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

Global Journal

of Science Frontier Research: C

Biological Sciences

Small Scale Cultivation

Biotechnology of Saffron

Highlights

Storage Response of Neem

Different Organic Substrates

Discovering Thoughts, Inventing Future

VOLUME 15 ISSUE 6 VERSION 1.0

Global Journal of Science Frontier Research: C
Biological Science

Global Journal of Science Frontier Research: C
Biological Science

Volume 15 Issue 6 (Ver. 1.0)

Open Association of Research Society

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 Headquarters
301st Edgewater Place Suite, 100 Edgewater Dr.-Pl,
Wakefield MASSACHUSETTS, Pin: 01880,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, 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: *investors@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)

Integrated Editorial Board
(Computer Science, Engineering, Medical, Management, Natural Science, Social Science)

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.)

Chief Author (HON.)

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

Dean & Editor-in-Chief (HON.)

Contents of the Issue

Global Journal of Science Frontier Research: C
Biological Science
Volume 15 Issue 6 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

A New Approach to Biotechnology of Saffron (Crocus Sativus L.)

By Karagyozov T. H., Mammadova M. H., Asadova S. Sh. & Azizov I. V.
Institute of Botany of Nat. Acad. Sci. of Azerbaijan, Azerbaijan

Abstract- To develop effective approaches for biotechnological propagation of saffron(*Crocus sativus L.*)*in vitro* methods for the induction of morphogenesis and organogenesis were used. Factors influencing morphogenesis and organogenesis of saffron were considered. By using a temperature gradient under *in vitro* conditions was obtained *de novo* from 10 to 25 microcorms. Some issues related to biotechnology of saffron were elucidated. The effect of the temperature factor and gibberellin on the efficiency of callus formation and morphogenesis *in vitro*werediscussed. The methodical approaches to increase the efficiency of morphogenesis and organogenesis of *Crocus sativus L.* in *in vitro* conditions were offered.

Keywords: *saffron, Crocus sativus L., in vitro, morphogenesis, temperature qradient.*

GJSFR-C Classification : *FOR Code: 270499*

Strictly as per the compliance and regulations of :

A New Approach to Biotechnology of Saffron (Crocus Sativus L.)

Karagyozov T. H. [α], Mammadova M. H. [σ], Asadova S. Sh. [ρ] & Azizov I. V. [ω]

Abstract- To develop effective approaches for biotechnological propagation of saffron(*Crocus sativus L.*)*in vitro* methods for the induction of morphogenesis and organogenesis were used. Factors influencing morphogenesis and organogenesis of saffron were considered. By using a temperature gradient under *in vitro* conditions was obtained *de novo* from 10 to 25 microcorms. Some issues related to biotechnology of saffron were elucidated. The effect of the temperature factor and gibberellin on the efficiency of callus formation and morphogenesis *in vitro*werediscussed. The methodical approaches to increase the efficiency of morphogenesis and organogenesis of *Crocus sativus L.* in *in vitro* conditions were offered.

Keywords: saffron, Crocus sativus L., in vitro, morphogenesis, temperature qradient.

I. Introduction

Saffron (*Crocus sativus L.*) as the most valuable medicinal plant known since ancient times. In recent years the area of cultivation of saffron in the world tends to increase, although in a number of European countries the production of its flower production was reduced due to the high cost and the urbanization of rural areas. Presently, demand for saffron is much higher than the norm of its reproduction. The increasing worldwide demand for floral products saffron stimulate research related to its reproduction, including with the use of biotechnological methods.

At the first international symposium on saffron biotechnology has been included in the list of priorities for the next hundred years [1]. Currently conducted biotechnology research towards the development of micro propagation techniques of different cultures, including of saffron.

Prospects for biotechnology *in vitro* considered as the basis for implementing future advances in molecular genetic improvement of saffron, as well as obtaining planting material free of pathogens.

Although research in cellular biotechnology *Crocus sativus L.* already have their own history [2-4], but so far the results achieved do not give grounds for approval of availability methodical basis, to effectively and consistently get the results that ensure the production of planting material with a sufficiently high rate of reproduction.

Author α σ ρ ω: Institute of Botany of Nat. Acad. Sci. of Azerbaijan, Baku, Azerbaijan, AZ 1073, Baku, Badamdar highway, 40.
e-mails: biotexnologaz@mail.ru, ibrahim.azizov47@gmail.com, info@fliporamailer.com

Analysis of the available information in the press really shows that one of the reasons for the current situation in this area is the lack of a common approach in researches on biotechnology in vitro.The first phase of research on the induction of callus formation, morphogenesis, organogenesis in vitro, which was characterized by the establishment of optimal concentrations of hormonal inductors, and combinations thereof, has been successfully implemented. Despite the large number and variety of options for phytohormones and received on that basis the effects did not contributed to the development of a single methodological approach. The next stage in the development of methodological approaches based on the use of low positive temperature (5°C) for the induction of organogenesis in the single-stage circuit producing microcorns from callus cells, which is common at this time.

However, the ability to maximize the use of the temperature factor is not fully implemented.

In this respect, the classic position on the impact of state initial explant on the progress in the implementation of morpho -physiological potency *in vitro* relative geophytes such as the crocus is the most illustrative.Numerous observations suggest that the winter months with negative temperatures lead to increased formation of floral organs of *Crocussativus L.*

The aim of this work was to improve the method of clonal propagation applied to saffron.

II. Material and Methods

The starting material in our research was corms of saffron. To study the effect gibberellin on embryogenesis and organogenesis corms incubated ingibberellic acid solutions of 20-50 mg / l for 12 and 24 hours. As starting explant were used discs cormssliced in the transverse direction.

Corms sterilized in 70-80% ethanol followed by 2-3 times washing with sterile water. For further sterilization used a solution of sodium hypochlorite containing 5% of the basic substance, at various dilutions with the addition of TWEEN 20. Then were washed 3-fold with sterile water for 10 -15 minutes. Sterilized corns planted on an agar medium M-S [5].

Embodiments of the medium contained BAP (benzylaminopurine) 2.4 D (2, 4 -dichlorphenoxyacetic acid), kinetin (6-furfurylaminopurine), NAA (1-naphthylacetic acid), at various concentrations (mg /

l),agar - 0.7-0.8%; sucrose - 30, 60, 90 g / l; pH - 5.6-5.8. Planted material was cultivated in the dark at 21^0 C and relative humidity of 70-80%.

III. Results and Discussion

The experiments with the use of a temperature gradient revealed variants of medium, ensuring the most effective organogenesis. In conditions of incubation at a constant temperature did not obtained organogenesis of explants *in vitro*. When had used the temperature gradient, depending on the ratios of phytohormones and initial stages of embryogenesis before temperature gradient, on medium, containing BAP (4 mg / l) and NAA (1 mg / L) had formed of 10 to 25 micro corms in a flask (Fig.1).

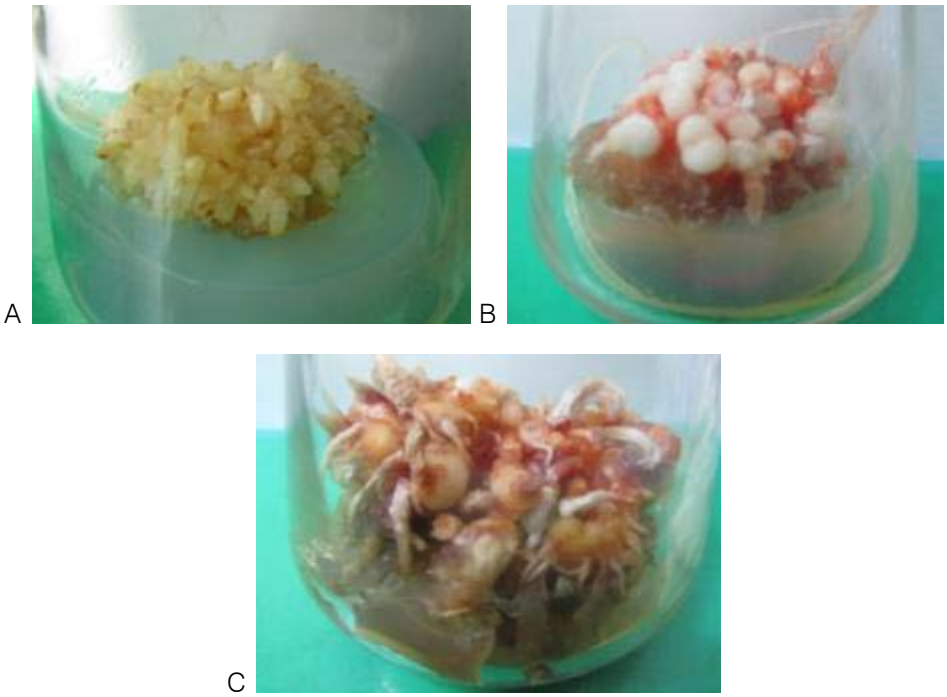


Fig.1 : Consecutive stages of embryogenesis (A), morphogenesis (B) and organogenesis (C) from Crocus sativusL. in culture *in vitro*

In the process of the temperature gradient, depending upon the composition of medium,was observed increase number of formed embryoids.

A similar effect has not presented in the literature. The applied temperature gradient could potentially allow reduce the time of incubation, which is currently equal to 5 weeks at a stable temperature.

Effect of temperature on themorpho - physiological processes may be associated with its impact on the level of free gibberellin when temperatures will contribute to their release from the bound state.Influence of exogenous gibberellin on activity of replacement meristems in corms saffron flowers and increasing the number of floral shoots had shown in the experiments [6].

Increasing the concentration of sucrose in a medium to 60 -90 g/l resulted in an increase of embryoids, but in this case significantly increased infection and it appeared relatively late. Apparently, it was associated with infection of internal tissues of corms.

Using gibberellin in our experiments was effective only in cases of environments in which were present BAP, 2,4-D and kinetin. In the absence of BAP, 2,4-D and kinetinuse of gibberellin has not very effective, and in some cases adversely affect the processes of organogenesis. This may reflect the complex interactions gibberellic acid with other phytohormones and perhaps may be particularly characteristic of corms *in vitro*. Regarding the callus cells from leaf explants *Crocus sativus L.* is evidence of a positive effect of exogenous gibberellin on organogenesis at various hormonal background[7,8].

IV. Conclusions

Thus, consideration of the above factors that could have some impact on the efficiency of organogenesis in conditions *in vitro*, as well as the use of a temperature gradient that was not applied early, allowed realize morphogenesis on the stage of organogenesis and *de novo* get corms of saffron *in vitro.*

References Références Referencias

1. Fernandez I.A. and Abdullayev F. Foreword and preface. //Proceedings of the First International

Symposium on Saffron Biology and Biotechnology. 2004. P. 3-4.
2. Fernandez J.A. Biology, biotechnology and biomedicine of saffron // Recent Research in Developmental Plant Science. -2004.- 2 s.127-159.
3. M. Kafi, A. Koocheki, MH Rashid and N. Nassiri. Saffron (Crocus sativus L.) .// Production and Processing. Enfield, NH, USA: Science Publishers. -2006-, 244 pp.
4. Fernandez, J.A. Genetic resources of saffron and allies (Crocus sativus L..) // ActaHorticulturae.-2007.-739. - P. 167-185.
5. Murashige T., Skoog F. A revised medium for rapid growth and bicassays with tobacco tissue cultures // Physiol. Plant.-1962. 15.- P. 473 -497.
6. AzizbekovaN.Sh., Milyayeva E.L., Lobova N.V. Influence of gibberellin and kinetin on formation of floral organs of saffron. // Phyziologiyaraseniy. 1978. V.25.3 P.603-609.
7. Raja W., Zaffer G., Wani S.A. In vitro microcorm formation in saffron (Crocus sativus L.) // Online articles of II İnternational Symposium on Saffron Biology and Technology. - 2007. - http://www.ishs.org / ishs-article/739_37.
8. Butenko R.G. The induction of morphogenesis in tissue culture of plant. // In: .Hormonal regulation of plant ontogenesis.M.Nauka.1984.P.42-54.

This page is intentionally left blank

Global Journal of Science Frontier Research: C
Biological Science
Volume 15 Issue 6 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Storage Response of Neem (*Azadirachta Indica* A. Juss.) Seed under Different Moisture and Temperature Regime

By Devendra Kumar
Forest Research Institute, India

Abstract- Effect of four storage temperatures (T_1-ambient room temperature (35±5°C), T_2-Air conditioner (25±2°C), T_3- Fridge (5±1°C) and T_4-Freezer (-4±1°C) and four moisture levels M_1 (38%), M_2 (21%), M_3 (12%), M_4 (5.5%) were studied on seed longevity of seeds under controlled conditions. After setting of desired moisture content seeds were then subjected to storage treatments in 200μ thick polythene bag and kept in airtight plastic container at different temperature levels and tested upto 270 days respectively. Seeds were sown in between paper (BP) for germination study in laboratory at 30±1°C and relative humidity (90±3%).

Keywords: *germination percentage, mean germination time (MGT), germination value (GV), azadirachta indica, viability.*

GJSFR-C Classification : *FOR Code: 270499*

Strictly as per the compliance and regulations of :

Storage Response of Neem (*Azadirachta Indica* A. Juss.) Seed under Different Moisture and Temperature Regime

Devendra Kumar

Abstract- Effect of four storage temperatures (T_1-ambient room temperature (35±5ºC), T_2-Air conditioner (25±2ºC), T_3- Fridge (5±1ºC) and T_4-Freezer (-4±1ºC) and four moisture levels M_1 (38%), M_2 (21%), M_3 (12%), M_4 (5.5%) were studied on seed longevity of seeds under controlled conditions. After setting of desired moisture content seeds were then subjected to storage treatments in 200μ thick polythene bag and kept in airtight plastic container at different temperature levels and tested upto 270 days respectively. Seeds were sown in between paper (BP) for germination study in laboratory at 30±1ºC and relative humidity (90±3%).

Freshly collected seeds after drying at target levels showed germination from 93 to 96.5 %. Seeds having M_1, M_2 and M_3 moisture content completely lost germination well before 90 days at T_1 temperature. Seeds of M_4 moisture level showed 55.37% decline in germination upto 90 days. Seeds containing moisture M_1, M_2, M_3 and M_4 at T_2 and T_3 level showed 100%, 56.5%, 14.74%, 5.21% and 100%, 18.14%, 11.58%, 6.25% respectively decline in germination upto 90 days of storage. Seeds (M_4) stored at T_4 level showed 20.83% reduction in seed germination. After 150 days of seed storage, the rate of decline was observed higher in T_1 at all level of moistures, T_2 at M_1 (100%), M_2 (64.29%), M_3 (8.64%), M_4 (5.69%) and in T_3 at M_1 (100%), M_2 (8.61%), M_3 (16.67%), M_4 (8.89%). Rate of decline in germination percentage was lower at T_4 temperature and M_4 (3.46%) moisture level between these two periods. Seeds stored at low temperature and moisture content (T_3M_4) exhibited greater mean viability period (P_{50}, 326 days) as compared to the seeds stored at higher temperature and moisture. However, P_{50} was not increased when seeds were stored at lower temperature and moisture content (T_4M_4, 184 days). Thus present finding reveals that seeds of neem may be stored at 5±1ºC (T_3) temperature with moisture 5.5% (M_4) for 326 days (P_{50}) and data also indicate the orthodox behaviour of neem seed of this region.

