α gliadin subunits with combination of glutenins are play important role agronomic and bread making traits (Ojaghiand and Akhundova, 2010).

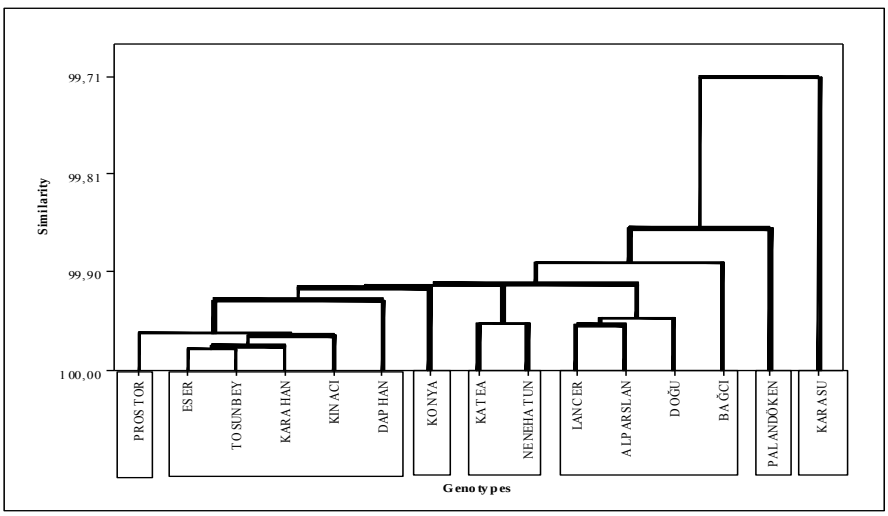


Figure 2 : Dendogram assigning genetic relationships among bread wheat genotypes for gliadin pattens

© 2013 Global Journals Inc. (US)

Agronomic characters are essential corner stones of breeding programs (Darwinkel et al., 1977; Genc, 1977; Poehlman, 1987). A number of yield components are used not only in breeding programs but genotype description. Monitoring such yield and yield components separately or their relationships each other lights the way for breeding programs, agronomic studies and genotype classification (Hsu and Walton, 1971; Nass, 1973; McVetty and Evans, 1980). Plant and spike heights, spikelet and seed numbers per spike, seed weight per spike, harvest index and grain yield are some of the most used characters and they could be used in genotypic classification (Ojaghi and Akhundova, 2010). Similar to gliadin patterns, agronomic traits ranged 85,40-142, 47 cm in plant height, 7,73-11,35 cm in spike height, 14,40-18,67 in spikelet number per spike, 28,47-57,87 in seed number per spike, 1,23-2,23 gr in seed weight per spike, 42,34-56,6 in harvest index and 218,11-582,67 kg/da in grain yield (Table 2). Agronomic characters are commonly are named as yield components. The dendogram tree of agronomic traits is given in Figure 3.

Evaluated in eight were wheat genotypes (Figure 3). Prostor, Konya 2002 and Katea 1 drew their own single groups. The other wheat genotypes formed dual or multiple groups: dual groups; Nenehatun and Doğu 88, Karasu 90 and Karahan 99, Alparslan and Lancer wheat genotypes; multiple group; Eser, Tosunbey, Daphan, Bağcı 2002 and Kınacı 97 wheat genotypes. Even though agronomic traits are under genotype x environment interactions, with certain approaches they are used to show genotypic differences (Metakovsky and Branlard, 1998; Ojaghi and Akhundova, 2010). Similar to our findings, Nenehatun, Doğu 88, Alparslan and Karasu 90 have similar yield capacity and they are suggested to Eastern Anatolia climatic conditions. In the same way, Tosunbey, Eser, Kınacı 97 and Bağcı 2002 were developed for Central Anatolia climatic conditions.

The aim of bread wheat breeding programs is to develop high yielding and high-quality wheat cultivars. To achieve this aim, in addition of yield potential, wheat genotypes are evaluated for high quality such as for protein content, zeleny sedimentation, energy value such as alveograph W_{energy}, water absorption and test weight (Dexter et al. 1981; Atlı 1999; Akcacık, 2006). Genotypes having higher values in protein content, zeleny sedimentation, alveograph W_{energy}, farinograph water absorption and test weight will be promising genotypes in breeding programs (Arat, 1949., Seçkin, 1970., Ünal, 1991., Atlı, 1999). The dendogram tree of quality traits is given in Figure 4.

Genotypes could be divided into nine groups (Figure 4). Prostor, Daphan, Konya 2002, Bağcı 2002 and Eseer wheat genotypes had single groups. Nenehatun, Palandöken 97 The other wheat genotypes formed dual or multiple groups: dual groups; and Doğu 88, Karasu 90 and Karahan 99, Alparslan and Lancer wheat genotypes; multiple group; Eser, Tosunbey, Daphan, Bağcı 2002 and Kınacı 97 wheat genotypes. Even though agronomic traits are under genotype x environment interactions, with certain approaches they are used to show genotypic differences (Metakovsky and Branlard, 1998; Ojaghi and Akhundova, 2010). Similar to our findings, Nenehatun, Doğu 88, Alparslan and Karasu 90 have similar yield capacity and they are suggested to Eastern Anatolia climatic conditions. In the same way Tosunbey, Eser, Kınacı 97 and Bağcı 2002 were developed for Central Anatolia climatic conditions.

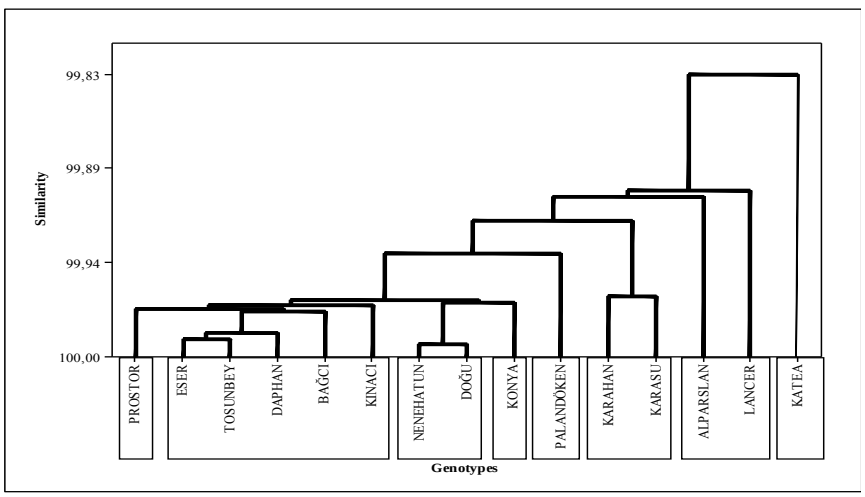


Figure 3 : Dendogram of agronomic traits showing relationships among bread wheat genotypes

© 2013 Global Journals Inc. (US)

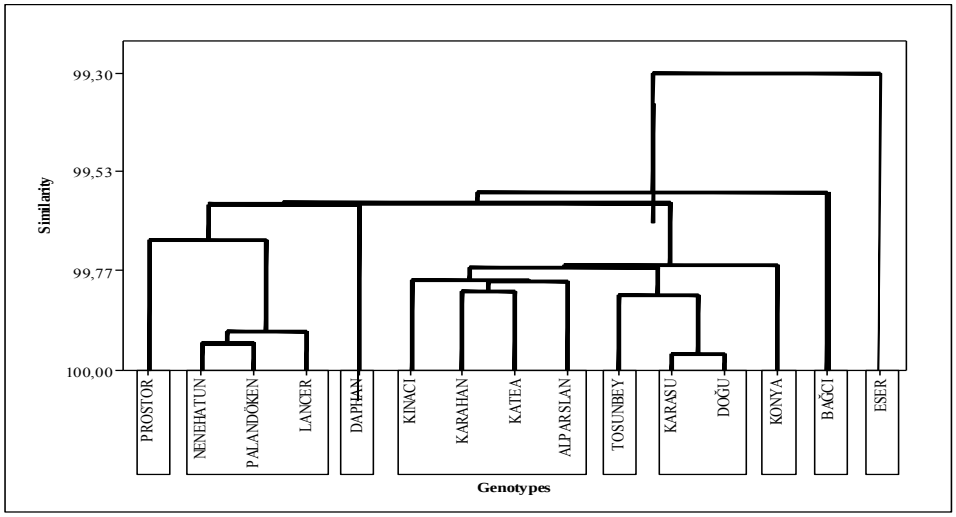


Figure 4 : Dendogram of quality traits showing relationships among bread wheat genotypes

Table 3 shows joint analysis of wheat genotypes for gliadin subunits, agronomic and quality traits. Prostor wheat genotype differed fro the other genoypes in three traits (gliadin subunits, agronomic and quality traits); Eser, Tosunbey and Kınacı 97 genotypes showed similarities in agronomic traits and gliadin subunits. As described earlier, some genotypes presented similarities in each analysis and these similarities in terms of genotypes was different for each traits (gliadin subunits, agronomic and quality traits).

Interesting phenomenon is that some genotypes could exhibit similarities by some traits (Eser, Tosunbey and Kınacı 97 genotypes in agronomic traits and gliadin subunits).or a genotype could significantly differ in all traits (Prostor genotype in all three traits). Studies revealed that agronomic and quality traits in wheat genotypes subject to genotype x environment interactions and this interaction differs in each genotype (Rodrigve and Carrillo, 1996; Şehirali and Özgen, 2007). Gliadin subunits stable with genotypes and don't change with changing environmental conditions (Bushuk and Zillman 1978; Rodrigve and Carrillo, 1996; Persson and Von Bothmer, 2000). Genetic diversity in genotypes can be controlled by polymeric markers and electropheretic patterns of gliadin subunits in genotypes are therefore very useful not only in genotype identification but in breeding programs (Nevo and Payne 1987; Metakovsky and Branlard, 1998; Pfluger et al., 2001). Studies stressed that agronomic and quality traits can be used in genotype classification (Kün, 1985; Şehirali, 2007), but both are influenced from genotype and environment conditions (Darwinkel et al., 1977; Genc, 1977; Poehlman, 1987; Gupta et al., 1993; Indrani and Venkateswara, 2000). Correlations between gliadin subunits, agronomic and quality traits are shown in Table 4. Positive and significant correlation ($P<0,05$) was found between protein content and α gliadin pattern. Besides correlations between seed number per spike and ω gliadin pattern, seed number per spike and α gliadin pattern, seed number per spike and β gliadin pattern, seed weight per spike and ω gliadin pattern, spikelet number per spike and test weight, spikelet number per spike and thousand seed weight were determined as negative and significant ($P<0,05$). Moreover, correlations between seed number per spike and γ gliadin pattern, seed number per spike and β gliadin pattern, seed weight per spike and ω, γ, β, α gliadin patterns, spike height and test weight were negative and significant at 1% (Table 4).

Table 3 : Joint analysis of wheat genotypes for gliadin subunits, agronomic and quality traits

Agron. Traits	Gliadin Subunits	Quality Traits
Prostor	Prostor	Prostor
Eser	Eser	Nenehatun
Tosunbey	Tosunbey	Palandöken 97
Bağcı 2002	Karahan 99	Lancer
Kınacı 97	Kınacı 97	Daphan
Daphan	Daphan	Kınacı 97
Nenehatun	Konya 2002	Karahan 99
Doğu 88	Katea 1	Katea 1
Konya 2002	Nenehatun	Alparslan
Palandöken 97	Lancer	Tosunbey
Karahan 99	Alparslan	Karasu 90
Karasu 90	Doğu 88	Doğu 88
Alparslan	Bağcı 2002	Konya 2002
Lancer	Palandöken 97	Bağcı 2002
Katea 1	Karasu 90	Eser

© 2013 Global Journals Inc. (US)

Table 4 : Correlations between gliadin subunits, agronomic and quality traits

	ω	γ	β	α		PSI	TeWe	ThSW	WAb
PSI	0,119	-0,010	0,185	0,308	Plant Height	-0,192	-0,194	0,154	0,297
Test Weight	0,104	0,210	-0,205	0,031	Spike Height	0,009	-0,689**	-0,246	-0,464
Thou. Seed We.	-0,049	-0,008	0,038	-0,320	Splt per Spk.	-0,071	-0,552*	-0,685*	-0,250
Protein Con	0,201	0,409	0,329	0,635*	Seed per Spk	-0,057	-0,553*	-0,177	-0,426
Zeleny Sedim.	0,128	0,178	-0,115	0,281	Seed W.per Spk	-0,093	-0,465	0,091	-0,347
Alveo. W_{en}	-0,061	0,237	-0,156	0,243	Harvest Index	-0,093	-0,189	0,392	-0,020
Farin. Water Ab	0,036	0,404	0,048	0,221	Yield	0,170	-0,219	0,439	-0,015
Gluten Index	-0,052	-0,035	-0,092	-0,105		PrCo	Sed	Wen	GI
Plant Height	-0,025	0,357	0,497	0,265	Plant Height	0,010	0,061	-0,078	0,086
Spike Height	-0,239	-0,367	0,155	-0,069	Spike Height	-0,279	-0,195	-0,410	0,198
Splt per Spk.	-0,105	-0,240	-0,163	0,009	Splt per Spk.	-0,378	0,357	-0,134	0,177
Seed per Spk	-0,623*	-0,717**	-0,633*	-0,584*	Seed per Spk	-0.361	-0,053	-0,256	0,010
Seed W.per Spk	-0,767**	-0,853**	-0,698**	-0,663**	Seed W.per Spk	-0,378	-0,279	-0,330	-0,133
Harvest Index	0,184	-0,176	-0,284	-0,370	Harvest Index	-0,208	-0,231	-0,318	-0,315
Yield	0,219	0,330	0,322	0,156	Yield	0,142	-0,397	-0,312	-0,330

Determinations in correlation between gliadin patterns and agronomic and quality traits are hard due to high molecular weight subunits of glutenin (Fido et al., 1997). Branlard and Dardevet (1985) found a negative correlation between ω gliadin and a number of quality traits. Whereas, positive correlation was found between γ gliadin subunit and gluten quality (Rashed et al., 2007). Significant positive effects of gliadin isoforms were found on agronomic traits and environmental adaptation (Metakosky and Branlard, 1998). Metakovsky and Branlard (1998) stated that genetic diversity in genotypes can be controlled by polymeric markers and electropheretic patterns of gliadin subunits in genotypes. Determination of gliadin subunits is therefore very useful not only in genotype idendification but in breeding programs (Bushuk and Zillman 1978; Persson and Von Bothmer, 2000).

So, quality and agronomic traits, and gliadin electrophoretic profiles revealed that comprehensive diversity occurs among genotypes. Determination of quality and agronomic traits in genotypes needs long-term measurements to reach reliable results and they are widely affected from environmental conditions (Vaquero ve ark., 1990; Metakovsky and Branlard, 1998; Ojaghi and Akhundova, 2010). Gliadin pattern of wheat genotypes are free from environment, they are easy and forceful method in evaluation of genetic materials, breeding programs, pure seed productions in hexaploid wheat. It is well known that yield is controlled polygenic activities and it is difficult to increase directly, however certain traits are significantly correlated with yield. Assigning and monitoring traits could help to increase yield and quality.

References Références Referencias

1. Akçacık, A.G. (2006). Determination of suitable bread wheat and general and specific combination ability and heritability parameters for quality and yield by using linextester analyses method. Ph. D. Thesis, Selçuk University, Department of Field Crops, Konya, 161 p.
2. Akçura M (2006) Characterization of turkish winter bread wheat landraces genetic resource. Ph. D. Thesis, Selcuk University, Department of Field Crop, Konya, 2006.
3. Arat SO (1949) Wheat technology. Ministry of Agriculture Directorate of Publications, Number: 654.
4. Atlı A (1999) Quality of wheat and products. Symposium on Problems and Solutions in Agriculture in Central Anatolia Grain, 8-11 June, Konya.
5. Bettge A, Rubenthaler GL and Pomeranz Y (1989) Alveograph algorithms to predict functional properties of in bread and cookiebaking. Cereal Chemistry, 66: 81–86.
6. Bietz JA and Wall JS (1973) Isolation and characterization of gliadin-like subunits from glutenin. Cereal Chem. 50:537.
7. Blum A (1988) Plant breeding for stress environments. CRC Press Inc., Boca Raton, FL, 233 pp.
8. Branlard G and Dardevet M (1985) Diversity of grain protein and bread quality. I. Correlation between gliadin bands and technological characteristics. J Cereal Sci, 3:329–343.
9. Bushuk W and Zillman RR (1978) Wheat cultivar ıdentification by gliadin electrophoregrams. ı. apparatus, method and nomenclature. Can. J. Plant Sci., 58:505-515.
10. Clarke JM, Romagosa I and DePauw RM (1991) Screening durum wheat germplasm for dry growing conditions: Morphological and physiological criteria. Crop Sci., 31:770-775.

© 2013 Global Journals Inc. (US)

11. Darwinkel A, Hag BA and Kuizenga J (1977) Effect of sowing date and seed rate on crop development and grain production of winter wheat. Netherlands J. Agric. Sci. 24:83–94.
12. Dexter JE and Matsuo RR (1981) Effect of starchy kernels, immaturity, and shrunken kernels on durum wheat quality. Cereal Chem. 58:395-400.
13. Fido RJ, Bekest F, Grast PW and Tahtam AS (1997) Effects of α-, β-, γ-, and ω- Gliadins on Dought Mixing Properties of Wheat Flour. Journal of Cereal Science, 26:271-277.
14. Genç I (1977) Physiological and morphological basis in cereals. Çukurova Uni. Agric. Fac. Press. No: 22, Ankara.
15. Gepts P (1990) Biochemical evidence bearing on the domestication of *Phaseolus* (Fabaceae) beans. Econ. Bot. 44 (3 Suppl.):28-38.
16. Hruskova M, and Svec I (2009) Wheat hardness in relation to other quality factors. Czech Journal of Food Sciences 27(4):240-248.
17. Hsu P and Walton PD (1970) The inhertitance of morphological and agronomic characters in spring wheat. Euphytica. 19:54-60.
18. Jones RW, Taylor NW and Senti FR (1959) Electrophoresis and fractionation of wheat gluten. Arch. Biochem. Biophys. 84:363-376.
19. Kasarda DD, Okita TW, Bernardin JE, Baecker PA, Nimmo CC, Lew EJL, Dietler MD and Greene FC (1984) Nucleic acid (dDNA) and amino acid sequences of a-type gliadins from wheat *(Triticum aestivum).* Proc. Natl. Acad. Sci. USA, 81: 4712-4716.
20. Keskin S, Asal S and Kavuncu O (1996) Genetic analysis and gliadin banding patterns in some bread wheat varieties grown in turkey and their hybrids. Tr. J. of Agriculture and Forestry 23: 291-298.
21. Kharabian A, Jones A and Kaviani B (2008) Electrophoretic profiles of gliadin subunits to evaluate genetic diversity of *Triticum persicum* Boiss. and *Triticum pyramidale* Pervical. Plant Omics Journal, 1(1):9-16.
22. Kün E, (1985) Hot climate cereals. Ankara University Faculty of Agriculture Publications, Ankara. 1985
23. Lafiandra D and Kasarda DD (1985) One- and two-dimensional (two pH) polyacrylamide gel electrophoresis in a single gel: separation of wheat proteins. Cereal Chem 62:314-319.
24. Lee JW and Ronalds JA (1967) Effect of environment on wheat gliadin. Nature (London) 213: 844-846.
25. Lehmensiek A, Eckermann PJ, Verbyla AP, Appels R, Sutherland MW, Martin D, Daggard GE, (2006) Flour yield QTLs in three Australian doubled haploid populations. Australian Journal of Agricultural Research 57:1115–1122.
26. McVetty PBE and Evans LE (1980) Breeding methodology in wheat. I. Determination of characters measured on F spaced plants for yield selection in spring wheat. Crop Sci. 20:584-586.
27. Metakovsky EV, Wrigley CW, Bekes F and Gupta RB (1990) Gluten polypeptides as useful genetic markers of dough quality in Australian wheats. Aust J Agr Res 41:289-306.
28. Metakovsky EV, Annicchiarico P, Baggini G, Pogana NE (1997) Relationship between gliadin alleles and dough strength in Italian bread wheat cultivars. J. Cereal Sci. 25:229 236.
29. Metakovsky EV, Branlard G (1998) Genetic diversity of French common wheat germplasm based on gliadin alleles. Theor. Appl. Genet. 96:209-218.
30. Nass HG (1973) Determination of characters for yield selection in spring wheat. Can. J. Plant Sci. 53: 755-762
31. Nevo E, Payne PL (1987) Wheat storage proteins:diversity of HMWglutenin subunits in wild emmer from Israel.Geographical patterns and ecological predictability. Theoretical and Appl. Genet. 74: 827-836.
32. Nevo E, Beiles A and Krugman T (1988) Natural selection of allozyme polymorphisms: a microgeographical differentiation by edaphic, topographical, and temporal factors in wild emer wheat (*Triticum dicoccoides*). Theor Appl Genet, 76: 737–752
33. Nizar MA (2002) Gliadins polymorphism and cluster analyses of Syrian grown durum wheat. Plant Breeding and Seed Science, 46: 45-56,
34. Ojaghi J and Akhundova E (2010) Genetic diversity in doubled haploid wheat according to the acid-PAGE method, morphological traits and baking quality.Turk J Biol. 34: 343-353
35. Orth RA, O'Brien L and Jardine C (1976) A factor analysis of bread wheat quality tests. Aust. J. Aguic. Res.,27:575-82
36. Payne PI (1987) Genetics of wheat storage protein and the effect of allelic variation on bread baking quality. Annu. Rev. Plant physiol.38: 141-153.
37. Persson K, Von Bothmer R (2000) Assessing the variation in cultivars and Swedish landraces of rye (Secale careale L.) Hereditas, 13: 7-17.
38. Pflüger LA, D'Ovidio R, Margiotta B and Pena R (2001) Characterisation of high- and low molecular weight glutenin subunits associated to the D genome of *Aegilops tauschii* in a collection of synthetic hexaploid wheats. Theor Appl Genet. 103: 1293–1301.
39. Poehlman JM (1987) Breeding field crops, Van Nostrand Reinhold Company Inc. 115 Fifth Avenue New York.
40. Porceddu E, Ceoloni C, Lafiandra D, Tanzarella OA and Scarascia Mugnozza GT (1988) Genetic

© 2013 Global Journals Inc. (US)

resources and plant breeding: problems and prospects. In: Miller TE, Koebner RMD (Eds.), Proceedings of the Seventh International Wheat Genetics Symposium, Institute of Plant Science Research, Cambridge, pp. 7–22.

