YIELD AND QUALITY OF POTATO (*Solanum tuberosum* L.) AS INFLUENCED BY DIFFERENT MULCH MATERIALS AND THEIR PERFORMANCE IN AMBIENT CONDITION

FARZANA NOWROZ

DEPARTMENT OF AGRONOMY

SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA -1207

DECEMBER, 2015

YIELD AND QUALITY OF POTATO (*Solanum tuberosum* L.) AS INFLUENCED BY DIFFERENT MULCH MATERIALS AND THEIR PERFORMANCE IN AMBIENT CONDITION

BY

FARZANA NOWROZ

REGISTRATION NO. 10-03897

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

MASTER OF SCIENCE
IN
AGRONOMY

SEMESTER: JULY- DECEMBER, 2015

Approved by:

Professor Dr. Tuhin Suvra Roy Department of Agronomy SAU, Dhaka **Supervisor**	**Professor Dr. Md. Shahidul Islam** Department of Agronomy SAU, Dhaka **Co-Supervisor**

.....

Professor Dr. Md. Fazlul Karim
Chairman
Examination Committee
Department of Agronomy
SAU, Dhaka

DEPARTMENT OF AGRONOMY

Sher-e-Bangla Agricultural University (SAU)
Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

This is to certify that the thesis entitled, " ***Yield and Quality of Potato (Solanum tuberosum L.) as Influenced by Different Mulch Materials and their Performance in Ambient Condition."*** *Submitted to the DEPARTMENT OF AGRONOMY, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE in AGRONOMY*** *embodies the result of a piece of bona-fide research work carried out by* ***Farzana Nowroz, Registration No. 10-03897*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree.*

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

Dated:
Dhaka, Bangladesh

Professor Dr. Tuhin Suvra Roy
Department of Agronomy
SAU, Dhaka
Supervisor

ACKNOWLEDGEMENT

All of my gratefulness to The Almighty Allah Who enabled me to accomplish this thesis paper.

I would like to express my heartiest respect, deepest sense of gratitude, profound appreciation to my supervisor, ***Professor Dr. Tuhin Suvra Roy****, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka for his sincere guidance, scholastic supervision, constructive criticism and constant inspiration throughout the course and in preparation of the manuscript of the thesis.*

I would like to express my heartiest respect and profound appreciation to my co-supervisor, ***Professor Dr. Md. Shahidul Islam****, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka for his utmost cooperation and constructive suggestions to conduct the research work as well as preparation of the thesis.*

I express my sincere respect to the Chairman, ***Professor Dr. Md. Fazlul Karim,*** *Examination Committee, Department of Agronomy and all the teachers of the Sher-e-Bangla Agricultural University, Dhaka for providing the facilities to conduct the experiment and for their valuable advice and sympathetic consideration in connection with the study.*

I would like to thank all of my family members who have helped me with technical support to prepare this thesis paper. I also thank all of my roommates and friends to help me in my research work.

Mere diction is not enough to express my profound gratitude and deepest appreciation to my parents and friends for their ever ending prayer, encouragement, sacrifice and dedicated efforts to educate me to this level.

The Author

YIELD AND QUALITY OF POTATO (*Solanum tuberosum* L.) AS INFLUENCED BY DIFFERENT MULCH MATERIALS AND THEIR PERFORMANCE IN AMBIENT CONDITION

ABSTRACT

An experiment was conducted at Sher-e-Bangla Agricultural University, Dhaka during the period from November, 2014 to June, 2015 to study the yield and quality of potato (*Solanum tuberosum* L.) as influenced by different mulch materials and their performance in ambient condition. Five varieties *viz*., 'Asterix', 'Lady rosetta', 'Courage', 'Diamant' and 'BARI TPS-1' and four mulch materials *viz*., control, water hyacinth, rice straw and rice husk were considered for the study. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Mulch materials may improve the quality of potato. Result revealed that, different potato varieties and/or mulch materials had significant effect on most of the yield and quality contributing parameters studied in this experiment. Among the five varieties 'Diamant' produced maximum tuber , marketable and seed potato yield. But 'Lady rosetta' showed better quality in respect of dry matter content and specific gravity. Whereas, 'Asterix' performed the best on the basis of reducing sugar and sucrose content. Among four mulch materials rice straw showed the best performance when comparing tuber yield, weight of marketable yield, weight of seed potato, dry matter content and specific gravity but not for reducing sugar and sucrose content. Among the twenty treatment combinations 'Diamant' variety with rice straw produced maximum tuber yield (33.33 t ha^{-1}), maximum marketable yield (29.86 t ha^{-1}) and maximum seed potato yield (29.55 t ha^{-1}). But in case of quality parameters 'Lady rosetta' with rice straw performed the best one showing the highest dry matter (25.14%) and specific gravity (1.343) and 'Asterix' with control exhibited the lowest reducing sugar (.123 mg/g FW) and sucrose content (2.323 mg/g FW). In conclusion, 'Diamant' with rice straw was the best while comparing yield but 'Lady rosetta' and 'Asterix' were suitable for processing quality when cultivated with rice straw and control respectively. 'Lady rosetta' and 'Asterix' also showed superior performance in ambient storage condition upto 40 days after storing compared to other varieties.

LIST OF CONTENTS

LIST OF CONTENTS (Cont'd)

LIST OF CONTENTS (Cont'd)

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST 0F FIGURES

LIST OF APPENDIXES

ACRONYMS AND ABBREVIATIONS

AEZ = Agro-Ecological Zone

BADC = Bangladesh Agricultural Development Corporation

BARI = Bangladesh Agricultural Research Institute

BBS = Bangladesh Bureau of Statistics

FAO = Food and Agricultural Organization

DAS = Days after storing

et al. = and others

LER = Land Equivalent Ratio

LSD = Least Significant Difference

MP = Muriate of Potash

pH = Hydrogen ion conc.

RCBD = Randomized Complete Block Design

TSP = Triple Super Phosphate

TCRC = Therapeutics Chemical Research Corporation

°c = Degree celcius

Fig. = Figure

CHAPTER I

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a tuber crop belonging to the family Solanaceae. It is originated in the central Andean area of South America (Keeps, 1979). It is the fourth world crop after wheat, rice and maize. The Food and Agriculture Organization reported that the world production of potato in 2013 was about 368 million tons which was higher (364 million tons in 2012) than that of the previous year (FAOSTAT, 2013). Bangladesh is the seventh potato producing country in the world (FAOSTAT, 2013). In Bangladesh, it ranks second 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^{-1} and 8603000 metric ton respectively (BBS, 2013). The total production is increasing day by day as such consumption also rapidly increasing in Bangladesh (BBS, 2013). Potato varieties cultivated during the winter in all the districts of Bangladesh. Potato consumption as processed and fresh food is also increasing considerably in Bangladesh (Brown, 2005).

Now-a-days potato being the third staple vegetable crop could contribute in poverty alleviation and food security in Bangladesh. It is a carbohydrate-rich crop, and is consumed almost absolutely as a vegetable in Bangladesh. The annual demand for potato in Bangladesh is 6.5-7 million tons against its production of 8.9 million tons (BBS, 2014). It was reported that, in 2009, both the fresh and processed potato consumption was 28.94 kg/capita/year that increased to 46.40 kg/capita/year in 2013 indicating the increasing demand of potato consumption in Bangladesh (BBS, 2014). Additionally the increasing demands of potato processed food specially chips has been gaining popularity

indicating the demands of the varieties with good processing quality with the attributes beneficial for human health. A lot of research efforts have been made considering the yield potential of potato varieties but very few observations were made on the processing quality and health concern issue. Processing quality of potato tubers is determined by high dry matter, specific gravity, sugar content, low reducing sugar, flavonoids and phenol contents (Abong *et al*., 2009).

Potato is not only a vegetable crop but also an alternative food crop against rice and wheat. Nutritionally, the tuber is rich in carbohydrates or starch and is a good source of protein, vitamin C and B, potassium, phosphorus and iron. Most of the minerals and protein are concentrated in a thin layer beneath the skin, and skin itself is a source of food fiber. Bangladesh has a significant agro-ecological potential of growing potato. 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^{-1} in USA,42.1 t ha^{-1} in Denmark and 40.0 t ha^{-1} in UK (FAO, 2009). Storage problem is also a serious problem in Bangladesh. In tropical and subtropical areas like Bangladesh it is difficult to produce seed tubers of potato due to lack of appropriate storage facilities and transport, as well as the presence of viral diseases (Omidi *et al*., 2003).

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. 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. Through constant evaluation of the traits, varietal performance and considerations of other characteristics, about 10 HYV have been released for cultivation in the country. However, the Bangladesh Agricultural Development Corporation (BADC) is working for distribution seed among farmers and imports huge amount of potato seeds every year in this regard. ‘‘Diamant’’ a variety from Holland with oval to oblong shape, pale yellow tubers, smooth skin and shallow eyes is quite disease resistant.

Potato is grown during the winter season when rainfall is scarce and irrigation becomes essential for providing sufficient moisture to the growing crop. Irrigation facilities are not uniform in all the regions of Bangladesh due to costly establishment of pumps and due to downfall of underground water layer. To minimize the cultivation cost, mulching could be effectively used instead of irrigation. Different kinds of mulches play important role in conserving soil moisture. Soil temperature is important for potato production, which is influenced by mulch. Artificial mulch such as crop residues, plant species, or polyethylene sheet is generally practiced for production of horticultural crops (Wilhoit *et al*., 1990). Mulching can have an effect on the external quality of tubers (scab of tubers, mechanical damages, greening of potato tubers) and inner quality (chemical composition) as well. From inner quality point of view, potatoes are mainly valued for its starch, reducing sugar, non-reducing sugar, polyphenol, vitamin C content and specially for the high content of vitamin C (Asghari-Zakaria *et al*., 2009). Sometimes potato produced in Bangladesh is not of good quality enough in respect of dry matter content, starch content, non-reducing sugar content etc. which are not present at optimum level in produced

product (Keijbets, 2008). So using different mulch materials may put contribution for improving quality of potato in Bangladesh condition.

Potato is a perishable commodity and three variables determine storage losses in potatoes: i) quality of the tuber at the beginning of the storage, ii) storage conditions and iii) duration of storage (Barton *et al*., 1989). 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 Berga 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 evident that uses of mulching to different varieties in the crop field is very important variable in potato production and storage can effect potato in great extent also. However, in developing the cultivars, much emphasis was given to productivity and late blight tolerance while less emphasis was given to processing quality. To meet the demand for suitable cultivars for processing, there is an urgent need to evaluate the suitability of the already released cultivars. Moreover, there is hardly information available on the influence of the storage length on the postharvest quality of ware potato stored under ambient conditions. Depending on the above discussion, a research was undertaken to find out the effect of mulching on the yield and quality of potato varieties in ambient storage condition with the following objectives:

1) To study the effect of different mulch materials on yield and quality of potato.
2) To compare the different physical characteristics and sugar contents of the potato tuber with different mulch materials at the ambient storage condition.
3) To find out superior potato variety/s for processing purpose.

CHAPTER II

REVIEW OF LITERATURE

Mulching practices 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. Many research works have been conducted on the effect of different mulches with different varieties of potato on the growth, yield, storage and quality of potato in various parts of the world. Some of the important research reports regarding potato cultivar, yield, storage and quality have been reviewed here in this chapter.

2.1 Influence of variety on yield and quality of potato

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

Cota and Hadzic (2013) conducted a two-year experiment included four potato varieties (Desire, Romano, Bistra and Kis Sora). 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 Kis Sora. 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.

Schwarz and Geisel (2012) reported that storage problems most often occured 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.

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.

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 chlorophyll. Correlations between first class yield and total yield as well as total yield and tuber number per plant were highly significant.

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.

Storability of tubers obtained from 9 hybrid True Potato Seed (TPS) progenies were compared with that of non-TPS cultivar ‘‘Diamant’’ under ambient conditions (22.0-34.8°C 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’’ (Roy *et al*., 2006). 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 (32.5t ha^{-1}) 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^{-1}. Variety Ailsa produced the maximum yield (46.67 t ha^{-1}) which was followed by Cardinal (42.21 t ha^{-1}).

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); 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).

Madalageri (1999) studies on tuber uniformity and storage behaviour of 7 TPS progenies (hybrids and open pollinated progenies) in comparison with tuber planted cultivars revealed that the TPS progenies were as good as those of tuber planted crops in respect of physiological loss in weight, and frequency and weight of rotten and sprouted tubers after 3 months of storage under ambient conditions. However, only hybrid populations HPS I/13, HPS II/13 and TPS-C-3 had comparable scores with the tuber planted standard varieties in respect of tuber uniformity. The produce from open pollinated TPS families

recorded significantly lower uniformity scores than their counterpart hybrid populations or the tuber planted standard varieties.

Rasul *et al*. (1997) studied storage behavior of some exotic, recommended and advanced lines of potato were studied in 1991 at RARS, Jessore by storing their tubers in netted wooden box under natural condition. Much variation was observed among the varieties/lines for all the characters studied. Percent weight loss was higher in exotic varieties (12.89-35.52%). Cent percent sprouting was earlier in recommended varieties/lines (96 days) than of exotic ones (118.7 days). On an average, tubers shrank earlier in existing varieties per lines than first generation materials. Rottage of tubers by bacterial soft rot (*Erwinia* sp) during storage varied from 31.3 to 36.8%. Recommended varieties Kufri, Sindhuri, Cardinal, Multa, advanced lines P-93 and first generation varieties viz. Granoloa, Modial, Producent and Vital performed the best on the basis of studied storage characteristics.

Van Ittersum *et al*. (1993) reported that replanting soon after their harvest gave low yield because of dormancy and low growth vigor. In the research reported in this paper, we investigated the advancing effect of a haulm application of gibberellic acid (750 g GA ha^{-1}) 6 days before haulm pulling and its interaction with storage temperature regimes on the growth vigor of immaturely harvested seed tubers of three cultivars. The effect on tuber yield was also examined in one experiment. The storage regimes were: 18°C continuously, hot pre-treatments of different duration (different periods at 28°C and subsequently 18°C) and a cold pre-treatment (20 days at 20°C and subsequently 18°C). Both a foliar spray with GA and storage at 28°C enhanced physiological aging of the tubers and greatly advanced the growth vigor, without negative effects on the

morphology of the plants. At early planting, the effect of the treatments on tuber yield were small for 'Diamant' (short dormancy), but strongly positive for Desiree and Draga (long dormancy).

Hossain *et al*. (1992) reported that the maximum tuber weight loss was (31.15%) recorded in the check variety Cardinal. In case of indigenous varieties, Jalpai lost maximum weight (19.16%) and Shilbilati lost the minimum (9.15%). The authors also reported that sprouting of tubers was started after 83 days in indigenous cultivars, while Cardinal sprouted first after 54 days of storage. In case of indigenous varieties, Bograi sprouted first after 70 days and Hagrai was most delayed (97 days).

Hossain and Rashid (1991) studied storage quality of three sizes of tubers of eight TPS progenies against standard variety Cardinal for 120 days after harvest (April to July) under natural storage condition. Weight loss of tubers due to transpiration and respiration was 23.93% in TPS progenies and 11.95% in Cardinal with average monthly loss of 5.98% and 2.99%, respectively. Small size tubers were found to suffer most from dehydration. *Erwinia* sp. and *Fusarium* sp. have been identified to cause rotting of tubers in storage. The incidence of soft rot and dry rot were 33.40% and 34.15%, respectively. No rot was observed in Cardinal during the period of study. Maximum potato loss was recorded in large size tubers. Tubers of the TPS progenies sprouted earlier than Cardinal. Maximum number of sprouts per tubers and length of the longest sprout were recorded in TPS progenies. Tubers of TPS progenies shriveled earlier than Cardinal.

Usually, in Bangladesh, storage of potato starts during the month of March when both temperature and humidity rise up sharply which accelerates both physiological activities of tubers responsible for its deterioration and activities of the organisms responsible for

various storage diseases. It has been reported (Anon., 1989) that the local varieties have a long period of dormancy and both and seed potatoes cm be stored at home without much physiological deterioration until the next planting season.

Sowa and Kuzniewicz (1989) studied the causes of loss during potato storage and indicated that the main causes of storage losses were respiration, evaporation and storage rot. In that study, storability was largely a varietal trait, although environmental conditions during both growth and storage were also important. Storage losses were lowest in the clone Clamp (4.4%) which increased with increasing temperature in the store (about 9%). Overall storage losses ranged from 9.4% in Janka to 32.5% in Sasanka. Storage losses due to rots ranged from 0.8% in Azalia to 22.69% in Sasanka.

Anonymous (1989) observed that during storage period sprouting of tubers is an important evaluatary character of varieties. As soon as sprouting starts, the tubers rapidly loss its quality. Unfortunately, the potato tubers cannot store for more than 4 to 5 months without much deterioration of quality under ordinary storage conditions. Exotic varieties sprouted earlier than the local ones. Sprouting in local varieties was first to observed after 102 days. It was also observed that the average dormancy period was higher in local varies (95 days) than the exotic varieties (83 days).

Lisinska and Leszezynski (1989) stated that all the losses observed during potato storage, in respective of storage methods could be divided into two groups. Quantitative losses included weight losses of tubers due to vital process of tubers (respiration, evaporation, sprouting) and those resulting from parasites and pathogenic micro flora. The extent of such losses, apart from varietal properties is affected by the maturity and wholesomeness of tubers as well as internal condition of storage house. Quantitative losses are more

difficult to detect since they do not reveal any decrease in the weight of tubers. They include quantitative losses of specific components but total content of dry matter not change significantly. Obviously, the difference between two groups of losses has only theoretical significance.

Picha (1986) stated that no sprouting was found when cured sweet potatoes were stored at 15.6°C and 90% RH for up to a year. The total weight loss of six cultivars was estimated. Transpiration played vital role for weight loss. Respiration contributed more total weight loss during the later period of storage than first month in storage.

In Korea Republic sweet potatoes cv. Hongmi, Eunmi, Hwangmi and Sinmi were stored in man-made cave (0-15°C, 15-75% RH) or a store house (15-18°C, 80-85% RH). After a period of three months in the cave storage, tuber decomposition was less for sweet potatoes stored in the middle of the cave than for those stored at the entrance. Decomposition became the highest at cave than in the storehouse (Lee *et al*., 1985).

During the year 1980-81 the storage performance of some exotic and local cultivars of sweet potato was studied at the Bangladesh Agricultural University Farm. Among the cultivars studied, the storage ability of the cultivars ACC-6, TIS-3032, TIS-3247, AIS-230 and AIS-243-2 was quite good. New 10 and TIS 3032 showed the long dormancy period (Hossain *et al*., 1984).

The indigenous potato varieties showed a capability to store well and have a general popularity for taste (Ahmad and Kader, 1981). They observed that when stored under non-refrigerated conditions, the indigenous varieties showed a longer dormancy and stored better.

Storage life of potato tubers mainly depends on temperature and humidity which influence evaporation, respiration, sprout growth and ultimately weight loss of tubers. Low temperature and high humidity in storage results gave minimum loss. The local varieties are liked by the farmers, keep well under ordinary room condition and possess a high market value (Khan *et al*., 1981). Theses varieties show differences in certain characteristics which are very important in connection with market value and local popularity.

Ahmad (1979) reported that the farmers of the north-west part of Bangladesh use local varieties of potato instead of high yielding exotic varieties only because they had a longer dormancy and keeping quality even under ordinary storage.

2.1 Influence of mulch on yield and quality of potato

Azad *et al*. (2015) conducted a research in order to determine the effect of mulch on some characteristics of potato. The experimental treatments consisted of mulch in five levels (clear mulch, white mulch, black mulch, double layer mulch and control, without mulch) and cultivar in two levels (Agria and Sante). The effect of mulch on the fresh and dry weight of weed was significant, so that the black and double layer mulches had greatest impact on reducing the fresh and dry weight of weed, respectively. As compared to control, clear mulch treatments could reduce the period of tuber formation by 6.33 days. Double layer mulches showed the highest number of stolons at 60-day after planting. In comparison to the control, mulch could reduce the days to harvest, while the clear (104.83 days), double layer (105 days), and white (105.16 days) mulches all had significant differences when compared to the control (108.16 days). Cultivar Sante and

double layer mulch also had the greatest impact on early potato crop. Mulch was not, however, seen to have significant effect on yield per plant.

Begum and Saikia (2014) conducted a field experiment to find the effect of six levels of irrigation under mulch and no mulch condition. The results indicated that irrigation applied at critical stages significantly recorded highest tuber yield (18.03 t ha-1). However irrigation applied at 25 mm CPE recorded significantly the highest yield of both B grade (25-50 g) and C grade (50-75 g) tubers. Both B and C grades has higher market price and mostly preferred by people than A grade and D grade size tubers. Likewise, application of mulch significantly 24.04% higher yield over non mulch condition. Besides this, mulching also significantly increased the yield of B grade and C grade tubers along with tuber numbers as compared to no mulch condition. But there was no significant increase in yield in both A grade and D grade tubers was observed due to application of irrigation and mulch.

Caruso *et al*. (2013) carried out a research on potato (*Solanum tuberosum* L.) growing in the field in order to evaluate the effects of two mulching treatments (black biodegradable film and bare soil) and six plant densities (12.5, 10.0, 8.3, 7.1, 6.2 and, as a control, 5.3 plants per m^2) on growth, yield and quality of "new potato" winter-spring and summer-autumn crops. Only in the case of the summer-autumn crop cycle, mulching resulted in a higher yield, plant dry matter and leaf area compared with the bare soil control, while in both crop cycles this latter treatment induced a delay in harvest. The winter-spring cycle gave a higher production of 40-70 mm tubers, while the summer-autumn cycle resulted in a higher vitamin C content.

Razzaquea and Alib (2009) carried out an experiment during rabi season of 1999-2000 to 2000-2001 with five recommended potato varieties viz. Heera, Dhera, 'Diamant', Chamak and Cardinal along with two types of mulching materials viz rice straw and water hyacinth to find out suitable variety and mulching material(s) for obtaining higher yield under no tillage condition. Heera produced highest yield under both rice straw (19.45 t ha^{-1}) and water hyacinth (23.15 t ha^{-1}) mulch. Rest of the variety performed more or less similar in both cases. Both Heera and Dhera seemed to be suitable for cultivation in no tillage condition.

Chowdhury *et al*. (2000) conducted a field experiment in the rabi season of 1997-1998 on a clay terrace soil in Salna, Gazipur, Bangladesh, to study the effect of rice straw mulching and irrigation on the yield total water use and water use efficiency of an indigenous low yielding cultivar of potato, Lalpakri. Irrigation is indispensable in the rabi season of Bangladesh and the yield was significantly lowest in the treatment of no irrigation after seedlings establishment. Rice straw mulch conserved soil moisture and maintained a higher moisture regime in each irrigation level through the cropping period. The treatments of rice straw mulching and the single irrigation at 30 days after sowing were the best combination with a satisfactory high yield. Bhuyan (2003) conducted a field experiment at the Horticulture Farm of Bangladesh Agricultural University, Mymensingh during the period from November 2002 to March 2003 to investigate the effect of mulching, variety and crop management practices on growth and yield of potato. The experiment was conducted with four mulching treatments, (no mulch no irrigation, irrigation, saw dust and straw mulch); two varieties ('Diamant'' and 'Cardinal') and use of organic manure without pesticides application). Mulching treatments showed

significant effect on most of the yield and yield components. The highest yield (21.31 t ha^{-1}) was obtained from straw mulch followed by sawdust (19.47 t ha^{-1}), irrigation treatment (19.06 t ha^{-1}) and no mulch no irrigation treatment (15.29 t ha^{-1}). The variety also caused significant variations on most of the parameters. The variety 'Diamant' gave the higher yields (19.07 t ha^{-1}) and compare to Cardinal (18.51 t ha^{-1}) yield.

