EFFECT OF POTASSIUM ON GROWTH AND YIELD OF RADISH CULTIVARS

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JUNE, 2011

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

MASTER OF SCIENCE (MS)
IN
HORTICULTURE

SEMESTER: JANUARY-JUNE, 2011

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This is to certify that the thesis entitled, "**EFFECT OF POTASSIUM ON GROWTH AND YIELD OF RADISH CULTIVARS**" submitted to the Department of Horticulture, Faculty of Agriculture, 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 **S. M. AL-BERUNI**, Registration No. 05-1704 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, 2011

Place: Dhaka

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Dedicated to
My
Beloved Parents

ACKNOWLEDGEMENT

All praises are due to the Almighty "Allah" Who kindly enabled the author to complete the research work and the thesis.

The author feels proud to express his profound respect, deepest sense of gratitude, heartful appreciation to my supervisor ***Prof. Dr. Md. Ismail Hossain,*** *Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka for his constant inspiration, scholastic guidance and invaluable suggestions during the conduct of the research and for his constructive criticism and whole hearted cooperation during preparation of this thesis.*

The author express his heartfelt gratitude and indebtness to my co-supervisor ***Jasim Uddain,*** *Assistant professor, Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka for his assistance in planning and execution of the study and for his constructive instruction, critical reviews and heartiest cooperation during preparation of the manuscript.*

The author also express his heartfelt thanks to all the teachers of the Dept. of Horticulture, Sher-e-Bangla Agricultural University, Dhaka for their help, valuable suggestions and encouragement during the period of study.

The Author is also wish to acknowledge is indebtedness to the Farm Division of SAU and other staff of the Department of Horticulture for their co-operation in the implementation of research works.

The Author is also thankful to Arif for their constant encouragement.

At last but not the least, the Author feel indebtedness to be beloved parents and relatives, whose sacrifice, inspiration, encouragement and continuous blessing paved the way to is higher education.

The Author

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ABSTRACT

The experiment was conducted at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka during the period from October 2010 to January 2011 to study the effect of potassium on growth and yield of radish cultivars. In experiment, the treatment consisted of three varieties, viz. V_1: BARI Mula-1 (Tasakisan), V_2: BARI Mula-2 (Pinky), V_3: BARI Mula-3 (Druti) and four different levels of potassium viz. K_0 (Control), K_1 (80 kg), K_2 (100 kg) and K_3 (120 kg) respectively. Two factorial experiments were laid out in the Randomized Complete Block Design (RCBD) with three replications. Significant variations in all parameter were observed due to variety except root diameter. The tallest plant, maximum number of leaves, diameter of root, length of root and fresh weight of roots were produced from V_3. The maximum yield (24.47 t/ha) was recorded from V_3 and minimum from V_1.The maximum yield of radish (24.47 t/ha) was obtained from K_2 and lowest from K_0 .The tallest plant, maximum number of leaves, diameter of root, length of root and yield (24.47 t/ha) were produces from V_3K_2. The minimum yield was obtained from the V_1K_0. Highest benefit cost ratio (BCR) was obtained from V_3K_2 (4.19) and lowest from V_1K_0 (1.90).

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ABBREVIATIONS AND ACRONYMS

AEZ	=	Agro-ecological Zone
ANOVA	=	Analysis of variance
BARI	=	Bangladesh Agricultural Research Institute
BADC	=	Bangladesh Agricultural Development Corporation
BARC	=	Bangladesh Agricultural Research Council

BCR	=	Benefit Cost Ratio
cv.	=	Cultivar
CV%	=	Percentage of coefficient of variance
DAT	=	Days after transplanting
DMRT	=	Duncan’s Multiple Range Test
et al.	=	And others
FAO	=	Food and Agricultural Organization
ha	=	Hectare
LSD	=	Least Significant Difference
MOP	=	Muriate of Potash
ppm	=	Parts per million
RH	=	Relative humidity
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Resources Development Institute
TSP	=	Triple Super Phosphate

CHAPTER I

INTRODUCTION

Radish (*Raphanus sativus* L.) is a vegetable crop under the family Brassicaceae. It is an herbaceous plant. It may be reffered as to underground-modified root, which is fusiform in shape. The stem is short at vegetative stage but elongated at the reproductive stage, leaves are generally lyrate and leaf blade is simple. Flower may be white or sometimes-pink. Fruit is called siliqua, which is 3-8 cm long with 6-12 seeds (Rashid, 1999). Radish (*Raphanus sativus* L.) is a popular and important vegetable crop in Bangladesh. It is mainly a winter vegetable crop but available in markets from early September to May. It can be grown any time of the year in Bangladesh (Rashid, 1983). This crop can withstand so diversified climate that the crop is grown in tropical, subtropical and even in temperate countries. There are many opinions among the scientists regarding to its place of origin. China and India was the native lands of radish (Katyal and Chandha,1985).