Keywords: germination percentage, mean germination time (MGT), germination value (GV), azadirachta indica, viability.

I. Introduction

The seed's longevity can be predicted successfully from moisture content and storage temperature specifications for most of the species. Those seeds can be dried to moisture content of 5% are generally regarded as desiccation tolerant and known as orthodox seeds. They can usually be stored for periods of many years. Longevity of orthodox seeds is increased in a specific and predictable way, over a wide range of environmental conditions by decreasing storage temperature and moisture (Roberts 1973). The seeds that require relatively high moisture content to maintain maximum viability are termed as recalcitrant. Recalcitrant seeds are sensitive to desiccation and low temperature (Chin and Roberts 1980; Hanson 1984; Pammenter and Berjak 1999). Storage life of such seeds ranges from few days to few months. These seeds are shed at high moisture contents and are intolerant of dehydration and of chilling. A further group of seeds that demonstrate behaviour intermediate between the afore-mentioned categories of desiccation tolerance and storage behaviour has been described (Ellis et al. 1990, 1991).

Neem (*Azadirachta indica*, A. Juss.) belongs to Meliaceae family, is an important multipuopose tree species for arid and semi arid regions. It is generally propagated by seeds; however, the seed have a short storage life and loose viability rapidly which is a major problem for tree planting programmes. Neem, seeds of Asian origin have been shown more or less recalcitrant (Gamene et al. 1994) while those of African provenances as orthodox (Bellefontaine and Audinet 1993). However, behaviour of neem seed has been described as short-lived (Ezumah 1986; Maithani et al. 1989). Some researchers have categorized it as having intermediate storage longevity (Sacandé et al. 1996, 1998; Hong and Ellis 1998). It has a short period of seed viability (Gamene et al. 1996) and is mainly determined by the level of desiccation tolerance of the seeds (Roberts and Ellis 1989; Kraak 1993). Berjak and Dumet (1996) also reported neem seeds having intermediate to recalcitrant storage behaviour and could be stored as intact seeds or as isolated embryonic axes while Sacandé et al. (2000) reported that storage behaviour of neem seeds has features that characterize it as orthodox. The longevity of neem seeds appears very uncertain. Thus there are many conflicting reports as to the status of seed as recalcitrant, intermediate or orthodox probably owing to the limited desiccation conditions to determine the desiccation tolerance of seed and their subsequent longevity.

Author: Forest Tree Seed Laboratory, Silviculture Division, Forest Research Institute, P.O. New Forest, Dehradun -248006, India.
e-mail: drdevendrakumar1968@yahoo.co.in

In the present study, an attempt has been made to determine the optimum temperature and moisture content during the storage of neem seed which may provide a lead for researchers to resolve of seed storage behaviour protocol of neem seed.

II. Material and Methods

Twenty middle aged neem trees were selected for seed collection around the Jodhpur city (latitude 24° 40'N and longitude 71°15'E), Rajasthan, India. Out of twenty trees, ten tree randomly taken for study. Seeds from all ten trees were collected during July, 2003 and mixed lots were prepared for experiments. The temperature was mean min 20-22°C and mean max 33-34°C and humidity between 22-59% during the entire experiment period. The green-yellow colour (Kumar and Mishra 2007) fruits were collected directly from tree branches (Kumar and Mishra 2007) of selected seed stand. Fruits were kept in gunny bags at ambient room temperature (35±5°C) for one day to soften the pulp. Seeds were extracted (Kumar et al. 2007, 2009), and Seed were dried in a dryer at 45±1°C to take various moisture level of seeds for experiment. Four initial moisture levels M_1 (38%), M_2 (21%), M_3 (12%), M_4 (5.5%) and four storage temperatures (T_1-ambient room temperature (35±5°C), T_2-air conditioner (25±2°C), T_3-referigerator (5±1°C) and T_4-fridger (-4±1°C) were taken for study (Table 1) on seed longevity under controlled conditions. Moisture content was determined as per ISTA (1993) at initial level only.

Seeds were then subjected to storage treatments in sealed 200μ thick polythene bags and kept in airtight plastic container at different temperature level and tested upto 270 days respectively. Germination test were conducted in laboratory. Seeds were sown in between paper (BP) for germination study (Kumar et al. 2007) using four replications of 100 seeds each incubated at 30±1°C and 90±5% R.H. (Relative humidity). Germination data were recorded daily up to 21 days and seed was considered germinated when radicle became 1 cm in length. Speed of germination in terms of Mean Germination Time (MGT) in days was calculated as per Rawat and Thapliyal (2003) and germination value was calculated as per the method described by Djavanshir and Pourbeik (1976). The obtained data of germination percentage, germination value (GV) and time taken to complete germination in terms of mean germination time (MGT) were analyzed through ANOVA using SPSS computer package. The P values < 0.05 were taken as significant.

Probit Analysis for Prediction of Mean viability period (P_{50})

Survival curves were derived by using probit analysis (Roberts 1973). Survival curves were drawn between expected germination and storage period (days). For all the experiment conducted in laboratory the pattern of decline in germination in each condition was subjected to probit analysis for estimating the mean viability period i.e. P_{50} (half viability period or time taken for death of 50% seeds). The germination data were transformed to probit values (Finney 1952) and then subjected to regression with storage period in days. The slope of the regression line from this probit analysis indicated the rate of deterioration (Vertucci et al. 1994). Because 0 cannot be converted into probit value, where such values were obtained experimentally. They were given a constant value of 0.5%. The P_{50} was calculated for each storage condition separately from the regression equation developed as above.

III. Results

Seeds containing different moisture levels were stored at various levels of temperature as described in materials and methods and tested up to 270 days. Freshly collected seeds after drying at target levels showed germination from 93 to 96.5 % (Table 1). Seeds having M_1, M_2 and M_3 moisture content completely lost germination well before 90 days at T_1 temperature. Seeds of M_4 moisture level seeds showed 55.37% decline in germination up to 90 days. Seeds containing moisture M_1, M_2, M_3 and M_4 at T_2 and T_3 level showed 100%, 56.5%, 14.74%, 5.21% and 100%, 18.14%, 11.58%, 6.25% respectively decline in germination up to 90 days of storage. Seeds (M_4) stored at T_4 level showed 20.83% reduction in seed germination. Seeds stored for longer period (150 days), the rate of decline was observed higher in T_1 at all level of moistures, T_2 at M_1 (100%), M_2 (64.29%), M_3 (8.64%), M_4 (5.69%) and in T_3 at M_1 (100%), M_2 (8.61%), M_3 (16.67%), M_4 (8.89%). Rate of decline in germination percentage was lower at T_4 temperature and M_4 (3.46%) between these two periods.

Germination percentage obtained after different periods of storage under each condition were transformed to probit values. These values were subjected probit analysis against days of storage for each condition separately Figure 1A-1D. With the help of regression equations, expected probit germination was calculated. The expected probit germination was transformed into expected germination and resulting survival curves were presented in Figure 2. It is evident from the survival curves that the more flat gradient, the greater variation between seeds and viability periods. At higher temperatures the gradient is steeper and exhibited rapid deterioration of seeds. The pattern of decline in germination at different level of temperature moisture is shown in Figure 2. Seeds stored at lower temperature and moisture content exhibited greater P_{50} of T_3M_4 (326 days) (Table 6) as compared to the seeds stored at higher temperature and moisture content. However, P_{50} was not increased when seeds were stored at lower temperature and moisture content (T_4M_4, 184 days). Other combinations of temperature and moisture showed P_{50} of 201 days (T_3M_2), 169 days

(T_3M_3), 146 days (T_2M_3), 85 days (T_1M_4), 80 days (T_1M_2) and T_1M_1, T_1M_2, T_1M_3, T_2M_1 and T_3M_1 showed lowest P_{50} of 31 days for each (Table 6).

Effect of Temperature on Longevity of Seed

Seeds showed significant variation in longevity within the same temperature at varied level of moisture content. It is evident from Table 2 that seeds stored at high temperature lost viability very soon. Seeds stored at lower temperature maintained viability well. T_3 exhibited highest mean germination percentage (53.06) followed by T_2 and T_1 with 44.44 and 17.63 respectively as storage temperature reduced, the mean germination percentage increased. The pattern of decline in MGT is shown in Figure 3. Mean MGT was lowest at T_3 (11.93 days) followed by T_2 and T_1 with 12.72 and 14.59 days respectively (Table 3). The maximum mean GV exhibited by T_3 (27.28) followed by T_2 (22.20) and T_1 (10.39). The moisture decreased and GV was increased (Table 4).

Effect of Moisture on Longevity of Seed

Seeds showed significant variation in germination with moisture content reduction. Low moisture content increased and maintained viability for longer period as compared to those treatments having higher moisture content. M_4 showed higher mean germination percentage (61.47) followed by M_3, M_2 and M_1 with 41.89, 34.64 and 15.50 respectively (Table 2). The mean MGT decreased with decrease in moisture content. The moisture M_4 exhibited lowest mean MGT followed by M_3, M_2 and M_1 with 12.73, 13.30 and 14.78 respectively (Table 3). The maximum mean GV was recorded in M_4 (31.43) followed by M_3 and M_2 with 21.11, 17.68 respectively. The M_1 exhibited poorer mean GV (Table 4).

Interactive Effect of Moisture and Temperature on Longevity of Seed

The interaction of temperature and seed moisture content in maintaining viability over a period of time is quite evident in Table 2 to 4. Seed stored at higher moisture content lost germination rapidly at higher temperature as compared to seed stored at lower moisture contents. Similarly seed dried to lower moisture contents maintained viability much better even at higher temperature. Seed stored at higher temperature (T_1) with high moisture content (M_1) showed significant lower mean germination percentage (15.50) followed by M_2 and M_3 with 16.08 and 15.83 respectively. M_4 exhibited better mean germination percentage at this temperature (23.08). Significantly maximum mean germination percentage exhibited by M_4T_3 (82.50) and M_4T_2 (78.83) combinations followed by T_3M_2, T_2M_3 and T_3M_3 combinations with 62.25, 57.83 and 52.00 percent respectively (Table 2).

T_3 temperature exhibited lower mean MGT (11.93 days) followed by T_2 and T_3 with 12.72 days and 14.59 days respectively. The lower MGT was exhibited by T_3M_4 (9.91 days) followed by T_2M_4 (10.50 days), T_3M_2, T_3M_2 and T_2M_3, they exhibited significantly lower MGT with 11.21, 11.82, 11.63 days respectively and remained insignificant with each other (Table 3).. The poorer MGT exhibited by T_1M_4 (14.12 days), T_2M_2 (13.98 days) followed by T_1M_1, T_1M_2, T_1M_3, T_2M_1, T_3M_1 (Table 2) and T_1M_1, T_1M_2, T_1M_3, T_2M_1, T_3M_1 remained insignificant with each other. T_3M_4 exhibited maximum GV (43.15) followed by T_2M_4 (39.18) and remained insignificant. T_3M_2 (30.05) was followed by T_2M_3 and T_3M_3 with 27.40 and 26.32 respectively. Rest combinations of various temperatures and moistures showed poorer GV (Table 4).

When seeds were stored at very low temperature (T_4, -4°C) at low moisture (M_4), mean germination percentage (58.07) and mean germination value (28.54) were reduced. MGT was also higher (11.17 days) (Table 5) as compared to T_3M_4. However, these results were better than seeds stored at ambient room temperature (T_1M_4). Taken as a whole temperature T_3 (5°C) and moisture M_4 (5.5%) were observed the best combination of temperature and moisture.

IV. Discussion

Reduction in moisture content of seed and lowering the temperature and relative humidity in which seed is stored extends the storage life of most seeds. The moisture content of seed is directly affected by the relative humidity of the atmosphere around it. As the relative humidity increases the seed moisture percentage are also increases. Seeds are shed from the parent plant at low moisture content, having undergone maturation drying and are capable of tolerating dehydration down to 5 to 6 percent are called orthodox seed. When dry, the viability of these seeds can be prolonged by keeping them at the lowest temperatures and moisture (Roberts 1972). In contrast, recalcitrant seeds do not undergone maturation drying and are shed at relatively high moisture contents. Seeds of most tropical and subtropical trees and shrubs are recalcitrant (King and Roberts 1979; Hanson 1984) seeds are not storable under conditions suitable for orthodox seeds (Roberts et al. 1984). These seeds can only be stored in wet medium to avoid dehydration injury and at relatively warm conditions as these are mostly sensitive to chilling injury (Lyons et al. 1979; Chin and Roberts 1980; Graham and Patterson 1982). There is no successful method for long-term storage of recalcitrant seeds. Whether neem is a genuine recalcitrant or short live orthodox species, however, is still nebulous (Willan 1985). Occurrence of high moisture content in fresh seeds (Maithani et al. 1989) and manifestation of chilling damage by the seeds (Ezumah 1986; Maithani et al. 1989). But on the basis of low moisture content of seeds from a Haiti plantation it has been argued that neem is not a recalcitrant species (Chaney and Knudson 1988).

The viability of neem seed declines rapidly with storage period increased. Most works report poor or no germination after 2-6 months of storage (Tiwari 1992). Survival of seeds with high moisture content (30-40%) is in the range of a few to 12 weeks (Chaisurisri et al. 1986). Seeds dried upto 10-12% moisture contents can be stored only a few months (Ponnuswamy et al. 1990), which led to the idea that neem seed is recalcitrant. However the storage of seeds with low moisture content of 5-8% and at 4°C resulted in 40% viability after a number of years (Roederer and Bellefontaine 1989, Dickie and Smith 1992, Bellefontaine and Audinet 1993). Nevertheless, neem seed does not behave like truly orthodox seed that can tolerate drying to very low moisture content (1-2%) and storage at low temperature.

In case of this study desiccation of seed increased the longevity brought down at moisture content upto M_4 (5.5%) in storage and these seeds were found to tolerate desiccation without significant loss in viability. Present studies are in accordance with the finding of Sacande et al. (1998), Sacande and Hoekshtra (1999) and Sacande (2000). In contrast to our studies Gamene et al. (1996) mentioned that drying of neem seed upto 6.4 and 4.8% moisture content resulted in significant loss of germination while 9-13% moisture content was best for storage. However, Pammentor and Berjak (1999) reported below 5% moisture content was sensitive to desiccation damage that occurs water, required maintaining the integrity of intracellular structure removed.

The seed stored at lower temperature (-4°C) with lower moisture content (M_4) also showed significant loss of viability due to chilling injury of seeds. In this study relatively faster loss of viability was noticed in M_1, M_2 followed by M_3 at all the temperatures. Present studies are in accordance with Berjak et al. (1995). In present studies, optimum conditions (lower moisture content (M_4 -5.5%) and temperature (T_3 5±1°C)) for storage were observed significantly better and in accordance with Hong and Ellis (1988) and Sacande et al. 1996.

Chilling sensitivity was particularly prominent in this material and also known for other intermediate and recalcitrant seed types of tropical origin (Corbineau and Come 1988, Chine et al. 1989, Tompsett 1994). The chilling sensitivity of the fruits and leaves of tropical plants has been attributed to a conformational transition in cell membranes from the liquid crystalline to gel phase (Lyons et al. 1979, Wang 1982), often followed by lateral phase separation of the components of the membrane (Platt-Alota and Thomson 1987). Diagnostic for such phenomena are leakage of cytoplasmic solutes from the cell and the dysfunction of membrane proteins (Yamawaki et al. 1983, Yoshida et al. 1986). The transition temperature (T_m) of membranes in chilling sensitive tropical plants has been estimated at approximately 10°C (Crowe et al. 1989), which means that membrane is in liquid crystalline phase under ambient conditions. In neem seeds storage below 10°C was successful than above 10°C.