Collins (1997) reported that transparent black polythene and polythene coated black paper mulches increased soil temperature and advanced emergence of potato. He also reported that transparent black polythene and polythene coated black paper mulches non significantly reduced the yield of potato from bare soil of 46.9 and 48.3 t ha^{-1} and clear polythene mulch.

Khalak and Kumaraswamy (1992) conducted a field trial in 1985- 1987 on red sandy soil at Bangalore, Karantakca. Potatoes cv. Kufri jyoti was irrigated with 20 or 40 mm water and the crop was given no mulch, straw mulch or polythene mulch. Tuber yield and N uptake were the highest in both years with 20mm irrigation water. Mulching with straw and polythene gave average tuber yields of 18.2 and 16.7 t ha^{-1} respectively compared with 14.3 t ha^{-1} without mulching. Jalil (1995) conducted an experiment at the Horticulture farm, Bangladesh Agricultural University, Mymensingh in order to study effect of mulch on potato. Black polythene mulched potato took minimum time to reach 80% emergence, resulted maximum coverage of area. However, yield was higher with water hyacinth mulch. Lang (1984) reported that the percentage of potato tuber production >6 cm diameter was higher under polythene mulch. Polythene mulch conserved more moisture in the soil than control (Harris, 1965).

Siddique and Rashid (1990) conducted experiments for 3 seasons (1987/88) to study the

effect of irrigation and mulching on the yield of 3 varieties of potato (Challisha, Lalpakri and Pakri Lalita). Water hyacinth was used for mulching. From the results they found that the varieties responded very well to both irrigation and mulching. Mangaser *et al*. (1986) stated that mulch in potato improved yield and proportion of marketable size tubers compared to no mulch plants. They also reported that potato planting with mulch should be done from the last week of November up to second week of December to obtain the best yield. Polythene mulch conserved more moisture in the soil than control (Harris, 1965). Mulching conserved the soil moisture better in potato cultivation (Prihar, 1986; Devaux and Haverkort, (1987) and Ifenkwe and Tong (1987). Yamaguchi *et al*. (1964) also reported that average minimum temperature fall within the range in bare soil than from clear and black polythene, which delay mergence.

Sarker and Hossain (1989) studied the effect of weeding and mulching on potato cv. Cardinal and reported that the percentage of foliage coverage, which ranged from 40.0 to 65.00, was significantly different among the treatments, the lowest coverage being obtained from the control (no weeding) treatment. Mulching also increased growth of leaf and stem (Kim *et al*. 1988). According to Devaux (1984), mulching reduced the soil temperature due to better ground cover.

Sutater (1987) found an increase in plant height and the number of potato leaf with different mulching treatments. Sarker and Hossain (1989) reported that one weeding just after emergence or mulching by paddy straw appeared optimal for the growth of a good potato crop. In another study, Taja *et al*. (1991) reported that mulching by rice straw with optimum inorganic fertilizer application of 50 kg N/ha were good for canopy coverage of potato.

Manrique and Meyer (1984) found in a study of black and white plastic and various qualities of barley straw as mulches for non-heat tolerant potato variety at Manilla Agricultural Experiment Station, Lima, Peru, that during winter, soil temperature in plastic mulched plots ranged from 18 to 26°C. The condition gave relatively higher tuber yields in most of the varieties. Rashid *et al*. (1981) conducted a trial at Joydebpur, Dhaka on potato cv. Cardinal cultivated with or without ridges, without mulching or mulching with water hyacinth, rice straw, or spike lets (Chitta). Tuber yield was the highest (17.6 t ha^{-1}) when the plants ridged and mulched with water hyacinth. Emergence in the no mulched plots was significantly lower than that of mulched plots. Challaiah and Kulkani (1979) conducted an experiment in potato with irrigation at 13 to 15 days interval in combination with polythene mulch. Polythene mulch gave higher yield (30.64 t ha^{-1}). Bhattacharjee *et al*. (1979) demonstrated that potato yields were higher with straw mulch than that of without mulch on coarse textural soil in Patna, India. Burger and Nel (1984) reported that mulching by straw produced 30% more tubers than the no mulch potato crops. Similarly, Natheny *et al*. (1992) also found that white, pale blue and stripped straw mulch produced more than 15% marketable tubers of potato than the no much control plots. Mulching helps in checking evaporation and thus soil can retain sufficient amount of moisture. Polyethylene film mulches reduce evaporation in vegetable cultivation (Lamont, 1993). In a separate experiment, Bieoral (1970) found that polythene sheets caused a 2% increase in the moisture content of the top 30cm of the soil. Black polythene, sawdust and dried grass mulch in tomato production improved soil moisture retention but black polythene mulch had the best result (Patil and Basad, 1972).

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted at the Agronomy field and laboratory, Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from November, 2014 to June, 2015. 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 Site description

3.1.1 Geographical location

The experimental area was situated at 23°77′ N latitude and 90°33′ E longitude at an altitude of 8.6 meter above the sea level (UNDP - FAO, 1988).

3.1.2 Agro-Ecological Region

The experimental site belongs to the Agro-ecological zone of "The Modhupur Tract", AEZ-28 (Anon., 1988). 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., 1988).

3.1.3 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.

3.1.4 Climate

Experimental site was located in the subtropical monsoon climatic zone, set aparted by winter during the months from November to April (Rabi season). 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 I.

3.2 Details of the Experiment

3.2.1 Treatments

Two sets of treatments included in the experiment were as follows:

Factor A: Potato varieties

1) V_1 = Asterix
2) V_2 = Lady rosetta
3) V_3 = Courage
4) V_4 = Diamant
5) V_5 = BARI TPS-1

Factor B: Mulch materials

1) M_1 = Control
2) M_2 = Water Hyacinth (5 t ha^{-1})
3) M_3 = Rice straw (5 t ha^{-1})
4) M_4 = Rice husk (5 t ha^{-1})

Treatment combinations were as:

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, V_4M_4, V_5M_1, V_5M_2, V_5M_3, V_5M_4.

3.2.2 Planting material

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

1) Asterix
2) Lady rosetta
3) Courage
4) Diamant
5) BARI TPS-1

3.2.3 Experimental design and layout

Experiment was done in Randomized Complete Block Design (RCBD) with three replications and thus the number of plots came to 60. The size of unit plot was 4m × 2.5m where the tubers were planted at 50 cm × 25 cm spacing. The distances between plot to plot and replication to replication were 1 m and .75 m, respectively.

3.3 Crop management

3.3.1 Collection of seed

All variety of seed potato (certified seed) was collected from Bangladesh Agricultural Development Corporation (BADC).

3.3.2 Preparation of seed

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

3.3.3 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 tilt. 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.

3.3.4 Manure and fertilizer application

The crop was fertilized as per recommendation of TCRC (2014). The experimental plot was fertilized with following dose of cowdung, urea, triple super phosphate (TSP), muriate of potash, gypsum, zinc sulphate, magnesium sulphate and boric acid.

Manure and fertilizer		**Doses ha^{-1}**
Cowdung	=	10 t
Urea	=	250 kg
TSP	=	150 kg
MP	=	250 kg
Gypsum	=	120 kg
$ZnSO_4$	=	10 kg
$MgSO_4$	=	100 kg
Boric acid	=	10 kg

Cowdung was applied 10 days before final land preparation. 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.

3.3.5 Planting of seed tuber

The well sprouted healthy and uniform sized potato tubers were planted and 8 potatoes were used for $1m^2$. 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 4-5 cm depth in plot on November 17, 2014.

3.3.6 Intercultural operations

3.3.6.1 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 three times.

3.3.6.2 Weeding and mulching

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

3.3.6.3 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.

3.3.6.4 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.

3.3.6.5 Haulm cutting

Haulm cutting was done at February 15, 2014 at 90 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.

3.3.6.6 Harvesting of potatoes

Harvesting of potato was done at March 8, 2014 at 10 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.

3.4 Recording of data

Experimental data were recorded from 20 DAP and continued until harvest. Dry weights of different plant parts were collected after harvesting. The following data were collected during the experimentation.

1) **Yield parameters**
    i. Yield (t ha^{-1})
    ii. Different grading
    iii. Seed and non-seed potato
    iv. Marketable and non-marketable potato

1) **Processing and storage parameters**

i. Tuber flesh dry matter content (%)

ii. Weight loss (%) at 20, 40 and 60 days after storing (DAS)

iii. Specific gravity at 0, 20, 40 and 60 DAS

iv. Total Soluble Solid (TSS) at 0, 20, 40 and 60 DAS

v. Reducing sugar and non-reducing sugar at 0, 20, 40 and 60 DAS

vi. Skin color at 0, 20, 40 and 60 DAS

vii. Flesh color at 0, 20, 40 and 60 DAS

viii. Firmness (Done by Force Gauge)

3.5 Procedure of recording data

3.5.1 Yield of tuber (t ha^{-1})

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

3.5.2 Grading of tuber (% by number and % by weight)

Tubers harvested from each plot were graded by number and by weight on the basis of diameter into the >55 mm, 45-55 mm, 28-45 mm and <28 mm and converted to percentages. A special type of frame (potato riddle) was used for grading of tuber.

3.5.3 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°C for 72 hours. Dry matter content was calculated as the ratio between dry and fresh weight and expressed as a percentage (Barton, 1989).

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

It was measured by using the following formula –

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

3.5.5 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.

3.5.6 Color measurements

Color was measured with a color spectrophotometer NF333 (Nippon Denshoku, Japan) using the CIE Lab L*, a* and b* color scale. The 'L*'value is the lightness parameter indicating degree of lightness of the sample; it varies from 0 = black (dark) to 100 = white (light). Then a* which is the chromatic redness parameter, whose value means tending to red color when positive (+) and green color when negative (–). The b* is yellowness chromatic parameter corresponding to yellow color when it is positive (+) and blue color when it is negative (–). Each sample consisted of 10 slices, each of which was measured thrice.

3.5.7 Weight loss (%)

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

% WL = (IW-FW)/IW× 100

Where,

%WL = Percent total weight loss

IW = Initial weight of tubers (kg)

FW = Final weight of tubers (kg)

3.5.8 Reducing sugar and non-reducing sugar

Extraction of sugar

For the analysis of sugar content like glucose and sucrose potato flesh was extracted. For each extraction, 1.0 g fresh sample of chopped potato was taken from uniform tuber samples. Sugar was extracted using 5 ml of 80% ethanol heated 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. 8 mL 80% EtOH, was added and it was repeated 4 and 5 for 3 times in total. All the supernatants was mixed well and the final volume was made up to 25 mL using 80% EtOH.

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.

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 Statistical Analysis

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

CHAPTER IV

RESULTS AND DISCUSSION

The effect of variety and mulching practices and their interaction on the quality, yield and storage of potato have been presented and discussed in this chapter under the following headings.

4.1 Yield parameters

4.1.1 Tuber yield (t ha^{-1})

Tuber yield was significantly influenced by different varieties (Fig.1). Results revealed that the highest tuber yield (30.58 t ha^{-1}) was observed from V_4 ('Diamant') which was significantly different from all other variety. The second highest tuber yield (29.68 t ha^{-1}) was achieved by V_2 ('Lady rosetta') which was also significantly different from all other variety yield. On the other hand, the lowest tuber yield (24.09 t ha^{-1}) was found from V_3 ('Courage') which was also statistically different from others. The results obtained from the present study was similar with the findings of Mahmud *et al*. (2009), Haque (2007) and Das (2006).

Significant variation was found for tuber yield influenced by different mulch materials (Fig.2). Results showed that the highest tuber yield (30.45 t ha^{-1}) was observed from M_3 (Rice straw) which was statistically different from all other treatments. Again, the lowest tuber yield (22.49 t ha^{-1}) was found from M_1 (Control) which was also statistically different from all other treatments. Similar results was also found by Azad *et al*. (2015), Caruso *et al*. (2013) and Razzaquea and Alib (2009).

Combined effect of varieties and mulch materials on tuber yield of potato had significant influence (Table 4.1). Results indicated that the highest tuber yield (33.33 t ha^{-1}) was found from V_4M_3 which was statistically similar with V_2M_3 (31.92 t ha^{-1}) and V_4M_2 (32.97 t ha^{-1}) followed by V_1M_2, V_1M_3, V_1M_4, V_2M_2, V_2M_4, V_4M_4 and V_5M_3. On the other hand, the lowest tuber yield (18.34 t ha^{-1}) was found from the treatment combination of V_3M_1 which was statistically similar with V_5M_1 (21.40 t ha^{-1}) followed by the treatment combinations of V_1M_1, V_2M_1, V_3M_4 and V_4M_1.

4.1.2 Number of marketable yield (%)

Percent (%) number of marketable yield was significant influenced by different varieties (Fig.3). Results exposed that the highest % number of marketable yield (82.73%) was observed from V_4 ('Diamant') which was statistically identical with V_2 ('Lady rosetta') (81.04 t ha^{-1}) where the lowest % number of marketable yield (70.90%) was found from V_3 ('Courage') which was statistically different from others. Bejhati *et al*. (2013) showed similar trend of change in yield attributes of potato.

Significant variation was also found for % number of marketable yield influenced by different mulch materials (Fig.4). Results showed that the highest % number of marketable yield (83.06%) was observed from M_3 (Rice straw) which was statistically different from all other treatments. Again, the lowest % number of marketable yield (65.64%) was found from M_1 (Control) which was also statistically different from all other treatments. This result is in agreement with

Uddin (1997), who reported that higher yield produce by the mulching treatment was possibly attributed by the better supply of soil moisture, nutrient and better physical condition at the soil.

Combined effect of varieties and mulch materials on % number of marketable yield of potato had significant influence (Table 4.1). Results indicated that the highest % number of marketable yield (86.82%) was found from V_4M_3 which was statistically identical with V_2M_2, V_2M_3 and V_4M_2 and closely followed by V_1M_3, V_2M_4 and V_4M_4. On the other hand, the lowest % number of marketable yield (56.40%) was found from the treatment combination of V_3M_1 followed by V_5M_1 which was statistically different from all other treatment combinations.

4.1.3 Number of non-marketable yield (%)

Percent (%) number of non-marketable yield was significant influenced by different varieties (Fig.5). Results showed that the highest % number of non-marketable yield (29.10%) was observed from V_3 (‘Courage’) which was statistically different from others, where the lowest % number of non-marketable yield (17.27%) was found from V_4 (‘Diamant’) which was statistically identical with V_2 (‘Lady rosetta’). Mondol (2004) showed that, ‘Diamant’ gives relatively lower non-ware tuber than other varieties.

Significant variation was also found for % number of non-marketable yield influenced by different mulch materials (Fig.6). Results showed that the highest %

number of non-marketable yield (34.36%) was observed from M_1 (Control) which was statistically different from all other treatments. Again, the lowest % number of non-marketable yield (16.94%) was found from M_3 (Rice straw) which was also statistically different from all other treatments. Caruso *et al*. (2013) showed similar pattern of mulch effect on potato tuber.

Combined effect of varieties and mulch materials on % number of non-marketable yield of potato had significant influence (Table 4.1). Results indicated that the highest % number of non-marketable yield (43.60%) was found from V_3M_1 which was significantly different from all other treatment combination. On the other hand, the lowest % number of non-marketable yield (13.18%) was found from the treatment combination of V_4M_3 which was statistically identical with V_4M_2 and closely followed by V_2M_3 which were statistically different from all other treatment combinations.

4.1.4 Marketable yield (t ha^{-1})

Marketable yield t ha^{-1} was significantly influenced by different varieties (Fig.7). Results revealed that the highest marketable yield (26.27 t ha^{-1}) was observed from V_4 (‘Diamant’) which was significantly different from all other variety. The second highest marketable yield (24.77 t ha^{-1}) was achieved by V_2 (‘Lady rosetta’) which was also significantly different from all other variety yield. Again, the lowest marketable yield (17.76 t ha^{-1}) was found from V_3 (‘Courage’) which was

also statistically different from others. Bejhati *et al*. (2013) showed similar trend of change in yield attributes of potato.

Significant variation was found for marketable yield influenced by different mulch materials (Fig.8). Results showed that the highest marketable yield (25.90 t ha^{-1}) was observed from M_3 (Rice straw) which was statistically different from all other treatments. Again, the lowest marketable yield (15.29 t ha^{-1}) was found from M_1 (Control) which was also statistically different from all other treatments. Caruso *et al*. (2013) showed similar pattern of mulch effect on potato. Uddin (1997), who reported that higher yield produce by the mulching treatment was possibly attributed by the better supply of soil moisture, nutrient and better physical condition at the soil.

Combined effect of varieties and mulch materials on marketable yield of potato had significant influence (Table 4.1). Results indicated that the highest marketable yield (29.86 t ha^{-1}) was found from V_4M_3 which was statistically identical with V_4M_2 (29.45 t ha^{-1}) followed by V_2M_2, V_2M_3 and V_4M_4. On the other hand, the lowest marketable yield (10.56 t ha^{-1}) was found from the treatment combination of V_3M_1 which was statistically different from all other treatment combinations followed by V_2M_1, V_1M_1 and V_5M_1.

4.1.5 Non-marketable yield (t ha^{-1})

Non-marketable yield t ha $^{-1}$ was significantly influenced by different varieties (Fig.9). Results revealed that the highest non-marketable yield (6.33 t ha^{-1}) was observed from V_3 ('Courage') which was significantly different from all other variety. Again, the lowest non-marketable yield (4.31 t ha^{-1}) was found from V_4 ('Diamant') which was also statistically different from others. Mondol (2004) showed that, 'Diamant' gives relatively lower non-ware tuber than other varieties.

Significant variation was found for non-marketable yield influenced by different mulch materials (Fig.9). Results showed that the highest non-marketable yield (7.20 t ha^{-1}) was observed from M_1 (Control) which was statistically different from all other treatments. Again, the lowest non-marketable yield (4.55 t ha^{-1}) was found from M_3 (Rice straw) which was also statistically identical with M_2 (Water Hyacinth). Caruso *et al*. (2013) showed similar pattern of mulch effect on potato tuber.

Combined effect of varieties and mulch materials on non-marketable yield of potato had significant influence (Table 4.1). Results indicated that the highest weight of non-marketable yield (8.04 t ha^{-1}) was found from V_5M_1 which was statistically identical with V_3M_1 (7.78 t ha^{-1}) and closely followed by V_1M_1 and also significantly different from all other treatments. On the other hand, the lowest non-marketable yield (3.47 t ha^{-1}) was found from the treatment combination of V_4M_3 which was statistically identical with V_4M_2 which were also significantly

different from all other treatment combinations. Caruso *et al*. (2013) showed similar pattern of mulch effect on potato.

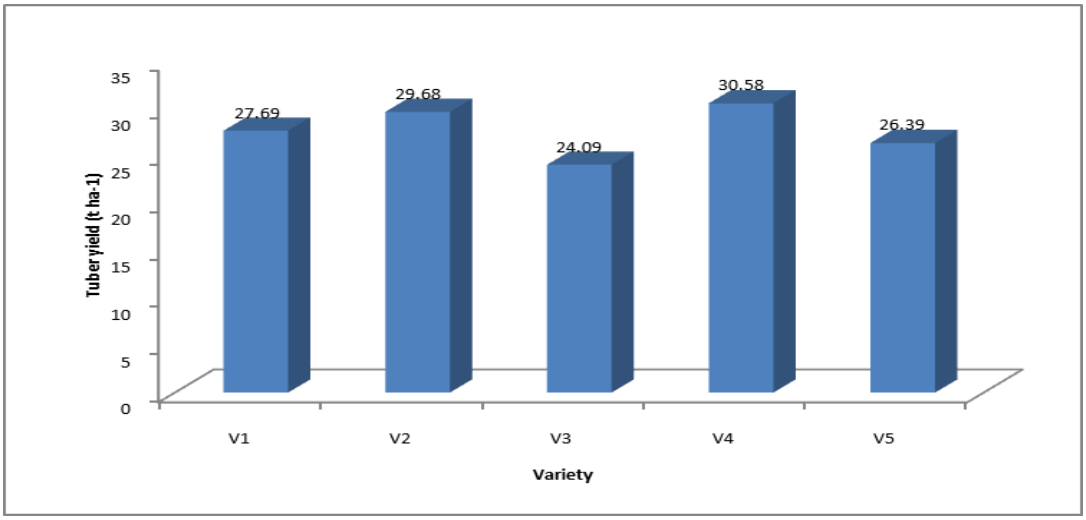


Fig. 1. Tuber yield (t ha^{-1}) of potato as influenced by different varieties (LSD value .857)

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

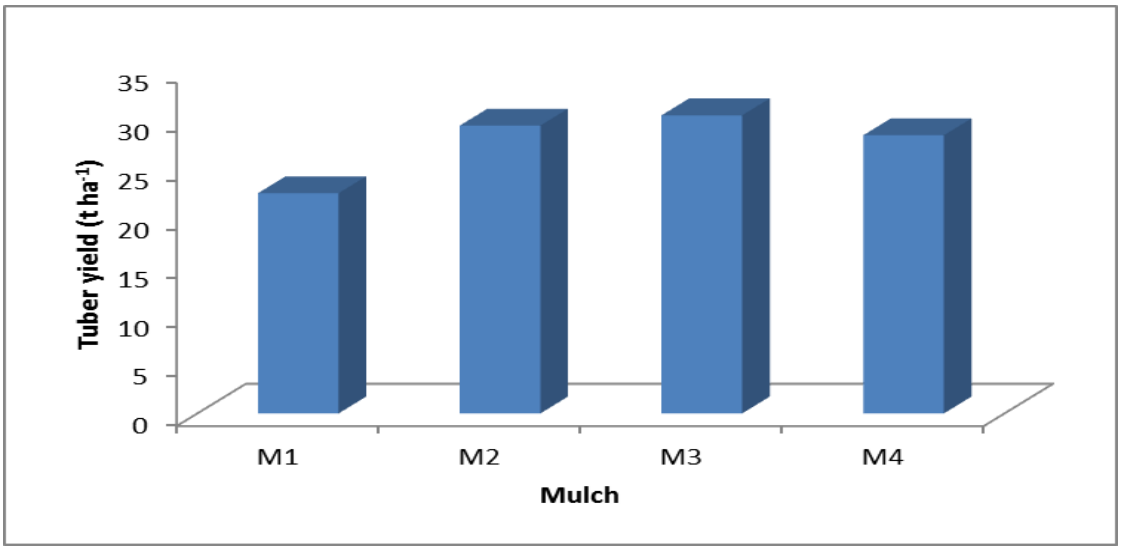


Fig. 2. Tuber yield (t ha^{-1}) of potato as influenced by different mulch materials (LSD value .916)