41. Rashed MA, Abou-Deif MH, Sallam MAA, Aida Rızkalla A, Walaa Ramada A (2007) Identification and prediction of the flour quality of bread wheat by gliadin electrophoresis, Journal of Applied Sciences Research, 3 (11): 1393-1399.
42. Sade B, Topal A and Soylu S (1999) Determination of durum wheat varieties grown under irrigated conditions in Konya. Turkey 3. Field Crops Congress: 91-96. 15-20 November, Adana.
43. Seçkin R (1970) The factors that affect of wheat quality and composition. Ankara University Agricultural Faculty Publications.430 Conferences Series 8., Ankara.
44. Slafer GA and Miralles DJ (1992) Green area duration during the grain filling period of wheat as affected by sowing date, temperature and sink strength. J Agron Crop Sci 168: 191–200.
45. Şehirali S and Özgen M (2007) Plant breeding. Ankara University Agricultural Faculty Publications, 1553/506, 270 p, Ankara.
46. Tanaka H, Tomita M, Tsujimoto H, Yasumuro Y (2003) Limited but specific variation of seed storage proteins in Japanese common wheat (*Triticum aestivum* L.). Euphytica, 132:167-174.
47. Uluöz M (1965) Analysis methods of wheat, flour and bread. A.U. Agricultural Faculty Publications 29, 91 s .
48. Ünal S (1991), Cereal techtonology. A.U. Agricultural Faculty Publications, 29. İzmir
49. Vaquero F, Rebordinos, L, Vences FJ and Perez de la Vega M (1990) Genetic mapping of isozyme loci in *Secale cereale* L. Theor. Appl. Genet., 80: 88-94.
50. Weegels PL, Hamer RJ, Schofield JD (1996) Functional properties of wheat glutenins. J. Cereal Sci. 23:1-17.
51. Wilson JA (1984) Hybride wheat breeding and commercial seed development. Plant Breeding Reviews,2: 303-319.
52. Wrigley CW (1970) Protein mapping by combined gel electrofocusing and electrophoresis: Application to the study of genotypic variations in wheat gliadins. Biochem. Genet. 4: 509.
53. Yang RC, Jana S and Clarke JM (1991) Phenotypic diversity and association of some potentially drought responsive characters in durum wheat. Crop Sci., 31:1484-1491
54. Zeleny L (1947) A simple sedimentation test for estimating the bread-baking and gluten qualities of wheat flour. Cereal Chem. 24: 465-475.
55. Zillman RR, Bushuk W (1979) Wheat cultivar identification by gliadin electrophoregrams. II. Effects of environmental and experimental factors on the gliadin electrophoregrams. Can. J. Plant Sci. 59: 281-286.

© 2013 Global Journals Inc. (US)

This page is intentionally left blank

© 2013 Global Journals Inc. (US)

Global Journal of Science Frontier Research
Agriculture and Veterinary
Volume 13 Issue 8 Version 1.0 Year 2013
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Nitrogen Management in Banana (*Musa Paradisica* L.) Cv. Basrai through Drip under Paired Row System

By C. B. Patel & Y. N. Tandel
Navsari Agricultural University, Navsari

Abstract - A field experiment was conducted under south Gujarat conditions at Fruit Research Station, Navsari Agricultural University, Gandevi, Dist. Navsari. The treatments comprised of three levels of nitrogen *viz*., 100, 150 and 200 g per plant and three methods of application *viz* ., 100, 75 and 50 per cent through drip and rest as soil application. In control, recommended dose of 200-90-200 g NPK per plant was applied fully in soil. The phosphorus (90 g plant^{-1}) along with 5 kg FYM per plant were applied at the time of planting, while potassium (200 g plant^{-1}) was applied in three equal splits as soil application at monthly interval from third month onward. The experiment thus included ten treatments, which were replicated four times. The trial was laid out in randomized block design. The banana was planted at 1.0m x 1.2 m x 2.0 m spacing with pair row method (6250 plants ha^{-1}). In the drip system, daily irrigation at 0.75 pan evaporation rate was followed; while in control plot, surface irrigation was given at 12-15 days interval in winter season and at 8-10 days interval in summer.

Keywords : banana, nitrogen, fertigation, yield, economics.

GJSFR-D Classification : FOR Code: 079999, 670104

NITROGEN MANAGEMENT IN BANANA MUSA PARADISICA L.CV. BASRAI THROUGH DRIP UNDER PAIRED ROW SYSTEM

Strictly as per the compliance and regulations of :

© 2013. C. B. Patel & Y. N. Tandel. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Nitrogen Management in Banana (*Musa Paradisica* L.) Cv. Basrai through Drip under Paired Row System

C. B. Patel[α] & Y. N. Tandel[σ]

Abstract - A field experiment was conducted under south Gujarat conditions at Fruit Research Station, Navsari Agricultural University, Gandevi, Dist. Navsari. The treatments comprised of three levels of nitrogen *viz.*, 100, 150 and 200 g per plant and three methods of application *viz.*, 100, 75 and 50 per cent through drip and rest as soil application. In control, recommended dose of 200-90-200 g NPK per plant was applied fully in soil. The phosphorus (90 g plant^{-1}) along with 5 kg FYM per plant were applied at the time of planting, while potassium (200 g plant^{-1}) was applied in three equal splits as soil application at monthly interval from third month onward. The experiment thus included ten treatments, which were replicated four times. The trial was laid out in randomized block design. The banana was planted at 1.0m x 1.2 m x 2.0 m spacing with pair row method (6250 plants ha^{-1}). In the drip system, daily irrigation at 0.75 pan evaporation rate was followed; while in control plot, surface irrigation was given at 12-15 days interval in winter season and at 8-10 days interval in summer.

Results revealed that the banana plants fertilized with different doses of nitrogen through drip as well as soil application in three different methods were significantly affected on vegetative growth, quality and yield of banana under pair row method of planting. The maximum (103.44 cm) plant height and circumference (43.93 cm) of the pseudostem were registered in the treatment of 150 g N per plant applied through drip only. The number of leaves and leaf area were not influenced by various levels of nitrogen. Early flowering and early maturity were noticed in treatment of 150 g N per plant applied through drip only, while the plants treated with lower and higher levels of nitrogen showed late flowering and late maturity.

Yield and yield attributing characters like bunch length (60.05 cm), number of hands per bunch (8.97), number of fingers per bunch (147.41) and bunch weight (19.60 kg plant^{-1}) were significantly higher in above treatments. Significantly the treatment of 150 g N per plant applied through drip gave highest (122.52 t ha^{-1}) banana fruit yield and net return (Rs. 390167 ha^{-1}) with computing higher (1: 14.78) cost benefit ratio among all the treatments during study.

Keywords : banana, nitrogen, fertigation, yield, economics.

Author α : Fruit Research Station Navsari Agricultural University Navsari.
Author σ : Assistant Professor (Horticulture), ASPEE College of Horticulture & Forestry, NAU, Navsari.
E-mail : yatintandel1512000@yahoo.co.in

I. Introduction

One of the major hurdles in development of Indian agriculture is low fertilizer consumption and low fertilizer use efficiency. Day by day prices of fertilizers are kissing to the sky. So in today's perspective, it is essential, especially in crops like banana which are the heavy feeder of nutrients that we study and suggest to the farmers the most efficient method of fertilizer application with its efficient form and splitting to get maximum fertilizer use efficiency and net profit. In recent years, liquid fertilizers are used as a strong alternative to solid fertilizers. The major advantage of liquid fertilizers is that, they are completely soluble in water and can be applied through drip system with an ease, without any harm and in number of splits. The second strong point goes in favour of liquid fertilizer is that they contain major essential nutrients in readily available form. It ultimately increases the FUE by increasing the nutrient uptake and minimizing the losses. Therefore in recent years task before agricultural scientists is that, while suggesting drip method of irrigation to farmer, side by side they also should suggest proper planting technique, which will help in minimizing the system cost and allow mechanization of farming.

Banana and plantain to be the fourth most important global feed commodity after rice, wheat and milk in terms of the gross value of production, are of great socio-economic significance in India. Banana belongs to Musaceae family, its botanical name is *Musa paradisica* L. Banana ranks first in production and second in area among the fruits grown in India. Banana is a tropical mesophyte plant and requires an ample and frequent supply of water. Many previous workers have reported that water deficiency adversely affects the crop growth and yield (Samson, 1980 and Young *et al.*, 1985). Shmeuli (1953) quoted that 66 per cent soil available water as a critical level, below which banana growth and development suffered.

II. Materials and Methods

The field experiment entitled "Nitrogen management in banana (*Musa paradisica* L.) cv. Basrai through drip under pair row method of

© 2013 Global Journals Inc. (US)

planting" was conducted at the Fruit Research Station, Navsari Agricultural University, Gandevi (south Gujarat). The research station belongs to agro-climatic zone-I and agro-ecological situation-III. The experiment was laid out in a Randomized Block Design with ten treatments replicated four times. The treatments comprised of three levels of nitrogen *viz.*, 100, 150 and 200 g per plant. These levels of nitrogen were applied in three methods *viz.*, 100, 75 and 50 per cent through drip and the rest of nitrogen was applied in soil along with phosphorus and potassium as per recommended schedule. In control (T_{10}), total recommended dose 200-90-200 g NPK plant^{-1} was applied in soil.

T_1 100 g N through drip

T_2 75 g N through drip + 25 g N as soil application

T_3 50 g N through drip + 50 g N as soil application

T_4 150 g N through drip

T_5 112.5 g N through drip + 37.5 g N as soil application

T_6 75 g N through drip + 75 g N as soil application

T_7 200 g N through drip

T_8 150 g N through drip + 50 g N as soil application

T_9 100 g N through drip + 100 g N as soil application

T_{10} Control (Recommended 200 g N as soil application)

This experiment was framed out with a view to determine the optimum dose of nitrogen for banana under drip irrigation system, to obtain higher yield of better quality fruits by adopting pair row method of planting and to workout ultimate economics for saving water and fertilizers and its adaptability. Two years' pooled results of the experiment are summarized here.

III. Results and Discussion

The vegetative growth of banana plants like plant height and stem girth were significantly influenced while number of leaves and leaf area were not altered by the various levels of nitrogen applied through drip as well as in soil application (Table -1). The result indicates that the height and stem girth increased with the increase levels of nitrogen. The treatment of 150 g nitrogen per plant applied 100 per cent through drip recorded the highest plant height and stem girth while the lowest value were recorded under treatment 200 g N per plant totally applied in soil up to 180 days after planting (DAP) during study period. It was observed that the plants treated with 100 per cent nitrogen through drip increase the height and girth of the plant, it might be due to increase in formation and elongation of meristematic tissues since nitrogen is responsible for the formation, growth and development of the cells. The nitrogen applied in soil may be lost and less available to plant after longer period as compared to drip method. Under drip system, as the moisture availability and nitrogen levels were increased, stem girth was also increased. Similar results were also reported by Hegde and Srinivas (1991).

Days to flowering and harvest were significantly affected by the application of varying doses of nitrogen applied through drip either fully or partly to banana under high density plantation. The results revealed that the early flowering and harvest were noticed in the treatment T_4 (150 g N per plant applied through drip only) which was statistically at par with all treatments containing application of different levels of nitrogen through drip except control (total recommended dose 200-90-200 g NPK plant^{-1} was applied in soil). In the present investigation various levels of nitrogen were applied through the drip in liquid state after dissolving urea in water. The superiority of liquid fertilizers in advancing the flowering and that will leads to early harvesting over solid fertilizer in banana. The early maturity of banana obtained was in conformity with those reported by Hegde and Srinivas (1991) and Singh and Suryanarayana (1999).

Yield and yield contributing parameters were recorded the overall highest in the treatment with 150 g N per plant applied through drip during experimentation. Similar findings were observed by Srinivas (1977), while studying the effect of N, P and K fertilizers on banana cv. Basrai. Kohli *et al.* (1976) reported that the nitrogen application significantly influenced the fruit yield in all the three crops (plant crop, first ratoon and second ratoon) under closer spacing. Though the treatment T_4 (150 g N per plant) recorded the higher bunch length (60.06 cm) and bunch girth (106.43 cm), however the difference was non-significant. The highest (9.09) numbers of hands per bunch were recorded in the treatment T_7 where 200 g N per plant was applied through drip only. It was at par with T_4 (150 g N per plant). Similarly, higher numbers of fingers was also recorded in T_5 (148.24) and T_4 (147.41). The application of higher levels *i.e.* 200 g N per plant applied in soil registered lowest numbers of hands as well as number of fingers per bunch in banana cv. Basrai. Drip irrigated banana crop supplied with 50 per cent lesser quantity of fertilizer was found superior over the conventional

© 2013 Global Journals Inc. (US)

method as reported by previous workers Hegde and Srinivas (1991). In present investigation, the banana crop fertilized with 150 g N per plant through drip recorded significantly highest (122.52 t ha^{-1}) yield. This effect was obviously due to liquid form of nitrogen, which is in readily available form so as to increase uptake efficiency of plant. These results are in conformity with the previous work done by Arscott (1970).

IV. Economics

High density plantation in banana enabled to achieve higher yields. The trial was planted geometrically in pair row method at the spacing 1.0 m x 1.2 m x 2.0 m which accommodate 6250 plants per hectare. Further, the beneficial effect of drip irrigation was clearly reflected in yield with an application various levels of nitrogen to banana crop cv. Basrai. The nitrogen 100 per cent applied through drip proved its superiority in yield over rest of the other treatments. The treatment 150 g N per plant applied through drip only computed the highest net return Rs. 3,90,167 ha^{-1} with highest (1:14.78) cost benefit ratio. The nitrogen applied through drip was found beneficial, 25 per cent (50 g N per plant) N and 40 per cent irrigation saved and proportionately the yield and income increased were more as compared to cost under drip with pair row method of planting. Similar finding was reported by Hegde and Srinivas (1991).

V. Conclusion

It is clear from the study that the treatment T_4 (150 g N per plant applied through drip only) registered the maximum plant height and stem girth. It also resulted in early flowering and early maturity. The yield attributing characters like bunch length, number of hands per bunch, number of fingers per bunch, bunch weight per plant were also better under the same treatment. All these resulted into the production of maximum banana fruit yield (122.52 t ha^{-1}) under pair row planting method. The fruit quality parameters remained almost unaltered. Further, drip irrigation method saved 51 per cent water and 25 per cent nitrogen. Economically also it gave highest net profit (Rs. 3,90,167 ha^{-1}) with computing higher (1:14.78) cost benefit ratio during both the years of experimentation.

References References References

1. Arscott T. G. (1970) Nitrogen fertilization of banana (Musa cavendish Lambert.) through sprinkler irrigation system. Tropic. Agric. Trin., 47 (1): 17-22.
2. Hedge D.M. and Srinivas K. (1991). Growth, yield, nutrient uptake and water use of banana crops under drip and basin irrigation with N and K fertilization. Tropical Agriculture, 68 (4): 331-334.
3. Kohli R.R., Chacko E.K. and Randhawa G.S. (1976) Effect of spacing and nutritional levels on growth and fruit yield of Robusta banana. Indian J. Agric. Sci., 46 (8): 382-385.
4. Samson J.A. (1980) Tropical fruits Longmans, London. pp. 119-161.
5. Shmeuli E. (1953) Irrigation studies in the Jordan Valley. I. Physiological activity of banana in relation to soil moisture. Bull. Res. Counc. Israel, 3: 228-247.
6. Singh D.B. and Suryanarayana M.A. (1999) Response of Cavendish banana to different nitrogen levels and their split applications. J. Applied Hort. (Lucknow), 1 (2): 122-124.
7. Srinivas K. (1977) Growth, yield and quality of banana in relation to N fertigation. Tropical Agriculture, 74 (4): 260-264.
8. Young, S.C.H., Summis T.W. and Wu J.P. (1985) Banana yield as affected by deficit irrigations and pattern of lateral layouts. Trans. ASAE, 28: 507-510.

Table 1 : Effect of different levels of nitrogen on growth, flowering and harvest of banana cv. Grand Nain

Treatments	Plant height (cm)		Stem girth (cm)		No. of leaves		Leaf area (sq. cm)		Days to flowering	Days to harvest
	180 DAP*	At shooting	180 DAP*	At shooting	180 DAP*	At shooting	180 DAP*	At shooting		
T_1	99.77	165.09	40.94	67.12	15.20	24.27	0.449	0.87	358.30	455.66
T_2	100.90	157.33	42.36	66.75	15.20	24.61	0.470	0.84	349.28	445.72
T_3	96.16	158.22	40.71	64.98	15.30	24.37	0.433	0.85	360.83	452.72
T_4	103.80	162.06	43.93	68.58	15.70	24.73	0.479	0.87	336.70	431.27
T_5	100.80	164.20	42.92	68.16	15.86	24.86	0.471	0.87	353.48	449.21
T_6	105.22	159.22	43.66	66.97	15.83	24.75	0.486	0.85	340.52	439.78
T_7	100.08	161.50	42.60	68.36	15.37	24.86	0.452	0.87	351.05	448.78
T_8	100.53	163.09	42.50	68.51	15.67	24.75	0.472	0.86	344.33	441.28

© 2013 Global Journals Inc. (US)

T_9	100.64	159.08	41.63	66.62	15.33	24.83	0.456	0.85	350.39	452.53
T_{10}	83.67	157.86	35.10	65.05	14.91	23.91	0.361	0.82	393.42	486.77
S.Em. ±	2.98	3.07	1.16	1.12	0.232	0.25	0.022	0.02	8.24	7.81
C.D.@5%	8.43	NS	3.27	NS	NS	NS	NS	NS	26.37	24.97
C.V. %	7.89	2.48	7.78	2.75	4.25	1.95	9.21	2.91	2.68	2.16

* Days after planting

Table 2 : Effect of different levels of nitrogen on yield and yield parameters of banana cv. Grand Nain

Treatments	Bunch length (cm)	Bunch girth (cm)	No. of hands/ bunch	No. of fingers/ bunch	Bunch weight/ plant	Finger length (cm)	Finger girth (cm)	Weight of finger (g)	Days taken for ripening	Yield (t/ha)
T_1	57.67	104.22	8.53	131.61	17.35	20.16	11.99	120.76	10.63	108.47
T_2	55.80	98.55	8.74	135.14	16.55	18.63	11.19	112.40	9.80	103.47
T_3	56.48	100.67	8.77	129.36	16.41	19.15	11.53	114.32	10.75	102.55
T_4	60.05	106.43	8.97	147.41	19.60	20.29	12.10	118.78	9.58	122.52
T_5	59.88	102.22	9.01	148.24	18.87	19.50	11.70	112.77	9.97	117.96
T_6	58.32	100.73	8.97	139.16	17.82	19.07	11.47	114.77	9.57	111.39
T_7	59.49	103.11	9.09	141.36	17.97	19.28	11.61	111.90	10.02	112.32
T_8	58.97	102.23	8.91	142.85	17.33	19.54	11.75	114.46	9.43	108.34
T_9	56.02	101.96	8.69	133.33	16.81	19.17	11.56	115.27	9.72	105.09
T_{10}	53.96	99.03	8.10	118.95	13.90	19.18	11.82	106.14	11.12	86.87
S.Em. ±	1.07	2.57	0.13	4.95	0.76	0.63	0.27	4.57	0.35	4.77
C.D.@5%	3.18	NS	0.37	15.83	2.44	NS	NS	NS	0.99	15.27
C.V. %	4.92	2.59	4.06	6.05	8.19	2.14	1.62	4.63	9.59	8.19

Table 3 : Effect of different levels of nitrogen on economics of banana cv. Grand Nain

Treatments	Expenditure on fertilizers (Rs.)	Yield (t ha^{-1})	Gross income (Rs. ha^{-1})	Net profit (Rs. ha^{-1})	Cost benefit ratio (CBR)
T_1	23884	108.47	368798	344914	1:14.44
T_2	23884	103.17	351798	327914	1:13.73
T_3	23884	102.55	348670	324786	1:13.60
T_4	26401	122.52	416568	390167	1:14.78
T_5	26401	117.96	401064	374663	1:14.19
T_6	26401	111.39	378726	352325	1:13.35
T_7	28919	112.32	381888	352969	1:12.21
T_8	28919	108.34	368356	339437	1:11.74
T_9	28919	105.09	357306	328387	1:11.36
T_{10}	28919	86.87	295358	266439	1:9.21

* Price of urea, SSP and MOP were considered Rs. 3.71, Rs. 3.07 and Rs. 3.88 kg^{-1}, respectively

* Market price of banana fruit was considered Rs. 3.40 kg^{-1} (Rs. 3400 t^{-1})

* As per recommendation, 90 g phosphorus and 200 g potash were applied as common in each treatment

© 2013 Global Journals Inc. (US)

Global Journal of Science Frontier Research
Agriculture and Veterinary
Volume 13 Issue 8 Version 1.0 Year 2013
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Comparison of Microbial Load Associated with Smoked Fish *(Chrysichthys Nigrodigitatus)* from Oyan Lake and Ogun Waterside in Ogun State, Nigeria

By Adelaja, Olusunmbo Adeolu, Olaoye, Olalekan Jacob, Ikenweiwe Nofisat Bolatito & Ashley-Dejo. Samuel, Segun
Federal University of Agriculture, Nigeria

Abstract - This study compares the microbial load associated with smoked fish (Chrysichthys nigrodigitatus) from Oyan lake and Ogun waterside in Ogun State. Three samples each were purchased from Lafenwa and Makun-omi markets respectively. Microbial load in the skin, intestine and gills were assessed using Mac-conky Agar (MA), and Nutrient Agar (NA) to isolate bacteria while Sabouraud Dextrose Agar (SDA) was used to isolate fungi. The average bacterial counts for all the samples ranged from 3.1 $x10^6$ to 4.9 $x10^6$ in makun market while 6.8 $x10^6$ to 13.8 $x10^6$ in lafenwa market has the highest bacteria count. The microorganism isolated and identified in the markets include the following families of bacteria: Bacillus spp (10%, 10%), Micrococcus spp (10%, 10%), Staphylococcus saprophyticus (5%, 10%), Escherichia coli (10%, 15%) and Staphylococcus aureus (5%, 10%) of which Staphylococcus saprophyticus, Escherichia coli and Staphylococcus aureus percentage occurrence rate were higher in lafenwa market.

