YIELD VARIATION, SUGAR AND ANTIOXIDANT CONTENT OF POTATO AS INFLUENCED BY VERMICOMPOST AND FOLLOWED BY PERFORMANCE AT AMBIENT STORAGE CONDITION

JANNATUL FERDOUS

INSTITUTE OF SEED TECHNOLOGY
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

DECEMBER, 2015

YIELD VARIATION, SUGAR AND ANTIOXIDANT CONTENT OF POTATO AS INFLUENCED BY VERMICOMPOST AND FOLLOWED BY PERFORMANCE AT AMBIENT STORAGE CONDITION

By

JANNATUL FERDOUS
Reg. no. 10-04079

A Thesis
Submitted to the Institute of seed technology,
Sher-e-Bangla Agricultural University, Dhaka,
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE (MS)
IN
SEED TECHNOLOGY

SEMESTER: JULY-DECEMBER, 2015

Approved By:

Prof. Dr. TuhinSuvra Roy
Dept. of Agronomy,
SAU
Supervisor

Prof. Dr. Md. Shahidur Rashid Bhuiyan
Dept. of Genetics and Plant Breeding,
SAU
Co-supervisor

Prof. Dr. Mohammed Ali
Chairman
Examination Committee
Institute of Seed Technology

INSTITUTE OF SEED TECHNOLOGY

Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

*This is to certify that the thesis titled, "**YIELD VARIATION, SUGAR AND ANTIOXIDANT CONTENT OF POTATO AS INFLUENCED BY VERMICOMPOST AND FOLLOWED BY PERFORMANCE AT AMBIENT STORAGE CONDITION''**submitted to the **Institute of Seed Technology, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka** in partial fulfilment of the requirements for the degree of**MASTER OF SCIENCE (MS)**in **SEED TECHNOLOGY** embodies the result of a piece of bona fide research work carried out by **JANNATUL FERDOUS, Reg. No. 10-04079** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged by the Author.

(Prof. Dr. TuhinSuvra Roy)
Department of Agronomy
Sher-e-Bangla Agricultural University
Supervisor

Dated:
Place: Dhaka, Bangladesh

Dedicated to those who are

Working for poverty elimination

ACKNOWLEDGEMENT

All praises are due to the Almighty Allah, the Supreme Authority of this Universe, who enabled the another to pursue her education in Agriculture and to complete as well as to submit the thesis for the degree of Master of Science (MS) in Seed Technology.

It is a matter of dignity and pride for the author to express her heartiest gratitude and profound respect to her honorable teacher, research supervisor ***Professor Dr. Tuhin Suvra Roy****, Department of Agronomy, Sher-e-Bangla Agricultural University (SAU), Dhaka for her helpful advice to complete the work, otherwise it would be too tough to complete the thesis with the stipulated period. Sincere appreciation is also due to her constructive criticism and meticulous corrections of this thesis.*

The anther express her heartiest respect, sincere appreciation and immense indebtedness to her respectable teacher and research co-Supervisor, ***Professor Dr. Md. Shahidur Rashid Bhuiya,,*** *Department of Agronomy, SAU, Dhaka for her scholastic guidance during planning and execution of the research, valuable suggestions and all kind of support throughout the period of research work and preparation of manuscript.*

It is also a great pleasure for the author to express her sincere and deep sense of gratitude to ***Prof. Dr. Mohammad Ali****, Director, Institute of Seed Technology, SAU, Dhaka, for her encouragement and co-operation and for providing all the necessary facilities during entire period of this program.*

It is also a great pleasure for the author to express her sincere and deep sense of gratitude to ***Ministry of Science and Technology*** *for giving* ***NST Fellowship*** *which funded my research work.*

The another feel proud to express thanks from the core of my heart to her parents, brother, sisters, relatives, well- wishers and friends for their inspiration, help and encouragement throughout the study.

The Author

YIELD VARIATION, SUGAR AND ANTIOXIDANT CONTENT OF POTATO AS INFLUENCED BY VERMICOMPOST AND FOLLOWED BY PERFORMANCE AT AMBIENT STORAGE CONDITION

ABSTRACT

The experiment was conducted at Sher-e-Bangla Agricultural University, Dhaka-1207, during the period from November, 2014 to April, 2015 to evaluate the effect of variety and vermicompost on the yield, sugar and antioxidant activity of potato and their performance under ambient storage condition. The experiment consists of two factors, *i.e.,* factor A:- Potato varieties (V-4): V_1:BARI TPS-1, V_2:BARI Alu-28 (Lady Rosetta),V_3: BARI Alu-25 (Asterix)and V_4:BARI Alu-29 (Courage); factor B:-Vermicompost level (M-4):M_1: 0 t/ha, M_2: 2 t/ha, M_3:4 t/ha and M_4: 6 t/ha and was laid out in a split-plot design with 3 replications. The present study revealed that vermicompost had significant effect on most of the yield and quality contributing parameters. Results demonstrated that yield and other parameters increased with increasing vermicompost level. Among the sixteen treatment combination, Asterix with vermicompost at the rate of 4 t/ha produced the maximum yield (36.01 t/ha) but Asterix with vermicompost at the rate of 6t/ha showed the highest specific gravity, dry matter, glucose, sucrose, ascorbic acid, antioxidant and polyphenol content. These two combinations also showed little bit higher concentration of glucose and sucrose compared to those of other combinations.In case of ambient storage condition; dry matter, specific gravity, starch, polyphenol and ascorbic acid decreased with increasing storing period while weight loss, total soluble solid (TSS), glucose, sucrose and antioxidant content increased with increasing storing period of up to 60 days. Lady Rosetta and Asterix may store under ambient storage condition up to 60 DAS without imparting any significant quality losses just prior to sprouting of tuber. It may be concluded that, the potato growers of Bangladesh may apply vermicopmpost on their field at the rate of 6 t/ha for maintaining better yield and good processing quality.

LIST OF CONTENTS

CONTENTS (Cont'd)

LIST OF FIGURES

LIST OF FIGURES (Cont'd)

LIST OF TABLES

LIST OF TABLES(Cont'd)

LIST OF TABLES (Cont'd)

LIST OF APPENDICES

LIST OF APPENDICES (Cont'd)

LIST OF PLATES

LIST OF ACCRONYMS AND ABBREVIATIONS

ACCRONYM	ABBREVAITION
AEZ	Agro-Ecological Zone
Agric.	Agriculture
Agril.	Agricultural
Agron.	Agronomy
Annu.	Annual
Appl.	Applied
Biol.	Biology
Chem.	Chemistry
cm	Centi-meter
CV	Coefficient of Variance
DAS	Days After Storage
Dev.	Development
Ecol.	Ecology
Environ.	Environmental
et al	et alii, And others
Exptl.	Experimental
g	Gram (s)
Hortc.	Hotriculture
i.e.	*id est* (L), that is
J.	Journal
kg	Kilogram (s)
LSD	Least Significant Difference
M	Vermicompost
M.S.	Master of Science
m^2	Meter squares
mg	Milligram
Nutr.	Nutrition
Physiol.	Physiological
Progress.	Progressive
Res.	Research
SAU	Sher-e-Bangla Agricultural University
Sci.	Science
Soc.	Society
t/ha	Ton per hectare
UNDP	United Nations Development Programme
viz	*videlicet* (L.), Namely
V	*variety*
%	Percentage
@	At the rate of

CHAPTER I

INTRODUCTION

Potato (*Solanum tuberosum* L.) belonging to the *Solanaceae* family is grown in nearly 150 countries and is the world's single most important tuber crop with a vital role in the global food system and food security (Singh, 2010). It is the fourth world crop after wheat, rice and maize. The total world potato production is estimated at 364808.768 ton in 2012 (FAOSTAT, 2013). It is the most highly produced non-grain staple crop in the world, with one third of total production harvested in densely-populated developing countries, like China and India (CIP, 2008). In world top 25 potato producing countries, Bangladesh ranks 8thposition (FAOSTAT, 2014). In Bangladesh, it ranks 2nd after rice in production (FAOSTAT, 2013). The total area under potato crops, per ha yield and total production in Bangladesh are 444534.41 hectares, 19.35 t/ha and 8603000 metric ton, respectively (BBS, 2013). The total production is increasing day by day because of an alternative food crop against rice and wheat and is a rich crop of nutrient substances as such consumption also rapidly increasing in Bangladesh (BBS, 2013).

Nutritive value of potato is relatively high, because of protein content and composition high percentage of essential amino acids: lysine, leucine, phenyl alanine, threonine and valine (Gumul *et al*., 2011). Potato is also characterized by high amounts of starch, and lower content of sugars. Potato is an excellent source of vitamin C and other biologically active substances, such as polyphenols and flavonoids, which are commonly described as antioxidants (Leszczynski, 2000; Wroniak, 2006). These substances have beneficial influence on human being, as they protect against cardiovascular disease, and cancer, as well as reduce blood cholesterol level (Astley, 2003). Ascorbic acid (L-AA, vitamin C) as additive is largely accepted in human diets because of its antioxidative potential.

Several types of food supplementation exist, but natural food sources seem to be superior to that (Davey *et al*., 2000). The recommended daily allowance value of vitamin C is specified with 60 mg/day for adults (Anonymous, 1989), DGE-recommendation (German Society of Nutrition) is about 100 mg/day for adults (Anonymous, 2001). Potato peel is a good source of natural antioxidants. It extract provide protection against acute liver injury (Singh *et al*., 2008) and oxidative damage to erythrocytes (Singh and Rajini, 2008).

In recent years, the Tuber Crops Research Centre of BARI has collected many new varieties of potato from the International Potato Research Centre, Peru, and from other sources. These are being tested under Bangladesh field conditions, to determine whether they can be recommended for cultivation in the country and processing industry also. The Centre has already made good contribution towards the development of some high yielding potato varieties. Several dozens of high yielding varieties (HYV) of potato were brought to Bangladesh and tried experimentally under local conditions before being recommended for general cultivation.

Due to the increasing demand of consumers and foreign importers on this important crop, special attention should be given to increase its yield and quality. The area and production of potato in Bangladesh has been increasing during last decades but the yield per unit area remains more or less static. The yield is very low in comparison to that of the other leading potato growing countries of the world, 40.16 t/ha in USA, 42.1 t/ha in Denmark and 40.0 t/ha in UK (FAO, 2009). Storage problem is also a serious problem in Bangladesh. Storage conditions in potato make several differences in the physiochemical properties of the tubers and textures. Sugar and starch are important components of carbohydrates in case of potato. Potato is a perishable commodity and three variables determine storage losses in potatoes: quality of the tuber at the beginning of the storage, storage conditions, and duration of storage (Burton *et al*. 1992).

Storage losses are often specified as weight losses and losses in the quality of potatoes which are caused by respiration (Basker, 1975); sprouting (Amoros *et al*., 2000); evaporation of water from the tubers (Kabira and Lemaga, 2003); changes in chemical composition and physical properties of the tuber (Cronk *et al*., 1974; Maga, 1980) and damage by extreme temperatures (Linnemann *et al*., 1985). It is because too high sucrose level produces black coloration during frying of the potato which is not acceptable. In domestic consumption also high amount of sucrose is not desirable. Now-a-days gradual deficiencies in soil organic matter and reduced yield of crop and quality are alarming problem in Bangladesh. The cost of inorganic fertilizers is very high. On the other hand, the organic manure is easily available to the farmers and its cost is low compared to that of inorganic fertilizers. Vermicompost is a good source of different macro and micronutrients particularly NPKS. The increased microbial activity improves the availability of soil phosphorous and nitrogen. Vermiculture is the science of rearing of earthworms for mass propagation on organic wastes under semi-natural conditions and vermicomposting is the bioconversion of organic waste materials through earthwormic ways (Senapat, 1992). Senesi and Brunetti (1996) mentioned that vermicomposting is a controlled, aerobic, biological process and able to convert biodegradable humus like organic substances and suitable for the application of soil amendment.

Vermiculture is a cost-effective tool for environmentally sound waste management (Banu *et al.,* 2001; Asha *et al.,* 2008). Earthworms are the crucial drivers of the process, as they aerate condition and fragment the substrate and thereby drastically alter the microbial activity and their biodegradation potential (Fracchia *et al.,* 2006; Lazcano *et al.,* 2008). From inner quality point of view, potatoes are mainly valued for its starch, reducing sugar, non-reducing sugar, polyphenol, vitamin C content and especially for the high content of vitamin C (Asghari-Zakaria *et al*., 2009).

Sometimes potato produced in Bangladesh is not good quality enough in respect of dry matter , starch and non-reducing sugar content etc. which are not present at optimum level in produced product (Keijbets, 2008). So using different amount of vermicompost materials may put contribution for improving quality of potato in Bangladesh condition. Response of vermicompost on yield and quality of potato is still unknown especially in Bangladesh condition. So, the present research work was carried out to fulfill the following objective-

i) To evaluate the yield and quality attribute of different potato varieties

ii) To study the effect of vermicompost on yield and quality of potato tubers and

iii) To assess interaction of vermicompost and variety of potato on yield and quality of potato tubers.

CHAPTER II

REVIEW OF LITERATURE

Potato is a starchy, tuberous crop grown as an important crop in Bangladesh . Applying vermicompost with different varieties; both are important factors influencing the yield, quality of potato and also in storage condition. The average yield of potato in Bangladesh is much lower than that of the other countries of the world. Storage facilities are also rare in Bangladesh. Numerous experiments have been conducted throughout the world on potato crop but information regarding vermicompost response in potato varieties and their effects on yield and quality parameters and antioxidant activity are still inadequate. Some of the important research reports regarding potato cultivar, yield, storage and quality have been reviewed here in this chapter.

2.1 Response to potato variety

Valcarcel (2015) conducted an experiment to evaluate the total phenolics, total flavonoids and antioxidant activity both in skin and flesh tissues of 60 varieties of potato planted in two trial sites. Site and year of cultivation significantly affected the three parameters studied. Higher levels of total phenolics, total flavonoids and antioxidant activity were found in the skin than in the flesh of tubers. Blue variety ‘Congo’ showed the highest values in both tissues, except antioxidant activity in the skin which was higher in variety ‘Edzell Blue’. Maximum values in skin and flesh, respectively, were 12.6 and 3.6 mg/g gallic acid equivalents for total phenolics, 9.5 and 2.3 mg/g catechin equivalents for total flavonoids and 18.8 and 4.4 mg/g Trolox equivalents for antioxidant activity on a dry-weight basis. Strong positive correlations were found among total phenolics, total flavonoids and antioxidant activity.

Kassim *et al*. (2014) found that reducing physiological functions of above ground part of potato plant (leaf area and total chlorophyll content), the number and the weight of tuber decreased, so the productivity of the plant decreased.

Rojoni *et al.* (2014) conducted an experiment at the Horticulture farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to evaluate the yield potential of BARI TPS-1 and they found BARI TPS-1 produced gross tuber yield 27.67 tha^{-1}.

Sandhu *et al*. (2014) conducted an experiment and the results revealed that four varieties (atlantic, lady rosetta, Kufri chipsona-1 and kufripukhraj) were used to determine tuber dry matter, reducing sugars, chip colour, sucrose, free amino acids, chip yield and total phenols content. Variety kufripukhraj showed maximum physiological as well as total weight Loss followed by lady rosetta, Atlantic and Kufri chipsona-1 both at 50 and 75 DAS. During both the years, all the three processing varieties exhibited significantly less reducing Sugars than table variety kufri pukhraj both at 50 and 75 DAS. Generally, at higher temperatures of storage, the metabolic consumption of reducing sugars is higher due to higher rate of respiration. Sucrose content in tubers of all the four Varieties increased gradually during storage up to75 DAS during both years. Maximum sucrose was recorded in Lady Rosetta at 0, 50 and 75 DAS during both the years. Total phenol content of tubers of all the four varieties under study showed increasing Trend up to 75 DAS during both the years of study. Highest content of total phenols were noticed in control var. Kufri Pukhraj followed by lady rosetta, kufri Chipsona-1 and Atlantic both at 50 and 75 DAS during two years.

Al-Weshahy *et al*. (2013) undertook a study with the objective of evaluating the storage stability of the polyphenols and the antioxidant activity in the peel from two varieties of potatoes, Penta and Marcy, grown in Ontario, Canada. Samples were stored at −20, 4 and 25 °C for 0, 2, 4 and 8 weeks.

Peel from Penta variety contained higher levels of total polyphenolic compounds, 2.4 mg/g of peel dry weight compare to Marcy, 1.14 mg/g of peel dry weight. Chlorogenic and caffeic acids were the major polyphenolic compounds present in both verities. Levels of polyphenolic compounds in the peel were influenced by storage temperature with maximum loss observed at 25 °C. Storage time caused a decline in the levels of polyphenolic compounds up to 4 weeks at all temperatures followed by a significant increase at the end of week 8. There was a parallel increase in the antioxidant activity of the peel samples during storage and until the end of 8 weeks of storage. At all temperatures of storage, there was a significant relationship ($r = 0.43$, $P \leq 0.05$) between the amount of polyphenolic compound in the peel samples and their antioxidant capacity. Results suggested that, potato peel as a valuable source of polyphenolic compounds requiring proper storage condition to maintain their antioxidant properties.

Cota and Hadzic (2013) conducted a two-year experiment included four potato varieties (Desire, Romano, Bistra and KisSora). The aim was to select new varieties for cultivation. Productive characteristics of potato varieties (yield, weight and number of tubers per box) were examined. In the frame of qualitative properties, dry matter content and starch were examined. Higher average yield was achieved by Romano cultivar by 8% compared to Desire and Kissora. Dry matter content ranged from 21.80% in Romano to 22.20% in Desiree.

Sohail *et al*. (2013) reported that the local varieties consisted thick juice than HYV varieties like TPS which can be an indication of using the local varieties for ready to drink juice along with other materials like malt and flavours.

Abebe (2013) carried out an experiment at three distinct locations in the Amhara region of Ethiopia for evaluation of the specific gravity of 25 potato varieties. The pooled specific gravity values ranged from 1.058 to 1.102.

The specific gravity of tubers of the improved variety Belete was the highest while that of Menagesha was the lowest. Furthermore, the specific gravity values for varieties grown at Debretabor were higher than those for the corresponding varieties grown at Adet and Merawi. He mentioned that specific gravity is the measure of choice for estimating dry matter and ultimately for determining the processing quality of potato varieties.

Behjati *et al*. (2013) conducted a field experiment to evaluate the yield and yield components on promising potato clones. Clone No. 397031-1, had the highest yield and Lady Rosetta variety had the lowest yield compared with other varieties. The lowest and highest average number of main stems per plant, related to Lady Rosetta and clone No. 397067-2. Lady Rosetta variety had the highest number of tube per plant and clone No. 397067-2 had the lowest number of tubers per plant. The lowest and highest average tuber weight per plant related to clone No. 397067-2 and Lady Rosetta variety respectively.

Albishi *et al*.(2013) conducted an experiment of four potato varieties (Purple, Innovator, Russet and Yellow) were determined using the Folin-Ciocalteu method. The respective antioxidant activities of these potatoes and/or their skins were evaluated using several in vitro assays. The phenolic profiles of potato peel and flesh samples were determined using high-performance liquid chromatography with photodiode array detection (HPLC-DAD).Bound and esterified phenolics contributed as much or even more than the free phenolics to the antioxidant activity of the peels; extracts from Purple variety showing the highest activity. The peels of all varieties showed significantly ($p < 0.05$) higher phenolic content and antioxidant activities than their respective flesh. Chromatographic data showed differences in the amounts, but not in types, of phenolic compounds in the potato peel samples .Thus potato processing discard may be used in food formula-ions and their extracts could potentially be employed as an effective source of antioxidants in food systems.

Deuber *et al*. (2012) conducted an experiment and reported that the polyphenol contents decreased from the peel via the outer to the inner flesh and differed among the cultivars. The cultivars Vitelotte and Luminella had the highest polyphenol contents (5202 and 572µg/g dry weight (DW) in the outer flesh), whereas Charlotte and Bintje had the lowest contents (19.5 and 48.0µg/g DW). Chlorogenic acid and its isomers (neo- and crypto-chlorogenic acid) were the major polyphenols. Glycoalkaloid contents were highest in the peel and lowest in the inner flesh, values in the flesh were below guideline limits in all cultivars. In conclusion, potatoes contribute to the daily intake of polyphenols and their consumption, thereby, may have positive effects on health.

Schwarz and Geisel (2012) reported that storage problems most often occur because of conditions in the field and not conditions in storage. Adverse weather, disease or improper harvesting and handling of tubers can cause problems in storage. Tubers that are rotting, frozen, chilled or diseased must be managed differently than mature, sound tubers. Good storage management will help to salvage problem tuber lots, but storage will never improve a poor quality variety.

Cornacchia *et al*. (2011)) conducted a experiment with4 different early potato cultivars ('Ariana', 'Liseta', 'Safrane' and 'Spunta') and stored for 8 days at 5°C and for 6 days at 20°C with the aim to investigate their browning potential and their post-cutting performance on the basis of their initial quality attributes such as color, polyphenol oxidase (PPO) activity, total phenolics, ascorbic acid contents, sugar composition and antioxidant activity (AOX). In addition, color changes and general appearance were monitored during storage, and a study of the correlations among monitored parameters was carried out.

Results showed that 'Safrane' also received the highest appearance score during the first days of storage at both storage temperatures, and had a high ascorbic acid content (31.2 mg/100 g Fw) and antioxidant activity (26.6 mg TE/100 g Fw). 'Liseta' and 'Ariana' showed intermediate potential in terms of storability and appearance, while 'Spunta' was the least suitable to be used as fresh-cut. Results of this work contributed to increased knowledge on the suitability of potato cultivars to be processed as fresh cut produce, to allow the fresh-cut industry to be supplied with raw material suitable for processing throughout the year, according to seasonal availability.

Hossain (2011) conducted three experiments with BARI released twelve potato varieties to determine the yield potentiality, natural storage behavior and degeneration rate for three consecutive years. He found that the highest emergence was observed in Granola at 34 DAP. At 50 DAP plant height (cm) of Diamant was (43.50), BARI TPS 1 (47.70), Felsina (52.00), Asterix (52.97), Granola (38.30), Cardinal (46.33). Foliage coverage (%) of Diamant was (83.33), BARI TPS 1 (85.56), Felsina (82.22), Asterix (89.44), Granola (85.56), Cardinal (81.67). No. of stems hill-1 of Diamant was (4.06), BARI TPS 1 (3.21), Felsina (3.14), Asterix (4.03), Granola (3.30), Cardinal (3.89). Tuber yield hill-1 (g) of Diamant was (244.2), BARI TPS 1 (227.9), Felsina (300.1), Asterix (276.9), Granola (277.0), Cardinal (316.9). Under the grade 28-40mm, the highest number (48.63%) of seed tubers was produced by Granola which was statistically identical with Asterix (46.43%). Under the same grade (28-40 mm), the highest weight (43.46%) of seed tubers was produced by Patrones followed by Asterix (37.16%), Granola (36.64%) and Multa (35.39%) among which there was no significant variation.

Karim *et al*. (2011) conducted an experiment with ten exotic potato varieties (var. All Blue, All Red, Cardinal, Diamant, Daisy, Granola, Green Mountain, Japanese Red, Pontiac and Summerset) to determine their yield potentiality. The highest total tuber weight per plant (344.60g) recorded in var.

Diamant and total tuber weight plant-1 was the lowest (65.05 g) recorded in var. All red, all blue varieties showed the most potential yield in this experiment.

Asmamaw *et al.* (2010) conducted a study to investigate the influence of genotype, growing environment and storage period on postharvest quality of seven released potatocultivars grown at Adet (2240 masl), Chilga (2270 masl), and Dabat (2620 masl),northwest Ethiopia in 2006. Cured tubers of each cultivar from each location were stored at ambient conditions for 8 weeks in a locally constructed dark room in Adet, the location with the highest temperatures. The quality of the tubers and the crispsprepared from them was evaluated at weekly intervals. Tubers from cvsJalenie, Guassa and Zengena had a high specific gravity (1.088–1.094) and dry matter percentage (26.2–27.1%) when grown in Dabat and Chilga, and a lower specific gravity (1.064–1.072) and dry matter percentage (22.3-22.7%) when grown in Adet. These cultivars produced crisps with a taste value of 8 (like very much) when growninChilga and Dabat and of almost 7 (like moderately) when grown in Adet. There was a progressive reduction in specific gravity, dry matter percentage, and taste of crisps with increase in storage time. Cultivars with higher dry matter concentrate on maintained a better quality than cultivars with a lower dry matter concentration. Across growing locations and cultivars, 57% of the crisps samples were white to cream colored, 33.3% light tan and 9.5% dark tan after 1 week of storage, whereas after 6 weeks of storage none of the cultivars produced white cream colored crisps. It is reasonable to conclude that cvsJalenie, Guassa, and Zengena can produce tubers with a high dry matter percentage under Chilga and Dabat conditions, from which acceptable crisps can be prepared from tubers stored up to 6 weeks under ambient conditions.

Guler (2009) observed that first; second, third class tuber yields and total tuber yield, tuber number per plant, mean tuber weight and leaf chlorophyll were significantly influenced by potato cultivar. There were significant correlations between chlorophyll and yield and yield related characters.

Total yield significantly correlated with leaf chl. Correlations between first class yield and total yield as well as total yield and tuber number per plant were highly significant.

Mahmud *et al*. (2009) assessed the yield of seed size tubers in five standard potato cultivars (Cardinal, Multa, Ailsa, Heera, and Dheera) in relation to dates of dehaulming (65, 70, and 80 days after planting) in a Seed Potato Production Farm, Debijong, Panchagarh. The maximum seed tuber yield was recorded from Cardinal at 80 DAP followed by Heera and Cardinal at 70 DAP, Dheera and Ailsa at 75 DAP.

Avramiuc *et al*. (2008) conducted an experiment and this work pointed out the change of the ascorbic acid (vitamin C) content from potato tubers, stored for three months under apartment house cellar conditions. The ascorbic acid content from potato tubers has decreased by 26.23% (as compared to the ascorbic acid content determined at harvesting), after the first 30 days of storage, by 40% (as compared to the ascorbic acid content determined at 30 days of storage) after 60 days, and only by 10.5% (as compared to the ascorbic acid content determined at 60 days of storage), after 90 days of storage. After 90 days of storage, the initial content of the ascorbic acid from potatoes stored in wooden boxes has decreased by 60.38%. The ascorbic acid content from potatoes, stored in tightly closed glass jars, was less modified. Thus, the determinations carried out and reported at the same time intervals have shown that, after 30 days of storage, the values of the ascorbic acid content have decreased by 10.5%, after other 30 days, by 6.72% and after the last 30 days, by 4.46%. After 90 days of storage under these conditions, the initial content of the ascorbic acid from potato tubers was diminished by 20.22%. The greater the average temperature of the analyzed interval was, the greater the diminution in the acid ascorbic content of stored potatoes.

Haque (2007) conducted a field experiment with 12 exotic potato germplasm to determine their suitability as a variety in Bangladesh. He found that all the varieties gave more than 90% emergence at 20-35 DAP. He also observed that Plant height (cm) of Quincy was (87.8), Sagitta (65.8), Diamant (62.6); No. of stems hill-1 was counted in Diamant (7.2), Quincy (4.5), Sagitta (4.4); Plant diameter (cm) of Sagitta was (4.0), Quincy (3.7), Diamant (2.6) at 60 DAP; Foliage coverage (%) of Sagitta was (100.0), Diamant (98.3), Quincy (96.6); No. of tubers plant-1 of Diamant was (13.06), Sagitta (8.34), Quincy (6.71); Wt. of tubers plant-1 (kg) of Quincy was (0.64), Sagitta (0.63), Diamant (0.49); dry matter (%) of Sagitta was 20.8%, Diamant 20.1% and Quincy 18.5%.

Das (2006) carried out an experiment to study the physio-morphological characteristics and yield potentialities of potato varieties. He found that Foliage coverage (%) of Diamant was (93.3), Asterix (71.7), Granola (66.7), Quincy (90.0), Courage (63.3), Felsina (83.3), Lady Rosetta (83.3), Laura (78.3); No. of tubers hill-1 of Diamant (11.7), Asterix (8.00), Granola (11.3), Quincy (9.33), Courage (7.33), Felsina (8.00), Lady Rosetta (10.3), Laura (8.33); Tuber weight hill-1 (g) of Diamant (380), Asterix (285), Granola (275), Quincy (300), Courage (320), Felsina (333), Lady Rosetta (348), Laura (258); Dry matter (%) of Diamant (25), Asterix (17.5), Granola (23), Quincy (31), Courage (34.5), Felsina (22.5), Lady Rosetta (22.0), Laura (27.0); Regarding size grade distribution of tubers the varieties Courage, Espirit, Granola, Lady rosetta, Laura were found superior.

Roy *et al*. (2006)studied that storability of tubers obtained from 9 hybrid True Potato Seed (TPS) progenies were compared with that of non-TPS cultivar 'Diamant' under ambient conditions (22.0-34.80C and 58.0-93.6% RH). Dormant period, days to start shrinkage and days to 100% shrinkage of all TPS progenies were significantly longer than those of 'Diamant' especially in P-364 X TPS-67 and P-364 X TS-9. The results of correlation analysis among these parameters also indicated that the storability of the TPS progenies was superior to that of 'Diamant' The rate rotten tubers of all the TPS progenies.