M_1 = Control
M_3 = Rice straw
M_2 = Water Hyacinth
M_4 = Rice husk

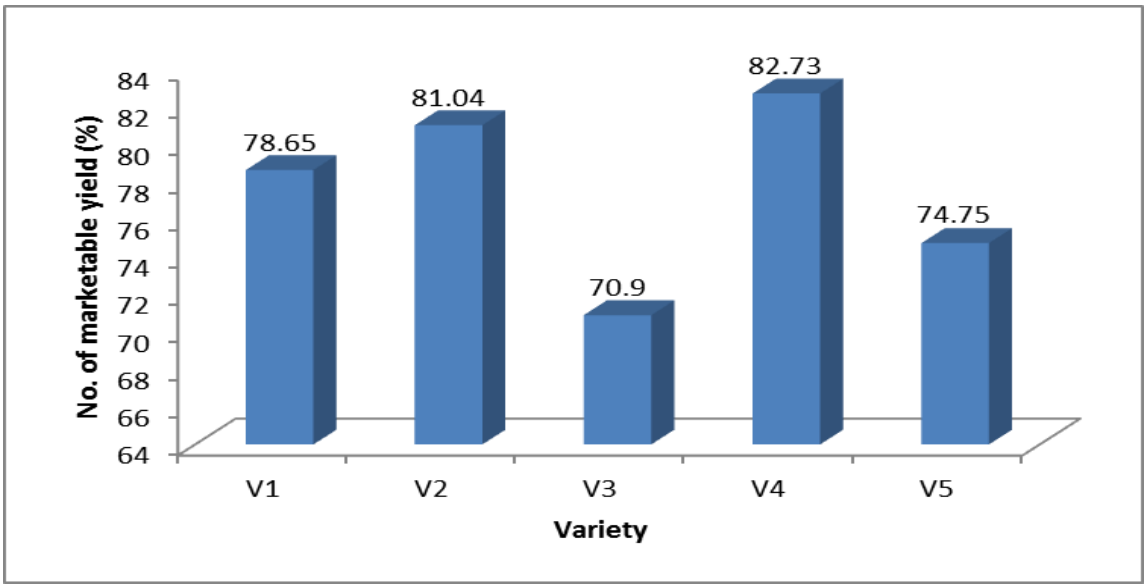


Fig. 3. Number of marketable yield (%) of potato as influenced by different varieties (LSD value 1.812)

V_1 = Asterix V_4 = Diamant

V_2 = Lady rosetta V_5 = BARI TPS-1

V_3 = Courage

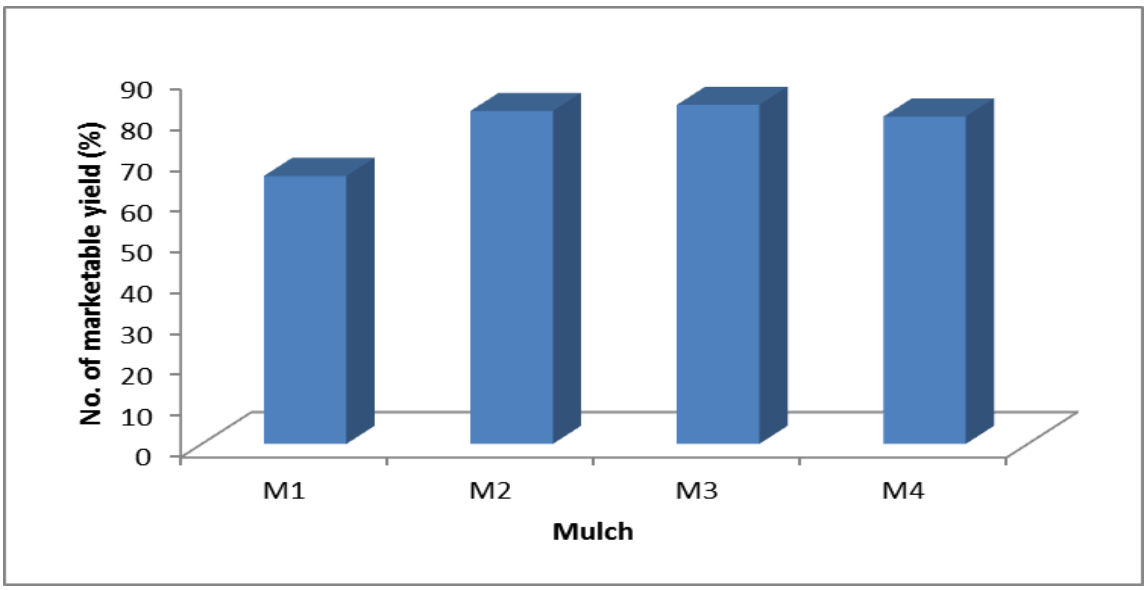


Fig. 4. Number of marketable yield (%) of potato as influenced by different mulch materials (LSD value 2.017)

M_1 = Control M_2 = Water Hyacinth

M_3 = Rice straw M_4 = Rice husk

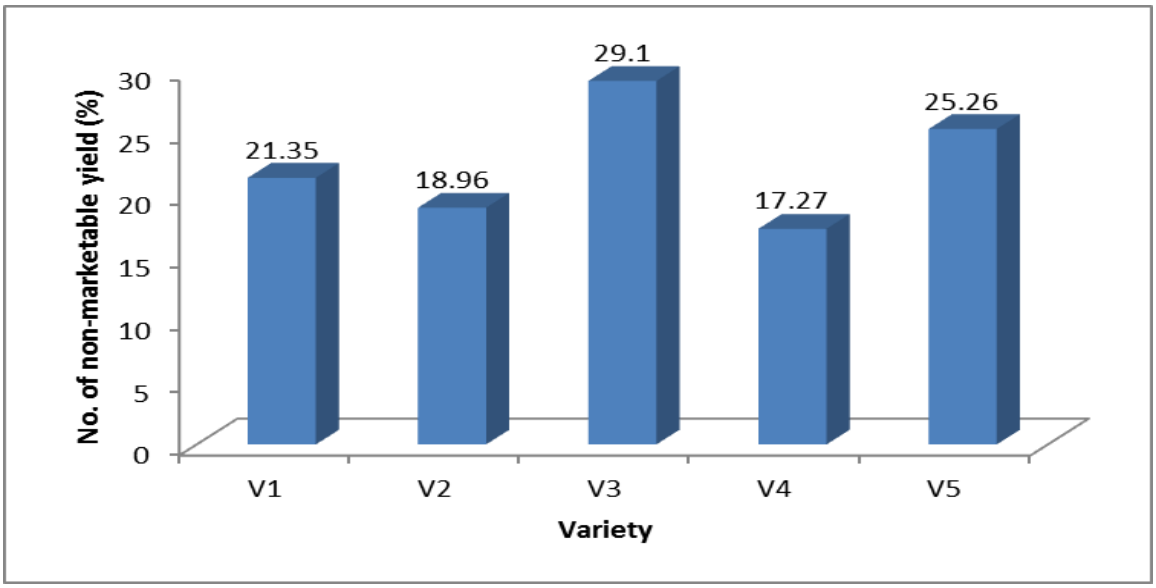


Fig.5. Number of non-marketable yield (%) of potato as influenced by different varieties (LSD value 1.751)

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

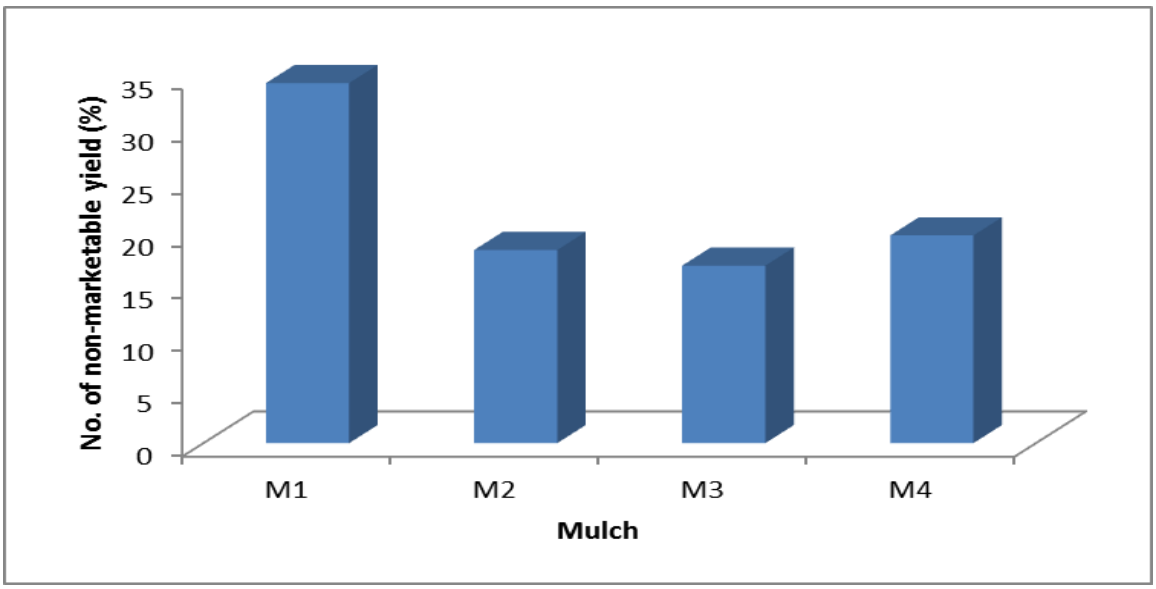


Fig. 6. Number of non-marketable yield (%) of potato as influenced by different mulch materials (LSD value 1.427)

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

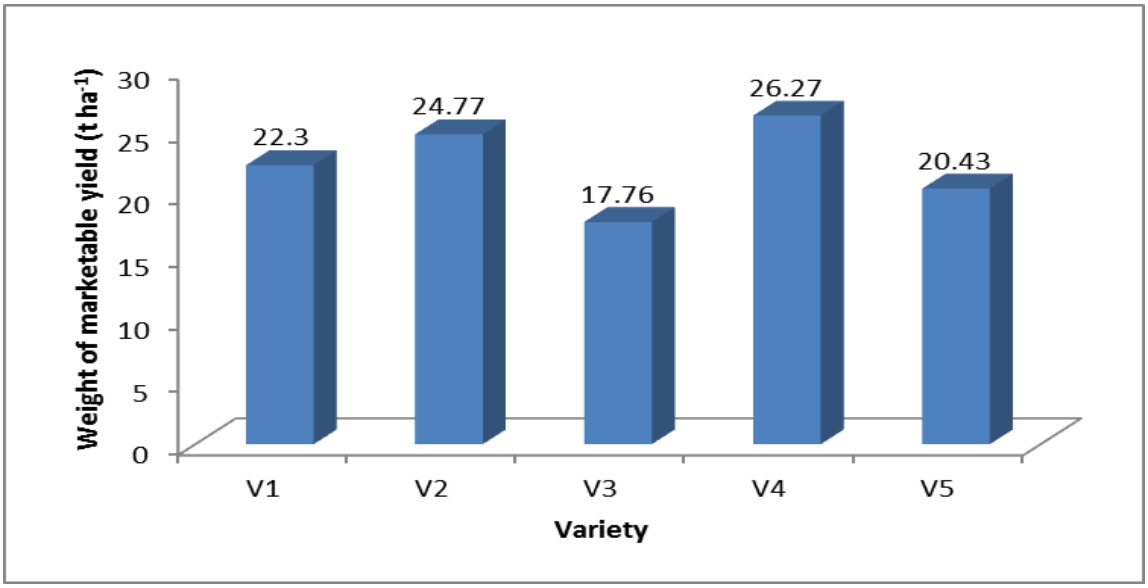


Fig. 7. Marketable yield (t ha^{-1}) of potato as influenced by different varieties (LSD value .669)

V_1 = Asterix V_4 = Diamant
V_2= Lady rosetta V_5 = BARI TPS-1
V_3 = Courage

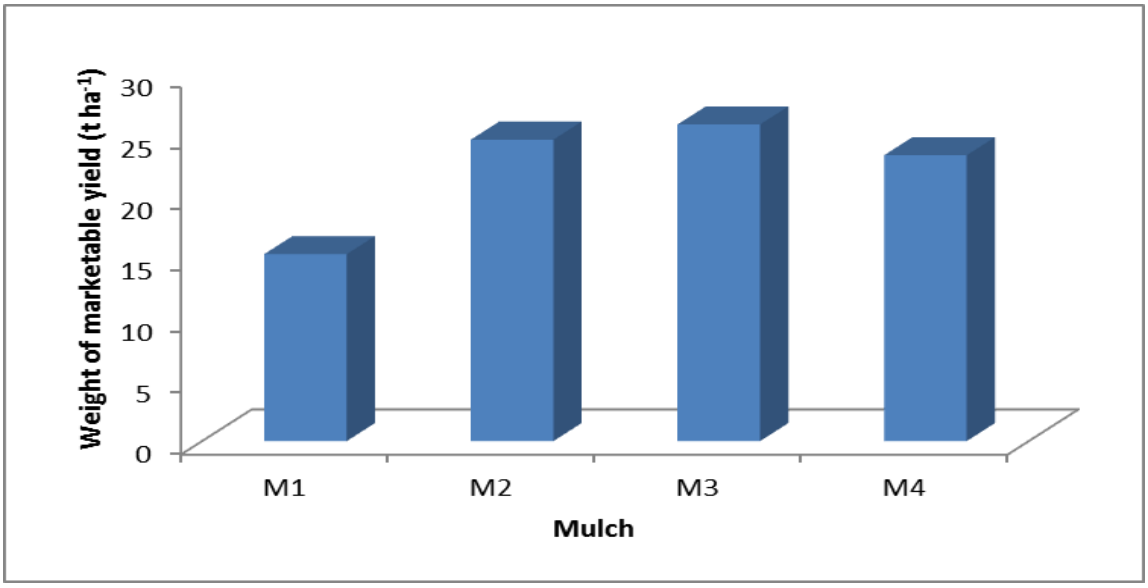


Fig. 8. Marketable yield (t ha^{-1}) of potato as influenced by different mulch materials (LSD value .544)

M_1 = Control M_2 = Water Hyacinth
M_3 = Rice straw M_4 = Rice husk

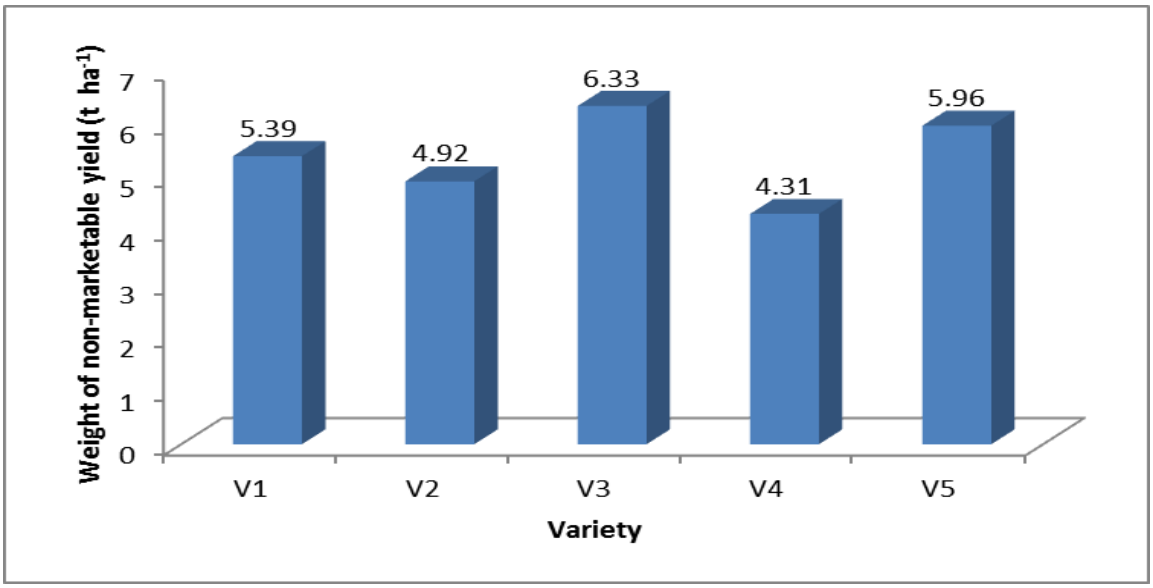


Fig. 9. Non-marketable yield (t ha^{-1}) of potato as influenced by different varieties (LSD value .237)

V_1 = Asterix V_4 = Diamant
V_2= Lady rosetta V_5 = BARI TPS-1
V_3 = Courage

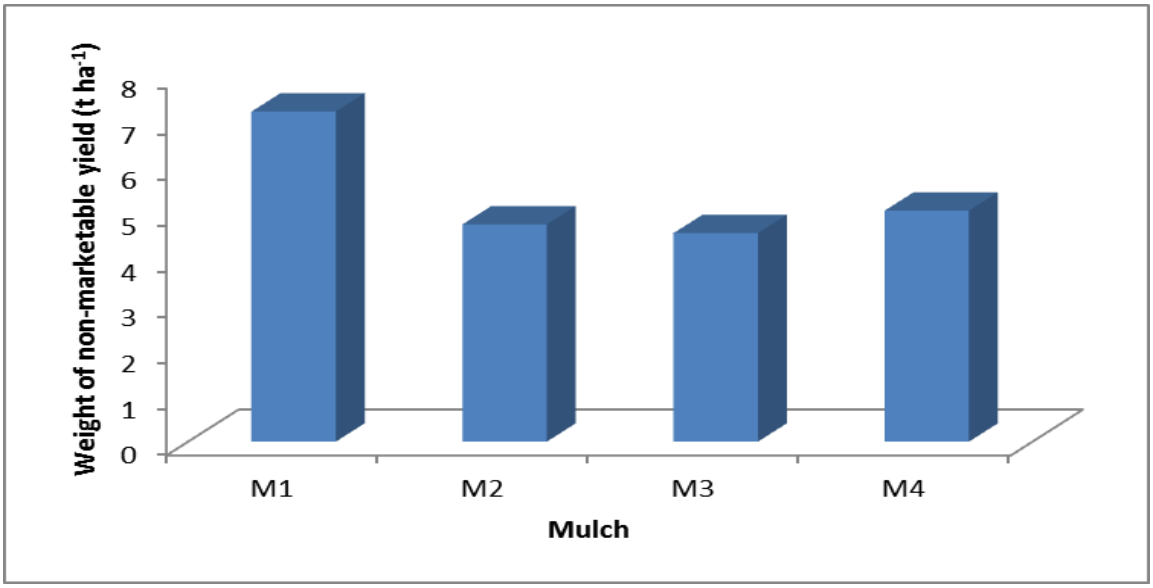


Fig. 10. Non-marketable yield (t ha^{-1}) of potato as influenced by different mulch materials (LSD value .226)

M_1 = Control M_2 = Water Hyacinth
M_3 = Rice straw M_4 = Rice husk

Table 4.1 Combined effect of varieties and mulch materials on yield of potato

Treatment	Yield parameters				
	Tuber yield (t ha^{-1})	Number of marketable yield (%)	Number of non-marketable yield (%)	Marketable yield (t ha^{-1})	Non-marketable yield (t ha^{-1})
V_1M_1	23.44 e-g	67.58 i	32.42 c	16.30 m	7.14 a-b
V_1M_2	28.70 a-e	81.74 c	18.26 i	23.73 g	4.97 e
V_1M_3	30.28 a-d	83.62 a-b	16.38 j	25.68 e	4.60 e
V_1M_4	28.35 a-e	81.66 c	18.34 i	23.49 g	4.86 e
V_2M_1	24.48 d-g	70.18 h	29.82 d	17.60 *l*	6.88 b
V_2M_2	31.30 a-c	85.04 a	14.96 j-k	27.26 b	4.04 f
V_2M_3	31.92 a-b	85.18 a	14.82 j-l	27.87 b	4.05 f
V_2M_4	31.03 a-d	83.77 a-b	16.23 j	26.33 c-d	4.70 e
V_3M_1	18.34 g	56.40 k	43.60 a	10.56 o	7.78 a
V_3M_2	26.53 b-f	75.34 f	24.66 f	20.49 i-j	6.04 b
V_3M_3	26.61 b-f	77.73 e	22.27 g	21.11 i	5.50 c
V_3M_4	24.88 c-g	74.14 g	25.86 e	18.89 k	5.99 b-c
V_4M_1	24.77 c-g	73.33 g	26.67 e	18.63 k	6.14 b
V_4M_2	32.97 a-b	86.50 a	13.50 *l*	29.45 a	3.52 g
V_4M_3	33.33 a	86.82 a	13.18 *l*	29.86 a	3.47 g
V_4M_4	31.26 a-c	84.27 a-b	15.73 j	27.14 b	4.12 e-f
V_5M_1	21.40 f-g	60.71 j	39.29 b	13.36 n	8.04 a
V_5M_2	27.50 a-f	79.25 d	20.75 h	22.38 h	5.12 c-d
V_5M_3	30.11 a-d	81.97 c	18.03 i	24.96 f	5.15 c-d
V_5M_4	26.55 b-f	77.05 e	22.95 g	21.03 i	5.52 c
$LSD_{0.05}$	6.61	1.781	1.341	0.762	0.901
CV(%)	10.62	10.49	8.364	7.312	8.316

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.2 Grading parameters of potato

4.2.1 Number of seed potato (%)

Percent (%) number of seed potato was significantly influenced by different varieties (Table 4.2.1). Results showed that the highest % number of seed potato (84.05%) was observed from V_4 ('Diamant') which was significantly different from all other test varieties where the lowest % number of seed potato (70.72%) was found from V_3 ('Courage') which was statistically different from others. Similar results was also observed by Hossain (2011) and Guler (2009).

Significant variation was also found for % number of seed potato influenced by different mulch materials (Table 4.2.1). Results showed that the highest % number of seed potato (84.14%) was observed from M_3 (Rice straw) which was statistically different from all other treatments. Again, the lowest % number of seed potato (67.44%) was found from M_1 (Control) which was also statistically different from all other treatments. Similar results were also found by Begum and Saikia (2014).

Combined effect of varieties and mulch materials on % number of seed potato had significant influenced (Table 4.2.2). Results indicated that the highest % number of seed potato (89.96%) was found from V_4M_3 which was statistically identical with V_4M_2. On the other hand, the lowest % number of seed potato (54.44%) was found from the treatment combination of V_3M_1 which was statistically different from all other treatment combinations.

4.2.2 Seed potato yield (t ha^{-1})

Seed potato yield t ha^{-1} was significantly influenced by different varieties (Table 4.2.1). Results revealed that the highest weight of seed potato (25.52 t ha^{-1}) was observed from V_4 ('Diamant') which was statistically identical with V_2 ('Lady rosetta'). Again, the lowest seed potato yield (16.84 t ha^{-1}) was found from V_3 ('Courage') which was statistically different from others. Similar results was also observed by Hossain (2011) and Guler (2009).

Significant variation was found for seed potato yield influenced by different mulch materials (Table 4.2.1). Results showed that the highest seed potato yield (25.24 t ha^{-1}) was observed from M_3 (Rice straw) which was statistically different from all other treatments. Again, the lowest seed potato yield (14.80 t ha^{-1}) was found from M_1 (Control) which was also statistically different from all other treatments. Similar results were also found by Begum and Saikia (2014).

Combined effect of varieties and mulch materials on seed potato yield had significant influence (Table 4.2.2). Results indicated that the highest seed potato yield (29.55 t ha^{-1}) was found from V_4M_3 followed by V_4M_2 which was statistically different from all other treatment combination. On the other hand, the lowest seed potato yield (9.84 t ha^{-1}) was found from the treatment combination of V_3M_1 which was statistically different from all other treatment combinations.

4.2.3 Number of french-fry potato (%)

Percent (%) number of french-fry potato was significantly influenced by different varieties (Table 4.2.1). Results exposed that the highest % number of french-fry potato

(0.33%) was observed from V_4 ('Diamant') which was significantly different from other test varieties where V_1 ('Asterix'), V_3 ('Courage') and V_5 ('BARI TPS-1') showed no french-fry potato. Walter *et al*. (1997) observed similar varieties in their five variety experiment in sweet potatoes.

Significant variation was also found for % number of french-fry potato influenced by different mulch materials (Table 4.2.1). Results showed that the highest % number of french-fry potato (0.27%) followed by M_2 (Water Hyacinth) where M_1 (Control) and M_4 (Rice husk) showed no french-fry potato.

