EFFECT OF VERMICOMPOST ON GROWTH AND YIELD OF POTATO (*Solanum tuberosum* L.)

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EFFECT OF VERMICOMPOST ON GROWTH AND YIELD OF POTATO (*Solanum tuberosum L.*)

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CERTIFICATE

This is to certify that the thesis entitled **"EFFECT OF VERMICOMPOST ON GROWTH AND YIELD OF POTATO (*Solanum tuberosum* L.)"** submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **HORTICULTURE**, embodies the result of a piece of *bona fide* research work carried out by **MD. JAHIDUL ISLAM**, Registration No. **09-03387** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated: June, 2015
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Dedicated To
My Beloved Parents

ABBREVIATIONS AND ACRONYMS

AEZ	=	Agro-Ecological Zone
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
FAO	=	Food and Agricultural Organization
DAS	=	Days after sowing
et al.	=	and others
LER	=	Land Equivalent Ratio
LSD	=	Least Significant Difference
MoP	=	Muriate of Potash
pH	=	Hydrogen ion conc.
RCBD	=	Randomized Complete Block Design
TSP	=	Triple Super Phosphate

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The Author

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ABSTRACT

An experiment was carried out at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka during the period from November 2014 to February 2015 to evaluate the effect of vermicompost on growth and yield of potato. The experiment was laid out in a Randomized Complete Block Design with three replications. The experiment consisted of two factors viz., three varieties (V_1= Diamant, V_2= Cardinal and V_3= Lady Rosetta) and four levels of vermicompost (T_0= Control, T_1= Vermicompost at 6 t ha^{-1}, T_2= Vermicompost at 8 t ha^{-1} and T_3= Vermicompost at 10 t ha^{-1}). Results revealed that variety and vermicompost and also their interaction had significant effect on all growth parameters and yield contributing characters. In case of variety, and vermicompost the highest tuber yield (24.64 t ha^{-1}) and (26.30 t ha^{-1}) were found from V_1 and T_2 respectively. In terms of combined effect the highest number of tuber $hill^{-1}$ (8.1), weight of tuber $hill^{-1}$ (343.3 g), tuber weight $plot^{-1}$ (6.18 kg), dry weight of 100 g tuber (23.2 g) and the highest tuber weight ha^{-1} (27.47 t) were obtained from V_1T_2. So, it can be concluded that vermicompost 8 t ha^{-1} can be used as organic manure.

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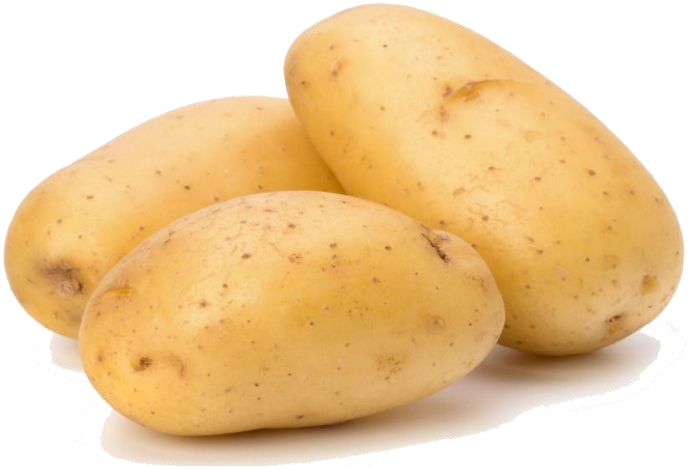


Chapter I

Introduction

CHAPTER I

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a tuber crop belongs to the family Solanaccae. It originated in the central Andean area of South America (Keeps, 1979). Potato was introduced in this subcontinent in the sixteenth century. It was grown then in small plots as a vegetable. Potatoes have been grown in Bangladesh since at least in the 19th century. By 1920s, the first commercial production of the crop was established in the country (Islam *et al.*, 1980).

Potato is one of the most important food crops grown in almost all countries of the world. Over one billion people consume potato worldwide and it is the staple diet of half a billion people in developing countries. Potato ranks fourth in the world (325.30 million tons) and third in Bangladesh (8.0 million tons) with respect to food production (Elias and Nazrul, 1982). Nutritionally, the tuber is rich in carbohydrates or starch and is a good source of protein, vitamin C and B, potassium, phosphorus, and iron. Being a carbohydrate rich crop, potato can partially substitute rice, which is our main food item. Because of the dry matter, edible energy and edible protein content, potato is considered nutritionally a superior vegetable as well as a versatile food item not only in our country but also throughout the world. Various other food items are also made from potato. Recently, the government has been trying to diversify food habits and encourage potato consumption to reduce pressure on rice.

Potato has become one of the major food and cash crops in Bangladesh. Recent reports indicate that in 2013-14 year the area coverage (4.6 lakh hectare), production (90.9 lakh MT) and yield (19.4 t ha^{-1}) (BBS, 2014). The average yield of potato was 14.89 t ha^{-1} in Bangladesh (FAO, 2005) that is very low in comparison to that of other leading potato growing countries in the world, such as, USA (43.49 t ha^{-1}), Denmark (39.41 t ha^{-1}) and UK (43.38 t ha^{-1}) (FAO, 2005). The reasons for low yield of potato in Bangladesh are climatic

limitation, poor yielding seed tubers and unscientific production practices such as imbalanced fertilizer management and soil moisture regulation.

Potato is undoubtedly one of the most important crop which requires both organic and mineral fertilizer for higher yield. Continuous use of inorganic fertilizer in crop cultivation is causing health hazards and creating problems to the environment including the pollution of air, water and soil. The use of chemical fertilizer is badly affecting the texture and structure of the soil, decreasing soil organic matter and hampering soil microorganism activity (Brady, 1990). The organic matter of most of the soils of Bangladesh is below 2% as compared to an ideal minimum value 4% (Bhuiya, 1994). The extensive use of chemical fertilizer and pesticides has become a matter of great concern in recent days. Both chemical and organic manures can play a major role to improve this situation. Asumus and Gorlitz (1986) observed that combined application of OM and mineral fertilizer increased potato yield. Ilin *et al.* (1992) also observed that application of mineral fertilizers and OM increased tuber yield by 43-45.3%. Nutrients in organic forms significantly affect potato plant growth, development and yield (Plaza, 2004). The use of organic amendments such as traditional thermophilic composts has long been recognized as an effective means of improving soil structure, enhancing soil fertility, increasing microbial diversity and populations (Barakan *et al.*, 1995).

Vermicompost improves the physical, chemical and biological properties of soil (Kale, 1998). There is a good evidence that vermicompost promotes growth of plants (Rajkhowa *et al.*, 2000) and it has been found to have a favourable influence on all yield parameters of crops like wheat, paddy and sugarcane (Ansari, 2007).

It is evident that use of vermicompost is a very important variable in potato production. Depending on the above discussion, the present research was undertaken with the following objectives:

1. To study the varietal performance of potato in respect of growth and yield

2. To find out the optimum dose of vermicompost for enhancing the growth and yield of potato

3. To evaluate the suitable combination of variety and vermicompost for successful potato production

Chapter II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

In this chapter, research works have been reviewed relating to the application of different organic manures with or without inorganic fertilizer to different potato varieties on the yield and yield contributing characters.

2.1 Effect of variety on the growth and yield of potato

Hossain *et al.* (1991) conducted a yield trial with thirty exotic varieties and studied that the highest yielding varieties on average over 3 generations (1986-87 to 1988-89) were cardinal (23.9 t ha^{-1}) and Diamant (23.4 t ha^{-1}). The largest proportions of medium grade tubers were produced by Lady Rosetta and Nicola. Morene, Origo and Mondial showed promising results for a number of traits.

Anonymous (1991) conducted a trial with 24 exotic potato varieties and found that the highest mean yield was obtained from Obelix (22.38 t ha^{-1}) in the first generation. The second highest yield was produced by Thebes (20.58 t ha^{-1}) closely followed by Arinda, Binella, Cosmos, Ajiba and Cardinal with a range from 19.77-18.90 t ha^{-1}. In the second generation, Bartina gave the highest average yield of 24.3 t ha^{-1} followed by Escort (22.3 t ha^{-1}), Mondial (21.4 t ha^{-1}) and check variety Diamant (21.0 t ha^{-1}). The varieties namely, Alkon, Liseta, Morene, Obelix, Thebes, Ajiba and Allard produced average yield ranging from 19.0 to 21.0 t ha^{-1} which was slightly lower than that of Diamant. The varieties Flavostar (21.3 t ha^{-1}), Mondial (20.0 t ha^{-1}) and variety Morene (19.0 t ha^{-1}) produced on an average higher yield and that of check variety Diamant (18.9 t ha^{-1}) in the third generation.

Akhter *et al.* (1991) was studied the hulking behaviour of potato in exotic varieties recommended or likely to be recommended for commercial cultivation in Bangladesh. Varietal differences were observed for all the character studied. Greatest number of stolons and tubers per plants were

observed 70 days after planting but yield and dry matter content were greatest at 100 days. The highest yield varieties were Cardinal, Diamant and Desire in 1087-88 (434.1, 430.5 and 420.1 g plant^{-1}) respectively and Diamant in 1088-80 (317.0 g ha^{-1}).

Thirteen Dutch potato varieties were evaluated at different locations in Bangladesh during 1991-92 in their first, second and third generations (Anonymous, 1992). In the first generation, the mean yield over the locations showed that the variety Mondial was the top most yielder (28.1 t ha^{-1}) followed by Diamant (26.5 t ha^{-1}) and Obelix (25.0 t ha^{-1}). Diamant produced the highest mean yield (26.2 t ha^{-1}) in the second generation. In the third generation, the highest mean yield was obtained from Bartina (25.1t ha^{-1}) followed by Diamant (24.6 t ha^{-1}) and Alkon (23.6 t ha^{-1}).

Rosul *et al.* (1993) evaluated fifteen potato cultivars from the Netherlands for yield over 3 generation at Jessore during 1989-92. Fresh and dry yield were significantly higher in the second generation compared to the first and third generations. On average increase in fresh yield over first generation were observed in Bartina, Escort, Liseta, Romano and Morene (17.3-64.5%). Similarly dry matter yield increased in Bartina, Liseta, Escort, Morene and Thebes (17.6-67.4%). Overall Ajiba, Bartina, Liseta, Mondial Morene and Thebes slowed acceptable performance in comparison with the recommended cultivar Diamant.

Conducting an experiment with 10 exotic varieties of potato in their first generation at Tuber Crops Research Sub-centre, Bogra during the rabi season of 2002-03. Hoque (1993) reported that the tallest plants were found in the variety Provento while maximum number of stems hill^{-1} was produced by Diamant (4.3). In this trial, Medusa was found to be the highest yielder (22.7 t ha^{-1}). It was also reported that maximum marketable yield was obtained from Provento (80.8%) while Sante produced maximum amount (03.8%) of medium size (28-55 mm) tubers by weight.

Brief descriptions are given by Glukhov (1994) of 2 varieties bred, tested and multiplied by scientists of the All-Russian Institute of Potato Farming at their base at Belousovskoe Experimental Farm in the Kaluga province of European Russia. The former is able to give yields of 15 t ha^{-1} within 60 days of planting. The midlate Belousovskii produces 18-20 tubers $cluster^{-1}$. The flesh is white. The marketable tubers weigh 50-120 g and contain 25-26% dry matter and up to 20% starch.

Rabbani and Rahman (1995) carried out varietal yield trial on live indigenous potato varieties in the 1994-95 growing season. They found that Ausha took the shortest time (12.3 day) for 80% emergence and the variety Dohazarial took longest time (15.8 days) to complete 80% emergence. Maximum plant height was found in the variety Shadaguti (81.7 cm) while the variety Ausha was found to attain the minimum height (59.7 cm) at maximum vegetative growth stage. The highest number of tubers $hill^{-1}$ (27.5) was found in the variety Shadaguti on the other hand the lowest number of tuber hill (16.2) was found in the variety Lalpakri. They found that the variety Ausha gave the highest yield of tubers (26.30 t ha^{-1}). The lowest yield of tuber (22.92 t ha^{-1}) was found in the variety Lalshil.

Yield formation was studied by Reust (1997) in mid-early varieties Agria and Matilda, and mid-late Panda, grown during 1992-95. Mean daily yield increases varied from 500 to 1000 kg ha^{-1}, and high yielding variety Agria showed the highest rate of daily increase. Early in the season, starch content increased in proportion to the tuber bulking rate.

The results of field trials are summarized by Guarda *et al.* (1997) at 8 sites throughout Italy in 1997 to gather data on the morphological, production, phytopathological and food processing characteristics of 35 potato cultivars. A method is outlined which uses the data gathered to calculate a general varietal index. This index can be used to describe the relative merits of each variety, and hence to decide which varieties are best cultivated under different conditions and for different purposes.

Five potato cultivars of Dutch origin were compared in trials by Ghimbasan (1997) in Romania in 1993 on humus-semiclay and sandy (stony) soils. Doritta, Aminca, Sante, Carlita and Novita produced 46.91, 50.95, 45.00, 41.47 and 27.90 t ha^{-1} on the humus-semiclay soil and 42.94, 35.71, 36.67, 35.32 and 22.22 t ha^{-1} on the sandy soil. The tuber yields of Doritta and Aminca were not significantly different from the standard variety Sante, whereas Novita produced significantly lower yield than Sante on both types of soil.

Wu *et al.* (1997) conducted an experiment with potato variety Yushu-1 that was selected from the progeny of the cross Gaoyuan 7 × 762-93. Yushu-1 has early maturity, high yield, is resistant to disease and deterioration. It can be harvested 65 days after planting. Tuber yield is 33.7 t ha^{-1} in spring and 22.5 t ha^{-1} in autumn. The tubers have good quality and are suitable for export and processing. Yushu-1 can be grown on the plains as part of a double cropping system or by single cropping in mountainous districts.

A brief report is given by Kuznetsova (1997) of small-scale Russian tests over 12 years involving at least 3-4 varieties each year. Among the most promising varieties were Bronnitskii and the German variety Adretta. In tests of 5 varieties during 1995-96 (2 from the Netherlands and 3 from Russia), the highest yielding was Radja from the Netherlands (over 2 kg $plant^{-1}$). Promising also was the Russian variety Effekt, which responded well to cultural conditions. The best for flavour were those from the Netherlands.

Akhter *et al.* (2001) found that the introducing variety from Lima, Peru Heera, Chamak and Dheera are well suited and adopted to Bangladesh environment and have been approved by National seed board (NSB). The plant types tuber sizes and other morphological characters of these varieties are agronomically acceptable. The yield range of these varieties (28-45 ton ha^{-1}) are generally higher that of the check (25-30 ton ha^{-1}) variety Diamant.

Alam *et al*. (2003) conducted an experiment for the performance of some exotic potato varieties under Bangladesh conditions. Characterization was done with fourteen exotic varieties of potato namely Mondial, Granola, Cardinal, Ailsa, Petronese, Morene, Diamant, Cleopetra, Binella, Dheera, Multa, Kufri Sindhuri, Heera, Chamak and a local check (Lal Pakri) under Bangladesh condition. The plant traits were spready and green in color with no flowering habit except variety Chamak. The yield ranged of exotic varieties was 19.44 to 46.67 ton per hectare. Variety Ailsa produced the maximum yield (46.67 t ha^{-1}) which was followed by Cardinal and Mondial.

Hossain *et al.* (2003) observed that the yield contributing characters of the varieties differed significantly. Highest yield (27.31 ha^{-1}) was obtained from the variety Akira and it was identical to Jaerla (26.30 t ha^{-1}) and these two varieties out yielded the check variety Diamant (22.81 ha^{-1}). The varieties Carlita, Baraka, Jaerla, Bintje, Midas, Ultra, Akira, Dura, Granola, Futuri and Diamant yielded more than 20.0 t ha^{-1}. Most of the varieties perhaps did not able to show their full yield potentially due to the new environment of their first generation in Bangladesh.

A field experiment was conducted by Ray *et al.* (2004) in West Bengal, India during 1999-2000 and 2000-01 to study tuber yield, dry matter content and storage life of potato tubers under room temperature using newly released indigenous processing cultivars viz. Kufri Chipsona-1 and Kufri Chipsona-2 and six Dutch potato cultivars viz. Cardinal, Diamant, Ajax, Fresco, Marfona and Sante. The cultivar Kufri Jyoti was used as control. Among the nine cultivars, Diamant recorded the maximum tuber yield (30.53 t ha^{-1}) followed by Cardinal (29.76 t ha^{-1}), K. Chipsona-1 (26.53 t ha^{-1}), K. Jyoti (25.39 t ha^{-1}) and K. Chipsona-2 (24.07 t ha^{-1}). Only three cultivars viz. K. Chipsona-1 (21.98%), K. Chipsona-2 (20.85%) and Diamant (19.18%) recorded higher dry matter content than that of K. Jyoti (18.87%).

The evaluation of nine potato cultivars (Diamant, Desiree, 9511, 9620, 9619, 384093, Hateema, Adora and Draga) was done by Abbasi *et al*. (2004) in Faisalabad, Pakistan on the basis of different plant growth and yield parameters. The emergence percentage of all the cultivars showed non-significant difference except Draga, which gave the lowest percentage of emergence. Maximum numbers of plants were observed in Hateema, Desiree, Diamant and Adora. The cultivar 9619 gave maximum number of stems per hill. The highest number of large tubers per plot (66.75) was produced by 9620 and Draga gave minimum number of large tubers per plot (7.75) while maximum weight of large tubers per plot (6.09 kg $plot^{-1}$) was given by the variety 9620. The highest number of medium tubers per plot was produced by variety 9619 with 195.3 followed by Diamant with 168.3 numbers of medium tubers per plot, while Adora gave lowest number of medium tubers per plot (93.00). The maximum number of total tubers per plot (1343) was produced by 9619 followed by Diamant (1247.50). The maximum weight (54.11 kg $plot^{-1}$) of tubers was found in 9619 while the lowest weight (25.30 kg $plot^{-1}$) of tubers was given by Draga.