However, was significantly higher than that of 'Diamant' because of their high susceptibility to infectious diseases, indicating the importance of the selection of TPS progenies with high disease resistance during storage under ambient conditions. Tuber size also affected the storability of TPS progenies; small tubers were preferable to medium and large ones, except for their high shrink ability.

Rainys and Rudokas (2005) studied with early (Goda and Voke), moderately early (Lady Rosetta) and moderately late (Saturna and Heres) potato cultivars in Lithuania. Tuber yield was significantly affected by the fertilizers, genotype and weather conditions. The growing period and cultivar had significant effects on starch and dry matter contents of tubers. Averaged over the 3 years, the highest starch and dry matter contents were recorded for Lady Rosetta (17.0-17.9 and 23.2-24.1%) and Saturna (17.1-17.4 and 23.5-23.8%). The cultivars had the highest starch and dry matter contents in 2002 (14.9-21.0 and 21.3-27.1%).

Anonymous (2005) evaluated twenty one varieties along with two standard checks Diamant and Granola at seven locations. The yields of the varieties varied from location to location as well as within location. Of all the stations, except Pahartoli, none crossed the check variety Diamant but comparatively higher yields were produced by the varieties Espirit, Courage, Innovator, Quincy, Matador, Markies, Laura and Lady Rosetta.

Kumar *et al*. (2005) determined under water weight, specific gravity, dry matter and starch content of potatoes grown at Modipuram, Uttar Pradesh. He found that there was a positive correlation between under water weight and specific gravity (r=0.99), under water weight and dry matter (r=0.92).

Mahmood (2005) was carried out an experiment at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh to investigate the effect of planting method and spacing on the yield of potato using Cv. BARI TPS-1. He found highest yield (32.5 t/ha) from BARI TPS-1.

Rytel (2004) reported that the rate of dry matter and starch accumulation depends on cultivar and growing conditions.

Mondol (2004) conducted an experiment to evaluate the performance of seven exotic (Dutch) varieties of potato. He found that plant height (cm) of Diamant was (18.07 cm), Granola (13.47 cm); No. of main stem hill-1 of Diamant (4.36), Granola (4.90); No. of tubers hill-1 of Diamant (12.00), Granola (10.93); Weight of tubers plant-1 (kg) of Diamant (0.57), Granola (0.39); Dry matter (%) of Diamant (17), Granola (16.30).

Alam *et al*. (2003) conducted a field experiment with fourteen exotic varieties of potato under Bangladesh condition. The highest emergence (91%) was observed from Cardinal which was statistically identical with most of the varieties except the variety Granola (63%). The highest number of stem hill-1 was recorded in Ailsa (4.59) followed by Cardinal (4.50). Significantly maximum number of leaves hill-1 was produced from the plants of the variety Ailsa (53.80), which was followed by Cardinal (49.75). The yields ranged of exotic varieties were 19.44 to 46.67 t/ha. Variety Ailsa produced the maximum yield (46.67 t/ha) which was followed by Cardinal (42.21 t/ha).

Hossain (2000) conducted an experiment to study the effects of different levels of nitrogen on the yield of seed tubers in four potato varieties. He found that the tallest plants were produced by the seedling tubers of BARI TPS-1 (74.51 cm) and the shortest plants came from the variety Diamant (58.63 cm).The foliage coverage (%) of Diamant at 75 DAP was (79.00), BARI TPS-1 (89.00); No. of stems hill-1 of Diamant was (3.50), BARI TPS-1 (2.71); No. of tubers hill-1 of Diamant was (7.85), BARI TPS-1 (9.55); Weight of tubers hill-1 of Diamant was (416.67), BARI TPS-1 (491.33); Dry matter of tuber (%) of Diamant was (19.71), BARI TPS-1 (18.18).

Mareschi *et al*. (1982) conducted an experiment in various regions of France (particularly in the North-East) potatoes have remained an important source of vitamin C.

They measured by a specific method the loss of ascorbic acid in the Bintje species of potatoes (grown in Pas-de-Calais) due to storage and different cooking procedures. Storage for 3 months in the dark at +12 degrees C decreases the ascorbic acid level by about 50%, storage for 6-8 months by about 66%. Cooking of peeled potatoes (in water, vapor or as French fries) causes an additional loss of vitamin C of roughly 40-45% whereas unpeeled potatoes loose only about 7% by cooking. When cooked potatoes are kept warm, on a hot plate, for an hour the loss of ascorbic acid amounts up to 70%. Thus three major factors determine the spontaneous destruction of ascorbic acid in potatoes, i.e. the length and conditions of storage (aging), the way of cooking and warming up. Potatoes, even when consumed in considerable quantities, can only supply part of the French recommended Daily Allowance particularly from January through June.

2.2 Response to Vermicompost

Akbasova *et al.* (2015) conducted an experiment and reported that the increase of root crops yield 1.2-1.5 times in making 8 t/ha vermicompost in gray soils was established. It was shown that the use vermicompost as a fertilizer was more expedient, as it contains more nutrients (N.P.K) and organic humic acids compared to conventional compost. Vermicompost has a direct physiological effect on plants; it stimulates the development of root systems and reduces the harmful effects of pollutants.

Kashem *et al.* (2015) conducted a study attempted to compare the effect of cow manure vermicompost and inorganic fertilizers on the vegetative growth and fruits of tomato plant (*Solanum lycopersicum* L.). An air dried sandy loam soil was mixed with five rates of vermicompost equivalent to 0 (control), 5, 10, 15 and 20 t/ha and three rates of NPK fertilizer equivalent to 50% (N-P-K = 69-16-35 kg t/ha), 100% (N-P-K = 137-32-70 kg ha^{-1}) and 200% (N-P-K = 274-64-140 kg ha^{-1}).The data revealed that shoot length, number of leaves, dry matter weight of shoots and roots, fruit number and fruit weight were influenced significantly ($P < 0.05$) by the application of vermicompost.

The highest dose of vermicompost of 20 t/ha increased dry weight of shoot of 52 folds and root of 115 folds, number of fruit(s)/plant of 6 folds and mean fruit weight of 29 folds while the highest rate of NPK fertilizer of 200% increased dry weight of shoot of 35 folds and root of 80 folds, number of fruit(s)/plant of 4 folds and mean fruit weight of 18 folds over the control treatment. The growth performance of tomato was better in the vermicompost amended soil pots than the plants grown in the inorganic fertilizer amended soil pots.

Shirzadi (2015) carried out a study to evaluate the use of organic fertilizers (Vermicompost and Chicken manure) on the plant's height and number and weight of micro tuber Marfona cultivator potato (diameter of 25 to 35mm) with 2factors of vermicompost in 4levels (0,3,6and 9 t/ha) and chicken manure in4 levels (0,10,12 and 14 t/ha). The result showed that with increasing vermicompost fertilizer, plant's height was reduced. Also highest number and weight of tubers with a diameter of 25-35mm belonged to 12 tons Chicken manure treatment without vermicompost.

Ramamurthy *et al*. (2015) was conducted an experiment to show the Influence of different percentages of vermicompost (25%, 50%, 75% and 100%) on the tuber length, width, circumference and weight of the radish plant (*Raphanus sativus* L.) was carried out at different period of exposures (30, 60 and 90 days). The maximum tuber length (20.67, 23.67 and 27.55cm) and weight (189.31, 215.31 and 244.64gm) were noticed in 75% of vermicompost concentration at 30, 60 and 90 days respectively except tuber width and circumference. During 60 and 90 days of exposure the maximum width and circumference were noticed in 50% of vermicompost and thereafter both width and circumference decreased in commensurate with increasing vermicompost concentration. The study reveals the 75% concentration of the vermicompost influence the tuber yield status of Radish plant.

Panwar and Wani (2014) a field experiment was done in the sweet potato filed with Nitrogen, Potash, and Phosphorus was applied in form of organic manure Farm yard Manure, Vermicompost and Neemcake (Vermicompost) recorded highest survival percent , length of vine, number of branches/vine, shoot fresh weight, shoot dry weight, tuber yield plot^{-1}, number of tuber plot^{-1} under poplar trees. The maximum Gross return was noticed in with Rs. 99204.00. The maximum Benefit cost ratio was noticed in with 1:1.37.

Singh and Chauhan (2014) conducted an experiment and the results revealed that plant per meter row length, height of main shoot, dry matter(g) and number of leaves/plant higher in treatment (1/3 N-FYM+1/3N-Vermicompost +1/3N-Neem cake plus agronomic practices). On an average treatment (1/3 N-FYM+1/3N-Vermicompost +1/3N-Neem cake plus agronomic practices for weed and pest control (without chemical) significantly maximum tuber yield and A grade B grade and C grade tuber of potato.

Singh *et al.*(2014) was done a field experiment was conducted for two years to investigate the effect of vermicompost, organic mulching and irrigation level on growth, yield and quality attributes of tomato (*Solanum lycopersicum* L.). The vermicompost together with organic mulching increased plant height (106.5 cm), leaf area (40.6 cm2), leaf weight (1301 mg/ leaf), fruit weight (92.9 g), fruit yield (4.013 kg plant^{-1}), fruit density (0.972 g cc^{-1}), post-harvest shelf-life (15.0 days) and TSS (5.2º Brix) of tomato significantly. Application of vermicompost alone too increased the shelf-life of fruits by 25-106 % and TSS beyond 4.5 %, both of which are traits highly desirable for production of summer tomato and the related processing industry.

Maria *et al.* (2013) conducted an experiment with maize grown for grain were 4 treatments established-a control treatment and three treatments with dose increasing of granulated vermicompost (4.6; 9.2; 11.6 t/ha, respectively), which supplied 57, 114 and 142 kg.ha-1 total nitrogen to the soil, respectively. The experiment was not irrigated.

The experiment with potatoes included 7 treatments of fertilization. The first treatment was a control treatment, i.e., without the appliance of dry granulated vermicompost. In treatment 2 to 6 increasing doses of vermicompost (3.3; 6.6; 9.9; 13.2 and 19.8, respectively) were applied. Through the following doses of granulated vermicompost were applied to the soil 40, 80, 120, 160, 240 kg ha^{-1} N. Not only was the granular vermicompost applied in treatment 7, but also the industrial NPK fertilizer (150 kg urea + 200 kg ha^{-1}NPK 15-15-15. The grain yield was increased with the dose increasing of vermicompost. A thousand kernel weight, starch content and magnesium content parameters with the increasing dose of vermicompost were reduced. A dose of 4.6 t/ha vermicompost seems like the most appropriate for the parameters of a thousand kernel weight, starch and magnesium content. The increasing doses of vermicompost significantly increased the yield of potato tubers, starch content and dry matter content in tubers. The application of granulated vermicompost reduced vitamin C content in potato tubers. The use of fertilizers resulted to increasing the nitrate content in potato tubers however the application of granulated vermicompost has increased the contents of nitrates to a lesser extent than the joint application of NPK fertilizer and granulated vermicompost.

Mojtaba *et al.* (2013) conducted an experiment on which experimental factors included nitrogen fertilizer with three levels (50, 100 and 150 kg ha^{-1} as urea) and vermicompost with 4 levels *viz*., 0(control), 4.5, 9, and 12 t/ha. Results illustrated that the highest amount of plant height, leaf and stem dry weight, Leaf Area Index(LAI), fresh and dry weight of tuber, total tuber weight, total number of tuber, tuber diameter ,nitrogen percent of tuber, potassium percent of tuber and phosphorous percent of tuber were found from application of 150 kg N ha^{-1}. Data also demonstrated that vermicompost application at the rate of 12 t/ha promoted all above traits except plant height in compared to control treatment.

Furthermore, the interaction effects between different nitrogen rates and vermicompost application significantly improved growth parameters, yield and N.P.K content of tuber compared with nitrogen and/or vermicompost alone treatments. To gain highest yield and avoidance of environments pollution use of 150 kg N ha^{-1} nitrogen fertilizer and vermicompost application of 12 t/ha are suggested.

Raja and Veerakumari (2013) conducted an experiment and find the impact of vermicompostsviz. Cowdung, vermicompost, leaf ash vermicompost and poultry feather vermicomposton the yield and alkaloid content of medicinal plant, with as omniferous were assessed and compared with the plants cultivated in the soil amended with chemical fertilizer and the plants cultivated without any fertilizer (control).The plant growth parameters such as shoot length, root length, shoot dry weight, root dry weight, shoot wet weight, root wet weight, shoot: root ratio and the alkaloid with a ferin A and with anolide D were significantly increased in the plants cultivated in the soil amended with poultry feather vermicompost.

Kumar *et al*. (2012) conducted a field experiment with farm yard manure (FYM), poultry manure (PM), vermicompost (VC) and solubilizing bacteria (PSB) and *Azotobacter*+ PSB) in allocated plots for potato yield. The results showed that 50 % of the recommended dose of NPK through inorganic + 50% recommended dose of nitrogen (RDN) through organic manures (FYM, PM or VC) or 100% recommended dose of NPK through inorganic fertilizers alone influenced the tuber yield, nutrient uptake, soil fertility and paid higher returns compared to other treatments. Seed treatment with *Azotobacter*+ PSB proved better in tuber yield, nutrient uptake and recorded higher returns as compared to sole treatment of either *Azotobacter*or PSB. Three years pooled result revealed that integrated application of 50 % of recommended NPK through inorganic and 50 % RDN through PM recorded significantly highest tuber yield (22.73 t/ha) closely followed by 100 % recommended NPK through inorganic (22.20 t/ha) which were 228 % and 223 % respectively, over control.

Integrated application of inorganic and organic fertilizers and seed treatment with *Azotobacter*+ PSB biofertilizers improved tuber yield, nutrient uptake, and gave higher return as compared to other treatment combinations. Total organic carbon (TOC), soil microbial biomass carbon (SMBC), available N, P, and K status of the soil after 3 years were maximum when 50 % recommended dose of NPK were applied through inorganic and remaining 50 % RDN through PM.

Meenakumari and Shekhar (2012) conducted an experiment to determine the effect of vermicompost and other fertilizers on growth, yield and fruit quality of tomato in the field condition. The field trials were conducted using different fertilizers having equal concentration of nutrients to determine their impact on different growth parameters of tomato plants. Six types of experimental plots were prepared where was kept as control and five others were treated by different category of fertilizers Chemical fertilizers, Farm Yard Manure (FYM), Vermicompost, and FYM supplemented with chemical fertilizers and vermicompost supplemented with chemical fertilizer respectively).The treatment plots showed 73% better yield of fruits than control, Besides, vermicompost supplemented with N.P.K treated plots displayed better results with regard to fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant from other fertilizers treated plants.

Zandonadi and Busato (2012) reported that vermicomposting is a crucial eco-friendly technology capable of recycling organic wastes to be used as fertilizers. Through its hormone-like substances, vermicompost, liquid humus or worm bed leachate stimulates plant growth. Additionally, manipulation of microbial population present in vermicompost and its products may increase both nutrient content and availability.

Goutam *et al.* (2011) was Field trials were conducted using different fertilizers having equal concentration of nutrients to determine their impact on different growth parameters of tomato plants. Six types of experimental plots were prepared where was kept as control and five others were treated by different category of fertilizers Chemical fertilizers, Farm Yard Manure (FYM), Vermicompost, and FYM supplemented with chemical fertilizers, respectively. The treatment plots showed 73% better yield of fruits than control, Besides, vermicompost supplemented with N.P.K treated plots displayed better results with regard to fresh weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant from other fertilizers treated plants.The application of vermicompost @ 5 t/ha, 5 cm thick mulching with dried crop residues, two-thirds dose of NPK fertilizer (80:40:40 kg ha^{-1}) and 30 % irrigation is optimum for obtaining better quality and productivity of field grown tomatoes during dry period of mild-tropical climate.

Jaipaul *et al*. (2011) was studied the effect of different organic fertilizers on potato yield and other quality attributes for three years (2007-2009) under rainfed conditions of central Himalayan region of Uttarakhand on alfisol soil. Though the yield and other traits were significantly higher in conjoint use of nutrients than organic fertilizers but among the organic fertilizers, chicken manure + biofertilizers resulted in maximum plant height (70.73 cm), highest number of tubers (7.5 /plant), highest yield of large sized tubers (40 %),total yield (18.86 t/ha), highest uptake of nutrients (N:P:K: 82.1:18.0:91.2 kg/ha), maximum dry matter (20.06 %), specific gravity (1.06), protein (8.39 %), starch (10.76 %), ascorbic acid (21.73 mg/100g) and minimum reducing sugars (0.30 %). The highest B:C ratio (4.86) was also obtained for conjoint use of fertilizers and manures followed by the treatment comprising chicken manure and biofertilizers (2.30).

Shweta and Sharma (2011) was conducted an experiment with Application of organic manures along with chemical fertilizers had a significant effect on the tuber and haulm yield. Highest tuber (30.46t/ha) and haulm yield (9.04 t/ha) was recorded with application of 100 % NPK + 25 t/ha vermicompost and was significantly higher over sole use of chemical fertilizers. Tuber yield of potato recorded under 100% of recommended dose of NPK without organics (21.39 t/ha) was at par with 25 t FYM/ha or 12.5 t VC/ha applied along with 75% of recommended dose of NPK thereby, indicating a saving of 25% in NPK.

Ansari (2008) studied the effect of vermicompost application in reclaimed sodic soils on the productivity of potato (*Solanum tuberosum*), spinach (*Spinacia oleracea*) and turnip (*Brassica campestris*). The soil quality was monitored during the experiment followed by productivity. The treatments were 4, 5 and 6 t/ha of vermicompost as soil application in plots already reclaimed by Vermitechnology. Among the different dosages of vermicompost applied there has been a significant improvement in the soil quality of plots amended with vermicompost @ 6 t/ha. The overall productivity of vegetable crops during the two years of the trial was significantly greater in plots treated with vermicompost @ 6 t/ha. The present investigation showed that the requirement of vermicompost for leafy crops like spinach was lower (4 t/ha), whereas that for tuber crops like potato and turnip was higher (6 t/ha).

Alam *et al.*(2007)conducted an experiment to study the effect of vermicompost and NPKS fertilizers on growth and yield of potato (cv. Cardinal). The land was medium fertile and PH was 5.4. There were 12 treatments *viz*., control, vermicompost 2 3 4 5 (VC) 2.5 t/ha, VC 5.0 t/ha , VC 10.0 t/ha , VC 2.5 t/ha+50% NPKS . VC 5 t/ha+50% 6 7 8 9 NPKS, VC 10 t/ha+50% NPKS, VC 2.5 t/ha+100% NPKS, VC 5 t/ha+100% NPKS, 10 11 12 VC 10 t/ha+100% NPKS 50% NPKS and 100% NPKS. The experiment was laid out in RCBD with three replications. The doses of N-P-K-S were 90-40-100-18 kgha^{-1} for potato.

Application of 10 vermicompost and NPKS significantly influenced the growth and yield of potato.The treatment produced the highest (25.56 t/ha) tuber yield of potato. The lowest yield and yield contributing parameters recorded in control. Application of various amounts of vermicompost (2.5, 5, 10 t/ha) with NPKS fertilizers (50% and 100%) increased the vegetative growth and yield potato. Vermicompost at 2.5 5 and 10 t/ha with 50% of NPKS increased tuber yield over control by 78.3, 96.9 and 119.5 t/ha, respectively and vermicompost at 2.5, 5 and 10 t/ha with 100% of NPKS increased tuber yield by 146.8, 163.1 and 197.9 %, respectively.The results indicated that vermicompost (10 t/ha) with NPKS (100%) produced the highest growth and yield of potato.

Sood and Sharma (2001) was doing a field experiments during 2000 at Shimla for assessing the utility of growth promoting bacteria, *Azotobacter and* Vermicompost for potato production indicated 'that *Bacillus cerus*(A) and *Bacillus subtilis*(B) separately increased the tuber yield of potato from 115 to 268 q ha^{-1} par with 100% NPK treatment. Vermicompost @ 5 t/ha increased the tuber yield by 34 to 65 t/ha. The increase in yield was more when optimum NPK dose of fertilizer was applied. Inoculation of seed tubers with *Azotobacter* in the absence of N increased the tuber yield by 68 $q\ ha^{-1}$and the effect of *Azotobacter* decreased gradually as the dose of N was increased.

CHAPTER III

MATERIALS AND METHODS

This chapter presents a brief description about experimental period, site, climatic condition, crop or planting materials, treatments, experimental design and layout, crop growing procedure, intercultural operations, data collection and statistical analysis. The details of experimental materials and methods are described below:

3.1 Experimental period

The experiment was conducted at the Agronomy Research Field, Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from November 1, 2014 to April 30, 2015 .

3.2 Site description

3.2.1 Geographical location

The experimental area was situated at $23^0$77'N latitude and $90^0$33'E longitude at an altitude of 8.6 meter above the sea level (Anon., 2004).

3.2.2 Agro-ecological region

The experimental site belongs to the agro-ecological zone of "Modhupur Tract", AEZ-28 (Anon, 1988a). This was a region of complex relief and soils developed over the Modhupur clay, where floodplain sediments buried the dissected edges of the Modhupur Tract leaving small hillocks of red soils as 'islands' surrounded by floodplain (Anon,1988b). The experimental site is shown in the map of AEZ of Bangladesh in Appendix I.

3.2.3 Climate of the experimental site

Experimental site was located in the sub-tropical monsoon climatic zone, set a parted by winter during the months from November 01, 2014 to April 30, 2015

.

Plenty of sunshine and moderately low temperature prevails during experimental period, which is suitable for potato growing in Bangladesh. The weather data during the study period at the experimental site are shown in Appendix II.

3.2.4 Soil

Top soil was silty clay in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. Soil pH was 5.6 and has organic carbon 0.45%. The experimental area was flat having available irrigation and drainage system and above flood levels. The selected plot was medium high land.

3.3 Details of the experiment

3.3.1 Treatments

The experiment is consisted of two factors as follows:

Factor A: Potato varieties (4)

V_1:BARI TPS-1

V_2:BARI Alu-28 (Lady Rosetta)

V_3: BARI Alu-25 (Asterix)

V_4:BARI Alu-29 (Courage)

Factor B: Vermicompost level (4)

M_1: 0 t/ha

M_2: 2 t/ha

M_3: 4 t/ha

M_4: 6 t/ha

Treatment combinations were as: 16

V_1M_1, V_1M_2, V_1M_3, V_1M_4,

V_2M_1, V_2M_2, V_2M_3, V_2M_4,

V_3M_1, V_3M_2, V_3M_3, V_3M_4,

V_4M_1, V_4M_2, V_4M_3 and V_4M_4

3.3.2 Planting material

Four varieties of potato were used as planting materials as follows:

BARI TPS-1 (V_1);

Lady Rosetta (V_2);

Asterix (V_3) and

Courage (V_4)

3.3.3 Experimental design and layout

Experiment was provoked in a split-plot design with3 replications. The variety was assigned to main plot and vermicompost to sub plot. Distance between row to row was 50 cm and plant to plant distance was 25 cm. Distance between plot to plot was 75 cm. The size of the unit plot was 2 m× 2.5 m.

3.4 Crop management

3.4.1 Collection of seed

All variety of seed potato (certified seed) was collected from, Tuber Crops Research Centre (TCRC), Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur and from BARI sub-station. Individual weight of seed potato was 60-70 g.

3.4.2 Preparation of seed

Collected seed tubers were kept in room temperature to facilitate sprouting. Finally sprouted potato tubers were used as planting material.

3.4.3 Land preparation

The land of the experimental site was first opened in the last week of October with power tiller. Later on, the land was ploughed and cross-ploughed four times followed by laddering to obtain the desirable tilth. The corners of the land were spaded and weeds and stubbles were removed from the field. The land was finally prepared on 14 November 2014 three days before planting the seed. In order to avoid water logging due to rainfall during the study period, drainage channels were made around the land.

The soil was treated with Furadan 5G @10 kg ha^{-1} when the plot was finally ploughed to protect the young plant from the attack of cut worm.

3.4.4 Manure and fertilizer application

The experimental soil was fertilized with following dose of urea, Triple Super Phosphate (TSP), Muriate of Potash (MoP), gypsum, zinc sulphate and boric acid.

Fertilizers	Dose (kg ha^{-1})
Urea	250
TSP	150
MoP	250
Gypsum	120
Zinc Sulphate	10
Boric Acid	10

(Mondal *et al.*, 2011)

The total amount of vermicompost was applied at 7 days before planting as per treatment. Total amount of triple superphosphate, gypsum, zinc sulphate, magnesium sulphate, boric acid and half of urea was applied at basal doses during final land preparation. The remaining 50% urea was side dressed in two equal splits at 35 and 50 days after planting (DAP) during first and second earthing up.

3.4.5 Planting of seed tuber

The well sprouted healthy and uniform sized potato tubers were planted according to treatment. Seed potatoes were planted in such a way that potato does not go much under soil or does not remain in shallow. On an average, potatoes were planted at 4-5cm depth in soil on November 21, 2014.

3.4.6 Intercultural operations

3.4.6.1 Irrigation: Just after full emergence the crop was irrigated by flooding so that uniform growth and development of the crop was occurred and also moisture status of soil retain as per requirement of plants.

In total four-time irrigation were applied throughout the whole cropping period by four times. Excess water was not given, because it always harmful for potato plant.

3.4.6.2 Weeding and mulching

Weeding and mulching were necessary to keep the plots free from weeds and to conserve soil moisture. The newly emerged weed was uprooted carefully after complete emergence of sprouts and afterwards when necessary. Mulching was done for breaking the surface crust as and when needed.

3.4.6.3 Earthing up

Earthing up process was done in the plot at two times, during crop growing period. First was done at 35 DAP and second was at 50 DAP.

3.4.6.4 Plant protection measures

Dithane M-45 was applied at 30 DAP as a preventive measure for controlling fungal infection. Ridomil (0.25%) was sprayed at 45 DAP to protect the crop from the attack of late blight.

3.4.6.5 Haulm cutting

Haulm cutting was done at February 22, 2015 at 85 DAP, when 40-50% plants showed senescence and the tops started drying. After haulm cutting the tubers were kept under the soil for 10 days for skin hardening. The cut haulm was collected, bagged and tagged separately for further data collection.

3.4.6.6 Harvesting of potatoes

Harvesting of potato was done on March 1, 2015 at 7 days after haulm cutting. The potatoes of each plot were separately harvested, bagged and tagged and brought to the laboratory. The yield of potato plant^{-1} was determined in gram. Harvesting was done manually by hand.

3.5 Recording of data

Experimental data were recorded from 40 DAP and continued until harvest. Dry weights of different plant parts were collected after harvesting. The following data were collected during the experimentation.

a) Yield and yield contributing parameters:

1. No.of tubers/hill
2. Weight of tuber/hill
3. Average tuber weight
4. Yield (t/ha)
5. Marketable yield
6. Non-marketable yield
7. Seed potato yield
8. Non-seed potato yield

b) Processing and storage parameter:

1. Weight loss (%) at 20, 40 and 60 days after storing
2. Tuber flesh dry matter content (%)at 0, 20, 40 and 60 days after storing
3. Firmness at 0, 20, 40 and 60 days after storing
4. Specific gravity at 0, 20, 40 and 60 days after storing
5. Glucose content at 0, 20, 40 and 60 days after storing (Done by Somogi-Nelson method)
6. Sucrose content at 0, 20, 40 and 60 days after storing (Done by Somogi-Nelson method)
7. Starch content at 0, 20, 40 and 60 days after storing
8. Antioxidant determination at 0, 20, 40 and 60 days after storing
9. Total phenolic content at 0, 20, 40 and 60 days after storing
10. Ascorbic acid determination at 0, 20, 40 and 60 days after storing

3.6 Procedure of recording data

3.6.1 Yield of tuber (t/ha)

Tubers of each plot were collected separately from which yield of tuber $hill^{-1}$ was recorded in kilogram and converted to ton/ha.

3.6.2 Average weight of tuber (g)

Average weight of tuber was measured by using the following formula-

$$\text{Average weight of tuber} = \frac{\text{Yield of tuber/plot}}{\text{Number of tubers/plot}}$$

3.6.3 Marketable tuber and non-marketable tuber

On the basis of weight, the tubers have been graded into marketable tuber (>20g) and non-marketable tuber (<20g).

3.6.4 Seed yield

On the basis of the size of the tuber (28-55mm) the seed type potato tuber were graded.

3.6.5 Dry matter content (%)

The samples of tuber were collected from each treatment. After peel off the tubers the samples were dried in an oven at 72^0C for 72 hours. Dry matter content was calculated as the ratio between dry and fresh weight and expressed as a percentage (Barton, 1989).

3.6.6 Weight loss (%)

At the end of the experiment, remaining good tubers were recorded and their percentage was calculated on the basis of initial weight of tuber. Weight loss was calculated using the following formula:

$\% \text{ WL} = (\text{IW}-\text{FW})/\text{IW} \times 100$

Where,

%WL = Percent total weight loss

IW = Initial weight of tubers (kg)

FW = Final weight of tubers (kg)

3.6.7 Specific Gravity (g cm^{-3})

It was measured by using the following formula –

$$\text{Specific gravity} = \frac{\text{Weight of tuber in air}}{\text{Weight of tuber in fresh water at } 4^{0}C}$$

3.6.8 Total soluble solids (TSS)

TSS of harvested tubers was determined in a drop of potato juice by using Hand Sugar Refractometer "ERMA" Japan, Range: 0-32%according to (AOAC, 1990)and recorded as %Brix from direct reading of the instrument.