Those seeds were stored at very low temperature (T_4, -4°C) at low moisture (M_4), reduced mean germination percentage (58.07) and mean germination value (28.54) was observed. MGT was also higher as compared T_3M_4. Over all temperature T_3 (5°C) and moisture M_4 (5.5%) were observed the best combination of temperature and moisture level for storage of seed in controlled conditions. Studies are in accordance with Sacande et al. 2000 as they reported that the storage behaviour of neem seeds has featured that characterize it as orthodox.

V. Acknowledgement

Author is thankful to Director, AFRI, Jodhpur (Raj.), India for providing facilities for the execution of the work.

References Références Referencias

1. Bellefontaine, R. and Audinet, M. 1993. La conservation de graines de neem (*Azadirachta indica* A. Juss.). In: Some, L.M. and De Kam, M. (eds.), *Tree seed problems*, *with special reference to Africa*, Barkhuys Publishers, Leiden, The Netherlands, pp. 268-274.
2. Berjak, P., Dumet, D. 1996. Cryopreservation of seeds and isolated embryonic axes of Neem (*Azadirachta indica*). *Cryo-Letters*, **17**: 99-104.
3. Berjak, P., Campbell, G.K., Farrant, J.M., Omandi-Oloo, W., Pammenter, N.W. 1995. Responses of seeds of *Azadirachta indica* (neem) to short-term storage under ambient or chilled conditions. *Seed Science and Technology*, **23**: 779-792.
4. Chaisurisri, K., Ponoy, B., Wasuwanich, P. 1986. Storage of *Azadirachta indica* A. Juss. Seeds. *The Embryon*, 1: 19-27.
5. Chaney, W.R., Knudson, D.M. 1988. Germination of seeds of *Azadirachta indica* enhanced by endocarp removal. *International Tree Crop Journal*, **5**: 230-233.
6. Chin, H.F. and Roberts, E.H. 1980. Recalcitrant crop seeds. Tropical press, Kualalumper, Malaysia.
7. Chin, H.F., Krisinapillay, B., Stanwood, P.C. 1989. Seed moisture recalcitrant vs. orthodox seeds. In: Stanwood, P.C. and McDonald, M.B. (eds.), *Seed Moisture*, CSSA Special Publisher, No.14. Madison, USA, Crop Science Society of America, pp- 5-22.
8. Corbineau, F. and Come, D. 1988. Storage of recalcitrant seeds of four tropical species. *Seed Science and Technology*, **16**: 97-103.
9. Crowe, J.H., Hoekstra, F.A., Crowe, I.M., Anchordologuy, T.J., Dorbnis, E. 1989. Lipid phase transitions measured in intact cells with Fourier

transform infrared spectroscopy. *Cryobiology*, **26**: 76-84.
10. Dickie, J.B. and Smith, R.D. 1992. Limits to the survival of essentially orthodox seeds at low moisture contents in some woody species. Poster, Fourth International workshop on seeds, Angers, France.
11. Djavanshir, K., Pourbeik, H. 1976. Germination value –a new formula. *Silvae Genetica*, **25**: 79-83.
12. Ellis, R.H., Hong, T.D., Roberts, E.H. 1990a. An intermediate category of seed storage behaviour of Coffee. *Journal of Experimental Botany*, **41**: 1167-1174.
13. Ellis, R.H., Hong, T.D. and Roberts, E.H. 1990b. Moisture content and the longevity of seeds of *Phaseolus vulgaris*. *Annals of Botany*, **66**: 341-348.
14. Ellis, R.H., Hong, T.D., Roberts, E.H. 1991. An intermediate category of seed storage behaviour II. Effects of provenance, immaturity and imbibition on desiccation-tolerance in coffee. *Journal of Experimental Botany*, **42**: 653-657.
15. Ezumah, B.S. 1986. Germination of storage of neem (*Azadirachta indica* A. Juss.). *Seed Science and Technology*, **14**: 593-600.
16. Finney, D.J. 1952. Plant Analysis. II edition. Cambridge.
17. Gamene, C.S., Kraak, H.L. and Pijlen, J.G. 1994. *Azadirachta indica* seeds from Burkina Faso: intermediate storage behaviour, In: *Proceeding of the International Workshop on Desiccation Tolerance and Sensitivity of Seeds and Vegetative Plant Tissues*, Kruger National Park, South Africa, pp- 23.
18. Gamene, C.S., Kraak, H.L., Van Pijlen, J.G., De Vos, C.H.R. 1996. Storage behaviour of neem (*A. indica*) seeds from Burkino Faso. *Seed Science and Technology*, **24**: 441-448.
19. Graham, M., Patterson, B.D. 1982. Responses of plants to low, non-freezing temperatures: proteins, metabolism and acclimation. Annual Review of Plant Physiology, **33**: 347-372.
20. Hanson, J. 1984. The storage of seeds of tropical fruits, In: Holden, J.H.W. and Williams, J.T. (eds.) *Crop Genetic Resources: Conservation and evaluation*, Allen and Unwin London, pp-53-62.
21. ISTA 1993. International Rules for Seed Testing. *Seed Science and Technology*, **21**.
22. King, M.W. and Roberts, E.H. 1979. The storage of recalcitrant seed- achievements and possible approaches. International Board for Plant Genetic Resources, Rome.
23. Kraak, H.L. 1993. Physiological aspects of storage of recalcitrant seeds, In: Some, L.M. and De Kam, M. (eds.) "*Tree seed problems, with special reference to Africa*", Bakhuys Publishers, Leiden, The Netherlands, pp- 239-253.
24. Kumar, Devendra, Mishra, D.K., Singh, B., Singh, V.P. 2008. Effect of methods of drying on viability, storability and seedling performance of Neem (*Azadirachta indica* A. Juss.) seeds. *The Indian Forrester*, **134**: 991-1002.
25. Kumar, Devendra, Mishra, D.K., Singh, B. 2007. Effect of temperature, media and light on germination of Neem (*Azadirachta indica* A. Juss.) seeds. *The Indian Forrester*, **133**: 1636-1642.
26. Kumar, Devendra, Mishra, D.K., Singh, R. 2007. Effect of different methods of seed extraction on viability, storability and seedling performance of neem (*Azadirachta indica* A. Juss.) seeds. *My Forest*, **43**:129-138.
27. Kumar, Devendra, Mishra, D.K., Sharma, S.K. 2009. A simplified package of seed processing of important agro forestry species (*Azadirachta indica* A. Juss.) for forestry field personals. In: Singh, O. and Singh, V.R.R. (eds.), Proceeding of "*IV National Forestry Conference*", 9th-11th November, 2009, organized at Forest Research Institute, Dehradun, India, pp- 82-90.
28. Kumar Devendra, Mishra, D.K. 2007. Effect of methods of seed collection on seed qualities and storability of *Azadirachta indica* A. Juss. (Neem) seed. *Journal of Non Timber Forest Produce*, **14**: 271-276.
29. Kumar Devendra, Mishra, D.K. 2007. Effect of fruits colour on germination, storability, and seedling performance in Neem (*Azadirachta indica* A. Juss.) seed. *Journal of Non Timber Forest Produce*, **14**: 209-215.
30. Lyons, J.M., Raison, J.K., Steponkus, S.L. 1979. The plant membrane in response to low temperature: an overview. In: J. M., Graham, D. and Raison, J.K. (eds.), *Low temperature stress on crop plants. The role of the membrane*, Lyons, New York, USA, Academic Press, pp- 1-24.
31. Maithani, G.P., Bahuguna, V.K., Rawat, M.M.S., Sood, O.P. 1989. Fruit maturity and interrelated effects of temperatures and container on longevity of neem (*Azadirachta indica*) seed. *The Indian Forester*, **115**: 89-97.
32. Pammenter, N.W., Berjak, P. 1999. A review of recalcitrant seed physiology in relation to desiccation-tolerance mechanism. *Seed Science and Technology*, **9**: 13-37.
33. Platt-Alota, K.A., Thomson, W.W. 1987. Freeze fracture evidence for lateral phase separation in the plasmalemma of chilling injured avocado fruit. *Protoplasma*, **136**: 71-80.
34. Ponnuswamay, A.S., Vinaya Rai, R.S., Surendran, C., Karivaratharaju, T.V. 1990. Studies on maintaining seed longevity and the effect of fruit grades in neem (*Azadirachta indica*). *Journal of Tropical Forest Science*, **3**: 285-290.
35. Rawat, M.M.S., Thapliyal, R.C. (2003). Endogenous rhythm in seed germination of *Dendrocalamus strictus*. *Seed Science and Technology*, **31**: 21-27.

36. Roberts, E.H. 1972. Storage environment and the control of viability. In: Roberts, E.H. (ed.), *Viability of seeds* Chapman and Hall, London, pp- 14-58
37. Roberts, E.H. 1973. Predicting the storage life of seeds. *Seed Science and Technology*, **1**: 499-514.
38. Roberts, E.H., Ellis, R.H. 1989. Water and seed survival. *Annals of Botany*, 63: 39-52.
39. Roberts, E.H., King, M.W. and Ellis, R.H. 1984. Recalcitrant seeds- their recognition and storage. In: Holden, J.H.W. and Williams (eds), *Crop Genetic Resources- Conservation and Evaluation*, George Allen & Unwin, London, pp- 38-52.
40. Roederer, Y., Bellefontaine, R. 1989. Can Neem seed be expected to keep their germination capacity for several years after collection? *Forest Genetic Resources Information*, **17**: 30-33.
41. Sacande, M., Van Pijlen, J.C., De Vos, C.H.R., Hoekstra, F.A., Bino, R.J., Groot, S.P.C. 1996. Intermediate storage behaviour of neem tree (*Azadirachta indica*) seeds from Burkino Faso. In: A.S. Poulsen, and Stubsgaard, F. (eds.), *Improved methods for the handling and storage of intermediate /recalcitrant tropical forest tree seeds*, Ouedraogo, Rome, Italy, International Plant Genetic Resources Institute (IPGRI),pp-101-104.
42. Sacande, M., Folkert A. Hockstra, Jaap G. Pijlen, Groot, S.P.C. 1998. A multifactorial study of conditions influencing longevity of neem (*Azadirachta indica*) seeds . *Seed Science and Technology*, **8**: 473-482.
43. Sacande, M. and Hoekstra, F.A., 1999. *Improving the storage longevity of intermediate neem* (*Azadirachta indica*) *seeds*. In: Marzalina, M., Khoo, K.C., Jayanthi, N., Tsan, F.Y., Krishnapillay, B. (eds) IUFRO Seed Symposium -1998 "Recalcitrant seeds"; Proceedings of the Conference, Kualampur, Malaysia, 12-15 October, 1998. 1999, pp. 64-73.
44. Tiwari, D.N. 1992. Monograph on Neem (*Azadirachta indica* A. Juss). International Book Distributors, Dehradun, India.
45. Tompsett, P.B. 1994. Capture of genetic resources by collection and storage of seeds: a physiological approach. In: Leakey, R.R.B. and Newton, A.C. (eds.), *Tropical Trees: the potential for domestication and the rebuilding of forest resources*, ITE Symposium No 29. ECTF Symposium No 1, London, HMSO, pp-61-71.
46. Vertucci, C.W., Roos, E.E., Crane, J. 1994. Theorical basis of protocols for seed storage III>Optimum moisture contents for pea seeds stored at different temperature. *Annal of Botany*, **74**: 531-540.
47. Wang, C.Y. 1982. Physiological and biochemical responses of plants to chilling stress. Horticulture Science, **17**: 173-186.
48. Willan, R.L. 1985. A guide to Forest seed handling with special reference to the tropics. FAO Forestry Paper 20/2. FAO, Rome.
49. Yamawaki, K., Yamauchi, N., Chachin, K., Iwata, T. 1983. Relationships of mitochondrial enzyme activity to chilling injury of cucumber fruit. *Journal of the Japanese Society for Horticulture Science*, **52**: 93-98.
50. Yoshida, S., Kawata, T., Uemura, M. and Niki, T. 1986. Properties of plasma membrane isolated from chilling sensitive etiolated seedlings of *Vigna radiata* L. *Plant Physiology,* 80: 152-160.

Table 1 : Moisture and temperature levels taken for study and initial germination percentage under controlled environment. Values are means of four replications and each replication contains 100 seeds

Temperatures Level	Moistures Level	Target Moistures	Time taken to target moisture	Initial Germination
T_1 (35±5°C)	M_1	38%	12 hrs	93%
T_2 (25±2°C)	M_2	21%	17 hrs	96.5%
T_3 (5±1°C)	M_3	12%	42 hrs	96.5%
T_4 (-4±1°C)	M_4	5.5%	144 hrs	96%

Table 2 : Effect of moisture and temperature on mean germination percentage during storage of seeds. Seed lots were stored for 270 days in a sealed polythene (200μ thick) bag in an airtight plastic container at desired incubation temperatures after drying of seeds upto indicated moisture levels. Seeds performance was taken at 0 days (fresh), 30, 60, 90, 105, 150, 180, 210 and 270 days of storage under controlled environment. Values are means of four replications and each replication contains 100 seeds. Values in parenthesis are arc sin transformed

Temperatures	Moistures				
	M_1	M_2	M_3	M_4	Mean
T_1	15.50 [f] (12.54)	16.08 [f] (13.31)	15.83 [f] (12.97)	23.08 [e] (19.95)	17.63 [c] (14.69)
T_2	15.50 [f] (12.54)	25.58 [d] (23.84)	57.83 [c] (48.29)	78.83 [a] (64.43)	44.44 [b] (37.27)
T_3	15.50 [f] (12.54)	62.25 [b] (53.45)	52.00 [c] (46.56)	82.50 [a] (66.30)	53.06 [a] (44.71)
Mean	15.50 [d] (12.54)	34.64 [c] (30.20)	41.89 [b] (35.94)	61.47 [a] (50.23)	

Table 3 : Effect of moisture and temperature on mean MGT/speed of germination (days) during storage of seeds under controlled environment. Values are means of four replications and each replication contains 100 seeds

Temperatures	Moistures				
	M_1	M_2	M_3	M_4	Mean
T_1	14.78 [a]	14.72 [a]	14.74 [a]	14.12 [b]	14.59 [a]
T_2	14.78 [a]	13.98 [b]	11.63 [c]	10.50 [d]	12.72 [b]
T_3	14.78 [a]	11.21 [c]	11.82 [c]	9.91 [e]	11.93 [c]
Mean	14.78 [a]	13.30 [b]	12.73 [c]	11.51 [d]	

Values not followed by same letter are significantly different (P>0.05)

Table 4 : Effect of moisture and temperature on mean germination value (GV) during storage of seeds under controlled environment. Values are means of four replications and each replication contains 100 seeds

Temperatures	Moistures				
	M_1	M_2	M_3	M_4	Mean
T_1	9.62 [c]	10.37 [c]	9.62 [c]	11.95 [c]	10.39 [c]
T_2	9.62 [c]	12.63 [c]	27.40 [b]	39.18 [a]	22.20 [b]
T_3	9.62 [c]	30.05 [b]	26.32 [b]	43.15 [a]	27.28 [a]
Mean	9.62 [d]	17.68 [c]	21.11 [b]	31.43 [a]	