Combined effect of variety and mulching practices on % number of french-fry potato had significant influence (Table 4.2.2). Results indicated that the highest % number of french-fry potato (1.00%) was found from V_4M_3 followed by V_2M_3 and V_4M_2 where the rest of the treatment combination showed no french-fry yield.

4.2.4 Weight of french-fry potato (t ha^{-1})

Weight of french-fry potato t ha^{-1} was significantly influenced by different varieties (Table 4.2.1). Results revealed that the highest weight of french-fry potato (0.10 t ha^{-1}) was observed from V_4 ('Diamant') followed by V_2 ('Lady rosetta') which was significantly different from all other variety where V_1 ('Asterix'), V_3 ('Courage') and V_5 ('BARI TPS-1') showed no french-fry potato.

Significant variation was found for weight of french-fry potato influenced by different mulch materials (Table 4.2.1). Results showed that the highest weight of french-fry potato (0.08 t ha^{-1}) was observed from M_3 (Rice straw) followed by M_2 (Water Hyacinth) where M_1 (Control) and M_4 (Rice husk) showed no french-fry yield of potato.

Combined effect of varieties and mulch materials on weight of french-fry potato had significant influence (Table 4.2.2). Results indicated that the highest weight of french-fry potato (0.30 t ha^{-1}) was found from V_4M_3 followed by V_4M_2 and V_2M_3 where the rest of the treatment combination showed no french-fry yield.

4.2.5 Number of chips potato (%)

Percent (%) number of chips potato was significant influenced by different varieties (Table 4.2.1). Results exposed that the highest % number of chips potato (14.26%) was observed from V_3 ('Courage') which was which was significantly different from all other test varieties where the lowest % number of chips potato (8.25%) was found from V_4 ('Diamant') which was statistically different from others. Zelalem *et al*. (2009) a significant increase in total and >55mm size tuber yield occurred only from the selective variety.

Significant variation was also found for % number of chips potato influenced by different mulch materials (Table 4.2.1). Results showed that the highest % number of chips potato (15.43%) was observed from M_1 (Control) which was statistically different from all other treatments. Again, the lowest % number of chips potato (8.18%) was found from M_3 (Rice straw) which was also statistically different from all other treatments. Mangaser *et al.* (1986) showed that, mulch improve the tuber size of potato.

Combined effect of varieties and mulch materials on % number of chips potato had significant influenced (Table 4.2.2). Results indicated that the highest % number of chips potato (17.94%) was found from V_3M_1 followed by V_1M_1 and V_5M_1 where the lowest %

number of chips potato (3.18%) was found from the treatment combination of V_4M_3 which was statistically different from all other treatment combinations.

4.2.6 Weight of chips potato (t ha^{-1})

Weight of chips potato t ha^{-1} was significantly influenced by different varieties (Table 4.2.1). Results revealed that the highest weight of chips potato (3.33 t ha^{-1}) was observed from V_3 ('Courage') which was statistically identical with V_5 ('BARI TPS-1'). Again, the lowest weight of chips potato (2.35 t ha^{-1}) was found from V_4 ('Diamant') which was also statistically different from other varieties. Zewide *et al*. (2012) observed, similar result in their experiment.

Significant variation was found for weight of chips potato influenced by different mulch materials (Table 4.2.1).Results showed that the highest weight of chips potato(3.39 t ha^{-1}) was observed from M_1 (Control) which was statistically different from all other treatments. Again, the lowest weight of chips potato (2.37 t ha^{-1}) was found from M_3 (Rice straw) which was also statistically different from all other treatments. Lang (1984) observed similar trend with polythene mulch.

Combined effect of varieties and mulch materials on weight of chips potato had significant influenced (Table 4.2.2). Results indicated that the highest weight of chips potato (3.85 t ha^{-1}) was found from V_1M_1 followed by V_3M_3 and V_5M_2. On the other hand, the lowest weight of chips potato (1.01 t ha^{-1}) was found from the treatment combination of V_4M_3 which was statistically different from all other treatment combinations.

4.2.7 Number of non-seed potato (%)

Percent (%) number of non-seed potato was significant influenced by different varieties (Table 4.2.1). Results exposed that the highest % number of non-seed potato (29.28%) was observed from V_3 ('Courage') which was significantly different from all other test varieties where the lowest % number of non-seed potato (15.95%) was found from V_4 ('Diamant') which was statistically different from others. According to Anonymous (2005), 'Diamant' showed similar result over Granola.

Significant variation was also found for % number of non-seed potato influenced by different mulch materials (Table 4.2.1). Results showed that the highest % number of non-seed potato (32.56%) was observed from M_1 (Control) which was statistically different from all other treatments. Again, the lowest % number of non-seed potato (15.86%) was found from M_3 (Rice straw) which was also statistically different from all other treatments. Razzaquea and Alib (2009) showed similar result while working with five potato varieties.

Combined effect of varieties and mulch materials on % number of non-seed potato had significant influenced (Table 4.2.2). Results indicated that the highest % number of non-seed potato (45.56%) was found from V_3M_1 followed by V_1M_1, V_2M_1 and V_5M_4. On the other hand, the lowest % number of non-seed potato (10.04%) was found from the treatment combination of V_4M_3 followed by V_2M_3 and V_4M_2 which were statistically different from all other treatment combinations.

4.2.8 Non- seed potato yield (t ha^{-1})

Non-seed potato (t $ha^{-1)}$ was significantly influenced by different varieties (Table 4.2.1). Results revealed that the highest non-seed potato yield (7.25 t ha^{-1}) was observed from V_3 ('Courage') which was significantly different from all other variety. Again, the lowest non-seed potato yield (5.06 t ha^{-1}) was found from V_4 ('Diamant') which was also statistically different from others. According to Anonymous (2005), 'Diamant' showed similar result over Granola.

Significant variation was found for non-seed potato yield influenced by different mulch materials (Table 4.2.1).Results showed that the highest non-seed potato yield (7.69 t ha^{-1}) was observed from M_1 (Control) which was statistically different from all other treatments where the lowest non-seed potato yield (5.21 t ha^{-1}) was found from M_3 (Rice straw) which was statistically identical with M_4 (Rice husk). Razzaquea and Alib (2009) showed similar result while working with five potato varieties.

Combined effect of varieties and mulch materials on non-seed potato yield had significant influenced (Table 4.2.2). Results indicated that the highest non-seed potato yield (8.50 t ha^{-1}) was found from V_3M_1 which was statistically identical with V_1M_1 followed by V_2M_1, V_1M_2 and V_4M_1. On the other hand, the lowest non-seed potato yield (3.78 t ha^{-1}) was found from the treatment combination of V_4M_3 followed by V_4M_2 and V_1M_4 which were statistically different from all other treatment combinations.

Table 4.2.1 Single effect of varieties and mulch materials on grading of potato

Treatment	Grading of potato							
	% number of seed potato	Seed potato yield(t ha^{-1})	% number of french-fry potato	Weight of French fry potato (t ha^{-1})	% Number of chips potato	Weight of chips potato (t ha^{-1})	% Number of non-seed potato	Non-seed potato yield(t ha^{-1})
Effect of variety								
V_1	75.65 c	21.32 b	0.00 c	0.00 c	11.10 c	2.94 b	24.35 b	6.37 b
V_2	81.37 b	24.06 a	0.08 b	0.03 b	9.76 d	2.79 b	18.63 c	5.62 c
V_3	70.72 d	16.84 d	0.00 c	0.00 c	14.26 a	3.33 a	29.28 a	7.25 a
V_4	84.05 a	25.52 a	0.33 a	0.10 a	8.25 e	2.35 c	15.95 d	5.06 d
V_5	76.26 c	19.82 c	0.00 c	0.00 c	12.72 b	3.23 a	23.74 b	6.58 b
$LSD_{0.05}$	1.201	1.512	0.124	0.243	1.014	0.344	1.326	0.256
CV(%)	11.43	10.87	12.79	8.08	12.51	10.77	6.52	9.34
Effect of mulching								
M_1	67.44 c	14.80 c	0.00 c	0.00 c	15.43 a	3.39 a	32.56 a	7.69 a
M_2	79.66 b	23.20 b	0.07 b	0.02 b	10.78 b	3.08 b	20.34 b	6.20 b
M_3	84.14 a	25.24 a	0.27 a	0.08 a	8.18 c	2.37 d	15.86 c	5.21 c
M_4	79.20 b	22.82 b	0.00 c	0.00 c	10.48 b	2.86 c	20.80 b	5.60 c
$LSD_{0.05}$	1.146	1.116	0.114	0.041	1.171	0.294	1.267	0.441
CV(%)	11.43	10.87	12.79	8.08	12.51	10.77	6.52	9.34

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

Table 4.2.2 Combined effect of varieties and mulch materials on grading of potato

Treatment	Grading of potato							
	% number of seed potato	Seed potato yield (t ha^{-1})	% number of French fry potato	Weight of French fry potato (t ha^{-1})	% Number of chips potato	Weight of chips potato (t ha^{-1})	% Number of non-seed potato	Non-seed potato yield(t ha^{-1})
V_1M_1	67.72 j	15.28 k	0.00 c	0.00 c	16.59 b	3.85 a	32.28 b	8.16 a
V_1M_2	75.19 f	21.26 f	0.00 c	0.00 c	10.22 e	2.90 f	24.81 f	7.44 b
V_1M_3	84.22 c	24.99 d	0.00 c	0.00 c	7.66 h	2.23 h	15.78 k	5.29 g
V_1M_4	75.48 f	23.76 e	0.00 c	0.00 c	9.92 f	2.78 f	24.52 g	4.59 h
V_2M_1	70.04 i	16.73 j	0.00 c	0.00 c	13.10 c	3.17 d	29.96 c	7.75 b
V_2M_2	84.46 c	26.34 c	0.00 c	0.00 c	8.24 g	2.53 g	15.54 k	4.96 g
V_2M_3	86.07 b	27.17 b	0.33 b	0.10 b	9.16 f	2.87 f	13.93 m	4.75 g-h
V_2M_4	84.92 c	26.00 c	0.00 c	0.00 c	8.54 g	2.57 g	15.08 *l*	5.03 g
V_3M_1	54.44 k	9.84 m	0.00 c	0.00 c	17.94 a	3.28 d	45.56 a	8.50 a
V_3M_2	75.49 f	19.40 h	0.00 c	0.00 c	12.83 d	3.35 c	24.51 g	7.13 c
V_3M_3	78.64 e	20.18 g	0.00 c	0.00 c	13.92 c	3.67 b	21.36 i	6.43 d-e
V_3M_4	74.31 f-g	17.95 i	0.00 c	0.00 c	12.34 d	3.02 e	25.69 e	6.93 c
V_4M_1	73.20 g-h	17.42 i	0.00 c	0.00 c	13.22 c	3.22 d	26.80 d	7.35 b
V_4M_2	88.06 a	28.83 b	0.33 b	0.10 b	8.86 g	2.88 f	11.94 n	4.14 i
V_4M_3	89.96 a	29.55 a	1.00 a	0.30 a	3.18 j	1.01 j	10.04 o	3.78 j
V_4M_4	84.98 c	26.29 c	0.00 c	0.00 c	7.75 h	2.27 h	15.02 *l*	4.97 g
V_5M_1	71.80 i	14.71 *l*	0.00 c	0.00 c	16.32 b	3.45 c	28.20 c	6.69 d
V_5M_2	75.10 f	20.17 g	0.00 c	0.00 c	13.76 c	3.73 b	24.90 f	7.33 b-c
V_5M_3	81.83 d	24.30 d	0.00 c	0.00 c	6.96 i	2.06 i	18.17 j	5.81 f
V_5M_4	76.31	20.08 g	0.00 c	0.00 c	13.85 c	3.66 b	23.69 h	6.47 d-e
$LSD_{0.05}$	1.145	0.763	0.070	0.061	0.814	0.183	0.261	0.401
CV(%)	11.43	10.87	12.79	8.08	12.51	10.77	6.52	9.34

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.3 Dry matter content (%)

Percent (%) dry matter content was significant influenced by different test varieties at different days after harvest (DAS) (Fig.11). Results signified that the highest % dry matter content (23.74, 22.8, 20.94 and 18.09 at 0, 20, 40 and 60 DAS, respectively) was observed from V_2 ('Lady rosetta') which was significantly different from all other varietal performance where the lowest % dry matter content (21.30, 20.40, 18.77 and 16.06 at 0, 20, 40 and 60 DAS, respectively) was found from V_4 ('Diamant') which was significantly identical with V_5 ('BARI TPS-1') at 0 and 40 DAS. Rainys and Rudokus (2005), observed similar result in their experiment in Lithuania.

Significant variation on % dry matter content of potato at different days after storing by different mulch materials was found under the present study (Fig.12). Results demonstrated that the highest % dry matter content 23.33, 22.42, 20.68 and 17.94 at 0, 20, 40 and 60 DAS, respectively) was observed from M_3 (Rice straw) which was closely followed by M_2 (Water Hyacinth) at all DAS but statistically different from all other treatments. Again, the lowest % dry matter content (20.63, 19.73, 18.05 and 15.38 at 0, 20, 40 and 60 DAS, respectively) was found from M_1 (Control) which was also significantly different from all other treatments. Caruso *et al.* (2013) also observed, mulch material improve dry matter % in potato.

Combined effect of variety and mulching practices on % dry matter content of potato had also significant influence at different DAS (Table 4.3). Results revealed that the highest % dry matter content 25.14, 24.18, 22.22 and 19.26 at 0, 20, 40 and 60 DAS, respectively) was found from V_2M_3 which was closely followed by V_2M_2 at all duration after storing hut significantly different from all other treatment combinations. On the other hand, the lowest % dry matter content at 0, 20, 40 and 60 DAS (20.32, 19.4, 17.7 and 15, respectively) was found from the treatment combination of V_4M_1 followed by V_1M_1, V_2M_1 and V_4M_4 at different DAS but significantly different from all other treatment combinations.

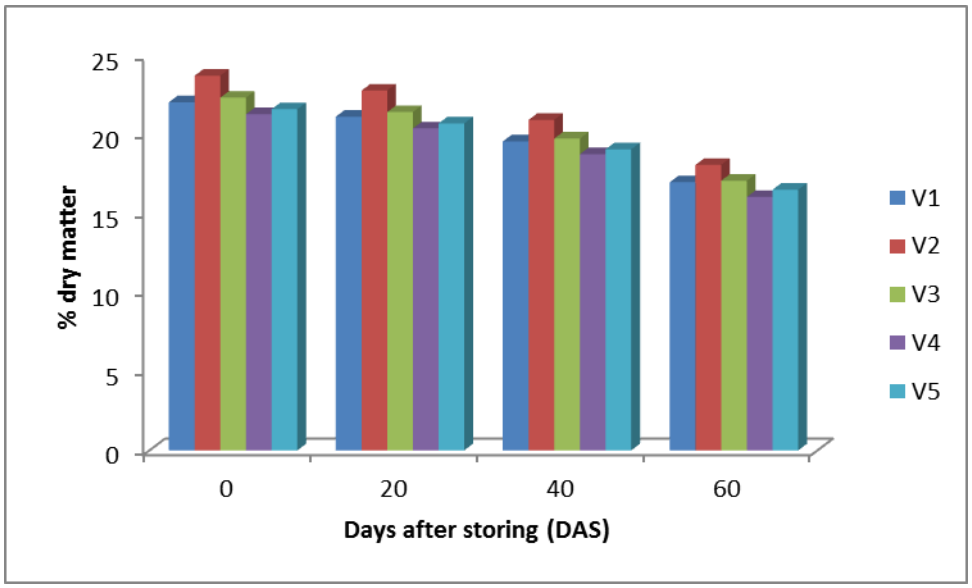


Fig. 11. Dry matter content (%) of potato as influenced by different varieties in ambient condition (LSD value .877, .8932, .8541 and .8985 at 0, 20, 40 and 60 DAS respectively)

V_1 = Asterix
V_2= Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

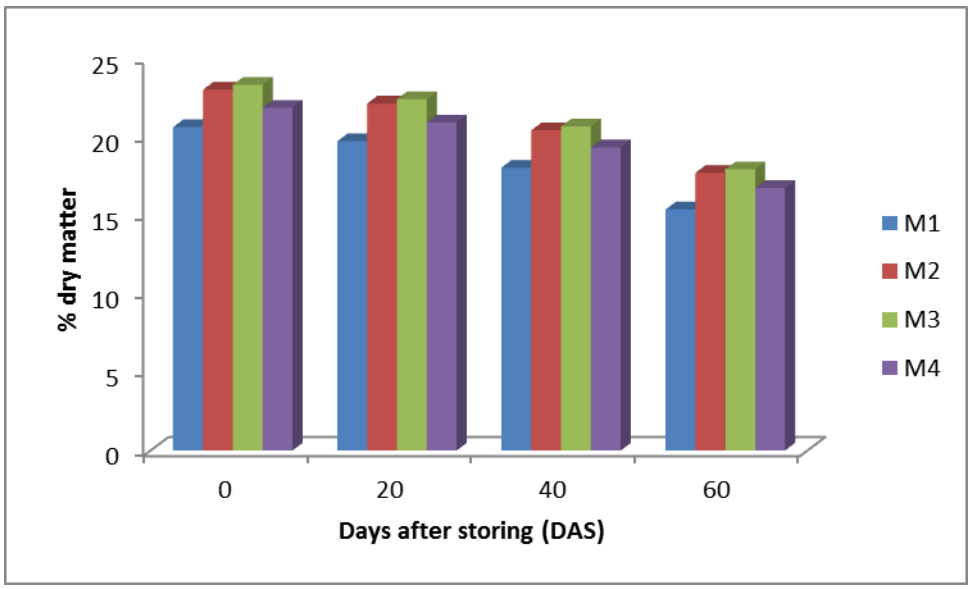


Fig.12. Dry matter content (%) of potato as influenced by different mulch materials in ambient condition (LSD value .8185, .7567, .7458 and .1.067 at 0, 20, 40 and 60 DAS, respectively)

M1 = Control
M3 = Rice straw
M2 = Water Hyacinth
M4 = Rice husk

Table 4.3 Combined effect of varieties and mulch materials on dry matter content (%) of potato under varying storage period

Treatment	% Dry matter			
	0 DAS	**20 DAS**	**40 DAS**	**60 DAS**
V_1M_1	20.67 j	19.78 j	18.13 j-k	15.46 g-h
V_1M_2	22.87 e-f	22.02 c-d-e	20.53 d-e	18.00 c
V_1M_3	23.18 d-e	22.26 c-d	20.63 d-e	18.01 c
V_1M_4	21.53 h-i	20.55 h-i	19.01 g-h-i	16.47 e
V_2M_1	20.88 i-j	19.98 i-j	18.22 j-k	15.50 g-h
V_2M_2	24.78 a-b	23.86 a	21.93 a-b	19.00 a-b
V_2M_3	25.14 a	24.18 a	22.22 a	19.26 a
V_2M_4	24.15 b-c	23.19 b	21.39 b-c	18.59 b-c
V_3M_1	20.76 j	19.90 i-j	18.18 j-k	15.48 g-h
V_3M_2	23.24 d-e	22.33 c-d	20.67 d	18.04 c
V_3M_3	23.60 c-d	22.66 b-c	21.00 c-d	18.34 b-c
V_3M_4	21.80 g-h	20.86 g-h	19.18 g-h	16.50 e
V_4M_1	20.32 j	19.40 j	17.70 k	15.00 h
V_4M_2	21.80 g-h	20.98 g-h	19.46 f-g	16.61 d-e
V_4M_3	22.18 f-g-h	21.24 f-g	19.54 f-g	16.84 d-e
V_4M_4	20.91 i-j	19.99 i-j	18.39 i-j-k	15.79 f-g
V_5M_1	20.53 j	19.58 j	18.04 k	15.46 g-h
V_5M_2	22.40 f-g	21.49 e-f-g	19.55 f-g	16.94 d-e
V_5M_3	22.57 e-f	21.74 d-e-f	19.99 e-f	17.24 d
V_5M_4	20.97 i-j	20.08 i-j	18.75 h-i-j	16.42 e-f
$LSD_{0.05}$	0.6465	0.6073	0.6207	0.6465
CV(%)	8.667	6.794	9.335	7.283

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.4 Specific gravity

Specific gravity of different potato varieties was not significantly influenced at different days after harvest (DAS) (Table 4.4.1). But results indicated that numerically the highest specific gravity (1.16, 1.15, 1.086 and 1.068 at 0, 20, 40 and 60 DAS, respectively) was observed from V_2 ('Lady rosetta') and the lowest specific gravity (1.072, 1.053, 1.050 and 1.045 at 0, 20, 40 and 60 DAS, respectively) was found from V_4 ('Diamant'). The results obtained from the present study was conformity with the findings of Abebe (2013) and Kumar *et al*. (2005).

Different mulch materials had also non-significant effect on specific gravity of potato at different days after harvest (Table 4.4.1). But results showed that the highest specific gravity (1.144, 1.115, 1.080 and 1.063 at 0, 20, 40 and 60 DAS, respectively) was observed from M_3 (Rice straw) where the lowest specific gravity (1.056, 1.047, 1.043 and 1.038 at 0, 20, 40 and 60 DAS, respectively) was found from M_1 (Control). Doring *et al*. (2005) observed, tuber crop having mulch materials show better result over no mulch.

Specific gravity was not also significantly influenced by combined effect of variety and mulching practices at different DAS (Table 4.4.2). But results indicated that the highest specific gravity (1.343, 1.238, 1.125 and 1.080 at 0, 20, 40 and 60 DAS, respectively) was found from V_2M_3 where the lowest specific gravity (1.043, 1.034, 1.030 and 1.025 at 0, 20, 40 and 60 DAS, respectively) was found from the treatment combination of V_4M_1.

Table 4.4.1 Single effect of varieties and mulch materials on specific gravity of potato under varying storage period

Treatment	Specific gravity			
	0 DAS	20 DAS	40 DAS	60 DAS
Effect of variety				
V_1	1.081	1.064	1.060	1.053
V_2	1.160	1.150	1.086	1.068
V_3	1.086	1.069	1.065	1.055
V_4	1.072	1.053	1.050	1.045
V_5	1.077	1.058	1.054	1.049
$LSD_{0.05}$	NS	NS	NS	NS
CV(%)	3.226	3.217	2.493	4.129
Effect of mulching				
M_1	1.056	1.047	1.043	1.038
M_2	1.096	1.090	1.070	1.061
M_3	1.144	1.115	1.080	1.063
M_4	1.083	1.063	1.058	1.054
$LSD_{0.05}$	NS	NS	NS	NS
CV(%)	3.226	4.129	3.217	2.493

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

NS-Non significance

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

Table 4.4.2 Combined effect of varieties and mulch materials on specific gravity of potato under varying storage period

Treatment	Specific gravity			
	0 DAS	20 DAS	40 DAS	60 DAS
V_1M_1	1.059	1.050	1.044	1.040
V_1M_2	1.092	1.071	1.070	1.060
V_1M_3	1.094	1.074	1.070	1.060
V_1M_4	1.079	1.060	1.054	1.052
V_2M_1	1.064	1.053	1.051	1.049
V_2M_2	1.119	1.174	1.087	1.080
V_2M_3	1.343	1.283	1.125	1.080
V_2M_4	1.112	1.089	1.080	1.063
V_3M_1	1.063	1.053	1.051	1.043
V_3M_2	1.095	1.080	1.073	1.060
V_3M_3	1.102	1.084	1.080	1.062
V_3M_4	1.082	1.060	1.054	1.053
V_4M_1	1.043	1.034	1.030	1.025
V_4M_2	1.084	1.061	1.057	1.053
V_4M_3	1.089	1.063	1.060	1.053
V_4M_4	1.072	1.053	1.051	1.050
V_5M_1	1.052	1.043	1.037	1.033
V_5M_2	1.090	1.063	1.062	1.053
V_5M_3	1.092	1.071	1.063	1.060
V_5M_4	1.072	1.054	1.053	1.050
$LSD_{0.05}$	NS	NS	NS	NS
CV(%)	3.226	3.217	2.493	4.129

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

NS-Non significance

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.5 Skin color

4.5.1 Color skin L*

Significant variation was found in terms of color skin L* at different days after harvest (DAS) influenced by different test varieties (Table 4.5.1). Results revealed that the highest color skin L* (60.95, 61.71, 61.76 and 61.38 at 0, 20, 40 and 60 DAS, respectively) was observed from V_5 ('BARI TPS-1') which was significantly different from all other varieties. Again, the lowest color skin L* (54.46, 51.92, 54.51 and 56.15 at 0, 20, 40 and 60 DAS, respectively) was found from V_3 ('Courage') which was also different from all other test varieties. Walter *et al*. (1997) observed similar results in experimenting physical characters of potato varieties.