Luthra *et al.* (2006) reported that Kufri Arun is a medium maturing, main season, high yielding table potato variety suitable for cultivation in north Indian plains. It is a clonal selection from the cross between Kufri Lalima and MS/82-797. Its plants are tall and vigorous with field resistance to late blight. Its tubers are red, oval with shallow to medium eyes and creamy-light yellow flesh, and having good keeping quality. It is fertilizer responsive and capable of yielding 350-400 q ha^{-1} under optimum agronomical practices.

Pandey *et al.* (2006) reported that Kufri Chipsona-3 is a medium maturing, late blight resistant potato variety with oval tubers, white smooth skin and cream/pale yellow flesh. The variety is meant for processing, especially chip making, and is an improvement over the existing varieties Kufri Chipsona-1 and Kufri Chipsona-2. The total and process grade tuber yields of Kufri Chipsona-3 are higher than those of Kufri Chipsona-1 and Kufri Chipsona-2.

The total tuber yields are higher than even the popular table variety Kufri Bahar. Kufri Chipsona-3 yields excellent defect free tubers. The physical maturity of its tubers occurs at 110 days.

Awal *et al*. (2007) carried out an experiment to study the morphological characteristics and yield potentialities of 23 potato varieties viz., Almera, Ampera, Asterix, Aziza, Courage, Dheera, Diamant, Eldena, Espirit, Felsine, Granola, Innovator, Ladyolympic, Ladyrosetta, Laura, Marbel, Markies, Melody, Processor, Provento, Quiney, Remarka and Terragold. The varieties Ladyrosetta, Diamant, Provento, Granola and Dheera showed greater number of seed tuber emergence (>90%) while Terragold, Ladyolympic, Processor, Laura, Remarka and Almera showed poor performance (<40%) within 20 days after planting. Plant height ranged between 37 (Processor) to 76 cm (Quiney). Highest number of sprout per hill was produced in Diamant (8.53) followed by Innovator or Asterix while lowest in Ladyolympic (2.73). Largest canopy foliage expansion was noticed in Diamant (93%) followed by Quiney, Dheera and Innovator, and minimum (47%) in Ladyolympic. The varieties Diamant, Markies, Espirit and Ladyrosetta were found superior for most of the growth traits and produced more than 18 t ha^{-1} tuber while Ladyolympic, Eldena, and Terragold exhibited as poor yielder (<10 t ha^{-1}). The higher tuber yield of Diamant, Markies, Espirit and Ladyrosetta might be attributed due to the higher number or weight of tuber $hill^{-1}$.

2.2 Effect of vermicompost and other organic manures

Adhikari *et al*. (1992) in a field trial on potatoes cv. Kufri gave 150 Kg nitrogen as urea or ammonia sulphate + 40 tons cowdung manure 302 tons mustard oilcake or 20 tons poultry litter or 230 Kg nitrogen as urea or ammonium sulphate + 20 tons cowdung manure 1.6 tons mustard oilcake or 10 tons poultry litter ha^{-1} to give total nitrogen application in each treatment of about 310 Kg ha^{-1}. Tuber yield percentage of tuber > 45 mm and net profit

were maximum with the application of 150 Kg nitrogen as ammonium sulphate + 20 tons poultry litter ha^{-1}.

In another experiment Zavalin *et al*. (1993) also stated that the optimum potato yield of 27.1 t ha^{-1} was given by the plants having 90 Kg N+ 60 Kg P + 120 Kg K+ 5 t peat manure compos t ha^{-1}.

Guarda and Tassoni (1994) carried out an experiment on a clay-loam soil where they applied 0, 100, 200 or 300Kg N ha^{-1} in organic or mineral forms. Farmyard manure was applied in two split doses (30% immediately often planting and the rest 50 days later). They found that yield responses to N rate were dissimilar between the N sources. However, potatoes given organic nitrogen yielded 1-2 t ha^{-1} less than where mineral nitrogen was applied.

Krupkin *et al*. (1994) carried out an experiment to study effect of poultry manure, a mixture of poultry manure plus hydrolysis lignin, and a compost of poultry manure plus hydrolysis lignin organic fertilizers for potatoes, carrots and cabbage with and without irrigation. The results showed that these organic fertilizers improved yield and quality of the crop, especially on soil having a low content of nitrate N, but had only little effect on soils well supplied with nitrate N. the lignin based fertilizers i.e. a mixture of poultry manure hydrolysis lignin and a compost of poultry manure plus hydrolysis lignin were similar in their effect to poultry manure.

Another field experiment was conducted by Khalak and Kumaraswamy (1994) in red loam soil at Bangalore, potatoes cv. Kufri Jyoti to assess the effect on dry mater accumulation and growth attributes of potato as influenced by irrigation and fertilizer (50, 100, or 150 kg ha^{-1} each of N, P_20_5 and K_2O). They found that leaf area index, leaf area duration, total dry matter accumulation increased with the rate of $N + P_2O_5 + K_2O$ application.

Datta and Chakraborty (1995) conducted a field experiment with 0.50 or 100 Kg ha^{-1} each of N, P_20_5, K_20, and manure with 5 tons rice husk ash, 0.5 tons mustard oilcake or 10 tons FYM ha^{-1}. The highest potato tuber yield (27 t ha^{-1})

was obtained from the highest NPK rate used. Amongst the manures the tuber yield were in the under of FYM > rice husk ash> mustard oil cake. Blecharczyk and Skrzypezak (1995) observed that FYM reduced tuber dry matter and starch contents, but increased their yield.

A field experiment was carried out by Sarker *et al*. (1996) at the Gangachra Series of Mithapukur, Rangpur to assess the effect of fertilizers alone and in combination with cow dung on the growth and yield potato. They found that the highest tuber yields of 29.97 t ha^{-1} was produced by the combined effect of 150 kg N + 60 kg P + 120 kg K + 20 kg S + 40 kg Zn + 2 kg B + 15 kg Mg ha^{-1} + 5 t ha^{-1} of cow dung .

Ghosh and Das (1998) reported that the potatoes grown at Sriniketan (West Bengal) in winter 1995-96 and 1996-97 were given different biofertilizers and growth regulators. Treatments included combinations of Buckup (Well matured cattle manure containing vesicular arbuscular mycorrhiza and phosphate solubilizing bacteria), Elecra (liquid organic manure extracted from marigold plants), Bioplin (liquid suspension of Azotobacter), Micrin (liquid organic manure containing humic and fulvic acid), Vitormone (liquid suspension of several dormant Azotobecter species) and protein hydrolysate (plant growth regulators containing amino acids). Plant height and number of shoots $plant^{-1}$ increased considerably when the crop received both biofertilizer and growth regulators together. Crop growth rate, tuber bulking rate, large and medium sized tubers and total tuber yield were greatest from combinations of both biofertilizers and growth regulator. Among the single applications, Vitormone gave the greatest yield improvement (22.6%) followed by protein hydrolysate (22.1%). Combined application of Bioplin along with protein hydrolysate or Micrin and Elecra along with Vitormone, gave 38-42% yield improvement over controls.

Neher (1999) conductcd a field experiment at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh during the period from November, 1997 to February, 1998 in order to study the effect of fertilizer viz.,

no fertilizer, organic, inorganic, organic + inorganic and irrigation viz. no irrigation, irrigation at 20, 15 and 10 days interval. The results demonstrated that fertilizer management practices had significant effects on the yield and yield contributing characters. The maximum plant height (52.0 cm), fresh weight of haulm (0.102 Kg $hill^{-1}$, dry weight of haulm (10.078 g $hill^{-1}$), weight of tuber (396 g $hill^{-1}$) and yield of tuber (27.09 t ha^{-1}) were recorded when inorganic fertilizer managements were applied. However, the maximum number of main stems (3.65) per hill and dry matter of tubers (21.08%) were obtained from organic fertilizer management practices. Inorganic fertilizer management practices gave the highest percentage of >55mm (20.27) and 46-55mm (47.49) grade tubers. Inorganic fertilizer management practices gave significantly better result compared to other treatment.

Krishnamurthy *et al*. (2001) conducted field experiments in Bangalore, Karnataka, India, during the rabi seasons of 1996-97 and 1997-98 and investigated the effect of integrated use of organic manures and fertilizers on potato crops grown from true seed. The experiments consisted of 12 treatments combinations of organic sources: green plus at four tones ha^{-1} (organic manure), biofertilizers (*Azotobacter chroococcum*), city compost and control (no organic manure) and fertilizer levels (100, 125 and 150 % of recommended dose of NPK). The highest seed yield of 20.8% was recorded with green and followed by city compost (13.9%) and biofertilizer application (11.6%). The highest total tuber yield of 28.7 t ha^{-1} was observed with city compost, followed by green plus (27.4% t ha^{-1}) and biofertilizer (20.4% t ha^{-1}). Application of 150% recommended dose of NPK recorded the highest seed yield of 33.3 Kg ha^{-1} and tuber yield of 29.8 t ha^{-1}, closely followed by application of 125% of recommended doses of NPK. Combination of city compost and 150% recommended dose of NPK recorded the highest seed and tuber yield compared to all other treatment combinations.

Marks and Krzysztofik (2001) observed the effect of different forms of organic manure and cultivation techniques on the quality of potato tuber yield. The application of organic manure (processed biomass form) and patch growing of potatoes improved the quality of potato yield compared with farmyard manure and ridge cultivation.

Gladkikh *et al*. (2001) conducted a trial with mineral fertilizer (various rates and combinations of N, P and K) and organic fertilizer in a farm of pet manure^{-1} compost. The crop rotations comprised tomatoes, cabbage, carrots, potatoes and cucumbers. The results were given from the 10m rotation (1993-98). Yields were greatest in the treatments with complete mineral fertilizer, and with combined mineral and organic fertilizer.

Kaur and Singh (2001) conducted an experiment with potato to know the effects of inorganic and organic (farmyard manures) manure on yield and yield attributes and reported that chemical fertilizers along with farmyard manure increased potato yield than absolute application of chemical fertilizers.

Singh and Singh (2001) examined the effect of organic fertilizers (farmyard manure at 70% and oilseed cake + rock phosphate at 30%; Azotobacter at 20 kg ha^{-1} and oilseed cake + wood ashes + rock phosphate and NPK fertilizer at 60: 70: 70 kg ha^{-1}) on yield performance of radish and reported that the highest yield (122.4 q ha^{-1}) was obtained with farmyard manure and oilseed cake + rock phosphate.

Abuou-Hussein (2002) conducted an experiment with potato to evaluate the effect of chicken manure, compost and bio-fertilizer along or in combination on vegetative growth, tuber characteristics and yield and reported that chicken manure + compost + bio-fertilizer increased plant height, total yield, fresh and dry weight of leaves and stems than the other combination of manures.

Devi *et al*. (2002) conducted an experiment to assess the integrated use of organic manures, chemical fertilizer and microbial inoculants as bio-fertilizer on the yield and economics of aubersine cv. Jhuri. The treatments comprised of

50, 75 and 100% N alone or in combination with microbial inoculants and three sources of organic manure (Cowdung, slurry, poultry). Treatment with 50% N + 25% poultry manure + biofertilizer resulted the highest yield (27.6 t ha^{-1}) and benefit-cost ratio (7.7:1).

Urashima *et al.* (2002) conducted an experiment to know the effect of organic matter application (cattle faces compost and hog faces compost) on the quality and performance of radish and reported that the growth and leaf colour of radish were superior in the continuous compost applied plots with increasing rate of application. The authors further reported that the organic fertilization showed no significant effect on the quality of radish compared to that of chemical fertilizer application.

Experiments were conducted in Nigeria during 1998-99 to determine the effects of organic and inorganic fertilizers on the yield of potato cultivars by Okonkwo and Eanq (2003). The fertilizer treatments comprised full dose of poultry manure (4.4 t ha^{-1}), full dose of cow dung (4.9 t ha^{-1}), full dose of NPK fertilizer (100 kg N and P_2O_5 + 40 kg K_2O), half dose of NPK fertilizer + half dose of poultry manure, half dose of NPK fertilizer + half dose of cowdung and control (no fertilizer applied). Application of half dose of NPK + half dose of poultry manure or cowdung significantly increased potato yield than the control and this treatment was more economical than other treatments.

Boligowa and Glen (2003) conducted field experiments to investigate the yield and quality of potato cv. Ibis tuber under different organic fertilizer regimes. The organic fertilizers were: manure, stubble, spring barley straw and white mustard straw. The highest dry matter content was obtained with the combined application of straw with manure treatment and the highest yield was obtained under manure treatment.

Arafa (2004) conducted an experiment of different NPK treatments on growth, yield, quality and chemical components of two potato cultivars. The effects of 3 levels of NPK fertilizers, i.e. 125+30+100, 150+45+150 and 175+60+200 Kg

ha^{-1}, on the growth, yield and its components, quality as well as chemical compositions (N, P, K, Fe, Mn, Zn, reducing, no reducing and total sugars) of foliage and tubers of 2 potato cultivars (lady Rosetta and Hermis) were investigated under sandy soil conditions in Ismaalia Governorate, Egypt, during the summer seasons of 2002 and 2003. The second level of NPK significantly increased plant height, number of branches per plant, fresh and dry weights of plant foliage, numbers of tubers per plant, tuber weight, plant yield, total yield, marketable yield, large (more than 55 mm in diameter) tuber percentage and chemical composition of foliage and tubers. Hermis compared with Lady Rosetta significantly increased the vegetative growth, yield and its components as well as chemical composition of plant foliage and tubers.

Samsunnahar (2005) conducted an experiment with red amaranth to evaluate the effect of organic farming (cowdung, poultry manure, inorganic fertilizer, cowdung plus inorganic fertilizer and poultry manure plus inorganic fertilizer) on soil nutrient and yield performance and reported that the yield contributing characters were significantly influenced by different treatments. Organic manure in combination with inorganic fertilizer showed the best performance for plant height, which resulted the highest yield. Among the treatments, poultry manure in combination with inorganic fertilizer produced the highest yield. Furthermore, the same type of results was also reported by Islam (2005) in potato.

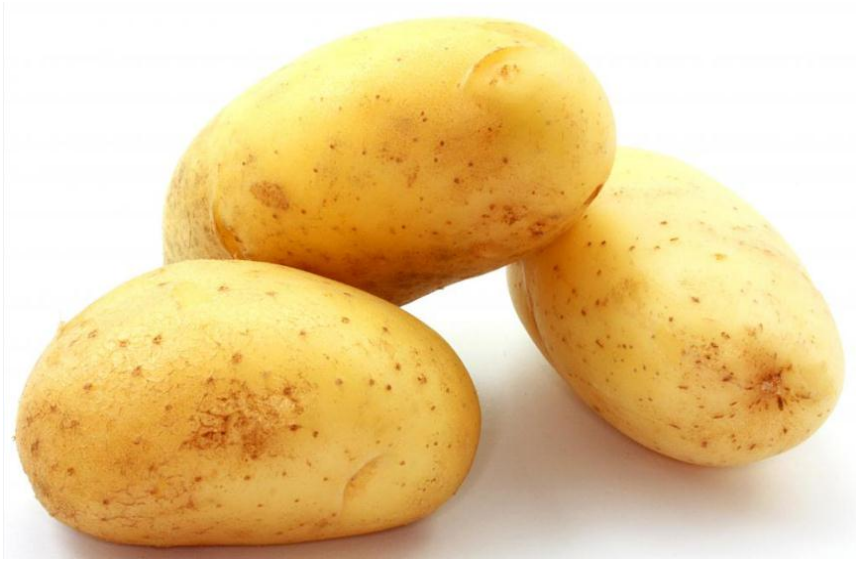
Dan and Thind (2005) conducted an experiment to know the effects of K_2O (0, 30, 60, 90 or 120 kg ha^{-1}), farmyard manure (0 or 50 t ha^{-1}) and irrigation level on the quality and yield of potato cv. Kufri Badshah in Punjab, India and reported that the yield of tubers of the grade A size increased by 94.5 and 70.3% with FYM application over no FYM application. The authors further reported that 60 kg K_2O and 50 t FYM ha^{-1} were optimum for enhancing potato tuber yield.

Alam *et al*. (2007) conducted an experiment to study the effect of vermicompost and NPKS fertilizers on growth and yield of potato (cv. Cardinal) in Level Barind Tract (AEZ-25) soils of Bangladesh. The organic matter of the experimental field soil was very low and in case of N, P, K and S also low. Application of vermicompost and NPKS significantly influenced the growth and yield of potato. The treatment, Vermicompost 10 t ha^{-1}+100% NPKS (doses of N-P-K-S were 90-40-100-18 kg ha^{-1} for potato) produced the highest (25.56 t ha^{-1}) tuber yield of potato. The lowest yield and yield contributing parameters recorded in control. Application of various amounts of vermicompost (2.5, 5, 10 t ha^{-1}) with NPKS fertilizers (50% and 100%) increased the vegetative growth and yield potato. Vermicompost at 2.5, 5 and 10 t ha^{-1} with 50% of NPKS increased tuber yield over control by 78.3, 96.9 and 119.5 t ha^{-1} respectively. And vermicompost at 2.5, 5 and 10 t ha^{-1} with 100% of NPKS increased tuber yield by 146.8, 163.1 and 197.9 %, respectively. The results indicated that vermicompost (10 t ha^{-1}) with NPKS (100%) produced the highest growth and yield of potato.