3.6.9 Reducing sugar and non-reducing sugar

3.6.9.1 Extraction of sugar

For the analysis of sugar content like glucose and sucrose potato flesh was extracted. For each extraction, 1.0g fresh sample of chopped potato was taken from uniform tuber samples. Sugar was extracted using 5ml of 80% ethanol heat at 80°c for 30 min using a dry block heat bath and the extracts was centrifuged at 5000 rpm for 10 min and decanted the supernatant. 8mL 80% EtOH, was added and it was repeated 4 and 5 for 3 times in total. All the supernatants were mixed well and the final volume was made up to 25 mL using 80% EtOH.The residue is used for starch analysis.

3.6.9.2 Reducing sugar determination (glucose)

Reducing sugar was estimated by the photometric adaptation of the Somogyi method with some modification. Copper solution and Nelson reagent and standard glucose solution (0.5 mL) were used. 3 mL sample solution was put into a small glass container. Then it was completely dried up on an electric heater, 3 mL distilled water was added, and then mixed well. Then .5ml solution was taken from this, two times and was put in different test tubes. In one test tube, 0.5 mL Copper solution was added and was boiled (100˚C) for 10 min. After boiling, immediately the test tube was cooled in tap water. 0.5 mL Nelson reagent in the test tube was added, and mixed them well. After 20 min, 8 mL distilled water was added and mixed well (Total volume = 9.5 mL).

After that the absorbance at 660 nm (Abs1) was measured and the reducing sugar content was calculated.

3.6.9.3 Non-reducing sugar determination (Sucrose)

0.2 mL Invertase solution (1,000 U/0.1 mL) was diluted with 50 mL distilled water, and add one drop of Vinegar. 0.5 mL solution, which was left during reducing sugar determination, was put into a test tube. Then 0.5 mL diluted Invertase solution (20 Unit/0.5 mL) was added and incubated for 30 min at ambient temperature and then .05ml Copper solution was added and boiled (100˚C) for 10 min. After boiling, immediately the test tubes were cooled in tap water. 0.5 mL Nelson reagent in the test tube was added, and mixed them well. After 20 min, 8 mL distilled water was added and mixed well (Total volume = 9.5 mL). After that the absorbance at 660 nm (Abs2) was measured and the reducing sugar content was calculated.

3.6.9.4 Measurement of starch in potato tubers

The residue remained after extraction for sugar, was washed for several times with water to ensure that there was no more soluble sugar in the residues. After that using tap water and mark up to 250 ml beaker. Stir well on a magnetic stirrer. Then 0.5 mL solution was taken from the beaker into 3 test tubes. 0.5 mL was taken during the stirring. Then boiling the test tubes for 10 min at 100 ˚C. 1 mL Amyloglucosidase solution was added and mix well and heat at 50-60˚C for 2 hrs in hot water. After cooling, a 0.5 mL Copper solution was added and mix well, heat at 100C for 10 min., cool in tap water again added 0.5 mL Nelson solution, mix well and added 7 mL distilled water, mix well (Final volume = 9.5 mL), and measure the absorbance at 660 nm (Abs4). . Calculate starch content using the glucose standard curve.

3.6.9.5 Polyphenole determination: The content of total phenolic compounds was determined spectrophotometrically according to Folin-Ciocalteu method (Singleton *et al*., 1999) with slight modification.

The absorbance of reaction solution was measured at 760 nm against a blank sample. The measurement was compared to a standard curve of gallic acid solutions and expressed as microgram of gallic acid equivalents per gram fresh weight (µg GAEg-1FW).

3.6.9.6 Antioxidant determination

Preparation of sample same as polyphenole determination.Total antioxidant capacity of fresh potatoes were quantified using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method. The absorbance reading was used to calculate spectrophotometer at 517nm wave length. All the values of antioxidant were expressed as Trolox micrograms per gram fresh weight (Trolox µg/g FW) using a nonlinear regression algorithm from Trolox standard curve.

3.7 Ascorbic acid determination

5gm of tuber sample was taken after meshing in a beaker.Then 10ml of HPO3 was added in the sample and volume up to same.After centrifugation (2000rpm, 10min) then it filtrates and take 5ml of solution for titrationthen those are titrated against indophenol solution and titration record was kept.After that in x axis used concentration of Ascorbic acid (mg) and in y axis value of titration.

Calculation:

Titration value ±value from standard curve /value of x in standard curve

=result *10ml/5ml AsA mg /10g FW

=new result/10 AsA mg/g FW

3.8 Firmness

The fresh potato tubers were cut into several slices to take the firmness reading by a firmness meter. The reading seems that, how much pressure is taken by the potato tuber slice to make it chips.

3.9 Statistical Analysis

The data obtained for different characters were statistically analyzed following the analysis of variance techniques by using MSTAT-C computer package program. The significant differences among the treatment means were compared by Least Significant Difference (LSD) at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

The present investigation was attempted to evaluate the response of variety and vermicompost on different yield and storage characteristics of potato. In this chapter; figures, tables and appendices have been used to present, discuss and compare the findings obtained from the present study. The ANOVA (analysis of variance) of data in aspects of all the quantitative and qualitative characteristics have been presented in Appendix (III-XIV). The revelation and all possible interpretations were given under the following headings:

4.1 Effect of variety on yield and yield contributing characters of potato

4.1.1 Number of tubers/hill

Singnificant variation was found among different varieties to number of tuber per hill (Appendix III). The maximum (9.833) number of tuber was found from Lady Rosseta (V_2) and the minimum (6.50) was found from Courage(V_4) (Table 1).

4.1.2 Weight of tuber/ hill

Singnificant variation was found among different varieties to weight of tuber per hill (Appendix III). The highest (390.0 g) weight of tuber was found from Lady Rosseta (V_2)and the lowest (324.6 g) was found from Bari Tps-1,V_1(Table 1).

4.1.3 Average tuber weight

Singnificant variation was found among different varieties to average tuber weight (Appendix III). The highest (53.57 g) average weight of tuber was found from V_4 and the lowest (40.17 g) was found from V_2 which was statistically similar to V_1 (Table 1).

4.1.4 Tuber yield

Significant variation was found among different varieties to tuber yield (Appendix III). The highest (31.20 t/ha) yield of tuber was found from V_2 and the lowest (25.97 t/ha) was found from V_1 (Table 1).

The yields of different cultivars of potato were significantly different from each other reported by Kundu *et al*. (2012). Similar trend of yield performance was also reported by Hossain (2011), Dhar *et al.* (2009) and Das (2006).The probable reason for variation in yield due to the heredity of the variety, difference in agro-ecological conditions and soils of the experimental site.

Table 1.Effect of variety on yield and yield contributing characters of potato

Variety	No. of tubers/hill	Weight of tuber/ hill (g)	Average tuber weight (g)	Tuber yield (t/ha)
V_1	7.58 b	324.6 c	42.95 c	25.97c
V_2	9.83 a	390.0 a	40.17 c	31.20 a
V_3	7.41 b	356.8 b	48.69 b	28.55 b
V_4	6.50 c	344.8 b	53.57 a	27.5bc
CV (%)	9.03	13.19	6.29	6.14
$LSD_{0.05}$	0.70	3.73	2.91	1.73
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta,V_3 – Asterix,V_4 – Courage

4.2 Effect of variety on the marketable grading of potato and yield for seed purpose

4.2.1 Marketable yield

Marketable yield t /ha was significantly influenced by different varieties (Appendix III). The highest (26.55 t/ha) marketable yield of tuber was found from V_2 and the lowest (22.10t/ha) was found from V_1 (Table 2).This variation might be due to different tuber size of potato varieties.

4.2.2 Non-marketable yield

Significant variation was found among different varieties to non-marketable yield (Appendix III). The highest (4.79 t/ha) non-marketable yield of tuber was found from V_2 and the lowest (3.87 t/ha) was found from V_1which was statistically similar to V_3 and V_4(Table 2). This variation might be due to different tuber size and percentage of tuber size of potato varieties.

4.2.3 Seed potato

Singnificant variation was found among different varieties to seed potato yield (Appendix III). The highest (21.73 t/ha) yield as seed potato was found from V_2 and the lowest (17.75 t/ha) was found from V_1 (Table 2).This variation might be due to different tuber size of potato varieties.

4.2.4 Non-seed potato

Remarkable variation was found among different varieties to non-seed potato yield (Appendix III). The highest (9.46 t/ha) yield as non-seed potato was found from V_2 and the lowest (8.22t/ha) was found from V_1 (Table 2).

Table 2.Effect of variety to grading of yield for marketing and yield for seed purpose of potato

Variety	Marketable yield (t/ha)	Non-marketable yield (t/ha)	Seed potato (t/ha)	Non-seed potato (t/ha)
V_1	22.10 c	3.87 b	17.75 c	8.22 c
V_2	26.55 a	4.79 a	21.73 a	9.46 a
V_3	24.29 b	4.26 b	19.67 b	8.87 b
V_4	23.47 bc	4.23 b	18.95 b	8.63 bc
CV (%)	5.94	9.61	5.19	6.70
$LSD_{0.05}$	1.42	0.41	1.01	0.58
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.3 Effect of vermicompost on yield and yield contributing characters of potato

4.3.1 Number of tubers/hill

Significant variation was found among different levels of vermicompost on number of tuber per hill (Appendix III). The maximum (8.24) number of tuber was found from M_4 which was statistically similar to $M_2$and the minimum (7.41) was found from M_3 (Table 3).

4.3.2 Weight of tuber/ hill

Significant variation was found among different levels of vermicompost on weight of tuber per hill (Appendix III). The highest (387.3 g) weight of tuber was found from M_4 and the lowest (347.6 g) was found from M_2(Table 1).

4.3.3 Average tuber weight

Significant variation was found among different levels of vermicompost on average tuber weight (Appendix III). The highest (50.75 g) average weight of tuber was found from M_3 which was statistically similar to M_4 and the lowest (40.24 g) was found from M_1(Table 3).

4.3.4 Tuber yield

Significant variation was found among different levels of vermicompost on tuber yield (Appendix III). The highest (30.99 t/ha) yield of tuber was found from M_4which was statistically similar to M_3 and the lowest (24.68 t/ha) was found from M_1 (Table 3).This variation might be due to change the yield contributing character under different vermicompost level.

Table 3. Effect of vermicompost on yield and yield contributing characters of potato

Vermicompost level	No. of tubers/hill	Weight of tuber/ hill (g)	Average tuber weight (g)	Tuber yield (t/ha)
M_1	7.66 bc	308.5 d	40.24 c	24.68 c
M_2	7.99 ab	347.6 c	45.69 b	27.81 b
M_3	7.41 c	372.8 b	50.75 a	29.82 a
M_4	8.24 a	387.3 a	48.68 a	30.99 a
CV (%)	5.42	4.82	7.29	7.44
$LSD_{0.05}$	0.35	14.38	2.85	1.78
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability, * = Significant at 5% level of probability
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.4 Effect of vermicompost on potato grading for marketing and yield for seed purpose of potato

4.4.1 Marketable yield

Marketable yield t ha^{-1} was significantly influenced by different varieties (Appendix III).The highest (26.55 t/ha) marketable yield of tuber was found from M_4 and the lowest (20.85 t/ha) was found from M_1 (Table 4).This variation might be due to change in tuber size under different vermicompost level.

4.4.2. Non-marketable yield

Significant variation was found among different varieties to non-marketable yield (Appendix III). The highest (4.43 t/ha) non-marketable yield of tuber was found from M_4 which was statistically similar to M_4 and M_4. The lowest yield (3.95 t/ha) was found from M_1(Table 4). This variation might be due to change in tuber size under different vermicompost level. Present experiment showed that amount of non-marketable tuber number increases with increasing vermicompost levels.

4.4.3 Seed potato

Significant variation was found among different varieties to seed potato yield (Appendix III). The highest (21.66 t/ha) yield as seed potato was found from M_4 and the lowest (16.71 t/ha) was found from M_1 (Table 4).This variation might be due to change in tuber size under different vermicompost level.

4.4.4 Non-seed potato

Percent number of non seed potato was significantly influenced by different varieties (Appendix III). The highest (9.32 t/ha) yield as non-seed potato was found from M_4 which was statistically similar to M_3 and M_2. The lowest yield (7.97 t/ha) was found from M_1 (Table 4).

Table 4.Effect of vermicompost on grading of yield for marketing and yield for seed purpose of potato

Vermicompost level	Marketable yield (t/ha)	Non-marketable yield (t/ha)	Seed potato (t/ha)	Non-seed potato (t/ha)
M_1	20.85 d	3.95 b	16.71 d	7.97 b
M_2	23.61 c	4.34 a	19.07 c	8.74 a
M_3	25.40 b	4.42 a	20.66 b	9.16 a
M_4	26.55 a	4.43 a	21.66 a	9.32 a
CV (%)	5.20	9.83	5.27	7.72
$LSD_{0.05}$	1.06	0.35	0.867	0.57
Level of significance	**	*	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability, * = Significant at 5% level of probability
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.5 Combined effect of variety and vermicompost on yield, yield contributing characters, grading of yield for marketing and yield for seed purpose of potato

4.5.1 Number of tubers/hill

In respect of tuber number per hill due to different varieties and vermicompost levels was found statistically significant (Appendix III).The maximum (11.3) number of tuber was found from V_2M_4 and the minimum (5.66) was from V_1M_1 (Table 5).

4.5.2 Weight of tuber/ hill

In case of weight of tuber per hill due to different varieties and vermicompost levels was found statistically significant (Appendix III). The highest (450.2 g) weight of tuber was found from V_3M_3 which was statistically similar to $V_2M_4$and V_1M_4.The lowest (230.4 g) weight was found from V_1M_1(Table 5).

4.5.3 Average tuber weight

Different varieties and vermicompost levels intracted significantly for average tuber weight (Appendix III). The highest (64.31 g) average weight was found from V_3M_3 which was statistically similar to V_4M_2 and V_4M_4. The lowest (30.70 g) was fond from V_2M_2(Table 5).

4.5.4 Tuber yield

In respect of tuber yield due to different varieties and vermicompost levels was found statistically significant (Appendix III). The highest (36.01 t/ha) tuber yield was found from V_3M_3 which was statistically similar to V_2M_4, V_1M_4, V_2M_1 and V_4M_2. The lowest (18.43 t/ha) tuber yield was found from V_1M_1(Table 5) and similar with $V_4M_{1.}$

4.5.5 Marketable yield

Significant variation was found among different combination of varieties and vermicompost levels on marketable yield of tuber

(Appendix III). The highest (30.66 t/ha) marketable yield of tuber was found from V_3M_3 which was statistically similar to V_2M_4 and V_1M_4. The lowest (15.55 t/ha) tuber yield was found from V_1M_1 (Table 5).

4.5.6 Non-marketable yield

Non-marketable yield t /ha was significantly influenced by different varieties (Appendix III). The highest (5.36 t/ha) non-marketable yield of tuber was found from V_3M_3 which was statistically similar toV_2M_3 V_2M_4, V_1M_4, V_2M_1 and V_4M_2. The lowest (2.89 t/ha) tuber yield was found from V_1M_1 (Table 5).

4.5.7 Seed potato

Number of seed potato was significantly influenced by different combination of varieties and vermicompost levels on yield as seed of tuber (Appendix III). The highest (25.39 t/ha) yield as seed of tuber was found from V_2M_4 which was statistically similar to V_1M_4 and V_3M_3. The lowest (11.95 t/ha) tuber yield as seed was found from V_1M_1 (Table 5).

4.5.8 Non-seed potato

Significant variation was found among different combination of varieties and vermicompost levels on yield as non-seed of tuber (Appendix III). The highest (10.7 t/ha) non-seed yield of tuber was found from V_3M_3 which was statistically similar to V_1M_4, V_2M_1, V_2M_3, V_2M_4 and V_4M_2. The lowest (6.49t/ha) tuber yield was found from V_1M_1 (Table 5).

Table 5.Combined effect of variety and vermicompost on yield, yield contributing characters, grading of yield for marketing and yield for seed purpose of potato

Combination	No. of tubers/hil	Weight of tuber/ hill (g)	Average tuber weight (g)	Tuber yield (t/ha)	Marketable yield (t/ha)	Non-marketable yield t/ha	Seed potato (t/ha)	Non-seed potato (t/ha)
V_1M_1	5.66 h	230.4 i	40.96c-e	18.43 g	15.55 h	2.89 g	11.95 i	6.49 g
V_1M_2	7.33 de	333.8 ef	46.81 b-d	26.71 de	22.66 ef	4.04 d-f	18.20 fg	8.51 c-e
V_1M_3	8.00cd	299.9 g	37.48 e	23.99 ef	20.44 f	3.55 e-g	16.35 g	7.64 d-g
V_1M_4	9.33b	434.4 ab	46.54b-d	34.75ab	29.76 a	5.00 ab	24.49 ab	10.2 a
V_2M_1	10.0b	406.0 bc	40.60de	32.48a-c	27.48 b	5.00 ab	22.77 bc	9.71 a-c
V_2M_2	10.0 b	307.0 fg	30.70 f	24.56 ef	20.87 f	4.26 b-e	16.65 g	7.91 d-f
V_2M_3	8.00cd	397.6 c	49.70 b	31.81 bc	27.08 bc	4.72 a-d	22.12 cd	9.68 a-c
V_2M_4	11.3a	449.5 a	39.66 e	35.96a	30.78 a	5.18a	25.39a	10.5 a
V_3M_1	8.00cd	332.8 ef	41.59 c-e	26.62 de	22.50 ef	4.12 c-f	18.09 fg	8.53 c-e
V_3M_2	8.33c	346.3 de	41.55 c-e	27.70 de	23.51 de	4.20 c-e	18.99 ef	8.71 b-e
V_3M_3	7.00 ef	450.2 a	64.31a	36.01a	30.66 a	5.36 a	25.29 a	10.7 a
V_3M_4	6.33 f-h	298.1g	47.31bc	23.85 ef	20.48 f	3.36 fg	16.31 g	7.53 e-g
V_4M_1	7.00 ef	264.8 h	37.83 e	21.19 fg	17.88 g	3.80 ef	14.03 h	7.16 fg
V_4M_2	6.33 f-h	403.5c	63.71a	32.28a-c	27.40 bc	4.88 a-c	22.42 c	9.86 ab
V_4M_3	6.67 e-g	343.5 de	51.53b	27.48 de	23.40 de	4.08 c-f	18.89 ef	8.59 b-e
V_4M_4	6.00 gh	367.3 d	61.21a	29.38 cd	25.19cd	4.19 c-e	20.46de	8.92 b-d
CV (%)	5.42	4.82	7.29	7.44	5.20	9.83	5.27	7.72
$LSD_{0.05}$	0.717	28.76	5.69	3.55	2.11	0.711	1.73	1.14
Level of significance	**	**	**	**	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$

** = Significant at 1% level of probability

V_1 – BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.6 Percent of weight loss

4.6.1 Effect of variety

Profound variation was found among different varieties to tuber weight loss at 20 DAS (Appendix IV). The maximum (6.707 %) weight loss was exhibited by $V_1$and the minimum (2.267 %) was found by V_4 (Figure 1).

In case of weight loss at 40 DAS due to different varieties was found statistically significant (Appendix IV). The maximum (10.77 %) weight loss was exhibited by $V_1$and the minimum (4.086 %) was found by V_4(Figure 1).

In respect of weight loss at 60 DAS due to different varieties was found statistically significant (Appendix IV). The maximum (16.30 %) weight loss was exhibited by V_3 and the minimum (5.219 %) was found by V_4 (Figure 1).Weight loss is primarily attributed to the water loss that occurs through the outermost skin tissues during the processes of respiration and sprouting (Tester *et al*., 2005).

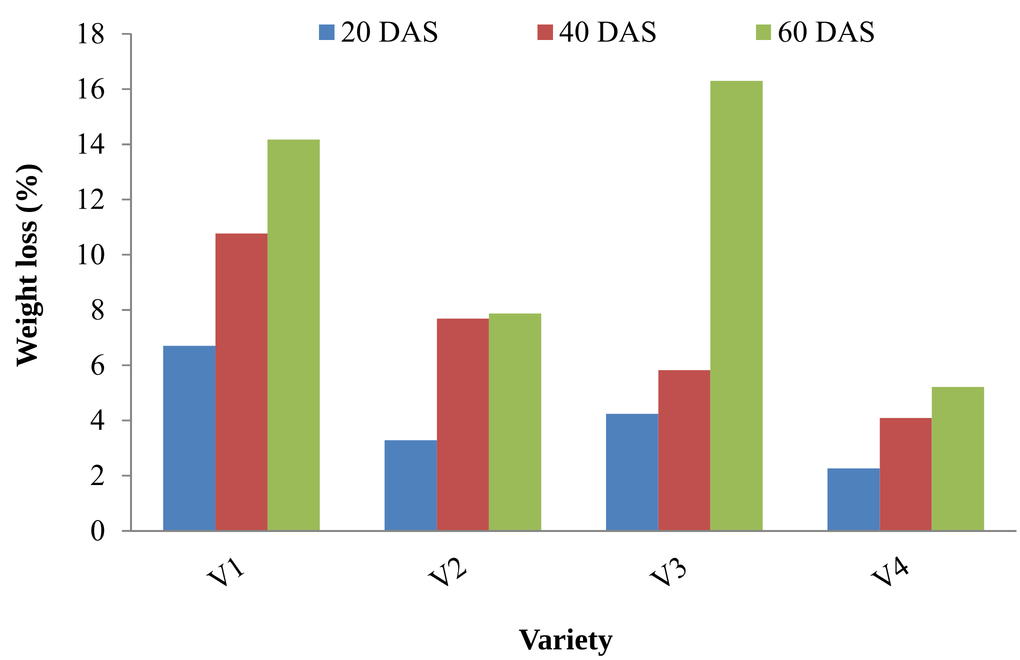


Figure 1. Effect of variety to weight loss (%) of potato tuber at different days after storage(LSD values 0.109, 0.576 and 0.411 for 20DAS, 40 DAS and 60 DAS, respectively).

V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.6.2 Effect of vermicompost

Profound variation was found among different levels of vermicompost on tuber weight loss at 20 DAS (Appendix IV). The maximum (5.938 %) weight loss was exhibited by $M_3$and the minimum (2.348 %) was found by M_2 (Figure 2).

In case of weight loss at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix IV). The maximum (10.65 %) weight loss was exhibited by $M_3$and the minimum (3.643 %) was found by M_2 (Figure 2).

In respect of weight loss at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix IV). The maximum (13.59 %) weight loss was exhibited by M_3which was statistically similar to$M_1$and the minimum (6.645 %) was found by M_4 (Figure 2).

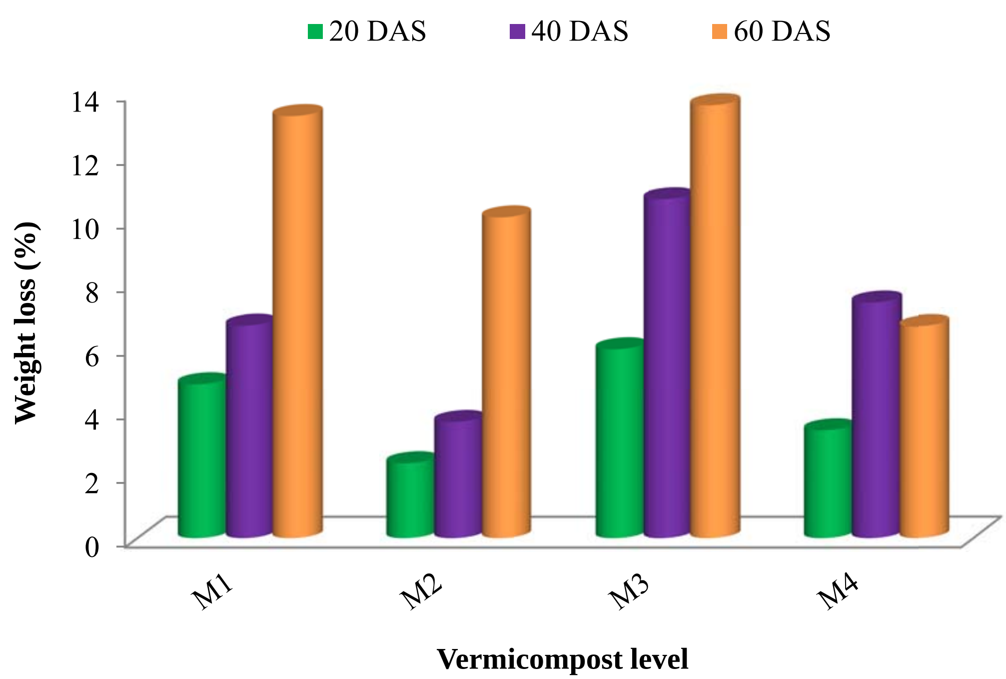


Figure 2. Effect of vermicompost on weight loss (%) of potato tuber at different days after storage (LSD values 0.324, 0.648and 0.548for 20DAS, 40 DAS and 60 DAS, respectively).M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.6.3 Combined effect of variety and vermicompost

Profound variation was found among different variety and vermicompost levels on tuber weight loss at 20 DAS (Appendix IV). The maximum (13.9 %) weight loss was exhibited by V_1M_3 and the minimum (1.19 %) was found by V_2M_2(Table 6).

In case of weight loss at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix IV). The maximum (25.4 %) weight loss was exhibited by V_1M_3 and the minimum (2.38 %) was found by V_2M_2 (Table 6).

In respect of weight loss at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix IV). The maximum (33.051%) weight loss was exhibited by V_3M_1 and the minimum (3.560 %) was found by V_4M_2 (Table 6).

Table 6. Combined effect of variety and vermicompost level on percent weight loss at different days after storage of potato tuber

Combination	Weight loss (%)		
	20DAS	40DAS	60DAS
V_1M_1	3.03 ef	4.44 d-g	7.47 e
V_1M_2	5.00 d	5.46 d	6.57 ef
V_1M_3	13.9a	25.4a	31.55 b
V_1M_4	4.81 d	7.70 c	11.07 d
V_2M_1	2.14 gh	5.05 d-f	7.46 e
V_2M_2	1.19 i	2.38 i	5.54 fg
V_2M_3	6.46 c	8.54 c	11.25 d
V_2M_4	3.35 e	14.7 b	7.25 e
V_3M_1	11.6 b	13.4 b	33.05 a
V_3M_2	1.53 hi	3.88 e-h	24.66 c
V_3M_3	1.74 hi	3.30 g-i	4.28 hi
V_3M_4	2.02 gh	2.62 hi	3.22 i
V_4M_1	2.49 fg	3.75 f-i	5.01 gh
V_4M_2	1.67 hi	2.85hi	3.56 i
V_4M_3	1.56 hi	5.27de	7.26 e
V_4M_4	3.35 e	4.47 d-g	5.04 gh
CV (%)	9.31	10.86	5.97
$LSD_{0.05}$	0.64	1.29	1.09
Level of significance	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.7 Dry matter content

4.7.1 Effect of variety

Profound variation was found among different varieties to dry matter content at 0 DAS (Appendix V). The maximum (23.54 %) dry matter was retained by V_3 and the minimum (19.56 %) was found by V_1 (Figure 3).

In case of dry matter content at 20 DAS due to different varieties was found statistically significant (Appendix V). The maximum (22.91 %) dry matter was retained by V_3 and the minimum (18.66 %) was found by V_1 (Figure 3).

In aspect of dry matter content at 40 DAS due to different varieties was found statistically significant (Appendix V). The maximum (22.15 %) dry matter was retained by V_3 and the minimum (17.67 %) was found by V_1 (Figure 3).

In respect of dry matter content at 60 DAS due to different varieties was found statistically significant (Appendix V). The maximum (21.70 %) dry matter was retained by V_3 and the minimum (17.05 %) was found by V_1 (Figure 3).

The variation in dry matter content among the potato varieties were also observed by Suyre *et al.,* (1975)and Capezio (1987). Variation in tuber dry matter content may be attributed to cultivars inherent in the production of total solids. Burton (1966) reported that genetic differences among varieties a role in their ability to produce high solids when grown on the same test plot. Dry matter content is subjected to the influence of both the environment and genotypes (Miller *et al.,* 1975; Tai and Coleman, 1999).