Keywords : chrysichthys nigrodigitatus, smoked fish, microbial load, health.

GJSFR-D Classification : FOR Code: 670103, 630399p

COMPARISON OF MICROBIAL LOAD ASSOCIATED WITH SMOKED FISH CHRYSICHTHYS NIGRODIGITATUS FROM OYAN LAKE AND OGUN WATERSIDE IN OGUN STATE, NIGERIA

Strictly as per the compliance and regulations of :

© 2013. Adelaja, Olusunmbo Adeolu, Olaoye, Olalekan Jacob, Ikenweiwe Nofisat Bolatito & Ashley-Dejo. Samuel, Segun. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Comparison of Microbial Load Associated with Smoked Fish *(Chrysichthys Nigrodigitatus)* from Oyan Lake and Ogun Waterside in Ogun State, Nigeria

Adelaja, Olusunmbo Adeolu [α], Olaoye, Olalekan Jacob [σ], Ikenweiwe Nofisat Bolatito [ρ] & Ashley-Dejo. Samuel, Segun [ω]

Abstract - This study compares the microbial load associated with smoked fish (Chrysichthys nigrodigitatus) from Oyan lake and Ogun waterside in Ogun State. Three samples each were purchased from Lafenwa and Makun-omi markets respectively. Microbial load in the skin, intestine and gills were assessed using Mac- conky Agar (MA), and Nutrient Agar (NA) to isolate bacteria while Sabouraud Dextrose Agar (SDA) was used to isolate fungi. The average bacterial counts for all the samples ranged from 3.1 $x10^6$ to 4.9 $x10^6$ in makun market while 6.8 $x10^6$ to 13.8 $x10^6$ in lafenwa market has the highest bacteria count. The microorganism isolated and identified in the markets include the following families of bacteria: Bacillus spp (10%, 10%), Micrococcus spp (10%, 10%), Staphylococcus saprophyticus (5%, 10%), Escherichia coli (10%, 15%) and Staphylococcus aureus (5%, 10%) of which Staphylococcus saprophyticus, Escherichia coli and Staphylococcus aureus percentage occurrence rate were higher in lafenwa market. The fungal family include; Fusarium spp (14.3%, 28.6%), Mucor spp (14.3%, 28.6%) and Aspergillus fumigatus (0.0%, 14.3%). The results therefore showed that smoked fish from Oyan lake were heavily contaminated than that of Ogun waterside when compared with the maximum recommended bacteria count for good quality product and this has effect on human health after consumption. The contamination of the surrounding environment with industrial and domestic waste should be controlled as well as ensure proper handling of fish. The health implication to consumers and the public health importance was also revealed in the study.

Keywords : chrysichthys nigrodigitatus, smoked fish, microbial load, health.

I. Introduction

Fish is a major source of protein and its harvesting, handling, processing and distribution provide livelihood for millions of people. It is the most important animal protein food available in the tropics, and it represents about 14% of all animal protein on a global basis, (Abolagba and Mella, 2008). Fish is eaten fresh, preserved or processed (smoked) and form a much-cherished delicacy that cuts across socio-economic, age, religious and educational barriers (Adebayo-Tayo *et al.,* 2008).

Fish is soft and easily damaged; therefore rough handling and bruising results in contamination of fish flesh. Fish will become unfit for human consumption within about one day of capture, unless it is subjected to some form of processing or preservation. Even after the fish has been processed, particularly if traditional methods have been used, the fish is still subject to many forms of loss and spoilage (Shewan, 2000). The microbial flora associated with freshly harvested fish is principally a function of the environment in which the fish are caught and not of the fish species; hence, the indigenous microbial populations of fish can vary significantly (Shewan, 2000). Fish, because of their soft tissues and aquatic environment are extremely susceptible to microbial contamination. Millions of bacteria, many of them potential spoilers, are present in the surface slime, on the gills and in the intestines of live fish, although the flesh itself is normally sterile. Bacterial growth and invasion on the fish are prevented by the body's natural defence system during life but after death the defence system breaks down and the bacteria multiply and invade the flesh. And also immediately fish dies, it remains in first class quality only for a short while (Clucas and Ward, 1996). However, spoilage soon sets in which is occasioned by an increase in the ambient temperature that triggers favourable conditions for microorganisms to strive.

According to (Aberoumand, 2010), *Escherichia coli* is a classic example of enteric bacteria causing gastroenteritis. *E coli* including other coliforms and bacteria as *Staphylococcus spp* and sometimes enterococci are commonly used as indices of hazardous conditions during processing of fish. Scientists have shown that the contamination of food of fish origin with pathogenic *E. coli* probably occur during handling of fish and during the production process (Jimoh *et al.,* 2009). The microorganisms associated with smoked fish pose a great threat to the populace as the transfer of the microorganisms attack the immune

Authors α ρ ω: Department of Aquaculture and Fisheries Management, Federal University of Agriculture, P.M.B 2240, Abeokuta, Ogun State, Nigeria. E-mail : adeolu247@yahoo.com
Author σ : Agricultural Media Resources and Extension Centre, Federal University of Agriculture, P.M.B 2240, Abeokuta, Ogun State, Nigeria.

© 2013 Global Journals Inc. (US)

system of the consumer, usually man, thereby, giving room for the invasion of disease.

II. Materials and Methods

a) Sample Collection

Three samples each of smoked fish (*Chrysichthys nigrodigitatus*) were purchased from major market (Lafenwa and Makun-omi) of fish processors from Oyan lake and Ogun waterside in Ogun state, Nigeria. A total of six (6) samples of smoked *Chrysichthys nigrodigitatus* were purchased and collected with a sterile aluminium foil (3 smoked *Chrysichthys nigrodigitatus* from each location) and samples were transported to the Veterinary Microbiology Laboratory, Federal University of Agriculture, Abeokuta in a well covered ice cold cooler for analysis and these samples were labelled; OL1, OL2, OL3, OW1, OW2, OW3. A sterile scalpel was used to cut a large portion of the skin and flesh of the fish in a sterile container and analysed for bacteria and fungi.

b) Microbiological Analysis

The samples were analyzed for Total Plate Count (TPC), Total Coliform Count (TCC), occurrence of bacteria and fungi and identification of bacteria and fungi.

c) Sample Preparation

One gram of the fish sample for microbiological evaluation was weighed into 9ml of sterile water in the bijou bottle. This was done for samples gotten from each location and was taken as the original stock sample of each market location. One millimeter of the original stocks solution was transferred into 9ml of sterile distilled water and mixed thoroughly to give 10^{-2} dilution of the original sample and this was done for each market sample and the bottles were labelled: S1(10^{-1}), S1(10^{-2}), S2(10^{-1}), S2(10^{-2}).....S6(10^{-1}), S6(10^{-2}). The serial dilution was carried out using a sterilized micropipette from tube one to the last tube. The NA, PDA and MA were prepared according to manufacturer instruction and sterilized using autoclave for 15 minutes at 121^0 C. It was then removed and allowed to cool before it was poured into plates. The plates were then allowed to set, after which one millimetre of the serial diluted sample of 10^{-8} dilution was inoculated on the surface of the well dried NA, PDA and MA and gently swirled to completely spread. The inoculated NA and MA plates were incubated at 37°C for period of 18-24 hours while the PDA was incubated at room temperature for 5 days. Each bacteria isolates obtained was counted and estimated according to method of Miles and Mistra (Baker and Beach, 2000) while the fungi colonies were also counted and estimated.

d) Estimation of bacteria total count according to Hedges (2002)

To 90ml of sterile water was homogenized 10g of the fish sample to make 1/10 dilution, while 9ml of sterile water was put in 8 sterile test tubes and serial dilution of the homogenized samples was made to the 8th tube. One ml was discarded from the 8th tube and 1ml of the dilution was spread on well dried Nutrient agar. It was allowed to dry and incubated at 37^0C for 18 – 24 hours. Bacteria colonies seen were counted and estimated accordingly.

e) Estimation of fungi total count according to Hedges (2002)

To 90ml of sterile water was homogenized 10g of the fish sample to make 1/10 dilution, while 9ml of sterile water was put in 5 sterile test tubes and serial dilution of the homogenized samples was made to the 5th tube. 1ml was discarded from the 5th tube and 1ml of the dilution was spread on well dried Sabouraud Dextrose agar. It was allowed to dry and incubated at room temperature for 5 days. Fungi colonies seen were counted and estimated accordingly.

f) Bacteria identification according to Monical (1996)

Homogenized fish sample was cultured on Blood agar and MacConkey agar using sterile wire loop and incubated at 37^0C for 18 to 24 hours in aerated condition. Colonies seen were purify on nutrient agar and their colonial morphology such as shape, colour, consistency, edges, elevation, pigmentation and hemolysis were individually examined.

g) Biochemical Test

Each bacteria colony was identified by their Gram stain and biochemically characterized by their sugar fermentation test, coagulase, catalase, indole, citrate, oxidase, H_2S production and urea.

III. Results

Table 1 shows the average bacteria count obtained from the skin of smoked *Chrysichthys nigrodigitatus* from Makun-omi market (Ogun waterside) was 3.1×10^6 while the mean count for intestine was 4.9 $\times10^6$ and the gill recorded average microbial count of 4.2×10^6cfu/g. The average bacteria count obtained from the skin, intestine and gill of smoked *Chrysichthys nigrodigitatus* from Lafenwa market (Oyan lake) were 13.8×10^6, 10.7×10^6 and 6.8×10^6cfu/g respectively. The result showed that bacteria load obtained from the smoked fish (*Chrysichthys nigrodigitatus*) in Oyan lake were higher than the recommended value but fell within range in Ogun waterside. Table 2 shows the average fungi count obtained from smoked *Chrysichthys nigrodigitatus* while Table 3 and 4 revealed the results of percentage of occurrence of bacteria and fungi in smoked *Chrysichthys nigrodigitatus.* Table 5 and 6 shows the cultural and morphological characteristics of bacteria and fungi isolates while Table 7 revealed the biochemical test used in characterization of the bacteria isolates from smoked fish (*Chrysichthys nigrodigitatus).*

© 2013 Global Journals Inc. (US)

Table 1 : The average bacterial count in the fish samples

Location and fish specie	Body parts	Average Bacterial Count (X 10^6CFU/g)
OW *(Chrysichthys nigrodigitatus)*	Skin	3.1
	Intestine	4.9
	Gill	4.2
OR *(Chrysichthys nigrodigitatus)*	Skin	13.8
	Intestine	10.7
	Gill	6.8

KEY: CFU/g= colony forming unit per gram.

Table 2 : Average fungi count in the fish samples

Location and fish specie	Body parts	Average FungiCount (X 10^6CFU/g)
OW *(Chrysichthys nigrodigitatus)*	Skin	0.0
	Intestine	0.2
	Gill	0.0
OR *(Chrysichthys nigrodigitatus)*	Skin	0.3
	Intestine	0.3
	Gill	0.0

KEY: CFU/g= colony forming unit per gram.

Table 3 : Percentage occurrence of bacteria in the fish samples (*Chrysichthys nigrodigitatus*)

Locations	Isolate	Number	Percentage (%)
Ogun waterside	*Bacillus spp*	2	10.0
	Staphylococcus saprophyticus	1	5.0
	Micrococcus spp	2	10.0
	Escherichia coli	2	10.0
	Staphylococcus aureus	1	5.0
Oyan lake	*Bacillus spp*	2	10.0
	Staphylococcus saprophyticus	2	10.0
	Micrococcus spp	2	10.0
	Escherichia coli	3	15.0
	Staphylococcus aureus	3	15.0

Table 4 : Percentage occurrence of fungi in the fish samples (*Chrysichthys nigrodigitatus*)

Locations	Isolate	Number	Percentage (%)
Ogun waterside	*Fusarium spp*	1	14.3
	Mucor spp	1	14.3
	Aspergillus fumigatus	0	0.0
Oyan lake	*Fusarium spp*	2	28.6
	Mucor spp	2	28.6
	Aspergillus fumigatus	1	14.3

© 2013 Global Journals Inc. (US)

Table 5 : Cultural and morphological characteristics of bacteria in the fish samples (*Chrysichthys nigrodigitatus*)

Suspected isolates	Morphology	Microscopic
Bacillus spp	Creamy white, raised with rough edges	Gram positive bacilli
Staphylococcus saprophiticus	Creamy, slightly raised with smooth edges	Gram positive cocci in cluster
Micrococcus spp	Creamy deep yellow, slightly raised with smooth edges	Gram positive cocci
Eschericia coli	Whitish, raised with rough edges	Gram negative bacilli
Staphylococcus aureus	Golden yellow, slightly raised with smooth edges	Gram positive cocci in cluister

Table 6 : Cultural and morphological characteristics of fungi in the fish samples (*Chrysichthys nigrodigitatus*)

Suspected isolates	Morphology	Microscopic
Fusarium spp	Whitish cotton aerial	Elongated ovoid curved microconidia
Mucor spp	Yellow-white fluffy strand with brown reverse side	Hyphae without rhizoids, dispersed, branched, large globose sporangiophore
Aspergillus fumigates	Creamy yellow filamentous colonies	Large/globose conidiphore, loose columna with biseriated hypha

Table 7 : Biochemical test of the bacteria isolated from the fish samples (*Chrysichthys nigrodigitatus*)

GRAM	MOTILITY	GLUCOSE	LACTOSE	MANNITOL	MALTOSE	INDOLE	METHYL RED	VOGUES PROKAMER	CITRATE	H_2S	SUCROSE	UREA	OXIDASE	COAGULASE	CATALASE	ORGANISM ISOLATED
-	+	+	+	+	+	+	+	-	-	-	N/A	-	--	N/A	+	*Escherichia coli*
+	+	+	+	+	+	-	-	+	-	-	+	-	-	N/A	+	*Bacillus spp*
+	-	+	+	+	+	N/A	+	-	N/A	N/A	+	N/A	+	-	+	*Micrococcus spp*
+	N/A	+	+	+	+	N/A	`-	+	N/A	N/A	+	-	-	+	+	*Staphylococcus aureus*
+	N/A	+	+	+	+	N/A	-	+	N/A	N/A	+	-	+	+	+	*Staphylococcus saprophyticus*

KEY:
- : NEGATIVE
+ : POSITIVE
N.A : NOT APPLICABLE

IV. Discussion

This study shows that pathogenic bacteria and fungi are present in smoked *Chrysichthys nigrodigitatus* in Lafenwa and Makun-omi markets in Ogun State. According to International Commission on Microbiological Specification for Food (ICMSF, 1986), the maximum recommended bacteria count for good quality product is 5.0×10^5 (5.7Log cfu/g). The bacteria load obtained from the smoked fish (*Chrysichthys nigrodigitatus*) in Oyan lake was higher than the recommended value lake but fell within range in Ogun waterside. Bacteria present in the fish samples include, *Bacillus spp, Staphylococcus saprophiticus, Micrococcus spp, Eschericia coli* and *Staphylococcus aureus.* The occurrence of *Staphylococcus aureus* and *Eschericia coli* in the smoked-dried fish samples were in accordance with Martin (1994) when he stated that these organisms were the commonest micro-organisms associated with smoked fish. The presence of *Staphylococcus aureus* in fish samples according to Okonko *et al.* (2008) might have been through contamination by handling.

The bacteria group of *Staphylococcus aureus* according to Herman *et al.* (2011) reported that it was one of the most common causes of human disease and they constitute the normal flora of the human skin and mucous membrane without resulting in a diseased

© 2013 Global Journals Inc. (US)

condition. This bacteria class may also cause superficial and systemic infections such as boils, impetigo and folliculitis while more serious and more common infections could be pneumonia, bacteremia and other infections of the bones and wounds. Also, *Eschericia coli* usually cause diarrhea and kidney damage as well as uncomplicated community acquired urinary tract infections. The fungi present in the fish samples are *Fusarium spp, Mucor spp* and *Aspergillus fumigatus.* It was observed in this study that the presence of fungi particularly aflatoxigenic molds in these fish specie is very significant as it was indicated by food safety standard that aflatoxigenic molds produce mycotoxins which have pathogenic effects on man; it destroys the liver and kidney resulting to death. The presence of the organisms could be as a result of handling during smoking and also cross contamination during storage, after smoking and handling during sales of smoked fish.

V. Conclusion

In conclusion, smoked fish (*Chrysichthys nigrodigitatus*) from Lafenwa market were heavily contaminated with many bacteria species including members of the genera *Escherichia* and *Staphylococcus* due to the greater unhygienic conditions of the environment than Makun-omi market. The public health concern of smoked *Chrysichthys nigrodigitatus* is therefore the poor handling and processing either by the processors, marketers or the consumers. This has greatly contributed to the contamination of these products by various pathogenic micro organisms which make their consumption hazardous to health.

VI. Recommendation

Environmental sanitation education and orientation should be organized for fish processors; this will enable them to reduce the unattractive environment that makes their operations smelly and repulsive. The relevant national and municipal authorities must ensure improve quality of smoked fish to safeguard public health and enhance food safety in the country.

References References References

1. Aberoumand, A. (2010). Estimation o Microbiological Variations in Minced Lean Fish Products. *World Journal of Fish and Marine Sciences* 2(3): 204 – 207.
2. Abolagba, O.J. and Melle, O.O (2008). Chemical composition and keeping qualities of a Scaly Fish Tilapia (*Oreochromis niloticus*) Smoked with two Energy Sources. *African J. Gen. Agric.,* KLOBEX, 4(2): 113-117.
3. Adebayo-Tayo, B. C, A.A. Onilude and U.G. Patrick, (2008). Mycoflora of Smoke-dried Fishes Sold in Uyo, Eastern Nigeria. *World J. Agric Sci.* Pp23
4. Clucas, I.J. and Ward, A.R (1996): Post Harvest Fisheries Development. A Guide to Handling, Preservation, Processing and Quality. Chatham Maritime, Kent ME4TB, United Kingdom. pp: 665.
5. Hedges, A. J. 2002. Estimating the precision of serial dilution and viable bacteria count. *Int. Jour. Of Food Microbiology*, 76(3): 207 – 214.
6. Herman, H. H., W. Lin, P. J. Petrecca, M. R. Simmons and J. Houghton 2011. Centrifugal Bioreactors and their application in remediations. *Remediation Journal* 11(4): 15 – 33.
7. Martins, A.M. (1994). Fisheries Processing: Biochemical Applications. Published by Chapman and Hall, London. pp: 1-88.
8. Okonko, T.A, Ogunnusi, A.A, Ogunjobi, A.O, Adedeji, O.D, Adejoye, E.T, Babalola and Ogun, A.A (2008): Microbial Studies on Frozen Shrimps Processed in Ibadan and Lagos, Nigeria. Scientific Research 3: 543-545.
9. Shewan, J.M. (2000). The Microbiology of Sea Water Fish. In Fish as Food. Ed by G.Borgstrom,.1 New York Academic press., pp: 487.