Ansari (2008) carried out an investigation to study the effect of vermicompost application in reclaimed sodic soils on the productivity of potato (*Solanum tuberosum*), spinach (*Spinacia oleracea*) and turnip (*Brassica campestris*). The soil quality was monitored during the experiment followed by productivity. The treatments were 4, 5 and 6 t ha^{-1} of vermicompost as soil application in plots already reclaimed by Vermitechnology. Among the different dosages of vermicompost applied there has been a significant improvement in the soil quality of plots amended with vermicompost @ 6 tonnes per ha. The overall productivity of vegetable crops during the two years of the trial was significantly greater in plots treated with vermicompost @ 6 tonnes per ha. The present investigation showed that the requirement of vermicompost for leafy crops like spinach was lower (4 t ha^{-1}), whereas that for tuber crops like potato and turnip was higher (6 t ha^{-1}).

Venkatasalam *et al*. (2012) conducted a study with FYM and vermicompost for different Indian potato cultivars to compare their effect on potato seed production. Uniform size (20-25 g) sprouted virus free buffer stock tubers of Indian potato cultivars viz., Kufri Ashoka, Kufri Badshah, Kufri Bahar, Kufri Chandramukhi, Kufri Chipsona 1, Kufri Chipsona 2, Kufri Kanchan, Kufri Lalima, Kufri Lauvkar and Kufri Pukhraj were planted (2-3 cm depth) in pots (20 × 20 cm) $3/4^{th}$ filled with two different organic manures in the ratio of 2:1. The approximate quantity of FYM and vermicompost used per pot was about 300 and 200 g respectively. The recommended dose of NPK fertilizers (120 N: 100 P_2O_5: 100 K_2O kg ha^{-1}) was applied in two split doses, 50% N, 100% P and 100% K at the time of planting and remaining 50% of N 45 days after planting (DAP). In general, most of the yield attributing characters of potato was significantly augmented by farmyard manure as compared to vermicompost. Results indicated that the plant height, number of compound leaves and tuber weight were significantly affected by organic manures and varieties whereas; the number of stems was significantly influenced by the type of organic manure and not by varieties. Organic manures significantly influenced the plant height, FYM enhanced the plant height in Kufri Ashoka, Kufri Bahar, Kufri Chandramukhi, Kufri Chipsona-2, Kufri Lalima, Kufri Lauvkar and Kufri Pukhraj whereas, vermicompost in Kufri Badshah. However, organic manures had no effect on plant height of Kufri Kanchan. The maximum number of tubers per plant was recorded in Kufri Lalima (18.2) with FYM, whereas they were minimum in Kufri Lauvkar (4.8) with vermicompost. The effect of vermicompost on number of tubers was as par with FYM in most of the varieties however, FYM statistically increased per plant tuber yield in almost all the varieties except Kufri Chipsona-2 and the maximum tuber yield per plant was recorded in Kufri Chipsona-1 (132 g).

Yourtchi *et al*. (2013) carried out a field experiment to study the effect of nitrogen fertilizer and vermicompost on vegetative growth, yield and NPK uptake by tuber of potato. Experimental factors included nitrogen fertilizer with three levels (50, 100 and 150 kg ha^{-1} as urea) and vermicompost with 4 levels (0, 4.5, 9, and 12 ton ha^{-1}). Results illustrated that the highest plant height, leaf and stem dry weight, Leaf Area Index (LAI), fresh and dry weight of tuber, total tuber weight, total number of tuber, tuber diameter, nitrogen percent of tuber, potassium percent of tuber and phosphorous percent of tuber were found from application of 150 kg N ha^{-1}. Data also demonstrated that vermicompost application at the rate of 12 ton ha^{-1} promoted all above traits except plant height in compared to control treatment. Furthermore, the interaction effects between different nitrogen rates and vermicompost application significantly improved growth parameters, yield and NPK content of tuber compared with nitrogen and/or vermicompost alone treatments. To gain highest yield and avoidance of environments pollution use of 150 kg N ha^{-1} nitrogen fertilizer and vermicompost application of 12 ton ha^{-1} are suggested.



Chapter III

Materials & Methods

CHAPTER III

MATERIALS AND METHODS

An experiment was carried out to study the effect of vermicompost on growth and yield of potato during the period from November 2014 to February 2015. Materials and methods of the present study have been discussed by the following headings –

3.1 Location of the experiment

The research work was carried out at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka-1207. The experimental field was located at $90^0 35'$ E longitude and $23^0 74'$ N latitude at a height of 8.2 m above the sea level (Anon, 1981).

3.2 Climate

The climate of the experimental field was sub-tropical and was characterized by high temperature, heavy rainfall during Kharif-1 season (March-June) and scanty rainfall during Rabi season (October-March) associated with moderately low temperature. The monthly average temperature, humidity, rainfall and sunshine hours prevailed at the experimental area during the study period were collected from the Bangladesh Meteorological Department (climate division) and have been presented in Appendix 1.

3.3 Soil

The land belongs to the Agro-ecological zone "Madhupur tract" (AEZ-28) having shallow red brown terrace soils and Tejgaon soil series (FAO, 1988). The soil of the experimental site were well drained and medium high. The physical and chemical properties of soil of the experimental site sandy loam in texture and having soil pH varied from 5.5-5.6. The analytical data of the soil sample collected from the experimental field were determined in the SRDI, Soil Testing Laboratory, Dhaka have been furnished in Appendix 2.

3.4 Planting Materials

The planting materials comprised the three seed tubers of high yielding variety Diamant, Cardinal and Lady Rosetta. The experimental potato accessions were collected from Bangladesh Agricultural Research Institute (BARI).

3.5 Treatments of the experiment

The experiment consisted of 2 factors namely, variety of tubers and application of different rates of vermicompost. **Factor A:** three potato varieties (V_1= Diamant, V_2= Cardinal, V_3= Lady Rosetta) and **Factor B:** different rates of vermicompost (T_0 = Control, T_1= Vermicompost at the rate of 6 ton ha^{-1}, T_2= Vermicompost at the rate of 8 ton ha^{-1}, T_3 = Vermicompost at the rate of 10 ton ha^{-1})

3.6 Design and layout of the experiment

The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications (Figure 1). Total area was divided into three equal block. A block consisted of 12 unit plots. As the experiment was replicated thrice, the total number of plots was 36. The size of unit plot was 1.5 m × 1.5 m. A spacing of 0.5 m was provided between the plots and 1 m spacing was provided between two blocks and followed plant spacing was 50 cm × 25 cm.

3.7 Seed tuber preparation

Pre-heating and fanning of seed tuber was done in cold storage premises. Then, they were kept in well ventilated place where defused light available for sprout initiation of tubers. The well sprouted tubers were selectively cut into uniform sizes (30-50 g), 24 hours before planting to get desired eye number.

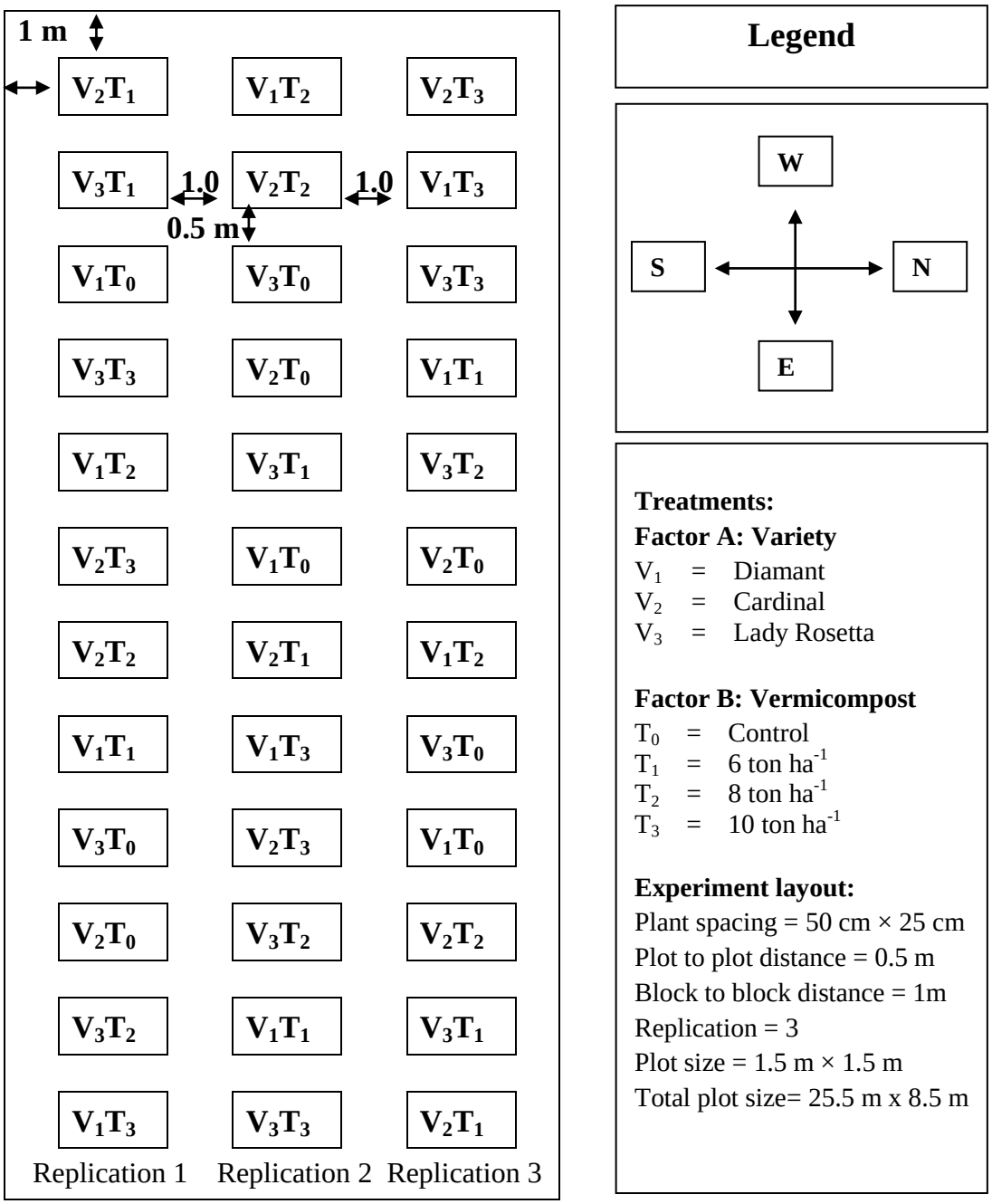


Fig.1. Layout of experimental field

3.8 Land preparation

The land of the experimental plot was first opened on 25 October, 2014 with a power tiller and it was exposed to the sun for few days prior to next ploughing. It was then thoroughly prepared by ploughing and cross ploughing with a power tiller followed by laddering to obtain a good tilth. The subsequent operations were done with harrow, spade, hammer, basket etc. The clods were broken into fine soil particles and the surface was leveled until the desired tilth was obtained. The weeds and stubbles were removed and the plots were prepared after applying the basal dose of manure and fertilizers. Irrigation and drainage channels were prepared around the plot. The soil was treated with insecticides (Furadan 5G @ 10 kg ha^{-1}) at the time of final land preparation to protect young plants from the attack of soil insects such as cutworm and mole cricket.

3.9 Manures and fertilizers

Manures and fertilizers applied to the plot according to "Krishi Projukti Hat Boi" of BARI. Instead of cowdung vermicompost was used as manure. The doses of manures and fertilizers have been stated below:

Manures and fertilizers Doses/hectare

Vermicompost	:	As per treatment
Urea	:	250 kg ha^{-1}
MoP	:	250 kg ha^{-1}
Gypsum	:	120 kg ha^{-1}
$ZnSO_4$	:	10 kg ha^{-1}
Boron	:	10 kg ha^{-1}
TSP	:	150 kg ha^{-1}

The entire amount of vermicompost as organic manure, TSP, MoP, Gypsum, $ZnSO_4$, Boron and half of Urea was applied as basal during final land preparation. The remaining half of urea was applied as side dressing at 35 days after planting during earthing up operation followed by irrigation.

3.10 Planting of seed tubers

The seed tubers were planted in the experimental plots on 15 November 2014 at a depth of 5 cm maintaining a spacing of 50 cm × 25 cm. Each plot accommodated 18 seed tubers in 3 rows, containing 6 seed tubers per row. The soil along the rows of seed tubers were ridged up immediately after planting

3.11 Intercultural operations

3.11.1 Weeding and mulching

Manual weeding was done as and when necessary to keep the plots free from weeds. The soil was mulched by breaking the crust of the soil for easy aeration and to conserve soil moisture as and when needed. Mulching also helped to disturb the emergence of Bathua plants (*Chenopodium album*) and other weeds. These two operations were done carefully without hampering the luxurious crop health.

3.11.2 Earthing up

The soil along the rows of seed tubers were ridged up immediately after planting. The earthing up was done at 35 days of the planting which was preceded by top dressing of the remaining half of urea and also it was treated as a final earthing-up.

3.11.3 Irrigation

Three irrigations were provided throughout the growing period. The first irrigation was given at 35 days after planting followed by two irrigations at 20 days interval after the first application.

3.11.4 Plant protection

Except cutworm, no other insects were found harmful for potato in growing season. To protect the soil borne insects Furadan 5G was applied @10kg ha^{-1} during the final land preparation. Dursban was applied @ 2 ml L^{-1} after 20 DAS to control the cutworm. Dithane M-45 was applied @ 2 g L^{-1} at 10 days interval as a preventive measure against late blight (*Phytophthora infestans*) of potato. Poison bait was used in some plots for protecting the tuber from the rat.

3.12 Haulm cutting

Haulm cutting was done at maturity level on 10 February, 2015. After haulm cutting the tubers were kept under the soil for skin hardening.

3.13 Harvesting

The maturity of the crop was determined by the appearance of the yellowish color of the leaves, falling of the stems on the ground and finally drying of leaves. Ten sample plants were harvested at first from each plot and then the whole plot was harvested with the help of spade. Care was taken to avoid injury of potatoes during harvesting. Harvesting was done on 18 February, 2015.

3.14 Collection of data

Data were recorded on different morphological, yield components and yield from ten randomly selected sample plants. Data on different parameters were recorded as per the following parameters:

3.14.1 Growth related

1. Plant height (cm)
2. Days to 100% emergence
3. Number of leaves plant^{-1}
4. Leaf length (cm)
5. Leaf breadth (cm)
6. Number of main stem hill^{-1}

3.14.2 Yield and yield related

1. Fresh weight of haulm hill^{-1}
2. Dry weight of haulm hill^{-1}
3. Number of tuber hill^{-1}
4. Weight of tuber hill^{-1} (g)
5. Tuber weight plot^{-1} (kg)
6. Dry weight of 100 g fresh tuber
7. Tuber yield ha^{-1} (t)

3.15 Procedure of recording data

3.15.1 Days required for 100% plant emergence

This was achieved by recording the number of days required to 100% plant emergence from the date of operation carefully.

3.15.2 Plant height

The height of the 10 sample plants (From those plants data were collected) was measured with a meter scale and was expressed in centimeter (cm). The height was measured from the base of the plant to the longest end of the shoot at 30, 45, 60 and 75 DAS.

3.15.3 Number of main stems per hill

The number of stem per hill was calculated from the average of 10 hills selected randomly from each unit plot and mean was calculated out.

3.15.4 Number of leaves plant^{-1}

Average number of leaves was counted from randomly selected 10 plants from each unit plot at 30, 45, 60 and 75 DAS.

3.15.5 Leaf length (cm)

Leaf length of selected leaves was taken from 10 randomly selected plants. Average length of compound leaves was determined from each unit plot at 30, 45, 60 and 75 DAS and was expressed in centimeter.

3.15.6 Leaf breadth (cm)

Leaf breadth of selected leaves was taken from 10 randomly selected plants. Average breadth of compound leaves was determined from each unit plot at 30, 45, 60 and 70 DAS and was expressed in centimeter.

3.15.7 Fresh weight of haulm hill^{-1}

Weight of haulm was taken from 10 randomly selected hill during harvest and average weight was expressed in gram. The weight of the haulm was immediately taken after harvest.

3.15.8 Dry weight of haulm hill^{-1}

After recording the fresh weight of the haulm, the haulms were chopped and dried well in sun for two days. The sun dried haulms were then oven dried at 65^0 C for 72 hours until a constant weight was achieved. The dry weight of the sample was recorded and the mean value was calculated and expressed in gram.

3.15.9 Number of tubers hill^{-1}

The number of tubers from 10 selected plants was counted at harvest and average number of tubers was calculated.

3.15.10 Weight of tubers hill^{-1} (g)

The weight of tubers from 10 selected plants from each unit plot were recorded at harvest and average weight of tubers per hill was calculated and expressed in gram.

3.15.11 Tuber weight plot^{-1} (kg)

The weight of tubers plot^{-1} was recorded at the time of harvest of all tubers from all plants of a unit plot.

3.15.12 Dry weight of 100 g fresh tuber

Samples of fresh potato from each plot was prepared and from each sample 100g fresh potato was taken for measuring dry weight. The tubers were chopped and dried well in sun then the sun dried tubers were dried in an oven at 65^0 C for 72 hours until a constant weight was achieved. Then the dry weight were measured and recorded.