The crop is becoming popular day by day among all classes of people, poor or rich, urban or rural. This is one of the top ranking vegetables in Japan, in respect of acreage under cultivation and its consumption (Rashid, 1983). Radish is cultivated everywhere in Bangladesh and is grown mainly as a kitchen garden crop for home consumption. It grows commercially in our country.

Rashid (1976) mentioned that a hundred gram of edible root contains 1% protein, 4% carbohydrate, little fat, 15 calories, negligible vitamin A, 0.03 mg thiamine, 0.03 mg riboflavin, 0.30 mg niacine, 25 mg vitamin C, 30 mg calcium and 1.00 mg iron. The leaves are also nutritionally rich. One hundred gram of edible leaf

contains 18660 IU vitamin A, 103 mg vitamin C and 310 mg calcium others. The Japaneses use the fleshy roots as pickle or boiled slices (Katyal and Chadha, 1985). In Bangladesh the root is eaten mainly in curries or as salad. Red radish contains 39.30 to 185 mg anthocyanin/100 g skin and 12.2 to 53 mg anthocyanin/100 g root (Giusti, *at al*. 1998). Otsuki, F. *at al.* (2002) isolated twelve acylated anthocyanins from red radish. Six of them were identified as petargonidin based. Radish has a cooling effect on human body and is suitable for patients suffering from Piles, liver troubles, enlarged splin and jaundice (Katyal and Chadha, 1985).

Yield of any crop can be increased up to substantial quantity by using improved varities and improved production technologies. Improved production technique and proper management are, therefore, important factors are considered to boost production of radish in Bangladesh.

The deficit situation of radish production in our country can be overcome either by bringing more area under radish cultivation or by increasing the yield through improvement of production technology, such as optimizing the dose of N, P and K fertilizers. Nitrogen plays an important role for the vegetative growth of the crop which ultimately helps in increasing root size and total yield. Nitrogen imparts greenness to plants by enhancing chlorophyll synthesis and induces more photosynthetic production per unit photosynthetic area.

The radish is a shallow rooted and potash-loving crop; hence fairly high concentration of nutrients including potassium must be maintained in the upper layer of the soil. Generally a heavy dose of fertilizer is recommended for radish

cultivation. Like other tuber and root crops, radish is very responsive to potash. Among the various nutrients required to produce high yield of radish, potassium is considered to be very important element due to its influence for translocation of photosynthates, root size and yield per plant. Potassium is one of the major nutrients taken up by the plant in large quantities and the adequate level of potassium increases crop resistance to various diseases, stalk and stem breakage and at stress conditions (Razzaque *et al.*, 1990).

A little investigation has been reported on the influences of variety and potassium fertilizer alone on radish yield in Bangladesh. Considering the above facts the present investigation was under taken with the following objectives:

i) to identify appropriate dose of potassium on growth and yield of radish,

ii) to find out the suitable variety for higher and yield of radish, and

iii) to determine the suitable combination of potassium and varieties for radish cultivation.

CHAPTER II

REVIEW OF LITERATURE

A lot of information has been accumulated on the effect of potassium on the productivity of different annual crop on different parts of the world. A

considerable amount of such research works have been reported on vegetable crops but report in this subject on radish is meager. Experimental reports on the influence of manure on soil condition and crop productivity are also available to a considerable extent but such report on radish is totally lacking. However, some of the available literatures related to the present investigation have been presented below.

2.1 Literature on variety

Gormade *et al*. (1989) investigated on seed production in same varieties of radish as influenced by dates of steckling planting found that steckling of 45 days old planted on 24 oct. (earliest planting) gave the highest seed yield (13.9 q/ha) on average for all cultivars.