There was a significant decrease in dry matter concentration through time and cultivars with high dry matter concentration at harvest could be stored for extended periods at ambient temperature without significant quality. Loss of tuber dry matter during storage period may be due to respiration (Burton *et al*., 1992). Sprouting is a physiological process at which resting buds break their dormancy and resume growth by utilizing stored food (Salisbury and Ross, 1992)

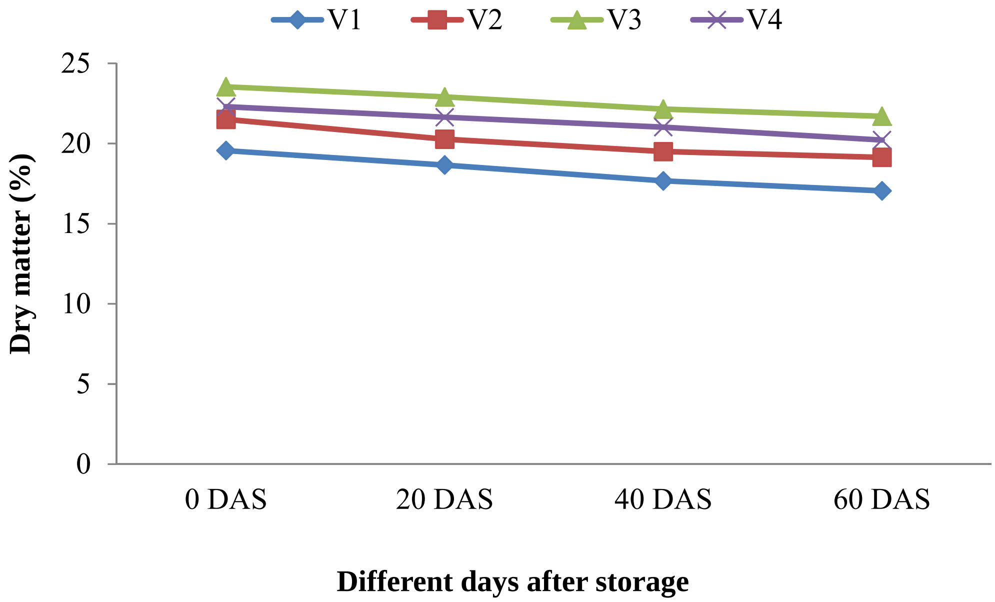


Figure 3. Effect of variety to dry matter content (%) of potato tuber at different days after storage (LSD values 0.460, 0.694, 0.803and 0.889for 0 DAS, 20DAS, 40 DAS and 60 DAS, respectively).
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.7.2 Effect of vermicompost

Profound variation was found among different levels of vermicompost on tuber dry matter content at 0 DAS (Appendix V). The maximum (24.19 %) dry matter was retained by $M_4$and the minimum (19.30 %) was found by M_1 (Figure 4).

In case of dry matter content at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix V). The maximum (22.99 %) dry matter was retained by $M_4$and the minimum (18.37 %) was found by M_1 (Figure 4).

In case of dry matter content at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix V). The maximum (21.78 %) dry matter was retained by M_4 which was statistically similar to M_3 and the minimum (17.90 %) was found by M_1 (Figure 4).

In respect of dry matter content at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix V). The maximum (21.40 %) dry matter was retained by M_4 and the minimum (17.20 %) was found by M_1 (Figure 4).

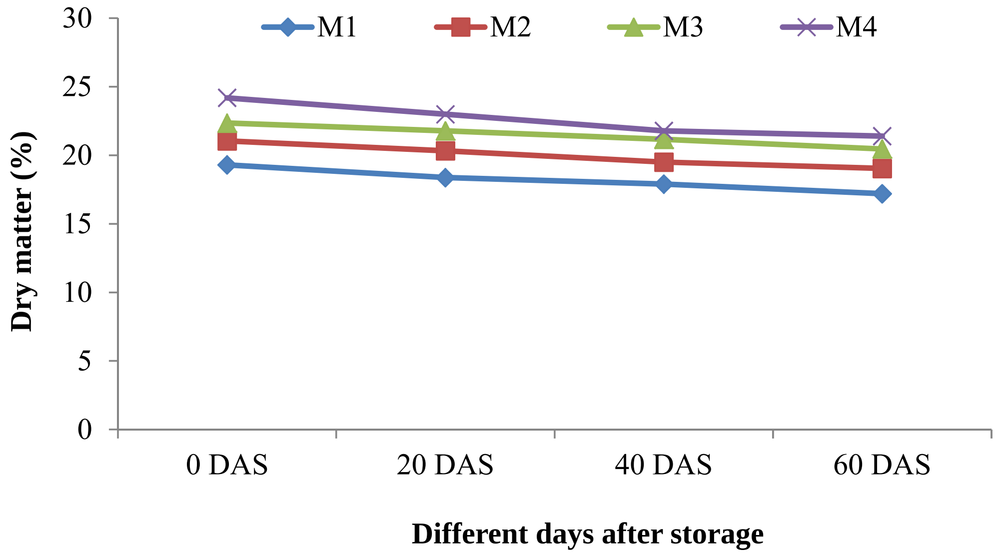


Figure 4. Effect of vermicompost on dry matter (%) of potato tuber at different days after storage (LSD values 0.782, 0.744, 0.710and 0.739for 0 DAS, 20DAS, 40 DAS and 60 DAS, respectively).
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.7.3 Combined effect of variety and vermicompost

Profound variation was found among different variety and vermicompost levels on tuber dry matter content at 0 DAS (Appendix V). The maximum (25.13 %) dry matter was retained by V_3M_4which was statistically similar to V_2M_4,V_3M_2, V_3M_3, V_4M_3 and V_4M_4 and the minimum (18.39 %) was found by V_1M_1 which was statistically similar to V_1M_2 and V_2M_1(Table 7).

In case of dry matter content at 20 DAS due to different variety and vermicompost levels was found statistically significant (Appendix V). The maximum (24.22 %) dry matter was retained by V_4M_4 which was statistically similar to V_2M_4,V_3M_2, V_3M_3, V_3M_4 and V_4M_3 and the minimum (16.94 %) was found by V_1M_1 (Table 7).

In case of dry matter content at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix V). The maximum (24.12 %) dry matter was retained by V_4M_4 which was statistically similar to V_3M_3 and V_4M_3 and the minimum (16.44 %) was found by V_1M_1 (Table 7).

In respect of dry matter content at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix V). The maximum (23.25 %) dry matter was retained by V_4M_4 which was statistically similar to V_3M_3 and V_3M_4 and the minimum (15.22 %) was found by V_1M_1(Table 7).

Table 7. Combined effect of variety and vermicompost level on percent dry matter content at different days after storage of potato tuber

Combination	Dry matter (%)			
	0 DAS	20 DAS	40 DAS	60 DAS
V_1M_1	18.39 f	16.94 e	16.44 i	15.22 i
V_1M_2	18.57 f	18.14 c-e	17.54 g-i	17.0 gh
V_1M_3	19.12 ef	18.63 cd	18.13 gh	17.89fg
V_1M_4	22.14 b-d	20.93 b	18.57fg	18.07fg
V_2M_1	18.82 f	17.56 de	16.86hi	16.16 hi
V_2M_2	19.79 ef	19.67 bc	18.88fg	18.38fg
V_2M_3	22.46 bc	20.99 b	20.57 de	20.41de
V_2M_4	24.96 a	22.88 a	21.68cd	21.59 b-d
V_3M_1	20.57 de	20.54 b	20.46 de	20.19 de
V_3M_2	24.23 a	23.01 a	21.70cd	21.41 b-d
V_3M_3	24.23 a	24.12 a	23.67ab	22.49a-c
V_3M_4	25.13 a	23.95 a	22.76a-c	22.70ab
V_4M_1	19.42 ef	18.44 c-e	17.83g-i	17.23 gh
V_4M_2	21.62 cd	20.49 b	19.88ef	19.35 ef
V_4M_3	23.59 ab	23.40 a	22.26 bc	21.06 cd
V_4M_4	24.55 a	24.22 a	24.12a	23.25a
CV (%)	4.29	4.23	4.20	4.50
$LSD_{0.05}$	1.57	1.48	1.42	1.47
Level of significance	**	**	**	*

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix,V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.8 Firmness

4.8.1 Effect of variety

Firmness was significant influenced by different test varieties at 0 DAS (Appendix VI). The maximum (43.57) firmness of tuber flesh was taken by V_3which is statistically similar to V_2 and the minimum (39.19) was taken by V_1 (Figure 5).

The firmness of tuber flesh at 20 DAS due to different varieties was found statistically significant (Appendix VI). The maximum (42.94) firmness of tuber flesh was retained by V_3 which is statistically similar to V_1 and the minimum (36.49) was taken by V_2 (Figure 5).

The firmness of tuber flesh at 40 DAS due to different varieties was found statistically significant (Appendix VI). The maximum (34.57) firmness of tuber flesh was retained by $V_4$and the minimum (30.93) was taken by V_2 which was statistically similar to V_3 (Figure 5).

In respect of firmness of tuber flesh at 60 DAS due to different varieties was found statistically significant (Appendix VI). The maximum (31.28) firmness of tuber flesh was retained by $V_4$and the minimum (27.85) was found by V_1 (Figure 5).

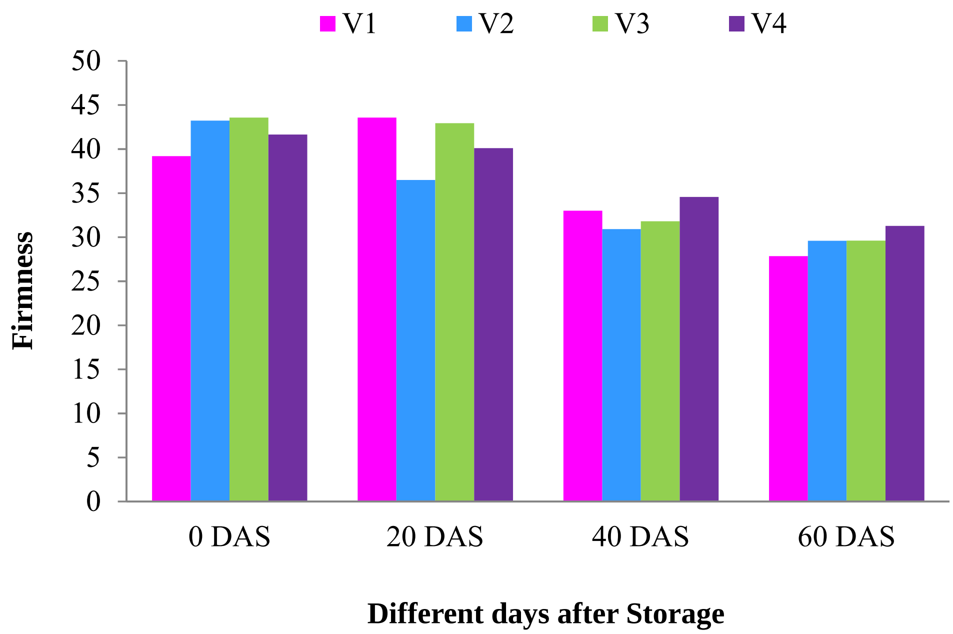


Figure 5. Effect of variety to firmness of potato tuber flesh at different days after storage (LSD values 1.30, 1.39, 1.00and 1.43for 0 DAS, 20DAS, 40 DAS and 60 DAS, respectively).

V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.8.2 Effect of vermicompost

No variation was found among different levels of vermicompost on firmness of tuber flesh at 0 DAS (Appendix VI). But, numerically, the maximum (42.52) firmness of tuber flesh was taken by M_2 and the minimum (41.47) was taken by M_3 (Figure 6).

Firmness of tuber flesh at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix VI). The maximum (41.99) firmness of tuber flesh was taken by M_1 and the minimum (40.91) was taken by M_3which was statistically similar to $M_4$and M_2 (Figure 6).

At 40 DAS due to different levels of vermicompost was found statistically significant (Appendix VI). The maximum (36.08) firmness of tuber flesh was taken by $M_4$and the minimum (31.25) was taken by M_3 which was statistically similar to M_1(Figure 6).

In respect of firmness of tuber flesh at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix VI). The maximum (30.56) firmness of tuber flesh was taken by M_4which was statistically similar to M_1 and the minimum (28.96) was taken by M_2 (Figure 6).

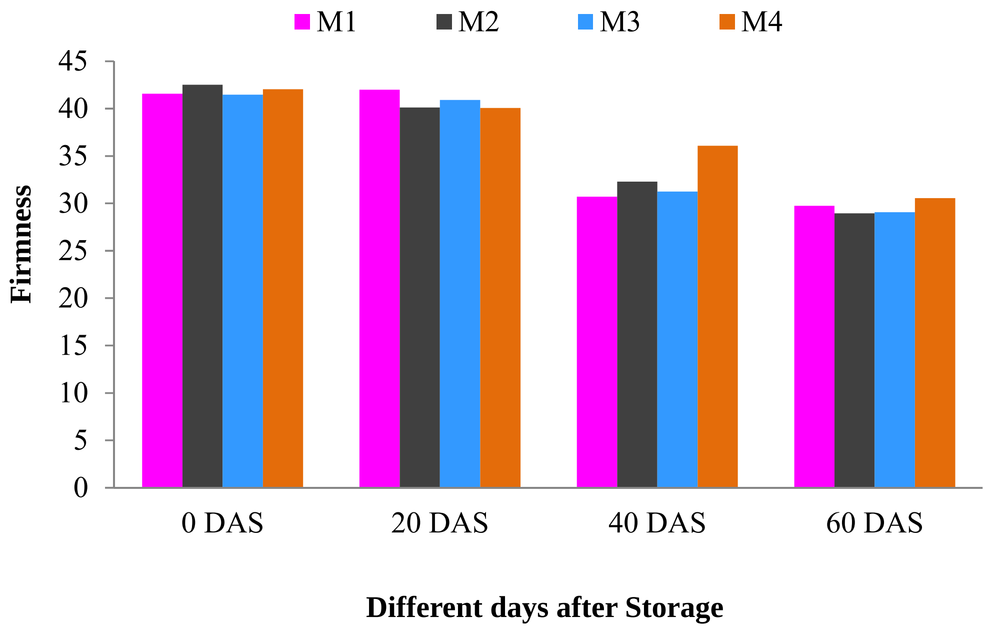


Figure 6. Effect of vermicompost on firmness of potato tuber flesh at different days after storage (LSD values NS, 0.957, 0.930and 1.11for 0 DAS, 20DAS, 40 DAS and 60 DAS, respectively).
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.8.3 Combined effect of variety and vermicompost

Combined effect of varieties and vermicompost on firmness of potato had also significant influence at 0 DAS (Appendix VI). The maximum (46.77) firmness of tuber flesh taken by V_3M_1which was statistically similar to $V_3M_2$and the minimum (38.78) was taken by V_1M_1(Table 8).

Firmness of tuber flesh at 20 DAS due to different variety and vermicompost levels was found statistically significant (Appendix VI). The maximum (47.30) firmness of tuber flesh taken by V_3M_3 and the minimum (33.57) was taken by V_2M_3 (Table 8).

In case of firmness of tuber flesh at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix VI). The maximum (39.15) firmness of tuber flesh taken by V_3M_4 which was statistically similar to $V_1M_2$and the minimum (26.56) was taken by V_3M_2 (Table 8).

The firmness of tuber flesh at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix VI). The maximum (32.73) firmness of tuber flesh taken by V_3M_4 which was statistically similar to V_4M_2, V_4M_1, V_4M_3, V_4M_4, V_3M_1 and V_1M_4 and the minimum (25.05) was taken by V_1M_2 (Table 8).

Table 8. Combined effect of variety and vermicompost on firmness of tuber flesh at different days after storage of potato

Combination	Firmness			
	0DAS	20DAS	40DAS	60DAS
V_1M_1	38.78 i	44.51 b	29.80 ef	27.55 ef
V_1M_2	39.53hi	44.63 b	38.65 ab	25.05 g
V_1M_3	38.20 i	41.25 c	28.21 fg	28.08 de
V_1M_4	40.27 f-i	43.90 b	35.37 c	30.72 a-c
V_2M_1	42.13d-g	38.76 de	29.31 f	29.34 b-e
V_2M_2	42.30d-f	35.83 f	31.84 de	32.57 a
V_2M_3	43.70 b-d	33.57 g	29.84 ef	27.89 d-f
V_2M_4	44.74 bc	37.80 e	32.72 d	28.56 c-e
V_3M_1	46.77 a	44.39 b	31.59 de	30.93 a-c
V_3M_2	45.59 ab	39.59 c-e	26.56 g	25.64 fg
V_3M_3	40.10 g-i	47.30 a	30.00 ef	29.14 b-e
V_3M_4	41.81 d-g	40.48 cd	39.15 a	32.73 a
V_4M_1	38.61 i	40.32 cd	32.12 d	31.17 ab
V_4M_2	42.69 c-e	40.46 cd	32.14 d	32.57 a
V_4M_3	43.89b-d	41.51 c	36.96 bc	31.12 ab
V_4M_4	41.40 e-h	38.11 e	37.07 bc	30.25 a-d
CV (%)	2.72	2.79	3.39	4.44
$LSD_{0.05}$	1.91	0.191	1.86	2.21
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.9 Total Soluble Solid (TSS^o)

4.9.1 Effect of variety

Significant variation was found among different varieties to total soluble solid of tuber at 0 DAS (Appendix VII). The highest (5.125^o) total soluble solid of tuber was exhibited by V_1which is statistically similar to $V_4$and the lowest (4.537^o) was exhibited by V_2 (Table 9).

In case of total soluble solid of tuber at 20 DAS due to different varieties was found statistically significant (Appendix VII). The highest (7.575^o) total soluble solid of tuber was exhibited by V_1 and the lowest (6.425^o) was exhibited by V_2which was statistically similar to V_3(Table 9).

Total soluble solid of tuber at 40 DAS due to different varieties was found statistically significant (Appendix VII). The highest (7.475^o) total soluble solid of tuber was exhibited by $V_1$and the lowest (6.625^o) was exhibited by V_2 which was statistically similar to V_3 andV_3(Table 9).

In respect of total soluble solid of tuber at 60 DAS due to different varieties was found statistically significant (Appendix VII). The highest (7.688^o) total soluble solid of tuber was exhibited by V_1which was statistically similar to V_4 and the lowest (7.150^o) was exhibited by V_2 (Table 9).

Table 9. Effect of variety to total soluble solid at different days after storage of potato tuber

Variety	Total soluble solid (TSS^o)			
	0DAS	20DAS	40DAS	60DAS
V_1	5.12 a	7.57 a	7.47 a	7.68 a
V_2	4.53 c	6.42 c	6.62 b	7.15 b
V_3	4.82 b	6.57 c	6.65 b	7.17 b
V_4	5.00 ab	6.90 b	6.95 b	7.55 a
CV (%)	4.73	3.39	6.36	4.31
$LSD_{0.05}$	0.23	0.23	0.44	0.31
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.9.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on total soluble solid of tuber at 0 DAS (Appendix VII). The highest (5.125^o) total soluble solid of tuber was exhibited by M_2which is statistically similar to M_1 and$M_4$and the lowest (4.512^o) was exhibited by M_3 (Table 10).

Total soluble solid of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix VII). The highest (7.000^o) total soluble solid of tuber was exhibited by M_4which was statistically similar to M_3 and$M_2$and the lowest (6.600^o) was exhibited by M_1(Table 10).

Total soluble solid of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix VII). The highest (7.063^o) total soluble solid of tuber was exhibited by M_4which was statistically similar to M_3 and$M_2$and the lowest (6.688^o) was exhibited by M_1(Table 10).

In respect of total soluble solid of tuber at 60 DAS due to different levels of vermicompost was found statistically non-significant (Appendix VII). But, numerically, the highest (7.46^o) total soluble solid of tuber was exhibited by M_4 and the lowest (7.28^o) was exhibited by M_1 (Table 10).

Table 10. Effect of vermicompost on total soluble solid at different days after storage of potato tuber

Vermicompost level	Total soluble solids (TSS^o)			
	0DAS	**20DAS**	**40DAS**	**60DAS**
M_1	4.90 a	6.60 b	6.68 b	7.28
M_2	5.12 a	6.87 ab	7.05 a	7.45
M_3	4.51 b	7.00 a	6.90 ab	7.35
M_4	4.95 a	7.00 a	7.06 a	7.46
CV (%)	6.08	5.00	4.82	3.24
$LSD_{0.05}$	0.25	0.28	0.28	-
Level of significance	**	*	*	NS

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS = Not significant
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.9.3 Combined effect of variety and vermicompost

Significant variation was found among different variety and vermicompost levels on total soluble solid of tuber at 0 DAS (Appendix VII). The maximum (5.50^o) total soluble solid of tuber exhibited by V_4M_2which was statistically similar to V_1M_1, V_1M_2, V_1M_4, V_3M_1,V_4M_1andV_4M_4. The minimum (3.90^o) total soluble solid was exhibited by V_2M_1 (Table 11).

In aspect of total soluble solid of tuber at 20 DAS due to different variety and vermicompost levels was found statistically non-significant (Appendix VII). But, numerically, the maximum (7.80^o) total soluble solid of tuber exhibited by $V_1M_3$and the minimum (6.10^o) was exhibited by V_3M_1 (Table 11).

Total soluble solid of tuber at 40 DAS due to different variety and vermicompost levels was found statistically non-significant (Appendix VII). But, numerically, the maximum (7.70^o) total soluble solid of tuber exhibited by $V_1M_2$and the minimum (6.10^o) was exhibited by V_3M_1 (Table 11).

Total soluble solid of tuber at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix VII). The maximum (7.80^o) total soluble solid of tuber exhibited by V_1M_3which was statistically similar to V_1M_2, V_1M_4, V_2M_4, V_4M_2, V_1M_1, V_4M_1, V_3M_2 and V_3M_3 The minimum (6.90^o) total soluble solid of tuber was exhibited by V_2M_3 which was statistically similar to V_3M_1 (Table 11).

Table 11. Combined effect of variety and vermicompost on total soluble solid at different days after storage of potato tuber

Combination	Total soluble solids (TSS^o)			
	0DAS	20DAS	40DAS	60DAS
V_1M_1	5.50a	7.30	7.20	7.55 a-c
V_1M_2	5.20ab	7.60	7.70	7.70ab
V_1M_3	4.65 b-e	7.80	7.50	7.80a
V_1M_4	5.15 a-c	7.60	7.50	7.70ab
V_2M_1	3.90 f	6.10	6.35	7.10 c-e
V_2M_2	5.00 a-d	6.30	6.55	7.00 de
V_2M_3	4.65 b-e	6.60	6.50	6.90 e
V_2M_4	4.60 c-e	6.70	7.10	7.60ab
V_3M_1	5.10 a-c	6.10	6.10	6.90 e
V_3M_2	4.80 b-e	6.70	6.95	7.40 a-d
V_3M_3	4.50 de	6.90	6.90	7.40 a-d
V_3M_4	4.90 b-d	6.60	6.65	7.00 e
V_4M_1	5.10 a-c	6.90	7.10	7.55 a-c
V_4M_2	5.50a	6.90	7.00	7.70ab
V_4M_3	4.25 ef	6.70	6.70	7.30 b-e
V_4M_4	5.15b-c	7.10	7.00	7.55 a-c
CV (%)	6.08	5.00	4.82	3.24
$LSD_{0.05}$	0.499	-	-	0.402
Level of significance	**	NS	NS	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability, NS = Not significant
V_1 –BARI TPS-1, V_2 – Lady Rosetta,V_3 – Asterix,V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.10 Specific gravity

4.10.1 Effect of variety

Specific gravity of different potato varieties was significantly influenced at 0 DAS (Appendix VIII). The highest (1.087) specific gravity of tuber was exhibited by V_3 and the lowest (1.052) was exhibited by V_1 (Table 12).In case of specific gravity of tuber at 20 DAS due to different varieties was found statistically significant (Appendix VIII). The highest (1.083) specific gravity of tuber was exhibited by $V_3$and the lowest (1.045) was exhibited by V_1 (Table 12).In aspect of specific gravity of tuber at 40 DAS due to different varieties was found statistically significant (Appendix VIII). The highest (1.080) specific gravity of tuber was exhibited by V_3 and the lowest (1.043) was exhibited by V_1(Table 12). In respect of specific gravity of tuber at 60 DAS due to different varieties was found statistically significant (Appendix VIII). The highest (1.077) specific gravity of tuber was exhibited by V_3 and the lowest (1.037) was exhibited by V_1 (Table 12).There was an overall reduction in specific gravity with increase in storage time and variation was found among genotypes (Asmamaw *et al*., 2010).

Table 12. Effect of variety to specific gravity at different days after storage of potato tuber

Variety	Specific gravity			
	0DAS	20DAS	40DAS	60DAS
V_1	1.05d	1.04d	1.04d	1.03d
V_2	1.06c	1.06c	1.06c	1.06c
V_3	1.08a	1.08a	1.08a	1.07a
V_4	1.08b	1.07b	1.07b	1.07b
CV (%)	2.64	1.62	2.10	3.40
$LSD_{0.05}$	0.0027	0.0017	0.0021	0.0037
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix,V_4 – Courage

4.10.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on specific gravity of tuber at 0 DAS (Appendix VIII). The highest (1.075) specific gravity of tuber was exhibited by M_3 and the lowest (1.068) was exhibited by M_1 which is statistically similar to M_2 (Table 13).In case of specific gravity of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix VIII). The highest (1.072) specific gravity of tuber was exhibited by $M_4$and the lowest (1.064) was exhibited by M_1which was statistically similar to M_2 (Table 13).In aspect of specific gravity of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix VIII). The highest (1.071) specific gravity of tuber was exhibited by $M_4$and the lowest (1.061) was exhibited by M_1which was statistically similar to M_2(Table 13).In respect of specific gravity of tuber at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix VIII). The highest (1.066) specific gravity of tuber was exhibited by M_4which was statistically similar to $M_3$and the lowest (1.058) was exhibited by M_1 which was also statistically similar to M_2(Table 13).

Table 13. Effect of vermicompost on specific gravity at different days after storage of potato tuber

Vermicompost level	Specific gravity			
	0DAS	**20DAS**	**40DAS**	**60DAS**
M_1	1.068c	1.064c	1.061c	1.058b
M_2	1.070c	1.065c	1.062c	1.059b
M_3	1.075a	1.070b	1.067b	1.065a
M_4	1.078b	1.072a	1.071a	1.066a
CV (%)	2.47	1.87	2.30	3.12
$LSD_{0.05}$	0.0022	0.0017	0.0020	0.0028
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.10.3 Combined effect of variety and vermicompost

No significant variation was found among different variety and vermicompost levels on specific gravity of tuber at 0 DAS (Appendix VIII). But, numerically, the maximum (1.094) specific gravity of tuber exhibited by V_3M_4 and the minimum (1.049) was exhibited by V_1M_1 (Table 14).

The specific gravity of tuber at 20 DAS due to different variety and vermicompost levels was found statistically significant (Appendix VIII). The maximum (1.090) specific gravity of tuber exhibited by V_3M_4 and the minimum (1.046) was exhibited by V_1M_3 (Table 14).

The specific gravity of tuber at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix VIII). The maximum (1.088) specific gravity of tuber exhibited by $V_3M_4$and the minimum (1.041) was exhibited by V_1M_2 which was statistically similar to V_1M_1 and V_1M_3(Table 14).

Specific gravity of tuber at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix VIII). The maximum (1.085) specific gravity of tuber exhibited by V_3M_4which was statistically similar toV_3M_3 and V_4M_4. The minimum (1.041) specific gravity of tuber was exhibited by V_1M_1 (Table 14).

Table 14. Combined effect of variety and vermicompost on specific gravity at different days after storage of potato tuber

Combination	Specific gravity			
	0DAS	20DAS	40DAS	60DAS
V_1M_1	1.049	1.047g	1.042h	1.041h
V_1M_2	1.050	1.042i	1.041h	1.035ij
V_1M_3	1.052	1.046gh	1.041h	1.038hi
V_1M_4	1.055	1.043hi	1.047g	1.032j
V_2M_1	1.064	1.059f	1.057f	1.054g
V_2M_2	1.066	1.062f	1.060f	1.058fg
V_2M_3	1.071	1.067e	1.065e	1.063ef
V_2M_4	1.072	1.068e	1.067e	1.065de
V_3M_1	1.080	1.078c	1.075cd	1.071cd
V_3M_2	1.081	1.078c	1.075cd	1.071cd
V_3M_3	1.091	1.086b	1.083b	1.082a
V_3M_4	1.094	1.090a	1.088a	1.085a
V_4M_1	1.077	1.073d	1.069e	1.066de
V_4M_2	1.081	1.077c	1.073d	1.070d
V_4M_3	1.084	1.080c	1.078c	1.076bc
V_4M_4	1.089	1.086b	1.082b	1.081ab
CV (%)	2.47	1.87	2.30	3.12
$LSD_{0.05}$	-	0.003	0.003	0.005
Level of significance	NS	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability, NS = Not significant
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.11 Glucose content

4.11.1 Effect of variety

Significant variation was found among different varieties to glucose content of tuber at 0 DAS (Appendix IX). The highest (0.7267 mg) glucose content of tuber was exhibited by V_3 and the lowest (0.5508 mg) was exhibited by V_1 (Table 15).

The glucose content of tuber at 20 DAS due to different varieties was found statistically significant (Appendix IX). The highest (0.795 mg) glucose content of tuber was exhibited by V_3 and the lowest (0.605 mg) was exhibited by V_1 (Table 15).

The glucose content of tuber at 40 DAS due to different varieties was found statistically significant (Appendix IX). The highest (1.592 mg) glucose content of tuber was exhibited by V_3 and the lowest (1.210 mg) was exhibited by V_1 (Table 15).

The glucose content of tuber at 60 DAS due to different varieties was found statistically significant (Appendix IX). The highest (1.433 mg) glucose content of tuber was exhibited by V_3 and the lowest (1.090 mg) was exhibited by V_1 (Table 15).