3.15.13 Total yield ha^{-1}

The yield obtained from each unit plot was converted into per hectare yield and expressed in t ha^{-1}

3.16 Statistical analysis

The data obtained for yield contributing characters and yield were statistically analyzed to find out the significance of the differences among the treatments. The collected data from the experimental plot on morphology yield and yield contributing characters are compiled and analyzed using the MSTAT-C package program. Morphological variation and yield performance among the treatments were studied by Analysis of Variance (ANOVA) by F-test. The significance of the difference between pairs of treatment means was evaluated by least significant difference (LSD) test at 5% and 1% level of probability (Gomez and Gomez, 1984).

Chapter IV

Results and Discussion

CHAPTER IV

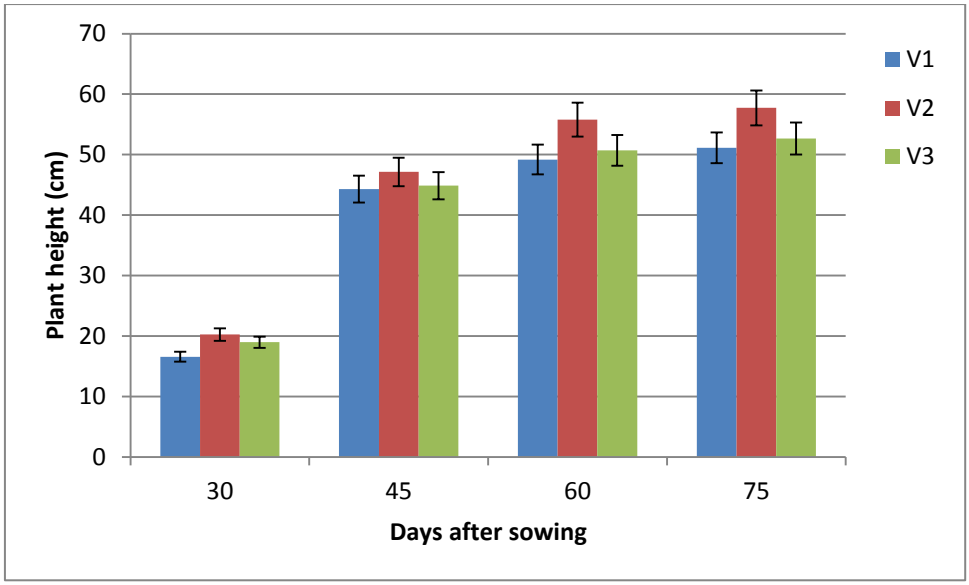
RESULTS AND DISCUSSION

The present experiment was conducted to determine the effect of vermicompost on growth and yield of potato. Data on different growth and yield contributing characters were recorded. The results of the present experiment have been presented and discussed with the help of table and graphs and possible interpretations given under the following headings –

4.1 Plant height

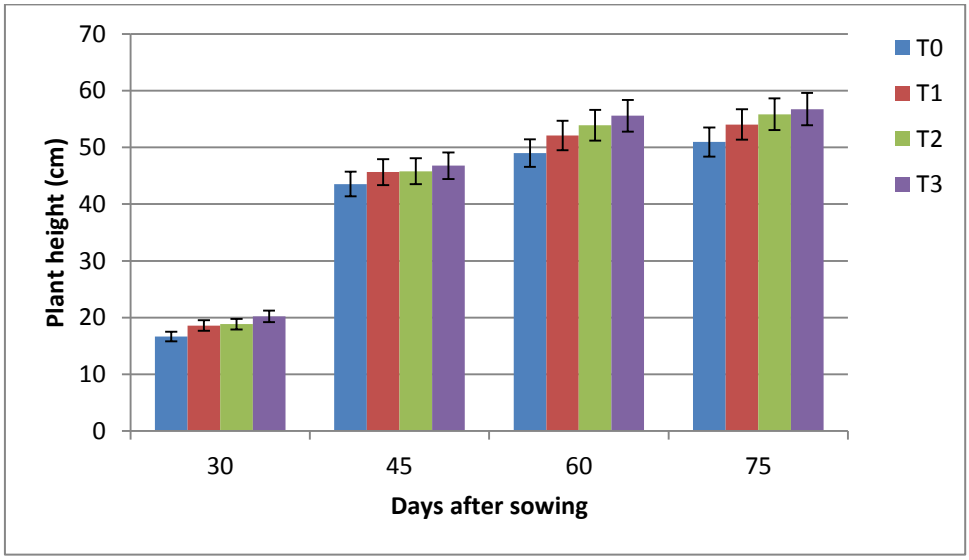
Significant variation was found in respect of different potato variety on plant height at different DAS (Figure 2 and Appendix 3). Results revealed that the highest plant height (20.2, 47.1, 55.8 and 57.7 cm at 30, 45, 60 and 75 DAS respectively) was recorded from V_2 (Cardinal) where the lowest plant height (16.6, 44.3, 49.2 and 51.2 cm at 30, 45, 60 DAS and 75 DAS respectively) was recorded from V_1 (Diamant). Intermediate results were found in V_3 (Lady Rosetta) at all growth stages. There it was also observed that plant height had increasing trend up to 60 days after planting and then very limited plant growth (plant height) was found at 75 DAS. Similar results were observed by Awal *et al*. (2007) and Rabbani and Rahman (1995) and they found that plant height was significantly influenced by different variety.

There was significant variation for using different levels of vermicompost on plant height of potato at different DAS (Figure 3 and Appendix 3). Results explained that the highest plant height (20.2, 46.8, 55.6, 56.7 cm at 30, 45, 60 and 75 DAS respectively) was achieved from T_3 (Vermicompost; 10 t ha^{-1}) which was statistically identical with T_2 (Vermicompost; 8 t ha^{-1}) at 75 DAS. On the other hand, the lowest plant height (16.7, 43.5, 48.9 and 50.9 cm at 30, 45, 60 and 75 DAS respectively) was observed from T_0 (Control) followed by T_1 (Vermicompost; 6 tha^{-1}) at all growth stages. The results were conformity with the findings of Yourtchi *et al*. (2013) and Venkatasalam *et al*. (2012).



V_1= Diamant, V_2= Cardinal, V_3= Lady Rosetta

Figure 2. Effect of variety on plant height of potato



T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

Figure 3. Effect of vermicompost on plant height of potato

Significant variation was found in combined effect of variety and vermicompost on plant height of potato at different DAS (Table 1 and Appendix 3). It was observed that at 30, 45, 60 and 75 DAS plant height was significantly influence by combined effect of variety and vermicompost. Results viewed that the highest plant height (22.3, 49.0, 57.3 and 62.6 cm at 30, 45, 60 and 75 DAS respectively) was found in V_2T_3 which was statistically identical to V_3T_3 at 60 DAS and at 75 DAS and closely followed by V_2T_1 at 45, 60 DAS and at 75 DAS. On the contrary the lowest plant height (15.4, 42.6, 46.2 and 50.0 cm at 30, 45, 60 and 75 DAS respectively) was found in V_1T_0 which was statistically same with V_1T_1, V_3T_0 and V_3T_1 at 75 DAS.

Table 1. Combined effects of variety and vermicompost on plant height of potato

Treatments	**Plant height (cm)**			
	30 DAS	**45 DAS**	**60 DAS**	**75 DAS**
V_1T_0	15.40 h	42.60 f	46.17 h	50.05 f
V_1T_1	17.07 f	45.93 de	49.33 fg	52.55 f
V_1T_2	16.67 fg	43.07 f	52.33 e	56.88 de
V_1T_3	17.13 ef	45.20 e	52.33 de	56.62 e
V_2T_0	16.10 g	44.97 e	53.10 de	59.28 cd
V_2T_1	17.73 e	47.93 ab	56.63 ab	61.95 ab
V_2T_2	19.67 c	46.60 cd	54.20 cd	59.22 cd
V_2T_3	22.33 a	49.00 a	57.27 a	62.62 a
V_3T_0	18.50 d	43.00 f	47.70 gh	50.42 f
V_3T_1	21.00 b	43.07 f	50.27 f	50.32 f
V_3T_2	20.20 c	47.67 bc	55.13 bc	59.72 bc
V_3T_3	21.20 b	46.07 de	57.07 a	62.48 a
$LSD_{0.05}$	0.6152	1.124	1.746	2.307
CV (%)	**10.94**	**5.76**	**12.32**	**12.01**

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

4.2 Days to 100% emergence

There was significant variation on days to 100% emergence of different variety of potato (Table 2 and Appendix 4). Results exposed that the maximum days to 100% emergence (15.7 days) was found in V_1 (Diamant) and the minimum days to 100% emergence (14.5 days) was found in V_3 (Lady Rosetta) while V_2 (Cardinal) showed (15.4 days) the intermediate result among the varieties. The present finding was similar with the findings of Awal *et al*. (2007). They found that the varieties Ladyrosetta, Diamant, Provento, Granola and Dheera showed greater number of seed tuber emergence (>90%) while Terragold, Ladyolympic, Processor, Laura, Remarka and Almera showed poor performance (<40%) within 20 days after planting.

Significant variation observed for different doses of vermicompost on days to 100% emergence of potato (Table 2 and Appendix 4). Results confirmed that the maximum days to 100% emergence (15.9 days) was recorded from T_0 (Control) and the minimum days to 100% emergence (14.6 days) was found from T_2 (Vermicompost; 8 t ha^{-1}) followed by T_1 (Vermicompost; 6 tha^{-1}) and T_3 (Vermicompost; 10 t ha^{-1}).

Days to 100% emergence of seedlings was significantly influenced by the combined effect of variety and vermicompost (Table 2 and Appendix 4). Result revealed that the maximum days to 100% emergence (16.3 days) was recorded from V_1T_0 which was closely followed by V_1T_1 and V_2T_0. Again, the minimum days to 100% emergence (13.7 days) was found in V_3T_2 followed by V_1T_2, V_2T_2, V_3T_1 and V_3T_3.

Table 2. Main and combined effects of variety and vermicompost on days to 100% emergence of potato

Treatments	Days to 100% emergence
Variety	
V_1	15.75 a
V_2	15.42 b
V_3	14.50 c
$LSD_{0.05}$	**0.1912**
Vermicompost	
T_0	15.89 a
T_1	15.33 b
T_2	14.56 c
T_3	15.11 b
$LSD_{0.05}$	**0.3799**
Combined effect	
V_1T_0	16.33 a
V_1T_1	16.00 ab
V_1T_2	15.00 de
V_1T_3	15.67 bc
V_2T_0	16.00 ab
V_2T_1	15.33 cd
V_2T_2	15.00 de
V_2T_3	15.33 cd
V_3T_0	15.33 cd
V_3T_1	14.67 ef
V_3T_2	13.67 g
V_3T_3	14.33 f
$LSD_{0.05}$	0.3824
CV (%)	**6.73**

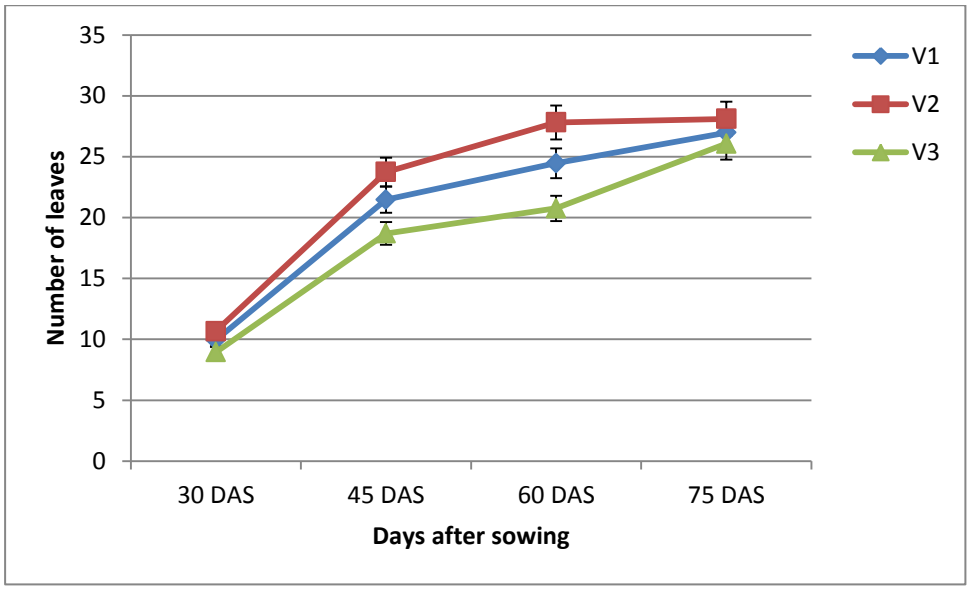
In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

4.3 Number of leaves plant^{-1}

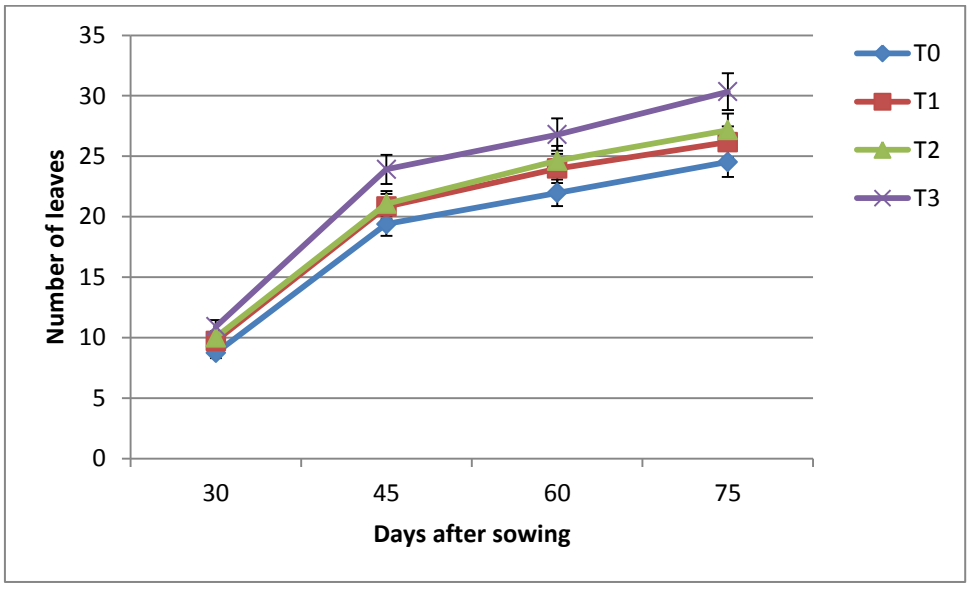
Different potato variety had significant effect on number of leaves plant^{-1} at different DAS (Figure 4 and Appendix 5). Results indicated that the highest number of leaves plant^{-1} (10.7, 23.7, 27.8 and 28.1 at 30, 45, 60 and 75 DAS respectively) was found from V_2 (Cardinal) which was statistically identical to V_1 (Diamant) at 30 DAS. Again, the lowest number of leaves plant^{-1} (8.9, 18.7, 20.8 and 26.1 at 30, 45, 60 and 75 DAS respectively) was recorded from V_3 (Lady Rosetta). The results obtained from V_1 (Diamant) gave intermediate result (21.5, 24.5 and 26.9 at 45, 60 and 75 DAS respectively). Such results under the present study might be due to cause of genetic characters and phenotypic variance which resulted varied leaf number plant^{-1}.



V_1= Diamant, V_2= Cardinal, V_3= Lady Rosetta

Figure 4. Effect of variety on number of leaves of potato

There was highly significant difference found for different levels of vermicompost on number of leaves plant^{-1} of potato at different DAS (Figure 5 and Appendix 5). Results explained that the highest number of leaves plant^{-1} (10.9, 23.9, 26.8 and 30.3 at 30, 45, 60 and 75 DAS respectively) were recorded from T_3 (Vermicompost; 10 t ha^{-1}) followed by T_2 (Vermicompost; 8 t ha^{-1}) and T_1 (Vermicompost; 6 tha^{-1}) at all growth stages. Another way the lowest number of leaves plant^{-1} (8.7, 19.4, 21.9 and 24.5 at 30, 45, 60 and 75 DAS respectively) were observed from T_0 (Control). Such results under the present study were supported by Yourtchi *et al*. (2013). They noticed that leaf and stem dry weight; Leaf Area Index (LAI) differed with the application of different rates of vermicompost.



T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

Figure 5. Effect of varmicompost on number of leaves of potato

Significant variation was found by combined effect of variety and vermicompost on number of leaves plant^{-1} of potato at different DAS (Table 3 and Appendix 5). Results showed that the highest number of leaves plant^{-1} (12.5, 25.6, 29.5 and 30.8 at 30, 45, 60 and 75 DAS respectively) were recorded from V_2T_3 which was statistically identical to V_1T_3 at 45 and 75 DAS and V_3T_3 at 75 DAS followed by V_1T_2, V_2T_2 and V_2T_1 at all growth stages. It was also recorded that the results from V_3T_0 was the lowest (7.5, 16.8, 17.4 and 22.9 at 30, 45, 60 and 75 DAS respectively) for number of leaves plant^{-1} followed by V_1T_0, V_1T_1 and V_3T_1 at all growth stages.