Values not followed by same letter are significantly different (P>0.05)

Table 5 : Effect of lower moisture and lower temperature on mean germination percentage, mean germination time (MGT) /speed of germination (days) and germination value (GV) during storage of seeds. Seed lots were stored for 270 days in a sealed polythene (200μ thick) bag in an airtight plastic container at desired incubation temperatures after drying of seeds upto indicated moisture levels. Seeds performance was taken at 0 days (fresh), 30, 60, 90, 105, 150, 180, 210 and 270 days of storage under controlled environment. Values are means of four replications and each replication contains 100 seeds. Values in parenthesis are arc sin transformed

Temperature	Moisture M_4 (5.5%)		
	Germination (%)	MGT	GV
T_4 (-4±1ºC)	58.07 (50.37)	11.17	28.54

Values not followed by same letter are significantly different (P>0.05)

Table 6 : Effect of different moistures and temperatures on the half viability period (P_{50}) on seed longevity

Temperatures	Moistures			
	M_1	M_2	M_3	M_4
T_1	31 days	31 days	31 days	85 days
T_2	31 days	80 days	146 days	278 days
T_3	31 days	201 days	169 days	326 days
T_4	-	-	-	184 days

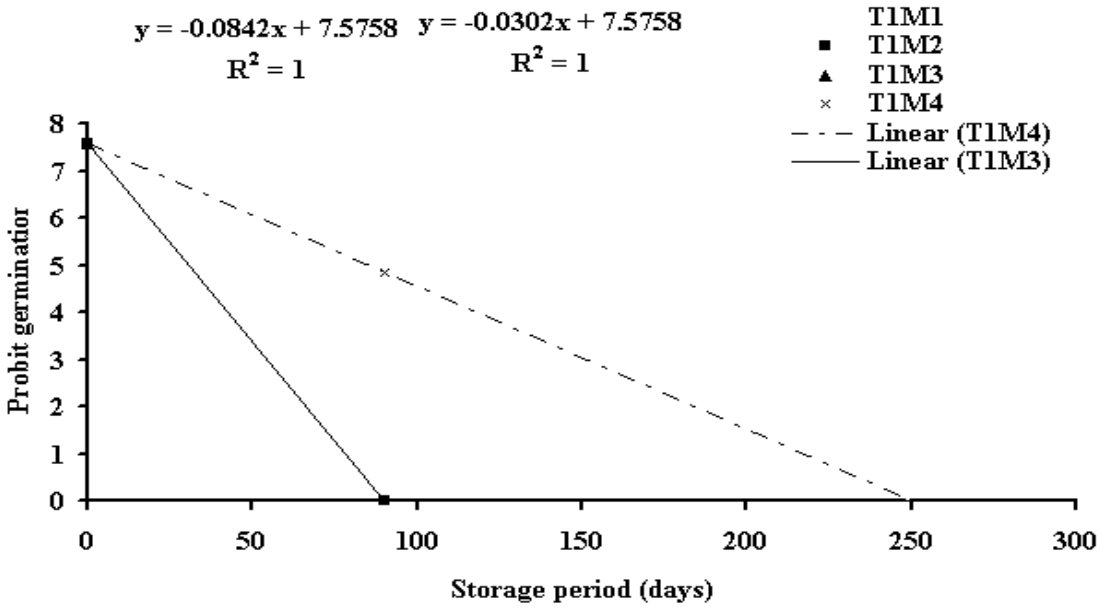


Figure 1A : Regression between probit germination and storage period (days) for seeds of different moisture levels (%) stored at ambient room temperature (T_1, 35±5°C)

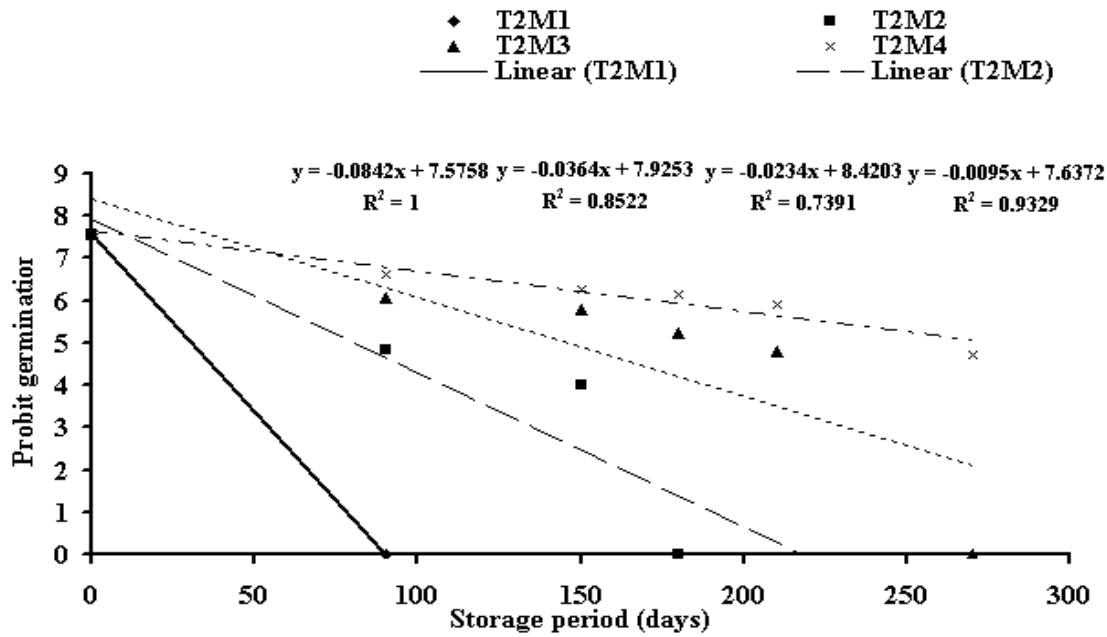


Figure 1B : Regression between probit germination and storage period (days) for seeds of different moisture levels (%) stored at T_2 temperature (25±2°C)

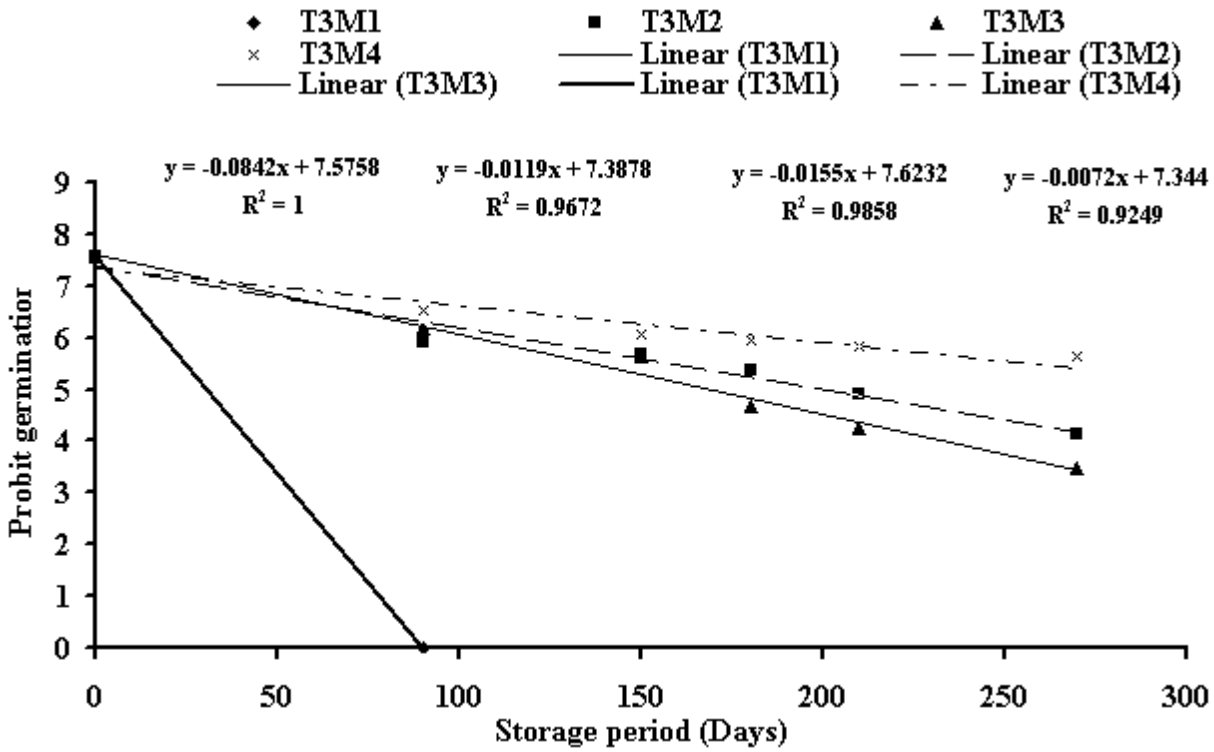


Figure 1C : Regression between probit germination and storage period (days) for seeds of different moisture levels (%) stored at T_3 temperature (5±1°C)

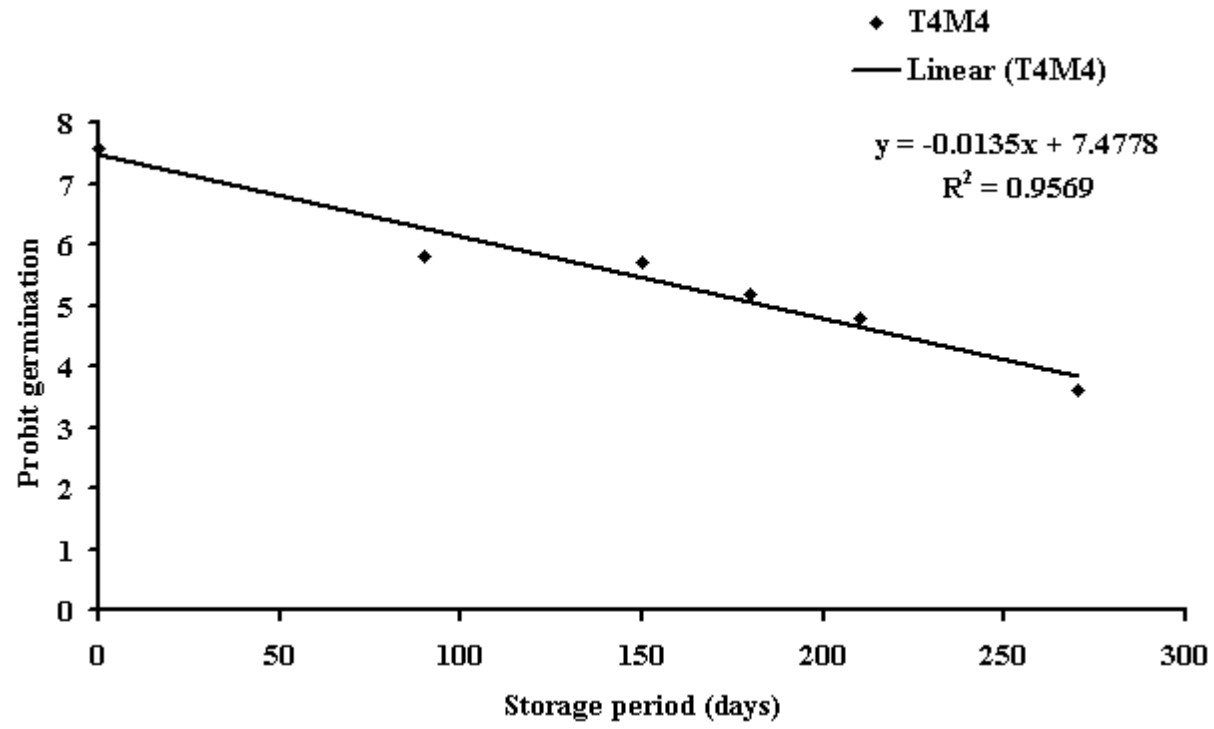


Figure 1D : Regression between probit germination and storage period (days) for seed of M4 moisture stored at T_4 temperature (-4±1°C).