© 2013 Global Journals Inc. (US)

This page is intentionally left blank

© 2013 Global Journals Inc. (US)

Global Journal of Science Frontier Research
Agriculture and Veterinary
Volume 13 Issue 8 Version 1.0 Year 2013
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Variability of Soil Thermal Properties of a Seasonally Cultivated Agricultural Teaching and Research Farm, University of Ibadan, South- Western Nigeria

By Oladunjoye, M.A., Sanuade, O.A. & Olaojo, A.A.
University of Ibadan, Ibadan

Abstract - Knowledge of the thermal properties of the soil top layer is of great importance in agricultural meteorology where problems of heat exchange at the soil surface are encountered. The availability of these data is important because of the improvements in wider applications of soil heat and water transport models as well as seed germination and crop growth. This research work therefore intends to determine the variability of soil thermal properties of a seasonally cultivated Agricultural Teaching and Research Farm located within the University of Ibadan campus, South-western Nigeria with a view to have understanding of how different soils warm up in order to allow better planning of planting of crops and have knowledge for the control of thermal-moisture regime of soil in the field and greenhouse.

Forty-five points were located for the measurements of thermal properties in cultivated fields of maize, pineapple, cowpea, Okro and vegetables. A *KD-2 Pro* thermal analyzer was used for the measurements of these thermal properties such as thermal conductivity, thermal resistivity, volumetric specific heat and thermal diffusivity.

Keywords : variability, thermal properties, moisture content, bulk density, agricultural farm, seed germination.

GJSFR-D Classification : FOR Code: 079999, 050303, 970107

VARIABILITY OF SOIL THERMAL PROPERTIES OF A SEASONALLY CULTIVATED AGRICULTURAL TEACHING AND RESEARCH FARM, UNIVERSITY OF IBADAN, SOUTH- WESTERN NIGERIA

Strictly as per the compliance and regulations of :

© 2013. Oladunjoye, M.A., Sanuade, O.A. & Olaojo, A.A. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Variability of Soil Thermal Properties of a Seasonally Cultivated Agricultural Teaching and Research Farm, University of Ibadan, South-Western Nigeria

Oladunjoye, M.A. [α], Sanuade, O.A. [σ] & Olaojo, A.A. [ρ]

Abstract - Knowledge of the thermal properties of the soil top layer is of great importance in agricultural meteorology where problems of heat exchange at the soil surface are encountered. The availability of these data is important because of the improvements in wider applications of soil heat and water transport models as well as seed germination and crop growth. This research work therefore intends to determine the variability of soil thermal properties of a seasonally cultivated Agricultural Teaching and Research Farm located within the University of Ibadan campus, South-western Nigeria with a view to have understanding of how different soils warm up in order to allow better planning of planting of crops and have knowledge for the control of thermal-moisture regime of soil in the field and greenhouse.

Forty-five points were located for the measurements of thermal properties in cultivated fields of maize, pineapple, cowpea, Okro and vegetables. A *KD-2 Pro* thermal analyzer was used for the measurements of these thermal properties such as thermal conductivity, thermal resistivity, volumetric specific heat and thermal diffusivity. Samples were collected at each location for the laboratory determination of soil moisture content and bulk density. The variability of soil thermal properties was analysed using classical statistics such as mean, range, standard deviation and coefficient of variation.

The results show that for the whole site, the thermal conductivity, volumetric specific heat, thermal diffusivity and temperature ranges from 1.103-2.151 W/mK, 1.247-2.936 mJ/m^{3}K, 0.486-1.000 mm^2/s and 23.83-34.49 ºC with mean values of 1.672 W/mK, 1.831 mJ/m^{3}K, 0.785 mm^2/s and 27.71 ºC respectively. Also soil moisture content and bulk density ranges from 0.146-0.223 m^{3}m^{-3} and 1.260-1.410 mg/m^3 with an average of 0.191 m^{3}m^{-3} and 1.340 mg/m^3 respectively.

It was found out that the thermal properties of agricultural soils within University of Ibadan vary from one point to the other and the variations are related to soil moisture content and bulk density which would have significant effects on plant germination and growth. This implies that knowledge of the thermal-moisture regime of soils is quite essential for better planning in agriculture.

Keywords : variability, thermal properties, moisture content, bulk density, agricultural farm, seed germination.

Authors α σ ρ : Department of Geology, University of Ibadan, Ibadan. E-mail : sheunsky@gmail.com

I. Introduction

Soil thermal properties are required in many areas of engineering, agronomy, and soil science, and in recent years considerable effort has gone into developing techniques to determine these properties. The thermal properties of soil are one of the factors that determine mass and energy exchange that takes place in soil-plant-atmosphere system. The determination of these properties such as thermal conductivity, thermal diffusivity and volumetric heat capacity, and their variability is therefore a very important factor in understanding these processes at an individual scale of crop field and larger areas. The investigation of these thermal properties can have significant practical consequences such as evaluation of optimum conditions for plant growth and development and can also be utilized for the control of thermal-moisture regime of soil in the field (Usowicz, 1991). Seed germination, seedling emergence, and subsequent stand establishment are influenced by the microclimate. Thermal properties of soils play an important role in influencing microclimate (Ghuman and Lal, 1985). These properties influence how energy is partitioned in the soil profile. The ability to monitor soil thermal properties is an important tool in managing the soil temperature regime to affect seed germination and growth. While related to soil temperature, it is more accurately associated with the transfer of heat throughout the soil, by radiation, conduction and convection. Plants processes such as root growth or germination do not occur until the soil reaches certain temperature depending on the particular plant. Another plant process adversely affected by cold temperature is transport of nutrients and water. A better understanding of how different soils warm up would benefit agriculture by allowing for better planning of planting of crops.

The use of a thermal probe called KD 2 Pro has made it possible to measure the thermal properties of soil (in-situ) as well as its spatial variability. Thermal properties and physical properties of soil in cultivated fields are modified by different treatments and crops. Hence the variability of thermal properties may be

© 2013 Global Journals Inc. (US)

different for an individual field with the growth of a specific crop compared with a group of fields with different crops.

For the agriculture farm within the premises of University of Ibadan, information on thermal properties has been lacking. These data are needed for constructing models to predict the thermal regime of soils. Such information assumes greater importance with increasing attention paid to developing the agricultural industry in University of Ibadan and its environs. Since the early growth and development of a crop may be determined to a large extent by microclimate, the practical significance of knowing the thermal properties of soils under a given set of conditions is most important.

This study therefore aims at determining the thermal properties of agricultural farm with different crops within University of Ibadan campus in order to establish the variability of thermal conductivity, thermal diffusivity and volumetric specific heat of soil as well as to investigate the distribution of soil water content and bulk density and its consequences on the variability of a particular thermal properties.

II. Site Description

The study area is a Teaching and Research Farm for undergraduate and postgraduate students of Faculty of Agriculture and Forestry located within the University of Ibadan campus between longitudes 07° 26' 00" to 07° 27' 30" and latitudes 03° 53' 00" to 03° 54' 30". (Figure 1). Different plants such as maize, pineapple, cowpea, okro and vegetables are cultivated on each farm land. The farm land has been in use for the past twenty years.

III. Method of Study

The thermal properties of soils in Teaching and Research Farm were determined using KD2 Pro (Plate 1). The KD2 Pro is a fully portable field and laboratory thermal properties analyzer. It uses the transient line heat source method to measure the thermal diffusivity, specific heat (heat capacity), thermal conductivity, and thermal resistivity. Sophisticated data analysis is based on over thirty years of research experience on heat and mass transfer in soils and other porous materials.

To measure the thermal resistivity, thermal sensor with one single needle (TR-1) (Plate 2) was employed. A small dual-needle sensor (SH-1) (Plate 3) was used to measure the thermal diffusivity and volumetric specific heat. These kind of sensors use the heat pulse methodology and yields reliable soil thermal resistivity (R) and the inverse thermal conductivity (λ), thermal diffusivity and volumetric specific heat estimations by a nonlinear least squares procedure during both processes.

The SH-1 is the only sensor that measures thermal diffusivity and specific heat. It is 30mm long, 1.28mm in diameter with 6mm spacing. TR-1 is a 10cm Sensor that measures thermal conductivity and thermal resistivity and conforms to IEEE Standard 442-1981 and ASTM Standard D5334-00. It is 100mm long and 2.4mm diameter

IV. Field Procedures

The first step to develop a protocol to measure the thermal properties begins with the field sampling design. The measurements include scooping of the top surface of the ground and verification and preparation of the thermal sensor (calibration) using standard glycerol in order to check whether it was functioning properly (Rao and Singh, 1999; Krishnaiah, 2003). The thermal sensor to be used was then selected. The needle was positioned with respect to the scooped ground. Thermal diffusivity and volumetric specific heat were then measured by using the thermal sensor SH-1 while thermal resistivity and its inverse were measured with TR-1. To take measurements with the KD2 Pro; appropriate sensor was attached and the KD2 Pro was turned on; sensor was properly inserted into the material to be measured (for the dual needle sensor, the needles must remain parallel to each other during insertion); when the KD2 Pro turns on, one should be in the Main Menu, press enter to begin the measurement. Then the instrument was allowed to rest for about fifteen minutes before taking the next readings.

Forty-five sample points (Figure 2) were tested for various thermal properties while samples were collected at these points to determined the moisture content and soil bulk density in the laboratory. The samples were kept in polythene bags and stored in a cool dry place before the necessary tests were carried out on them. The variabilities of these soil thermal properties were analyzed using classical statistics such as mean and extreme values, standard deviation and coefficient of variability.

V. Laboratory Procedures

a) *Moisture Content*

The standard reference used for the determination of moisture content was AASTHO T 265. A representative test specimen of about 300g was selected. The tare mass of a clean, dry container and lid, was determined and recorded as WC. Moist specimen was placed in the container and the lid was secured onto the container. The mass of the container, lid, and moist specimen was determined and recorded as W_1. The lid was then removed and the container was placed with the sample in the drying over for about 17 hours for the material to be dried to a constant mass. The container was then removed from the oven and the lid was replaced firmly. The material and container was

© 2013 Global Journals Inc. (US)

allowed to cool to room temperature. The mass of the container, lid, and dried specimen was measured and recorded as W_2.

The calculations are as follow:

Mass of the Water:

$Ww = W_1 - W_2$

Mass of the Solid Particle:

$Ws = W_2 - Wc$

Moisture Content (%):

$M_C = 100(Ww/Ws)$

Where:

Wc = mass of container and lid, g

W_1 = mass of container, lid, and moist specimen, g

W_2 = mass of container, lid, and oven-dried specimen, g.

b) Bulk Density

i. *Procedure*

a. The weight of a 25 mL graduated cylinder was determined. (Note: 1 mL = 1 cm^3)
b. the 25 mL was filled to the mark, by adding ~5 mL additions of soil and tapping lightly to pack the soil. (Vt for soil = 25 cm^3)
c. the weight of the graduated cylinder + soil and by difference the weight of the soil were determined. The soil's weight was corrected for moisture content.
d. A 100 mL graduated cylinder with tap water was filled to the 50 mL mark. The soil was quantitatively transferred from the 25 mL graduated cylinder to the water and was stirred to expel the air. It was allowed to stand for ~ 5 minutes.
e. The change in volume resulting from the addition of the soil was noted (Vs = volume change i.e volume after adding soil and stirring - 50 mL)

Calculations

Bulk density

ρ_b = OD wt/Vt

Vt = 25 cm^3

OD = Oven-dry weight OD wt = air-dry weight/(1 + water content)

Volume of solids (Vs) = (volume of soil + water) - (volume of water)

VI. Results and Discussion

a) Thermal Properties

i. *Thermal Conductivity*

For the whole site, the values of thermal conductivity range from 1.103 - 2.151 W/mK (Table 1) with a mean of 1.488 W/mK. Figure 3 shows the variation of thermal conductivity within the whole study site that comprises maize, pineapple, cowpea, okro and vegetable fields. It could be observed from the figure that there are much variations in thermal conductivity from one point to the other. Figures 4 and 5 also show the variation of soil moisture content and soil bulk density from one point to the other. The variation of thermal conductivity from one point to another may be as a result of variation in soil moisture content and bulk density [(Oladunjoye and Sanuade, 2012a; Rubio et al. (2009) and Singh and Devid (2000)]. However the plots of thermal conductivity against moisture content and soil bulk density shows a positive correlation with moisture content having the highest value of correlation coefficient (R = 0.4) (Figure 6A and 6B).

Considering individual fields, the thermal conductivity values of maize, pineapple, cowpea and okro+vegetable fields ranged from 1.103 - 2.015 W/mK, 1.777 - 2.151 W/mK, 1.183 - 1.873 W/mK and 1.354 - 1.920 W/mK with average values of 1.581 W/mK, 2.021 W/mK, 1.494 W/mK and 1.620 W/mK respectively (Tables 2, 3, 4, and 5). However, these variations from one field to another may be as a result of variations in soil moisture content [(Figure 8A -D) and soil bulk density (Figure 9A-D)]. From Figure 8A-D, it could be observed that there are strong positive correlations between soil moisture content and thermal conductivity in all fields with R = 0.98, 0.91, 0.92 and 0.83 for maize, pineapple, cowpea and okro+vegetable fields respectively (Ghuman and Lal, 1985; Brandon and Mitchell, 1989; Salomone et al, 1984; Salomone and Marlowe, 1989; Salomone and Kovacs, 1984; IEEE, 1998; Adjepong, 1997; Rubio et al, 2009; Singh and Devid, 2000; Oladunjoye and Sanuade, 2012a). Also there are positive correlations between thermal conductivity and soil bulk density (Zhang and Liu, 2006) with values of R^2 being smaller than that of soil moisture content (Figure 9A-D). This therefore means that the distribution of thermal conductivity in all fields was determined mainly by soil moisture content and partly by soil bulk density. High thermal conductivity ensures movement of heat into the ground. Interestingly, soils with lower thermal conductivity retain more heat than those with higher thermal conductivity once the sun goes down. Therefore, a balance neither too high nor too low is necessary to ensure proper conditions for seed germination and emergence (Alex Tan, 2013). From the thermal conductivity values of all the fields, it could be observed that the values are moderate which range from 1.103 – 2.151 W/mK. (Standard *Range of measurement is 0.02 – 4 W/mK*).

ii. *Thermal Diffusivity*

For the whole study sites, the values of thermal diffusivity ranges from 0.439 - 1.000 mm^2/s (Table 1, Fig. 10) with an average of 0.785 mm^2/s. There are variations in thermal diffusivity values from one point to another. However, the plots of thermal diffusivity against soil

© 2013 Global Journals Inc. (US)

moisture content and bulk density show positive correlations with R^2= 0.81 and 0.79 respectively (Figs. 11 & 12). This could mean that both soil moisture content and bulk density are contributing to the variation of thermal diffusivity in the whole study site. For the individual fields, the thermal diffusivity of maize, pineapple, cowpea and okro+vegetable fields have range of values from 0.605 - 0.925 mm^2/s, 0.740 - 1.000 mm^2/s, 0.486-0.740 mm^2/s and 0.820 - 0.990 mm^2/s with mean values of 0.768 mm^2/s, 0.868 mm^2/s, 0.578 mm^2/s and 0.878 mm^2/s respectively (Tables 2, 3, 4, and 5). Plots of soil moisture content against thermal diffusivity in all the fields (Figure 13A-D) show a moderate positive correlations except in cowpea field with relatively high positive correlation (Ghuman and Lal, 1985; Adjepong, 1997; Verhoef et al,1996 and Rubio et al, 2009.

As shown in Figure 14 A-D, there are positive correlations between soil bulk density and thermal diffusivity in all the fields (Oladunjoye and Sanuade, 2012b). It could be observed that R^2 values in the relationship between thermal diffusivity and soil moisture content and bulk density are relatively high. This suggests that the distribution of thermal diffusivity in all the fields were controlled by both soil moisture and soil bulk density. High thermal diffusivity in soils favour root growth (Rodrigo et al., 2009). High thermal diffusivity will allow proper transport of nutrients and water. From the above results, it could be noted that the thermal diffusivity for all the fields ranged from moderate to high with fields that contained pineapple and okro+vegetable being the fields with the highest thermal diffusivity. This means that soils that contained pineapple and okro+vegetable will favour root growth than those that contained maize and cowpea.

iii. *Volumetric Specific Heat*

For the whole study site, volumetric specific heat ranges from 1.247 - 2.936 J/m^{3}K (Table 1) with a mean of 1.831 J/m^{3}K. From Figure 15, it could be observed that there are variations in the volumetric specific heat in the whole study site from one point to the other. These variations could be as a result of soil moisture content or bulk density (Oladunjoye and Sanuade, 2012b). From both Figures 16 and 17, weak positive correlation exists between volumetric specific heat and soil moisture content and bulk density. Considering individual fields, volumetric specific heat values ranged from 1.605 - 1.980 J/m^{3}K, 1.522 - 1.822 J/m^{3}K, 1.247 - 1.645 J/m^{3}K and 1.887 - 2.936 J/m^{3}K with average values of 1.727 J/m^{3}K, 1.684 J/m^{3}K, 1.515 J/m^{3}K and 2.208 J/m^{3}K for maize, pineapple, cowpea and okro + vegetable fields respectively (Tables 2, 3, 4, and 5). The variation of volumetric specific heat with soil moisture contents and bulk density were determined.

From Figures 18A-D and 19A-D , it could be observed that the relationships between soil moisture content and volumetric specific heat are relatively higher than that of soil bulk density and volumetric specific heat. This suggests that the distribution of volumetric specific heat in all the fields were controlled by soil moisture content. Volumetric specific heat affects soil temperature to a greater extent. All things being equal, a soil with a high volumetric specific heat exhibits lesser temperature change than those having a low volumetric heat capacity (Ghuman and Jalota, 2005). From the results above, it was observed that the volumetric specific heat in all the fields could be classified as moderate with ranges from 1.247 – 2.936 J/m^{3}K (Standard *Range of measurement is 0.5 – 4 J/m^{3}K).* Therefore, the volumetric specific heat of the soils in all the field are good for planting of crops as the temperature will not be much affected.

iv. *Temperature*

For the whole site, temperature ranges from 23.21 – 34.49 °C (Table 1) with a mean of 27.71°C with lowest and highest values found in the field planted with okro and vegetables. Considering individual fields, temperature values range from 27.88 – 30.89 °C, 25.88 – 28.54 °C, 27.61 – 29.82 °C and 23.21 – 34.49 °C with mean values of 29.03 °C, 27.29 °C, 28.93 °C and 26.30 °C (Tables 2, 3, 4, and 5) in the fields that contain maize, pineapple, cowpea and okro+vegetable respectively. Figures 20 and 21 A-D show the variation of temperature in the whole site and in individual fields. However, Decagon Devices Inc. 2010 stated that for a soil in place, the temperature typically varies over a small enough range to have only a small effect on thermal properties unless the soil freezes. Minimum temperature or specific zero which is that temperature below which plants cease to grow and generally remain dormant is 6 °C for most plants while the maximum temperature is 55 °C beyond which most plants cannot live without water (Chima et al., 2011). From the above results, it could be seen that the temperature values in all the fields ranged from 23.21 – 34.49 °C which means that these values do not reach the maximum. At these temperatures, most and if not all plants can live and grow well, if other conditions for plant growth are met.

VII. Statistical Analysis

a) Mean

In the whole study site, the mean values of thermal conductivity, thermal diffusivity and volumetric specific heat are 1.672 W/mK, 0.785 mm^2/s and 1.831 J/m^{3}K respectively.

In the individual fields, the lowest mean values of thermal conductivity, thermal diffusivity and volumetric specific heat were obtained in the field that contained cowpea while the highest mean values were seen in both pineapple and okro + vegetable fields (thermal conductivity highest in pineapple field, thermal diffusivity and volumetric specific heat highest in Okro+vegetable field). The differences between the mean values in these

© 2013 Global Journals Inc. (US)

fields were calculated as 0.527 W/mK, 0.300 mm^2/s and 0.693 J/m^3K respectively for thermal conductivity, thermal diffusivity and volumetric specific heat. The mean temperature value for the whole site was calculated as 27.71 °C. Considering the individual fields, the lowest mean value of temperature was noticed in the field that contained both okro+vegetables while the highest was observed in the field that contained maize. The difference between the mean values of temperature in these fields was calculated as 2.73 °C.

b) Standard Deviation

i. *Thermal Properties*

Standard deviations were calculated as a measure of dispersion of the thermal properties. Considering the whole study site, the standard deviations of thermal conductivity, thermal diffusivity and volumetric specific heat were calculated as 0.342, 0.145 and 0.342 respectively. For the individual fields, the lowest standard deviation of thermal conductivity was seen in the field that has Pineapple while the highest was observed in the field that contained Maize. For thermal diffusivity, the field that has okro+vegetable has the lowest standard deviation while Maize field has the highest. Also for volumetric specific heat, the field that has Pineapple and Maize has the same and lowest standard deviation while the field with okro+vegetable has the highest standard deviation (Table 6).

c) Temperature

From Table 2, the standard deviation of the whole site was calculated as 2.299 which is very high. In the individual fields, the field that contained cowpea has the lowest standard deviation while okro+vegetable field has the highest standard deviation.

d) Coefficient of Variation

i. *Thermal Properties*

The coefficients of variation of particular thermal properties determined for the whole site vary from 18.5% to 23.0% with thermal diffusivity having the lowest CV while thermal conductivity has the highest. For the individual fields, the coefficients of variation range from 5.7 % to 21.1 % with the lowest and highest from thermal conductivity of the field that contained pineapple and maize respectively (Table 6). From the statistical analysis, the standard deviation values of all the thermal properties in the entire whole site and in individual fields, it could be said that all the properties are relatively uniform with thermal diffusivity more uniform. However, standard deviation alone is not particularly useful for this conclusion, hence coefficient of variation. From the coefficient of variation together with standard deviation, it could be said that the data are greatly uniform (coefficient of variation ranges from 5.7% to 23%). The higher the coefficient of variation, the greater the dispersion in the variable while the lower the coefficient of variation, the smaller the residuals relative to the predicted mean value (Bruin, 2006). Therefore lower values of coefficient of variation are suggestive of a good model fit.