Table 3. Main and combined effects of variety and vermicompost on number of leaves plant^{-1} of potato

Treatments	**Number of leaves plant^{-1}**			
	30 DAS	**45 DAS**	**60 DAS**	**75 DAS**
V_1T_0	9.50 bc	18.77 gh	21.93 ef	23.33 ef
V_1T_1	8.33 cd	20.33 ef	23.70 de	24.90 de
V_1T_2	10.10 b	21.70 cd	25.10 cd	29.30 ab
V_1T_3	9.80 bc	25.07 a	27.10 b	30.10 a
V_2T_0	9.17 bc	22.57 bc	26.53 bc	27.33 c
V_2T_1	10.47 b	23.73 b	28.37 ab	28.23 bc
V_2T_2	10.13 b	23.07 b	26.83 bc	26.77 cd
V_2T_3	12.47 a	25.60 a	29.50 a	30.77 a
V_3T_0	7.53 d	16.83 i	17.43 h	22.90 f
V_3T_1	10.40 b	17.73 hi	19.83 g	25.37 d
V_3T_2	10.00 b	19.13 fg	21.97 f	25.40 d
V_3T_3	10.27 b	21.07 de	23.77 de	30.17 a
$LSD_{0.05}$	1.476	1.214	1.698	1.753
CV (%)	**8.47**	**6.21**	**9.45**	**11.51**

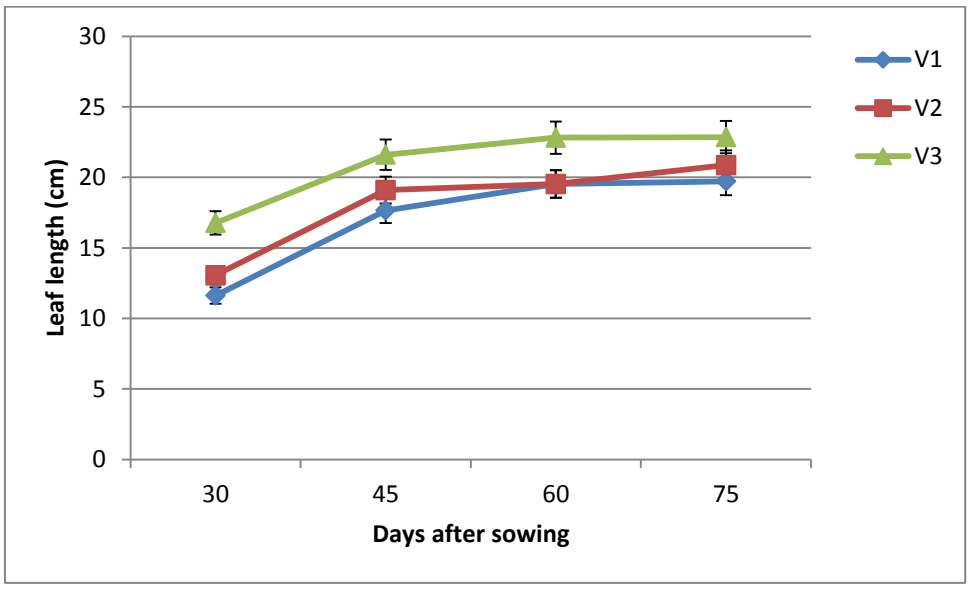
In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

4.4. Leaf length (cm)

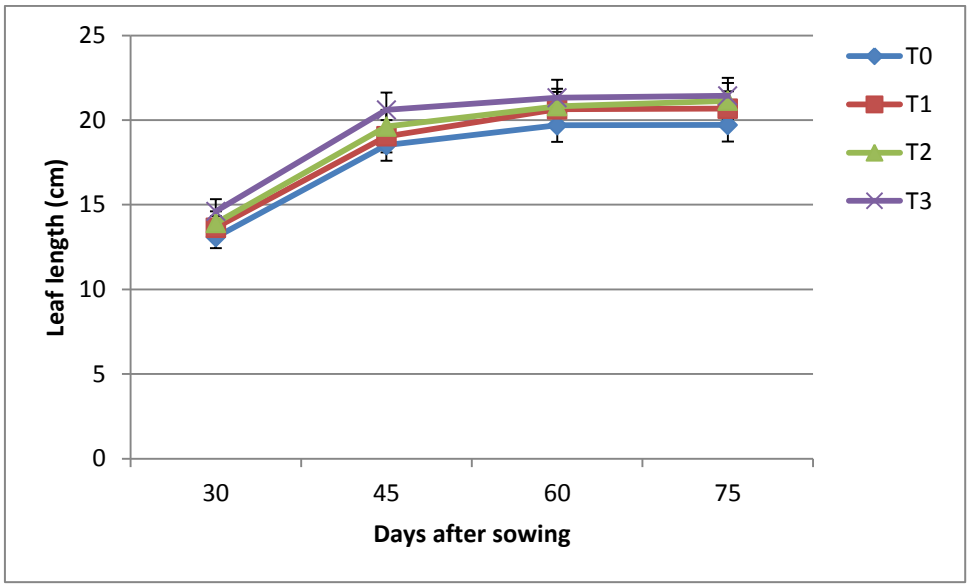
Leaf length was significantly influenced by different potato variety at different DAS (Figure 6 and Appendix 6). Results performed that the highest leaf length of potato (16.8, 21.6, 22.8 and 22.9 cm at 30, 45, 60 and 75 DAS respectively) was recorded from V_3 (Lady Rosetta) where the lowest leaf lengths of potato (11.6, 17.7, 19.5 and 19.7 at 30, 45, 60 and 75 DAS respectively) was found in V_1 (Diamant) but V_2 (Cardinal) gave intermediate results compared to highest and lowest number of leaves at all growth stages. Such results under the present study might be due to cause of genetic characters and phenotypic variance which resulted varied leaf length.



V_1= Diamant, V_2= Cardinal, V_3= Lady Rosetta

Figure 6. Effect of variety on leaf length of potato

Significant variation was detected for different levels of vermicompost on leaf length of potato at different DAS (Figure 7 and Appendix 6). Results explained that the highest leaf length of potato (14.6, 20.6, 21.3 and 21.4 cm at 30, 45, 60 and 75 DAS respectively) were achieved from T_3 (Vermicompost; 10 t ha^{-1}) and statistically similar to T_2 (Vermicompost; 8 t ha^{-1}) at 75 DAS. Similarly, the lowest leaf length of potato (13.1, 18.5, 19.7 and 15.9 cm at 30, 45, 60 and 75 DAS respectively) were observed from T_0 (Control) followed T_1 (Vermicompost; 6 t ha^{-1}) at all growth stages. Similar results under the present study were observed by Yourtchi *et al*. (2013). They found that Leaf Area Index (LAI) differed with the application of different rates of vermicompost where LAI is directly related to leaf length.



T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

Figure 7. Effect of varmicompost on leaf length of potato

Significant distinction was found by combined effect of variety and vermicompost on leaf length of potato at different DAS (Table 4 and Appendix 6). Results enlightened that the highest leaf length of potato (18.1, 23.3, 24.0 and 24.9 cm at 30, 45 and 60 and 75 DAS respectively) was recorded from V_3T_3. In contrast, the lowest leaf length of potato (10.9, 16.1, 19.1 and 19.7 cm at 30, 45, 60 and 75 DAS respectively) was found in V_1T_0 followed by V_1T_1, V_2T_0, V_2T_1 and V_2T_2 at all growth duration.

Table 4. Main and combined effects of variety and vermicompost on leaf length (cm) of potato

Treatments	**Leaf length (cm)**			
	30 DAS	**45 DAS**	**60 DAS**	**75 DAS**
V_1T_0	10.90 f	16.07 f	19.13 d	19.73 f
V_1T_1	11.60 ef	19.47 c	19.50 cd	22.07 de
V_1T_2	12.47 de	19.43 c	20.77 c	21.37 e
V_1T_3	15.90 b	20.17 c	22.20 b	23.20 c
V_2T_0	12.43 de	17.23 e	19.23 d	20.20 f
V_2T_1	13.20 cd	18.10 de	20.53 c	21.73 e
V_2T_2	12.30 de	18.17 de	19.57 cd	22.00 de
V_2T_3	14.27 c	19.20 cd	20.77 c	23.03 cd
V_3T_0	11.47 ef	19.30 cd	20.70 c	23.13 c
V_3T_1	16.93 b	21.30 b	23.40 a	24.43 ab
V_3T_2	16.17 b	21.63 b	23.63 a	23.73 bc
V_3T_3	18.07 a	23.30 a	24.00 a	24.90 a
$LSD_{0.05}$	1.096	1.117	1.169	0.9975
CV (%)	**8.63**	**10.83**	**6.64**	**13.17**

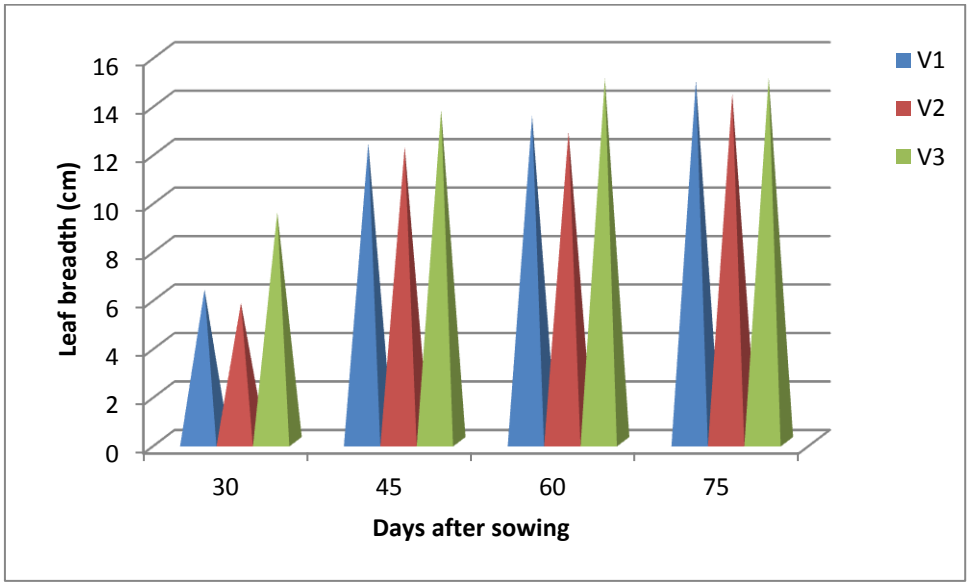
In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

4.5. Leaf breadth (cm)

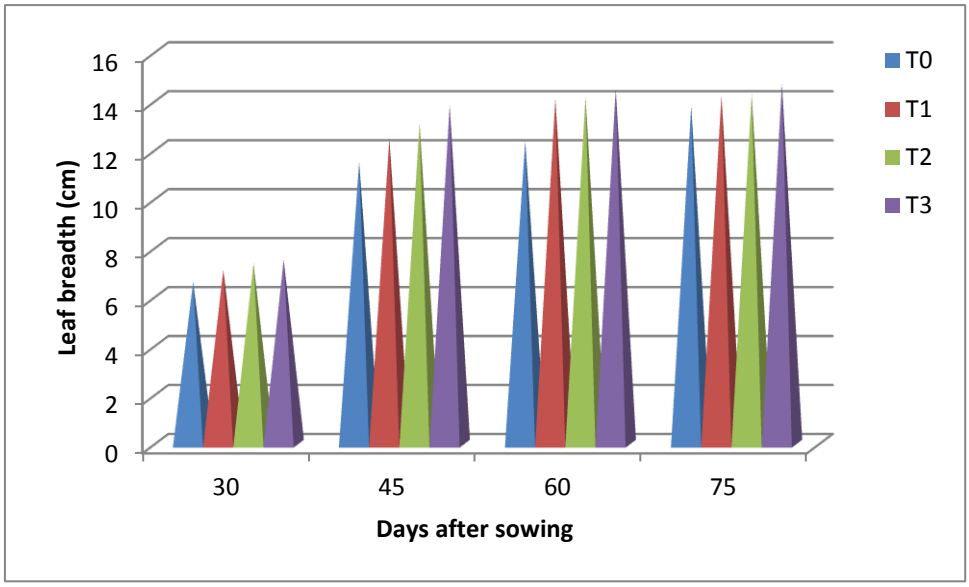
Significant influence was observed for different variety of potato on leaf breadth (cm) at different DAS (Figure 8 and Appendix 7). It was observed that the highest leaf breadth of potato (9.5, 13.7, 15.0 and 15.0 cm at 30, 45, 60 and 75 DAS respectively) was recorded from V_3 (Lady Rosetta) where V_1 (14.9 cm at 75 DAS) is statistically identical to V_3 (15.0 cm at 75 DAS). The lowest leaf breadth (5.7, 12.1, 12.8 and 14.4 cm at 30, 45, 60 and 75 DAS respectively) was recorded from V_2 (Cardinal). Such results under the present study might be due to cause of genetic characters and phenotypic variance which resulted varied leaf breadth.



V_1= Diamant, V_2= Cardinal, V_3= Lady Rosetta

Figure 8. Effect of variety on leaf breadth of potato

Significant dissimilarity was found on leaf breadth of potato by different levels of vermicompost at different DAS (Figure 9 and Appendix 7). It was found that the highest leaf breadth of potato (7.5, 13.8, 14.5 and 14.7 cm at 30, 45, 60 and 75 DAS respectively) was achieved from T_3 (Vermicompost; 10 t ha^{-1}) followed by T_2 (Vermicompost; 8 t ha^{-1}) at all growth stages. Another way the lowest leaf breadth of potato (6.6, 11.5, 12.4 and 13.8 cm at 30, 45, 60 and DAS respectively) was observed from T_0 (Control). Similar results under the present study were observed by Yourtchi *et al*. (2013). They found that Leaf Area Index (LAI) differed with the application of different rates of vermicompost where LAI is directly related to leaf breadth.



T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

Figure 9. Effect of varmicompost on leaf breadth of potato

Considerable variation was found by combined effect of variety and vermicompost on leaf breadth potato at different DAS (Table 5 and Appendix 7). It was observed that the highest leaf breadth of potato (10.1, 15.8, 15.8 and 16.8 cm at 30, 45, 60 and 75 DAS respectively) was found in V_3T_3 followed by V_3T_1 and V_3T_2 at all growth stages. Quite the opposite, the lowest leaf breadth of potato (5.4, 11.2, 12.6 and 15.0 cm at 30, 45, 60 and 75 DAS respectively) was found in V_2T_0, followed by V_1T_0, V_2T_2 and V_3T_0 at all growth stages.

Table 5. Main and combined effects of variety and vermicompost on leaf breadth (cm) of potato

Treatments	**Leaf breadth (cm)**			
	30 DAS	**45 DAS**	**60 DAS**	**75 DAS**
V_1T_0	5.63 f	11.63 de	12.67 d	15.40 ef
V_1T_1	5.60 f	12.03 d	12.23 cd	15.90 cd
V_1T_2	5.93 ef	12.97 c	13.93 c	16.03 bc
V_1T_3	5.77 f	13.07 bc	14.03 c	16.37 b
V_2T_0	5.37 f	11.20 e	12.63 d	15.03 f
V_2T_1	6.49 de	12.70 c	13.30 cd	15.57 de
V_2T_2	6.50 de	11.70 de	13.63 c	15.33 ef
V_2T_3	6.77 d	12.67 c	13.73 c	15.53 de
V_3T_0	8.83 c	11.73 de	13.43 cd	15.20 ef
V_3T_1	9.70 ab	13.63 b	15.80 a	15.80 cd
V_3T_2	9.27 bc	13.67 b	14.97 b	16.27 b
V_3T_3	10.07 a	15.80 a	15.83 a	16.83 a
$LSD_{0.05}$	0.6403	0.5792	0.7685	0.3470
CV (%)	**13.56**	**7.40**	**8.98**	**8.63**

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

4.6. Number of main stems hill^{-1}

Significant variation was found for different variety of potato on number of main stem hill^{-1} at different DAS (Table 6 and Appendix 8). It was observed that that the highest number of main stem hill^{-1} of potato (3.7, 3.8, 3.8 and 3.8 at 30, 45, 60 and 75 DAS respectively) was recorded from V_2 (Cardinal) followed by V_1 (Diamant) at all growth stages. Again, the lowest number of main stem hill^{-1} (3.1, 3.2, 3.2 and 3.2 at 30, 45, 60 and 75 DAS respectively) was found in V_3 (Lady Rosetta). The findings obtained from the present study was supported with the findings of Abbasi *et al*. (2004) and Hoque (1993). Abbasi *et al*. (2004) found that the cultivar 9619 gave maximum number of stems per plant compared to Hateema, Desiree, Diamant and Adora where Hoque (1993) observed maximum number of stems/hill was produced by Diamant (4.3) compared to Provento and Sante cultivar.

Significant influence was found by different levels of vermicompost on number of main stem hill^{-1} of potato at different DAS (Table 6 and Appendix 8). Results showed that the highest numbers of main stem hill^{-1} (3.6, 3.7, 3.8 and 3.8 at 30, 45, 60 and 75 DAS respectively) was achieved from T_3 (Vermicompost; 10 t ha^{-1}) which was closely followed by T_2 (Vermicompost; 8 t ha^{-1}) and T_1 (Vermicompost; 6 tha^{-1}). The lowest number of main stem hill^{-1} of potato (3.1, 3.2, 3.3 and 3.3 at 30, 45, 60 and DAS respectively) were observed from T_0 (Control). Parallel results was observed by Venkatasalam *et al*. (2012) and they found that the number of stems was significantly influenced by the type of organic manure and not by varieties. However, Neher (1999) observed the maximum number of main stems (3.65) per hill was obtained from organic fertilizer management practices.