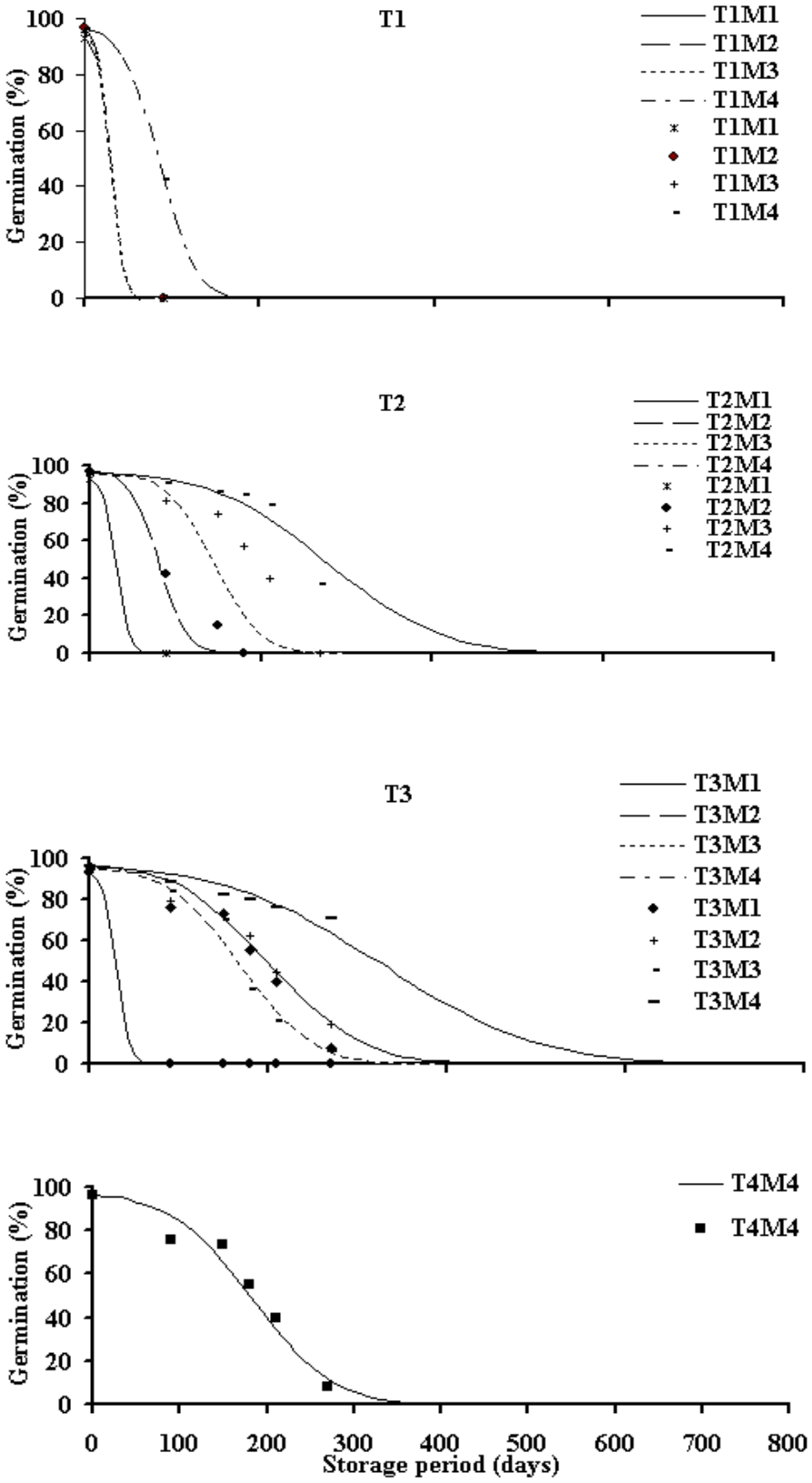
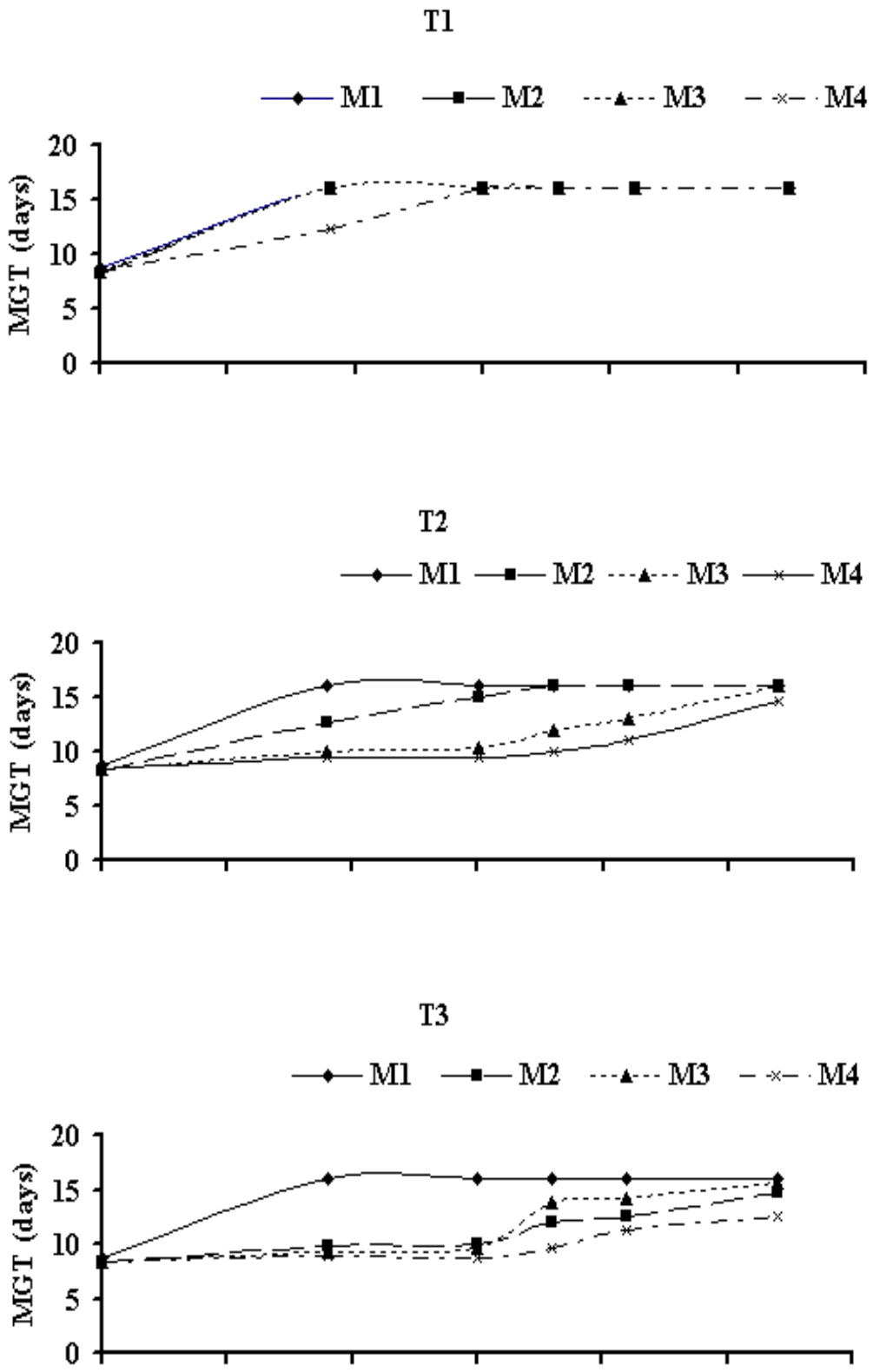


Figure 2 : Effect of different moisture and temperature on germination percentage during storage of seeds. Lines show survival curves. Points show original germination values



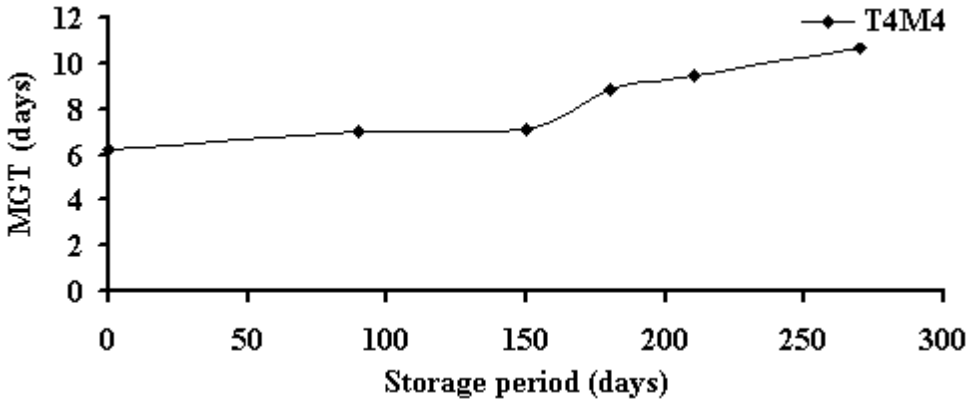
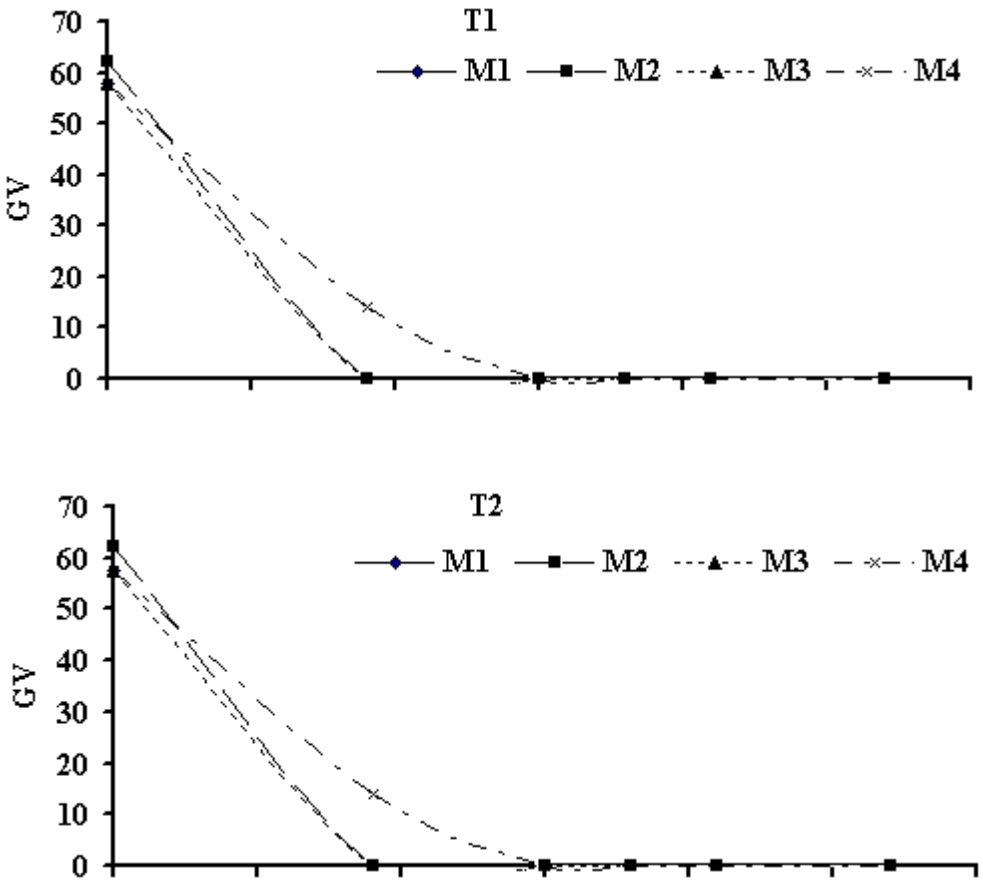


Figure 3 : Effect of different moisture and temperature on MGT (days) during storage of seeds



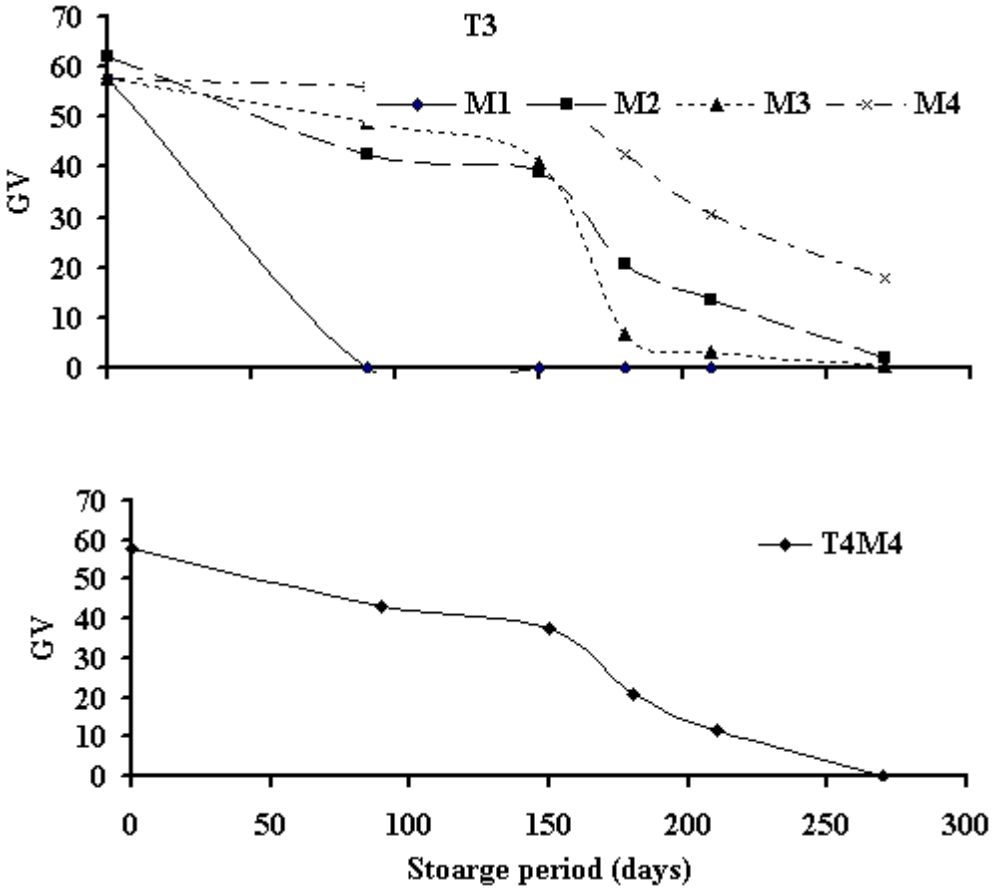


Figure 4 : Effect of different moisture and temperature and on GV during storage of seeds.

This page is intentionally left blank

Global Journal of Science Frontier Research: C
Biological Science
Volume 15 Issue 6 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Effect of Different Organic Substrates and their Pasteurization Methods on Growth Performance, Yield and Nutritionalvalues of Oyster Mushroom (*Pleurotus Ostreatus*) for Small Scale Cultivation at Arsi University, Ethiopia

By Demisie Ejigu & Tadesse Kebede
Arsi University, Ethiopia

Abstract- Mushrooms are important fungi that play a great role for food self-sufficiency and to fill the gap of protein deficiency in most cereal crops, vegetables and fruits. Moreover, they are known for their flavor enhancing property, medicinal value a well as cholesterol free food. However, Mushroom production in Ethiopia is still less known due to multiple problems which include high input cost, lack of quality of spawn, lack of proper production skill, and lack of information on substrates. In view of this, the experiment was conducted at Arsi University, College of Agriculture and Environmental Science during 2013/14 Cropping years with the objectives of evaluating different organic substrates and pasteurized methods on Pleurotus ostreatus yield, biological efficiencies and nutritional values. Factorial combination of seven substrates (Dried faba bean stalk, Maize Stalk, Wheat straw, Teff straw, Eucalyptus Sawdust, Wheat straw + Teff straw+ Faba bean stalk and Saw dust + Faba bean stalk) and two pasteurization methods (Cold water treatment and Hot water) were used.

Keywords: *oyster mushroom, substrates, yield and nutritional value.*

GJSFR-C Classification : *FOR Code: 060799*

Strictly as per the compliance and regulations of :

Effect of Different Organic Substrates and their Pasteurization Methods on Growth Performance, Yield and Nutritionalvalues of Oyster Mushroom (*Pleurotus Ostreatus*) for Small Scale Cultivation at Arsi University, Ethiopia

Demisie Ejigu [α] & Tadesse Kebede [σ]

Abstract- Mushrooms are important fungi that play a great role for food self-sufficiency and to fill the gap of protein deficiency in most cereal crops, vegetables and fruits. Moreover, they are known for their flavor enhancing property, medicinal value a well as cholesterol free food. However, Mushroom production in Ethiopia is still less known due to multiple problems which include high input cost, lack of quality of spawn, lack of proper production skill, and lack of information on substrates. In view of this, the experiment was conducted at Arsi University, College of Agriculture and Environmental Science during 2013/14 Cropping years with the objectives of evaluating different organic substrates and pasteurized methods on Pleurotus ostreatus yield, biological efficiencies and nutritional values. Factorial combination of seven substrates (Dried faba bean stalk, Maize Stalk, Wheat straw, Teff straw, Eucalyptus Sawdust, Wheat straw + Teff straw+ Faba bean stalk and Saw dust + Faba bean stalk) and two pasteurization methods (Cold water treatment and Hot water) were used. The experiment was arranged in RCBD with three replications by using the box constructed from the wood timber as blocks in cropping room. Carbon content, nitrogen content and water holding capacity of the substrates were analyzed at spawning and harvest of mushrooms and significant difference among the substrates and pasteurization methods (Hot and cold water) were observed. Phenological data including days to onset of mycelium invasion, days to appearance of pin heads and days to maturation of fruiting bodies of mushrooms and cap diameter and different nutritional analysis of mushroom for crude protein, organic carbon, organic matter and carbohydrates contents were analyzed and recorded and the significant difference among the substrates have been observed. Non-significance difference between pasteurization methods was observed on pin head formation, fruiting body formation, cup diameter, biological efficiency, Production rate, moisture content and dry matter content. To give general recommendation from this research for the producers, the highest yield of oyster mush room (1.58kg/4 kg of substrate) was recorded from maize stalk treated with hot water and the lowest was recorded from saw dust treated with hot water (0.50 kg/4 kg of substrate). The highest protein content was recorded from faba bean stalk Pasterualized with both cold and hot water (27.38%) and the lowest was recorded in case of wheat straw treated with hot water (17.03%).