Different mulch materials had also significant variation in case of color skin L* at different days after harvest (Table 4.5.1). Results revealed that the highest color skin L* (58.96, 57.13, 58.68 and 59.13 at 0, 20, 40 and 60 DAS, respectively) was observed from M_2 (Water Hyacinth) which was statistically identical with M_1 (Control) at 60 DAS but significantly different from all other mulch materials. Again, the lowest color skin L*(57.77, 55.75, 58.00 and 57.27 at 0, 20, 40 and 60 DAS, respectively) was found from M_4 (Rice husk) which was statistically identical with M_3 (Rice straw) at 0, 20, 40 and 60 DAS.

Color skin L* of potato was also significantly influenced by combined effect of varieties and mulch materials (Table 4.5.2). Results indicated that the highest color skin L* value (62.35, 63.11, 63.16 and 65.05 at 0, 20, 40 and 60 DAS, respectively) was achieved by the combined effect of V_5M_4 which was statistically similar with V_4M_2 , V_5M_2, V_5M_3 treatment combination. Again, the lowest color skin L* value (52.93, 49.35, 53.72 and

53.99 at 0, 20, 40 and 60 DAS, respectively) was found from the treatment combination of V_3M_4 which was closely followed by V_1M_1 and V_3M_3 at 60 DAS but significantly different from all other treatment combinations.

4.5.2 Color skin a*

Significant influence was found for color skin a* at different days after harvest (DAS) influenced by different test varieties (Table 4.5.1). Results revealed that the highest color skin a* (7.85, 20.11, 8.81 and 16.05 at 0, 20, 40 and 60 DAS, respectively) was observed from V_3 ('Courage') which was significantly different from all other varieties except V_2 ('Lady rosetta') at 60 DAS. Again, the lowest color skin a* (4.49, 6.54, 6.21 and 7.79 at 0, 20, 40 and 60 DAS, respectively) was found from V_5 ('BARI TPS-1') which significantly similar to V_4 ('Diamant'). Walter *et al*. (1997) observed similar results in experimenting physical characters of potato varieties.

Different mulch materials had also significant variation in case of color skin a* at different days after harvest (Table 4.5.1). Results revealed that at initial stage (0 DAS) the highest color skin a* (6.53) was found from M_1 (Control) which was significantly similar with M_2 (Water Hyacinth) and M_3 (Rice straw) but at 20, 40 and 60 DAS, respectively the highest color skin a* (16.65, 7.74 and 13.14, respectively) was observed from M_3 (Rice straw) which was statistically identical with M_4 (Rice husk) at 20, 40 and 60 DAS. Again, the lowest color skin a* at initial stage (6.16) was found from M_4 (Rice husk) but at 20, 40 and 60 DAS, respectively the lowest color skin a* (14.99, 6.99 and 11.08, respectively) was observed from M_4 (Rice husk) which was significantly similar to water hyacinth and rice straw.

Color skin a* of potato was also significantly influenced by combined effect of varieties and mulch materials (Table 4.5.2). Results indicated that the highest color skin a* value (8.60) at initial stage (0 DAS) was found from V_3M_1 which was closely followed by V_3M_3 and the lowest color skin a* value (2.85) at initial stage (0 DAS) was found from V_5M_4. But at 20, 40 and 60 DAS the highest color skin a* (22.64, 9.72 and 19.50, respectively) was achieved by the treatment combination of V_3M_3 which was significantly different from all other treatment combination. Again, the lowest color skin a* at 20, 40 and 60 DAS (5.82, 5.45 and 6.48, respectively) was found from the treatment combination of V_5M_2 which was significantly different from all other treatment combinations.

4.5.3 Color skin b*

Significant variation was found for color skin b* at different days after harvest (DAS) influenced by different test varieties (Table 4.5.1). Results revealed that the highest color skin b* (20.79, 21.56, 20.63 and 20.03 at 0, 20, 40 and 60 DAS, respectively) was observed from V_5 ('BARI TPS-1') which was significantly different from all other varieties. Again, the lowest color skin b* (11.32, 8.46, 12.24 and 10.01 at 0, 20, 40 and 60 DAS, respectively) was found from V_2 ('Lady rosetta') which was closely followed by V_3 ('Courage') at 20 and 60 DAS but significantly different from all other test varieties. Walter *et al*. (1997) observed similar results in experimenting physical characters of potato varieties.

Different mulch materials had also significant variation in case of color skin b* at different days after harvest (Table 4.5.1). Results revealed that at initial stage (0 DAS)

the highest color skin b* (16.26) was found from M_4 (Rice husk) but at 20, 40 and 60 DAS respectively the highest color skin b* (14.14, 17.01 and 14.57, respectively) was observed from M_1 (Control) which was significantly different from all other treatments. Again, the lowest color skin b* at initial stage (13.87) was found from M_3 (Rice straw) but at 20, 40 and 60 DAS respectively the lowest color skin b* (11.92, 15.44 and 13.55, respectively) was observed from M_2 (Water Hyacinth) which was closely followed by M_4 (Rice husk) at 60 DAS but significantly different from all other treatments.

Color skin b* of potato was also significantly varied by combined effect of variety and mulching practices (Table 4.5.2). Results indicated that the highest color skin b* value (22.66) at initial stage (0 DAS) was found from V_5M_4 and the lowest color skin b* value (10.31) at initial stage (0 DAS) was found from V_2M_3 followed by V_3M_4 and V_2M_4. But at 20, 40 and 60 DAS the highest color skin b* (23.38, 21.42 and 23.47, respectively) was achieved by the treatment combination of V_5M_1 which was significantly different from all other treatment combination. Again, the lowest color skin b* at 20, 40 and 60 DAS (5.81, 11.55 and 7.50, respectively) was found from the treatment combination of V_2M_2 followed by V_1M_4 and V_2M_1 at 60 DAS but significantly different from all other treatment combinations.

Table 4.5.1. Single effect of varieties and mulch materials on skin color of potato under varying storage period

Treatment	L*				a*				b*			
	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS
Effect of variety												
V_1	58.76 c	54.79 c	57.86 c	57.26 c	7.485 b	15.36 c	8.278 b	12.63 b	13.51 c	10.69 c	14.44 c	12.93 c
V_2	57.26 d	53.22 d	56.78 d	57.98b-c	7.175 c	19.9 a-b	7.587 c	15.45 a	11.32 d	8.462 d	12.24 d	10.01 d
V_3	54.46 e	51.92 e	54.51 e	56.15 d	7.846 a	20.11 a	8.812 a	16.05 a	13.08 c	7.630 d	14.51 c	10.20 d
V_4	59.94 b	59.01 b	60.41 b	58.23 b	4.616 d	18.76 b	6.043 d	9.488 c	17.34 b	16.57 b	19.39 b	17.39 b
V_5	60.95 a	61.71 a	61.76 a	61.38 a	4.488 d	6.535 d	6.241 d	7.287 d	20.79 a	21.56 a	20.63 a	20.03 a
$LSD_{0.05}$	0.9379	1.106	0.8351	0.8298	0.3014	1.256	0.3125	1.136	0.6780	1.215	0.9924	1.125
CV(%)	9.326	10.124	8.371	6.246	8.392	10.537	6.388	5.289	7.248	8.227	6.329	7.238
Effect of mulching												
M_1	58.48 b	55.67 b	58.30 b	58.84 a	6.533 a	16.59 a	7.464 a	11.48 b	15.16 b	14.14 a	17.01 a	14.57 a
M_2	58.96 a	57.13 a	58.68 a	59.13 a	6.253a-b	14.99 b	6.986 b	11.08 c	15.54 b	11.92 d	15.44 c	13.55 c
M_3	57.87 c	55.96 b	58.09 b	57.55 b	6.345a-b	16.65 a	7.736 a	13.14 a	13.87 c	12.64 c	16.20 b	14.04 b
M_4	57.77 c	55.75 b	58.00 b	57.27 b	6.156 b	16.32 a	7.382 a	13.02 a	16.26 a	13.24 b	16.32 b	14.29a-b
$LSD_{0.05}$	0.3918	0.3994	0.3475	0.3451	0.3379	0.3614	0.3644	0.3981	0.5041	0.4466	0.5024	0.4386
CV(%)	9.326	10.124	8.371	6.246	8.392	10.537	6.388	5.289	7.248	8.227	6.329	7.238

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix, V_2 = Lady rosetta, V_3 = Courage, V_4 = Diamant, V_5 = BARI TPS-1

M_1 = Control, M_2 = Water Hyacinth, M_3 = Rice straw, M_4 = Rice husk

Table 4.5.2 Combined effect of varieties and mulch materials on skin color of potato under varying storage period

Treatment	L*				a*				b*			
	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS
V_1M_1	58.07 c-e	56.05 d-e	57.05 c	55.59 h-j	7.400 c	13.17 f	8.530 a-c	11.20 g-h	13.24 e-g	12.62 d	13.73 e-g	13.00 f-g
V_1M_2	59.08 c-d	53.6f-g-h	61.11 b	57.10 f-h	7.520 b-c	15.21 e	7.807 c-d	11.97 f-g	13.95 e	11.04 d-e	16.51 c-d	13.65 e-f
V_1M_3	58.92 c-d	54.64 e-f	57.38 c	58.04 e-g	7.400 c	14.83 e	8.663 a-c	15.79 b-d	13.10 e-g	9.810 e-f	13.53 e-g	15.53 d-e
V_1M_4	58.98 c-d	54.78 e-f	55.89 c-e	58.34 d-f	7.620 b-c	18.24 d	8.113 b-d	11.57 f-g	13.77 e-f	9.290 e-f	13.98 e-f	9.550 i-j
V_2M_1	55.23 g-h	54.15 f-g	56.72 c-d	58.09 e-g	7.250 c	21.04 b	9.643 a	15.39 b-e	11.88 g-i	9.170 e-f	12.47 f-g	9.450 i-j
V_2M_2	55.65 f-h	52.23 g-h	54.69 e-f	60.10 b-d	7.050 c	21.65 a-b	7.053 d-f	14.72 d-e	12.37 f-h	5.812 i	11.55 g	7.500 j
V_2M_3	57.17 d-g	52.88 f-h	55.02 d-f	56.89 f-h	7.000 c	19.12 c-d	7.200 d-e	14.92 c-e	10.31 j	8.873 f-g	12.60 f-g	10.30 i
V_2M_4	54.01 h-i	53.62 f-h	54.62 e-f	56.84 f-h	7.400 c	15.12 e	6.450 e-g	16.80 b-c	10.71 i-j	9.993 e-f	12.36 f-g	12.80 f-h
V_3M_1	59.17 c-d	53.07 f-h	57.33 c	59.22 c-e	8.600 a	19.70 c	8.090 b-d	14.10 d-e	16.76 d	8.623 f-g	15.38 d-e	10.30 i
V_3M_2	56.70 e-g	51.85 h	56.45 c-e	56.72 f-h	7.150 c	19.08 c-d	9.210 a-b	13.45 e-f	11.87 g-i	7.180 g-i	15.45 d-e	10.90 g-i
V_3M_3	56.02 f-g	53.40 f-h	56.64 c-d	54.67 i-j	8.100 a-b	22.64 a	9.717 a	19.50 a	12.73 e-g	6.533 h-i	13.38 e-g	9.100 i-j
V_3M_4	52.93 i	49.35 i	53.72 f	53.99 j	7.533 b-c	21.76 a-b	8.230 b-d	17.13 b	10.98 h-j	8.183 f-h	13.82 e-g	10.50 h-i
V_4M_1	60.01 b-c	59.29 b-c	60.23 b	56.28 g-i	4.683 d-e	21.53 b	6.533 e-g	9.530 h-i	19.62 c	16.90 c	19.28 a-b	18.60 b-c
V_4M_2	61.37 a-b	57.53 c-d	59.97 b	61.05 b	4.900 d-e	19.82 c	6.250 e-g	8.787 i-j	19.97 b-c	12.70 d	19.17 a-b	19.01 b-c
V_4M_3	58.55 c-e	59.20 b-c	59.96 b	57.21 f-h	3.880 f	19.97 c	6.590 e-g	9.387 h-i	12.08 g-i	17.16 c	18.27 b-c	14.45 e-f
V_4M_4	57.48 d-f	60.03 b	61.46 a-b	58.38 d-f	5.000 d-e	13.71 f	5.937 e-g	10.25 g-i	17.69 d	19.54 b	20.82 a	17.50 c-d
V_5M_1	59.62 b-c	63.07 a	61.16 b	60.70 b-c	5.110 d-e	7.782 g	5.883 f-g	7.200 j-k	19.82 b-c	23.38 a	21.42 a	23.47 a
V_5M_2	62.35 a	63.11 a	63.16 a	65.05 a	4.647 e	5.850 h	5.450 g	6.480 k	19.54 c	22.86 a	21.08 a	18.42 b-c
V_5M_3	61.30 a-b	62.70 a	60.90 b	61.63 b	5.347 d	6.380 h	6.290 e-g	8.480 i-k	21.14 b	20.83 b	19.40 a-b	20.82 b
V_5M_4	62.86 a	57.97 c	61.83 a-b	58.14 e-g	2.847 g	6.130 h	6.200 e-g	6.987 j-k	22.66 a	19.18 b	20.62 a	17.42 c-d
$LSD_{0.05}$	1.748	1.743	1.750	1.668	0.603	0.962	1.100	1.877	1.348	1.784	1.999	2.249
CV(%)	9.326	10.124	8.371	6.246	8.392	10.537	6.388	5.289	7.248	8.227	6.329	7.238

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix, V_2 = Lady rosetta, V_3 = Courage, V_4 = Diamant, V_5 = BARI TPS-1

M_1 = Control, M_2 = Water Hyacinth, M_3 = Rice straw, M_4 = Rice husk

4.6 Flesh Color

4.6.1 Color flesh L*

Significant variation was found in case of color flesh L* at different days after harvest (DAS) influenced by different test varieties (Table 4.6.1). Results revealed that the highest color flesh L* (75.62, 74.21, 73.66 and 73.51 at 0, 20, 40 and 60 DAS, respectively) was observed from V_4 ('Diamant') which was significantly same with V_2 ('Lady rosetta'), V_3 ('Courage') and V_5 ('BARI TPS-1') at 40 DAS and also with V_5 ('BARI TPS-1') at 60 DAS. Again, the lowest color flesh L* (72.63, 69.38, 71.89 and 69.48 at 0, 20, 40 and 60 DAS, respectively) was found from V_1 ('Asterix') which was closely followed by V_2 ('Lady rosetta') but different from all other test varieties. Nourian *et al*. (2003) observed similar results in potato varieties.

Different mulch materials had also significant effect on color flesh L* at different days after harvest (Table 4.6.1). Results revealed that the highest color flesh L* (74.72, 72.17, 73.64 and 71.90 at 0, 20, 40 and 60 DAS, respectively) was observed from M_3 (Rice straw) which was statistically identical with M_2 (Water Hyacinth) at 60 DAS but significantly different from all other mulching practices. Again, the lowest color flesh L* (73.58, 71.01, 72.02 and 70.71 at 0, 20, 40 and 60 DAS, respectively) was found from M_4 (Rice husk) which was closely followed by M_1 (Control) at 0, 20, 40 and 60 DAS.

Color flesh L* of potato was also significantly influenced by combined effect of varieties and mulch materials (Table 4.6.2). Results indicated that the highest color flesh L* value (76.10, 75.31, 75.69 and 74.27 at 0, 20, 40 and 60 DAS, respectively) was achieved by the combined effect of V_4M_3 which was statistically identical with V_3M_2, V_5M_1 and V_5M_4 at 0,

20 and 60 DAS respectively but significantly different from all other treatment combination. Again, the lowest color flesh L* value (70.46, 67.70, 70.84 and 68.02 at 0, 20, 40 and 60 DAS, respectively) was found from the treatment combination of V_1M_4 which was closely followed by V_1M_2 and V_2M_1 at 60 DAS but significantly different from all other treatment combinations.

4.6.2 Color flesh a*

Significant influence was found for color flesh a* at different days after harvest (DAS) except initial stage (0 DAS) influenced by different test varieties (Table 4.6.1). Results revealed that the highest color flesh a* (17.05, 1.65 and 9.25 at 20, 40 and 60 DAS, respectively) was observed from V_3 ('Courage') which was significantly similar with V_2 ('Lady rosetta') at 40 and 60 DAS and with V_1 ('Asterix') at 40 DAS. Again, the lowest color flesh a* (1.94, 0.88 and 1.74 at 20, 40 and 60 DAS, respectively) was found from V_5 ('BARI TPS-1') which was significantly different from all other test varieties. Nourian *et al*. (2003) observed similar results in potato varieties.

Different mulch materials had also significant variation for color flesh a* at different days after harvest except initial stage (0 DAS) (Table 4.6.1). Results showed that the highest color flesh a* (11.14, 2.07 and 6.12 at 20, 40 and 60 DAS, respectively) was observed from M_3 (Rice straw) which was statistically identical with M_4 (Rice husk) at 20 and 60 DAS. Again, the lowest color flesh a* (10.49, 0.83 and 4.93 at 20, 40 and 60 DAS, respectively) was found from M_1 (Control) which was significantly different from all other treatments.

Color flesh a* of potato was also significantly influenced by combined effect of varieties and mulch materials except initial stage (0 DAS) (Table 4.6.2). Results indicated that the

highest color flesh a* value (20.98, 3.52 and 12.40 at 20, 40 and 60 DAS, respectively) was found from V_3M_3 followed by V_2M_1 at 60 DAS which was significantly different from all other treatment combinations. On the other hand, the lowest color flesh a* at 20, 40 and 60 DAS (1.70, 0.47 and 1.12, respectively) was found from the treatment combination of V_5M_1 followed by V_5M_2, V_5M_3 and V_5M_4 at 60 DAS and also significantly different from all other treatment combinations.

4.6.3 Color flesh b*

Significant variation was found for color flesh b* at different days after harvest (DAS) influenced by different test varieties (Table 4.6.1). Results signified that the highest color flesh b* (26.36, 26.14, 27.39 and 25.39 at 0, 20, 40 and 60 DAS, respectively) was observed from V_5 ('BARI TPS-1') which was significantly different from all other varieties. Again, the lowest color flesh b* (22.58, 18.11, 22.70 and 18.67 at 0, 20, 40 and 60 DAS, respectively) was found from V_4 ('Diamant') which was also significantly different from all other test varieties. Nourian *et al*. (2003) observed similar results in potato varieties.

Different mulch materials showed significant variation in terms of color flesh b* at different days after harvest (Table 4.6.1). Results revealed that the highest color flesh b* (25.40, 21.46, 28.33 and 23.92 at 0, 20, 40 and 60 DAS, respectively) was observed from M_4 (Rice husk) which was statistically identical with M_1 (Control) at 20 DAS and 60 DAS but significantly different from all other treatments. Again, the lowest color flesh b* (24.11, 19.87, 22.32 and 22.17 at 0, 20, 40 and 60 DAS, respectively) was observed from

M_2 (Water Hyacinth) which was statistically identical with M_4 (Rice husk) at 60 DAS but significantly different from all other treatments.

Color flesh b* of potato was also significantly varied by combined effect of varieties and mulch materials (Table 4.6.2). Results pointed out that the highest color flesh b* value (30.15, 26.60, 41.89 and 26.96 at 0, 20, 40 and 60 DAS, respectively) was found from V_5M_4 followed by V_5M_1, V_5M_2, V_5M_3 at 20 DAS and by V_3M_1 at 60 DAS. Again, the lowest color flesh b* (18.92, 14.93, 20.10 and 17.23 at 0, 20, 40 and 60 DAS, respectively) was found from the treatment combination of V_4M_2 followed by V_2M_3, V_3M_2 at 20 DAS; V_5M_2 at 40 DAS and by V_2M_2, V_2M_4 at 60 DAS.