Different genotypes have different regulation of reducing sugar accumulation associated with tuber sprouting and senescence in response storage period (Wiltshire and Cobb, 1996). The hydrolysis of sucrose by the invertase enzyme leads to the formation of glucose and fructose monomers within potato tubers (Kumar *et al*., 2004). The significant increase in glucose contents we report here later in the storage period due to earlier sprouting and the associated depletion of carbohydrate reserves in the tuber (Blenkinsop *et al*., 2002).

Table 15. Effect of variety to glucose at different days after storage of potato tuber

Variety	Glucose (mg/g FW)			
	0DAS	20DAS	40DAS	60DAS
V_1	0.550 d	0.605 d	1.210 d	1.090 c
V_2	0.592 c	0.650 c	1.303 c	1.173 b
V_3	0.726 a	0.795 a	1.592 a	1.433 a
V_4	0.626 b	0.690 b	1.380 b	1.245 b
CV (%)	5.07	4.62	3.26	6.30
$LSD_{0.05}$	0.031	0.031	0.044	0.077
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.11.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on glucose content of tuber at 0 DAS (Appendix VIII). The highest (0.6942 mg) glucose content of tuber was contained by $M_4$and the lowest (0.5375 mg) was contained by M_1(Table 16).In case of glucose content of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix VIII). The highest (0.760 mg) glucose content of tuber was contained by M_4 and the lowest (0.595 mg) was contained by M_1(Table 16).In aspect of glucose content of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix VIII). The highest (1.523 mg) glucose content of tuber was contained by M_4 and the lowest (1.184 mg) was contained by M_1(Table 16).In respect of glucose content of tuber at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix VIII). The highest (1.372 mg) glucose content of tuber was contained by $M_4$and the lowest (1.067 mg) was contained by M_1(Table 16).

Table 16. Effect of vermicompost on glucose at different days after storage of potato tuber

Vermicompost level	Glucose (mg/g FW)			
	0DAS	**20DAS**	**40DAS**	**60DAS**
M_1	0.537 d	0.595 d	1.184 d	1.067 d
M_2	0.610 c	0.667 c	1.341 c	1.207 c
M_3	0.654 b	0.717 b	1.438 b	1.293 b
M_4	0.694 a	0.760a	1.523 a	1.372 a
CV (%)	4.90	4.05	4.12	7.07
$LSD_{0.05}$	0.026	0.026	0.046	0.075
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.11.3 Combined effect of variety and vermicompost

Significant variation was found among different variety and vermicompost levels on glucose content of tuber at 0 DAS (Appendix IX). But, numerically, the maximum (0.82 mg) glucose content of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and the minimum (0.43 mg) was contained by V_1M_1 (Table 17).

In aspect of glucose content of tuber at 20 DAS due to different variety and vermicompost levels was found statistically significant (Appendix IX). The maximum (0.90 mg) glucose content of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and the minimum (0.480 mg) was contained by V_1M_1 (Table 17).

The glucose content of tuber at 40 DAS varial significantly due to intraction of vermicompost (Appendix IX). The maximum (1.80 mg) glucose content of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and the minimum (0.95 mg) was contained by V_1M_1 (Table 17).

In respect of glucose content of tuber at 60 DAS due to different variety and vermicompost levels was found statistically non-significant (Appendix IX). But, numerically, the maximum (1.62 mg) glucose content of tuber contained by $V_3M_4$and the minimum (0.86 mg) was contained by V_1M_1 (Table 17).

Table 17.Combined effect of variety and vermicomposton glucose at different days after storage of potato tuber

Combination	Glucose (mg/g FW)			
	0DAS	20DAS	40DAS	60DAS
V_1M_1	0.430 h	0.480 h	0.956 g	0.86
V_1M_2	0.566 fg	0.620 fg	1.243 ef	1.12
V_1M_3	0.586 e-g	0.643 e-g	1.290 d-f	1.16
V_1M_4	0.620 d-f	0.676 d-f	1.350 cd	1.22
V_2M_1	0.550 g	0.610 g	1.210 f	1.09
V_2M_2	0.590 e-g	0.640 e-g	1.290 d-f	1.16
V_2M_3	0.600 d-g	0.660 d-g	1.320 de	1.19
V_2M_4	0.630 de	0.690 de	1.390 cd	1.25
V_3M_1	0.610 d-g	0.670 d-g	1.330 c-e	1.20
V_3M_2	0.696 bc	0.760 bc	1.530 b	1.38
V_3M_3	0.780 a	0.850a	1.710 a	1.53
V_3M_4	0.820 a	0.900a	1.800 a	1.62
V_4M_1	0.560 fg	0.620 fg	1.240 ef	1.12
V_4M_2	0.590 d-g	0.650 e-g	1.300 d-f	1.17
V_4M_3	0.650 cd	0.716 cd	1.430 c	1.29
V_4M_4	0.706 b	0.776 b	1.550 b	1.40
CV (%)	4.90	4.05	4.12	7.07
$LSD_{0.05}$	0.053	0.053	0.092	-
Level of significance	*	**	**	NS

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability, * = Significant at 5% level of probability,
NS = Not significant
V_1 –BARI TPS-1, V_2 – Lady Rosetta,V_3 – Asterix,V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.12 Sucrose content

4.12.1 Effect of variety

Significant variation was found among different varieties to sucrose content of tuber at 0 DAS (Appendix X). The highest (2.170 mg) sucrose content of tuber was exhibited by V_3 and the lowest (1.527mg) was exhibited by V_1 (Table 18).

The sucrose content of tuber at 20 DAS due to different varieties was found statistically significant (Appendix X). The highest (2.600mg) sucrose content of tuber was exhibited by V_3 and the lowest (1.832 mg) was exhibited by V_1 which was statistically similar to V_2 (Table 18).

The sucrose content of tuber at 40 DAS due to different varieties was found statistically significant (Appendix X). The highest (5.20mg) sucrose content of tuber was exhibited by V_3 and the lowest (3.66 mg) was exhibited by V_1 (Table 18).

The sucrose content of tuber at 60 DAS due to different varieties was found statistically significant (Appendix X). The highest (4.682 mg) sucrose content of tuber was exhibited by V_3 and the lowest (3.298 mg) was exhibited by V_1 (Table 18).Kumar *et al*. (2004) reported that non-reducing sugar was increased from harvest till 8 weeks of storage in response to variety.

Table 18. Effect of variety to sucrose at different days after storage of potato tuber

Variety	Sucrose (mg/g FW)			
	0DAS	20DAS	40DAS	60DAS
V_1	1.527 d	1.832 c	3.66 d	3.298 d
V_2	1.687 c	2.020 c	4.04 c	3.640 c
V_3	2.170 a	2.600 a	5.20a	4.682 a
V_4	1.929 b	2.310 b	4.61 b	4.157 b
CV (%)	5.76	9.79	5.40	3.50
$LSD_{0.05}$	0.104	0.214	0.236	0.137
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.12.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on sucrose content of tuber at 0 DAS (Appendix X). The highest (2.149 mg) sucrose of tuber was contained by $M_4$and the lowest (1.558 mg) was contained by M_1 (Table 19).

The sucrose content of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix X). The highest (2.577 mg) sucroseof tuber was contained by M_4 and the lowest (1.863 mg) was contained by M_1which was statistically similar to M_2 (Table 19).

The sucrose content of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix X). The highest (5.149 mg) sucroseof tuber was contained by M_4 and the lowest (3.733 mg) was contained by M $_1$(Table 19).

The sucrose content of tuber at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix X). The highest (4.637mg) sucrose of tuber was contained by $M_4$and the lowest (3.360mg) was contained by M_1 (Table 19).

Table 19. Effect of vermicompost on sucrose at different days after storage of potato tuber

Vermicompost level	Sucrose (mg/gFW)			
	0DAS	20DAS	40DAS	60DAS
M_1	1.558 d	1.863 c	3.733 d	3.360 d
M_2	1.697 c	2.033 c	4.068 c	3.660 c
M_3	1.909 b	2.289 b	4.577 b	4.120 b
M_4	2.149 a	2.577 a	5.149 a	4.637 a
CV (%)	3.05	9.30	7.04	5.57
$LSD_{0.05}$	0.046	0.172	0.259	0.184
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.12.3 Combined effect of variety and vermicompost

Significant variation was found among different variety and vermicompost levels on sucrose content of tuber at 0 DAS (Appendix X). The maximum (2.68 mg) sucrose of tuber contained by V_3M_4.

The minimum (1.31 mg) was contained by V_1M_1 (Table 20).In aspect of sucrose content of tuber at 20 DAS due to different variety and vermicompost levels was found statistically non-significant (Appendix X). But, numerically, the maximum (3.22 mg) sucrose of tuber contained by V_3M_4 and the minimum (1.57 mg) was contained by V_1M_1 (Table 20).In case of sucrose content of tuber at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix X). The maximum (6.43 mg) sucrose of tuber contained by V_3M_4 and the minimum (3.14 mg) was contained by V_1M_1 (Table 20).In respect of sucrose content of tuber at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix X). The maximum (5.79 mg) sucrose content of tuber contained by V_3M_4 and the minimum (2.83 mg) was contained by V_1M_1 (Table 20).

Table 20. Combined effect of variety and vermicompost level on sucrose at different days after storage of potato tuber

Combination	Sucrose (mg/g FW)			
	0DAS	**20DAS**	**40DAS**	**60DAS**
V_1M_1	1.31 l	1.57	3.14 k	2.83 j
V_1M_2	1.38 l	1.66	3.31jk	2.98 ij
V_1M_3	1.68 hi	2.02	4.03 f-i	3.63 f-h
V_1M_4	1.74 h	2.08	4.16 e-i	3.75 fg
V_2M_1	1.50 k	1.79	3.59 i-k	3.23 hi
V_2M_2	1.62 ij	1.94	3.89 g-i	3.50 gh
V_2M_3	1.76gh	2.11	4.22 e-h	3.80 e-g
V_2M_4	1.86 ef	2.24	4.47 d-f	4.03 d-f
V_3M_1	1.87ef	2.24	4.48 d-f	4.04 d-f
V_3M_2	1.95 de	2.33	4.67de	4.20de
V_3M_3	2.18 c	2.61	5.22 bc	4.70 bc
V_3M_4	2.68a	3.22	6.43a	5.79a
V_4M_1	1.55 jk	1.85	3.71 h-j	3.34 hi
V_4M_2	1.84 fg	2.20	4.40 d-g	3.96 d-f
V_4M_3	2.01 d	2.42	4.83 cd	4.35 cd
V_4M_4	2.31 b	2.77	5.53 b	4.98 b
CV (%)	3.05	9.30	7.04	5.57
$LSD_{0.05}$	0.092	-	0.519	0.369
Level of significance	**	NS	*	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability, * = Significant at 5% level of probability,
NS = Not significant
V_1 –BARI TPS-1, V_2 – Lady Rosetta,V_3 – Asterix,V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.13 Starch content

4.13.1 Effect of variety

Significant variation was found among different varieties to starch content of tuber at 0 DAS (Appendix XI). The highest (30.48 mg) starch content of tuber was exhibited by V_3 which was statistically similar to $V_4$and the lowest (20.36 mg) was exhibited by V_1which was statistically similar to V_2 (Table 21).

In case of starch content of tuber at 20 DAS due to different varieties was found statistically significant (Appendix XI). The highest (16.69 mg) starch content of tuber was exhibited by V_3 and the lowest (12.27 mg) was exhibited by V_1 (Table 21).

In aspect of starch content of tuber at 40 DAS due to different varieties was found statistically significant (Appendix XI). The highest (15.13 mg) starch content of tuber was exhibited by V_3 and the lowest (9.210 mg) was exhibited by V_1 (Table 21).

In respect of starch content of tuber at 60 DAS due to different varieties was found statistically significant (Appendix XI). The highest (3.668 mg) starch content of tuber was exhibited by V_3 and the lowest (1.438 mg) was exhibited by V_1 (Table 21).

Starch contents decreased during storage for all potato clones produced. Due to increased metabolism, respiration and physiological aging of potato tubers, resulting in the observed earlier sprouting and higher carbohydrate consumption and breakdown of starch into glucose and fructose at the later part of storage (Wiltshire and Cobb, 1996) and also a direct relationship between dry matter and starch contents is expected.

Table 21. Effect of variety to starch at different days after storage of potato tuber

Variety	Starch (mg/g FW)			
	0DAS	20DAS	40DAS	60DAS
V_1	20.36 b	12.27 d	9.210 d	1.43 d
V_2	21.93 b	13.34 c	10.86 c	1.88 c
V_3	30.48 a	16.69 a	15.13 a	3.66 a
V_4	29.03 a	14.38 b	12.87 b	2.48 b
CV (%)	6.66	4.99	7.06	4.81
$LSD_{0.05}$	1.69	0.70	0.84	0.11
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.13.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on starch content of tuber at 0 DAS (Appendix XI). The highest (29.31 mg) starch of tuber was contained by $M_4$and the lowest (21.52 mg) was contained by M_1(Table 22).

The starch content of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix XI).The highest (17.90 mg) starch of tuber was contained by M_4 and the lowest (11.45 mg) was contained by M_1(Table 22).

The starch content of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix XI). The highest (14.86 mg) starch of tuber was contained by M_4 and the lowest (9.440 mg) was contained by M_1(Table 22).

The starch content of tuber at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix XI). The highest (3.757 mg) starch of tuber was contained by $M_4$and the lowest (1.293 mg) was contained by M_1(Table 22).

Table 22. Effect of vermicompost on starch at different days after storage of potato tuber

Vermicompost level	Starch (mg/g FW)			
	0DAS	**20DAS**	**40DAS**	**60DAS**
M_1	21.52 d	11.45 d	9.44 d	1.29 d
M_2	23.91 c	12.57 c	11.07 c	2.04 c
M_3	27.05 b	14.77 b	12.71 b	2.38 b
M_4	29.31 a	17.90 a	14.86 a	3.75 a
CV (%)	4.40	4.71	6.52	5.18
$LSD_{0.05}$	0.94	0.56	0.65	0.10
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.12.3 Combined effect of variety and vermicompost

Significant variation was found among different variety and vermicompost levels on starch content of tuber at 0 DAS (Appendix XI). The maximum (33.08 mg) starch of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and V_4M_4. The minimum (16.62 mg) was contained by V_1M_1 (Table 23).

In aspect of starch content of tuber at 20 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XI). The maximum (19.26 mg) starch of tuber contained by V_3M_4 and the minimum (9.470 mg) was contained by V_1M_1 (Table 23).

In case of starch content of tuber at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XI).The maximum (17.41 mg) starch of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and the minimum (5.960 mg) was contained by V_1M_1 (Table 23).

In respect of starch content of tuber at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XI). The maximum (6.370 mg) starch content of tuber contained by V_3M_4 and the minimum (0.7200 mg) was contained by V_1M_1 (Table 23).

Table 23. Combined effect of variety and vermicompost on starch at different days after storage of potato tuber

Combination	Starch (mg/gFW)			
	0DAS	20DAS	40DAS	60DAS
V_1M_1	16.62 i	9.47 g	5.96 j	0.72 i
V_1M_2	17.47 i	10.04 g	8.05 i	1.36 g
V_1M_3	21.90 g	12.78 de	9.85 g	1.47 g
V_1M_4	25.47 ef	16.81 b	12.98 d	2.20 f
V_2M_1	18.32 hi	9.69 g	8.38 hi	1.02 h
V_2M_2	19.75 h	11.63 ef	9.62 gh	2.10 f
V_2M_3	23.73 fg	14.38 c	11.58 ef	2.17 f
V_2M_4	25.91 e	17.64 b	13.88 cd	2.24 f
V_3M_1	27.83 d	15.00 c	13.09 d	2.33 ef
V_3M_2	29.28 cd	15.42 c	13.81 cd	2.59 d
V_3M_3	31.72 ab	17.10 b	16.21 ab	3.38 c
V_3M_4	33.08 a	19.26 a	17.41 a	6.37 a
V_4M_1	23.32 g	11.63 f	10.33 fg	1.10 h
V_4M_2	29.15 cd	13.18 d	12.79 de	2.12 f
V_4M_3	30.85 bc	14.84 c	13.19 d	2.51de
V_4M_4	32.79 ab	17.88 b	15.18 bc	4.22 b
CV (%)	4.40	4.71	6.52	5.18
$LSD_{0.05}$	1.88	1.12	1.31	0.206
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.14 Ascorbic acid content

4.14.1 Effect of variety

Significant variation was found among different varieties to ascorbic acid content of tuber at 0 DAS (Appendix XII). The highest (73.75 mg) ascorbic acid content of tuber was exhibited by V_3 and the lowest (45.62 mg) was exhibited by V_1(Table 24).

Ascorbic acid content of tuber at 20 DAS due to different varieties was found statistically significant (Appendix XII). The highest (68.04 mg) ascorbic acid content of tuber was exhibited by V_3 and the lowest (39.37 mg) was exhibited by V_1 (Table 24).

Ascorbic acid content of tuber at 40 DAS due to different varieties was found statistically significant (Appendix XII). The highest (57.97 mg) ascorbic acid content of tuber was exhibited by V_3 and the lowest (40.23 mg) was exhibited by V_1 (Table 24).

Ascorbic acid content of tuber at 60 DAS due to different varieties was found statistically significant (Appendix XII). The highest (51.24 mg) ascorbic acid content of tuber was exhibited by V_3 and the lowest (36.37 mg) was exhibited by V_1 (Table 24).

Hagg *et al*. (1998) reported that Ascorbic acid (AA) content significantly decreases during storage of potato tuber. The reduction is ascribed to the oxidation of ascorbic acid into dehydro ascorbic acid and afterward to diketo-gluconic acid. Being a water-soluble vitamin and susceptible to oxidation, AA contents rapidly decrease with increasing rates of respiration and water loss in storage.

Table 24. Effect of variety on ascorbic acid at different days after storage of potato tuber

Variety	Ascorbic acid (mg/g FW)			
	0DAS	20DAS	40DAS	60DAS
V_1	45.62 d	39.37 d	40.23 d	36.37 d
V_2	57.61 c	53.82c	44.11 c	39.40 c
V_3	73.75 a	68.04 a	57.97 a	51.24 a
V_4	68.94 b	62.52 b	53.69 b	47.88 b
CV (%)	6.20	4.48	5.30	4.96
$LSD_{0.05}$	2.59	2.51	2.59	2.16
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.14.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on ascorbic acid content of tuber at 0 DAS (Appendix XII). The highest (79.80 mg) ascorbic acid of tuber was contained by $M_4$and the lowest (46.63 mg) was contained by M_1(Table 25).

In case of ascorbic acid content of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix XII). The highest (74.95 mg) ascorbic acid of tuber was contained by M_4 and the lowest (40.20 mg) was contained by M_1 (Table 25).

Ascorbic acid content of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix XII). The highest (58.40 mg) ascorbic acid of tuber was contained by M_4 and the lowest (37.44 mg) was contained by M_1 (Table 25).

Ascorbic acid content of tuber at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix XII). The highest (52.52 mg) ascorbic acid of tuber was contained by $M_4$and the lowest (31.34 mg) was contained by M_1 (Table 25).

Table 25. Effect of vermicompost on ascorbic acid at different days after storage of potato tuber

Vermicompost level	Ascorbic acid (mg/g FW)			
	0DAS	**20DAS**	**40DAS**	**60DAS**
M_1	46.63 d	40.20 d	37.44 d	31.34 d
M_2	55.25 c	48.79 c	48.04 c	43.06 c
M_3	64.23 b	59.80 b	52.10 b	47.97 b
M_4	79.80 a	74.95 a	58.40 a	52.52 a
CV (%)	3.76	4.57	5.33	5.29
$LSD_{0.05}$	1.95	2.15	2.20	1.95
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.14.3 Combined effect of variety and vermicompost

Significant variation was found among different variety and vermicompost levels on ascorbic acid content of tuber at 0 DAS (Appendix XII). The maximum (90.89 mg) ascorbic acid of tuber contained by V_3M_4 and the minimum (36.75 mg) was contained by V_1M_1 (Table 26).

In aspect of ascorbic acid content of tuber at 20 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XII). The maximum (86.78 mg) ascorbic acid of tuber contained by V_3M_4 and the minimum (30.54 mg) was contained by V_1M_1 (Table 26).

Ascorbic acid content of tuber at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XII). The maximum (66.60 mg) ascorbic acid of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and the minimum (28.54 mg) was contained by V_1M_1 (Table 26).

Ascorbic acid content of tuber at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XII). The maximum (59.09 mg) ascorbic acid content of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and the minimum (25.94 mg) was contained by V_1M_1 (Table 26).

Table 26. Combined effect of variety and vermicompost on ascorbic acid at different days after storage of potato tuber

Combination	Ascorbic acid (mg/g FW)			
	0DAS	**20DAS**	**40DAS**	**60DAS**
V_1M_1	36.75 i	30.54 i	28.54 h	25.94 g
V_1M_2	39.50 i	30.58 i	41.67 g	35.54 f
V_1M_3	46.44 h	42.10 g	39.69 g	37.47 f
V_1M_4	59.78 ef	54.24 e	51.01 d	46.54 de
V_2M_1	38.90 i	36.90 h	32.21 h	28.94 g
V_2M_2	47.94 h	42.33 g	38.01 g	33.31 f
V_2M_3	61.81 e	58.40 e	48.99 de	45.20 e
V_2M_4	81.78 c	77.64 b	57.22 c	50.13cd
V_3M_1	56.01 fg	48.78 f	46.33 ef	37.27 f
V_3M_2	70.10 d	64.72 d	56.39 c	52.40 bc
V_3M_3	77.99 c	71.86c	62.54 ab	56.20 ab
V_3M_4	90.89a	86.78 a	66.60 a	59.09 a
V_4M_1	54.86 g	44.57 fg	42.70 fg	33.22 f
V_4M_2	63.48 e	57.54 e	56.10 c	51.00 c
V_4M_3	70.69 d	66.83 d	57.19 c	53.00 bc
V_4M_4	86.74 b	81.13b	58.76 bc	54.32 bc
CV (%)	3.76	4.57	5.33	5.29
$LSD_{0.05}$	3.89	4.31	4.40	3.89
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
** = Significant at 1% level of probability
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.15 Antioxidant content

4.15.1 Effect of variety

No variation was found among different varieties to antioxidant content of tuber at 0 DAS (Appendix XIII). But, numerically, the highest (21.43µg) antioxidant content of tuber was exhibited by V_3 and the lowest (20.49µg) was exhibited by V_1(Table 27).

In case of antioxidant content of tuber at 20 DAS due to different varieties was found statistically significant (Appendix XIII). The highest (22.44µg) antioxidant content of tuber was exhibited by V_3 which was statistically similar to $V_4$and the lowest (21.73µg) was exhibited by V_1 (Table 27).

Antioxidant content of tuber at 40 DAS due to different varieties was found statistically non-significant (Appendix XII). But, numerically, the highest (22.58µg) antioxidant content of tuber was exhibited by V_3 and the lowest (22.15µg) was exhibited by V_1 (Table 27).

Antioxidant content of tuber at 60 DAS due to different varieties was found statistically significant (Appendix XIII). The highest (27.74µg) antioxidant content of tuber was exhibited by V_3 which was statistically similar to $V_4$and the lowest (26.23µg) was exhibited by V_1 (Table 27).

Kumar *et al*. (2004) pointed out that the activity of total antioxidant increased from harvesting to 8 weeks of storage time and its activity varied with genotypic responses over storage period and this citation is in agreement with the findings of present research.

Table 27. Effect of variety to antioxidant at different days after storage of potato tuber

Variety	Antioxidant (Trolox µg/ g FW)			
	0DAS	**20DAS**	**40DAS**	**60DAS**
V_1	20.49	21.73 c	22.15	26.23 c
V_2	20.83	21.96 bc	22.28	26.81 b
V_3	21.43	22.44 a	22.58	27.74 a
V_4	21.09	22.17 ab	22.44	27.34 a
CV (%)	5.21	1.55	2.32	1.72
$LSD_{0.05}$	-	0.341	-	0.465
Level of significance	NS	**	NS	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability, NS = Not significant
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.15.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on antioxidant content of tuber at 0 DAS (Appendix XIII). The highest (21.82µg) antioxidant of tuber was contained by $M_4$and the lowest (20.22µg) was contained by M_1(Table 28).

In case of antioxidant content of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix XIII). The highest (22.72µg) antioxidant tof tuber was contained by M_4 and the lowest (21.48µg) was contained by M_1(Table 28).

Antioxidant content of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix XIII). The highest (22.94µg) antioxidant of tuber was contained by M_4 which was statistically similar to M_3 and the lowest (21.65µg) was contained by M_1(Table 28).

Antioxidant content of tuber at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix XIII). The highest (27.95µg) antioxidant of tuber was contained by $M_4$and the lowest (26.00µg) was contained by M_1 (Table 28).

Table 28. Effect of vermicompost on antioxidant at different days after storage of potato tuber

Vermicompost level	Antioxidant (Trolox µg/ g FW)			
	0DAS	20DAS	40DAS	60DAS
M_1	20.22 c	21.48 d	21.65 c	26.00 d
M_2	20.73 b	21.81 c	22.26 b	26.80 c
M_3	21.07 b	22.28 b	22.60 ab	27.38 b
M_4	21.82 a	22.72 a	22.94 a	27.95 a
CV (%)	2.14	1.61	1.90	1.39
$LSD_{0.05}$	0.377	0.299	0.357	0.317
Level of significance	**	**	**	**

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability
M_1– Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.15.3 Combined effect of variety and vermicompost

No significant variation was found among different variety and vermicompost levels on antioxidant content of tuber at 0 DAS (Appendix XIII). But, numerically, the maximum (22.43µg) antioxidant of tuber contained by V_3M_4 and the minimum (19.4µg5) was contained by V_1M_1 (Table 29).

In aspect of antioxidant content of tuber at 20 DAS due to different variety and vermicompost levels was found statistically non-significant (Appendix XIII). But, numerically, the maximum (23.09µg) antioxidant of tuber contained by V_3M_4 and the minimum (21.20µg) was contained by V_1M_1 (Table 29).

In case of antioxidant content of tuber at 40 DAS due to different variety and vermicompost levels was found statistically non-significant (Appendix XIII). But, numerically, the maximum (23.20µg) antioxidant of tuber contained by V_3M_4 and the minimum (21.23µg) was contained by V_1M_1 (Table 29).

Antioxidant content of tuber at 60 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XIII). The maximum (28.43µg) antioxidant content of tuber contained by V_3M_4 which was statistically similar to V_3M_3 and V_4M_4.The minimum (25.27µg) antioxidant was contained by V_1M_1 (Table 29).

Table 29. Combined effect of variety and vermicompost on antioxidant at different days after storage of potato tuber

Combination	Antioxidant (Trolox µg/ g FW)			
	0DAS	20DAS	40DAS	60DAS
V_1M_1	19.45	21.20	21.23	25.27 e
V_1M_2	20.31	21.53	22.12	25.62 e
V_1M_3	20.67	21.66	22.52	26.35 d
V_1M_4	21.51	22.51	22.74	27.67b
V_2M_1	20.33	21.30	21.58	25.54 e
V_2M_2	20.61	21.58	22.19	26.46 d
V_2M_3	20.78	22.43	22.56	27.55bc
V_2M_4	21.60	22.52	22.81	27.69b
V_3M_1	20.61	21.84	21.97	26.91 cd
V_3M_2	21.20	22.27	22.45	27.62b
V_3M_3	21.49	22.57	22.69	28.01ab
V_3M_4	22.43	23.09	23.20	28.43a
V_4M_1	20.51	21.57	21.84	26.28 d
V_4M_2	20.81	21.88	22.26	27.48bc
V_4M_3	21.32	22.48	22.64	27.60b
V_4M_4	21.72	22.74	23.01	28.00ab
CV (%)	2.14	1.61	1.90	1.39
$LSD_{0.05}$	0.755	0.598	0.715	0.635
Level of significance	NS	NS	NS	*

Numbers in columns followed by the same letter are not statistically different at $P_{0.05.}$
** = Significant at 1% level of probability, NS = Not significant
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.16 Polyphenol content

4.16.1 Effect of variety

Significant variation was found among different varieties to polyphenol content of tuber at 0 DAS (Appendix XIV). The highest (0.654 mg) polyphenol content of tuber was exhibited by V_3 and the lowest (0.352 mg) was exhibited by V_1(Figure 7).

In case of polyphenol content of tuber at 20 DAS due to different varieties was found statistically significant (Appendix XIV). The highest (0.437 mg) polyphenol content of tuber was exhibited by V_3 which was statistically similar to $V_4$and the lowest (0.273 mg) was exhibited by V_1 (Figure 7).

Polyphenol content of tuber at 40 DAS due to different varieties was found statistically significant (Appendix XIV). The highest (0.161 mg) polyphenol content of tuber was exhibited by V_3 and the lowest (0.109 mg) was exhibited by V_1 (Figure 7).

In respect of polyphenol content of tuber at 60 DAS due to different varieties was found statistically significant (Appendix XIV). The highest (0.130 mg) polyphenol content of tuber was exhibited by V_3 which was statistically similar to V_4 and the lowest (0.082 mg) was exhibited by V_1 (Figure 7).