Keywords: oyster mushroom, substrates, yield and nutritional value.

I. Background and Justification

Today as the challenge on world, the 20th century began with a world population of 1.6 billion and ended with six billion, and projected to be nearly nine billion by 2050, with most of the growth occurring in the developing country [1]. According to Population Institute of Ethiopia (2008), the Ethiopian population is 82.8 million and projected to be 149.5 million by mid of 2050. However, land in agricultural use has increased by only 11% from the early late seventeenth to the late twentieth century, meaning the land per capital declined by about 40%. Therefore, in the near future it will become increasingly difficult to produce the food required to feed the ever-growing human population [2]. Ethiopia is among few countries that failed to participate in the general thrust towards increasing average food consumption level. In 2010/2011 production season total crop production in Ethiopia was about 22.5 million tones on 13.5 million ha of land [3], making Ethiopia agriculture one of the least productive all over the world with productivity of less than 2t/ha. The food deficit of the under nourished Ethiopia people is 340 K cal/person/day and the share of cereals, root and tubers in total dietary energy supply is 79%. This problem is further aggravated by recurrent droughts [4].

Food grains are the principal dietary source of calories, proteins and other nutrients but their dietary supply is not sufficient and proteins supply is not in the required amount. Besides, economic and health factors make animal protein inaccessible to the majority of the people [5]. Developing countries like Ethiopia are caught in vicious circle of poverty, shortage of food and nutritional disorder. Erratic rainfall, shortage of land, low yield of traditional crops and low status of most crops

Author α: Arsi University. e-mail: Demisie@yahoo.com

especially in protein are among the causes of the three mentioned problems above. To tackle this problem, the Ethiopia government has been engaged in improving the agriculture sector through different initiatives. One of them being transforming the sector from subsistence to commercially oriented one by encouraging the production of high value diversified native and exotic crops.

[6] Reported productivity of fresh mushroom per kg of dry substrate was 0.8 to 1 kg. Dawit reported 7.3 kg of fresh Oyster mushroom produced from 10 kg dry cotton waste supplemented with 1% wheat bran. [7] Also grew Oyster mushroom on paddy straw, maize and sugarcane reported yield of 0.28 to 0.39 kg per kg of dry substrate.

Cultivation of oyster mushroom represents one of the major current economically profitable biotechnological process for the conversion of plant residues or a non-edible plant biomass in to nutritious / protein rich food, which will help in overcoming protein malnutrition problem in developing countries [8]. Time is, therefore ripe for developing new technologies for commodities like mushroom which increase production and productivity without using arable land. Such have great role to pay in achieving food self-sufficiency. It has wide range of substrate growth and temperature adaption. Furthermore, it is fast growing, requires no casing, less fragile than others and has market in the dry form as well as fresh form.

Mushrooms are highly perishable mostly due to moisture loss, wilting, color changes and poor preservative methods. Improving the shelf life and quality characteristics of mushroom will enhance marketability and add value in agricultural chain. Evolving preservation methods that are cheap and affordable by farmers has become imperative in order to have food sustainability [9]. The food processing industry provides a wide range of canned and processed mushroom products, including frozen, sterilized, dried, pickled, marinated, and salted mushrooms; mushroom powder; paste; and concentrates and extracts [10].

Mushrooms are a cash crop, the market for which is growing worldwide and in Ethiopia it is a new activity. In most countries, there is a well-established consumer acceptance for cultivated mushrooms. Even though, the first small research project on Oyster mushroom (Pleurotus ostreatus) was started in 1993 at Addis Ababa University Ethiopia, the mushroom production in Ethiopia is still less known due to many factors which include high in put cost, lack of quality spawn, lack of proper production skill and lack of information on substrate for mushroom cultivation.

Almost all producers use cotton hull as substrate, which not available for most farmers and comparatively too costly compared to other agricultural wastes. So, identification of different substrates from different types of crops and method of pasteurization is the critical for successful mushroom cultivation.

II. Objectives

1. To evaluate different Organic residues (substrates) and their combinations for Oyster Mush room cultivation in terms of yield, biological efficiency and nutritional values.
2. To assess the possibility of using different pasteurization methods of substrates on growth performance of oyster mushroom, yield and nutritional value.

III. Materials and Methods

a) Experimental Site and Cropping House Construction

The experiment was conducted at Arsi University, College of Agriculture and Environmental Science. Mushroom-growing house with a length (12 m), height (4m) and width (2.5m) has been constructed from locally available material, the wall lined with bamboo tree and wooden flat, the roof covered by iron sheet and the floor was cemented. The growing media/box with a length 70cm and width 50cm was constructed from wooden flat.

b) Experimental materials

The mushroom spawn produced from pure cultures of Pleurotus ostreatus (sajor-caju) has been collected from Ethio-mushroom and Spawn Enterprise Company.

c) Treatments and Experimental Design

The experimental treatments have been including Seven organic substrates (Sawdust, Faba bean stalk, Maize stalk, Wheat straw, Teff straw, Wheat straw + Teff straw and Saw dust + Faba bean stalk) and two Pasteurization methods (Cold treatment and Hot water treatments). Fourteen treatments have been laid out in a randomized complete design (RCBD), in a complete factorial arrangement with three replications.

d) Preparation of the Substrates for Seeding

All substrates were dried before shredding and the dried bean stalk, maize stalk, wheat straw, teff straw and saw dust were shredded or chopped into small pieces of approximately pieces of 2-4 cm size with axes. All naturally dried substrates were subjected to three days sun drying after shredded as correction factor to balance the natural difference in percentage water holding capacity.

The prepared required amount of each substrate has been subjected to different treatments as followed. For cold water treatment, the substrates used in this study were separately soaked in fresh tap water for 24 hrs using 100 liter aluminum cans and achieved sufficient imbibitions. Similarly, pasteurization of shredded substrates has been done by soaking in hot water at 70°C for one hour using aluminum cans.

The Pasteurized substrates separately kept on wire mesh tables and allowed to drain for 4 hours. The water content of the substrates was checked by squeezing in the palm and substrates were used for spawning when the water not dripped on squeezing.

e) Seeding of Substrates and Spawn Running

The pasteurized substrates were weighted in to small portion each weighing 4Kg dry weight basis and then filled into 50x70cm^2 box cemented by plastic sheet. The boxes arranged in a completely randomized block design with three replications keeping 5-10cm spacing between each box. Each box was inoculated with 50g of Spawn of mushroom strain and closed with plastic sheet to prevent possibility of contamination. The inoculated boxes were placed in spawn running room (part of the mush room house from which light excluded) until the substrate in each box fully colonized by mycelium. Mycelium invasion in the boxes visually followed in all substrates. The box has been opened and moved to the fruiting room (Mush room house fitted with fluorescent light) and allowed the development of fruiting bodies.

f) Mushroom Crop Management and Harvesting

The bags or substrates blocks were opened by cutting the polythene bags from sides and the plastic was removed. The exposed substrate blocks are kept on their original position as before. The substrate blocks was sprayed twice a day on the bags with water in order to maintain the relative humidity in the range of 80-85% during Cropping period till pin heading and subsequent fruiting when the condition was not fulfilled. Temperature of the cropping rooms was maintained at about above 15^{o}C and monitored by using a thermometer and also sufficient ventilation was provided during fructification to keep low CO_2 level. The fruiting bodies were harvested when the cap has opened up, the gills of the mushroom were visible and when the edge of the cap was slightly rolled inwards.

g) Analysis of substrates

All the substrates were analyzed for organic carbon, percentage nitrogen and water holding capacity before spawning and after harvesting of mushroom. Water holding capacity of the substrates was determined by soaking a weight amount of cold water and hot water treated substrates for 24 hrs. The moisture content was determined by weighing the pressed substrate before drying and also after drying in an oven at 70^{o}C to constant weight. The percent moisture content of substrate was determined as given below [11].

Percent water holding capacity = (wet weight - dry weight/wet weight of substrate) X 100

Organic carbon was determined using Walkley and Black Method (Walkley and Black, 1934). In this method after adding different chemicals on ground sample it was tittered by H_2SO_4 and the organic carbon was calculated by taking the volume difference. Percent nitrogen in tissue was determined using micro Kjeldahl method [12]. In this method a ground sample was digested, distilled and tittered and nitrogen was determined by taking the volume difference during titration.

h) Data collected

i. *Phenological observations*

Days to the completion of invasion of mycelium (MI) on different substrates, appearance of pin heads formation (PHF), and days to maturation of fruiting bodies formation (FBF) and Cap/pileups diameter from the day of spawning in different substrates were recorded.

ii. *Yield and yield related traits*

a. *Total yield*

Weight of fresh fruiting bodies was harvested from each substrate blocks and measured using sensitive balance. Data on weight of mushrooms from each substrate blocks at first, second and third flush harvesting stages were recorded separately and their total weight was considered as total yield which was also used for calculating biological efficiency.

b. *Biological efficiency*

The weight of each dry substrate and total fresh mushroom weight per box was recorded separately and then the biological efficiency (BE) of oyster mushrooms in each substrate was calculated as bellow:

$$BE = \frac{\text{Weight of fresh mushrooms}}{\text{Weight of dry substrate}} X .100$$

c. *Production rate*

On the basis of biological efficiency on each substrate and the time taken in days from spawning to harvesting, the production rate (PR) of oyster mushrooms in each substrate was calculated as below: PR = BE / Time

i) Nutritional Analysis of Mushroom

i. *Crude protein*

Ground and dried samples of fruiting bodies of oyster mushroom was analyzed for crude protein (CP) using Kjeldahl method. In this method a sample was digested, distilled and tittered and nitrogen was calculated by taking the volume difference during titration. In order to determine protein, percentage nitrogen was multiplied by 6.25.

ii. *Total ash and Organic matter*

Total ash (TA) content was estimated by heating 2gm of ground mushroom sample at 550^{0}C for 5 hrs. At this temperature all the organic matter burns off as CO_2

and the remaining matter was inorganic ash. The ash content was measured according to following formula:

% Total ash = (W3-W1 / W2-W1) x 100

Where, W1 = Weight of crucible

W2 = Weight of crucible + Sample

W3 = Weight of crucible + Ash

Based on percentage total ash, percent organic matter will be calculated by subtracting each value from 100.

iii. *Percentage moisture content and dry matter*

The moisture content of the fruiting bodies was determined as loss in weight which resulted from drying fresh mushroom samples at 70°C to constant weight and this was calculated using the following formula:-

$$\text{Percentage moisture content of fruiting body} = \frac{\text{Fresh weight} - \text{Oven dry weight}}{\text{Fresh weight}} \times 100$$

Based on moisture percentage, the **dry matter percentage** was calculated by subtracting each value from 100.

j) Statistical Data Analysis

All the data collected during the study were subjected to analysis of variance (ANOVA) using SAS statistical software. LSD was used to separate the treatment means at five percent probability level and Simple correlation between the treatments was computed.

IV. Results and Discussion

a) Results

The present study was conducted to evaluate the effect of different organic substrates and their pasteurization methods on yield and quality of oyster mushroom. Seven substrates (sawdust, dried faba beanstalk, maize stalk, wheat straw, tef straw, the combination of Saw dust + faba bean stalk and wheat straw+ tef straw+ faba bean stalk) and treated with hot water and cold water as check were evaluated using RCBD design in a factorial combination with three replications.

Carbon and nitrogen content and water holding capacity of the substrates were recorded before and after harvesting of mushrooms. Phenological observations like days to complete mycelium invasion, appearance of pin head and days to maturation of fruiting bodies of mushrooms were recorded. Yield and yield related attributes such as biological efficiency and production rate and quality attributes of mushroom such as percentage moisture content, crude protein (CP) and percent total ash and organic carbon were also estimated.

Table 1 : Effect of substrate type and pasteurization methods on Water holding capacity of substrates at spawning

	Moisture (%) at spawning						
	Substrates						
Pasteurization	Saw Dust	Fababean Stalk	Maize Stalk	Wheat Straw	Teff Straw	WTF Straw	Saw Dust & Fababean
Cold water	1.50n	34.20d	22.94h	16.26i	10.62k	30.78f	7.25l
Hot water	6.20m	32.77e	54.87a	37.17c	23.85g	39.88b	15.88j
LSD(0.05)				0.32			
CV (%)				0.82			

Means with in column followed by the same letter are not significantly different at 5% probability level

Table 2 : Effect of substrate type and pasteurization methods on water holding capacity of substrates at harvest

	Moisture(%) at harvest						
	Substrates						
Pasteurization	Saw dust	Fababean Stalk	Maize Stalk	Wheat straw	Teff straw	WTF straw	Saw dust& Faba bean
Cold water	6.50n	39.13d	27.98h	21.26i	15.62k	35.78f	12.25l
Hot water	11.20m	37.57e	59.96a	42.11c	28.85g	45.00b	20.96j
LSD(0.05)				0.28			
CV(%)				0.52			

Means with in column followed by the same letter are not significantly different at 5% probability level

Table 3 : Carbon and nitrogen content of substrates at spawning and harvest

Substrates	OC(%) at Spawning	OC(%) at harvest	N(%) at Spawning	N(%) at harvest	C:N at spawning	C:N at harvest
Saw Dust	74.97a	73.32a	0.08g	0.07f	937.18a	1024.98a
Fababean Stalk	44.85g	43.41f	1.32a	1.02a	33.93f	42.29e
Maize Stalk	50.11c	48.71c	0.65d	0.60c	77.14d	82.02d
Wheat straw	46.13d	44.64d	0.31f	0.27e	147.5b	165.54b
Teff straw	45.37f	43.98e	0.44e	0.39d	103.05c	113.89c
WTF straw	45.89e	44.44d	0.85b	0.74b	60.06e	67.23d
Saw & Faba.	59.75b	58.40b	0.80c	0.73b	74.73d	79.12d
LSD(0.05)	0.108	0.31	0.01	0.03	2.7	24.46
CV(%)	0.17	0.51	1.42	4.69	1.11	9.16

Means with in column followed by the same letter are not significantly different at 5% probability level. WTF straw =Wheat +Teff + Faba bean straw, Saw & Faba = Saw + Faba bean stalk.