VIII. Conclusions

The variability of thermal properties over cultivated fields is mainly determined by soil moisture content and bulk density values and their variation which is also modified by meteorological conditions, agricultural treatments and crops. Thermal properties of soils play an important role in influencing the microclimate. These properties influence how energy is partitioned in the soil profile. As regards soil temperature, it is more accurately associated with the transfer of heat throughout the soil, by radiation, conduction and convection. Plants processes such as root growth or germination do not occur until the soil reaches certain temperature depending on the particular plant. Another plant process adversely affected by cold temperature is transport of nutrients and water. A better understanding of how different soils warm up would benefit agriculture by allowing better planning of planting of crops.

Table 1 : Thermal properties of all the sampling points

Sample No	Thermal Diffusivity (mm^2/s)	Thermal Conductivity (W/mK)	Volumetric Specific Heat (J/m^3K)	Bulk Density (mg/m^3)	Moisture Content (m^3/m^3)	Temperature (°C)
1	0.651	1.379	1.605	1.350	0.174	28.80
2	0.874	1.630	1.891	1.360	0.187	27.88
3	0.605	1.220	1.671	1.300	0.171	30.89
4	0.746	1.899	1.682	1.330	0.192	28.33
5	0.770	1.695	1.786	1.350	0.188	29.26
6	0.751	1.103	1.650	1.340	0.169	28.64
7	0.910	1.777	1.980	1.370	0.191	30.89

© 2013 Global Journals Inc. (US)

8	0.759	1.974	1.681	1.340	0.194	27.88
9	0.693	1.116	1.620	1.350	0.170	29.50
10	0.925	2.015	1.700	1.380	0.198	28.24
11	0.900	2.151	1.742	1.340	0.223	25.88
12	0.800	2.000	1.729	1.330	0.211	26.71
13	1.000	2.145	1.765	1.410	0.226	26.30
14	0.950	2.062	1.800	1.380	0.218	25.97
15	0.884	1.979	1.525	1.370	0.209	27.67
16	0.952	2.105	1.822	1.400	0.216	27.40
17	0.850	1.876	1.524	1.370	0.199	28.38
18	0.757	1.777	1.522	1.350	0.194	28.54
19	0.740	2.001	1.624	1.330	0.210	27.87
20	0.850	2.112	1.784	1.360	0.213	28.13
21	0.712	1.696	1.625	1.300	0.162	29.73
22	0.645	1.183	1.608	1.310	0.159	29.82
23	0.584	1.443	1.468	1.290	0.155	29.36
24	0.500	1.529	1.597	1.270	0.155	27.61
25	0.486	1.409	1.446	1.290	0.151	29.61
26	0.462	1.873	1.456	1.280	0.152	29.06
27	0.439	1.525	1.247	1.260	0.146	28.35
28	0.614	1.350	1.420	1.310	0.152	29.00
29	0.600	1.412	1.640	1.290	0.163	28.46
30	0.740	1.520	1.645	1.320	0.168	28.30
31	0.850	1.600	2.016	1.350	0.203	23.82
32	0.864	1.883	2.936	1.360	0.210	24.26
33	0.990	1.920	2.748	1.380	0.212	25.00
34	0.845	1.416	1.983	1.360	0.198	24.69
35	0.835	1.775	2.547	1.340	0.209	25.76
36	0.843	1.595	1.990	1.350	0.201	29.17
37	0.820	1.354	1.887	1.300	0.198	32.30
38	0.846	1.426	2.018	1.340	0.203	24.45
39	0.900	1.526	2.223	1.360	0.206	25.01
40	0.830	1.400	1.998	1.320	0.199	24.91
41	0.850	1.456	2.000	1.350	0.202	26.24
42	0.940	1.800	2.334	1.370	0.209	24.01
43	0.982	1.875	2.116	1.380	0.210	23.21
44	0.930	1.690	2.335	1.360	0.208	34.49
45	0.838	1.580	1.990	1.330	0.200	27.12

© 2013 Global Journals Inc. (US)

Table 2 : Thermal and physical properties of soil in the maize field

Sample No	Thermal Conductivity (W/mK)	Thermal Diffusivity (mm^2/s)	Volumetric Specific Heat (J/m^3K)	Temperature (°C)	Moisture Content (m^3/m^3)	Bulk Density (mg/m^3)
1	1.379	0.651	1.605	28.80	0.174	1.350
2	1.630	0.874	1.891	27.88	0.187	1.360
3	1.220	0.605	1.671	30.89	0.171	1.300
4	1.899	0.746	1.682	28.33	0.192	1.330
5	1.695	0.770	1.786	29.26	0.188	1.350
6	1.103	0.751	1.650	28.64	0.169	1.340
7	1.777	0.910	1.980	30.89	0.191	1.370
8	1.974	0.759	1.681	27.88	0.194	1.340
9	1.116	0.693	1.620	29.50	0.170	1.350
10	2.015	0.925	1.700	28.24	0.198	1.380

Table 3 : Thermal and physical properties of soil in the pineapple field

Sample No	Thermal Conductivity (W/mK)	Thermal Diffusivity (mm^2/s)	Volumetric Specific Heat (J/m^3K)	Temperature (oC)	Moisture Content (m^3/m^3)	Bulk Density (mg/m^3)
1	2.151	0.900	1.742	25.88	0.223	1.340
2	2.000	0.800	1.729	26.71	0.211	1.330
3	2.145	1.000	1.765	26.30	0.226	1.410
4	2.062	0.950	1.800	25.97	0.218	1.380
5	1.979	0.884	1.525	27.67	0.209	1.370
6	2.105	0.952	1.822	27.40	0.216	1.400
7	1.876	0.850	1.524	28.38	0.199	1.370
8	1.777	0.757	1.522	28.54	0.194	1.350
9	2.001	0.740	1.624	27.87	0.210	1.330
10	2.112	0.850	1.784	28.13	0.213	1.360

Table 4 : Thermal and physical properties of soil in the cowpea field

Sample No	Thermal Conductivity (W/mK)	Thermal Diffusivity (mm2/s)	Volumetric Specific Heat (J/m3K)	Temperature (oC)	Moisture Content (m3/m3)	Bulk Density (mg/m3)
1	1.696	0.712	1.625	29.73	0.162	1.300
2	1.676	0.645	1.608	29.82	0.159	1.310
3	1.529	0.584	1.468	29.36	0.155	1.290
4	1.525	0.500	1.597	27.61	0.155	1.270
5	1.412	0.486	1.446	29.61	0.151	1.290
6	1.525	0.462	1.456	29.06	0.152	1.280
7	1.409	0.439	1.247	28.35	0.146	1.260
8	1.536	0.614	1.420	29.00	0.152	1.310
9	1.691	0.600	1.640	28.46	0.163	1.290
10	1.873	0.740	1.645	28.30	0.168	1.320

© 2013 Global Journals Inc. (US)

Table 5 : Thermal and physical properties of soil in the okro+vegetable field

Sample No	Thermal Conductivity (W/mK)	Thermal Diffusivity (mm^2/s)	Volumetric Specific Heat (J/m^3K)	Temperature (°C)	Moisture Content (m^3/m^3)	Bulk Density (mg/m^3)
1	1.600	0.850	2.016	23.82	0.203	1.350
2	1.883	0.864	2.936	24.26	0.210	1.360
3	1.920	0.990	2.748	25.00	0.212	1.380
4	1.416	0.845	1.983	24.69	0.198	1.360
5	1.775	0.835	2.547	25.76	0.209	1.340
6	1.595	0.843	1.990	29.17	0.201	1.350
7	1.354	0.820	1.887	32.30	0.198	1.300
8	1.426	0.846	2.018	24.45	0.203	1.340
9	1.526	0.900	2.223	25.01	0.206	1.360
10	1.400	0.830	1.998	24.91	0.199	1.320
11	1.456	0.850	2.000	26.24	0.202	1.350
12	1.800	0.940	2.334	24.01	0.209	1.370
13	1.875	0.982	2.116	23.21	0.210	1.380
14	1.690	0.930	2.335	34.49	0.208	1.360
15	1.580	0.838	1.990	27.12	0.200	1.330

Table 6 : Statistical summary of soil thermal properties, moisture content and bulk density on individual crop field

	Whole Site	Maize	Pineapple	Cowpea	Okro+vegetable
Thermal Conductivity					
SD	0.342	0.334	0.115	0.179	0.187
Mean	1.488	1.581	2.021	1.494	1.62
CV (%)	23	21.1	5.7	12	11.5
Volumetric Specific Heat					
SD	0.342	0.116	0.116	0.123	0.304
Mean	1.831	1.727	1.684	1.515	2.208
CV (%)	18.7	6.7	6.9	8.1	13.8
Thermal Diffusivity					
SD	0.145	0.1	0.082	0.099	0.055
Mean	0.785	0.768	0.868	0.578	0.878
CV (%)	18.5	13	9.4	17.1	6.3
Moisture Content					
SD	0.022	0.011	0.00936	0.0063	0.0047
Mean	0.191	0.183	0.212	0.156	0.205
CV (%)	11.5	6	4.4	4	2.3
Bulk Density					
SD	0.011	0.021	0.026	0.018	0.021
Mean	1.34	1.347	1.364	1.292	1.35
CV (%)	0.8	1.6	1.9	1.4	1.6

© 2013 Global Journals Inc. (US)

Plate 1 : KD 2 Pro

Plate 2 : TR-1 Sensor

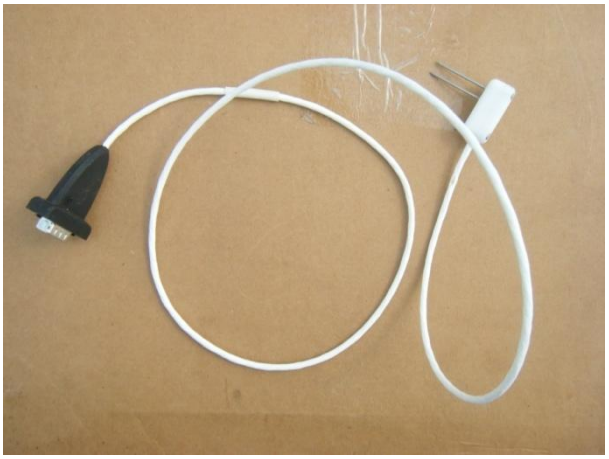


Plate 3 : SH-1 30mm Dual Sensor

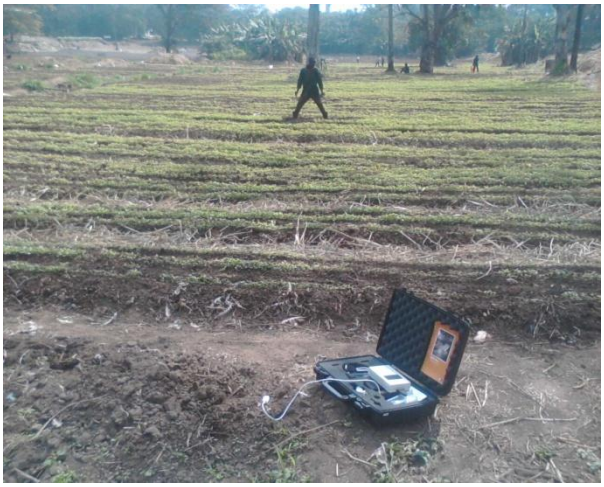


Plate 4 : KD 2 Pro Meter during measurement

© 2013 Global Journals Inc. (US)

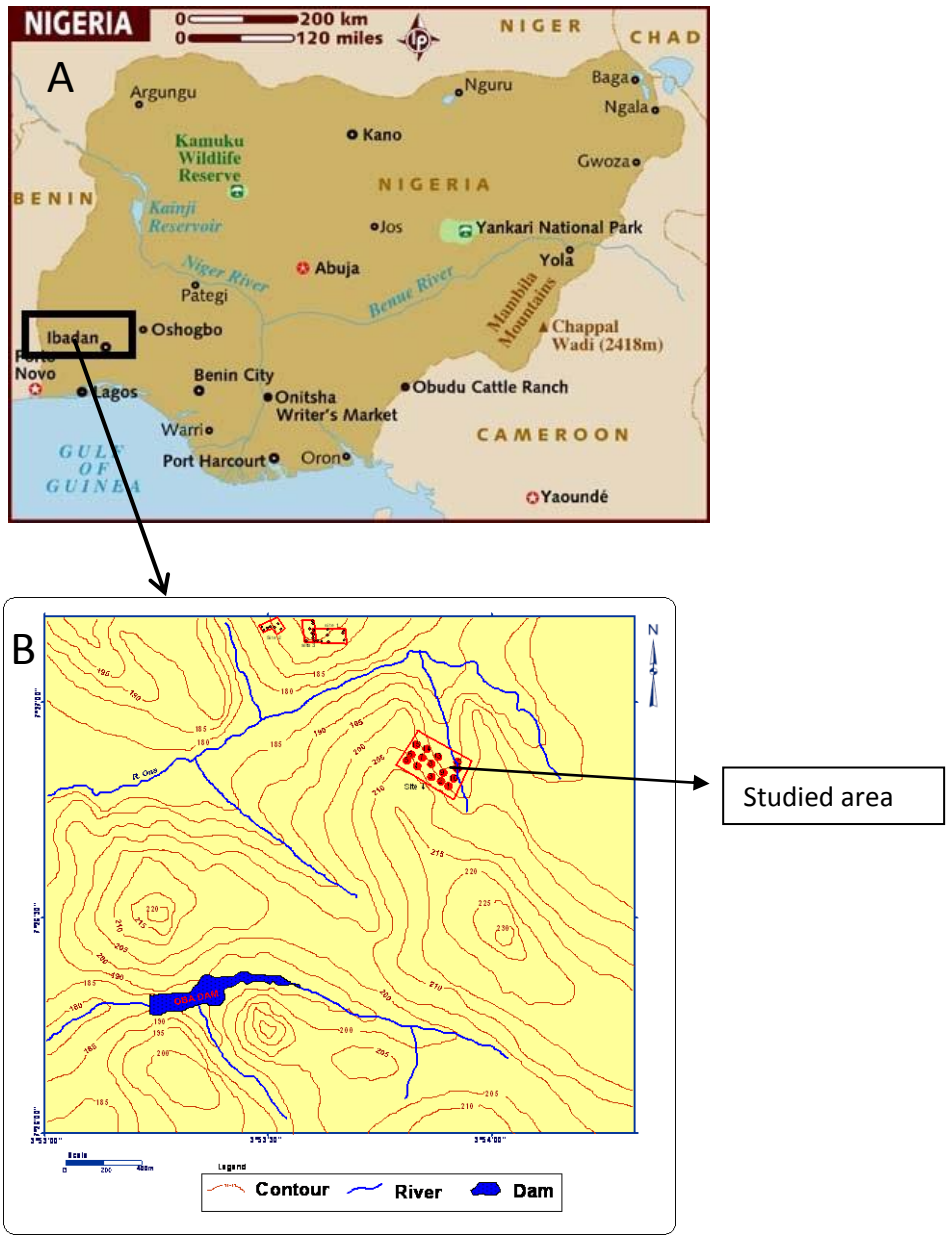


Figure 1 : (A) Topographical map of Nigeria showing Ibadan
(B) Topographical map of University of Ibadan showing studied area

© 2013 Global Journals Inc. (US)

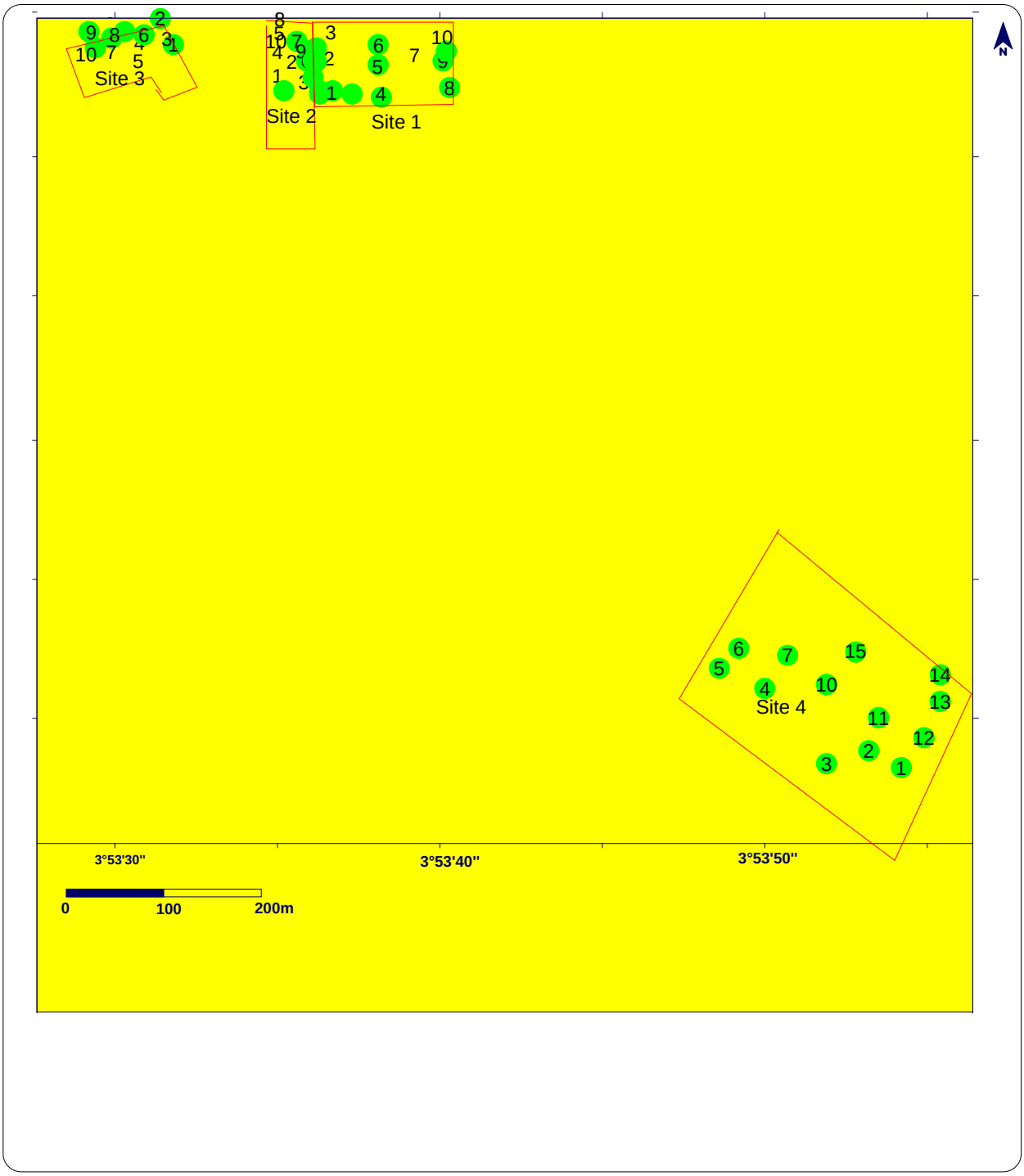


Figure 2 : Location map of the study area showing sites

© 2013 Global Journals Inc. (US)