Considerable influence was found by combined effect of variety and vermicompost on number of main stem hill^{-1} at different DAS (Table 6 and Appendix 8). Results elucidated that the highest number of main stem hill^{-1} of potato (4.2, 4.3, 4.6 and 4.8 at 30, 45, 60 and 75 DAS respectively) were found in V_2T_3 followed by V_1T_3, V_2T_2 and V_3T_3. Again, the lowest number of main stem hill^{-1} (2.8, 2.9, 3.3 and 3.3 at 30, 45, 60 and DAS respectively) were recorded from V_3T_0 followed by V_1T_0, V_2T_0 and V_3T_1 at maximum growth stages.

Table 6. Main and combined effects of variety and vermicompost on number of main stem hill^{-1} of potato

Treatments	**Number of main stem hill^{-1}**			
	30 DAS	**45 DAS**	**60 DAS**	**75 DAS**
Variety				
V_1	3.33 b	3.59 b	3.59 b	3.61 b
V_2	3.68 a	3.78 a	3.80 a	3.82 a
V_3	3.07 c	3.16 c	3.21 c	3.21 c
$LSD_{0.05}$	**0.093**	**0.191**	**0.156**	**0.139**
Vermicompost				
T_0	3.06 c	3.24 c	3.29 b	3.29 b
T_1	3.29 b	3.44 bc	3.44 b	3.60 a
T_2	3.44 ab	3.62 ab	3.65 a	3.64 a
T_3	3.64 a	3.73 a	3.79 a	3.79 a
$LSD_{0.05}$	**0.201**	**0.221**	**0.180**	**0.212**
Combined effect				
V_1T_0	3.03 f	3.17 de	3.70 ef	3.46 fg
V_1T_1	3.27 de	3.60 bc	4.20 bc	4.20 b
V_1T_2	3.33 cd	3.47 cd	3.93 de	3.73 de
V_1T_3	3.67 b	4.13 a	4.13 bd	4.20 b
V_2T_0	3.00 fg	3.17 de	3.43 g	3.40 fg
V_2T_1	3.53 bc	3.60 bc	4.30 b	3.93 cd
V_2T_2	3.67 b	3.80 b	4.06 bd	4.13 bc
V_2T_3	4.20 a	4.33 a	4.60 a	4.80 a
V_3T_0	2.80 g	2.93 e	3.33 g	3.34 g
V_3T_1	3.07 ef	3.13 de	3.66 f	3.73 de
V_3T_2	3.40 cd	3.40 cd	4.00 cd	3.60 ef
V_3T_3	3.33 cd	3.40 cd	3.93 de	3.86 d
$LSD_{0.05}$	0.200	0.298	0.227	0.220
CV (%)	**9.87**	**11.06**	**10.75**	**13.64**

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

4.7. Weight of haulm hill^{-1} at harvest

4.7.1 Fresh weight of haulm hill^{-1}

Fresh weight of haulm hill^{-1} was significantly powered by different variety of potato (Table 7 and Appendix 9). It was found that the highest fresh weight of haulm hill^{-1} at harvest (185.1 g) was achieved from V_2 (Cardinal) where the lowest fresh weight of haulm hill^{-1} at harvest (169.3 g) was achieved from V_1 (Diamant). The weight obtained from V_3 (Lady Rosetta) gave intermediate result.

Significant variation was found for different levels of vermicompost on fresh weight of haulm hill^{-1} at harvest (Table 7 and Appendix 9). It was observed that the highest fresh weight of haulm hill^{-1} at harvest (198.9 g) were achieved from T_3 (Vermicompost; 10 t ha^{-1}) followed by T_2 (Vermicompost; 8 t ha^{-1}) and T_1 (Vermicompost; 6 tha^{-1}) where the lowest fresh weight of haulm hill^{-1} at harvest (153.1 g) was achieved from T_0 (Control).

Significant variation was found in respect of fresh weight of haulm hill^{-1} at harvest by combined effect of variety and vermicompost (Table 7 and Appendix 9). It was examined that the highest fresh weight of haulm hill^{-1} at harvest of potato (246.3 g) was achieved from V_2T_3 followed by V_2T_2, V_2T_1, V_3T_1 and V_3T_3. But the lowest fresh weight of haulm hill^{-1} at harvest of potato (120.0 g) was recorded from V_1T_0 followed by V_1T_1, V_3T_2, V_3T_0 and V_1T_3.

4.7.2 Dry weight of haulm hill^{-1}

Dry weight of haulm hill^{-1} was significantly influenced by different variety of potato (Table 7 and Appendix 9). It was found that the highest dry weight of haulm hill^{-1} at harvest (31.6 g) was achieved from V_2 (Cardinal) which was statistically identical to V_3 (Lady Rosetta) (31.6 g) where the lowest dry weight of haulm hill^{-1} at harvest (31.2 g) was achieved from V_1 (Diamant). Such type of result under the present investigation might be due to cause of genetic variation, phenotypic characters, soil fertility and environmental adaptation to the variety.

Significant variation was found for different levels of vermicompost on dry weight of haulm hill^{-1} at harvest (Table 7 and Appendix 9). Results indicated that the highest dry weight of haulm hill^{-1} (36.0) was achieved from T_3 (Vermicompost; 10 t ha^{-1}) followed by T_2 (Vermicompost; 8 t ha^{-1}) at harvest where the lowest dry weight of haulm hill^{-1} at harvest (27.4 g) was achieved from T_0 (Control) which was statistically identical with T_1 (Vermicompost; 6 tha^{-1}) at harvest. Neher (1999) showed singnificant result on dry weight of haulm hill^{-1}.

Combined effect of variety and vermicompost had significant variation on dry weight of haulm hill^{-1} at harvest (Table 7 and Appendix 9). It was examined that the highest dry weight of haulm hill^{-1} at harvest (39.8 g) was achieved from V_2T_3 followed by V_3T_3, V_2T_2, V_3T_2 and V_1T_2. On the other hand, the lowest dry weight of haulm hill^{-1} at harvest of potato (25.4 g) was recorded from V_1T_0 which was statistically similar with V_1T_1 followed by V_3T_0, V_3T_1, and V_2T_0.

Table 7. Main and combined effects of variety and vermicompost on fresh weight and dry weight of haulm hill^{-1} at harvest of potato

Treatments	**Weight of haulm hill^{-1} at harvest**	
	Fresh weight (g)	**Dry weight(g)**
Variety		
V_1	169.30 b	31.16 b
V_2	185.10 a	31.57 a
V_3	170.00 b	31.48 a
$LSD_{0.05}$	**2.342**	**0.1136**
Vermicompost		
T_0	153.10 c	27.39 c
T_1	172.70 b	28.50 c
T_2	174.40 b	33.68 b
T_3	198.90 a	36.03 a
$LSD_{0.05}$	**2.704**	**1.488**
Combined effect		
V_1T_0	120.00 i	25.37 g
V_1T_1	134.30 h	27.00 fg
V_1T_2	176.30 f	32.43 c
V_1T_3	164.30 g	31.13 cd
V_2T_0	175.30 f	29.10 d-f
V_2T_1	197.30 c	29.50 de
V_2T_2	203.30 b	36.17 b
V_2T_3	246.30 a	39.83 a
V_3T_0	164.00 g	27.70 ef
V_3T_1	191.70 d	29.01 ef
V_3T_2	138.30 h	32.43 c
V_3T_3	186.00 e	37.13 b
$LSD_{0.05}$	4.025	1.944
CV (%)	**9.02**	**10.67**

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

4.8. Yield and yield contributing parameters

4.8.1. Number of tuber hill^{-1}

Significant variation was found for different variety of potato on number of tuber hill^{-1} (Table 8 and Appendix 10). Results revealed that the highest number of tuber hill^{-1} (7.5) was achieved from V_1 (Diamant) followed by V_3 (Lady Rosetta) where the lowest number of tuber hill^{-1} (7.2) was found in V_2 (Cardinal). Awal *et al*. (2007) observed the higher tuber yield of Diamant, Markies, Espirit and Ladyrosetta might be attributed due to the higher number tuber hill^{-1}. Rabbani and Rahman (1995) found the highest number of tubers hill^{-1} (27.5) was found in the variety Shadaguti compared to Ausha and Lalpakri.

Significant variation was found for different levels of vermicompost on number of tuber hill^{-1} (Table 8 and Appendix 10). Results showed that the highest number of tuber hill^{-1} (8.0) was achieved from T_2 (Vermicompost; 8 t ha^{-1}) which was statistically similar to T_3 (Vermicompost; 10 t ha^{-1}) where the lowest number of tuber hill^{-1} (6.7) was found in T_0 (Control) followed by T_1 (Vermicompost; 6 tha^{-1}). Similar result was found from Venkatasalam *et al*. (2012) and they observed that the maximum number of tubers per plant was recorded in Kufri Lalima (18.2) with FYM, whereas they were minimum in Kufri Lauvkar (4.8) with vermicompost.

Number of tuber hill^{-1} was significantly influenced by combined of different levels of vermicompost and variety of potato (Table 8 and Appendix 10). Results indicated that the highest number of tuber hill^{-1} (8.1) was achieved from V_1T_2 which was statistically identical to V_1T_3, V_2T_2 and V_3T_2 followed by V_3T_3, V_2T_3, and V_1T_1. The lowest number of tuber hill^{-1} (6.43) was found in V_2T_0 followed by V_1T_0 and V_3T_0.

4.8.2. Weight of tuber hill^{-1} (g)

Weight of tuber hill^{-1} was significantly influenced by different potato variety (Table 8 and Appendix 10). Results revealed that the highest weight of tuber hill^{-1} (308.3 g) was achieved from V_1 (Diamant) where the lowest weight of tuber hill^{-1} (288.9 g) was found in V_2 (Cardinal). The result obtained from V_3 (Lady Rosetta) gave intermediate result compared to highest and lowest tuber yield hill^{-1}. The result obtained from the findings of Awal *et al*. (2007) was similar and they observed the higher tuber yield of Diamant, Markies, Espirit and Lady rosetta might be attributed due to the higher weight of tuber hill^{-1}.

Weight of tuber hill^{-1} was significantly differed by different levels of vermicompost (Table 8 and Appendix 10). Results revealed that the highest weight of tuber hill^{-1} (328.9 g) was achieved from T_2 (Vermicompost; 8 t ha^{-1}) which was statistically identical to treatment T_3 (Vermicompost; 10 t ha^{-1}) where the lowest weight of tuber hill^{-1} (258.3 g) was found in T_0 (control). The results from T_1 (Vermicompost; 6 tha^{-1}) gave intermediate result compared to the highest and the lowest tuber weight hill^{-1}. The result obtained from the present study was similar with Yourtchi *et al*. (2013). They found weight of tuber hill^{-1} was increase with the application of vermicompost in association with inorganic fertilizer.

Significant variation was occurred by combined effect of different levels of vermicompost and variety of potato on weight of tuber hill^{-1} (Table 8 and Appendix 10). Results revealed that the highest weight of tuber hill^{-1} (343.3 g) was achieved from V_1T_2 followed by V_1T_3 (322.7 g), V_3T_2 (322.2 g) and V_2T_2 (321.6 g). The lowest weight of tuber hill^{-1} (251.7 g) was found in V_2T_0 followed by V_1T_0 (255.6 g) and V_3T_0 (258.3 g). The rest of the treatment combinations as V_1T_1, V_2T_1 and V_3T_1 were not significantly differed from each other but different from all other treatments.

4.8.3. Tuber weight plot^{-1} (kg)

Significant variation was observed on tuber weight plot^{-1} (kg) influenced by different variety of potato (Table 8 and Appendix 10). Results showed that the highest tuber weight plot^{-1} (5.55 kg) was achieved from V_1 (Diamant) whereas V_2 (Cardinal) provided the lowest tuber weight plot^{-1} (5.20 kg). The variety V_3 (Lady Rosetta) gave intermediate result compared to highest and lowest Tuber weight plot^{-1}. The findings were similar with the findings of Abbasi *et al*. (2004). The maximum weight (54.1 kg/plot) of tubers was found in 9619 while the lowest weight (25.3 kg plot^{-1}) of tubers was given by Draga.

Significant variation was recorded on tuber weight plot^{-1} as influenced by different levels of vermicompost (Table 8 and Appendix 10). Results illustrated that the highest tuber weight plot^{-1} (5.92 kg) was achieved from T_2 (Vermicompost; 8 t ha^{-1}) which was statistically similar to T_3 (Vermicompost; 10 t ha^{-1}) whereas T_0 (Control) gave the lowest tuber weight plot^{-1} (4.65 kg). The results recorded from T_1 (Vermicompost; 6 tha^{-1}) gave intermediate result compared to highest and lowest yield per plot. Similar results was also observed from the findings of Yourtchi *et al*. (2013), Venkatasalam *et al*. (2012), Ansari (2008) and Alam *et al*. (2007). They observed that application of vermicompost or other organic manure with or without inorganic fertilizer increase tuber yield.

Considerable dissimilarity was found on tuber weight plot^{-1} as influenced by the combined effect of different levels of vermicompost and variety of potato (Table 8 and Appendix 10). Results showed that the highest tuber weight plot^{-1} (6.18 kg) was achieved from V_1T_2 which was statistically similar with V_1T_3 followed by V_2T_2 and V_3T_2. The lowest tuber weight plot^{-1} (4.53 kg) was found in V_2T_0 which was statistically identical to V_1T_0 (4.60).

4.8.4. Dry weight of tuber 100^{-1} g

There was significant variation on dry weight of 100 g tuber as influenced by different potato variety (Table 8 and Appendix 10). Results explicated that the highest dry weight of 100 g tuber (21.2 g) was achieved from V_1 (Diamant) whereas V_2 (Cardinal) showed the lowest dry weight of 100 g tuber (20.0). The result obtained from V_3 (Lady Rosetta) gave intermediate result compared to highest and lowest dry weight of 100 g tuber. Dry matter content significantly differed for varietal difference and this was supported by Ray and Mukhopadhyay (2004) and they observed that only three cultivars viz. Chipsona-1 (21.98%), Chipsona-2 (20.85%) and Diamant (19.18%) recorded higher dry matter content than that of Jyoti (18.87%).

Significant variation was observed by different levels of vermicompost on dry weight of 100 g tuber (Table 8 and Appendix 10). Results revealed that the highest dry weight of 100 g tuber (22.4 g) was achieved from T_2 (Vermicompost; 8 t ha^{-1}) which was statistically identical to T_3 (Vermicompost; 10 t ha^{-1}) whereas T_0 (Control) resulted the lowest dry weight of 100 g tuber (18.2 g). The treatments T_1 (Vermicompost; 6 tha^{-1}) showed intermediate result compared to highest and lowest dry weight of 100 g tuber. Yourtchi *et al*. (2013) observed application of vermicompost with inorganic fertilizer had positive effect on dry matter content of tuber.

Dry weight of 100 g fresh tuber was found significant by the combined effect of different levels of vermicompost and variety of potato (Table 8 and Appendix 10). Results confirmed that the highest dry weight of 100 g tuber (23.2 g) was achieved from V_1T_2 which was statistically identical with V_1T_3 (23.1 g) followed by V_3T_2, V_2T_2 and V_3T_3. The lowest dry weight of 100 g tuber (18.3 g) was obtained from V_2T_0 followed by V_1T_0, V_3T_0, V_2T_1 and V_3T_1. The result obtained from all other treatment combination gave intermediate results regarding highest and lowest dry weight of 100 g tuber.

4.8.5. Tuber weight ha^{-1} (t)

Significant variation was observed on tuber weight ha^{-1} as affected by different potato variety (Table 8 and Appendix 10). Results exhibited that the highest tuber weight (24.64 t ha^{-1}) was recorded from V_1 (Diamant) whereas V_2 (Cardinal) gave the lowest tuber weight (23.10 t ha^{-1}). The variety, V_3 (Lady Rosetta) gave intermediate result compared to highest and lowest tuber weight. Ray and Mukhopadhyay (2004) observed that among the nine cultivars, Diamant recorded the maximum tuber yield (30.6 tha^{-1}) followed by Cardinal (29.8 t ha^{-1}), Chipsona-1 (26.6 tha^{-1}), Jyoti (25.4 t ha^{-1}) and Chipsona-2 (24.1 t ha^{-1}). Hossain *et al.* (2003) also found that the highest yield (27.3 t ha^{-1}) was obtained from the variety Akira and it was identical to Jaerla (26.3 t ha^{-1}) and these two varieties out yielded the check variety Diamant (22.8 t ha^{-1}).

There was significant variation found for different levels of vermicompost on tuber yield ha^{-1} (t) (Table 8 and Appendix 10). Results examined that the highest tuber weight ha^{-1} (26.30 t) was achieved from T_2 (Vermicompost; 8 t ha^{-1}) which was statistically similar to T_3 (Vermicompost; 10 t ha^{-1}) whereas the lowest tuber weight ha^{-1} (20.68 t) was found in T_0. The result acquired from T_1 (Vermicompost; 6 tha^{-1}) gave mid-level yield of tuber compared to highest and lowest tuber weight ha^{-1}. Similar results was also observed from the findings of Yourtchi *et al*. (2013), Venkatasalam *et al*. (2012), Ansari (2008) and Alam *et al*. (2007). They observed that application of vermicompost or other organic manure with or without inorganic fertilizer increase tuber yield.

Combined effect of different levels of vermicompost and variety of potato had significant influence on tuber weight (t ha^{-1}) (Table 8 and Appendix 10). The results under the study represented that the highest tuber weight ha^{-1} (27.47 t) was achieved from V_1T_2 followed by second highest tuber yield (26.53 t ha^{-1}) from V_1T_3 and third highest tuber yield (25.78 t ha^{-1}) from V_3T_2. The results obtained from V_2T_2, V_3T_3 and V_2T_3 were also promising compared to highest performance on yield but significantly different from all other treatment combination. Again, the lowest tuber weight ha^{-1} (20.13 t) was found in V_2T_0 which was significantly different from all other treatment combinations.