Table 4 : Effect of substrate type and pasteurization methods on Growth, BE and PR of oyster mushroom

Substrates	MI(days)	PHF(days)	FBF(days)	CD(cm)	BE(%)	PR
Saw Dust	12.50cd	55.00b	68.66b	2.50b	36.10cd	0.55cd
Fababean Stalk	16.50a	56.66b	66.83bc	7.16a	51.94bcd	0.84bcd
Maize Stalk	12.00d	45.00b	54.83c	7.00a	70.87ab	1.40a
Wheat straw	16.50a	72.83a	84.83a	6.63a	64.70ab	0.79bcd
Teff straw	12.50cd	52.50b	62.50bc	6.66a	32.44d	0.51d
WTF straw	14.00b	54.33b	65.50bc	8.50a	74.59a	1.16ab
Saw & Fab.	13.00c	54.16b	64.00bc	7.16a	53.72bc	0.93bc
LSD(0.05)	0.74	11.92	13.16	3.03	20.31	0.41
Pasteurization methods						
Hot water	13.57b	53.33	64.28	7.03	55.77	0.91
Cold water	14.14a	58.23	69.19	6.00	54.05	0.85
LSD(0.05)	0.39	NS	NS	NS	NS	NS
CV(%)	4.53	18.01	16.62	39.20	31.17	39.03

Means with in column followed by the same letter are not significantly different at 5% probability level;

NS = Non- significant, Biological efficiency, Production rate, WTF = Wheat + Teff + Fababean, Mycelium invasion, Pin head formation, fruiting body formation ,cup diameter,

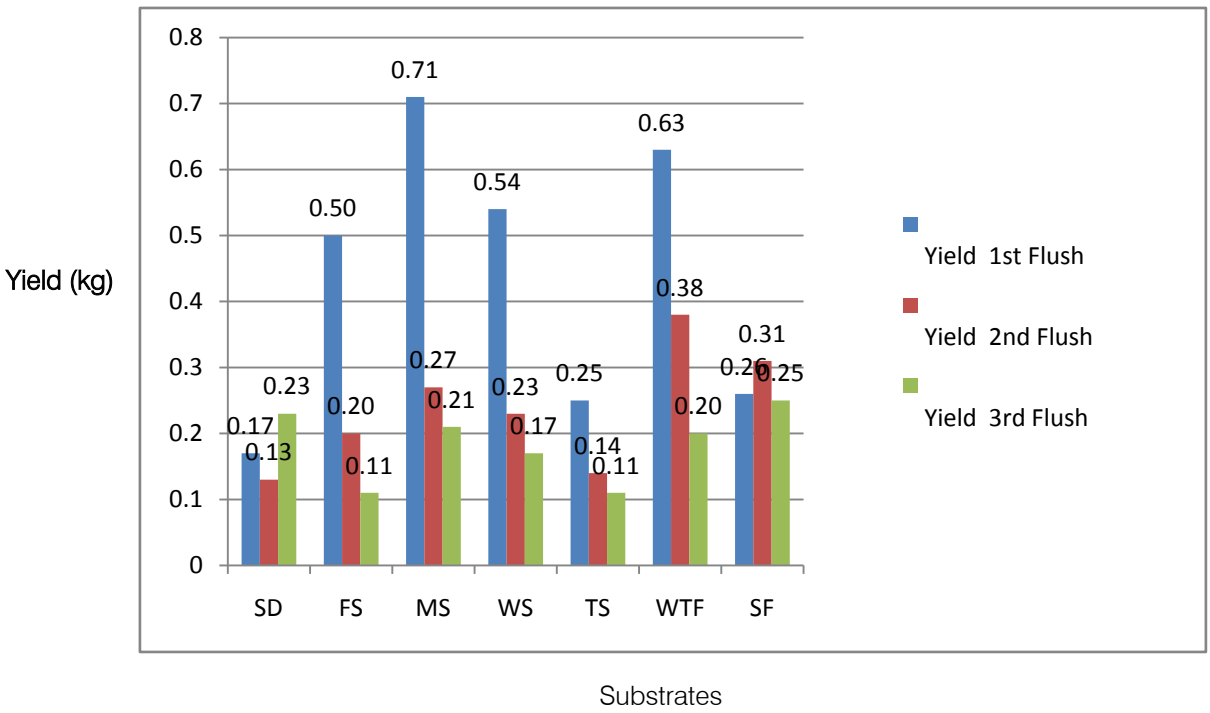


Fig.1 : Yield of Oyster mushrooms at different flushes

(SD= saw dust, FS= faba bean stalk, MS= maize stalk, WS= wheat straw, TS =tef straw, WTF= wheat + teff + faba bean, SF = saw dust + faba bean stalk; the unit of first, second and third flushes are in kg/ 4 kg dry substrate.)

Table 5 : Effect of substrate type and pasteurization methods on Total yield of oyster mushroom

	Total Yield (Kg)						
	Substrates						
Pasteurization Methods	Saw Dust	Faba bean Stalk	Maize Stalk	Wheat straw	Teff straw	WTF straw	SD+ FB
Cold water	0.58l	0.66j	0.83g	1.23c	0.35n	1.40b	0.86f
Hot water	0.50m	0.96e	1.58a	0.67i	0.62k	1.03d	0.80h
LSD(0.05)				0.01			
CV(%)				3.02			

Means with in row and column followed by the same letter are not significantly different at 5% probability level; WTF straw= Wheat + Teff + Faba bean stalk, SD+ FB+= Saw dust +Faba bean

Table 6 : Effect of Substrate type and Pasteurization methods on Protein content of oyster mushroom

	Protein Content (%)						
	Substrates						
Pasteurization methods	Saw Dust	Faba bean Stalk	Maize Stalk	Wheat straw	Teff straw	WTF straw	Saw & Fab.
Cold water	18.56h	27.38a	24.34c	18.03j	18.37i	27.37a	23.00e
Hot water	21.56f	27.38a	20.69g	17.03k	20.69g	26.47b	24.19d
LSD(0.05)				0.05			
CV(%)				0.45			

Means with in column followed by the same letter are not significantly different at 5% probability level

Table 7 : Effect of Substrate type and Pasteurization methods on some quality of oyster mushroom

Substrates	Total Ash(%)	Organic matter(%)	Moisture Cont.(%)	Dry matter cont.(%)
Saw Dust	8.40d	91.59b	85.46ab	14.53bc
Fababean Stalk	8.00d	91.99b	86.09ab	13.74bc
Maize Stalk	7.25e	92.74a	90.34a	8.99c
Wheat straw	11.08a	88.91e	88.27a	11.72bc
Teff straw	10.51b	89.48d	78.41cb	19.91bc
WTF straw	9.94c	90.06c	86.52ab	13.47bc
Saw &Fab.	8.45d	91.54b	73.73c	26.26a
LSD(0.05)	0.49	0.49	8.72	8.26
Pasteurization methods				
Hot water	9.32a	90.67b	84.86	14.61
Cold water	8.86b	91.13a	83.37	16.43
LSD(0.05)	0.26	0.26	NS	NS
CV(%)	4.58	0.45	8.74	44.87

Means with in column followed by the same letter are not significantly different at 5% probability level

V. Discussion

a) Substrate Characteristics

i. *Water holding capacity*

Results of interaction effect of different substrates in terms of water holding capacity showed that the mean highest and the lowest water holding capacity of the substrates at spawning was for maize stalk (54.87%) and saw dust (1.5%) when treated with hot and cold water, respectively which were significantly different from other treatments (Table 1). Similarly, significantly highest and lowest water holding capacity at harvest was also observed for maize stalk treated with hot water (59.96%) and saw dust treated with cold water (6.5%). This could be due to the soft tissue of maize stalk and woody nature of saw dust, respectively (Table 2).

All substrates were significantly different from one another in terms of water holding capacity both at spawning and harvest. The water holding capacity of all substrates increased after growing mushroom which could be due to the frequent watering of substrates and loosening effect on tissue (Table1 and Table 2).

The main effects of treatment methods on water holding capacity of substrates indicated that substrates treated with hot water showed significantly more moisture at spawning and harvesting as compared to cold water except in the case of fababean stalk, it was the reverse. This could be due to the ability of hot water to make the tissues of substrates more soft in order to observe more water and due to the decay of substrate by unwanted fungi on substrates treated with cold water (Table 1 and Table 2).

b) Chemical composition of the substrates

i. *Carbon content of the substrates*

The results of carbon content of the substrates measured before spawning and after harvest are presented in Table 3. Maximum carbon was recorded for saw dust at spawning (74.97%) and after harvesting (73.32%) which was significantly higher than all other treatments. Similar results for saw dust were reported [13]. The lowest carbon content at spawning (44.85%) and after harvesting (43.41%) was observed for faba bean stalk. In all organic substrates a slight reduction of organic carbon was observed from spawning to harvest which may be due to the utilization of carbon by the growing mushroom. Cold water treatment and hot water treatment did not significantly influence the carbon content of the substrates.

ii. *Nitrogen content of the substrates*

Results of measurement of nitrogen in different substrates showed maximum nitrogen content was recorded for the faba bean stalk at spawning (1.32%) and harvest (1.02) which was significantly higher than nitrogen content of all other substrates (Table 3). This result is in line with [14] who reported the nitrogen content of leguminous substrates was higher than that of non-leguminous substrates. In contrast to the nitrogen content of dried faba bean stalk, the significantly lower nitrogen content was recorded for saw dust both at spawning (0.08%) and harvest (0.07%). All substrates are significantly different from each other in terms of their nitrogen contents at spawning. Significant difference was not observed between the combination of wheat + teff straw + fababean stalk and saw + faba bean stalk in terms of nitrogen content at harvesting. In all organic substrates a reduction in

nitrogen content was recorded from spawning to harvesting of mushrooms which may be attributed to the utilization of nitrogen by the growing mushroom. Because of high carbon content and low nitrogen, C:N ratio for saw dust was found to be widest and that of dried faba bean stalk was narrowest both at spawning and harvest (Table 3). These results were in line with Richard who reported a C:N ratio of 600:1 and 16:1 for sawdust and dried bean pod husk, respectively. Significant difference was not observed between maize stalk and saw dust + faba bean in terms of C:N ratio at spawning and between wheat +teff + faba bean and Saw dust + faba bean at harvest statically. In all organic substrates a significant increase in C:N ratio was recorded from spawning to harvesting.

c) *Effect of Substrates and Pasteurization Methods on Growth and Yield*

i. *Mycelium invasion*

The fastest days to mycelium invasion (MI) of different organic substrates was recorded for maize stalk (12.00 days) however it was statistically at par with saw dust and bean straw (Table 4). Faba bean stalk and wheat straw were found to be invaded by inoculated mushroom spawn at the slowest rate (16.50 days).

Hot water treated substrates had significantly earlier invasion by mycelium than cold water. This could be due to the release of easily available nutrients from substrates and the reduction of unwanted green mould by effective hot water pasteurization. The pasteurization methods recorded significant differences with regard to days to mycelium invasion (Table 4). Interaction of substrates with pasteurization methods was non-significant for days to mycelium invasion.

ii. *Pin head formation*

With respect to the effect of different substrates on pin head formation, the slowest pin head formation (PHF) after spawning was observed in wheat straw (72.83 days). Significant difference was not observed among other substrates statically but Maize stalk recorded early pin head formation compared to others.

Significant difference was not observed between cold water and Hot water methods with regard to pin head formation statically (Table 4). But Hot water treated substrates had significantly earlier pin-head formation than cold water. This could be due to effect of hot water on chemical composition of substrates which may have increased availability of essential nutrients to the growing mushroom. There is no interaction effect between different substrates and pasteurization methods on pin head formation of the mushroom.

iii. *Fruiting body formation*

There was olso no interaction effect between the substrates and pasteurization methods on fruiting body formation of the mushroom. The fastest fruiting body formation (FBF) after spawning was observed on maize stalk (54.83 days) followed by teff straw however; teff straw was statistically at par with the other substrates except wheat straw. The slowest fruiting body formation was recorded on wheat straw (84.83 days). No significance difference was observed between Hot water and cold water treated substrates statically but numerically when it was observed Hot water treated substrates had significantly earlier ($p<0.05$) fruiting body formation than cold water (Table 4). This could be due to the effective pasteurization and increase in availability of nutrients due to hot water treatment of substrates.

iv. *Yield of oyster mushroom*

Harvesting of the mushrooms growing in different substrates was completed in three consecutive harvesting operations till all the mushrooms were harvested from each substrate. The yield of mushrooms in each flush and the total yield for each substrate are presented in Fig.1. The highest yield of mushrooms in first flush was obtained in maize stalk (0.71kg), in second flush was obtained in, Wheat + Teff + Fababean stalk (0.38 kg) and in third flush was obtained in saw dust + faba bean stalk (0.25kg). The lowest yield during the first and second flush was obtained for mushroom grown on saw dust 0.17 and 0.13 kg respectively, whereas the lowest yield in third flush was obtained for mushroom grown on faba bean stalk (0.11kg). In all cases yield showed a declining trend from the first flush to third flush. This could be due to the decreasing nutrient content of the substrate consumed by mushroom during growth from one flush stage to the next. But in the case of saw dust and saw dust + fababean stalk the highest yield was obtained in third and second flush respectively. This could be due to the hardness and less consumable of saw dust in the first flush.

v. *Total yield, biological efficiency and production rate*

Significant ($p<0.05$) variation was observed in total yield of oyster mushrooms as affected by the interaction of different substrates and Pasterualization methods used in this study (Table 5). The maize stalk Pasterualized with hot water gave significantly the highest yield (1.58 kg/ 4kg of dry substrate) while teff straw treated with cold water resulted in the lowest yield (0.35 kg/ 4kg of dry substrate). The highest yield of mushroom grown on maize stalk treated with the hot water and the lowest yield grown on teff straw treated with cold water may be due to the narrow C:N ratio of the maize stalk which provided enough nutrients and could be due to the effective pasteurization of the substrate with hot water in order to protecting unnecessary fungal pathogens that may occurred during the growing season of mushrooms.

Biological efficiency of various treatment combinations was calculated on the basis of percentage fresh mushroom production per unit dry weight of

substrate. Significantly ($p<0.05$) higher biological efficiency (74.59%) was recorded for mushrooms grown on the combination of wheat + teff + faba bean stalk (Table 4). This value is close to that mentioned by Kumar [15] who observed a biological efficiency in the range of 80 to 150% for oyster mushrooms grown in leguminous substrates. Similarly a Biological efficiencies range of 73 to 100 was reported by Tripathi. Significantly lower biological efficiency (32.44%) was recorded for the mushrooms grown on teff straw (Table 4). High value of biological efficiency was observed for mushrooms grown on narrow C:N ratio substrates such as faba bean stalk and Maize stalk and low value of BE was observed for mushrooms grown on wide C:N ratio substrates such as saw dust (937:1). This implies that nitrogen is also important for improving the yield (Table 4).

Results from main effect of pasteurization methods revealed that no-significant difference among pasteurization methods was observed in terms of BE statically. But hot water (55.77%) proved to be superior to cold water (54.05%) treatments in terms of BE (Table 4). This may be due to the effective pasteurization and increasing the availability of nutrients due to hot water treatment which contributed towards high biological efficiency.