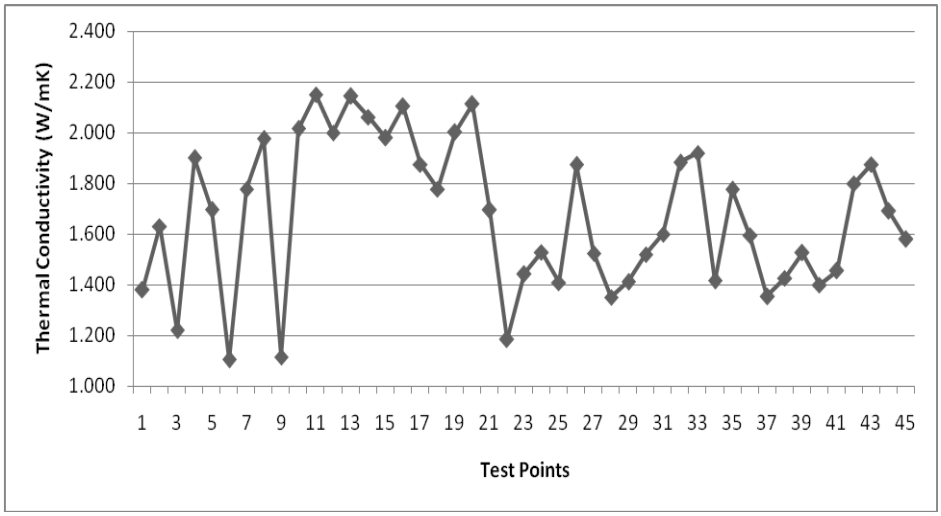


Figure 3 : Variation of Thermal Conductivity within the whole study site

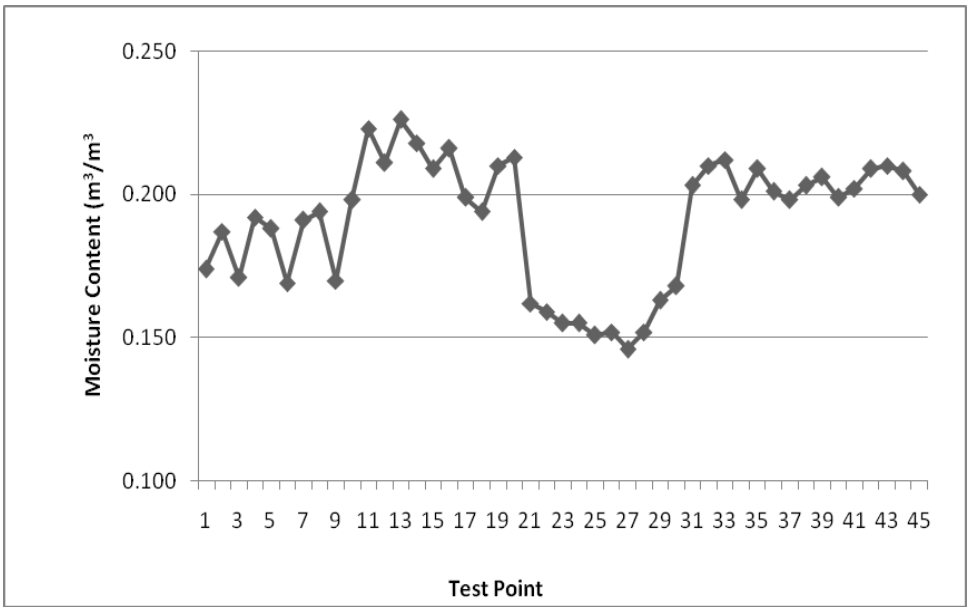


Figure 4 : Variation of Moisture content in the study site

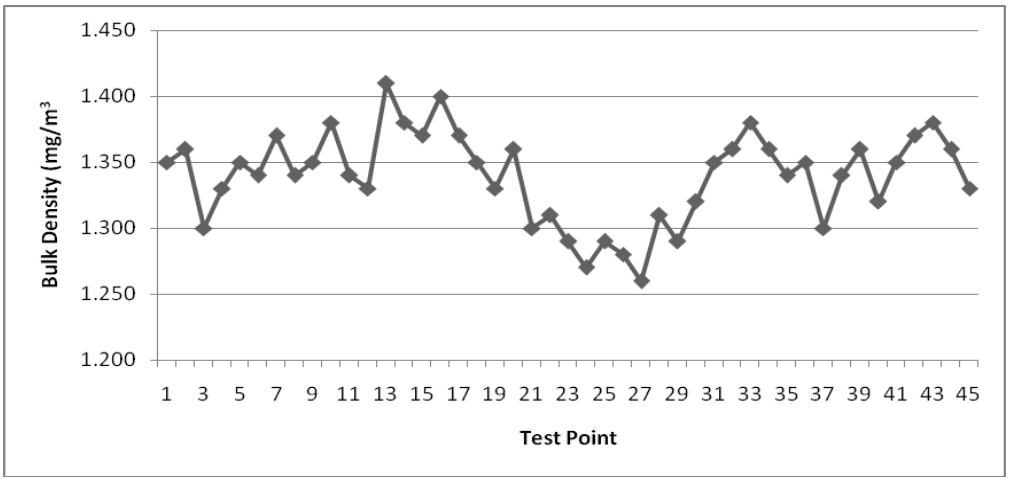
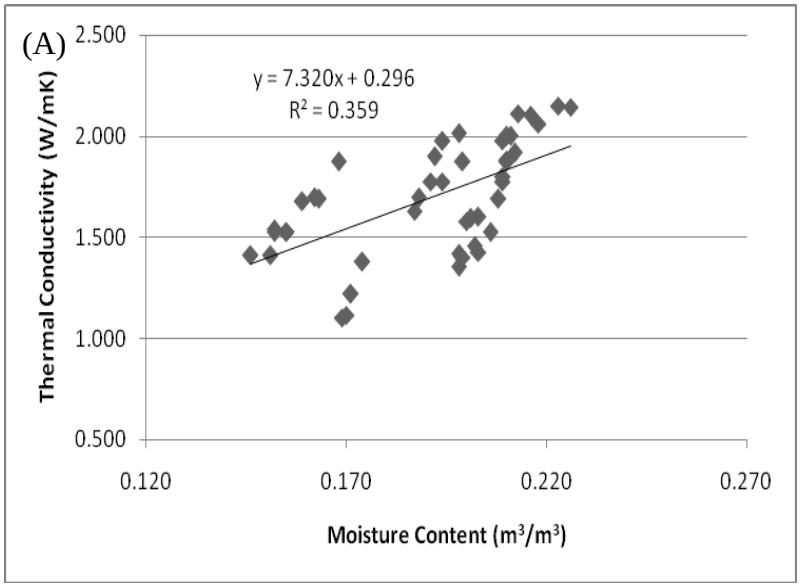


Figure 5 : Variation of Bulk density in the whole study site

© 2013 Global Journals Inc. (US)



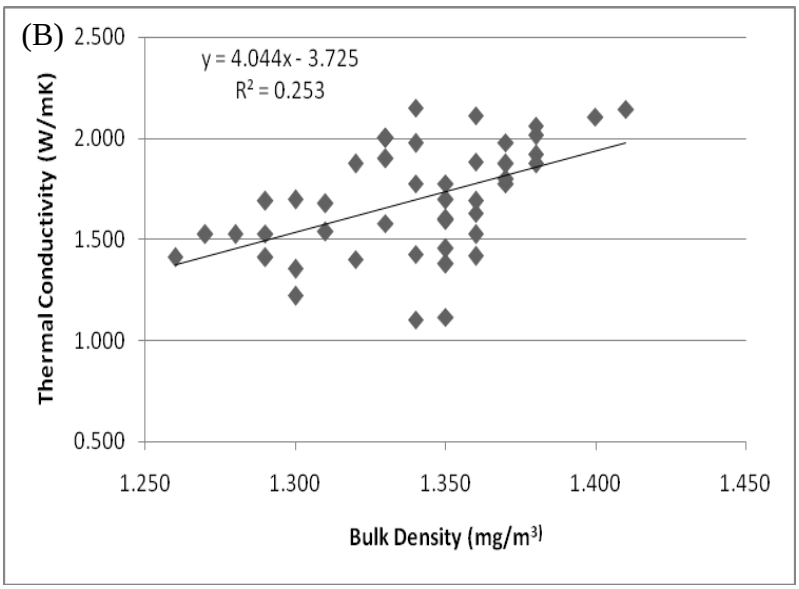
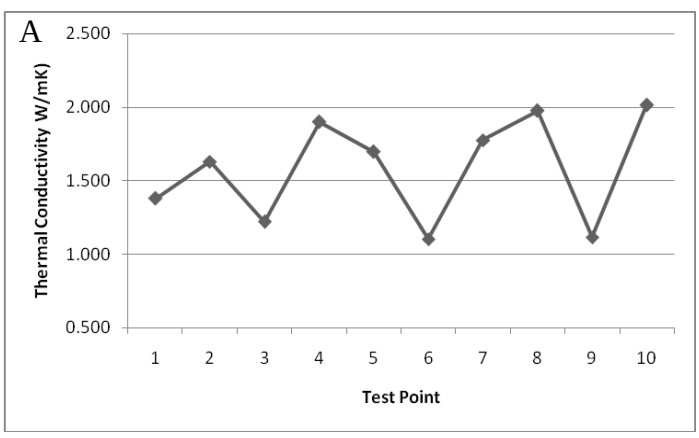


Figure 6 : Variation of thermal conductivity with (A) Moisture content (B) Bulk density



© 2013 Global Journals Inc. (US)

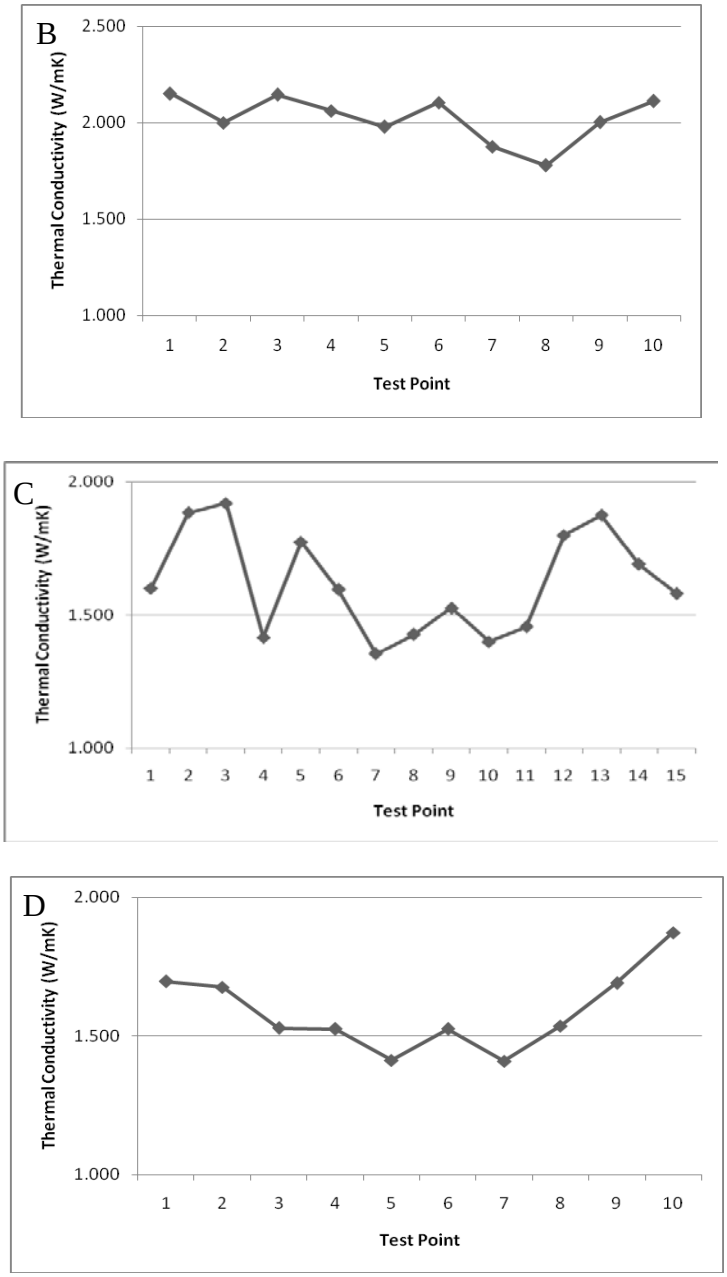
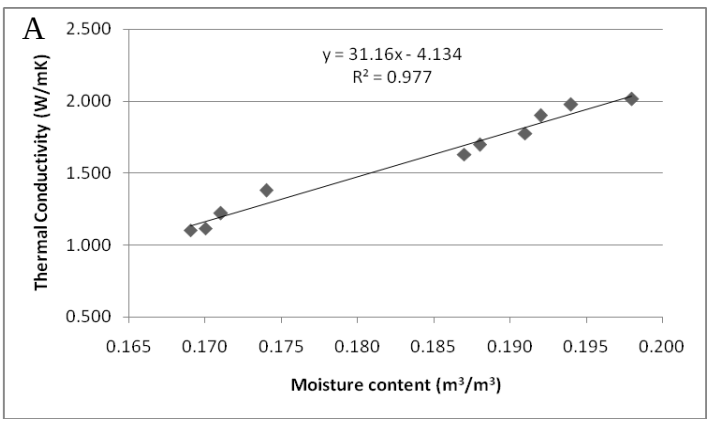


Figure 7 : Variation of thermal conductivity in all the fields (A) maize (B) Pineapple (C) cowpea and (D) Okro+vegetables



© 2013 Global Journals Inc. (US)

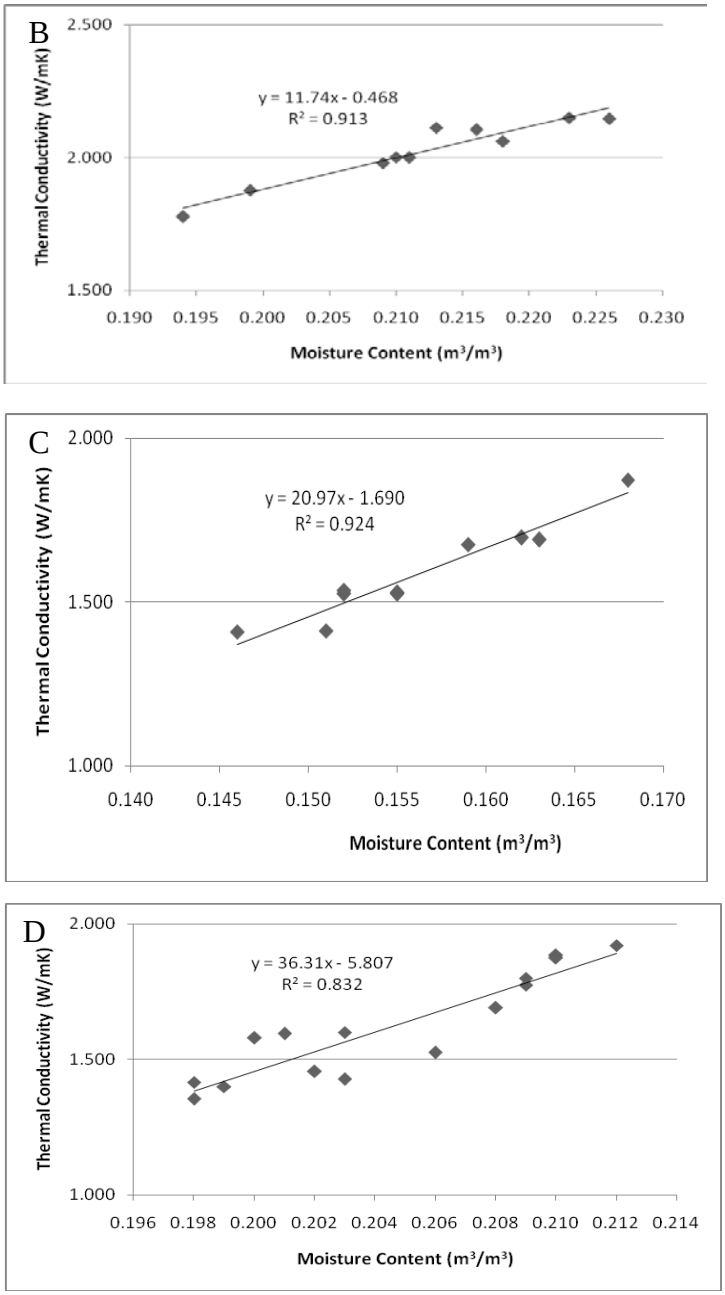
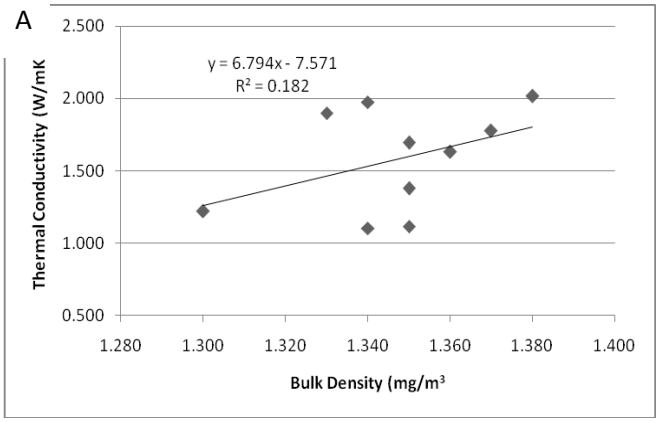


Figure 8 : Variation of thermal conductivity with moisture content in (A) maize (B) pineapple (C) cowpea and (D) okro +vegetable fields



© 2013 Global Journals Inc. (US)

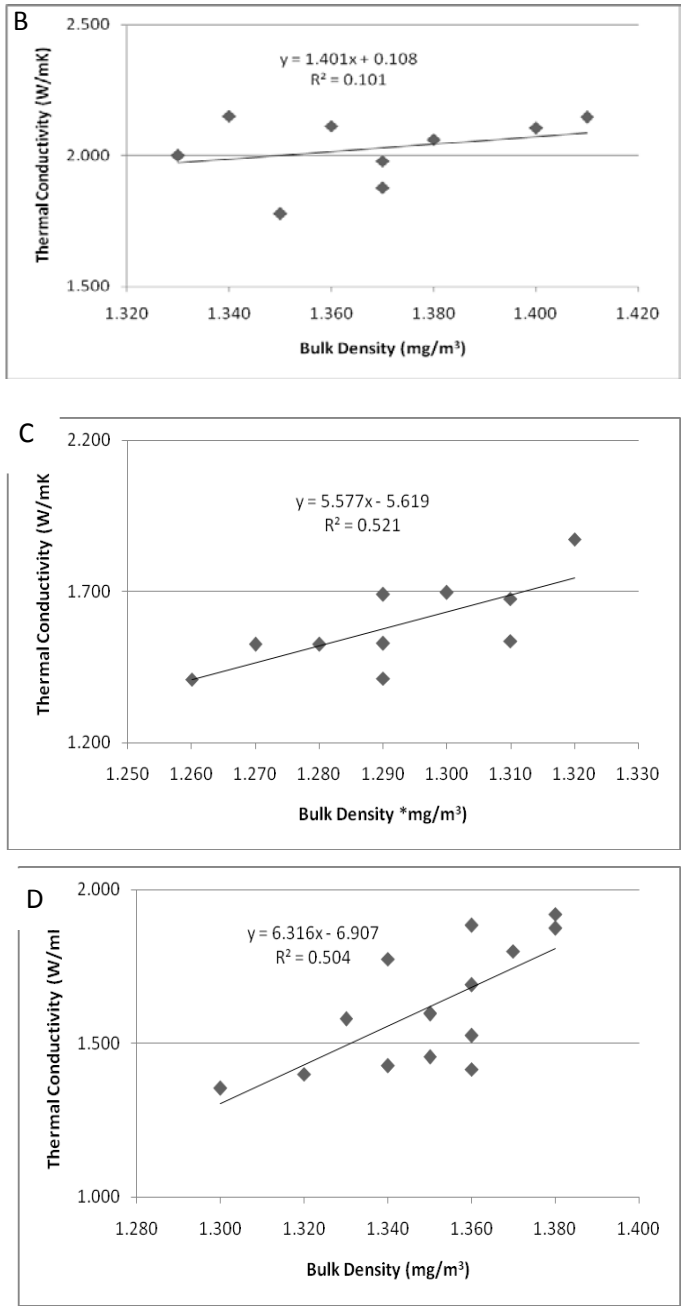


Figure 9 : Variation of thermal conductivity with Bulk density in (A) maize (B) pineapple (C) cowpea and (D) okro +vegetable fields

© 2013 Global Journals Inc. (US)