Table 4.6.1 Single effect of varieties and mulch materials on flesh color of potato under varying storage period

Treatment	L*				a*				b*			
	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS
Effect of variety												
V_1	72.63 d	69.38 d	71.89 b	69.48 c	0.611	9.025 c	1.596 a	5.000 b	25.04 b	21.23 b	22.8 c-d	22.26 d
V_2	72.72 d	70.74 c	73.45 a	70.03 b-c	0.454	13.39 b	1.637 a	8.462 a	24.02 c	18.17 c	23.21 c	24.04 c
V_3	75.07 b	70.67 c	73.43 a	70.80 b	0.653	17.05 a	1.653 a	9.250 a	25.12 b	20.86 b	25.37 b	24.76 b
V_4	75.62 a	74.21 a	73.66 a	73.51 a	0.593	12.97 b	1.092 b	4.167 b	22.58 d	18.11 c	22.70 d	18.67 e
V_5	74.12 c	72.16 b	73.59 a	73.06 a	0.363	1.938 d	0.884 c	1.742 c	26.36 a	26.14 a	27.39 a	25.39 a
$LSD_{0.05}$	0.4594	0.8676	0.8330	0.8367	NS	0.8545	0.1383	0.8577	0.2790	0.4489	0.4435	0.3859
CV(%)	8.729	11.428	9.337	8.414	4.329	4.227	5.126	4.559	7.569	6.593	8.671	7.339
Effect of mulching												
M_1	73.79 b-c	71.02 c	73.04 b	71.10 b	0.444	10.49 c	0.832 c	4.930 c	24.53 b	21.23 a	23.21 b	23.41 a
M_2	74.04 b	71.53 b	73.12 b	71.79 a	0.548	10.79 b	1.347 b	5.776 b	24.11 c	19.87 b	22.32 c	22.17 b
M_3	74.72 a	72.17 a	73.64 a	71.90 a	0.608	11.14 a	2.072 a	6.124 a	24.45 b	21.05 a	23.35 b	22.59 b
M_4	73.58 c	71.01 c	73.02 b	70.71 b	0.538	11.09 a	1.239 b	6.067 a	25.40 a	21.46 a	28.33 a	23.92 a
$LSD_{0.05}$	0.4109	0.4478	0.3436	0.4214	NS	0.1942	0.1259	0.2051	0.3420	0.4015	0.3967	0.5320
CV(%)	8.729	11.428	9.337	8.414	4.329	4.227	5.126	4.559	7.569	6.593	8.671	7.339

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

NS-Non significance

V_1 = Asterix, V_2 = Lady rosetta, V_3 = Courage, V_4 = Diamant, V_5 = BARI TPS-1

M_1 = Control, M_2 = Water Hyacinth, M_3 = Rice straw, M_4 = Rice husk

Table 4.6.2 Combined effect of varieties and mulch materials on flesh color of potato under varying storage period

Treatment	L*				a*				b*			
	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS
Interaction effect of variety and mulching												
V_1M_1	73.93 f-g	71.16 e-g	71.74 h	71.47 e-f	0.430	7.263 i	1.120 d-f	3.150 g-i	25.09 c-d	21.79 d	24.28 c-d	24.40 c-e
V_1M_2	72.40 h	71.05 e-g	71.66 h	68.17 h	0.763	8.633 h-i	1.863 c	5.900 e	23.30 e	24.06 c	22.17g-h	20.84 f
V_1M_3	73.45 g	71.08 e-g	73.32 d-f	72.45 c-d	0.550	8.700 h-i	2.600 b	5.550 e-f	23.02 e	19.65 e-f	24.48 c-d	24.67 b-e
V_1M_4	70.46 j	67.70 i	70.84 i	68.02 h	0.700	11.50 g	0.800 f-h	5.400 e-f	23.98 d-e	19.43 e-g	21.22 h-i	19.13 g-h
V_2M_1	73.92 f-g	69.82 h	75.41 a-b	68.32 h	0.367	14.33 d-e	1.237 d-e	11.50 a-b	23.20 e	17.43 h	23.93 c-e	24.30 c-e
V_2M_2	73.42 g	69.82 h	72.97 e-g	70.01 g	0.347	13.50 e-f	0.477 h	7.800 d	24.17 c-e	18.92 f-g	21.38 h-i	18.60 h-i
V_2M_3	71.08 i	69.65 h	73.26 d-f	69.63 g	0.520	15.90 c-d	1.310 d-e	5.200 e-f	23.30 e	15.69 i	24.64 c	20.30 f-g
V_2M_4	72.71 h	70.20g-h	72.17g-h	69.95 g	0.597	9.833 h	1.050 e-f	9.350 c-d	25.40 c	20.38 d-f	22.90 e-g	18.53 h-i
V_3M_1	75.50 b	71.62 d-f	72.62 f-g	72.55 c-d	0.630	9.650 h	0.563g-h	9.750 c	27.05 b	21.67 d	23.03 e-g	26.13 a-b
V_3M_2	76.06 a	68.44 i	74.67 b-c	70.07 g	0.500	13.61 e-f	0.937 e-g	4.250 e-h	25.40 c	15.37 i	27.10 b	24.27 c-e
V_3M_3	74.30 d-f	70.71 f-h	73.55 d-e	69.54 g	1.000	20.98 a	3.523 a	12.40 a	23.80 d-e	24.72 b-c	27.99 b	25.43 a-c
V_3M_4	74.44 d-f	71.91 d-e	73.82 d-e	71.05 f	0.270	16.70 b-c	1.817 c	10.60 b-c	24.22 c-e	21.68 d	23.38 d-f	23.20 e
V_4M_1	74.13 e-f	73.22 b-c	72.20g-h	73.70 a-b	0.667	11.93 f-g	0.710 f-h	4.900 e-g	24.23 c-e	20.51 d-e	22.56 f-g	25.17 b-d
V_4M_2	73.50 g	70.42g-h	72.31g-h	72.16 d-e	0.430	17.86 b	2.400 b	4.100 f-h	18.92 f	14.93 i	20.10 j	17.23 i
V_4M_3	76.10 a	75.31 a	75.69 a	74.27 a	0.537	14.05 e	0.767 f-h	3.800 f-h	24.85 c-d	19.17 e-g	23.39 d-f	23.68 d-e
V_4M_4	74.20 d-f	71.94 d-e	73.51 d-e	72.22 d-e	0.737	15.32 c-e	2.737 b	3.867 f-h	27.08 b	18.07g-h	24.76 c	23.02 e
V_5M_1	74.63 c-e	75.01 a	73.24 d-f	72.90 b-d	0.217	1.700 j	0.467 h	1.117 j	23.09 e	25.88 a-b	22.24 f-h	24.13 c-e
V_5M_2	74.80c-d	73.05 b-c	73.98 c-d	73.15 b-c	0.417	2.093 j	1.057 e-f	2.600 h-j	24.92 c-d	26.06 a-b	20.84 i-j	24.93 b-d
V_5M_3	75.07b-c	72.58 c-d	72.37g-h	73.72 a-b	0.717	1.850 j	0.530g-h	1.930 i-j	27.29 b	26.00 a-b	23.74 c-e	25.53 a-c
V_5M_4	76.05 a	73.93 b	74.76 b-c	74.15 a	0.297	2.110 j	1.483c-d	1.320 j	30.15 a	26.60 a	41.89 a	26.96 a
$LSD_{0.05}$	0.5457	1.001	0.7682	0.7840	NS	1.660	0.3621	1.557	1.138	1.378	1.030	1.495
CV(%)	8.729	11.428	9.337	8.414	4.329	4.227	5.126	4.559	7.569	6.593	8.671	7.339

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly V_1 = Asterix, V_2 = Lady rosetta, V_3 = Courage, V_4 = Diamant, V_5 = BARI TPS-1 and M_1 = Control, M_2 = Water Hyacinth, M_3 = Rice straw, M_4 = Rice husk

4.7 Firmness

Firmness was significant influenced by different test varieties at different days after harvest (DAS) (Table 4.7.1). Results revealed that the highest firmness (40.37, 38.21, 41.20 and 44.21 at 0, 20, 40 and 60 DAS, respectively) was observed from V_4 ('Diamant') which was significantly different from all other varietal performance. Again, the lowest firmness (30.11, 25.14, 31.01 and 35.12 at 0, 20, 40 and 60 DAS, respectively) was found from V_3 ('Courage') which was also significantly different from all other varietal performance. Ismail (1988), observed this kind of physical properties in potato varieties.

Performance on different mulch materials for the present study had also significant variation on firmness of potato at different days after harvest (Table 4.7.1). Results showed that the highest firmness (36.50, 34.51, 38.08 and 41.02 at 0, 20, 40 and 60 DAS, respectively) was observed from M_3 (Rice straw) which was statistically different from all other treatments. Again, the lowest firmness (34.39, 31.62, 35.19 and 38.55 at 0, 20, 40 and 60 DAS, respectively) was found from M_1 (Control) which was also significantly different from all other treatments. Shehata and Abo-Sadera (1994) observed similar result.

Combined effect of varieties and mulch materials on firmness of potato had also significant influence at different DAS (Table 4.7.2). Results indicated that the highest firmness (41.52, 42.22, 42.96 and 46.13 at 0, 20, 40 and 60 DAS, respectively) was found from V_4M_3 followed by V_4M_2 at 0 and 40 DAS which was significantly different from all other treatment combinations. On the other hand, the lowest firmness at 0, 20, 40 and 60 DAS (28.37, 21.78, 27.60 and 32.60, respectively) was found from the treatment combination of V_3M_1 followed by V_5M_1 and also significantly different from all other treatment combinations.

Table 4.7.1 Single effect of varieties and mulch materials on firmness of potato under varying storage period

Treatment	Firmness			
	0 DAS	20 DAS	40 DAS	60 DAS
Effect of variety				
V_1	35.965 c	34.210 c	36.945 c	39.608 c
V_2	32.320 d	32.170 d	34.710 d	37.903 d
V_3	30.110 e	25.145 e	31.008 e	35.118 e
V_4	40.370 a	38.210 a	41.198 a	44.205 a
V_5	38.145 b	35.028 b	38.953 b	41.628 b
$LSD_{0.05}$	0.4118	0.5575	0.4755	0.7214
CV(%)	5.371	6.834	6.743	5.229
Effect of mulching				
M_1	34.388 c	31.620 d	35.186 d	38.554 d
M_2	35.064 b	32.444 c	35.722 c	39.008 c
M_3	36.504 a	34.508 a	38.080 a	41.020 a
M_4	35.572 b	33.238 b	37.262 b	40.186 b
$LSD_{0.05}$	0.5472	0.4404	0.4253	0.5024
CV(%)	5.371	6.834	6.743	5.229

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

Table 4.7.2 Combined effect of varieties and mulch materials on firmness of potato under varying storage period

Treatment	Firmness			
	0 DAS	20 DAS	40 DAS	60 DAS
V_1M_1	30.54 i	26.24 j	33.26 j	36.79 h
V_1M_2	37.10 c-d	34.42 d	38.55 d	40.75 d-e
V_1M_3	37.76 c	35.07 d	38.71 d	41.05 d-e
V_1M_4	36.29 d-e	34.32 d	37.44 e	39.96 e-f
V_2M_1	31.28 h-i	27.61 i	33.66 i-j	36.83 h
V_2M_2	39.76 b	36.30 c	39.76 b-c	43.15 b-c
V_2M_3	39.78 b	36.37 c	40.03 b	43.34 b-c
V_2M_4	38.26 c	35.15 d	38.87 c-d	42.04 c-d
V_3M_1	28.37 j	21.78 *l*	27.60 *l*	32.60 j
V_3M_2	32.25 g-h	32.53 f-g	34.70 g-h	37.94 g-h
V_3M_3	34.81 f	34.05 d-e	35.80 f	38.82 f-g
V_3M_4	31.87 h	31.78 g-h	34.37 h-i	37.50 g-h
V_4M_1	31.84 h	31.32 h	34.14 h-j	37.37 g-h
V_4M_2	40.52 a-b	37.95 b	42.04 a	44.20 b
V_4M_3	41.42 a	42.22 a	42.96 a	46.13 a
V_4M_4	39.40 b	35.24 c-d	39.60 b-d	42.59 c
V_5M_1	30.25 i	24.95 k	29.51 k	34.25 i
V_5M_2	35.66 e-f	34.05 d-e	35.99 f	38.90 f-g
V_5M_3	37.16 c-d	34.65 d	38.63 d	40.83 d-e
V_5M_4	33.32 g	33.05 e-f	35.63 f-g	38.80 f-g
$LSD_{0.05}$	1.106	1.083	0.9510	1.443
CV(%)	5.371	6.834	6.743	5.229

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.8 TSS (Total soluble solid)

TSS was significant influenced by different test varieties of potato at different days after storing (DAS) (Table 4.8.1). Results revealed that the highest TSS (8.30, 7.63, 8.35 and 8.90 at 0, 20, 40 and 60 DAS, respectively) was observed from V_3 ('Courage') which was significantly different from all other varietal performance. Again, the lowest TSS (6.91, 6.28, 6.40 and 6.41 at 0, 20, 40 and 60 DAS, respectively) was found from V_1 ('Asterix') which was closely followed by V_5 ('BARI TPS-1') at 0 DAS and significantly different from all other varietal performance. Vaezzadeh and Naderidarbaghshahi (2012), observed similar trend in experimentation of five varieties.

Performance on different mulch materials for the present study had also significant variation on TSS of potato at different days after harvest (Table 4.8.1). Results showed that the highest TSS (7.73, 7.36, 7.54 and 7.86 at 0, 20, 40 and 60 DAS, respectively) was observed from M_4 (Rice husk) which was closely followed by M_1 (Control) and M_2 (Water hyacinth) at 20 DAS and 60 DAS but statistically different from all other treatments. Again, the lowest TSS (7.27, 6.60, 6.68 and 7.30 at 0, 20, 40 and 60 DAS, respectively) was found from M_3 (Rice straw) followed by M_2 (Water Hyacinth) at 60 DAS but significantly different from all other treatments. Shehata and Abo-Sadera (1994) observed similar result.

Combined effect of varieties and mulch materials on TSS of potato had also significant influence at different DAS (Table 4.8.2). Results indicated that the highest TSS (9.60, 8.20, 9.10 and 9.40 at 0, 20, 40 and 60 DAS, respectively) was found from V_3M_4 followed by V_2M_1 at 60 DAS which was significantly different from all other treatment combinations.

On the other hand, the lowest TSS at 0, 20, 40 and 60 DAS (6.20, 5.80, 6.00 and 5.90, respectively) was found from the treatment combination of V_1M_3 followed by V_4M_1 at 0 DAS; V_4M_3 at 20 DAS; V_1M_2 and V_4M_3 at 40 DAS and by V_1M_1 at 60 DAS.

Table 4.8.1 Single effect of varieties and mulch materials on TSS of potato under varying storage period

Treatment	TSS			
	0 DAS	**20 DAS**	**40 DAS**	**60 DAS**
Effect of variety				
V_1	6.91 c	6.28 e	6.40 d	6.41 e
V_2	7.21 b	7.40 b	7.20 b	8.15 b
V_3	8.30 a	7.63 a	8.35 a	8.90 a
V_4	7.20 b	6.80 d	6.73 c	7.10 d
V_5	7.09 b-c	7.05 c	6.93 b-c	7.42 c
$LSD_{0.05}$	0.249	0.201	0.289	0.280
CV(%)	7.834	5.931	8.352	6.449
Effect of mulching				
M_1	7.68 a	7.20 a	7.22 b	7.68 a-b
M_2	7.72 a	6.96 b	7.04 b	7.54 b-c
M_3	7.27 b	6.60 c	6.68 c	7.30 c
M_4	7.73 a	7.36 a	7.54 a	7.86 a
$LSD_{0.05}$	0.323	0.194	0.258	0.251
CV(%)	7.834	5.931	8.352	6.449

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

Table 4.8.2 Combined effect of varieties and mulch materials on TSS of potato under varying storage period

Treatment	TSS			
	0 DAS	**20 DAS**	**40 DAS**	**60 DAS**
V_1M_1	7.00 g-h	6.90 g-i	6.60 g-h	6.10 j
V_1M_2	7.20 f-g	7.10 f-g	6.00 j	6.70 h-i
V_1M_3	6.20 j	5.80 *l*	6.00 j	5.90 j
V_1M_4	6.60 i	6.80 h-j	6.60 g-h	6.95 g-h
V_2M_1	8.55 c	7.80 b-c	7.60 d	9.20 a-b
V_2M_2	8.63 c	7.50 d-e	8.50 b	9.10 b
V_2M_3	7.80 e	7.00 g-h	8.20 c	8.80 c
V_2M_4	9.00 b	7.30 e-f	8.00 c	8.30 d
V_3M_1	7.10 g-h	7.90 b	7.70 d	8.10 d
V_3M_2	7.70 e	7.40 d-e	7.10 e-f	8.10 d
V_3M_3	8.80 b-c	7.00 g-h	6.40 h-i	7.20 g
V_3M_4	9.60 a	8.20 a	9.10 a	9.40 a
V_4M_1	6.20 j	6.60 j-k	7.00 f	6.60 i
V_4M_2	8.10 d	6.40 k	7.00 f	7.60 e-f
V_4M_3	7.30 f-g	5.70 *l*	6.20 i-j	6.70 h-i
V_4M_4	7.20 g	7.00 g-h	6.70 g	7.50 f
V_5M_1	7.50 e-f	7.60 c-d	7.20 e-f	8.20 d
V_5M_2	7.00 g-h	7.00 g-h	6.60 g-h	7.80 e
V_5M_3	7.65 e	6.90 g-i	6.60 g-h	6.87 h-i
V_5M_4	6.85 h-i	6.70 i-j	7.30 e	6.80 h-i
$LSD_{0.05}$	0.277	0.2561	0.2452	0.2716
CV(%)	7.834	5.931	8.352	6.449

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.9 Reducing sugar (mg/g FW)

Reducing sugar was significantly influenced by different test varieties at different days after harvest (DAS) except 0 and 20 DAS (Table 4.9.1). Results revealed that the highest reducing sugar (0.482 and 0.405 mg/g FW at 40 and 60 DAS, respectively) was observed from V_3 ('Courage') which was significantly different from all other varietal performance. Again, the lowest reducing sugar (0.355 and 0.302 mg/g FW at 40 and 60 DAS, respectively) was found from V_1 ('Asterix') which was statistically identical with V_2 ('Lady rosetta'), V_4 ('Diamant') and V_5 ('BARI TPS-1'). Similar result was also observed by Kassim *et al*. (2014) and Shock *et al.* (1993).

Performance on different mulch materials for the present study had also significant variation on reducing sugar of potato at different days after harvest except 0 and 20 DAS (Table 4.9.1). Results showed that the highest reducing sugar (0.442 and 0.389 mg/g FW at 40 and 60 DAS respectively) was observed from M_2 (Water Hyacinth) which was statistically similar with M_3 Rice straw and M_4 Rice husk at 40 DAS. Again, the lowest reducing sugar (0.336 and 0.286 mg/g FW at 40 and 60 DAS respectively) was found from M_1 (Control) which was closely followed by M_4 (Rice husk) at 40 DAS and 60 DAS. Similar results are found by Patel *et al*. (1999).

Combined effect of varieties and mulch materials on reducing sugar of potato had significant influence at different DAS (Table 4.9.2). Results indicated that the highest reducing sugar (0.247, 0.267, 0.533 and 0.473 mg/g FW at 0, 20, 40 and 60 DAS, respectively) was found from V_3M_2 which was closely followed by V_3M_3 and V_1M_2 at 20, 40 and 60 DAS but significantly different from all other treatment combinations. On the

other hand, the lowest reducing sugar (0.123, 0.137, 0.260 and 0.187 mg/g FW at 0, 20, 40 and 60 DAS, respectively) was found from the treatment combination of V_1M_1 followed by V_5M_1 at 60 DAS but significantly different from all other treatment combinations.

Table 4.9.1 Single effect of varieties and mulch materials on reducing sugar of potato under varying storage period

Treatment	Reducing sugar (mg/g FW)			
	0 DAS	**20 DAS**	**40 DAS**	**60 DAS**
Effect of variety				
V_1	0.163	0.180	0.355 b	0.302 b
V_2	0.170	0.187	0.369 b	0.303 b
V_3	0.218	0.243	0.482 a	0.405 a
V_4	0.188	0.204	0.402 b	0.341 b
V_5	0.178	0.195	0.389 b	0.307 b
$LSD_{0.05}$	NS	NS	0.0453	0.0369
CV(%)	3.568	2.876	4.229	3.228
Effect of mulching				
M_1	0.155	0.171	0.336 b	0.286 c
M_2	0.198	0.221	0.442 a	0.389 a
M_3	0.197	0.213	0.419 a	0.335 b
M_4	0.183	0.201	0.397 a-b	0.316 b-c
$LSD_{0.05}$	NS	NS	0.0619	0.0405
CV (%)	3.568	2.876	4.229	3.228

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

NS-Non significance

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

Table 4.9.2 Combined effect of varieties and mulch materials on reducing sugar of potato under varying storage period

Treatment	Reducing sugar (mg/g FW)			
	0 DAS	**20 DAS**	**40 DAS**	**60 DAS**
V_1M_1	0.123 i	0.137 i	0.260 i	0.187 f
V_1M_2	0.230 b	0.250 a-b	0.503 a-b	0.447 a
V_1M_3	0.163 e-g	0.177 f-g	0.353 g	0.267 d-e
V_1M_4	0.137 h-i	0.157 h	0.303 h	0.280 d
V_2M_1	0.147 g-h	0.160 g-h	0.310 h	0.263 d-e
V_2M_2	0.193 c	0.213 c	0.423 d	0.377 b
V_2M_3	0.173 d-f	0.190 d-f	0.363 f-g	0.287 c-d
V_2M_4	0.167 e-f	0.183 e-f	0.367 f-g	0.287 c-d
V_3M_1	0.177 c-f	0.197 c-e	0.390 e-f	0.333 b-c
V_3M_2	0.247 a	0.267 a	0.533 a	0.473 a
V_3M_3	0.227 b	0.263 a	0.520 a	0.463 a
V_3M_4	0.220 b	0.243 b	0.483 b-c	0.377 b
V_4M_1	0.180 c-e	0.197 c-e	0.390 e-f	0.330 b-c
V_4M_2	0.160 f-g	0.177 f-g	0.347 g	0.280 d
V_4M_3	0.223 b	0.237 b	0.460 c	0.380 b
V_4M_4	0.190 c-d	0.207 c-d	0.410 d-e	0.373 b
V_5M_1	0.137 h-i	0.147 h-i	0.287 h-i	0.223 e-f
V_5M_2	0.180 c-e	0.203 c-d	0.417 d-e	0.353 b
V_5M_3	0.180 c-e	0.197 c-e	0.387 e-f	0.293 c-d
V_5M_4	0.217 b	0.233 b	0.467 c	0.357 b
$LSD_{0.05}$	0.0166	0.0165	0.0286	0.0437
CV(%)	3.568	2.876	4.229	3.228

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.10 Sucrose content (mg/FW)

Sucrose sugar content was significant influenced by different test varieties at different days after harvest (DAS) (Table 4.10.1). Results revealed that the highest sucrose content (3.322, 6.641, 7.305 and 7.192 mg/FWW at 0, 20, 40 and 60 DAS, respectively) was observed from V_4 ('Diamant') which was significantly different from all other varietal performance where the lowest sucrose content (2.417, 4.841, 5.311 and 5.198 mg/FW at 0, 20, 40 and 60 DAS, respectively) was found from V_1 ('Asterix') which was also significantly different from all other varietal performance in terms of sucrose content. Similar result was also observed by Kassim *et al*. (2014) and Sieczka and Maatta (1986).

Different mulch materials had also significant effect on sucrose sugar of potato at different days after harvest (Table 4.10.1). Results showed that the highest sucrose content (2.963, 5.924, 6.514 and 6.401 mg/FW at 0, 20, 40 and 60 DAS, respectively) was observed from M_3 (Rice straw) which was statistically identical with M_4 (Rice husk) at 0 and 60 DAS but significantly different from all other treatments. Again, the lowest sucrose content (2.812, 5.625, 6.170 and 6.057 mg/FW at 0, 20, 40 and 60 DAS, respectively) was found from M_1 (Control) which was significantly different from all other treatments. Similar results was observed by Yamaguchi *et al.* (1964).

Combined effect of varieties and mulch materials on sucrose content of potato had significant influence at different DAS (Table 4.10.2). Results indicated that the highest sucrose content (3.517, 7.033, 7.733 and 7.620 mg/FW at 0, 20, 40 and 60 DAS, respectively) was found from V_4M_3 which was closely followed by V_5M_4 at 0 DAS and 60 DAS but significantly different from all other treatment combinations. On the other hand, the lowest sucrose content (2.323, 4.647, 5.060 and 4.947 mg/FW at 0, 20, 40 and 60 DAS, respectively) was found from the treatment combination of V_1M_1 followed by V_1M_4 at all duration after harvest but significantly different from all other treatment combinations.