Significantly ($p<0.05$) the higher production rate (1.40) was recorded for maize stalk substrate followed by the mixture of wheat + tef straws + faba bean substrates (Table 4). The lowest production rate (0.51) was recorded for teff straw. However, significant difference was not observed between the wheat straw, faba bean stalk and the mixture of saw dust + faba bean stalk in terms of production rate statically. Teff straw, Saw dust and wheat straw showed lower PR as compared to the others. There was no significance difference ($p<0.05$) was observed between pasteurization methods statically but hot water treatment gave significantly ($p<0.05$) higher production rate compared to cold water (Table 4). This could be due to the effective pasteurization which reduced competition for the growing mushrooms and also the release of available nutrients due to hot water treatment.

d) Effect of Substrates and Pasteurization Methods on Quality Parameters of Oyster Mushrooms

In the present study, crude protein, total ash, organic matter, moisture content and dry matter percentage of oyster mushrooms at harvest were measured to assess quality of mushrooms grown on different substrates treated /Pasterualized with hot water and cold water.

i. *Crude protein*

The interaction effect (Table 6) of substrates and pasterualization methods on crude protein content of oyster mushroom in this study showed that the protein content (27.38%) of mushrooms grown on dried faba bean stalk treated by cold water and cold water were the highest and significantly ($p<0.05$) different from other combinations except in the case of the mixture of wheat, teff and faba bean stalk treated with cold water statically. The nitrogen contents of substrates directly correlated with the protein content of the oyster mushroom (refer Table 3 and 6). Similar values for crude protein of oyster mushrooms have been reported [16]. The positive correlation of high protein content with high nitrogen content of substrates implies that adequate nitrogen in the substrate is essential for synthesis of protein in mushroom fruiting bodies. The lowest value of crude protein was observed in the cold water treated saw dust (18.56%). Significant differences were also not observed between hot water treated maize stalk and teff straw.

ii. *Ash content*

The highest ash content (11.08%) was recorded for mushrooms grown on wheat straw followed by ash content of mushroom grown on tef and the mixture of wheat, teff and faba bean straw, respectively. This value was close to the value mentioned [17] who reported 11.5% ash for mushrooms grown on wheat straw. Contrary to the ash value of mushroom grown on wheat straw, lower ash content (7.25%) was recorded for mushroom grown on maize stalk (Table 7). There was no significance difference observed among ash content of mushroom grown on saw dust, faba bean and the mixture of fababean and saw dust. The ash content of oyster mush room recorded in this study ranged from 7.25% to 11.08%. In contrary, [18] reported 6.20% and 5.90% ash for oyster mushrooms grown on paddy straw and corn stalk, respectively. This difference could be due to straw type and method of analysis. On the other hand the result of this study is in agreement with [19] who reported ash content of 8.80% for oyster mushroom and 7.20% for P. sajor-caju respectively. Significant difference was observed among substrates.

Hot water treated substrates produced mushroom with significantly ($p<0.05$) higher ash content compared to cold treatment ones. It may be due to increased availability of mineral elements because of hot water treatment (Table 7).

iii. *Percentage organic matter*

Organic matter content of oyster mushrooms was significantly ($p<0.01$) affected by different substrates and their pasteurization methods. The highest organic matter (92.74%) was recorded for mushrooms grown on maize stalk substrate whereas the lowest organic matter (88.26%) was recorded for mushroom grown on wheat straw (88.91%). This may be due to highest and the lowest ash content of mushroom grown on maize stalk and wheat straw respectively (Table 7). No-significant difference was observed among the substrates such as saw dust, faba bean stalk

and the mixture of saw dust + faba bean stalk in relation to organic matter (Table 7).

Cold water treatment resulted in the highest organic matter (91.13%) while hot water treatment was the lowest (90.67%). This may be due to highest and the lowest ash content of mushroom treated by hot water and cold water, respectively (Table 7).

iv. *Percentage moisture content*

Percentage moisture content of oyster mushrooms grown in different substrates ranged from 73.73-90.34%. The highest moisture content of fresh mushrooms (90.34%) at harvest was recorded for mushroom grown on maize stalk which was significantly higher than other substrates which was at par with wheat straw (Table 7). The moisture content obtained in this study is close to the value mentioned [20], who reported 89% moisture for mushrooms grown on paddy straw. The lowest moisture content (73.73%) was recorded for mushroom grown on the substrate mixture of saw dust and faba bean stalk. These results are in line with that of [21] who reported a range of 70-90.9% moisture.

Non-significant difference was observed for moisture content of mushroom between the pasteurization methods statically but the mean value for moisture content of mushrooms under pasteurization methods of substrates resulted in higher moisture (84.86%) was recorder for mushrooms grown on hot water treatments (Table 7).

v. *Dry matter percentage*

The highest dry matter percentage of oyster mushroom (26.26%) was recorded for mushroom grown on substrates mixture of saw dust and faba bean stalk (Table 7). This may be due to the lowest moisture content of fresh mushroom (73.73%) grown on this substrate. The lowest percentage dry matter (8.99%) was found for mushroom grown on maize stalk in apart with other substrates. The dry matter percentage of oyster mush room found in this study ranged from 8.99 - 26.26 g. These results are in agreement with [22] who reported a range of 5.3-14.8g dry matter percentage.

The mean value for dry matter percentage of mushrooms under two pasteurization methods of substrates showed that non-significant statically but cold treatment resulted in the highest percentage dry matter (16.43%) while hot water treatment was the lowest (14.61%).

VI. Summary and Conclusions

Growth, yield and quality of mushrooms are substantially influenced by the substrate type on which it is grown. Studies on the effect of locally available substrates along with pasteurization methods on yield and quality of mushroom through systematic research are vital for optimizing productivity and choice of best quality mushrooms. In view of this, the present research work was conducted at the Arsi University, College of Agriculture and Environmental Science Research and Training Center during the year 2013-2014. A factorial experiment involving two treatment methods (cold water, and hot water) and seven substrates (sawdust, dried faba bean stalk, shredded maize stalk, wheat, tef straw, wheat + teff + faba bean stalk, and Saw dust + faba beanstalk + Saw dust) in a randomized complete block design with three replications was used.

All substrates were dried before shredding and the dried bean stalk, maize stalk, wheat straw, teff straw and saw dust were shredded or chopped into small pieces of approximately pieces of 2-4 cm size with axes. The required amount of each substrate has been subjected to different treatments such as cold water treatment, the substrates used in this study were separately soaked in fresh tap water for 24 hrs using 100 liter aluminum cans and achieved sufficient imbibitions. Similarly, pasteurization of shredded substrates has been done by soaking in hot water at 70°C for one hour using aluminum cans.

After proper draining, the pasteurized substrates were weighted in to small portion each weighing 4Kg dry weight basis and inoculated with oyster mushroom spawn made on wheat grains and then filled into 50x70cm^2 box cemented by plastic sheet. The temperature of the cropping room was maintained around 15-20°C and the relative humidity (80-85%) was adjusted by frequently spraying water over the wall of cropping room and on the boxes.

Substrates were analyzed for water holding capacity before and after growing the mushroom, Organic carbon was determined by Walkley and Black Method (Walkley and Black, 1934) and percent nitrogen in tissue was determined using micro Kjeldahl method (Black, 1965) both before and after growing mushroom. Days to complete mycelium invasion, appearance of pin heads, and onset of fruiting bodies in different substrates were recorded. Yield parameters such as biological efficiency (BE) and production rate (PR) of oyster mushrooms in each substrate was calculated after weighing fresh fruiting bodies using weight balance and dividing by dry weight of substrates. Quality parameters such as crude protein (CP), and total ash (TA) content were analyzed using Kjeldahl method and by heating known weight of grinded mushroom sample at 550°C for 5 hrs, respectively. Data were subjected to analysis of variance (ANOVA) using SAS statistical software. LSD was used to separate the treatment means at five percent probability level and Simple correlation between the treatments was computed.

The highest and the lowest water holding capacity of the substrates were recorded in maize treated with hot water (54.87 % and 59.96%) and saw dust treated with cold water (1.5% and 6.5%) both at spawning and harvesting respectively. Maximum carbon content was recorded for saw dust both at spawning

(74.97%) and harvest (73.32%) while lowest carbon at spawning (44.85%) and at harvest (43.41%) were observed for dried faba beanstalk while lowest nitrogen (0.08%) at spawning and harvest (0.07%) were observed for saw dust. Therefore widest C:N ratio was recorded for saw dust at spawning (937.18:1) and harvest (1024.98:1) while the narrowest C:N ratio was for faba bean stalk at spawning (33.93:1) and harvest (42.29:1).

The fastest mycelium invention (12 days), pin head formation (45 days) and fruiting body formation (54.83 days) was recorded for maize stalk straw while the lowest mycelium invention (16.50 days), pin head formation (72.83 days) and fruiting body formation (84.83 days) was recorded in wheat straw. The highest cup diameter (8.50cm) and the lowest (2.50cm) was observed in the substrate mixture of wheat+ teff+ faba been stalk and saw dust respectively. Hot water treated maize stalk followed by cold water treated the mixture substrates of wheat +teff+ faba bean stalk gave significantly higher total yield of (1.5 kg/ 4 kg of dry substrate) and (1.4 kg/4 kg of dry substrate), respectively, while the lowest yield was obtained on cold water treated sawdust (0.35 kg / 4kg of dry substrate). The mixture of substrates of wheat +teff +faba bean stalk was significantly better (74.59%) compared to all other substrates in terms of biological efficiency and the lowest biological efficiency (32.44%) was recorded in the case of teff straw. S Significantly the highest production rate (1.40) was recorded in maize stalk, while the lowest production rate was observed in teff straw (0.51).

The protein content of mushrooms grown on bean pod husk treated with cold and hot water (27.38%) was the highest in par with the substrate mixture of wheat + teff + faba bean stalk treated with cold water statically and significantly different from other treatment combinations. The lowest value of crude protein was observed in the hot water treated wheat straw (17.03%).

Ash content of mushrooms grown on wheat straw was the highest (11.08%) and significantly different from other substrates. Whereas, the lowest ash content (7.25%) was observer in mushroom grown on the maize stalk and the hot water treated substrates gave the higher ash content (9.32%) as compared to the cold water treated substances (8.86).

Organic matter content of mushrooms grown on maize was highest (92.74%) and significantly different from other substrates. While the least value (88.91%), was observed in mushroom grown on wheat straw. The mushroom grown on cold water treated substrates gave the higher organic matter content as compared to hot water treated substrates. Moisture content of fresh mushrooms grown on maize stalk was the highest (90.34%) and significantly different from other substrates. The lowest significantly different moisture content (73.73%) of fresh mushrooms was observed in substrate mixture of saw dust + faba bean stalk and inversely the highest (26.26%) percentage dry matter of mushrooms grown this substrate was recorded and significantly ($p<0.05$) different from other substrates and substrate combination. The lowest significantly ($p<0.05$) different percentage dry matter (8.99%) was observed in mushroom grown on maize stalk.

In general, results of the present study showed that hot water pasteurization of the substrates followed was effective to reduce competent micro organisms. Organic residues having wide C:N ratio and excessive WHC reduced the yield and quality of mushrooms, however, the level of contamination in substrates with wide C:N ratio was relatively less. On the other hand, crop residues with narrow C:N ratio such as dried faba bean pod stalk and maize stalk had a positive correlation with yield and quality of mushrooms but with some risk of relatively higher contamination due presence of readily available nutrients. Thus, a sort of compromise should be reached for yield and selecting different substrates for growing mushrooms, so as to obtain economical yield without much effect on the quality. The present study was conducted with a limited number of substrates. However there is a lot of scope for conducting similar studies on different substrates which are easily available locally to the farmers interested to grow mushrooms under different agro climatic conditions across the country.

References Références Referencias

1. Chang S. T. 2008. Overview of mushroom cultivation and utilization as functional foods. The Chines University press. Hong Kong.1-29 pp.
2. FAO, 2003. The State of Food Insecurity in the World. 2nd ed. Viale della Terme dicaracela, Rome, Italy.
3. CSA (Central Statistics Authority). 2012. Ethiopia - Agricultural Sample Survey 2010-2011.
4. FAO, 2000. Food insecurity: When People live with hunger and fear of starvation. 2nd ed. Viale della Terme di caracalla, Rome, Italy.
5. Dawit Abate, 1998. Mushroom Cultivation; A Practical Approach. Berhanena Selma Enterprise, Addis Ababa. Pp. 218-234.
6. Tripathi D. P. 2005. Mushroom cultivation. Vijay Primlani for Oxford and IBH publishing Co.Pvt.Ltd., Panchsheel Park, New Delhi, India.
7. Ragunathan R. R., Palanswami M. R. and Swanithan W.M.1996.Cultivation of Pleurotus species on various agro residues .J. Biochemistry 55:139-144
8. Jandaik, C. L and Goyal, S. P., 1995. Farm and farming of oyster mushroom (P. species). pp. 72-78. In: R. P. Singh and H.S. Chaube. Mushroom Production Technologies, G B Pant University of Agriculture and Technology, Pantngear, 263145, U.P. India.
9. Ola-Adams, B. A. 1995. Development of Wild Floral for Improved Nutrition. Paper Presented at the 27

Annual Conference, Nutrition Society of Nigeria, 5-8 April 1995, 18p.

10. Czapski, J. 2003. Evaluation of chemical compostion of commercially canned mushrooms processed from fresh and desalted mushrooms and derived from different geographic regions. *Vege. Crops Res. Bull.* 58, 135-141.
11. Singh, K. L., 2003. Animal nutrition laboratory manual cum record. Department of Animal Nutrition University of Agricultural Sciences. Hebbal Bangalore, 560024.
12. Black, C. A., 1965. Method of soil analysis. Amer. Soc. Agron. Madison Wisconsin, USA. Chang D.S.and Miles P.G.2004. Mushrooms cultivation, Nutritional value, Medicinal effect and environmental impact (2nd ed.). CRC press.45pp.
13. Richard, T. R @ bivit, 2003. Com. Florida's on line composting center: Element of Composting. http://www.Compost info. Corn/ tutorial/Element of composting. Htm as retrived on 31 Jan 2006.
14. Sharma, S. and M. Madan, 1993. Microbial protein from leguminous and non leguminous substrates. Acta Biotechnology 13(2): 131-139.
15. Kumar, G.B., 2005. Mushroom cultivation method. http:// karlmon.fjsyj-net/article- print asp article l234.
16. Chaube, H.S., 1995. Nutritional and medicinal value of mushrooms. pp. 7-9. In: R.P. Singh and H.S. Chaube. Mushroom Production Technologies, G. B. Pant University of Agriculture and Technology, Pantngear, 263145, U.P.India.
17. Ingram, S.P., 2002.The real nutritional value of fungi. http://www World of fungi. Org/mostly medical/ Stephanie ingram/Nutritional value htm as retrived on Feb 2006.
18. Ragunathan, R. R., M. R. Palanswami and W.M. Swanithan, 1996. Cultivation of Pleurotus species on various agro residues. J. Biochemistry 55: 139-144.
19. Oei P.2003. Manual on Mushroom cultivation. Techniques, Species and opportunities for Commercial application in the Developing countries. 2nd Ed. Tool publications, Amsterdam, the Netherlands .pp 224-275.
20. Benjamin, B.W., 2005. Mushroom Production. Oyster raw http://www.nutrition data. Com/facts. B0001-01czonc.htm.
21. Mckeller, R.L and R.E. Kohrman, 1995. Oyster mushroom production. J. Agr. Food Chem. 24: 549-570.
22. Bernas, E.T., G.B. Jawaraska and Z.M. Lisiewska, 2006. Edible mushroom as a source of valuable nutritive constituents. Acta Sci. Pol. Technol. Aliment 5(1): 5-20.

Global Journals Inc. (US) Guidelines Handbook 2015

www.GlobalJournals.org

FELLOWS

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (FARSS)

Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards "FARSS" title to individuals. The 'FARSS' title is accorded to a selected professional after the approval of the Editor-in-Chief/Editorial Board Members/Dean.

- The "FARSS" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSS or William Walldroff, M.S., FARSS.

FARSS accrediting is an honor. It authenticates your research activities. After recognition as FARSB, you can add 'FARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSS designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.

Once FARSB title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA). The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSS can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSS, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

The FARSS will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSS member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.
Once you are designated as FARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSS members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSS member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

The FARSS member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN SCIENCE (MARSS)

The ' MARSS ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The "MARSS" is a dignified ornament which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.

MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSS, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSS member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

AUXILIARY MEMBERSHIPS

Institutional Fellow of Global Journals Incorporation (USA)-OARS (USA)

Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as "Institutional Fellow of Open Association of Research Society" (IFOARS).

The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

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.

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.

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

INDEX

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