Table 8. Main and combined effects of variety and vermicompost on yield and yield contributing parameters of potato

Treatments	Number of tuber hill^{-1}	Weight of tuber hill^{-1} (g)	Tuber weight plot^{-1} (kg)	Dry weight of 100 g fresh tuber (g)	Tuber weight ha^{-1} (t)
Variety					
V_1	7.53 a	308.33 a	5.55 a	21.21 a	24.64 a
V_2	7.23 c	288.89 c	5.20 c	20.03 c	23.10 c
V_3	7.35 b	300.56 b	5.41 b	20.95 b	24.06 b
$LSD_{0.05}$	**0.104**	**2.116**	**0.101**	**0.119**	**0.163**
Vermicompost					
T_0	6.69 c	258.33 c	4.65 d	18.17 c	20.68 c
T_1	7.17 b	290.00 b	5.22 c	19.42 b	23.21 b
T_2	8.00 a	328.89 a	5.92 a	22.35 a	26.30 a
T_3	7.71 a	326.51 a	5.69 a	21.80 a	25.27 a
$LSD_{0.05}$	**0.450**	**2.445**	**0.242**	**1.0383**	**1.0612**
Combined effect					
V_1T_0	6.80 e	255.56 f	4.60 g	18.70 g	20.44 k
V_1T_1	7.33 bc	301.67 e	5.43 de	19.83 e	24.13 g
V_1T_2	8.10 a	343.33 a	6.18 a	23.17 a	27.47 a
V_1T_3	8.04 a	322.67 b	5.97 ab	23.13 a	26.53 b
V_2T_0	6.43 f	251.67 g	4.53 g	18.30 h	20.13 l
V_2T_1	6.97 de	300.11 e	4.97 f	19.20 f	22.09 i
V_2T_2	8.00 a	321.56 b	5.77 bc	21.90 bc	25.64 d
V_2T_3	7.53 bc	305.67 d	5.52 d	20.70 d	24.53 f
V_3T_0	6.83 e	258.33 f	4.83 f	19.10 f	21.47 j
V_3T_1	7.20 cd	292.78 e	5.27 e	19.23 f	23.42 h
V_3T_2	8.00 a	322.22 b	5.80 b	21.97 b	25.78 c
V_3T_3	7.60 b	309.44 c	5.57 cd	21.57 c	24.76 e
$LSD_{0.05}$	0.347	3.055	0.214	0.3470	0.1171
CV (%)	**8.25**	**13.94**	**12.65**	**10.89**	**8.13**

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability.

V_1 = Diamant
V_2 = Cardinal
V_3 = Lady Rosetta

T_0 = Control
T_1 = Vermicompost at the rate of 6 tha^{-1}
T_2 = Vermicompost at the rate of 8 t ha^{-1}
T_3 = Vermicompost at the rate of 10 t ha^{-1}

Chapter V

Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSION

An experiment was carried out to study the effect of vermicompost on growth and yield of potato during the period from November 2014 to February 2015. The research work was conducted at the experimental field of Horticulture farm of Horticulture Department, Sher-e-Bangla Agricultural University, Dhaka.

The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. The size of unit plot was 1.5 m × 1.5 m. A spacing of 0.5 m was provided between the plots and 1 m spacing was provided between two blocks and followed plant spacing was 50 cm × 25 cm. The experiment consisted of 2 factors namely, variety of tubers and application of different rates of vermicompost. Three varieties viz. V_1= Diamant, V_2= Cardinal and V_3= Lady Rosetta and four levels of vermicompost viz. T_0 = Control, T_1= Vermicompost; 6 t ha^{-1}, T_2= Vermicompost; 8 t ha^{-1} and T_3= Vermicompost; 10 t ha^{-1} were used for the experiment. Data were recorded on different parameters and analyzed statistically by using MSTAT computer package program.

Under the present study, different variety, different rates of vermicompost application in the potato field and their combination had significant influence on growth and yield of potato.

Different parameters studied during the experiment were significantly controlled by different variety. Results represented that the highest plant height (20.2, 47.1, 55.8 and 57.8 cm at 30, 45, 60 and 75 DAS respectively), number of leaves $plant^{-1}$ (10.7, 23.7, 27.8 and 28.1 at 30, 45, 60 and 75 DAS respectively), number of main stem $hill^{-1}$ (3.7, 3.8, 3.8 and 3.8 at 30, 45, 60 and 75 DAS respectively), fresh weight of haulm $hill^{-1}$ at harvest (185.1 g) and the

highest dry weight of haulm hill^{-1} at harvest (31.6 g) were achieved from V_2 (Cardinal).

Again, the highest leaf length (16.8, 21.6, 22.8 and 22.9 cm at 30, 45, 60 and 75 DAS respectively) and leaf breadth of potato (9.5, 13.7, 15.0 and 15.0 cm at 30, 45, 60 and 75 DAS respectively) were recorded from V_3 (Lady Rosetta) and also the minimum days to 100% emergence of seedlings (14.5) was found from V_3 (Lady Rosetta). Yet again, the highest number of tuber hill^{-1} (7.5), weight of tuber hill^{-1} (308.3 g), tuber weight plot^{-1} (5.55 kg), dry weight of 100 g tuber (21.2 g) and the highest tuber weight ha^{-1} (24.64 t) was achieved from V_1 (Diamant).

Results also revealed that the lowest plant height (16.6, 44.3, 49.2 and 51.2 cm at 30, 45, 60 and 75 DAS and respectively), leaf length (11.6, 17.7, 19.5 and 19.7 at 30, 45, 60 and 75 DAS respectively), fresh weight of haulm hill^{-1} at harvest (169.3 g), dry weight of haulm hill^{-1} at harvest (31.2 g) were achieved from V_1 (Diamant) and also the maximum days to 100% emergence of seedlings (15.8) was obtained from V_1 (Diamant) where the lowest number of main stem hill^{-1} (3.1, 3.2, 3.2 and 3.2 at 30, 45, 60 and 75 DAS respectively) and the lowest number of leaves plant^{-1} (8.9, 18.7, 20.8 and 26.1 at 30, 45, 60 and 75 DAS respectively) was recorded from V_3 (Lady Rosetta).

Similarly, the lowest leaf breadth (5.7, 12.1, 12.8 and 14.4 cm at 30, 45, 60 and 75 DAS respectively), number of tuber hill^{-1} (7.2), weight of tuber hill^{-1} (288.9 g), tuber weight plot^{-1} (5.2 kg), dry weight of 100 g tuber (20.0) and lowest tuber weight ha^{-1} (23.1 t) were obtained from V_2 (Cardinal).

Different rates of vermicompost that were used in the experiment showed significant effect on different parameters of potato varieties. Results indicated that the highest plant height (20.2, 46.8, 55.6, 56.7 cm at 30, 45, 60 and 75 DAS respectively), number of leaves plant^{-1} (10.9, 23.9, 26.8 and 30.3 at 30, 45, 60 and 75 DAS respectively), leaf length of potato (14.6, 20.6, 21.3 and 21.4 cm at 30, 45, 60 and 75 DAS respectively), leaf breadth of potato (7.5,

13.8, 14.5 and 14.7 cm at 30, 45, 60 and 75 DAS respectively), numbers of main stem hill^{-1} (3.6, 3.7, 3.8 and 3.8 at 30, 45, 60 and 75 DAS respectively), fresh weight of haulm hill^{-1} at harvest (198.9 g) and the highest dry weight of haulm hill^{-1} (36.0) was achieved from T_3 (Vermicompost; 10 t ha^{-1}) but the minimum days to 100% emergence of seedlings (14.6 days) was also found from T_2 (Vermicompost; 8 t ha^{-1}).

Again, it was found that highest number of tuber hill^{-1} (8.0), weight of tuber hill^{-1} (328.9 g), tuber weight plot^{-1} (5.92 kg), dry weight of 100 g tuber (22.4 g) and the highest tuber weight ha^{-1} (26.30 t) were achieved from T_2 (Vermicompost; 8 t ha^{-1}) which was statistically similar with treatment T_3 (Vermicompost; 10 t ha^{-1}).

Results also revealed that the maximum days to 100% emergence of seedlings (15.8 days) was observed from T_0 (Control) but the lowest plant height (16.7, 43.5, 48.9 and 50.9 cm at 30, 45, 60 and 75 DAS respectively), number of leaves plant^{-1} (8.7, 19.4, 21.9 and 24.5 at 30, 45, 60 and 75 DAS respectively), leaf length (13.1, 18.5, 19.7 and 15.9 cm at 30, 45, 60 and 75 DAS respectively), leaf breadth (6.6, 11.5, 12.4 and 13.8 cm at 30, 45, 60 and 75 DAS respectively), number of main stem hill^{-1} (3.1, 3.2, 3.3 and 3.3 at 30, 45, 60 and 75 DAS respectively), fresh weight of haulm hill^{-1} at harvest (153.1 g), dry weight of haulm hill^{-1} at harvest (27.4 g), number of tuber hill^{-1} (6.7), weight of tuber hill^{-1} (258.3 g), tuber weight plot^{-1} (4.65 kg), dry weight of 100 g tuber (18.2 g) and lowest tuber weight ha^{-1} (20.68 t) were observed from T_0 (Control).

Significant influence was also found caused by combined effect of variety and vermicompost on different parameters. Results specified that the highest plant height (22.3, 49.0, 57.3 and 62.6 cm at 30, 45, 60 and 75 DAS respectively), number of leaves plant^{-1} (12.5, 25.6, 29.5 and 30.8 at 30, 45, 60 and 75 DAS respectively), number of main stem hill^{-1} of potato (4.2, 4.3, 4.6 and 4.8 at 30, 45, 60 and 75 DAS respectively), fresh weight of haulm hill^{-1} at harvest (246.3 g) and highest dry weight of haulm hill^{-1} at harvest (39.8 g) were achieved from

V_2T_3. But the minimum days to 100% emergence (13.7 days) was found from the treatment combination of V_3T_2.

Again, the highest leaf length (18.1, 23.3, 24.0 and 24.9 cm at 30, 45, 60 and 75 DAS respectively) and highest leaf breadth of potato (10.1, 15.8, 14.2 and 10.8 cm at 30, 45, 60 and 75 DAS respectively) were found in V_3T_3. The results obtained in terms of highest number of tuber hill^{-1} (8.1), weight of tuber hill^{-1} (343.3 g), tuber weight plot^{-1} (6.2 kg), dry weight of 100 g tuber (23.2 g) and highest tuber weight ha^{-1} (27.47 t) were from V_1T_2.

Results also revealed that the lowest plant height (15.4, 43.0, 46.2 and 50.4 cm at 30, 45, 60 and 75 DAS respectively), leaf length (10.9, 16.1, 19.1 and 19.7 cm at 30, 45, 60 and 75 DAS respectively), fresh weight of haulm hill^{-1} at harvest (120.0 g) and the lowest dry weight of haulm hill^{-1} at harvest (25.4 g) were recorded from V_1T_0 where the maximum days to 100% emergence (16.3 days) was also recorded from V_1T_0.

Once more, the lowest number of leaves plant^{-1} (7.5, 16.8, 17.4 and 22.9 at 30, 45, 60 and 75 DAS respectively) and lowest number of main stem hill^{-1} (2.8, 2.9, 3.3 and 3.3 at 30, 45, 60 and 75 DAS respectively) were recorded from V_3T_0. Similarly, the lowest leaf breadth of potato (5.4, 11.2, 12.2 and 15.0 cm at 30, 45, 60 and 75 DAS respectively), number of tuber hill^{-1} (6.4), weight of tuber hill^{-1} (251.7 g), tuber weight plot^{-1} (4.53 kg), the lowest dry weight of 100 g tuber (18.3 g) and the lowest tuber weight ha^{-1} (20.13 t) were found from V_2T_0.

Conclusion:

From the above discussion it can be concluded that among the three varieties, V_1 (Diamant) showed the best performance in respect of yield and yield contributing characters. In terms of vermicompost application, among the 4 rates, T_2 (Vermicompost; 8 t ha^{-1}) gave the best result which was statistically similar with T_3 (Vermicompost; 10 t ha^{-1}). Again, Interaction effect of variety and vermicompost, V_1T_2 (Diamant × Vermicompost; 8 t ha^{-1}) provided the higher return in terms of yield compared to other combination.

Chapter VI

References

CHAPTER VI

REFERENCES

Abbasi, N.A., Hafiz, I.A. and Bilal, F. (2004). Evaluation of exotic potato varieties in ecological conditions of Islamabad during autumn season. *Int. J. Agric. Biol*, **6**(3): 479-482.

Abuou-Hussein, S.D. (2002). Effect of chicken manure, compost and biofertilizers on vegetative growth, tuber characteristics and yield of potato crop. *Egyptian J. Hort*, **29**: 135-149.

Adhikari, D.D., Sen, H. and Banerjee, N.C. (1992). Effect of different manures along with nitrogenous fertilizers on the growth and tuber yield of potato. *Hort. J*, **5**(2): 121-126.

Ahmed. K.I.J. (1982). Gardeners Book of Production and nutrition. House No. 2. Krishi Khamar Sharak, Farm Gate, Dhaka, Bangladesh. p. 72.

Akhter, M.I., Habib, A.K.M.A., Ali, M.S., Huq, Z N. and Zakaria, M. (2001). Studies on the development of new potato varieties. *Bangladesh J. Life Sci*. TCRC, BARI, Joydebpur, **13**(1 &2): 175 -180.

Akhter, S., Quasem, A. and Rashid, M.M. (1991). Studies on the Bulking behaviour of some exotic potato varieties. Proc. First National workshops on tuber crops. ICRC, BARI, Joydebpur, Bangladesh. pp. 127-130.

Alam, M.K., Zaman, M.M., Nazrul, M.I., Alam, M.S. and Hossain, M.M. (2003). Performance of Some Exotic Potato Varieties under Bangladesh Conditions. *Asian J. Plant Sci*, **2**: 108-112.

Alam, M.N., Jahan, M.S., Ali, M.K., Ashraf, M.A. and Islam, M.K. (2007). Effect of Vermicompost and Chemical Fertilizers on Growth, Yield and Yield Components of Potato in Barind Soils of Bangladesh. *J. App. Sci. Res*, **3**(12): 1879-1888.

Anonymous, (1981). Annual Research Report on Tuber Crops Improvement 1980-1981. Tuber Crops Research Center, BARI, Joydebpur, Gazipur.

Anonymous, (1991). Variety development from exotic sources. Annual Report. TCRC, BARI, Joydebpur, Gazipur, Bangladesh. pp. 30-61.

Anonymous, (1992). Variety development from exotic sources. Annual Report, TCRC, BARI, Joydebpur, Gazipur, Bangladesh. pp. 21-52.

Ansari, A.A. (2008). Effect of Vermicompost on the Productivity of Potato (*Solanum tuberosum*), Spinach (*Spinacia oleracea*) and Turnip (*Brassica campestris*). *World J. Agric. Sci*, **4** (3): 333-336.

Ansari, A.A. (2007). Urban Planning and Environment Strategies and Challenges. Macmillan India Ltd., New Delhi. pp: 277-279.

Arafa, M.M.E. (2004). Effect of different NPK treatments on growth, yield, quality and chemical components of two potato cultivars. *Annals of Agric. Sci*, **42**(2): 753-766 [Cited from CAB Abstr, **15**(2): 375, 2007].

Asumus, F. and H. Gorlitz, (1986). Studies on the effect and utilization of N from FYM and mineral fertilizer. Archiv fiir Acte-und pflazenbau and Boderkund, **32**(2): 115-121, [Cited from CAB Abst. 1995].

Awal, M.A., Das, S.K. and Dhar, M. (2007). Morphological characteristics and yield attributes of twenty three potato varieties. *J. Agro. Environ*, **1**(2): 15-19.

Barakan, F.N., Salem, S.H., Heggo, A.M. and Bin-Shiha, M.A. (1995). Activities of rhizosphere microorganisms as affected by application of organic amendments in a calcareous loamy soil and Nitrogen transformation. *Arid Soil Res Rehab*, **9**(4): 467-80.

BBS. (2014). Statistical Year Book, Bangladesh 2014. Bangladesh Bureau of Statistics. Statistics and Informatics Division. Ministry of Planning, Govt, of the People's Republic of Bangladesh. p.136

Bhuiyan, N.I. (1994). Crop production trend and need of sustainability in agriculture. A paper presented in a three-day workshop on "Integrated Nutrient Management for Sustainable Agriculture" held at SRS1, June 26-28.

Blecharezyk, A. and Skrzypczak. G. (1995). The effect of long-term organic and mineral fertilizer application on yields and chemical composition of tops and tubers of potatoes. *Prace Zakresu Nauk Rolniczych*, **79**:15-20 [Cited from Potato Abstr, **21**(4): 179, 1997].

Boligowa, E. and Glen, K. (2003). Yielding and quality of potato tubers depending on the kind of organic fertilization and tillage methods. *Electronic J. Polish Agric. Univ*, **6**: 1-7.

Brady, N.C. (1990). The Nature and Properties of Soils. 10 th Edn, Published by Macmillan Publishing Co., 886 Third Avenue, New york. 10022. pp. 173, 410.

Dan, S. and Thind, S.S. (2005). Role of FYM, potassium and irrigation levels on potato tuber quality in typic Ustipsments soil. *Potato J*, **32:** 85-88.