Gill and singh (1979) obtained higher field germination of Punjab sufaid variety of radish. Highest root yield was produced from mid October sowing compared to other sowing made from first September to first December.

Kang and Kim (1995) conducted and experiment on the growing character and selection of the rational seedling period of radish for after crop of maize and found that when radish is grown after a crop of *Zea mays* it grows slowly, particularly during the first 50 days after seed germination. The best growth and yield were obtained from seeds planted early in august when the accumulated temperature of 5˚ C was >1400-1500˚.

Vergote *et al.* (1997) reported several crop characteristics in a greenhouse study with radish in Belgium. Five radish cultivars (Bellar, Claudies, Niz 31-14, radish

sprit) were sown on 18 November and harvested on 17 February. cv. Spirit performed best having a high production and short shot length. In another trial in a green house with CO_2 producing heating system, cultivar ‘Bellar’, ‘Altox’, Radius and ‘Boy’ were sown on 30 October and 2 December and harvested on 20 January and 3 March, respectively. cv. ‘Boy’ had the best production and greatest resistance against leaf burn caused by CO_2.

Kano and Fukuoka (1995) reported the effects of soil temperature on hollowness in Japanese radish (*Raphanus sativus L.*) cv. ‘Gensuke’ and examine the effect of high soil temperature on the development of hollowing in the root of radish. Seeds were sown in the field on May, 10 July and 16 August 1992. Plants form the July sowing were subjected to soil temperature above 32˚C during the middle of the growth period. Root weight was reduced and hollowness occurred in roots from July sowing. Roots from July sowing had the greatest concentration of vessels in the central region. Lignin formed in salls surrounding the central cavity only in roots of July sowing. In a second experiment, seeds were sown on 30 April 1991, in plastic pots with heating cables to increase soil temperature. Soil heating from day 16 after sowing (DAS) to 30 DAS and 31 to 45 DAS showed root growth, and produced some hollow cavities, caused more vessels to form in the central area, and promoted lignifications near the central cavity. In contrast, soil heating during these periods had no effect on lignin formation. In conclusion, a large hollow cavity develops in the central region of the root as a result of active lignin formation in the surrounding cells induced by soil heating in the middle of the growth period.

Deotale *et al.* (1994) studied the performance of some radish (*Rhphanus stivas L.*) cultivars under Nagpur condition during rabi season. The radish cultivars trials were ‘Pusa Rashmi’, ‘Pusa Himani’, ‘Japanese White’, ‘Vijay’ and ‘Pusa Chetki’. ‘Pusa Rashmi’ was the best cultivars with respect to the following root length 45 days after sowing, which was 23.00 cm compared with 19.20-21.00 cm, root diameter of 3.86 cm compared with 3.01-3.50 cm, weight/plant of 299.12 g compared with 216.10-278.12 g; and yield of 27.26 t/ha compared with 24.11-27.14 t/ha. Baramasi produced the greatest leaf weight/plant of 136.56 g compared with 106.34-135.20 g for the other cultivars.

Capecka (1995) reported that the Japanese radish in field cultivation and found that Japanese radish cultivars ‘Tokinashi’ and ‘Minowase’ Summer cross F1 were sown in April, June or July in field trials near Krakow in 1990-92. The average growing period was 60-75 days. Tokinsashi formed shorter and thinner storage roots than ‘Minowase summer cross’. Marketable yields were 513 and 719 dt/ha, respectively. Both cultivars could be sown after 15 June and ‘Tokinashi’ could possibly be sown earlier. Japanese radishes were resistant to sponginess but susceptible to root deformation and cabbage fly infestation.

Sarveshwar *et al.* (1991) conducted the experiment to study the response of radish cultivars to different sowing dates and seed of radish cultivars ‘Pusa Himani’, ‘selection-9’, ‘Japanese White’, ‘local Red’ and ‘white Icicle’ were sown on 8 different dates between March and September 1987. Roots were harvested at marketable size and quality. Data of root weight, root length and diameter, size of plant canopy and bolted plants were recorded. The highest percentage of

marketable roots (35.31%) was recorded for ‘Pusa Himani’, followed by ‘white Icicle’ (34.86%).The lowest percentage of marketable roots was recorded for ‘Japanese white’ (22.70%). Pusa Himani gave significantly higher yield and longer roots (mean of 16.05 cm) in 7 of the 8 sowings had the maximum number of days to bolting and the least pithiness in roots. This cultivar was recommended for summer sowing in hilly refions.