Total amount of phenolics in potato varies significantly among different varieties (Brandl and Herrmann, 1984). Polyphenol oxidase activity increases in potato due to the availability of substrate and its subsequent oxidation during storage. Prominent increase in the PPO activity in different treatments after the 1stmonth till the end of the storage period might be associated with an increased substrate (polyphenol) oxidation. A high amount of phenolics during storage is attributed to low PPO and high antioxidant activity in potatoes (Lachman *et al*., 2008).Studies revealed that the phenolics content in potato continued to increase during storage period until the onset of PPO activity (Madiwale *et al*., 2011).

Kulen *et al*. (2013) demonstrated that storage time is also very important for phenolic compounds. They found that the total phenolic content (TPC) of potatoes was high at harvest, declined after two months of ambient storage.

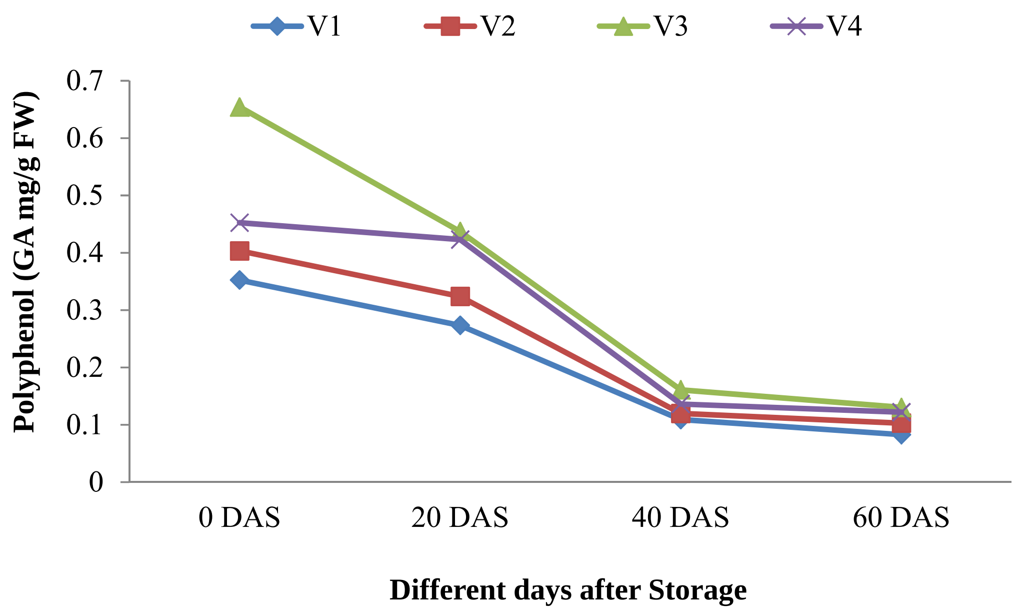


Figure 7. Effect of variety to polyphenol content of tuber at different days after storage (LSD values 0.031, 0.0757, 0.0070and 0.0170for 0 DAS, 20DAS, 40 DAS and 60 DAS, respectively).

V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage

4.16.2 Effect of vermicompost

Significant variation was found among different levels of vermicompost on polyphenol content of tuber at 0 DAS (Appendix XIV). The highest (0.666mg) polyphenol of tuber was contained by M_4 and the lowest (0.287 mg) was contained by M_1 (Figure 8).

In case of polyphenol content of tuber at 20 DAS due to different levels of vermicompost was found statistically significant (Appendix XIV). The highest (0.414 mg) polyphenol of tuber was contained by M_4 which was statistically similar to $M_1$and the lowest (0.245 mg) was contained by M_2(Figure 8).

Polyphenol content of tuber at 40 DAS due to different levels of vermicompost was found statistically significant (Appendix XIV). The highest (0.166 mg) polyphenol of tuber was contained by M_4 and the lowest (0.1108 mg) was contained by M_1which was statistically similar to M_2(Figure 8).

Polyphenol content of tuber at 60 DAS due to different levels of vermicompost was found statistically significant (Appendix XIV). The highest (0.141 mg) polyphenol of tuber was contained by $M_4$and the lowest (0.077 mg) was contained by M_1 (Figure 8).

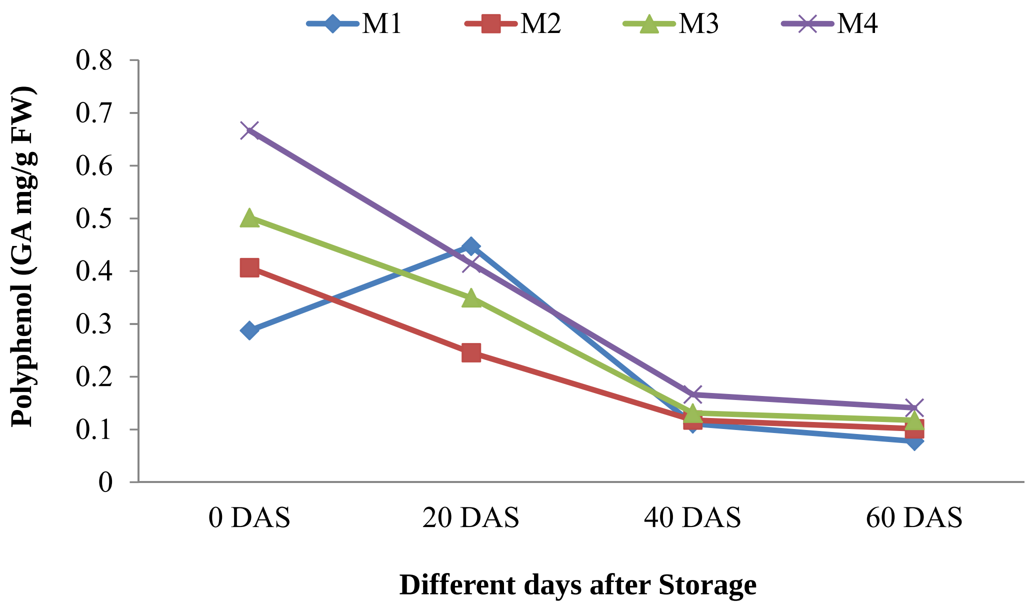


Figure 8. Effect of vermicompost on polyphenol content of potato tuber at different days after storage (LSD values 0.026, 0.0449, 0.0092and 0.0162for 0 DAS, 20DAS, 40 DAS and 60 DAS, respectively).M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.16.3 Combined effect of variety and vermicompost

Significant variation was found among different variety and vermicompost levels on polyphenol content of tuber at 0 DAS (Appendix XIV). The maximum (1.08 mg) polyphenol of tuber contained by V_3M_4 and the minimum (0.180 mg) was contained by V_1M_1 (Table 30).

In aspect of polyphenol content of tuber at 20 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XIV). The maximum (0.571 mg) polyphenol of tuber contained by V_4M_1 which was statistically similar to V_3M_3 and V_3M_4. The minimum (0.127 mg) was contained by V_1M_1 (Table 30).

In case of polyphenol content of tuber at 40 DAS due to different variety and vermicompost levels was found statistically significant (Appendix XIV). The maximum (0.2290 mg) polyphenol of tuber contained by V_3M_4 and the minimum (0.09100 mg) was contained by V_1M_1 (Table 30).

Polyphenol content of tuber at 60 DAS due to different variety and vermicompost levels was found statistically non-significant (Appendix XIV). But, numerically, the maximum (0.18 mg) polyphenol content of tuber contained by V_3M_4 and the minimum (0.06 mg) antioxidant was contained by V_1M_1 (Table 30).

Table 30. Combined effect of variety and vermicompost on a polyphenol at different days after storage of potato tuber

Combination	Polyphenol (GA mg/g FW)			
	0DAS	20DAS	40DAS	60DAS
V_1M_1	0.18 k	0.40 b-d	0.09 h	0.06
V_1M_2	0.33 hi	0.12 h	0.10 gh	0.09
V_1M_3	0.40 fg	0.24 g	0.11 fg	0.09
V_1M_4	0.50 de	0.31d-g	0.12 d-f	0.09
V_2M_1	0.26 j	0.37 c-e	0.10 gh	0.08
V_2M_2	0.37 gh	0.25 g	0.10 f-h	0.10
V_2M_3	0.456 ef	0.29 e-g	0.11 e-g	0.10
V_2M_4	0.52 cd	0.37 c-f	0.14 bc	0.13
V_3M_1	0.42 fg	0.43 bc	0.12 d-g	0.09
V_3M_2	0.49 de	0.32 d-g	0.13 c-e	0.11
V_3M_3	0.62 b	0.48ab	0.15 bc	0.14
V_3M_4	1.08a	0.50ab	0.22 a	0.18
V_4M_1	0.29 ij	0.57a	0.12 e-g	0.08
V_4M_2	0.43 f	0.27 fg	0.12 e-g	0.11
V_4M_3	0.53 cd	0.38 c-e	0.14 b-d	0.14
V_4M_4	0.56 c	0.46 bc	0.15 b	0.16
CV (%)	7.51	14.53	8.32	17.46
$LSD_{0.05}$	0.05	0.08	0.01	-
Level of significance	**	*	**	NS

Numbers in columns followed by the same letter are not statistically different at $P_{0.05}$.
* = Significant at 5% level of probability, ** = Significant at 1% level of probability,
NS = Not significant
V_1 –BARI TPS-1, V_2 – Lady Rosetta, V_3 – Asterix, V_4 – Courage
M_1 – Control, M_2 – 2 t/ha, M_3 – 4 t/ha, M_4 – 6 t/ha

4.17 Correlation coefficient (r):

The correlation was calculated on the basis of data from 0 days of storage *i.e.,* at harvesting day. A linear relation (r=0.751) present between the dry matter content and specific gravity of potato tuber (Figure 9). In Figure-10, a linear relation (r=0.828) between dry matter and glucose was present. In Figure-11, there was present a strong relation between dry matter and sucrose (r=0.854). In Figure-12, a strong linear relation (r=0.866) was present between dry matter and starch. The direct relationship between dry matter and starch contents is expected (Wiltshire and Cobb, 1996).In Figure-13, a strong linear relation (r=0.963) was present between dry matter and ascorbic acid content of potato tuber.

There was a positive relation (r=0.889) of dry matter with antioxidant content of potato tuber (Figure 14). A strong linear relation (r=0.786) was present between dry matter and polyphenol content of potato tuber (Figure 15). In Figure-16, a strong linear relation (r=0.779) between specific gravity and glucose content of potato tuber. In Figure-17, a strong linear relation (r=0.839) between specific gravity and sucrose content of potato tuber. A strong linear relation (r=0.884) between specific gravity and starch content of potato tuber was present (Figure 18). There was a strong linear relation (r=0.822) between specific gravity and ascorbic acid content of potato tuber (Figure 19). In Figure-20, a strong linear relation (r=0.679) between specific gravity and antioxidant content of potato tuber. A strong linear relation (r=0.666) between specific gravity and polyphenol content of potato tuber was present (Figure 21). There was a negative linear relation (r=-0.362) between specific gravity and weight loss of potato tuber (Figure 22). A negative linear relation (r=-0.328) between dry matter and weight loss of potato tuber was present (Figure 23).

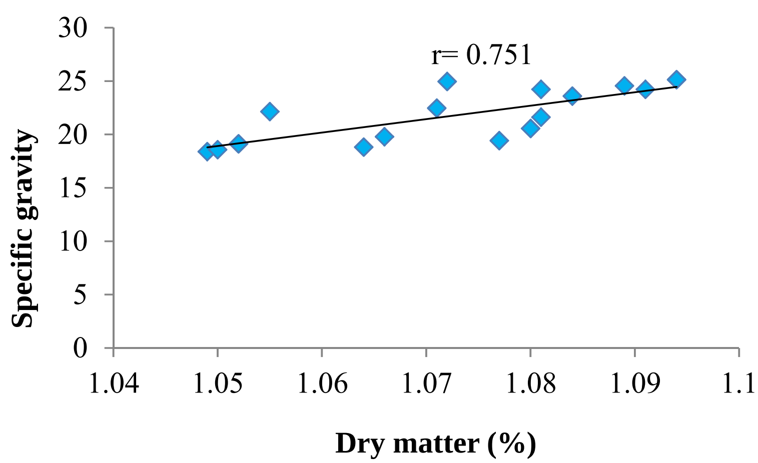


Figure 9. Relationship between dry matter and specific gravity of potato tuber at harvest

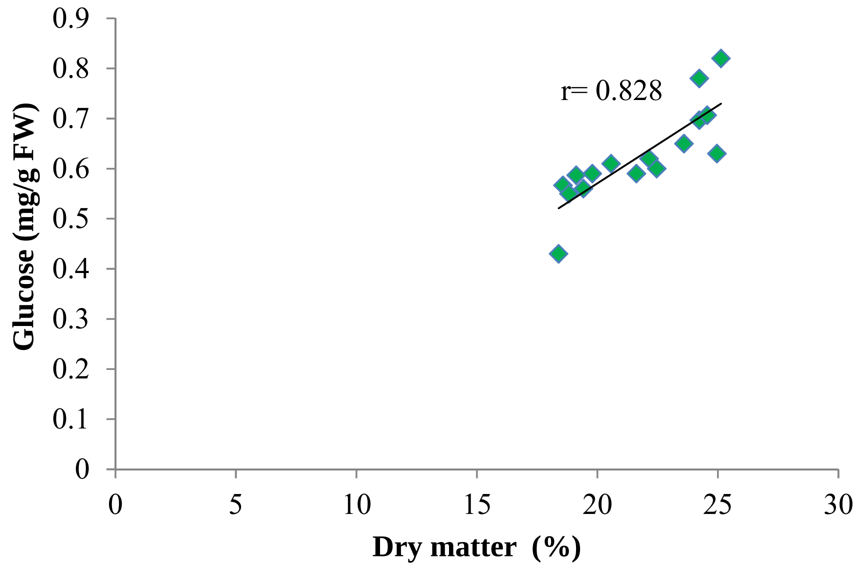


Figure 10. Relationship between dry matter and glucose content of potato tuber at harvest

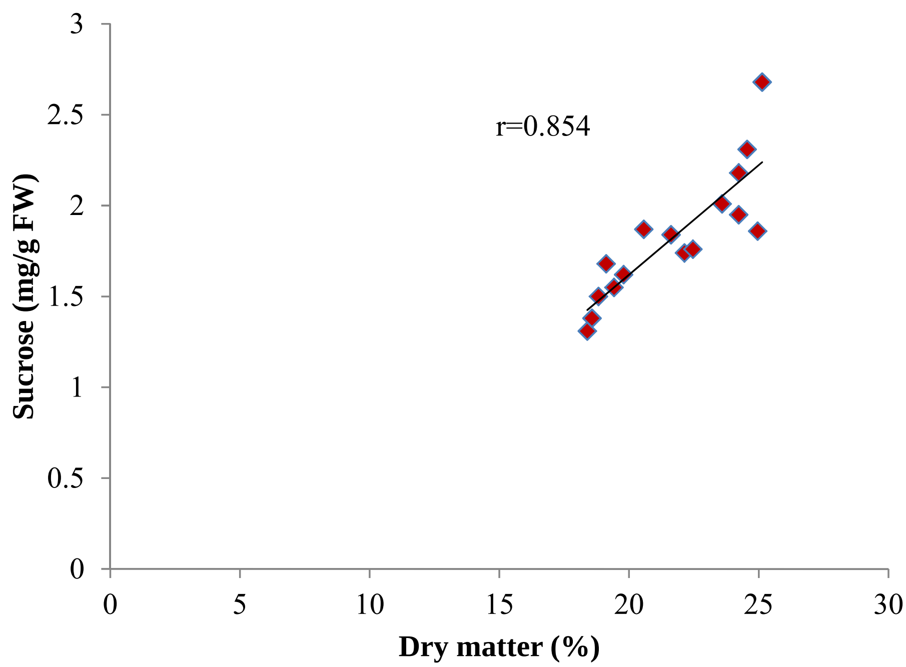


Figure 11. Relationship between dry matter and sucrose content of potato tuber at harvest

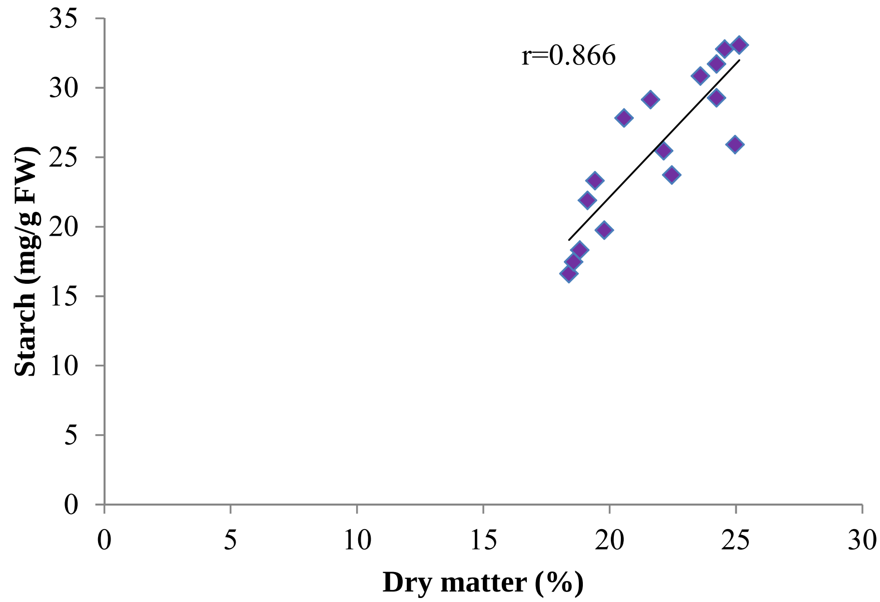


Figure 12. Relationship between dry matter and starch content of potato tuber at harvest

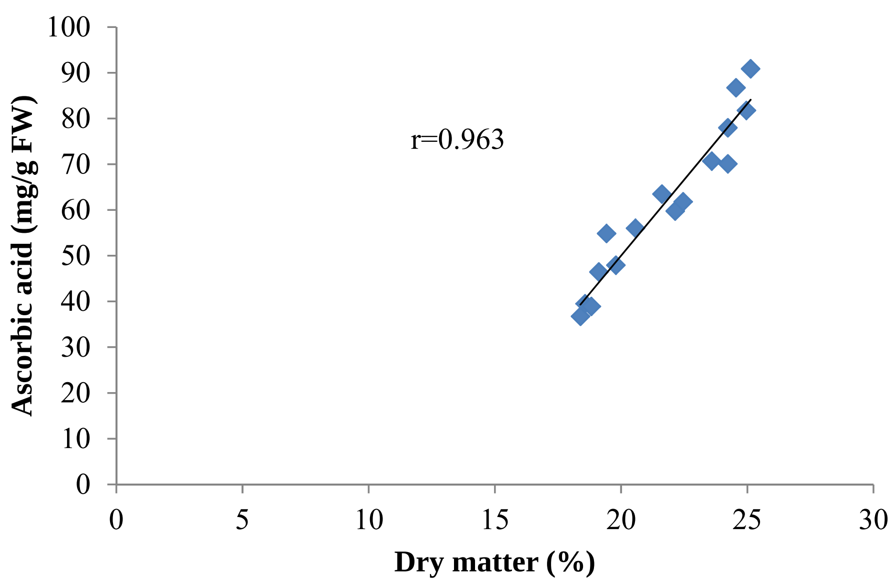


Figure 13. Relationship between dry matter and ascorbic acid content of potato tuber at harvest

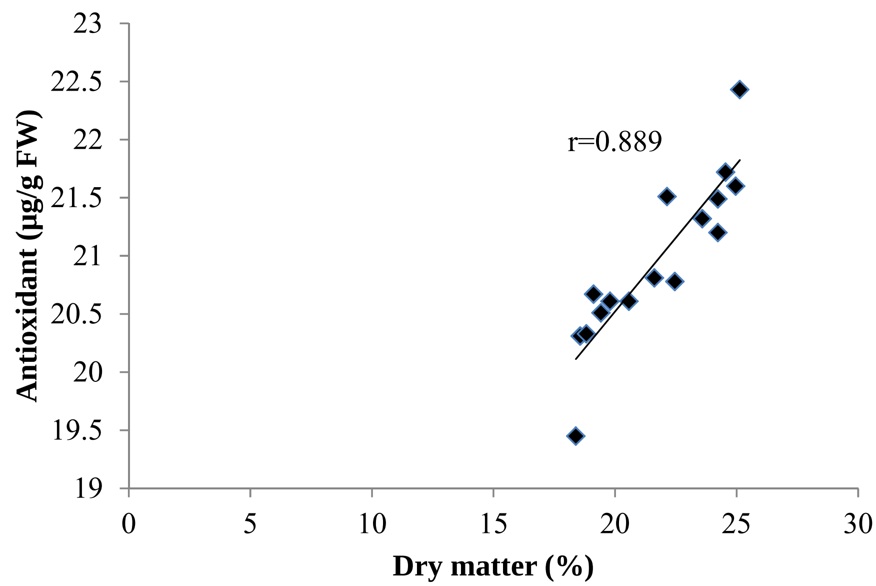


Figure 14. Relationship between dry matter and antioxidant content of potato tuber at harvest

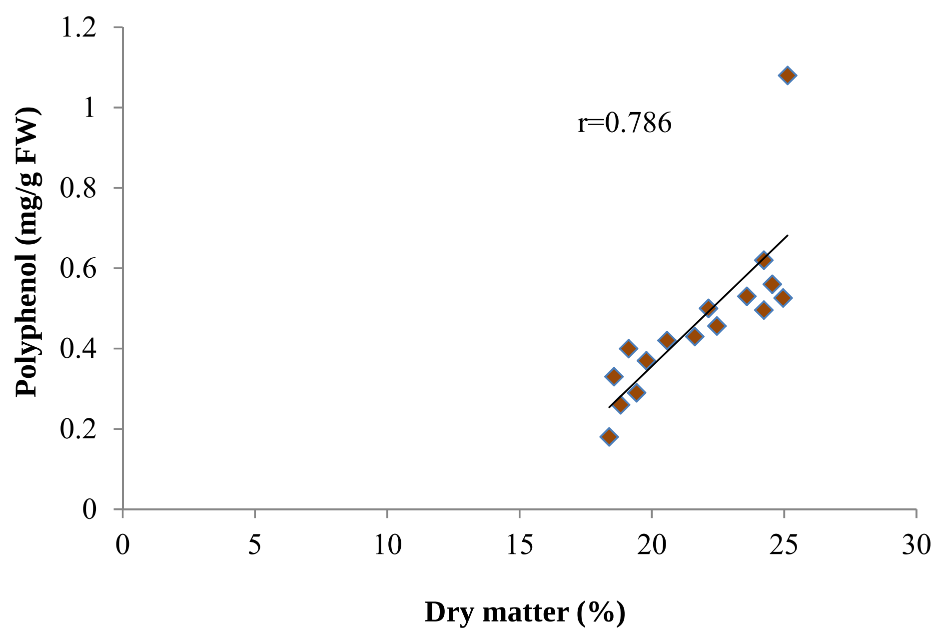


Figure 15. Relationship between dry matter and polyphenol content of potato tuber at harvest

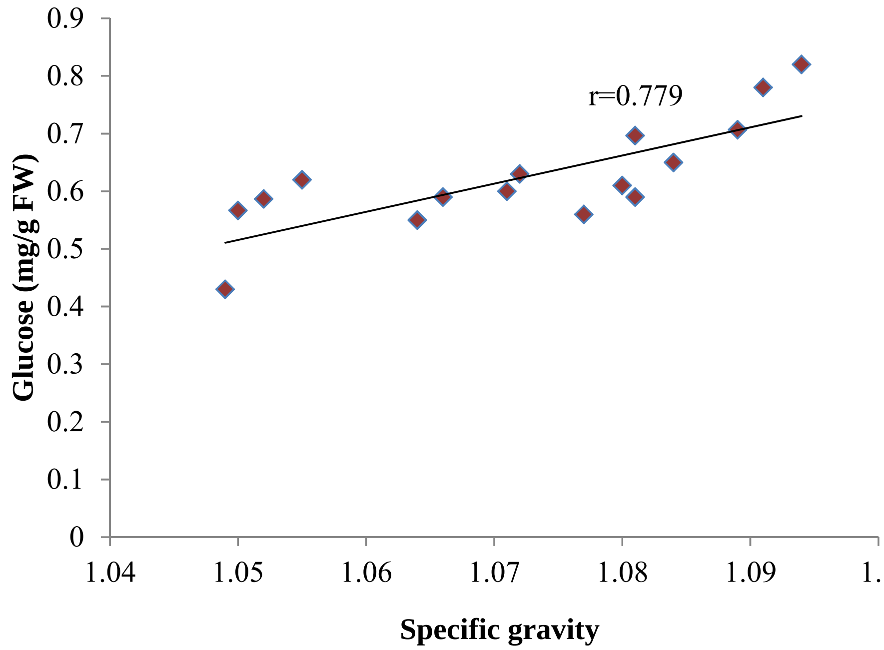


Figure 16. Relationship between specific gravity and glucose content of potato tuber at harvest

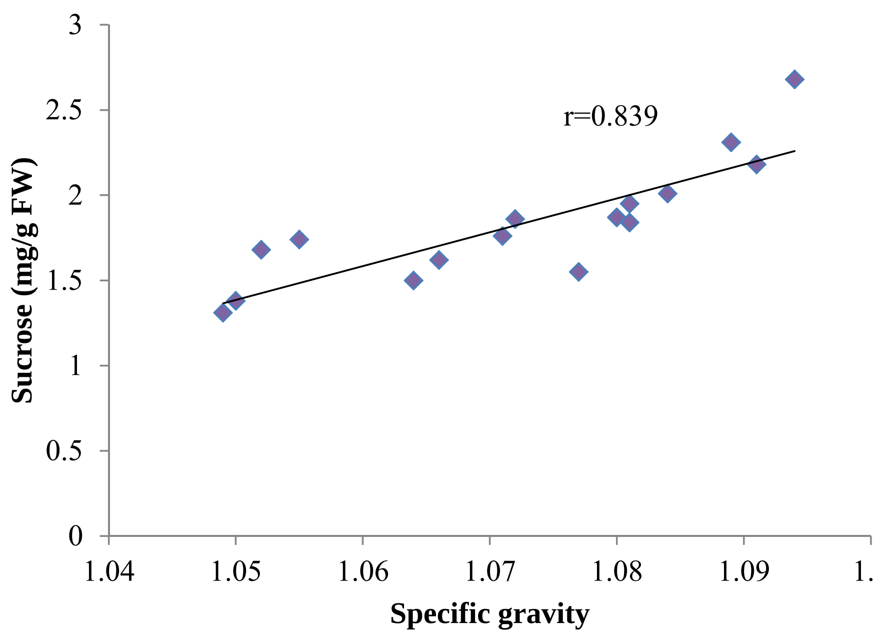


Figure 17. Relationship between specific gravity and sucrose content of potato tuber at harvest

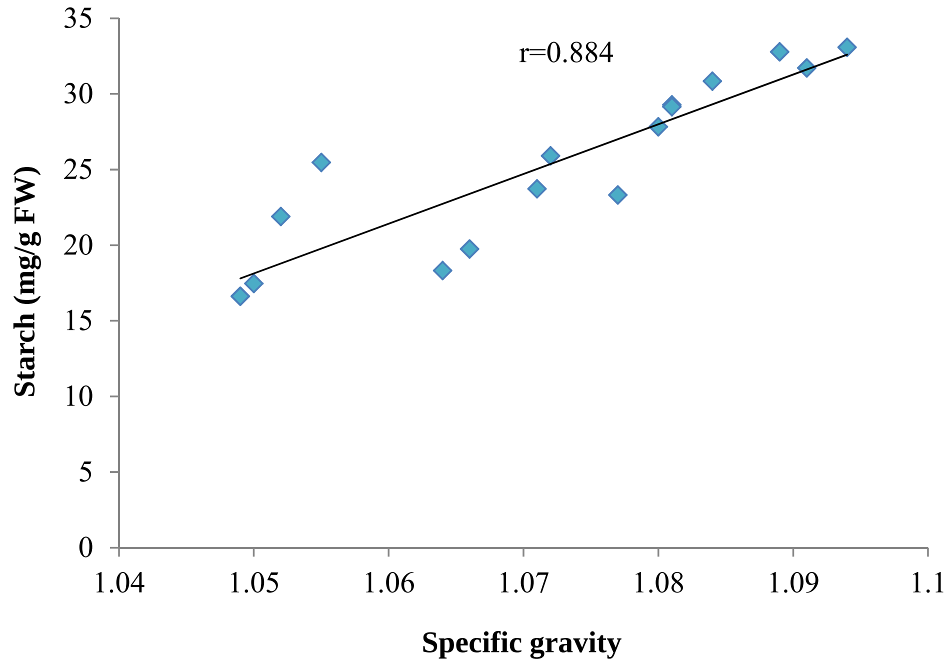


Figure 18. Relationship between specific gravity and starch content of potato tuber at harvest