Datta, A.C. and Chakraborty, T. (1995). Effcct of organic and Subabul (Leucaen leucocephala) leaf mulching under varying levels of fertility on growth and yield of potato (*Solarium tuberosum*) and weed biomass. *Indian J. Agron*, **40**(1): 140-142.

Devi. H.J., Maity. T.K., Thapa. U. and Paria. N.C. (2002). Effect of integrated nitrogen mangement on yield and economics of brinjal. *J. Int. Academicia*, **6**: 450-453.

Edwards, C.A. and Bohlen, P.J. (1996). Biology and Ecology of Earthworm 3rd Edn. Chapman and Hall, London. p. 426.

Edwards, C.A. and Burrows, I. (1988). The potential of earthworm composts as plant growth media. In: Edwards CA exhauster, (Eds.), Earthworms in Environmental and Waste Management. SPB Academic Publ. B.V. The Netherlands. pp. 211-220.

Edwards, C.A., (1988). Breakdown of animal, vegetable and industrial organic waste by earthworms. *Agric. Ecosyst. Environ*, **24**: 21-31.

Edwards, C.A., (1988). Breakdown of animal, vegetable and industrial organic waste by earthworms. *Agric. Ecosyst. Environ*, **24**: 21-31.

Elias, S.M. and Nazrul, M.I. (1982). Socio-economic Assessment of improved Technology of potato and Identification and Constraints to its higher production. Agricultural Economics Research Report No. 4. Joydebpur, Agricultural Economics Division, BARRI.

FAO. (1988). Production Year Book. Food and Agricultural Organization of the United Nations. Rome, Italy, 42: 190-193.

FAO. (2005). Production Year Book. Food and Agricultural Organization of the United Nations, Koine. p. 340.

Ghimbasan, R. (1997). Potato cultivation (growing) conditions, varieties and productions (crops). Bulletin-of-the-Transilvania-University-of Brasov, New-Series-Series-A, **4**(39): 31-34.

Ghosh, D.C. and Das, A.K. (1998). Effect of biofertilizers and growth regulators on growth and productivity of potato (Solarium tuberosum). Indian Agriculturist, **42** (2): 109-113.

Gladkikh, V.I., Sirota, S.M. and Belyakoy, M.B. (2001). Effect of prolonged systematic use of fertilizers on the yield and quality of vegetable crops. Agrokhimiya, **7**: 129-132.

Glukhov. A.P. (1994). Potato varieties of the Belousovskoe Experimental farm. *KartofeI* / *Ovoshchi*, **3**: 23.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research (2nd Edn.). John Willey and Sons, Singapore. pp. 28-92.

Gregoriou, S. and Onoufriou, N. (2002). Evaluation of potato varieties in Cyprus. Miscellaneous Reports Agricultural Research Institute, Ministry' of Agriculture, Natural Resources and the Environment, (81); 30.

Guarda, G. and Tassoni, F. (1994). Effect of mineral and organic nitrogen fertilizer on production and quality of potato chips. In: Proceedings of the third Congress of the European Society for Agronomy, Padova University, Italy, and 18-22 September 1994 [Cited from Potato Abstr, **22**(2):58, 1997].

Guarda, G., Colauzzi, M., Tassoni, F., Zuffellato, F. and Bellato, S. (1997). Varietal results for potato. *lnformatore Agrario,* **53**(49): 45-53.

Haase, T., Schuler, C., Kolsch, E., Hess, J. and Volkel, G. (2002). Organic table potato production: results of three years of variety trials. *Kartoffelbau.* **53**(4): 136-139.

Hoque, M.A. (1993). Evaluation of exotic potato varieties in Firs, generation Annual Report, TCRC, BARI, Joydebpur, Gazipur, Bangladesh, pp.1-7.

Hossain M.M., Akhter, M.I., Sattar, M.A., Rashid, M.H. and Ali, M.S. (2003). Maintenance ol Promising variety/Genotypes. Annual Res. Reports on tubers crop Improvement, TCRC, BARI, Joydebpur, Gazipur. pp. 13-15.

Hossain, A.E., Rashid, M.A., Sharker, M.H., Kabir, M.H., Elias, M., Hossain, M. M. and Quasem, A. (1991). Evaluation of Exotic Potato Varieties. Proc. First National Workshop on Tuber Crops. TCRC, BARI, Joydebpur, Bangladesh, pp. 38-50.

Hussain, H.A. and M.M. Rashid. (1974). Effcct of method of culture and depth of planting of seed on the yield of potato. Bangladesh Hort, **2**(1): 29-33.

Ilin, Z., Durvra, M., Markovic, V. Branka and Seferovic (1992). Yield and quality of young potato effected by irrigation and farm manure. *Savremena Poljop Rivreda*, **40**(1-2): 211-215. [*Cited from Potato Abstr*, **20**(3): 129, 1995].

Islam. M.R. (2005). Effect of organic farming on soil and potato quality and yield of potato. M. S Thesis, Dept. Environ. Sci., Bangladesh Agric. Univ., Mymensingh. Bangladesh.

Islam. M.S., Rahman. A.F.M. and Bari. M.H. (1980). Nitrogen, potassium and cowdung requirement of potatoes. Proceedings Workshop of Potato, Potato Research Centre, BARI. Gazipur-1701. p. 92-94.

Ismail, S.A., (2005). The Earthworm Book. Other India Press, apusa, Goa, pp: 101.

Kale, R.D., (1998). Earthworm Cinderella of Organic Farming. Prism Book Pvt Ltd, Bangalore, India, pp: 88.

Kaur, R. and Singh. N. (2001). Response ol potato to nitrogen and farmyard manure: a review. *Environ. Ecol*, **19**: 87-105.

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

Khalak. A. and Kumaraswmy, A.S. (1994). Effect of irrigation and residues of fertilizer levels on performance of finger millet in potato based cropping system. *Mysore J. Agril. Sci*, **28**(2): 111- 115.

Koppel, M. (2001). Sustainability of potato varieties for organic growing. Transactions of the Estonian Agricultural University, Agronomy, **213**: 73-78.

Krishnamurthy, N., Khalak, A., Sujith, G.M. and Khalak, K. (2001). Response of potato grown from TPS to integrated use of organic manures and fertilizers in alfisols of eastern dry zone of Karnataka. Changing scenario in the production systems of horticultural crops. *South Indian Hort*, **49**:165-167.

Krupkin, P.I., Kil-bi-Ya, I.A., Makrinova, M.A., Yaltonskii, I., Ya, K. and Yaltonsky, M.A. (1994). Effectiveness of lignin based fertilizers in Sibrria. Agrokhimiya, **12**: 53-64.

Kuznetsova. T. N. (1997). Testing potato varieties. *Kartofel* / *Ovoshchi.* **4**: 22.

Luthra, S.K., Pande, P.C., Singh, S.V., Pandey, S.K., Khurana, S.M.P., Khan. I.A., Singh, B.P. (2006). Kufri Arun: a new red skin potato variety. *Potato J*, **33**(1/2): 20-25.

Marks, N. and Krzysztofik, M. (2001). Influence of proecological manuring technique on the quality of potato tuber yield. *Inzynieria Rolnicza*, **5**(1): 205-211.

Moazzem, K.G. and Fujita, K. (2004). Potato marketing system and its changes in Bangladesh: From the perspective of village study in Comilla district. The Developing Economics. XLII-1 (March): 63-94.

Neher, A.N.M. (1999). Effect of fertilizer management practices and irrigation on production of potato. MS thesis, Dept. of Hort., BAU, Mymensingh.

Okonkwo, J.C. and Eanq, A.J. (2003). Effect of organic and inorganic fertilizers on the yield of true potato seed in Jos Plateau, Nigeria. *J. Sus. Agric. Environ*, **5**. 99- 104.

Pandey, S.K. Singh, S.V. Dinesh, K., Manivel, P., Marwaha, R.S., Parveen, K. and Singh, B.P. (2006). Kufri Chipsona-3: a high yielding potato variety for chipping with defect free tubers. *Potato J.* **33**(1/2): 26-34.

Plaza, A., Ceglarek, F. and Buraczynska, D. (2004). Tuber yield and quality of potato fertilized with intercrop companion crops and straw. *Electron J. Polish Agri. Uni. Agron,* **7**(1).

Rabbani, M.G. and Rahman, M.A. (1995). Performance of Dutch Potato Varieties in 3rd generation. A report of Netherlands Technical Assistance Unit CDP, Khamarbari, Dhaka. pp. 31-34.

Rajkhowa, D.J., Gogoi, A.K., Kandal, R. and Rajkhowa, K.M. (2000). Effect of vermicompost on Greengram nutrition. *J. Indian Soc. Soil Sci*, **48**: 207-208.

Ray, D. and Mukhopadhyay, S.K. (2004). Tuber yield, dry matter content and storage life of some potato processing varieties under alluvial zone of West Bengal. *Indian Agriculturist,* **48**(1/2): 113-117.

Reust, W. (1997). Yield formation and quality aspects of three potato varieties. Revue Suisse Agric. **29**(5): 217-220.

Rosul, M.G., Nahar, M.S., Akter, M.S., Quasem, M.A. and Rashid, M.A. (1993). Yield Potential of exotic potato varieties in subsequent generation. *Ann. Bangladesh Agric*. TCRC, BARI, Joydebpur, Gazipur, Bangladesh, **3**(1): 1-12.

Samsunnahar. M. (2005). Effect of organic farming on properties of soil and growth and yield of red amaranth. M.S Thesis, Dept. *Env. Sci*. Bangladesh Agric. Univ. Mymensingh.

Sarker, N.I., Zaman, S., Islam, M.S., Islam, M. and Mannaf, M.A. (1996). Effect of fertilizers alone and in combination with cowdung on the growth and yield of potato. *Bangladesh J. agril. Res*, **21**(2): 275- 282.

Senesi, N., T.M. Miano and G. Brunetti, 1996. Humic-like substances in organic Amendments and Effect of Native soil humic substances. In: Humic substances in Terrestrial Ecosystem (ed. A. Piccolo). Elsevier Science, pp: 531-593.

Shambhavi, S. and Sharma, R.P. (2011). Influence of vermicompost on the performance of potato in an acid alfisol. *Potato J,* **38**(2): 182-84.

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, pp. 166-167.

Singh. S.R. and Singh. A.K. (2001). Effect of organic farming technology on yield and quality of radish under mid hill of Himachal Province. *Agric. Sci. Digest*, **21**: 115-117.

Urashima. Y., Suga, Y., Fukunaqa. A., Ikeda, J. and Hori. K. (2002). Quality of Japanese radish under the compost successive application. *Hull. National Agric. Res*. Center for Western region (Japan), **1**: 61-75.

Venkatasalam, E.P., Singh, S. and Sharma, S. (2012). Effect of organic manures on yield and yield attributing characters of potato. *Potato J*, **39** (1): 84-87.

Vos, J. and Putten, P.E.L. (2000). Nutrient cycling in a cropping system with potato, spring wheat, sugar beet, oats and nitrogen catch crops. Input and uptake of nitrogen, phosphorus and potassium nutrient cycling in Agro-ecosystem, **56**(2): 87-97.

Wu. H.Z., Cui, X.C., Jin, F. (1997). Selection of' Yushu No. 1 potato - a new variety with disease resistance, high yield and good quality. *China Vegetables,* **3**: 23-25.

Yourtchi, M.S., Hadi, M.H.S. and Darzi, M.T. (2013). Effect of nitrogen fertilizer and vermicompost on vegetative growth, yield and NPK uptake by tuber of potato (Agria CV.). *Intl. J. Agri. Crop Sci,* **5**(18): 2033-2040.

Zaman, S.K. (2002). Integration of fertilizer and manure for sustainable soil fertility in ricer-rice cropping system. Ph.D. thesis. Dept. Soil Sci., Bangladesh Agric. Univ., Mymensingh.

Zavalin, A.A., Grcmitskikh, A.O. and Niang, A. (1993). Potato yield and quality as influenced by fertilizers and soil humidity. *Soviet Agril. Sci*, **3**:34-37.

Zink, T.A. and Allen, M.F. (1998). The effects of organic amendments on the restoration of a disturbed coastal sage scrub habitat. Restor Ecol, **6**(1): 52-58.

Appendices

APPENDICES

Appendix 1. Monthly records of Temperature, Rainfall, and Relative humidity of the experimental site during the period from October 2014 to February 2015

Year	Month	Air Temperature (^{0}c)			Relative humidity (%)	Rainfall (mm)	Sunshine (hr)
		Maximum	Minimum	Mean			
2014	November	29.5	18.6	24.0	69.5	0.0	233.2
	December	26.9	16.2	21.5	70.6	0.0	210.5
2015	January	24.5	13.9	19.2	68.5	4.0	194.1
	February	28.9	18.0	23.4	61.0	3.0	221.5

Source: Bangladesh Meteorological Department (Climate division), Agargaon, Dhaka-1207.

Appendix 2. The mechanical and chemical characteristics of soil of the experimental site as observed prior to experimentation

Particle size constitution:

Sand	:	40 %
Silt	:	40 %
Clay	:	20 %
Texture	:	Loamy

Chemical composition:

Constituents	:	0-15 cm depth
P^H	:	6.4
Total N (%)	:	0.07
Available P (µ gm/gm)	:	18.49
Exchangeable K (meq)	:	0.07
Available S (µ gm/gm)	:	20.82
Available Fe (µ gm/gm)	:	229
Available Zn (µ gm/gm)	:	4.48
Available Mg (µ gm/gm)	:	0.825
Available Na (µ gm/gm)	:	0.32
Available B (µ gm/gm)	:	0.94
Organic matter (%)	:	1.4

Source: Soil Resources Development Institute (SRDI), Farmgate, Dhaka.

Appendix 3. Effect of variety and vermicompost on plant height of potato

Source of variation	Degrees of freedom	Mean square of plant height (cm)			
		30 DAS	45 DAS	60 DAS	75 DAS
Replication	2	0.68	1.50	1.97	1.50
Factor A	2	6.28**	5.80*	6.44*	4.88**
Factor B	3	7.58*	9.51*	7.44*	9.52*
AB	6	2.62**	2.28**	3.26**	2.21**
Error	22	2.141	3.017	3.773	2.036

Appendix 4. Effect of variety and vermicompost on days to 100% emergence of potato

Source of variation	Degrees of freedom	Mean square of 100% emergence of potato
Replication	2	0.146
Factor A	2	3.147*
Factor B	3	5.424*
AB	6	1.029*
Error	22	1.142

Appendix 5. Effect of variety and vermicompost on number of leaves plant^{-1} of potato

Source of variation	Degrees of freedom	Mean square of number of leaves plant^{-1}			
		30 DAS	45 DAS	60 DAS	75 DAS
Replication	2	0.322	0.456	0.624	1.024
Factor A	2	2.19**	5.38*	5.28**	4.88*
Factor B	3	4.019*	10.27*	12.68*	10.27*
AB	6	2.716*	2.18**	0.49**	2.45**
Error	22	2.371	1.082	2.197	1.336

Appendix 6. Effect of variety and vermicompost on leaf length (cm) of potato

Source of variation	Degrees of freedom	Mean square of leaf length (cm)			
		30 DAS	45 DAS	60 DAS	75 DAS
Replication	2	0.240	0.428	0.467	0.414
Factor A	2	3.43*	4.44*	4.48*	3.47*
Factor B	3	8.85*	6.47*	9.68*	10.44*
AB	6	1.34**	2.27*	1.23**	2.29*
Error	22	1.105	2.283	1.1438	2.322

Appendix 7. Effect of variety and vermicompost on leaf breadth (cm) of potato

Source of variation	Degrees of freedom	Mean square of leaf breadth plant^{-1} (cm)			
		30 DAS	45 DAS	60 DAS	75 DAS
Replication	2	0.475	1.045	0.462	1.462
Factor A	2	5.443*	8.441*	4.482*	3.427*
Factor B	3	12.112*	12.417*	6.684*	7.443*
AB	6	1.324**	1.272*	2.272**	2.239*
Error	22	3.115	3.336	2.134	3.313

Appendix 8. Effect of variety and vermicompost on number of main stem hill^{-1} of potato

Source of variation	Degrees of freedom	Mean square of number of main stem hill^{-1}			
		30 DAS	45 DAS	60 DAS	75 DAS
Replication	2	0.682	1.506	0.971	1.502
Factor A	2	6.281**	5.802*	6.44*	7.884**
Factor B	3	4.583*	7.511*	10.44*	11.526*
AB	6	0.627**	2.283**	2.26**	2.215**
Error	22	2.141	3.012	3.774	3.011

Appendix 9. Effect of variety and vermicompost on fresh weight and dry weight of haulm hill^{-1} at harvest of potato

Source of variation	Degrees of freedom	Mean square	
		Fresh weight (g)	Dry weight(g)
Replication	2	1.442	1.143
Factor A	2	5.393**	6.392**
Factor B	3	7.541*	10.514*
AB	6	1.283*	2.286*
Error	22	2.14	2.143

Appendix 10. Effect of variety and vermicompost on yield and yield contributing parameters of potato

Source of variation	Degrees of freedom	Mean square				
		Number of tuber hill^{-1}	Weight of tuber hill^{-1} (g)	Tuber weight plot^{-1} (kg)	Dry weight of 100 g fresh tuber	Tuber weight ha^{-1} (t)
Replication	2	1.926	0.327	1.372	0.144	0.347
Factor A	2	0.482*	7.906*	4.216*	3.393**	6.472*
Factor B	3	13.843*	15.704*	8.434*	7.546*	12.793*
AB	6	9.792*	3.462**	2.095*	2.288*	3.071**
Error	22	3.449	4.213	3.272	2.144	2.165