Nautiyal *et al.* (1977) evaluated 14 radish cultivars for germination percentage, leaf number, length and width, root length and girth, top and fresh weight and root yield. The two highest yielding cultivars were ‘Newari’ (88.89 q/ha) and ‘Kalyanpur’ type (85.9 q/ha).

Pujari *et al.* (1977) reported that ‘Pusa Himani’, ‘Pusa Reshmi’, ‘Japanese white’ and ‘Nanthnagar local’ were high yielders compared to others. They had upright to semi-spreading type plants. Cultivars with spreading type of plant habit *viz.,* ‘Muli’, ‘Nepali’ and ‘Kanilal Bobai’ recorded low yield. The higher root weight recorded in ‘Pusa Himani’, ‘Pusa Reshmi’, ‘Japanese white’ and ‘Nanthanagar local’ was responsible for increased root to shoot ratio.

Rajagopal *et al.* (1979) evaluated 11 varieties of radish obtained from different parts of India for their performance at the Tamil Nadu Agriculture University and revealed that ‘Pusa chetki’ and ‘Pusa safed’ recorded higher yield (17.90 and 16.70 t/ha). Punjab safed had highest root length of 25.90 cm and lowest in ‘RS-13’ (13.40 cm). Highest yield recorded in ‘HR-1’ (594.98q/ha) followed by

‘Kalyanpur Type-1’ (585.88 q/ha) and ‘Punjab safed’ (540.65 q/ha) among the six varieties of radish evaluated.

Dixit *et al.* (1980) evaluated seven radish cultivars where ‘Japanese white’ gave the highest yield (56.11 q/ha) followed by ‘Kalyanpur Type-1’ (44.17 q/ha) and ‘scarlet long’ (37.21 q/ha).

Singh *et al.* (1990) reported that the highest yielding cultivars were ‘PS-5’, ‘Sutton long white’, ‘Pusa Reshmi’, ‘Jaunpuri’ and ‘Newari’ with 400, 365, 356, 333 and 332 q per ha, respectively. The lowest yielding cultivars were ‘Ambersari’ and ‘Barsati’ with 133 and 178 q per ha, respectively.

Sirohi *et al.* (1992) reported that ‘Pusa desi’ a white cultivar of the tropical radish group maturing of 50 to 55 days after sowing. The roots are white 30 to 35 cm long, tapering, medium thick, mildly pungent and average yielding, vary from 30 to 35 t per ha.

Lingaiah *et al.* (1992) evaluated four cultivars of radish for growth and yield components ‘Pusa chetki’ and ‘Arka Nishant’ gave the highest mean yields of 16.90 and 13.40 t per ha, respectively. The root to leaf ratio was highest in ‘Pusa chetki’.

Deotale *et al.* (1994) reported that ‘Pusa Reshmi’ was the best cultivar with aspect to the root length at 45 days after sowing which was 23.00 cm compared with

3.01 to 3.50 cm weight per plant of 299.12 g compared with 216.10 to 278.12 g and yield 27.14 t per ha for other cultivars. Baramasi produced the highest root weight per plant of 219.14 g compared with 108.11 to 142.33 g for other cultivars. Pusa chetki produced the highest leaf weight per plant of 136.56 g compared with 106.34 to 135.20 g for the other cultivars.

Kumar *et al.* (1995) reported that ‘Pusa Himani’ recorded significantly the highest plant height, number of leaves per plant, root length, root diameter, root weight and yield compared to the ‘white Icickle’. Pusa Himani was recommended for sowing during spring season.

Gupta *et al.* (1974) reported that the yield and growth characteristics of four varieties were investigated and results are tabulated. The results showed that ‘Japanese white’ and ‘Pusa Himani’ are the highest yielding under local conditions. The early variety ‘white Icicle’ was most suitable for kitchen gardens and intercropping with other vegetables.