Table 4.10.1 Single effect of varieties and mulch materials on Sucrose content of potato under varying storage period

Treatment	Sucrose content (mg/g FW)			
	0 DAS	**20 DAS**	**40 DAS**	**60 DAS**
Effect of variety				
V_1	2.417 e	4.841 e	5.311 e	5.198 e
V_2	2.599 d	5.198 d	5.710 d	5.597 d
V_3	2.944 c	5.861 c	6.447 c	6.333 c
V_4	3.322 a	6.641 a	7.305 a	7.192 a
V_5	3.198 b	6.388 b	7.026 b	6.912 b
$LSD_{0.05}$	0.0692	0.0640	0.0905	0.0905
CV(%)	3.224	3.653	2.941	3.438
Effect of mulching				
M_1	2.812 c	5.625 d	6.170 d	6.057 c
M_2	2.879 b	5.735 c	6.313 c	6.199 b
M_3	2.963 a	5.924 a	6.514 a	6.401 a
M_4	2.931 a	5.859 b	6.442 b	6.329 a
$LSD_{0.05}$	0.0331	0.0468	0.0619	0.0810
CV(%)	3.224	3.653	2.941	3.438

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

Table 4.10.2 Combined effect of varieties and mulch materials on Sucrose content of potato under varying storage period

Treatment	Sucrose content (mg/g FW)			
	0 DAS	**20 DAS**	**40 DAS**	**60 DAS**
V_1M_1	2.323 i	4.647 k	5.060 k	4.947 k
V_1M_2	2.433 h-i	4.863 i-j	5.370 i-j	5.257 i-k
V_1M_3	2.530 g-h	5.093 g-h	5.590 h-i	5.477 g-i
V_1M_4	2.380 h-i	4.760 j-k	5.223 j-k	5.110 j-k
V_2M_1	2.523 g-h	5.050 h-i	5.523 i	5.410 h-j
V_2M_2	2.643 g	5.287 f-g	5.813 g-h	5.700 g-h
V_2M_3	2.543 g-h	5.083 g-h	5.593 h-i	5.480 h-i
V_2M_4	2.687 f-g	5.373 f	5.910 g	5.797 g
V_3M_1	2.853 e-f	5.707 e	6.277 f	6.163 f
V_3M_2	2.997 d-e	5.927 d	6.520 e-f	6.407 e-f
V_3M_3	2.873 e-f	5.703 e	6.273 f	6.160 f
V_3M_4	3.053 d-e	6.107 d	6.717 e	6.603 d-e
V_4M_1	3.180 b-d	6.360 c	6.997 d	6.883 c-d
V_4M_2	3.280 b-c	6.557 b-c	7.213 b-d	7.100 b-c
V_4M_3	3.517 a	7.033 a	7.733 a	7.620 a
V_4M_4	3.310 b-c	6.613 b	7.277 b-c	7.163 b-c
V_5M_1	3.180 c-d	6.360 c	6.993 c-d	6.880 c-d
V_5M_2	3.040 d-e	6.043 d	6.647 e	6.533 e
V_5M_3	3.190 b-d	6.383 c	7.020 c-d	6.907 c-d
V_5M_4	3.383 a-b	6.767 b	7.443 b	7.330 a-b
$LSD_{0.05}$	0.1811	0.2024	0.2561	0.3003
CV(%)	3.224	3.653	2.941	3.438

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

4.11 Weight loss (%)

Percent (%) weight loss was significantly influenced by different varieties at different days after harvest (DAS) (Fig.13). Results revealed that the highest % weight loss (1.765, 3.473 and 6.284 at 20, 40 and 60 DAS, respectively) was observed from V_3 ('Courage') which was significantly different from all other varietal performance. Again, the lowest % weight loss (1.029, 1.889 and 4.791 at 20, 40 and 60 DAS, respectively) was found from V_1 ('Asterix') which was statistically identical with V_5 ('BARI TPS-1') at 20 DAS and 60 DAS. Rasul *et al*. (1997) and Hossain *et al*. (1992) observed, similar pattern of weight loss in ambient storage.

Percent weight loss had significant effect by mulch materials at 20, 40 and 60 DAS was observed (Fig.14). Results showed that the highest % weight loss (1.697, 2.602 and 5.826 at 20, 40 and 60 DAS, respectively) was observed from M_2 (Water Hyacinth) which was statistically identical with M_3 (Rice straw) at 40 and 60 DAS. Again, the lowest % weight loss (0.819, 2.250 and 5.055 at 20, 40 and 60 DAS, respectively) was found from M_1 (Control) which was closely followed by M_4 (Rice husk) at 40 DAS.

Combined effect of varieties and mulch materials on % weight loss of potato had significant influence at different DAS (Table 4.11). Results indicated that the highest % weight loss (2.913, 4.710 and 7.113 at 20, 40 and 60 DAS, respectively) was found from V_3M_2 which was statistically identical with V_5M_2 at 20 and 60 DAS but significantly different from all other treatment combinations. On the other hand, the lowest % weight loss (0.360, 1.527 and 4.163 at 20, 40 and 60 DAS, respectively) was found from the

treatment combination of V_1M_1 which was closely followed by V_4M_3 at 20, 40 and 60 DAS but significantly different from all other treatment combinations.

Such results under the present study might be due to cause of higher rate of reducing sugar by sprouting. Storage life of potato tubers mainly depends on temperature and humidity which influence evaporation, respiration, sprout growth and ultimately weight loss of tubers. Low temperature and high humidity in storage results gave minimum loss. The local varieties are liked by the farmers, keep well under ordinary room condition and possess a high market value (Khan *et al*., 1981). Sowa and Kuzniewicz (1989) studied the causes of loss during potato storage and indicated that the main causes of storage losses were respiration, evaporation and storage rot.

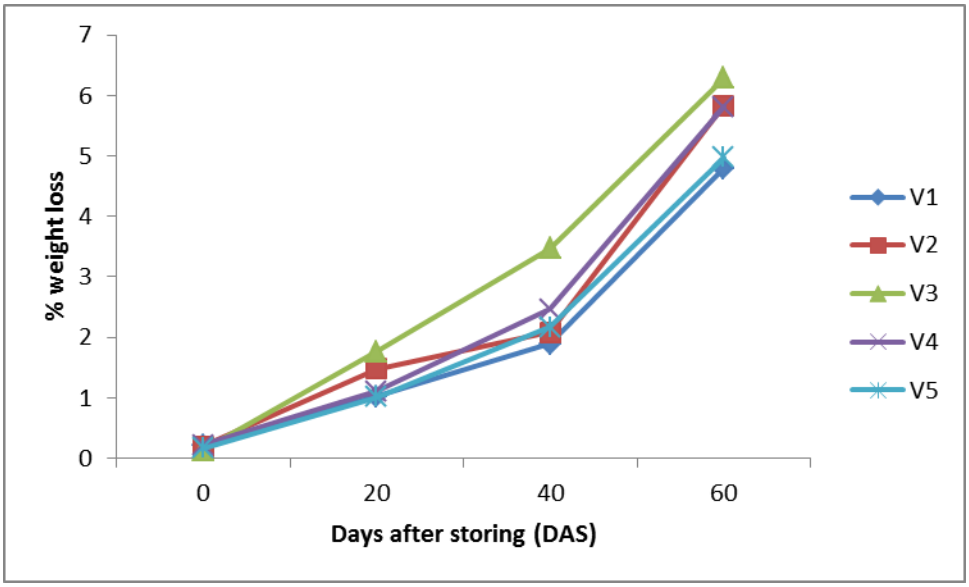


Fig. 13. Weight loss (%) of potato as influenced by different varieties in ambient condition (LSD value .1045, .1198 and .2945 at 20, 40 and 60 DAS, respectively)

V_1 = Asterix
V_2= Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

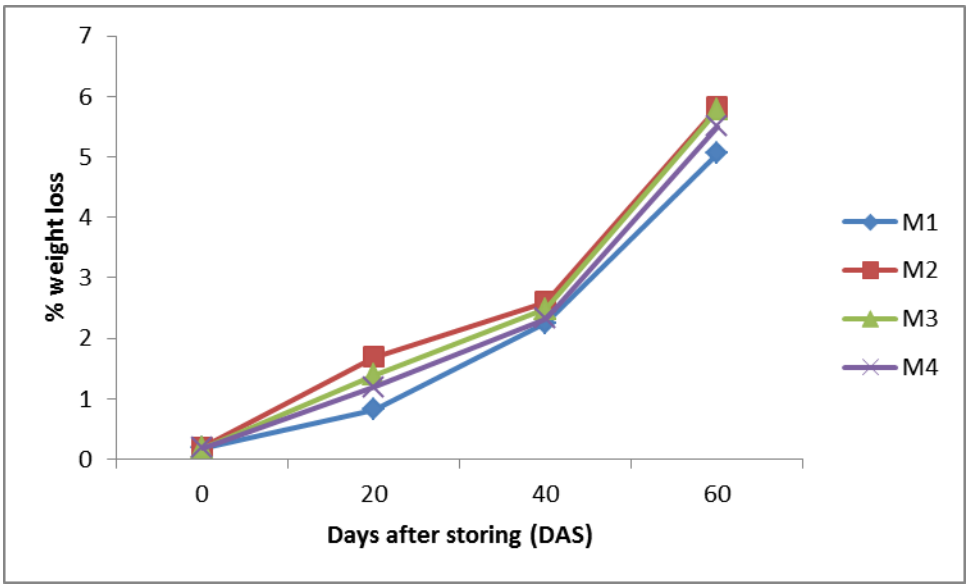


Fig. 14. Weight loss (%) of potato as influenced by different mulch materials in ambient condition (LSD value .2603, .1603 and .1551 at 20, 40 and 60 DAS, respectively)

M1 = Control M2 = Water Hyacinth
M3 = Rice straw M4 = Rice husk

Table 4.11 Combined effect of varieties and mulch materials on weight loss (%) of potato under varying storage period

Treatment	% Weight loss		
	20 DAS	40 DAS	60 DAS
V_1M_1	0.360 k	1.527 k	4.163 k
V_1M_2	1.580 c-d	2.707 c-d	5.857 d
V_1M_3	0.850 h	1.787 j	5.493 e-f
V_1M_4	1.327 e-g	2.187 g-h	6.020 c-d
V_2M_1	0.653 h-j	2.027 h-i	4.777 h-i
V_2M_2	1.120 f-g	2.123 g-h	5.013 g-h
V_2M_3	2.343 b	2.650 d-e	5.210 f-g
V_2M_4	1.787 c	1.873 i-j	5.973 c-d
V_3M_1	0.590 i-j	2.277 f-g	4.557 i-j
V_3M_2	2.913 a	4.710 a	7.113 a
V_3M_3	1.107 g	1.633 j-k	5.717 d-e
V_3M_4	0.837 h	2.120 g-h	5.360 f
V_4M_1	1.320 e-g	2.737 c-d	5.880 d
V_4M_2	1.347 e-f	2.697 c-d	6.183 b-c
V_4M_3	0.443 j-k	1.647 j-k	4.430 j-k
V_4M_4	1.327 e-g	2.650 d-e	5.827 d
V_5M_1	0.683 h-i	3.847 b	6.323 b
V_5M_2	2.747 a	2.913 c	6.863 a
V_5M_3	1.527 d-e	1.780 j	5.213 f-g
V_5M_4	0.717 h-i	2.420 e-f	4.837 h-i
$LSD_{0.05}$	0.2091	0.2218	0.2716
CV(%)	2.759	3.112	4.754

In a column means having similar letter (s) are statistically similar at 5% level of significance and those having dissimilar letter (s) differ significantly

V_1 = Asterix
V_2 = Lady rosetta
V_3 = Courage
V_4 = Diamant
V_5 = BARI TPS-1

M_1 = Control
M_2 = Water Hyacinth
M_3 = Rice straw
M_4 = Rice husk

CHAPTER VI

SUMMARY AND CONCLUSION

An experiment was conducted at the Agricultural farm of Sher-e-Bangla Agricultural University, Dhaka during the period from November, 2014 to June, 2015to study the yield and quality of potato (*Solanum tuberosum* L.) as influenced by different mulches and their performance in ambient condition. The experiment comprised of two factors namely 1) five different potato varieties (‘Asterix’, ‘Lady rosetta’, ‘Courage’, ‘Diamant’ and ‘BARI TPS-1’) and 2) four mulch materials (control, water hyacinth, rice straw and rice husk). The experiment consisting of 20 treatment combinations was laid out in the Randomized Complete Block Design (RCBD) with three replications. Sprouted seed tubers were planted in the field on 17 November 2014. Observations were made on yield and quality of storage. The collected data were analyzed and the differences between means were evaluated by Multiple t-test.

Different varietal treatments played important role on the yield and storage quality of potato. Variety V_4 (‘Diamant’) showed highest tuber yield t ha^{-1}, highest number of marketable yield (%),highest marketable yield(t ha^{-1}), highest % number of seed potato, highest seed potato yield (t ha^{-1}), highest % number of french-fry potato and highest weight of french-fry potato (t ha^{-1}), strong firmnes, where the variety V_3 (‘Courage’) showed lowest firmness, lowest tuber yield t ha^{-1}, lowest number of marketable yield (%), lowest marketable yield (t ha^{-1}), lowest % number of seed potato, lowest seed potato yield (t ha^{-1}) with highest TSS, Reducing sugar and Sucrose content. But ‘Lady rosetta’ showed highest dry matter content and specific gravity.

In terms of mulch materials, different mulching practices also showed positive response on skin and flesh color of potato. The mulch material M_3 (Rice straw) showed highest firmness, specific gravity, % dry matter, sucrose sugar content, tuber yield t ha^{-1}, number of marketable yield (%), marketable yield (t ha^{-1}), % number of seed potato, seed potato yield (t ha^{-1}), % number of french-fry potato and weight of french fry potato (t ha^{-1}) where M_1 (Control) treatment showed lowest firmness, specific gravity, % dry matter, reducing sugar, sucrose content, % weight loss, tuber yield t ha^{-1}), number of marketable yield (%), weight of marketable yield (t ha^{-1}), % number of seed potato and seed potato yield (t ha^{-1}). But M_4 (Rice husk) showed highest TSS**;** M_2 (Water Hyacinth) showed highest reducing sugar and % weight loss and M_1 (Control) showed highest % number of chips potato, weight of chips potato (t ha^{-1}), % number of non-seed potato and non- seed potato yield(t ha^{-1}).

In case of combined effect of variety and mulching practices; different treatment combination gave significant response on skin and flesh color of potato. Again, the treatment combination of V_4M_3 ('Diamant' × Rice straw) showed highest firmness, yield contributing characters and sucrose content where V_3M_4 ('Courage'× Rice husk) gave highest TSS and V_3M_2 ('Courage'× Water Hyacinth) gave highest reducing sugar and % weight loss.

The following conclusions could be drawn from the results of the present experiment.

1. Considering yield of potato, variety V_4 ('Diamant') gave the best performance and the variety V_2 ('Lady rosetta') gave satisfactory results for quality and 'Asterix' also gave good quality in some respect
2. In case of mulching practices, M_3 (Rice straw) showed the best performance for the maximum parameters and M_2 (Water Hyacinth) also gave satisfactory results

3. In terms of combined effect of variety and mulching materials; V_4M_3 (‘Diamant’ × Rice straw) was the best in respect of yield but (‘Lady rosetta’ × rice straw) was good for quality of potato

From this experiment it can be said that, adequate measures regarding these factors can improve potato yield with quality at great extent. More researches should be undertaken for improvement of this crop.

REFERENCES

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

Abong, G. O., Okoth, M. W., Imungi, J. K. and Kabira, J. N. (2010). Evaluation of selected Kenyan potato cultivars for processing into potato crisps. *Agric. Biol. J. North America*, **1**(5): 886-893.

Ahmad, K. U. (1979). Strategy of potato production in Bangladesh. Proc. Second Workshop of Potato Research Workers. Potato Research Centre, BARI, pp. 1-6.

Ahmad, K. U. and Kader, A. N. M. (1981). Indigenous potato varieties in Bangladesh. *Bangladesh J. Agril. Res*. **6**(1): 45-50.

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.

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

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

Anonymous. (1989). Central tuber crops research institute annual report. Thruvandrum, p. 86.

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

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

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

Azad, B., Hassandokht, M. R. and Parvizi, K. (2015). Effect of mulch on some characteristics of potato in Asadabad, Hamedan. *Int. J. Agron. Agric. Res. (IJAAR)*. **6**(3): 139-147.

Barton, W. G. (1989). The potato. Longman Scientific and Technical. 3^{rd} edition, 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.

Begum, B. and Saikia, M. (2014). Effect of irrigation and mulching on growth and yield attributes of potato. Agricultural Research Communication Centre. *Agric. Sci. Digest*. **34**(1): 76-78.

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.

Bhattacharjee, A. K., Singh, K. and Singh, K. K. (1979). Water management of the soils in the northern plains. Of Bihar (India): *J. Indian Potato Assoc*.**6** (2): 95-98.

Bhuyan, A. M. (2003). Effect of mulch and crop management practices on growth and yield of potato. MS thesis, Dept.of Hort., BAU, Mymensingh.

Bieloral, H. (1970). Water preservation by small-scale hydrological circulation in plastic tunnel. Hassadeh. **50**(80):987-989.

Brown, C. R. (2005). Antioxidants in potato. *American J. Potato Res*. **82**: 163-172.

Burger, M. S. and Nel, P. C. (1984). Potato irrigation scheduling and straw mulching. *South Africa J. Plant Soil.* **1**(4): 111-116.

Burton, W. G., Van, Es. A., Hartmans, K. J. (1992). The physics and physiology of storage. In: Harris PM (ed) The potato crop, 2nd ed[n]. Chapman and Hall, London, 608–727.

Caruso, G., Carputo, D., Conti, S., Borrelli, C., Maddaluno, P. and Frusciante, L. (2013). Effect of mulching and plant density on out-of-season organic potato growth, yield and quality. Department of Horticulture, University of Florence, Firenze, Italy. *Adv. Horti. Sci.* **27**(3): 115-121.

Challaiah and Kulkarni, G.N. (1979). Studies on the response of potato *(Solanum tuberosum* L.) to various soil moisture levels and mulches and its economics in relation to tuber yield. *Mysore J. Agril. Sci*. **13**(1): 35-40.

Chowdhury, M. M. H., Karim, A. J.M. S., Hossain, M. M. and Egashira.K. (2000). Yield and water requirement of indigenous potato grown on a clay terrace soil of Bangladesh. *J. Agril. Unive.***45** (2): 621 - 629.

Collins, M. (1997). Economic analysis of wholesale demand for sweet potatoes in Lima, Peru. M. Sc. Thesis, Department of Agricultural and Resource Economics, University of Florida, Gainesville, U.S.A.

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., 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.

Devaux, A. (1984). Thrue potato seed development. Circular, International Potato Center. **12**: 6-7.

Devaux, A. and Haverkort. A. J. (1987). The effect of shifting planting dates and mulching on late blight (*Phytophthora infestans*) and drought stress of potato crops grown under tropical highland conditions. Expt. Agric. **23**(3): 325-333.

Doring, T. F., Brandt, M., Hess, J., Finckh, M. and Saucke, H. (2005). Effect of straw mulch on yield, weed development, nitrate dynamics and soil erosion in organic potatoes. *Field Crops Res.* **94**: 238–249.

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.

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.

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

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.

Harris, R. E. (1965). Polythene covers and mulches for corn and bean production in northern regions. Proc. *Amer. Soc. Hort. Sci*. **87**:288-294.

Hossain, M. J. and Rashid, M. M. (1991). Keeping quality of tubers derived from true potato seed (TPS) under natural storage condition. *Bangladesh J. Bot*. **20**(1): 21-26.

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.

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.

Hossain, M. J. Habib, A. K. M. A. and Hossain, A. E. Bhuiyan, M. K. R. and Zakaria, M. (1992). Storability of tubers of some indigenous potato cultivars under natural storage. *Bangladesh Hort*. **20**(2): 81-88.

Hossain, M. M., Siddique, M. A. and Husain, A. (1984). Performance of some exotic and local cultivars of sweet potato in the summer climates of Bangladesh. *Bangladesh Hort*. **12**(1): 31-39.

Ifenkwe, O. P. and Tong, D. D. (1987). Effect of mulch on dry-season yields of 10 potato varieties in the Jos Plateau of Nigeria. Ottawa, Canada. International Development Research Centre.70-72 ISBNO-88936-498-2 [Cited from Field Crop Abstr.**42** (9): 7248, 1980].

Ismail, Z. E. (1988). Some of the physio-mechanical properties for potato planters. *J. Agric. Sci. Mansoura Uni*. **13** (4), 2259 – 2270.

Jalil, M. A. (1995). Effect of different mulches on the growth and yield of potato *(Solanum tuberosum).* MS thesis, Dept.of Hort., BAU, Mymensingh.

Kabira, J. and Berga, L. (2003) Potato processing quality evaluation procedures for research and food industryapplications in East and Central Africa. Kenya Agricultural Research Institute, Nairobi, Kenya.

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.

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. Appli, Nat. Soc. Sci.* **2**(6): 39-46.

Keeps, M. S. (1979). Production of field crops. 6th Edn. Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi. p. 369.

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

Khalak, A. and Kumaraswamy, A. S. (1992). Effect of irrigation of schedule and mulch on growth attributes and dry matter accumulation of potato. *Indian J. Agron.* **37**(3): 510-513.

Khan, A. L. Rashid, A. Bari, M. A. and Habib, A. K. M. A. (1981). Rejuvenation of local varieties through cleaning of yellows. Proc. 4th Workshop of potato Res. Workers, Potato Res. Centre, BARI, Joydebpur, Gazipur. pp. 85-88.

Kim, S. B., Kim, K. T., Park, Y. M. and Kang, B. K. (1988). Effect of harvesting times on the quality of potato tubers in fall cropping. *RDA J. Hort. Sci*. **40**(2): 136-140.

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.

Lamont, W. J. (1993). Plastic mulches for the production of vegetables crops. Hort. Tech. **3**(10): 35-39 [Cited from Hort Abstr., **64**(3): 1997]

Lang, H. (1984). Use of polythene film in early potato growing for reliability, yield and quality. Kartoffelbau. **35**(2): 65-69. [Cited from Potato Abs. **10**(2): 137, 1985.]

Lee, H. L., Choi, H. K., Yim, H. G. and Kim, H. J. (1985). Study on storage of sweet potatoes in a man-made cave. Research Reports of the Rural Development Administration, plant Environment, Mycology and Farm Products Utilization, Korea Republic. **27**(1): 127-130.

Linnemann, A. R., Van,Es. A., 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.

Lisinska, G. and Leszezynski, W. (1989). Potato science and technology, University Press, New York, USA. pp. 101-121.

Madalageri, M. B. (1999). True potato seed (TPS) technology for rainfedvertisols. IV. Tuber uniformity and storage behaviour of TPS genotypes vis-a-vis tuber planted cultivars. *Adv. Plant Sci. Res. India*. **10**: 29-32.

Maga, J. A. (1980) Potato glykoalkaloids. *Crit. Rev. Food Sci. Nut.*. **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.

Mangaser, V. T., Caccam, M. C. and Menguita, M. C. (1986). Planting dates and mulching effects on potato variety Cosima. *Philipine J. Crop Sci*. **11**:12-15.

Manrique, L. A. and Meyer, R. (1984). Effect of soil mulches on soil temperature, plant growth and potato yield in acridicisothermic environment in Peru. Turrialba, **34**(4): 413-419[Cited from Potato Abstr. **10**(11); 1649, (1985)

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

Natheny, T. A., Hunt, P. G. and Kasperbaucr, M. J. (1992). Potato tuber production in response to reflected light from different colored mulches. Crop Sci.**32** (4): 1021-1024.

Nourian, F., Ramaswamy, H. S. and Kushalappa, A. C. (2003). Kinetics of quality change associated with potatoes stored at different temperatures. *LWT-Food Sci. Technol*. **36**: 49-65.

Omidi, M., Shahpiri, A. and Yada, R. Y. (2003). Callus induction and plant regeneration in *vitro* in potato. Potatoes-healthy food for humanity: international developments in breeding, production, protection and utilization. A proceedings of the XXVI international horticultural congress, Toronto, Canada, 11-17, August, 2002. *Acta Hort*. **619**: 315-322.

Patel, H. R., Shekh, A. M., Patel, G. C., Mistry, D. S. and Patel, C. T. (1999). Influence of soil temperature on potato emergence. *J. Indian Potato Assoc*. **26**: 23–26.

Patil, A. V. and Basad, A. D. (1972). Effect of different mulching treatments on soil properties growth and yield of tomato (Var. Sioux). *Indian J. Hort*. **29**(2): 175-205.

Picha, D. H. (1986). Weight loss in sweet potato during curing and storage; contribution of transpiration and respiration. *J. American Soc. Hort. Sci*. **11**(6): 889-892.