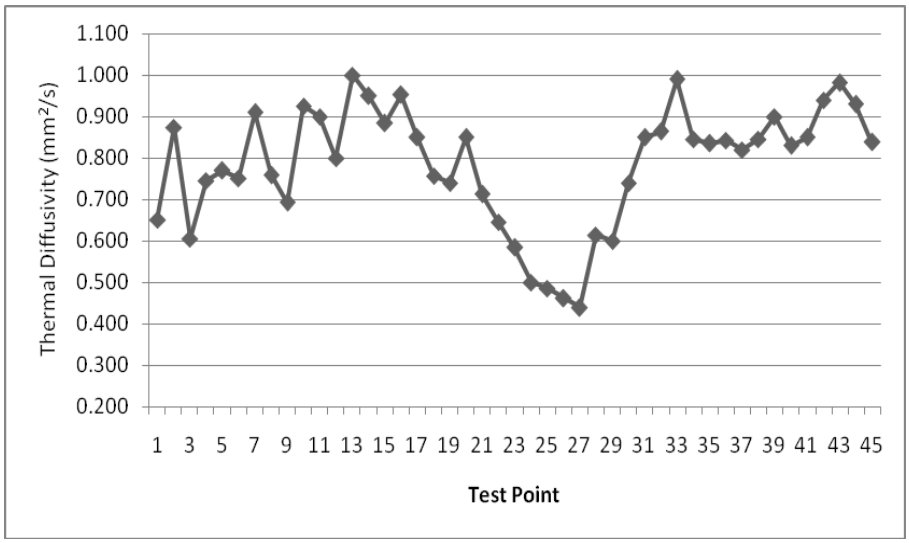


Figure 10 : Variation of thermal diffusivity in the whole study site

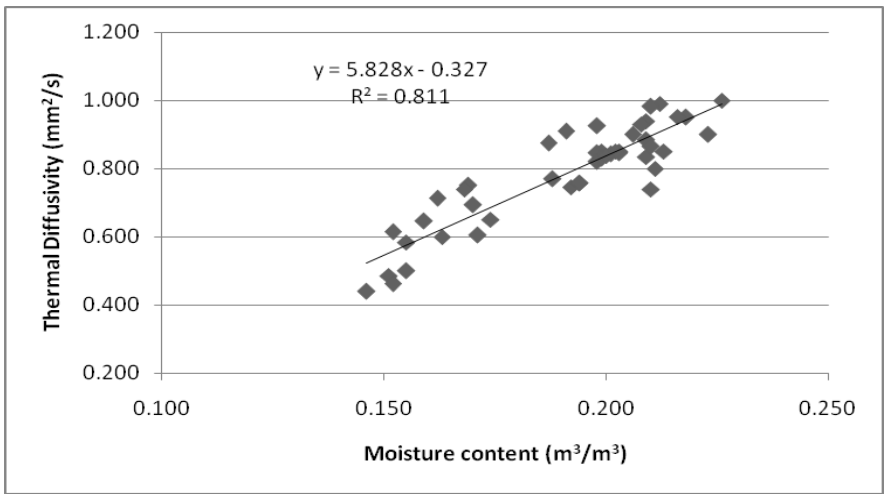


Figure 11 : Influence of Moisture content on thermal diffusivity in the whole study site

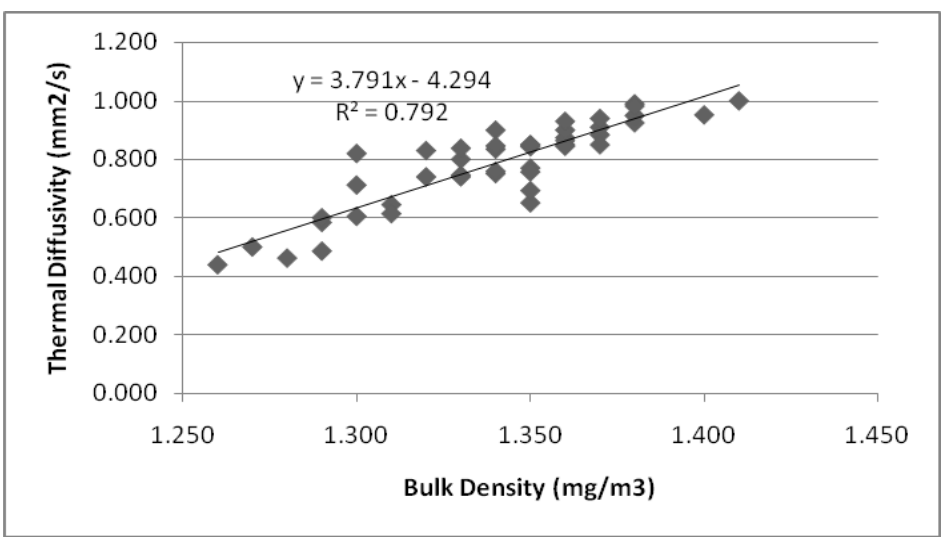


Figure 12 : Influence of Bulk Density on thermal diffusivity in the whole study site

© 2013 Global Journals Inc. (US)

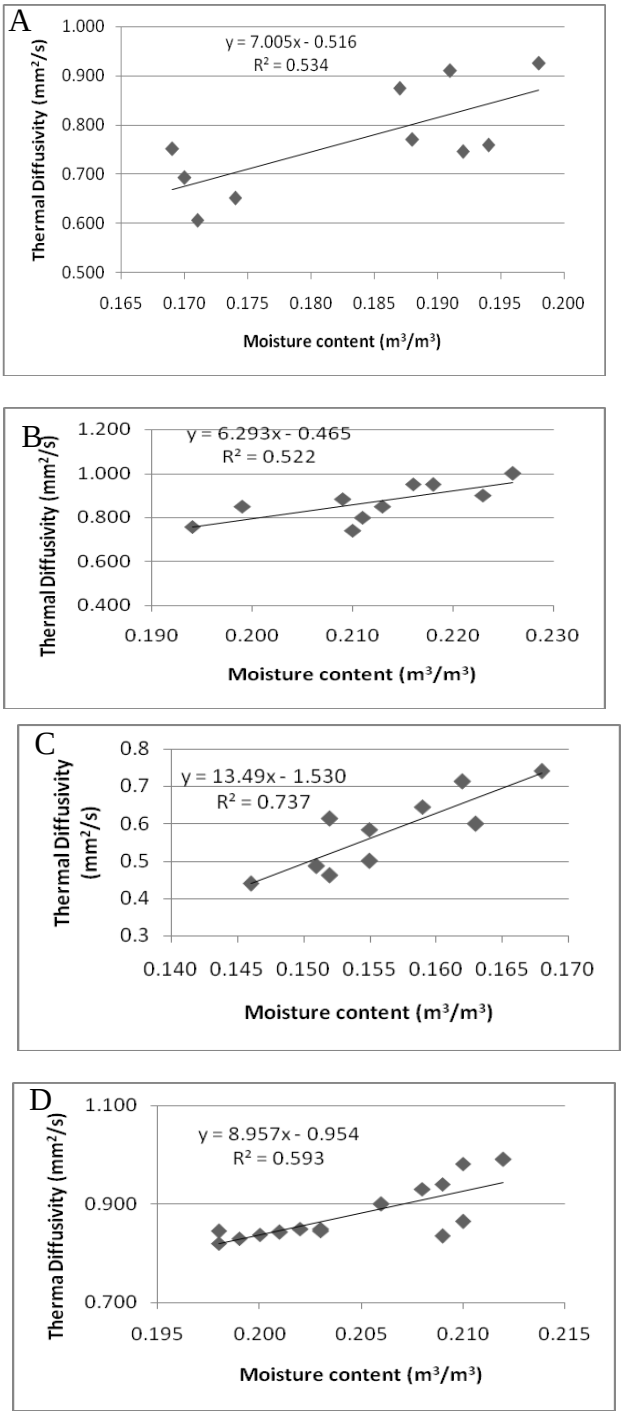


Figure 13 : Influence of moisture content on thermal diffusivity in (A) maize (B) pineapple (C) cowpea and (D) Okro+vegetable fields

© 2013 Global Journals Inc. (US)

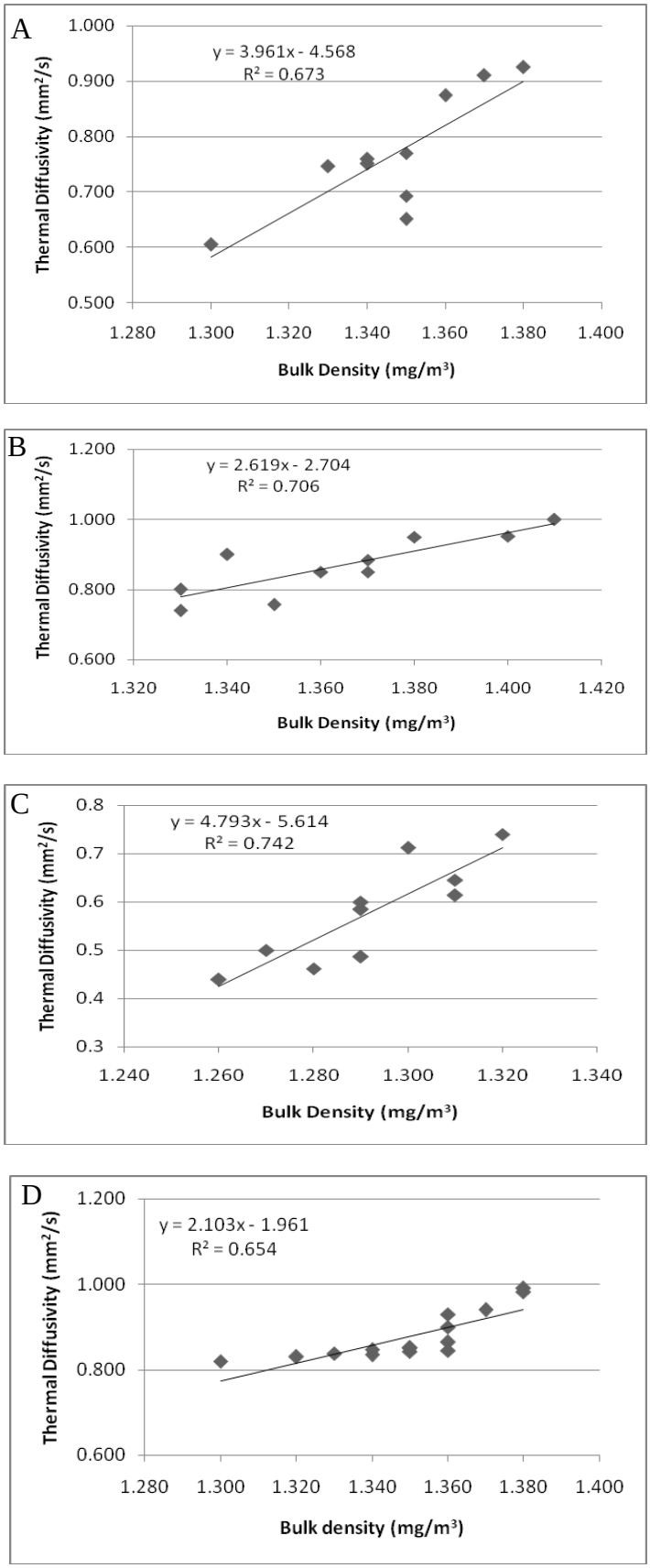


Figure 14 : Influence of Bulk density on thermal diffusivity in (A) maize (B) pineapple (C) cowpea and (D) Okro+vegetable fields

© 2013 Global Journals Inc. (US)

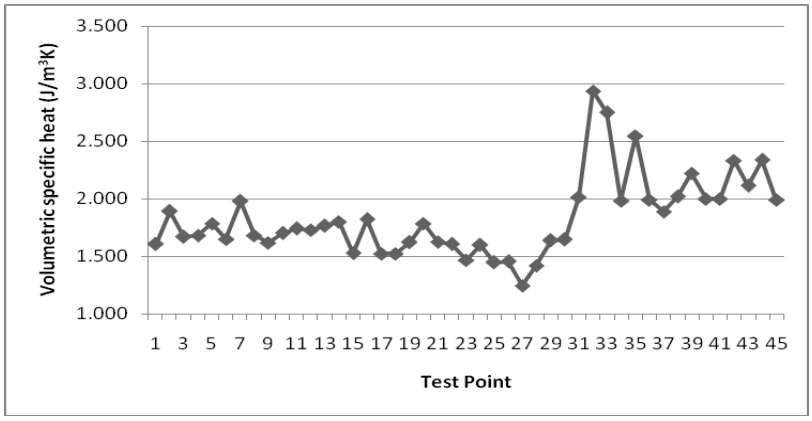


Figure 15 : Variation of volumetric specific heat in all the study sites

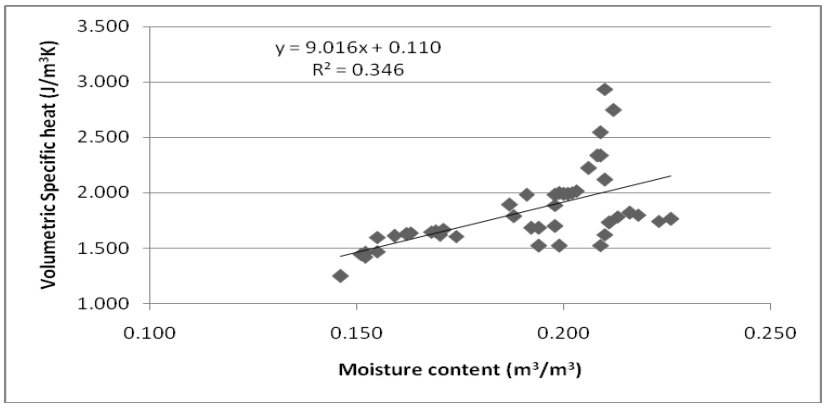


Figure 16 : Variation of volumetric specific heat with moisture content in the whole study site

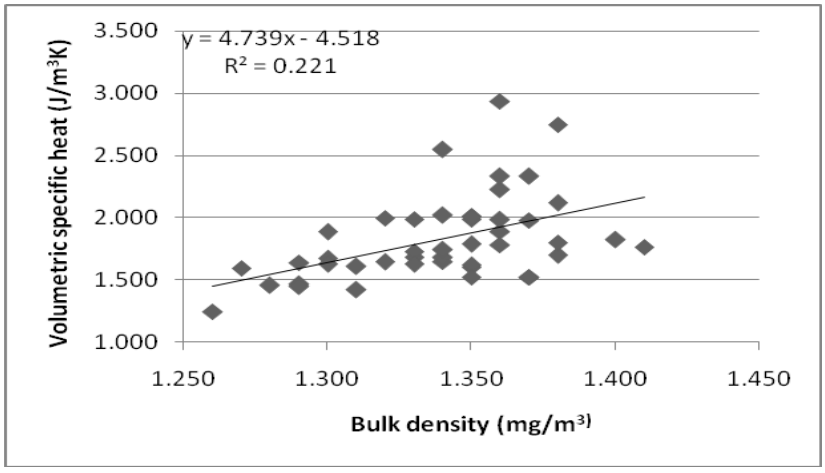


Figure 17 : Variation of volumetric specific heat with Bulk density in the whole study site

© 2013 Global Journals Inc. (US)

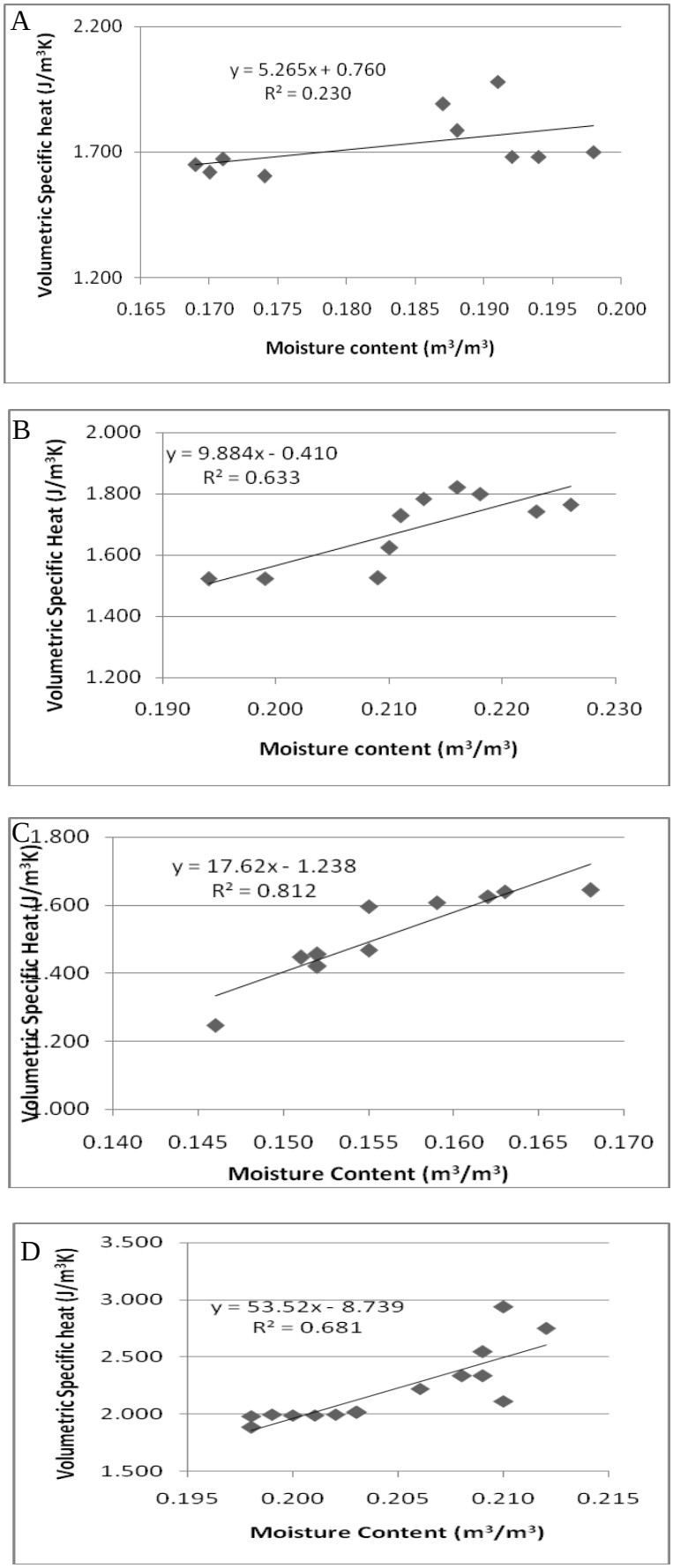


Figure 18 : Variation of volumetric specific heat with moisture content in (A) maize (B) pineapple (C) cowpea and (D) okro+vegetable fields

© 2013 Global Journals Inc. (US)

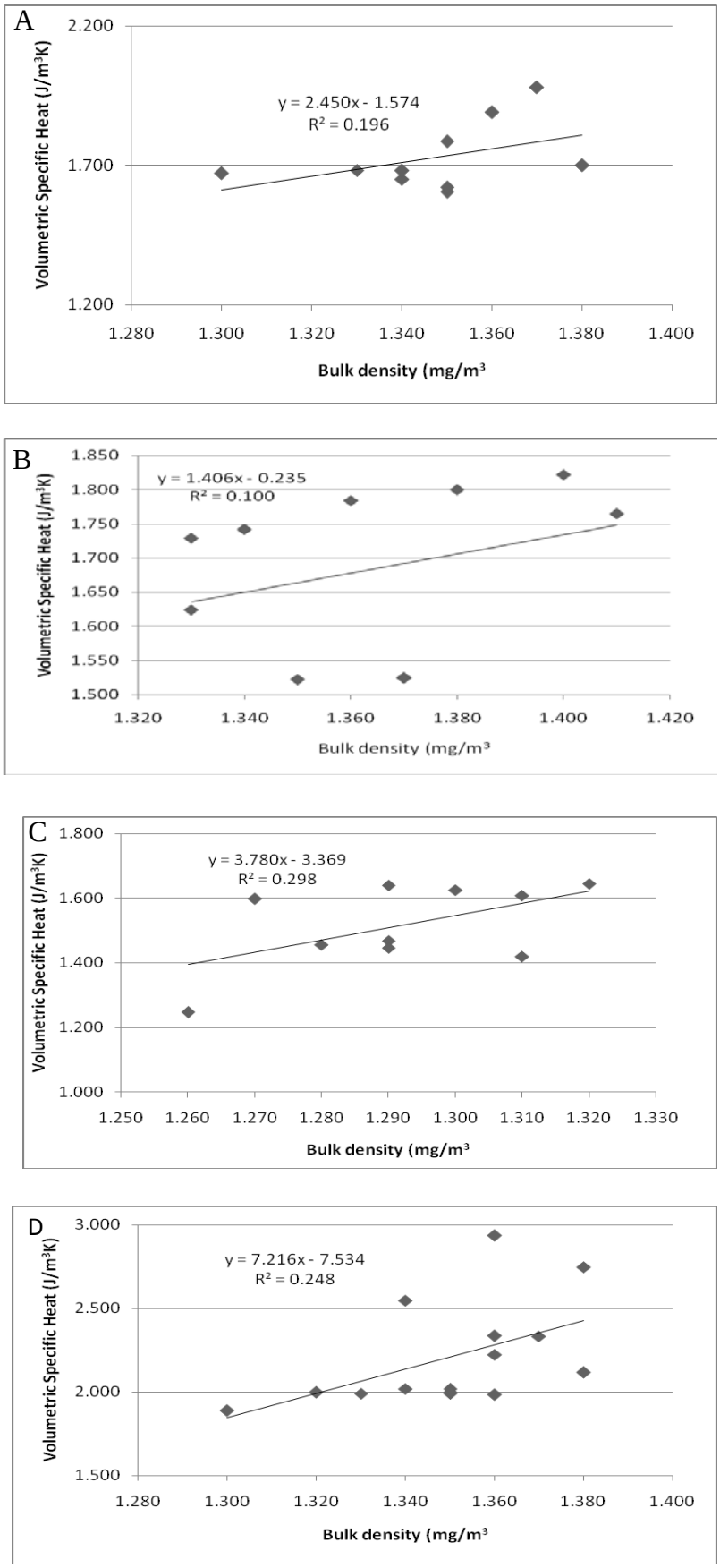


Figure 19 : Variation of volumetric specific heat with moisture content in (A) maize (B) pineapple (C) cowpea and (D) okro+vegetable fields