Shridhar (1998) conducted an experiment during the dry season (December – January) and rainy season (June – July) in 1989-90 in Port Blair, Andaman and Nicobar Islands to evaluate the growth and yield characteristics of radish cultivars. ‘Pusa Himani’, ‘Pusa Chetki’, ‘Japanese white’, ‘Pusa Reshmi’, ‘Jaunpuri safed’ and ‘Bombay red’. The rainy season crop was grown as rainfed while dry season crop was well irrigated. Pusa chetki had the highest yield

compared to other cultivars in both the season. On an average, it produced maximum root yield (267.50 q/ha), root diameter (3.88 cm), root weight per plant (83.35g) and less leaf/root ratio (0.72) followed by 'Pusa Reshmi' (207.57 q/ha, 3.23 cm, 62.35 g and 1.55, respectively). The lowest yield (134.31 q/ha), root weight (40.30 g) and root length (10.30 cm) was recorded by 'Jaunapuri' in both the seasons. Bombay red (commonly grown) exhibited an almost consistent performance irrespective of the seasons. The performance of 'Jaunapuri' and 'Punjab safed' was much lower than their main land yield levels indicating that both cultivars seemed to be strongly thermosensitive. The maximum root length was observed in 'Pusa Himani' (14.2 cm) and 'Japanese white' (14.2 cm), but was at par with 'Pusa chetki' (13.2 cm) and 'Pusa Reshmi' (13.3 cm) in both the seasons.

Sharma *et al.* (2002) twenty eight radish cultivars were evaluated for root yield and component traits during 1996-97 in Palampur, Himachal Pradesh, India. The cultivars significantly varied in terms of root weight, length, girth diameter and yield. Among Asian cultivars, 'Mino early white' had the highest root weight (186.13 g), length (18.65 cm) and yield per plot (18.82 kg). Whereas, 'Sutton's long white' had the longest roots (19.85 cm). Among the European cultivars, 'Palm Hirday (DPR-1)' had the highest root diameter (5.10 cm), girth (14.67 cm) and yield per plot (10.95 kg). The superior cultivars were 'Mino early white', 'Sutton's long white' and 'Nadauni' among Asian cultivars and 'Palam Hirday' among the European cultivars.

Li-Xian Hong *et al.* (2005) reported that ‘Qiufeng 2’ is a new radish F1 variety in China characterized by high yield potential, long storage life and vigorous growth. This mid to late maturing cultivar produces globose fleshy root with a red, smooth pericarp. The white and tender flesh has a moderate water content. The crop matures in approximately 90 days.

2.2 Literature on potassium

Akhtar Inam *et al.* (2011) conducted trials at Aligarh (India), K content was studied in two varieties each of radish and turnip, grown under three regimes of nitrogen (100, 150 and 200 kg/ ha 1). The number of leaves and dry matter content of tops and roots of both crops increased with increasing doses of N. With the increase of N fertilizer, radish biomass production, economic output and the root yield increased with the increase of economic output per kg of nitrogen from the negative to a positive correlation, and the growth yield is also growing. Appropriate amount of nitrogen fertilizer increased the plant's largest leaf length, maximum number of photosynthetic leaves, tops and root dry matter accumulation in various organs in radish and turnip varieties, showed a positive correlation between nitrogen deficiencies reduced dry matter accumulation amount. K content also increased with increasing doses of N, with 200 kg/ ha 1 giving the highest value. Local variety of each crop possessed comparatively less K content. Maximum K content was noted in ‘Pusa Rashmi’ (radish) and ‘Snow

Ball' (turnip) grown with 200 kg/ ha. At early stage, K content was more in tops, but as the plants grew the content became higher in roots.

Chandrasekharan (1983) carried out an experiment to study the effect of application of S and K on the yield and quality of radish and carrot. Significant increase in the yield of radish was obtained due to sulphur and potassium application. The highest yield of radish crop was obtained with a treatment combination of 10 ppm S and 75 kg potassium per hectare. Significant differences in the nitrogen, phosphorous and sulphur contents of radish leaves were observed at the same treatment and the quality parameters like protein, vitamin C and pungency differed significantly due to treatment combinations (S at 10 ppm and K at 75 kg/ha). He also reported the significant increase in the yield of carrot due to sulphur and potassium application. He also reported that quality parameters like protein, vitamin C and ß-carotene content of carrot increased significantly with increased application of S and K.