Prihar, S. S. (1986). Fertilizer and water use efficiency in relation to mulching. *Indian J. Agron*. **32**(4): 452-454.

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.

Rasul, M. G., Islam, M. S., Nahar, M. S. and Sheikh, M. H. R. (1997). Storability of different potato varieties under natural condition. Bangladesh *J. Sci. Ind. Res*., **XXXII** (4): 161-170.

Rashid, A., Ahmed, K. U. and Habib, A. K. M. A. (1981). Effect of artificial mulching on the performance of potato. *Bangladesh J. Hort*. **961**(1-2) 24-26.

Razzaque M. A. and Alib M. A. (2009). Effect of Mulching Material on the Yield and Quality ofPotato Varieties underno Tillage Condition of Ganges TidalFlood Plain Soil. *Bangladesh J. Sci. Ind. Res.* **44**(1), 51-56.

Razzaquea, M. A. and Alib, M. A. (2009). Effect of Mulching Material on the Yield and Quality of Potato Varieties under no Tillage Condition of Ganges Tidal Flood Plain Soil. *Bangladesh J. Sci. Ind. Res.***44**(1), 51-56.

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.

Sarker, M. H. and Hossain, A. K. M. A. (1989). Effect of weeding and mulching on the growth and yield of potato *(Solanum tuberosum* L). *Bangladesh J.Agric*. **14**(2): 105-112.

Schwarz, D. and Geisel, B. (2012). Special Storage Problems. This information is adapted from the publication titled Guide to Commercial Potato Production on the Canadian Prairies published by the Western Potato Council, 2003. pp. 101-07.

Shehata, S. A. and Abo-Sedera, F. A. (1994). Effect of irrigation frequency and N, K level on growth, yield, chemical composition and storage ability of potato. *Zagazig J. Agric. Res*. **21**: 129-149.

Shock, C. C., Holmas, Z. A., Stieber, T. D., Eldredge, E. P. and Zhangn, P. (1993). The effect of timed water stress on quality, total solids and reducing sugar content of potatoes. *American Potato J.* **70**:227-241.

Siddique, M. A. and Rashid, M. M. (1990). Scope for increasing indigenous potato Varieties of Bangladesh. In Seed Potato in Bangladesh. Proceedings of the international seminar on seed potato. Bangladesh Agricultural Development Corporation. Dhaka. Jan. 8-10, 1990. pp. 166-167.

Siddique, M. A. and Rashid, M. H. (2000). Role of true potato seed in potato development program.Workshop on potato Development in Bangladesh, ATDP/IFDC,Dhaka,Bangladesh,pp:43-48.

Sieczka, J. B. and Maatta, C. (1986). The effect of handling on chip color and sugar content of potato tubers. *American Potato J.* **63**:363-372

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.

Sowa, G. and Kuzniewicz, M. (1989). Cause of losses during potato storage. *Plant Breeding Abst.* **59**(7): 643.

Sutater, T. (1987). Shading and mulching effect on potato yield. Bull. Penelitian-Hortikultura. **15**(2): 191-198.

Taja, H. and Vandcr-Zaag, P. (1991). Organic residue management in the hot tropics: influence on the growth and yield of Solanum potato and maize. *Tropical Agric.* **68** (2): 111-118.

Uddin, M. A. (1997). Effect of mulching and fertilizer management practices on the growth and yield of garlic. MS Thesis, Department of Crop Botany, BAU. Mymensingh, Bangladesh.

UNDP-FAO. (1988). Land resources appraisal of Bangladesh for agricultural development. Report to Agro-ecological regions of Bangladesh. UNDP- FAO, BGD/81/ 035 Technical Report 2. p. 570.

Van Ittersum, M. K., Scholte, K. and Warshavsky, S. (1993). Advancing growth vigor of seed potatoes by a haulm application of gibberellic acid and storage temperature regimes. *American J. Potato Res*. **70**(1): 21-34.

Vaezzadeh, M., and Naderidarbaghshahi, M. (2012). The effect of various nitrogen fertilizer amounts on yield and nitrate accumulation in tubers of two potato cultivars in cold regions of Isfahan (Iran). *Intl. J. Agril. Crop Sci.* **4**(22): 1688-1691.

Walter, W. M. Jr., Collins, W.W., Truong, V. D. and Fine, T. I. (1997). Physical, compositional and sensory properties of French fry-type products from five sweet potato selections. *J. Agric. Food Chem*. **45**: 383-388

Whilhoit, J. H., Morse, R. D. and Vaughan, D. H. (1990). Strip tillage production of summer cabbage using high residue levels. *Agric.res*. **5**(4): 338-342.

Yamaguchi, M., Timm, H. and Spurr, A. R. (1964). Effect of soil temperature on growth and periderm structure of tubers. *Proc. American Soc.Hort.Sci.* **84**: 412-423

Zelalem, A., Tekalign, T., Nigussie, D. (2009). Response of potato (*Solanum tuberosum* L.) to different rates of nitrogen and phosphorus fertilization on vertisols at Debre Berhan, in the central highlands of Ethiopia. *African J. Pl. Sci*. **3**: 16–24.

Zewide, I., Mohammed, A. and Tulu, S. (2012). Effect of different rates of nitrogen and phosphorus on yield and yield components of potato (*Solanum tuberosum* L.) at Masha District, Southwestern Ethiopia. *Intl. J. Soil Sci*. ***7***: 146–156.

PLATES

Plate 1: Asterix potato produced from different treatment combination

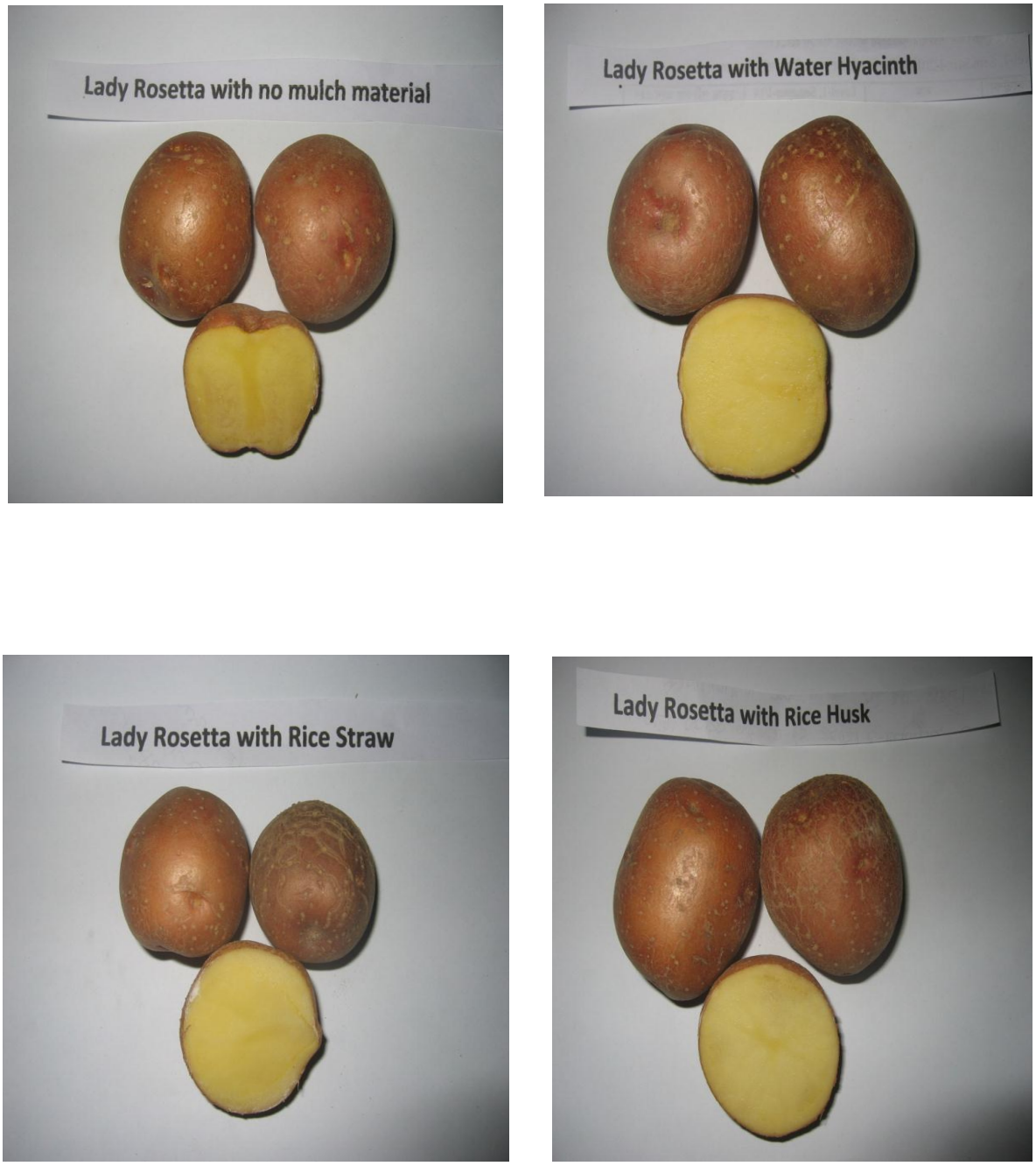


Plate 2: Lady rosetta potato produced from different treatment combination

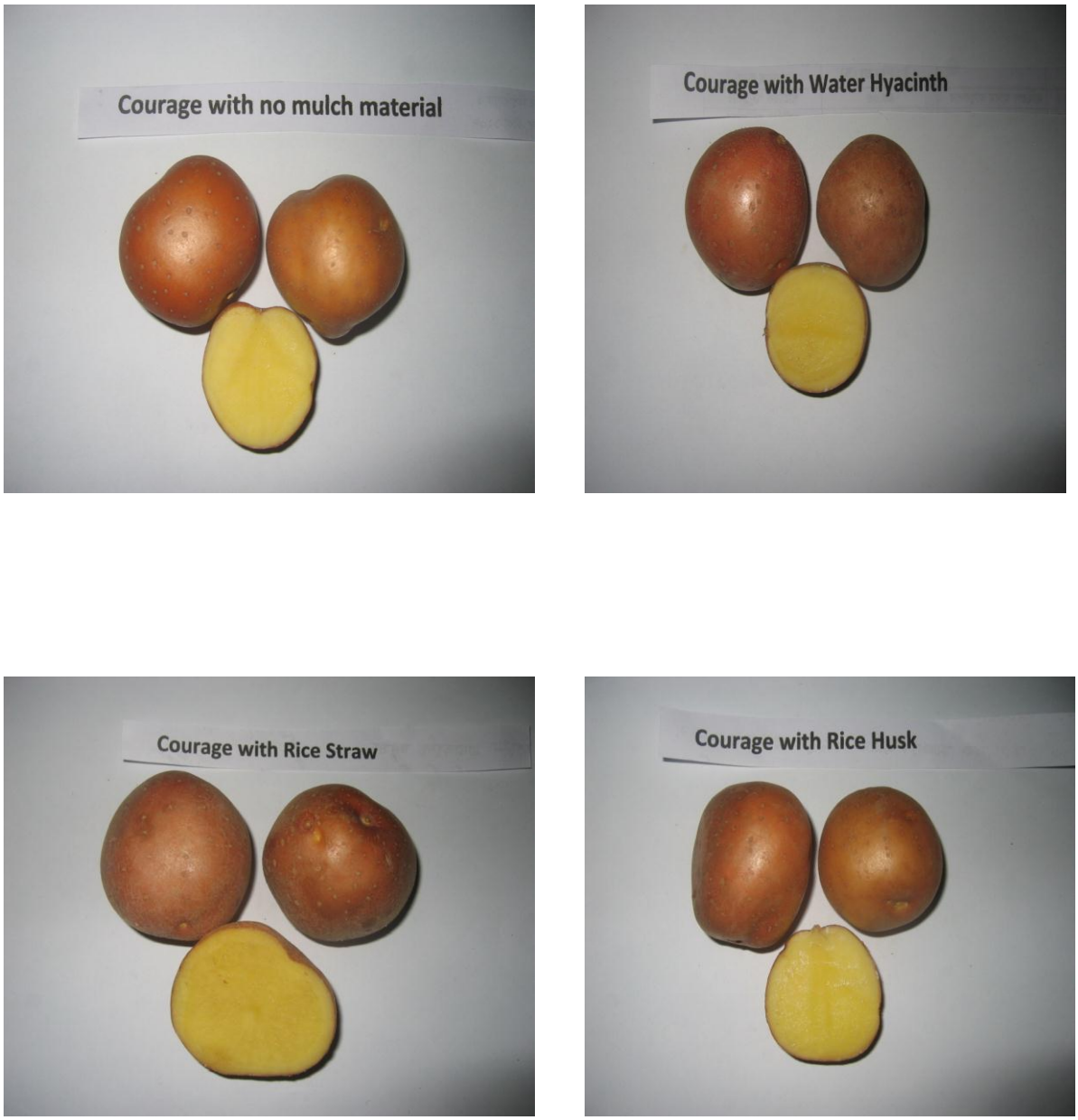
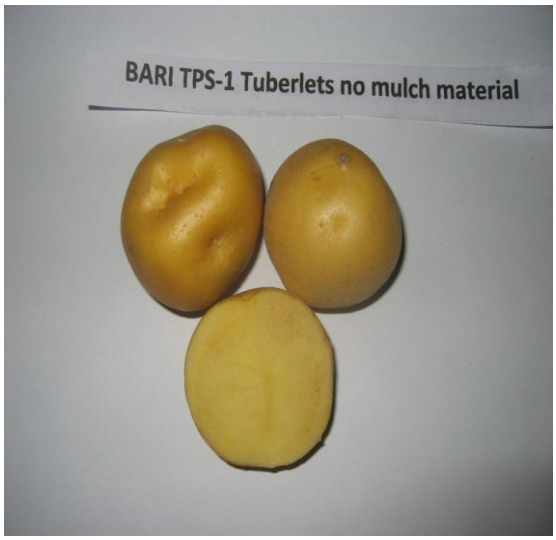
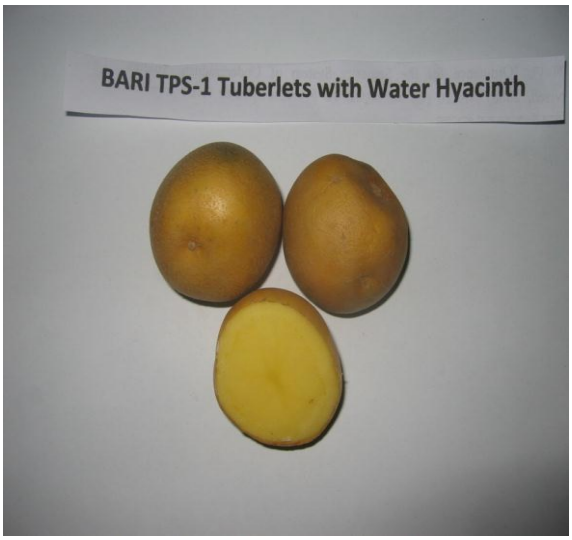


Plate 3: Courage potato produced from different treatment combination

Plate 4: Diamant potato produced from different treatment combination





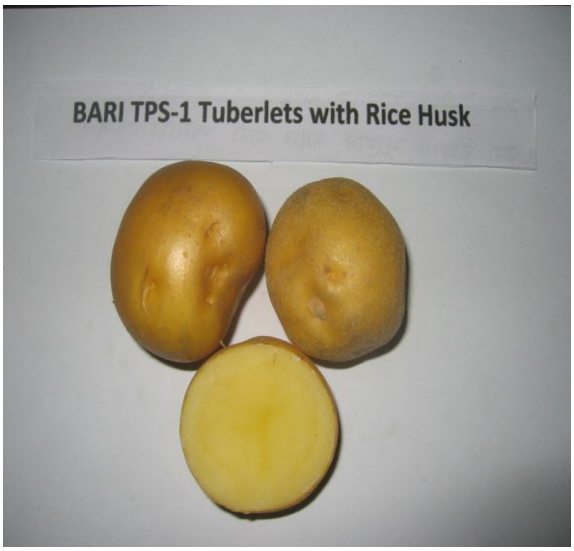


Plate 5: BARI TPS-1 potato produced from different treatment combination

APPENDIX

Appendix I. Monthly record of air temperature, rainfall, relative humidity, soil temperature and Sunshine of the experimental site during the period from November 2014 to March 2015

Month	Average air temperature (°C)			Average relative humidity (%)	Total rainfall (mm)	Total Sunshine per day (hrs)
	Maximum	Minimum	Mean			
November, 2014	29.7	20.1	24.9	65	5	6.4
December, 2014	26.9	15.8	21.35	68	0	7
January, 2015	24.6	12.5	18.7	66	0	5.5
February, 2015	36	24.6	30.3	83	37	4.1
March, 2014	36	23.6	29.8	81	45	3.9

Source: Bangladesh Meteorological Department (Climate & weather division), Agargoan, Dhaka – 1212

Appendix II. Yield parameters of potato as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of Yield parameters				
		Tuber yield (t ha^{-1})	Number of marketable yield (%)	Number of non-marketable yield (%)	Marketable yield(t ha^{-1})	Non-marketable yield(t ha^{-1})
Replication	2	2.692	1.066	2.814	1.617	1.950
Factor A	4	12.478*	0.301**	13.277*	15.142*	6.233*
Factor B	3	20.794*	0.075**	23.620*	65.133*	5.461**
AB	12	0.918**	0.019**	0.879**	29.564**	7.878*
Error	38	1.990	0.032	1.996	1.652	5.845

* = 5% level of significance ** = 1% level of significance

Appendix III. Grading parameters of potato as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of Grading of potato							
		% number of seed potato	Seed potato yield (t ha^{-1})	% number of french-fry potato	Weight of French fry potato (t ha^{-1})	% Number of chips potato	Weight of chips potato (t ha^{-1})	% Number of non-seed potato	Non-seed potato yield (t ha^{-1})
Replication	2	2.550	1.888	2.200	1.011	4.850	1.931	2.467	1.306
Factor A	4	6.392*	3.052*	0.600**	0.042**	7.808*	2.363**	12.208*	3.827*
Factor B	3	7.661*	6.315*	0.200**	0.008**	4.794*	11.267*	16.933*	4.361*
AB	12	5.869**	0.337**	0.200**	0.008**	4.142**	0.671**	5.642*	0.890**
Error	38	265.094	1.951	0.019	0.017	243.569	2.181	2.502	1.250

* = 5% level of significance ** = 1% level of significance

Appendix IV. Dry matter content (%) of potato as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of % Dry matter			
		0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	74.979	2.531	2.470	2.534
Factor A	4	8.222**	3.528*	18.200*	3.220*
Factor B	3	21.548*	5.824**	11.171*	8.196*
AB	12	29.591*	12.854*	21.942*	11.301*
Error	38	8.826	7.168	4.768	6.082

* = 5% level of significance ** = 1% level of significance

Appendix V. Specific gravity of potato harvest as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of Specific gravity			
		0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	0.000	0.000	0.039	0.002
Factor A	4	NS	NS	NS	NS
Factor B	3	NS	NS	NS	NS
AB	12	NS	NS	NS	NS
Error	38	0.001	0.000	0.018	0.002

* = 5% level of significance ** = 1% level of significance

Appendix VI. Quality of potato showing skin color as influenced by different varieties and mulch materials and their performance in ambient condition

Source of variation	Degrees of Freedom	Mean Square of colour Skin L				Mean Square of colour Skin A				Mean Square of colour Skin B			
		0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	0.431	6.020	0.241	3.445	0.127	5.192	0.121	1.372	0.685	9.723	0.222	6.798
Factor A	4	12.27*	20.40*	19.721*	25.73*	12.03*	19.318	7.956*	17.192*	14.718*	22.609*	15.079*	27.817*
Factor B	3	4.675**	6.932*	1.365**	12.85*	0.386**	9.054	1.442**	16.622*	15.058*	13.277*	6.188*	2.805**
AB	12	7.080*	7.568*	4.985*	13.16*	1.396*	20.405	1.928**	6.627*	13.447*	10.372*	2.346**	16.710*
Error	38	2.281	2.792	1.121	4.018	0.133	3.339	0.443	3.890	0.665	2.165	1.462	4.852

* = 5% level of significance ** = 1% level of significance

Appendix VII. Quality of potato showing color flesh as influenced by different varieties and mulch materials and their performance in ambient condition

Source of variation	Degrees of Freedom	Mean Square of colour Flesh L				Mean Square of colour Flesh A				Mean Square of colour Flesh B			
		0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS	0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	1.322	7.591	3.168	2.289	0.017	1.604	0.411	0.116	7.891	11.683	40.265	0.395
Factor A	4	2.913**	11.476*	6.576*	3.387**	NS	36.543*	1.548**	16.22*	3.919**	8.357*	49.823*	8.619*
Factor B	3	3.663**	4.477*	1.278**	4.793*	NS	1.384**	4.000*	4.553*	4.549*	7.527*	11.342*	9.390*
AB	12	3.227**	4.493*	5.209*	5.507*	NS	20.648*	2.009**	15.085*	14.834*	20.59*	54.620*	7.323*
Error	38	1.709	1.667	1.016	1.425	0.076	6.069	0.908	1.077	4.314	4.795	37.288	3.518

* = 5% level of significance ** = 1% level of significance

Appendix VIII. Quality of potato indicated by firmness as influenced by different varieties and andmulch materials their performance in ambient condition

Source of variation	Degrees of Freedom	Mean square of Firmness			
		0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	1.016	3.548	4.517	1.000
Factor A	4	72.831*	19.323*	27.477*	43.234*
Factor B	3	30.625*	11.591*	14.928*	26.230*
AB	12	41.405*	9.429**	8.811**	33.350*
Error	38	19.148	7.255	9.331	16.762

* = 5% level of significance ** = 1% level of significance

Appendix IX. TSS of potato as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of TSS			
		0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	0.429	0.002	0.128	1.781
Factor A	4	6.563*	3.343*	6.695*	11.059*
Factor B	3	0.729**	1.638*	1.932*	0.828**
AB	12	1.766*	0.362**	0.668**	1.209**
Error	38	0.891	0.259	0.222	0.315

* = 5% level of significance ** = 1% level of significance

Appendix X. Reducing sugar of potato as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of reducing sugar			
		0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	0.000	0.001	0.001	0.000
Factor A	4	NS	NS	0.030**	0.023**
Factor B	3	NS	NS	0.031**	0.028**
AB	12	0.002**	0.003**	0.011**	0.013 **
Error	38	0.001	0.000	0.000	0.000

* = 5% level of significance ** = 1% level of significance

Appendix XI. Sucrose content of potato as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of Sucrose content			
		0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	0.000	0.007	0.006	0.005
Factor A	4	1.778*	1.014*	2.601*	8.601*
Factor B	3	0.065**	0.265**	0.344*	0.344**
AB	12	0.031**	0.134*	0.163*	0.163*
Error	38	0.001	0.002	0.003	0.003

* = 5% level of significance ** = 1% level of significance

Appendix XII. Weight loss (%) of potato as influenced by different varieties and mulch materials in ambient condition

Source of variation	Degrees of Freedom	Mean square of Weight loss (%)			
		0 DAS	20 DAS	40 DAS	60 DAS
Replication	2	0.008	0.203	0.024	2.227
Factor A	4	NS	1.308**	4.711*	4.774*
Factor B	3	NS	2.037*	0.376**	1.876*
AB	12	NS	1.528*	1.191**	0.865**
Error	38	0.001	0.361	0.212	1.127

* = 5% level of significance ** = 1% level of significance