© 2013 Global Journals Inc. (US)

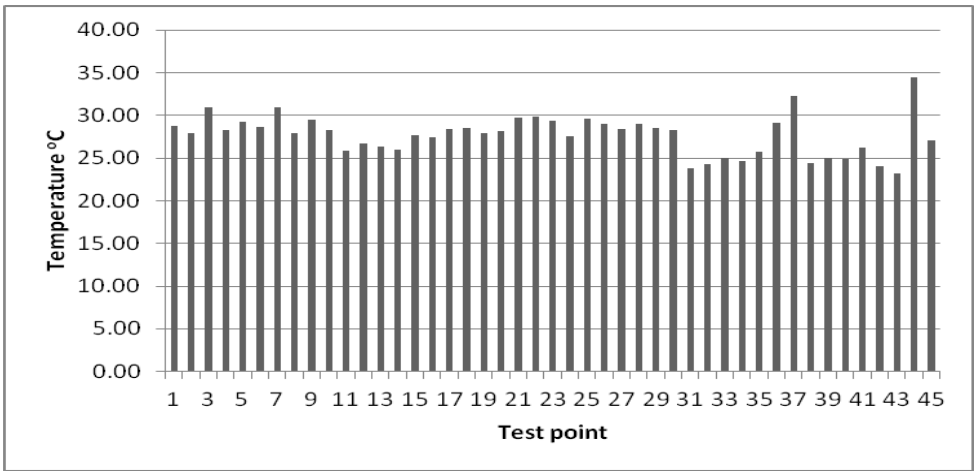
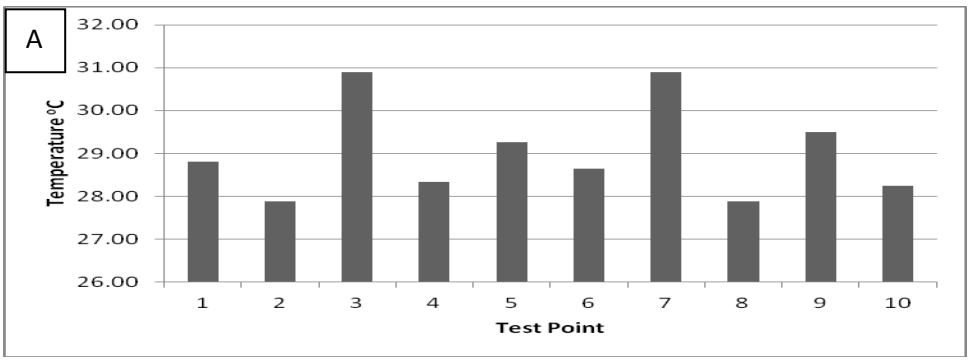
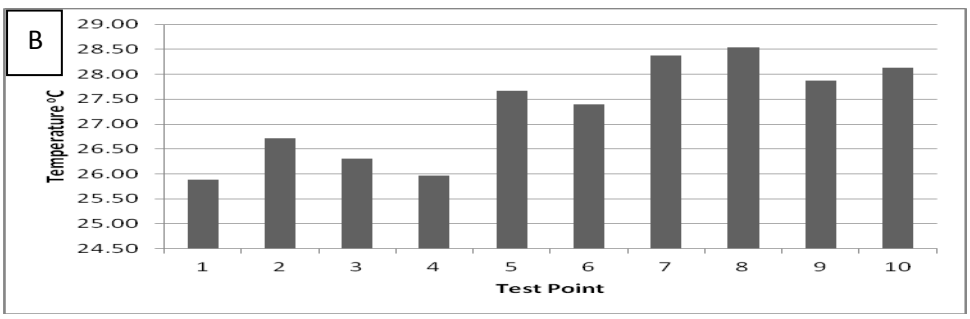
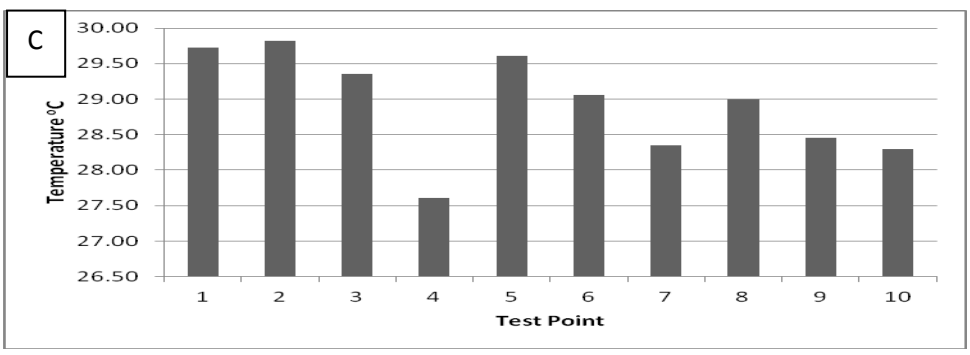


Figure 20 : variation of temperature in the whole site







© 2013 Global Journals Inc. (US)

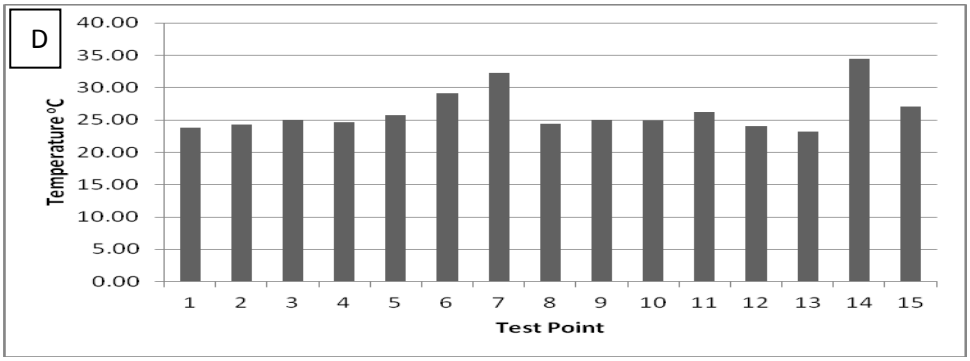


Figure 21 : Distribution of temperature in (A) maize (B) pineapple (C) cowpea and (D) okro+vegetable fields

References References References

1. Usowicz, B. 1991. Studies on the dependence of soil temperature on its moisture in field. Thesis. Academy of Agriculture, Lublin.
2. Ghauman, B. S. and Lal R. 1985. Thermal conductivity, thermal diffusivity, and thermal capacity of some Nigerian soils. *Soil Sci.* 139:74–80.
3. Rao .M.V.B.B.G. and Singh D. N. 1999. A generalized relationship to estimate thermal resistivity of soils. *Can Geotech J* 36.4:767–773
4. Krishanaiah S. 2003. Centrifuge modelling of heat migration in geomaterials. Diss. Civil, Engineering, IIT Bombay, India.
5. AASHTO T 265, 2008. Laboratory determination of moisture content of soils.
6. Oladunjoye, M. A. and Sanuade, O. A. 2012a. In situ determination of thermal resistivity of soil: case study of Olorunsogo power plant, southwestern Nigeria. *ISRN Civil Engineering*, Vol.2012, doi:10.5402/2012/591450.
7. M. C. Rubio, D. R. Cobos, R. Josa, F. Ferrer, 2009. A new analytical laboratory procedure for determining the thermal properties in porous media, based on the American standard D5334-05, *Estudios en la Zona no Saturada del Suelo IX* :18-20.
8. Singh, D.N. and Devid, K. 2000. Generalized relationships for estimating soil thermal resistivity. *Experimental Thermal and Fluid Sci.* 22: 133-143.
9. Brandon T. L. and Mitchell, J. K. 1989. Factors influencing thermal resistivity of sands. *Journal of Geotechnical Engineering,* Vol. 115, No. 12, Paper No. 24119.
10. Salomone L. A., Kovacs W. D. and Kusuda T. 1984. Thermal performance of fine-grained soils. *J Geotech Eng ASCE* 110.3:359–74.
11. Salomone, L.A. and Marlow, J. I. 1989. Soil rock classification according to thermal conductivity. EPRI CU-6482. Palo Alto, CA: Electric Power Research Institute.
12. L. A. Salomone, W. D. Kovacs, 1984. Thermal resistivity of soils. J Geotech Eng ASCE 3 (1984) 375–89.
13. IEEE, 1998. Guide for soil thermal resistivity measurements. Inst. of Electrical and Electronics Engineers, Inc. New York.
14. Adjepong, S. K., 1997. Investigation of the variation of the specific heat capacity of three texture types of soil with moisture content, Journal of Applied Science and Technology, 2: 7-12
15. Zhang, J. R. and Liu Z. Q. 2006. A study on the convective heat transfer coefficient of concrete in wind tunnel experiment. *China Civil Engineering Journal* 39.9: 39– 42.
16. Alex Tan, 2013. The effects of thermal conductivity of soil. www.ehow.com/list_5931951_effects-thermal-conductivity-soil.html.
17. Verhoef, A., van den Hurk, B.J.J.M., Jacobs, A.F.G. and Heusinkveld, B. G. 1996. Thermal soil properties for vineyard (EFEDA-I) and savanna (HAPEX-Sahel) sites. *Agricultural and Forest Meteorology* 78.1-2: 1-18
18. Oladunjoye, M. A. and Sanuade, O. A., 2012b. Thermal Diffusivity, Thermal Effusivity and Specific Heat of soils in Olorunsogo Power Plant, Southwestern Nigeria. *IJRRAS* 13(2): 502-521.
19. Rodrigo, C. R., Pablo, C. P. and Victor, G. G., 2009. Relationship between root growth of 'Thompson Seedless' Grapeviness and soil temperature. *Chilean Journal of Agricultural Research.* Vol.69 (4): 496-502.
20. Ghuman B. S. and Jalota, S. K., 2005. Encyclopedia of Soil Science, second edition, Rattan Lal.
21. Decagon Devices, Inc., 2011. KD2 Pro thermal properties analyzer operator's manual version 4.Decagon Devices, Inc., Pullman, WA.
22. Chima, G. N., Ijeoma M. A., Nwagbara M. O. and Nwaugo, V. O., 2011. Sensitivity of vegetation to decadal variations in temperature and rainfall over Northern Nigeria. *Journal of Soil Science and Environmental Management* Vol. 2(8): 228-236.
23. Bruin, J., 2006. Newtest: command to compute new test. UCLA: Statistical Consulting Group. http://www.ats.ucla.edu/stat/stata/ado/analysis/.

© 2013 Global Journals Inc. (US)

Global Journals Inc. (US) Guidelines Handbook 2013

www.GlobalJournals.org

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (FARSS)

- 'FARSS' title will be awarded to the person after approval of Editor-in-Chief and Editorial Board. The title 'FARSS" can be added to name in the following manner. eg. Dr. John E. Hall, Ph.D., FARSS or William Walldroff Ph. D., M.S., FARSS
- Being FARSS is a respectful honor. It authenticates your research activities. After becoming FARSS, you can use 'FARSS' title as you use your degree in suffix of your name. This will definitely will enhance and add up your name. You can use it on your Career Counseling Materials/CV/Resume/Visiting Card/Name Plate etc.
- 60% Discount will be provided to FARSS members for publishing research papers in Global Journals Inc., if our Editorial Board and Peer Reviewers accept the paper. For the life time, if you are author/co-author of any paper bill sent to you will automatically be discounted one by 60%
- FARSS will be given a renowned, secure, free professional email address with 100 GB of space eg.johnhall@globaljournals.org. You will be facilitated with Webmail, SpamAssassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.
- FARSS member is eligible to become paid peer reviewer at Global Journals Inc. to earn up to 15% of realized author charges taken from author of respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account or to your PayPal account.
- Eg. If we had taken 420 USD from author, we can send 63 USD to your account.
- FARSS member can apply for free approval, grading and certification of some of their Educational and Institutional Degrees from Global Journals Inc. (US) and Open Association of Research,Society U.S.A.
- After you are FARSS. You can send us scanned copy of all of your documents. We will verify, grade and certify them within a month. It will be based on your academic records, quality of research papers published by you, and 50 more criteria. This is beneficial for your job interviews as recruiting organization need not just rely on you for authenticity and your unknown qualities, you would have authentic ranks of all of your documents. Our scale is unique worldwide.
- FARSS member can proceed to get benefits of free research podcasting in Global Research Radio with their research documents, slides and online movies.
- After your publication anywhere in the world, you can upload you research paper with your recorded voice or you can use our professional RJs to record your paper their voice. We can also stream your conference videos and display your slides online.
- FARSS will be eligible for free application of Standardization of their Researches by Open Scientific Standards. Standardization is next step and level after publishing in a journal. A team of research and professional will work with you to take your research to its next level, which is worldwide open standardization.

- FARSS is eligible to earn from their researches: While publishing his paper with Global Journals Inc. (US), FARSS can decide whether he/she would like to publish his/her research in closed manner. When readers will buy that individual research paper for reading, 80% of its earning by Global Journals Inc. (US) will be transferred to FARSS member's bank account after certain threshold balance. There is no time limit for collection. FARSS member can decide its price and we can help in decision.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

- 'MARSS' title will be awarded to the person after approval of Editor-in-Chief and Editorial Board. The title 'MARSS" can be added to name in the following manner. eg. Dr. John E. Hall, Ph.D., MARSS or William Walldroff Ph. D., M.S., MARSS
- Being MARSS is a respectful honor. It authenticates your research activities. After becoming MARSS, you can use 'MARSS' title as you use your degree in suffix of your name. This will definitely will enhance and add up your name. You can use it on your Career Counseling Materials/CV/Resume/Visiting Card/Name Plate etc.
- 40% Discount will be provided to MARSS members for publishing research papers in Global Journals Inc., if our Editorial Board and Peer Reviewers accept the paper. For the life time, if you are author/co-author of any paper bill sent to you will automatically be discounted one by 60%
- MARSS will be given a renowned, secure, free professional email address with 30 GB of space eg.johnhall@globaljournals.org. You will be facilitated with Webmail, SpamAssassin, Email Forwarders, Auto-Responders, Email Delivery Route tracing, etc.
- MARSS member is eligible to become paid peer reviewer at Global Journals Inc. to earn up to 10% of realized author charges taken from author of respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account or to your PayPal account.
- MARSS member can apply for free approval, grading and certification of some of their Educational and Institutional Degrees from Global Journals Inc. (US) and Open Association of Research,Society U.S.A.
- MARSS is eligible to earn from their researches: While publishing his paper with Global Journals Inc. (US), MARSS can decide whether he/she would like to publish his/her research in closed manner. When readers will buy that individual research paper for reading, 40% of its earning by Global Journals Inc. (US) will be transferred to MARSS member's bank account after certain threshold balance. There is no time limit for collection. MARSS member can decide its price and we can help in decision.

Auxiliary Memberships

ANNUAL MEMBER

- Annual Member will be authorized to receive e-Journal GJSFR for one year (subscription for one year).
- The member will be allotted free 1 GB Web-space along with subDomain to contribute and participate in our activities.
- A professional email address will be allotted free 500 MB email space.

PAPER PUBLICATION

- The members can publish paper once. The paper will be sent to two-peer reviewer. The paper will be published after the acceptance of peer reviewers and Editorial Board.

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not conveninet , and then email the paper directly to dean@globaljournals.org.

Offline Submission: Author can send the typed form of paper by Post. However, online submission should be preferred.

© Copyright by Global Journals Inc.(US)| Guidelines Handbook

Preferred Author Guidelines

MANUSCRIPT STYLE INSTRUCTION (Must be strictly followed)

Page Size: 8.27" X 11'"

- Left Margin: 0.65
- Right Margin: 0.65
- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, "Abstract" word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

The Global Journals Inc. (US) welcome the submission of original paper, review paper, survey article relevant to the all the streams of Philosophy and knowledge. The Global Journals Inc. (US) is parental platform for Global Journal of Computer Science and Technology, Researches in Engineering, Medical Research, Science Frontier Research, Human Social Science, Management, and Business organization. The choice of specific field can be done otherwise as following in Abstracting and Indexing Page on this Website. As the all Global

Journals Inc. (US) are being abstracted and indexed (in process) by most of the reputed organizations. Topics of only narrow interest will not be accepted unless they have wider potential or consequences.

2. ETHICAL GUIDELINES

Authors should follow the ethical guidelines as mentioned below for publication of research paper and research activities.

Papers are accepted on strict understanding that the material in whole or in part has not been, nor is being, considered for publication elsewhere. If the paper once accepted by Global Journals Inc. (US) and Editorial Board, will become the copyright of the Global Journals Inc. (US).

Authorship: The authors and coauthors should have active contribution to conception design, analysis and interpretation of findings. They should critically review the contents and drafting of the paper. All should approve the final version of the paper before submission

The Global Journals Inc. (US) follows the definition of authorship set up by the Global Academy of Research and Development. According to the Global Academy of R&D authorship, criteria must be based on:

1) Substantial contributions to conception and acquisition of data, analysis and interpretation of the findings.

2) Drafting the paper and revising it critically regarding important academic content.

3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board's decision on publication of the paper is final and cannot be appealed elsewhere.

Permissions: It is the author's responsibility to have prior permission if all or parts of earlier published illustrations are used in this paper.

Please mention proper reference and appropriate acknowledgements wherever expected.

If all or parts of previously published illustrations are used, permission must be taken from the copyright holder concerned. It is the author's responsibility to take these in writing.

Approval for reproduction/modification of any information (including figures and tables) published elsewhere must be obtained by the authors/copyright holders before submission of the manuscript. Contributors (Authors) are responsible for any copyright fee involved.

3. SUBMISSION OF MANUSCRIPTS

Manuscripts should be uploaded via this online submission page. The online submission is most efficient method for submission of papers, as it enables rapid distribution of manuscripts and consequently speeds up the review procedure. It also enables authors to know the status of their own manuscripts by emailing us. Complete instructions for submitting a paper is available below.

Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Color Charges: It is the rule of the Global Journals Inc. (US) for authors to pay the full cost for the reproduction of their color artwork. Hence, please note that, if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a color work agreement form before your paper can be published.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

6.2 Early View of Global Journals Inc. (US) (Publication Prior to Print)

The Global Journals Inc. (US) are enclosed by our publishing's Early View service. Early View articles are complete full-text articles sent in advance of their publication. Early View articles are absolute and final. They have been completely reviewed, revised and edited for publication, and the authors' final corrections have been incorporated. Because they are in final form, no changes can be made after sending them. The nature of Early View articles means that they do not yet have volume, issue or page numbers, so Early View articles cannot be cited in the conventional way.

6.3 Author Services

Online production tracking is available for your article through Author Services. Author Services enables authors to track their article - once it has been accepted - through the production process to publication online and in print. Authors can check the status of their articles online and choose to receive automated e-mails at key stages of production. The authors will receive an e-mail with a unique link that enables them to register and have their article automatically added to the system. Please ensure that a complete e-mail address is provided when submitting the manuscript.

6.4 Author Material Archive Policy

Please note that if not specifically requested, publisher will dispose off hardcopy & electronic information submitted, after the two months of publication. If you require the return of any information submitted, please inform the Editorial Board or dean as soon as possible.

6.5 Offprint and Extra Copies

A PDF offprint of the online-published article will be provided free of charge to the related author, and may be distributed according to the Publisher's terms and conditions. Additional paper offprint may be ordered by emailing us at: editor@globaljournals.org .

Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Administration Rules Listed Before Submitting Your Research Paper to Global Journals Inc. (US)

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

© Copyright by Global Journals Inc.(US) | Guidelines Handbook

Index

A

Aflatoxigenic · 55
Ammonization · 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 18
Arabinoxylan · 10

C

Cellulolytic · 11
Cheesecloth · 5
Chrysichthys · 47, 49, 50, 51, 53, 55, 57

D

Dichlorophenoxy · 32
Dodecylsulfate · 32

E

Eragrostis · 1, 2, 3, 4, 13

G

Grapeviness · 81

H

Hemicellulose · 11
Homogenized · 50

J

Jipanayiotou · 2, 13

K

Kompozisyonununbazı · 23

L

Leguminosae · 12
Leucocephala · 12

M

Mesophyte · 42
Micropipette · 49
Morphometric · 30, 34
Mycotoxins · 55

N

Nigrodigitatus · 47, 49, 51, 53, 55, 57

O

Olorunsogo · 81
Oreochromis · 55

P

Paradisica · 42
Pietermaritzburg · 1, 3, 13
Polyunsaturated · 20
Populasyonundan · 24
Pseudostem · 42

R

Roughage · 1, 3, 4, 5, 7, 9, 10, 16

S

Staphylococcus · 47, 48, 51, 53, 54, 55

U

Ukulinga · 3, 4

save our planet

Global Journal of Science Frontier Research

Visit us on the Web at www.GlobalJournals.org | www.JournalofScience.org
or email us at helpdesk@globaljournals.org

ISSN 9755896

© Global Journals