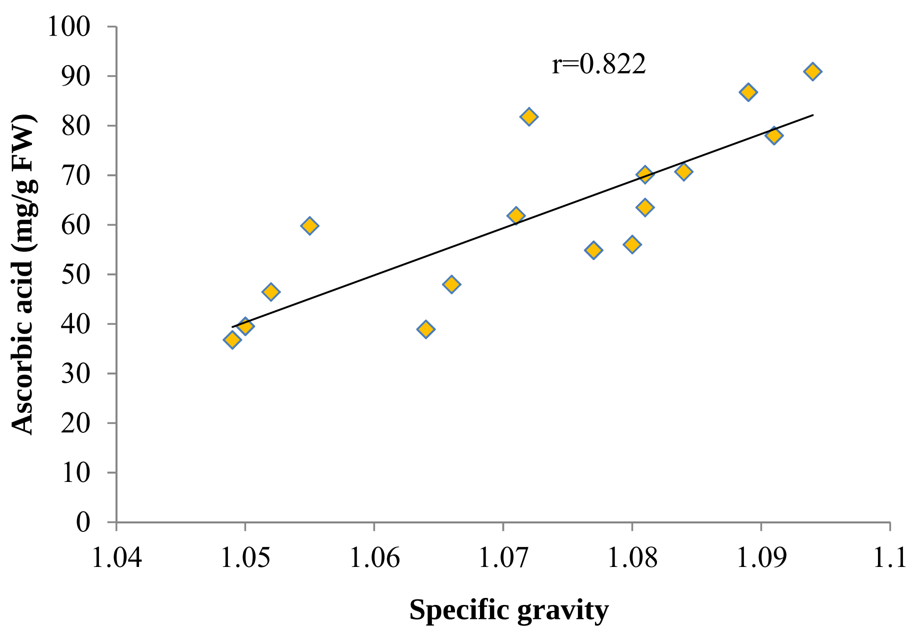


Figure 19. Relationship between specific gravity and ascorbic acid content of potato tuber at harvest

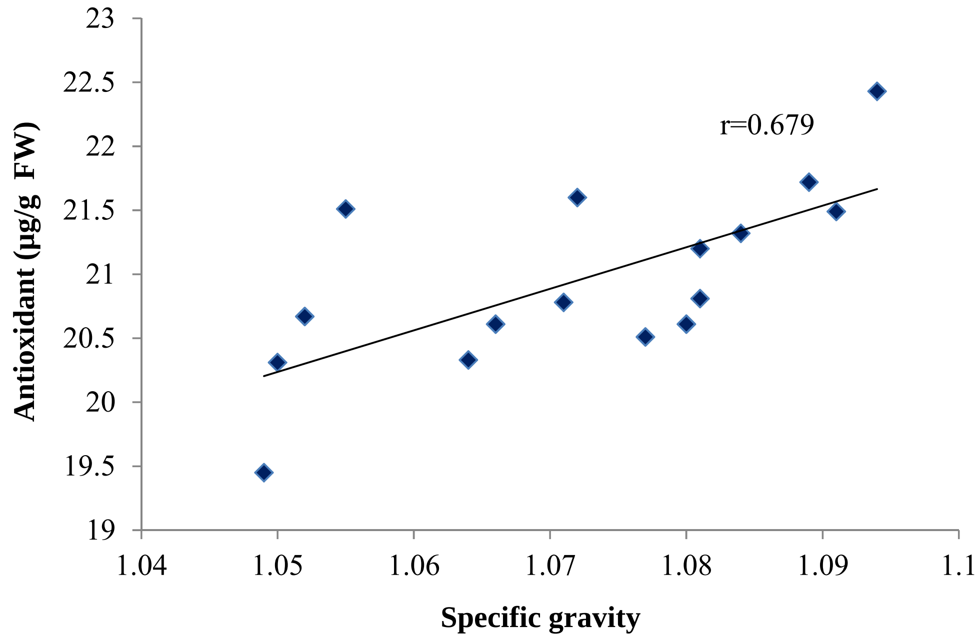


Figure 20. Relationship between specific gravity and antioxidant content of potato tuber at harvest

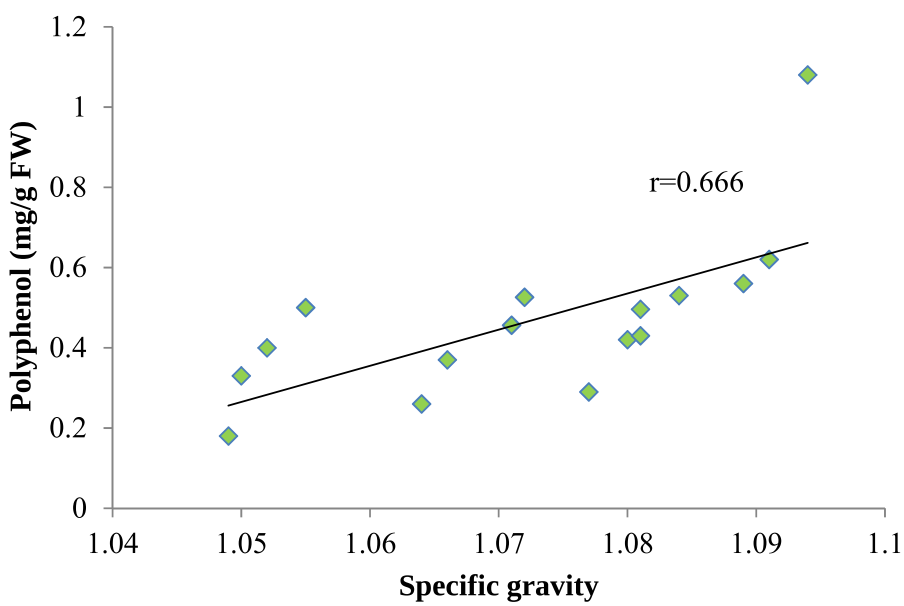


Figure 21. Relationship between specific gravity and polyphenol content of potato tuber at harvest

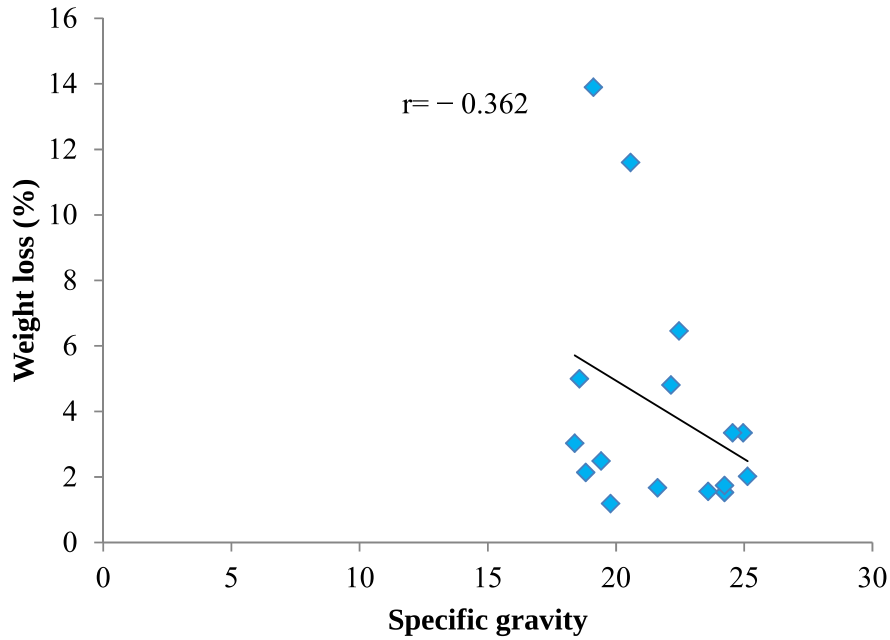


Figure 22. Relationship between specific gravity and weight loss of potato tuber at harvest

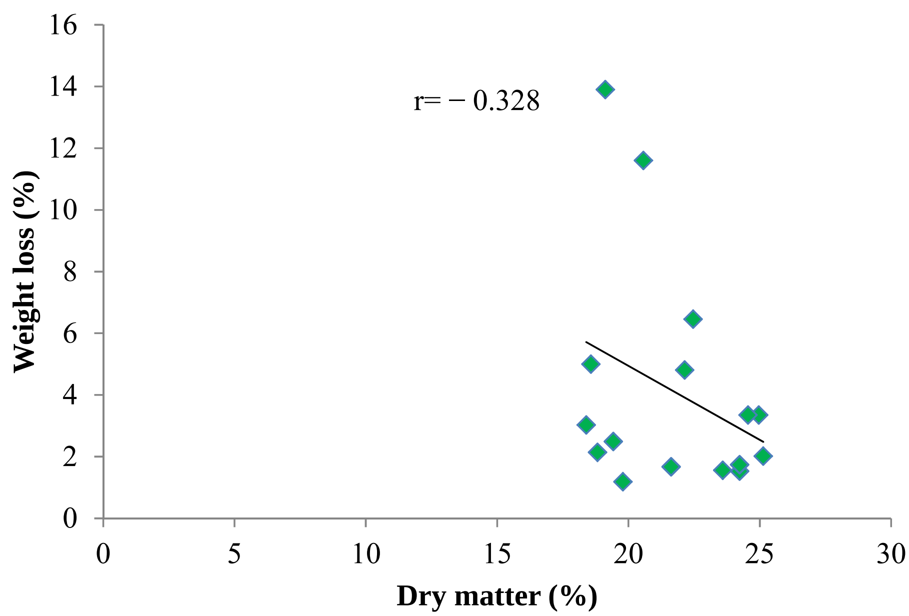


Figure 23. Relationship between specific gravity and weight loss of potato tuber at harvest

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the Agronomy Research Field, Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from November 1, 2014 to April 30, 2015 in Rabi season. The experimental area is situated at $23^{0}77$'N latitude and $90^{0}33$'E longitude at an altitude of 8.6 meter above the sea level. The experimental site belongs to the agro-ecological zone of "Madhupur Tract", AEZ-28. Top soil was silty clay in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. Soil pH was 5.6 and has organic carbon 0.45%. The experiment is consisted of two factors, *i.e.,* factor A:- Potato varieties (V-4): V_1:BARI TPS-1, V_2:BARI Alu-28 (Lady Rosetta), V_3: BARI Alu-25 (Asterix)and V_4:BARI Alu-29 (Courage); factor B:-Vermicompost level (M-4):M_1: 0 t/ha, M_2:2 t/ha, M_3:4 t/ha and M_4: 6 t/ha. Sixteen treatment combinations were used under study. Experiment was provoked in a split-plot Design with3 replications. The allocated plots were fertilized by recommended doses except treatment. All the intercultural operations and plant protection measures were taken as per when needed. Data on different yield, yield contributing characters, processing and storage parameters were collected and analyzed by using MSTAT-C program and means were compared by LSD technique at 5% level of probability.

Results revealed that, the maximum (9.83) number of tuber per hill was found from V_2 and the minimum (6.50) was found from V_4. The highest (53.57 g) average weight of tuber was found from V_4 and the lowest (40.17 g) was found from V_2 which was statistically similar to V_1. The highest (31.20 t/ha) yield of tuber was found from V_2 and the lowest (25.97 t/ha) was found from V_1. The highest (26.55 t/ha) marketable yield of tuber was found from V_2 and the lowest (22.10 t/ha) was found from V_1.

The highest (21.73 t/ha) yield of seed potato was found from V_2 and the lowest (17.75 t/ha) was found from V_1. The maximum (8.24) number of tubers was found from M_4 which was statistically similar to M_2 and the minimum (7.41) was found from M_3. The highest (50.75 g) average weight of tuber was found from M_3 which was statistically similar to M_4 and the lowest (40.24 g) was found from M_1. The highest (30.99 t/ha) yield of tuber was found from M_4which was statistically similar to M_3 and the lowest (24.68 t/ha) was found from M_1. The highest (26.55 t/ha) marketable yield of tuber was found from M_4 and the lowest (20.85 t/ha) was found from M_1.

The highest (21.66 t/ha) yield as seed potato was found from M_4 and the lowest (16.71 t/ha) was found from M_1. The maximum (11.3) number of tuber was found from V_2M_4 and the minimum (5.66) was from V_1M_1. The highest (64.31 g) average weight was found from V_3M_3 which was statistically similar to V_4M_2 and V_4M_4. The lowest (30.70 g) was fond from V_2M_2. The highest (36.01 t/ha) tuber yield was found from V_3M_3 which was statistically similar to V_2M_4, V_1M_4, V_2M_1 and V_4M_2. The lowest (18.43 t/ha) tuber yield was found from V_1M_1. The highest (30.66 t/ha) marketable yield of tuber was found from V_3M_3 and the lowest (15.55 t/ha) tuber yield was found from V_1M_1. The highest (25.39 t/ha) yield as seed of tuber was found from V_2M_4 and lowest (11.95 t/ha) tuber yield as seed was found from V_1M_1.The maximum (13.9 %) weight loss was exhibited by V_1M_3 and the minimum (1.19 %) was found by V_2M_2 at 20 DAS. The maximum (25.4 %) weight loss was exhibited by V_1M_3 and the minimum (2.38 %) was found by V_2M_2 at 40 DAS.

The maximum (33.05%) weight loss was exhibited by V_3M_1 and the minimum (3.56 %) was found by V_4M_2 at 60 DAS. The maximum (25.13 %) dry matter was retained by V_3M_4 and the minimum (18.39 %) was found by V_1M_1 at 0 DAS. The maximum (24.22 %) dry matter was retained by V_4M_4 and the minimum (16.94 %) was found by V_1M_1at 20 DAS.

The maximum (24.12 %) dry matter was retained by V_4M_4 which was statistically similar to V_3M_3 and V_4M_3 and the minimum (16.44 %) was found by V_1M_1 at 40 DAS. The maximum (23.25 %) dry matter was retained by V_4M_4 and the minimum (15.22 %) was found by V_1M_1. The maximum (47.30) firmness of tuber flesh taken by V_3M_3 and the minimum (33.57) was taken by V_2M_3 at 20 DAS. The maximum (39.15) firmness of tuber flesh taken by V_3M_4 and the minimum (26.56) was taken by V_3M_2 at 40 DAS. The maximum (32.73) firmness of tuber flesh taken by V_3M_4 and the minimum (25.05) was taken by V_1M_2 at 60 DAS.

The maximum (1.09) specific gravity of tuber exhibited by V_3M_4 and the minimum (1.04) was exhibited by V_1M_3 at 20 DAS. The maximum (1.08) specific gravity of tuber exhibited by $V_3M_4$and the minimum (1.04) was exhibited by V_1M_2 at 40 DAS. The maximum (1.08) specific gravity of tuber exhibited by V_3M_4andthe minimum (1.0) specific gravity of tuber was exhibited by V_1M_1 at 60 DAS. The highest (0.72 mg) glucose content of tuber was exhibited by V_3 and the lowest (0.55 mg) was exhibited by V_1 at 0 DAS. The highest (0.79 mg) glucose content of tuber was exhibited by V_3 and the lowest (0.60 mg) was exhibited by V_1 at 20 DAS. The highest (1.59 mg) glucose content of tuber was exhibited by V_3 and the lowest (1.21mg) was exhibited by V_1 at 40 DAS. The highest (1.43 mg) glucose content of tuber was exhibited by V_3 and the lowest (1.09 mg) was exhibited by V_1 at 60 DAS. The highest (0.69 mg) glucose content of tuber was contained by M_4 and the lowest (0.53 mg) was contained by M_1 at 0 DAS. The highest (0.76 mg) glucose content of tuber was contained by M_4 and the lowest (0.59 mg) was contained by M_1 at 20 DAS. The highest (1.52 mg) glucose content of tuber was contained by M_4 and the lowest (1.18 mg) was contained by M_1 at 40 DAS. The highest (1.37 mg) glucose content of tuber was contained by $M_4$and the lowest (1.06 mg) was contained by M_1 at 60 DAS. The maximum (0.90 mg) glucose content of tuber contained by V_3M_4 and the minimum (0.48 mg) was contained by V_1M_1 at 20 DAS.

The maximum (1.80 mg) glucose content of tuber contained by V_3M_4 and the minimum (0.95 mg) was contained by V_1M_1 at 40 DAS. The maximum (33.08 mg) starch of tuber contained by $V_3M_4$and the minimum (16.62 mg) was contained by V_1M_1 at 0 DAS. The maximum (19.26 mg) starch of tuber contained by V_3M_4 and the minimum (9.47 mg) was contained by V_1M_1 at 20 DAS. The maximum (17.41 mg) starch of tuber contained by V_3M_4 and the minimum (5.96 mg) was contained by V_1M_1 at 40 DAS. The maximum (6.37 mg) starch content of tuber contained by V_3M_4 and the minimum (0.72 mg) was contained by V_1M_1 at 60 DAS.

The highest (73.75) ascorbic acid content of tuber was exhibited by V_3 and the lowest (45.62) was exhibited by V_1 at 0 DAS. The highest (68.04) ascorbic acid content of tuber was exhibited by V_3 and the lowest (39.37) was exhibited by V_1 at 20 DAS. The highest (57.97) ascorbic acid content of tuber was exhibited by V_3 and the lowest (40.23) was exhibited by V_1 at 40 DAS. The highest (51.24) ascorbic acid content of tuber was exhibited by V_3 and the lowest (36.37) was exhibited by V_1 at 60 DAS. The highest (79.80) ascorbic acid of tuber was contained by $M_4$and the lowest (46.63) was contained by M_1 at 0 DAS. The highest (74.95) ascorbic acid of tuber was contained by M_4 and the lowest (40.20) was contained by M_1 at 20 DAS. The highest (58.40) ascorbic acid of tuber was contained by M_4 and the lowest (37.44) was contained by M_1 at 40 DAS. The highest (52.52) ascorbic acid of tuber was contained by $M_4$and the lowest (31.34) was contained by M_1 at 60 DAS. The maximum (90.89) ascorbic acid of tuber contained by V_3M_4 and the minimum (36.75) was contained by V_1M_1 at 0 DAS.

The maximum (86.78) ascorbic acid of tuber contained by V_3M_4 and the minimum (30.54) was contained by V_1M_1 at 20 DAS. The maximum (66.60) ascorbic acid of tuber contained by V_3M_4 and the minimum (28.54) was contained by V_1M_1 at 40 DAS. The maximum (59.09) ascorbic acid content of tuber contained by V_3M_4 and the minimum (25.94) was contained by V_1M_1 at 60 DAS.

The highest (22.44) antioxidant content of tuber was exhibited by V_3 which was statistically similar to $V_4$and the lowest (21.73) was exhibited by V_1 at 20 DAS. The highest (27.74) antioxidant content of tuber was exhibited by V_3 which was statistically similar to $V_4$and the lowest (26.23) was exhibited by V_1 at 60 DAS. The highest (21.82) antioxidant of tuber was contained by M_4 and the lowest (20.22) was contained by M_1 at 0 DAS. The highest (22.72) antioxidant of tuber was contained by M_4 and the lowest (21.48) was contained by M_1 at 20 DAS. The highest (22.94) antioxidant of tuber was contained by M_4 and the lowest (21.65) was contained by M_1 at 40 DAS.

The highest (27.95) antioxidant of tuber was contained by $M_4$and the lowest (26.00) was contained by M_1 at 60 DAS. The antioxidant content of potato tuber was statistically non-significant at 0, 20 and 40 DAS. The maximum (28.43) antioxidantcontent of tuber contained by V_3M_4 and V_4M_4.The minimum (25.27) antioxidantwas contained by V_1M_1 at 60 DAS. The highest (0.6542 mg) polyphenol content of tuber was exhibited by V_3 and the lowest (0.3525 mg) was exhibited by V_1 at 0 DAS. The highest (0.4371 mg) polyphenol content of tuber was exhibited by V_3 and the lowest (0.2734 mg) was exhibited by V_1 at 20 DAS. The highest (0.1610 mg) polyphenol content of tuber was exhibited by V_3 and the lowest (0.1091 mg) was exhibited by V_1 at 40 DAS. The highest (0.1303 mg) polyphenol content of tuber was exhibited by V_3 and the lowest (0.08275 mg) was exhibited by V_1 at 60 DAS. The highest (0.6667 mg) polyphenol of tuber was contained by M_4 and the lowest (0.2875 mg) was contained by M_1 at 0 DAS.

The highest (0.4146 mg) polyphenol of tuber was contained by M_4 which was statistically similar to $M_1$and the lowest (0.2457 mg) was contained by M_2 at 20 DAS. The highest (0.1662 mg) polyphenol of tuber was contained by M_4 and the lowest (0.1108 mg) was contained by at 40 DAS. The highest (0.1411 mg) polyphenol of tuber was contained by $M_4$and the lowest (0.0778 mg) was contained by M_1 at 60 DAS.

The maximum (1.08 mg) polyphenol of tuber contained by V_3M_4 and the minimum (0.180 mg) was contained by V_1M_1 at 0 DAS. The maximum (0.571 mg) polyphenol of tuber contained by V_4M_1 and the minimum (0.127 mg) was contained by V_1M_1 at 20 DAS. The maximum (0.2290 mg) polyphenol of tuber contained by V_3M_4 and the minimum (0.09100 mg) was contained by V_1M_1 at 40 DAS. In respect of polyphenol content of tuber at 60 DAS due to different variety and vermicompost levels was found statistically non-significant. The correlation between different characters showed more or less strong relation with each other.

On the basis of results from present study it can be concluded that, the variety and vermicompost has shown the statistically significant variation the parameters studied under present experiment. Most of the yield contributing traits showed the better performance in responsive to V_2 and in respect of vermicompost levels; most of the yield contributing traits performed the better results at M_4 treatment. But, in case of yield, the V_3M_3 combination exhibited the best (36.01 t/ha) one whereas, the V_1M_1 combination exhibited the worst (18.43 t/ha) one. On the basis of storage and processing parameters, it can be said that, V_3 has shown the better performance on most of the traits and M_4 treatment has also shown the significant better result on most of the traits.

Tuber produced from V_3M_4, contained maximum glucose, sucrose, starch, ascorbic acid, antioxidant and also contained maximum polyphenol, whereas the V_1M_1 exhibited worst one. In conclusion, the potato growers of Bangladesh may apply vermicopmpost on their field at the rate of 6 tons per hectare for better yield and processing quality in combination of Lady Rosetta and Asterix.

To validate the present result, more research programs should be conducted to assess the combined effect of variety and vermicompost on the basis of findings from present study in different major potato growing areas of Bangladesh.

REFERENCES

Abebe, T., Wongchaochant, S. and Taychasinpitak, T. (2013). Evaluation of specific sravity of potato varieties in Ethiopia as a criterion for determining processing quality. *Kasetsart J. Nat. Sci.,* **47**: 30-41.

Akbasova, A. D.,Sainova, G. A., Aimbetova, I. O., Akeshova, M. M. and Sunakbaeva, D. K. (2015).Impact of vermicompost on the productivity of agricultural crops.*Res. J. Pharma. Biol. Chem. Sci*. **6**(4): 20-24.

Alam, M. K., Zaman, M. M., Nazrul, M. I., Alam, M. S. and Hossain, M. M. (2003). Performance of some exotic potato varieties under Bangladesh conditions. *Asian J. Plant Sci.,***2**: 108-112.

Alam, M. N., Jahan, M. S., Ali, M. K., Ashraf, M. A. and Islam, M. K. (2007).Effect of vermicompost and chemical fertilizers on growth, yield and yield components of potato in Barind soils of Bangladesh.*J. Appli. Sci. Res.,* **3** (12): 1879-1888.

Albishi, T., John, J. A., Al-Khalifa, A. S. and Shahidi, F. (2013).Phenolic content and antioxidant activities of selected potato varieties and their processing by-products.*J. Function.Foods,***5**(2):590-600.

Al-Weshahy, A., El-Nokety, M., Bakhete, M. and Rao, V. (2013).Effect of storage on antioxidant activity of freeze-dried potato peels.*J.Food Res.Inter*.,**50**(2): 507-512.

Amoros, W., Espinoza, J. and Bonierbale, M. (2000). Assessment of variability for processing potential in advanced potato populations. *CIP, Lima*.

Anonymous. (1989). National Academy of Sciences: Dietary Recommended Allowances(10thed.). Washington, DC, National Academy Press, **173**(2): 97−104.

Anonymous. (2001). (http://www.dge.de-retrieved on 25 December, 2016).

Anonymous.(1988a).The Year Book of Production. FAO, Rome, Italy.

Anonymous. (1988b). Land resources appraisal of Bangladesh for agricultural development. Report No. 2. Agroecological Regions of Bangladesh, UNDP and FAO. pp. 472-496.

Anonymous.(2004). Effect of seedling throwing on the grain yield of wart land rice compared to other planting methods. Crop Soil Water Management Program Agronomy Division, BRRI, Gazipur- 1710.p. 56.

Anonymous.(2005).Secondary yield trial with exotic varieties(2nd Generation).Annual Report, Tuber Crops Research Centre, BARI, Joydebpur, Gazipur-1701.p.128.

Ansari, A. A. (2008). Effect of vermicompost on the productivity of potato (*Solanum tuberosum*), spinach (*Spinacia oleracea*) and turnip (*Brassica campestris*).*World J.Agril. Sci.,* **4**(3): 333-336.

AOAC .(1990). Official Methods of Analysis. Association of official Analytical Chemist (15th edn.), AOAC, Washington, DC, USA.

Asghari-Zakaria, R., Maleki-Zanjani, B. and Sedghi, E. (2009). Effect of *Invitro* chitosan application on growth and mini tuber yield of *Solanum tuberosum*L. *Plant Soil Environ*., **55**: 252-256.

Asha, A., Tripathi, A. K. and Soni, P. (2008). Vermicomposting: A Better Option for Organic Solid Waste Management. *J. Hum. Ecol.,* **24**: 59-64.

Asmamaw, Y., Tekalign, T. and Workneh, T. S. (2010). Specific gravity, dry matter concentration, pH, and crisp-making potential of Ethiopian Potato (*Solanum tuberosum* L.) cultivars as influenced by growing environment and length of storage under ambient conditions. *J. Potato Res.*, **53**(2):95-109.

Astley, S. B. (2003). Dietary antioxidants-Past, present and future Trends. *J. Food Sci. Technol*. **14**: 93-98.

Avramiuc, M., Fartaiş, L. and Herghelegiu, I. (2008). The variation of the ascorbic acid content from potato tubers during storage under house cellar conditions. *J. Plant Biol.,***14**(2): 5-15.

Banu, J. R., Logakanthi, S. and Vijayalakshmi, G. S. (2001). Biomanagement of paper mill sludge using an indigenous (*Lampitomauritii*) and two exotic (*Eudriluseugineae* and *Eiseniafoetida*) earthworms on potato. *J. Environ. Biol.,* **22**: 181–185.

Barton, W.G., and Longman,W. (1989). The potato. Scientific and Technical.3rd edition, USA press, California, USA. p. 599-601.

Basker, D. (1975).Centigrade scale temperature corrections to the specifie gravity of potatoes. *Potato Res*.,**18**:123–125.

BBS (Bangladesh Bureau of Statistics).(2013). Monthly statistical year book. Ministry of Planning, Govt. Peoples Repub. Bangladesh.p. 64.

Behjati, S., Choukan, R., Hassanabadi, H. and Delkhosh, B. (2013). The evaluation of yield and effective characteristics on yield of promising potato clones. *Ann. Biol. Res.* **4**(7): 81-84.

Blenkinsop, R. W., Copp, L. J., Yada, R. Y. and Marangoni, A. G. (2002). Changes in compositional parameters of tubers of potato (*Solanum tuberosum* L.) during low-temperature storage and their relationship to chip processing quality. *J. Agril. Food Chem.*, **50**(16): 4545-4553.

Brandl, W. and Herrmann, K. (1984). Occurrence of chlorogenic acid in potatoes. ZeitschriftfurLebensmittel-Untersuchungund. Forschung, **179**: 192–194

Burton, W. G., Van, Es. A. and Hartmans, K. J. (1992). The physics and physiology of storage. In: The potato crop, Harris, P. M. (ed.). Chapman and Hall, London, p. 608–727.

Capezio, S. B. (1987). Specific gravity variability in first clonal generation in potato. Balance, BS. As. (Argentina) p. 37.

CIP, (2008). Potato growth in accelerate (http://www.cipotato.org/potato/facts-Accessedon20 January, 2016).

Cornacchia, R., Cabezas-Serrano, A. B., Amodio, M. L. and Colelli, G. (2011).Suitability of 4 potato cultivars (*Solanum tuberosum* L.) to be processed as fresh-cut product. *American J. Potato. Res.*, **88**(5): 403-412.

Cota, J. and Hadzic, A. (2013).Yield and quality of potato varieties. University of Banjaluka, Faculty of Agriculture. *Agroznanje Agro-knowledge J.* **14**(1/4): 41-49.

Cronk, T. C., Kuhn, G. O. and McArdle, F. J. (1974).The influence of stage of maturity level of nitrogen fertilization and storage on the concentration of solanine in tubers of three potato cultivars. *Bull. Environ.Contam.Toxicol*.,**11**:163–168.

Das, S. K. (2006). Morphological and growth characteristics of potato varieties. M. S. thesis, Dept. of Crop Botany. Bangladesh Agricultural University, Mymensingh, Bangladesh.

Davey, M. W., Van-Montagu, M., Inze, D., Sanmartin, M., Kanellis,A., Smirnoff, N., Benzie, I. J. J., Strain, J. J., Favell, D. andFletcher,J. (2000). Plant L-ascorbic acid: chemistry, function, metabolism, bioavailability and effects of processing. *Environ. Toxicol. Pharmacol*., **26**(2): 241−246.

Deuber, H., Guignard, C., Hoffmann, L. and Evers, D. (2012). Polyphenol and glycoalkaloid contents in potato cultivars grown in Luxembourg. *Food Chem.*, **135**(4): 2814-2824.

Dhar, M., Hossain, M., Kundu, B. C., Rahman, M. H., Rahaman, E. H. M. S. and Kadian, M. S. (2009). Screening of potato varieties and germplasm against heat tolerance. Annual Report, August 2009. Tuber Crops Research Centre, BARI, Gazipur-1701. pp. 35-39.

FAO (2009). Production Year Book No. 67. Food and Agriculture Organization, Rome, Italy.p. 97.

FAOSTAT (2013). Statistical Database. Food and Agricultural Organization of United Nations, Rome, Italy. *Food and Agric.*, **80**: 825–860.

FAOSTAT. (2014). Statistical Database. Food and Agricultural Organization of United Nations, Rome, Italy. *Food and Agric.*, **80**: 810–820.

Fracchia, L., Dohrmann, A. B., Martinotti, M. G. and Tebbe, C. C. (2006). Bacterial diversity in a finished compost and vermicompost: differences revealed by cultivation independent analyses of PCR-amplified 16S r RNA genes. *Appl. Microbiol. Biotechnol*., **71**: 942–952.

Gomez, K. A. and Gomez, A. A. (1984). Statistical procedure for agricultural research. Second Edn. Intl. Rice Res. Inst., John Wiley and Sons. New York. pp. 1-340.

Goutam. K. C., Bhunia, G. and Chakraborty, S. K.(2011). The effect of vermicompost and other fertilizers on cultivation of tomato plants.*J. Hortic. Forestry,* **3**(2): 42-45.

Guler, S. (2009). Effects of nitrogen on yield and chlorophyll of potato (*Solanum tuberosum* L.) cultivars. *Bangladesh J. Bot,.* **38**(2): 163-169.

Gumul, D., Ziobro, R., Noga, M. and Sabat, R. (2011).Characterization of five potato cultivars according to their nutritional and pro-health components. *Acta .Sci. Polon. Technol. Alimt.*, **10**(1): 77-81.

Haque, M. E. (2007). Evaluation of exotic potato germplasm on yield and yield contributing characters. M. S. thesis, Dept. of Horticulture and postharvest technology. Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.

Hossain, M. S. (2000). Effects of different doses of nitrogen on the yield of seed tubers of four potato varieties. M. S. thesis, Dept. of Horticulture. Bangladesh Agricultural University, Mymensingh, Bangladesh.

Hossain, M. S. (2011). Yield potential, storage behavior and degeneration of potato varieties in Bangladesh. Ph.D. thesis, Seed science and technology unit. Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh.

Jaipaul, J., Sharma, S. and Sharma, A. K. (2011). Effect of organic fertilizers on growth, yield and quality of potato under rainfed conditions of central Himalayan region of Uttarakhand. *Potato J.*, **38**(2):173-184.

Kabira, J. N. and Lemaga, B. (2006). Potato Processing: Quality Evaluation procedures for research and food industries applications in East and Central Africa. *Kenya Agricultural Research Institute, Nairobi, Kenya*. p. 12.

Karim, M. R., Rahman, H., Ara, T., Khatun, M. R., Hossain, M. M. and Islam, A. K. M. R.(2011). Yield potential study of meristem derived plantlets of ten potato varieties (*Solanum tuberosum* L.). *Intl. Biosci.* **1**(2): 48-53.

Kashem, M. A., Ashoka, S. Imam, H. and Islam M. S. (2015). Comparison of the effect of vermicompost and inorganic fertilizers on vegetative growth and fruit production of tomato (*Solanum lycopersicum* L.). *Open J. Soil Sci.,* **5**: 53-58.

Kassim, N. A., Nerway, Z. A. A. and Yousif, K. H. (2014). Potato virus Y (PVY) surveying and its economic importance on potato crop. *Intl. J. Res. Appl. Nat. Soc. Sci.,* **2**(6): 39-46.

Keijbets, M. (2008). Potato processing for the consumer: Developments and future challenges. *Potato Res.,* **51**: 271-281.

Kulen, O., Stushnoff, C. and Holm, D. G. (2013). Effect of cold storage on total phenolics content, antioxidant activity and vitamin C level of selected potato clones. *J. Sci. Food Agric*, **93**(10): 2437-2444.

Kumar, D., Singh, B. P. and Kumar, P. (2004). An overview of the factors affecting sugar content of potatoes. *Annal. Appl. Biol.*, **145**(3): 247-256.

Kumar, D., Ezekiel, R., Singh, B. and Ahmed, I. (2005).Conversion table for specific gravity, dry matter and starch content from under water weight of potatoes grown in north-indian plains.*Potato J*., **32**(1-2): 79-84.

Kumar, M., Baishaya, L. K., Ghosh, D. C. and Gupta, V. K. (2012). Productivity and soil health of potato (*Solanum tuberosum* L.) field as influenced by organic manures, inorganic fertilizers and biofertilizers under high altitudes of eastern Himalayas. *J. Agril. Sci.,***4**(5): 2012.

Kundu, R.,Majumder, A. and Pal, S. (2012). Evaluation of potato cultivars against arsenic accumulation under an arsenic contaminated zone of Eastern India. *Potato J.,* **39**(1): 62-68.

Lachman, J., Hamouz, K., Orsak, M., Pivec, V. and Dvorak, P. (2008). The influence of flesh colour and growing locality on polyphenolic content and antioxidant activity in potatoes. *Sci. Hort.*, **117**(2): 109-114.

Lazcano, C., Gomez-Brandon, M. and Dominguez, J. (2008). Comparison of the effectiveness of composting and vermicomposting for the biological stabilization of cattle manure. Chemosphere, **72**:1013-1019.

Leszczynski, W. (2000). Jakośćziemniakakonsumpcyjnego (Quality of low-starch potato).*Zywn. Nauka Technol*. Jakosc. **4:** 5-27.

Linnemann, A. R., Van,Es. A. and Hartmans, K. J. (1985). Changes in content of L-ascorbic acid, glucose, fructose, sucrose and total glykoalkaloids in potatoes (cv. Bintje) stored at 7, 16, and 28 °C. *Potato Res*., **28**:271–278.

Maga, J. A. (1980). Potato glykoalkaloids. *Crit. Rev. Food Sci. Nutr.,* **12**:372–405.

Mahmood, S. (2005).A study of planting method and spacing on the yield of potato using TPS. *Asian J. Plant Sci.,* **4**: 102-105.

Mahmud, A. A., Akhter, S., Hossain, M. J., Bhuiyan, M. K. R. and Hoque, M. A. (2009).Effect of dehaulming on yield of seed potatoes. *Bangladesh J. Agril. Res.,* **34**(3): 443-448.

Mareschi, J. P., Belliot, J. P., Fourlon, C. and Gey, K. F. (1982). Changes in vitamin C content of Bintje potatoes during storage and usual culinary preparations. *Intl. J. Vitamin . Nutr. Res*.,**53**(4): 402-411.

Maria, K. Peter, K. and Marek, R. (2013). The effect of different doses application of dry granulated vermicompost on yield parameters of maize and potatoes. *Res. Gate,* **1**: 8 – 14.

Meenakumari, T. and Shekhar, M. (2012). Vermicompost and other fertilizers effect on growth, yield and nutritional status of tomato (*Lycopersicon esculentum*) plant. *World Res. J. Agril. Biotech*., **1**(1): 14-16.

Madiwale, G. P., Reddivari, L., Holm, D. G. and Vanamala, J. (2011). Storage elevates phenolic content and antioxidant activity but suppresses anti proliferative and pro-apoptotic properties of colored-flesh potatoes against human colon cancer cell lines. *J. Agril. Food. Chem.*, **59**(15): 8155-8166.

Miller, R. A., Harrington, J. D. and Kuhn, G. D. (1975). Effect of variety and harvest date on tuber sugars and chip color. *American Potato J.,* **52**: 379-386.

Mojtaba, S. Y., Mohammadreza, H. S. H. and Mohammad, T. D. (2013).Effect of nitrogen fertilizer and vermicompost on vegetative growth, yield and NPK uptake by tuber of potato (Agria CV.).*Intl. J. Agric. Crop Sci.,* **5**(18): 2033-2040.

Mondal, M. R. I., Islam, M. S., Jalil, M. A. B., Rahman, M. M., Alam, M. S. and Rahman, M. H. H. (2011). Krishi Projukti Hatboi (Handbook of Agro-technology), 5th edition. Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh, p: 307.

Mondol, M. S. S. Z. (2004). Performance of seven modern varieties of potato. M. S. thesis, Dept. of Horticulture. Bangladesh Agricultural University, Mymensingh, Banglsdesh.

Nelson, N., (1944). A photometric adaptation of the Somogyi method for the determination of glucose.*J. Biol. Chem.,* **187**: 375-380.

Panwar, S. and Wani, A. M. (2014).Effect of Organic production on growth and productivity of Sweet Potato (*Ipomoea batatas* L.) under Poplar based Agroforestry system. *Intl. J. Adv. Res*.**,** **2**(12): 229-232.

Rainys, K. and Rudokas, V.(2005). Potato tuber yield and quality as affected by growing conditions and varietal peculiarities. *Zemdirbyste, Mokslo Darbai*, **89**: 67-80.

Raja, M. and Veerkumari, K. (2013).Impact of Vermicompost on Growth and Development of Cabbage, *Brassica oleracea* Linn. and their Sucking Pest, *Brevicoryne brassicae* Linn. (Homoptera: Aphididae).*Res. J. Environ. Earth Sci.,* **5**(3): 104-112.

Ramamurthy, M., Umavathi, S.,Thangam, Y. and Mathivanan, R. (2015). Effect of vermicompost on tuber yield status of radish plant *Raphanus sativus.L. Int. J. Adv. Res. Biol.Sci,*. **2**(8): 50–55.

Rojoni, R. N., Islam, N., Roy, T. S., Sarkar, M. D. and Kabir, K. (2014). Yield potentiality of true potato seed seedling tubers as influenced by its size and clump planting. *App. Sci. Report*,**6**(2): 41-46.

Roy, T. S. Nishizawa, T. and Ali, M. H. (2006). Storability of Tubers Derived from True Potato Seed (*Solanum tuberosum L.*) under Ambient Storage Conditions. *Asian J. Plant Sci*.,**5**: 243-247.

Rytel, E. **(**2004). The effect of edible potato maturity on its after-cooking consistency (in Polish). *Zesz . Probl. Post .NaukRol*.**500:** 465-473.

Salisbury, F. B. and Ross, C. W. (1992). Plant physiology. 4thed. *Wadsworth, Belmont*. California, USA. P. 57-63.

Sandhu, K. S., Marwaha, R. S. and Kumar, P. (2014). Processing attributes of potato varieties stored at ambient conditions of north-western plains. *Potato.J.*, **41**(1): 25-33.

Schwarz, D. and Geisel, B.(2012). Special Storage Problems and potato production. Report of Western Potato Council, USA, pp. 101-107.

Senapati, B. K. (1992). Vermitechnology: an option for recycling cellulosic waste in India**.** In: New Trends in Biotechnology. Oxford and IBH Publications Pvt. Co. Ltd. Calcutta, p. 347-358.

Sensi, N., Miano, T. M. and Brunetti, G. (1996). Humic-like substances in organic amendments and effect of native soil humic substances. In: Humic substances in Terrestrial Ecosystem, Piccolo, A.(ed.). *Elsevier Sci*ence, p. 531-593.

Shirzadi, F. (2015). Evaluate the Use of Organic Fertilizers on the Plant's Height and Size and Number of Micro Tubers Potato in Mahidasht of Kermanshah. *Intl. J. Res. Studie Agrl. Sci.*, **1**(4): 21-24.

Shweta, S. and Sharma, R. P. (2011). Influence of Vermicompost on the performance of potato in an acid alfisol. *PotatoJ*., **38** (2): 182-184.

Singh, M. (2010). Projection of potato export from India: a markov chain approach. *Potato J.*, **37**: 18-55.

Singh, N. and Rajini, P. S. (2008). Antioxidant-mediated protective effect of potato peel. *Potato J*., **8**(5): 8-13.

Singh, N., Kamath, V., Narasimhamurthy, K. and Rajini, P. S. (2008). Protective effect of potato. *Potato J*., **11**(5): 28-33.

Singh, S. B. and Chauhan, S. K. (2014). Impact of organic manures on yield of potato (*Solanum tuberosum*L.) in semiarid condition of Western U.P. *J. Rural Agric. Res.*, **14**(1): 45- 46.

Singleton ,V. L., Orthofer, R. and Lamuela, R. M. (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalteureagent. *Methd. Enzymol.*,**299**: 152-178.

Sohail, M., Khan, R. U., Afridi, S. R., Imad, M. and Mehrin, B. (2013). Preparation and quality evaluation of sweet potato ready to drink beverage. ARPN*J. Agric. Biol. Sci.,* **8**: 279-282.

Sood, M. C. and Sharma, R. C. (2001). Value of growth promoting bacteria, vermicompost and *Azotobacter o*n potato production in Shimla hills. *J. Indian Potato Assoc***., 28(**I): 52-53.

Suyre, M., Khan, R. U., Fridi, S. R., Inmad, M. and Mehjarin, B. (1975). Preparation and quality evaluation of potato ready to drink beverage. ARPN *J. Agric. Biol. Sci.,* **8**: 27-33.

Tai, G. C. C. and Coleman, W. (1999).Genotype environment interaction of potato chip color. *Can. J. Plant Sci.,* **79**: 433-438.

Tester, R. F., Ansell, R., Snape, C. E. and Yusuph, M. (2005). Effects of storage temperatures and annealing conditions on the structure and properties of potato (*Solanum tuberosum*) starch. *Intl. j. boil. macromol.*, **36**(1): 1-8.

Valcarcel, J., Reilly, K., Gaffney, M. and O'Brien, N. M. (2015). Antioxidant activity, total phenolic and total flavonoid content in sixty varieties of potato (*Solanum tuberosum* L.) grown in Ireland**.** *J. Potato Res.*,**58**(3): 221-244.

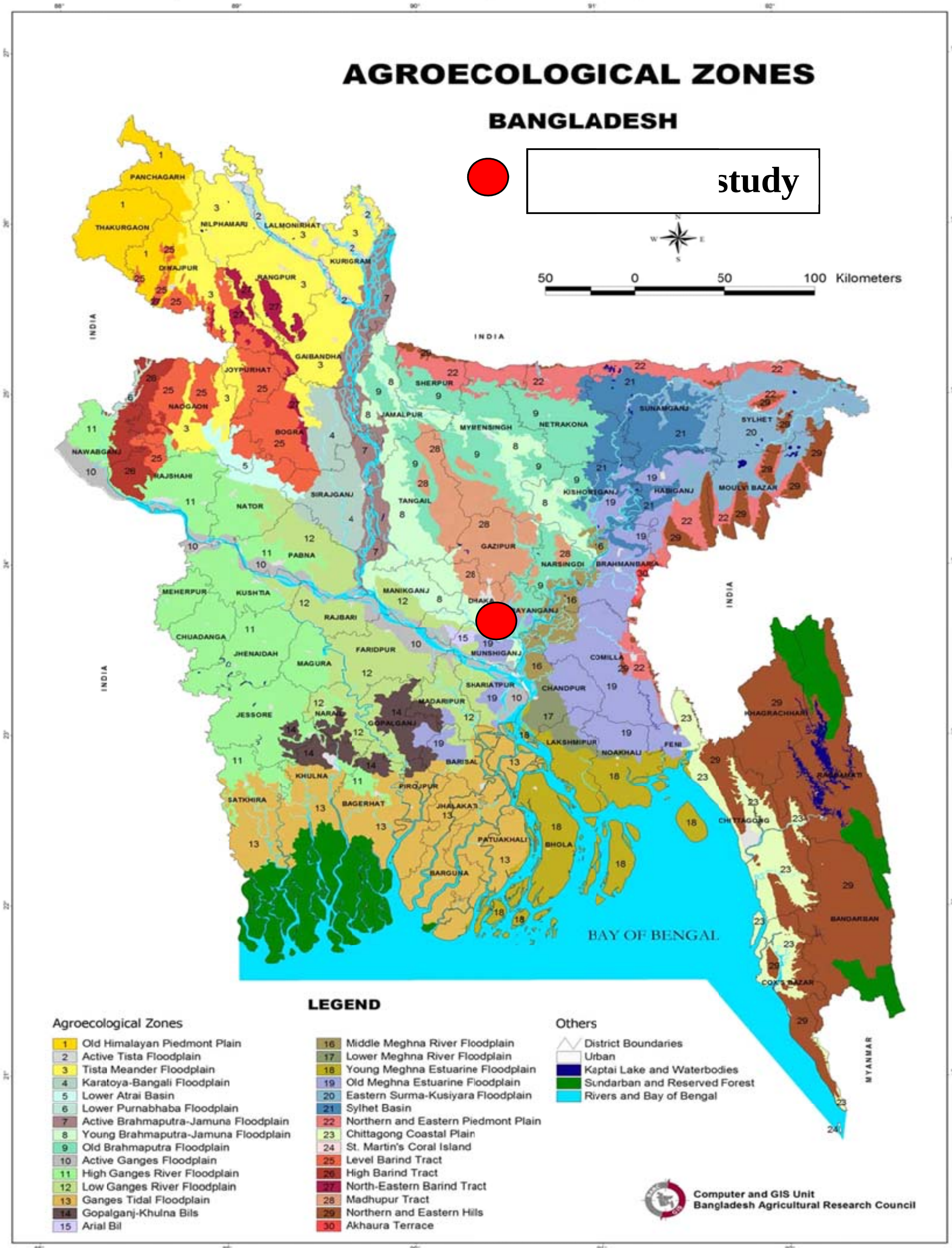
Wiltshire, J. J. J. and Cobb, A. H. (1996). A review of the physiology of potato tuber dormancy. *Annl. Appl. Biol.*, **129**(3): 553-569.

Wroniak, J. (2006). Waloryzywieniowezjemniakajadalnego(Nutritional benefits of potato). *Ziemn. Pol.,* **2**: 17-20.

Zandonadi, D. B. and Busato, J. G. (2012).Vermicomposthumic substances: technology for converting pollution into plant growth regulators. *Intl. J. Environ. Sci.Eng. Res.,* **3**(2):73-84.

APPENDICES

Appendix I: Map showing the site used for present study



Appendix II. Monthly meteorological information during the period fromNovember,2014to April, 2015

Year	Month	Air temperature (^{0}C)		Relative humidity (%)	Total rainfall (mm)
		Maximum	Minimum		
2014-2015	November	28.10	11.83	58.18	47
	December	25.00	9.46	69.53	0
	January	23.98	10.47	73.86	Trace
	February	26.45	14.83	75.38	Trace
	March	30.45	18.36	69.44	59
	April	35.93	42.35	73.92	103

Source: Metrological Centre(Climate Division), Agargaon, Dhaka

Appendix III. Mean square values of the data for yield and yield contributing characters of potato

Source of variation	df	Yield (t/ha)	Marketable yield (t /ha)	Non-marketable yield (t/ha)	Weight of tuber/ hill (g)	No. of tuber/hill	Average tuber weight (g)	Seed potato (t/ha)	Non-seed potato (t/ha)
Replication	2	2.944	0.193	0.074	99.91	0.333	1.84	1.877	0.586
Variety (A)	3	57.692**	41.753**	1.724**	9012.80**	24.047**	429.78**	33.54**	3.22**
Error	6	3.024	2.033	0.170	174.41	0.500	8.49	1.026	0.348
Vermicompost (B)	3	91.467**	73.916**	0.628*	14292.50**	1.601**	250.15**	56.01**	4.36**
Combination	9	88.017**	63.546**	1.635**	13756.34**	4.699**	250.91**	50.01**	5.38**
Error	24	4.446	1.573	0.178	291.23	0.181	11.41	1.059	0.461

** = Significant at 1% level of probability, * = Significant at 5% level of probability

Appendix IV. Mean square values of the data for percent weight loss at different days after storage of potato tuber

Source of variation	df	Weight loss (%)		
		20DAS	40DAS	60DAS
Replication	2	0.013	0.451	0.011
Variety (A)	3	43.356**	98.252**	325.093**
Error	6	0.012	0.332	0.170
Vermicompost (B)	3	30.000**	99.283**	126.029**
Combination	9	44.938**	121.072**	326.206**
Error	24	0.148	0.593	0.423

** = Significant at 1% level of probability

Appendix V. Mean square values of the data for percent dry matter at different days after storage of potato tuber

Source of variation	df	Dry matter (%)			
		0DAS	20DAS	40DAS	60DAS
Replication	2	0.052	1.813	0.502	0.495
Variety (A)	3	33.501**	39.874**	45.241**	45.985**
Error	6	0.212	0.486	0.647	0.792
Vermicompost (B)	3	51.298**	47.589**	36.637**	40.189**
Combination	9	2.895**	1.772**	2.510**	1.851*
Error	24	0.868	0.780	0.710	0.770

* = Significant at 5% level of probability, ** = Significant at 1% level of probability

Appendix VI. Mean square values of the data for firmness at different days after storage of potato tuber

Source of variation	df	Firmness			
		0DAS	**20DAS**	**40DAS**	**60DAS**
Replication	2	0.040	1.112	0.975	0.985
Variety (A)	3	47.606**	125.330**	29.798**	23.479**
Error	6	1.717	1.955	1.008	2.051
Vermicompost (B)	3	2.833NS	9.696**	70.354**	6.632*
Combination	9	16.346**	19.394**	38.955**	17.570**
Error	24	1.298	1.294	1.223	1.722

** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS = Not significant

Appendix VII. Mean square values of the data for total soluble solids (TSS) at different days after storage of potato tuber

Source of variation	df	Total soluble solids (TSS)			
		0DAS	**20DAS**	**40DAS**	**60DAS**
Replication	2	0.016	0.123	0.063	0.008
Variety (A)	3	0.778**	3.132**	1.875**	0.842**
Error	6	0.053	0.054	0.194	0.101
Vermicompost (B)	3	0.800**	0.427*	0.366*	0.094NS
Combination	9	0.414**	0.119NS	0.210NS	0.173**
Error	24	0.088	0.118	0.111	0.057

* = Significant at 5% level of probability, * = Significant at 5% level of probability, NS = Not significant

Appendix VIII. Mean square values of the data for specific gravity at different days after storage of potato tuber

Source of variation	df	Specific gravity			
		0DAS	20DAS	40DAS	60DAS
Replication	2	0.0006	0.0003	0.0007	0.0006
Variety (A)	3	0.3040**	0.3653**	0.3381**	0.4053**
Error	6	0.0008	0.0003	0.0005	0.0013
Vermicompost (B)	3	0.0251**	0.0166**	0.0258**	0.0199**
Combination	9	0.0014NS	0.0035**	0.0016**	0.0071**
Error	24	0.0007	0.0004	0.0006	0.0011

** = Significant at 1% level of probability, NS = Not significant

Appendix IX. Mean square valuesof the data for glucose at different days after storage of potato tuber

Source of variation	df	Glucose (mg/g FW)			
		0DAS	20DAS	40DAS	60DAS
Replication	2	0.001	0.001	0.002	0.013
Variety (A)	3	0.068**	0.079**	0.319**	0.256**
Error	6	0.001	0.001	0.002	0.006
Vermicompost (B)	3	0.054**	0.061**	0.253**	0.204**
Combination	9	0.003*	0.004**	0.014**	0.011NS
Error	24	0.001	0.001	0.003	0.008

** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS = Not significant

Appendix X. Mean square values of the data for sucrose at different days after storage of potato tuber

Source of variation	df	Sucrose (mg/g FW)			
		0DAS	20DAS	40DAS	60DAS
Replication	2	0.008	0.008	0.128	0.022
Variety (A)	3	0.950**	1.357**	5.449**	4.405**
Error	6	0.011	0.046	0.056	0.019
Vermicompost (B)	3	0.800**	1.166**	4.589**	3.735**
Combination	9	0.039**	0.058NS	0.230*	0.186**
Error	24	0.003	0.042	0.095	0.048

** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS = Not significant

Appendix XI. Mean square values of the data for starch at different days after storage of potato tuber

Source of variation	df	Starch (mg/g FW)			
		0DAS	20DAS	40DAS	60DAS
Replication	2	5.029	0.142	0.287	0.015
Variety (A)	3	305.368**	42.830**	78.490**	11.218**
Error	6	2.873	0.499	0.721	0.013
Vermicompost (B)	3	141.088**	96.922**	64.461**	12.774**
Combination	9	4.481**	1.748**	1.185NS	1.576**
Error	24	1.255	0.445	0.613	0.015

** = Significant at 1% level of probability, NS = Not significant

Appendix XII. Mean square values of the data for ascorbic acid at different days after storage of potato tuber

Source of variation	df	Ascorbic acid (mg/g FW)			
		0DAS	20DAS	40DAS	60DAS
Replication	2	3.94	6.28	3.87	4.19
Variety (A)	3	1891.18**	1875.15**	812.94**	586.35**
Error	6	6.77	6.29	6.73	4.71
Vermicompost (B)	3	2409.52**	2700.31**	929.49**	996.46**
Combination	9	46.97**	49.94**	32.71**	29.33**
Error	24	5.34	6.54	6.83	5.35

** = Significant at 1% level of probability

Appendix XIII. Mean square of the data for antioxidant at different days after storage of potato tuber

Source of variation	df	Antioxidant(µg/g FW)			
		0DAS	20DAS	40DAS	60DAS
Replication	2	0.165	0.017	0.011	0.267
Variety (A)	3	1.937NS	1.116**	0.406NS	5.185**
Error	6	1.190	0.117	0.269	0.217
Vermicompost (B)	3	5.349**	3.511**	3.618**	8.315**
Combination	9	0.112NS	0.077NS	0.040NS	0.341*
Error	24	0.201	0.126	0.180	0.142

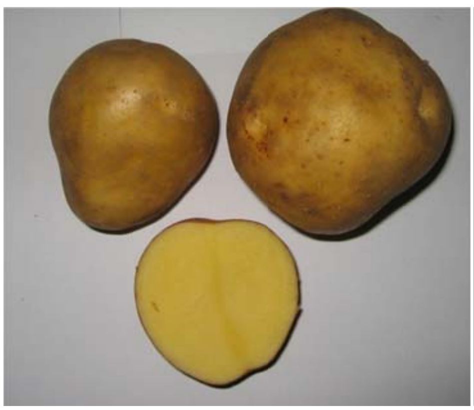
** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS = Not significant

Appendix XIV. Mean square values of the data for polyphenol at different days after storage of potato tuber

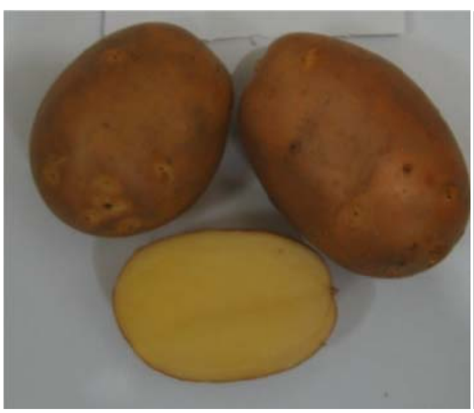
Source of variation	df	Polyphenol (GA mg/g FW)			
		0DAS	**20DAS**	**40DAS**	**60DAS**
Replication	2	0.001	0.0377	0.0001	0.0044
Variety (A)	3	0.210**	0.7456**	0.0613**	0.0539**
Error	6	0.001	0.0575	0.0005	0.0029
Vermicompost (B)	3	0.308**	0.9483**	0.0724**	0.0852**
Combination	9	0.031**	0.0801*	0.0073**	0.0050NS
Error	24	0.001	0.0280	0.0012	0.0037

* = Significant at 5% level of probability, ** = Significant at 5% level of probability, NS = Not significant

Plate 1. Experimental Signboard




a) BARI TPS-1 b) Lady Rosetta




c) Asterix d) Courage

Plate 2. Histological view of four potato varietie

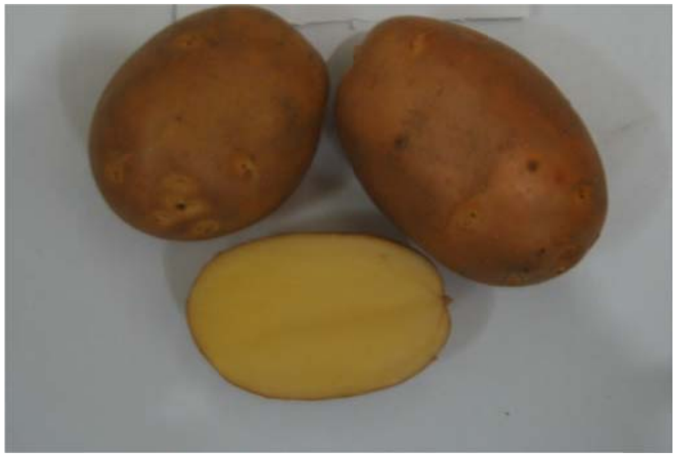


Plate 3. Best combination for storage and processing quality (V_3M_4)

a) Sedimentation of potato starch

b) Washing of potato starch

Plate 4 (a &b). Starch determination

Plate 5. Compartmentalization of starch in test tube

Plate 6. Compartmentalization of polyphenol in test tube

Plate 7. Sprouting of tubers at 60 DAS