Muttuswamy and Muthukrishnan (1971) reported that nitrogen and phosphorus alone affected the fresh weight of the top. Nitrogen increased the fresh top weight and root weight. The effect of potassium did not reveal any trend. The fresh weight of root showed a significant reponse to phosphorous-potassium interaction and the response of nitrogen was significant also in dry weight of tops and roots, which were applied at the rate of 50:100:100 kg per hectare.

Mishra (1987) obtained more plant height (170.00 cm) and number of branches (12.94/plant. when radish crop cv. Pusa Reshmi was nourished with 80, 40 and 40 kg of nitrogen, phosphorus and potassium per ha, respectively.

Jadhao *et al.* (1999) noticed that application of 100 kg nitrogen, 50 kg phosphorus and 25 kg potash increased the plant height (147.80 cm) and number of branches (17.80/plant) in radish cv. Pusa chetki.

Pimpini *et al.* (1992) reported that poultry manure and mineral fertilizer combinations (equivalent) to 140 kg N + 140 kg P_2O_5 + 100 kg K_2O per ha and 210 kg N + 210 kg P_2O_5 + 150 kg K_2O per ha) were compared with a non-fertilized control and with the control (RDF). All the fertilizer treatment increased the size of onion bulbs.

Yousef and Shafi (1969) reported that French break fast, scarlet globe and sparkler were considered best interms of appearance, earliness (25 – 28 days) and acceptable root weight of 'Pusa chetki' in white cultivar of the tropical radish group maturing in 40 to 45 days after sowing. It may be planted as a summer and monsoon crop from April to September and average yield varied from 200 to 300 quintals per ha (Choudhary and Shirohi, 1975).

Singh and Singh (2000) recorded that the higher plant height (63.52 cm), fresh weight of bulb (119.53 g) and total bulb yield (295.2 q /ha) in the treatment receiving 100 kg potassium per hectare.

Sarode *et al*. (2001) reported that application of fertilizers to onion as per soil test value (150:62:37 N, P_2O_5 and K_2O/ha) was significantly superior over other fertilizer levels. The yield was maximum (37.6 t/ha) when fertilizers were applied based on soil test values.

Kumar *et al*. (2001) observed that the increase in potassium application significantly increased the dry weight of tops and bulbs, bulb diameter, 100 bulb weight and bulb yield upto 40 kg K_2O/ ha.

Sharma *et al.* (2002) noticed that the application of fertilizers @ RDF (125 kg N, 33 kg, P_2O_5 and 50 kg K_2O/ha) and 150% RDF (187 kg N, 49 kg P_2O_5 and 75 kg K_2O /ha) registered 42 and 56% increases in bulb yield of onion, respectively over 50% NPK dose.

Yadav *et al*. (2002) noticed significantly higher yield of bulb (247.79 q / ha) and fresh weight of bulbs (49.53g) with application of 150 kg K2O ha-1 over other potassium levels. Increased bulb yield of garlic (97.24 q/ha) was obtained with 150:80:50 kg N, P_2O_5 and K_2O ha-1 application. However, considering economics of crops balanced use of N, P_2O_5 and K_2O fertilizers @ 100:40:50 gave optimum returns (Tiwari and Agarwal, 2003).

Hariyappa (2003) reported that, the application of potassium @ 125 kg/ha recorded significantly highest plant height, total dry matter production which was on par with 150 kg ha^{-1}. Same treatment recorded significantly higher bulb weight (106.44 g/plant), bulb length (4.68 cm), bulb diameter (5.32 cm) and bulb yield (22.87 t/ha) over control.

Singh *et al*. (2004) noticed that the maximum plant height, fresh weight of leaves and total chlorophyll content at 45 DAT and 90 DAT were noticed with application of potassium @120 kg/ha. The maximum yield attributes, *viz*. neck thickness (0.92 cm), number of scales (7.73), bulb diameter (5.03 cm), fresh weight of bulb (48.89 g) and bulb yield (211.50 q/ha) were also recorded with same level of potassium.

Girigowda *et al*. (2005) reported that higher bulb yield (41.69 t/ha) was recorded with fertilizer level of (188:75:188, N, P_2O_5 and K_2O kg /ha) and was on par with fertilizer level of 156:63:156 kg N, P_2O_5 and K_2O $ha^{-1.}$

CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials and methods that were used in the experiment. It includes a short description of location of the experimental plot, characteristics of soil, climate and materials used for the experiment. The details of the experiment are described below.

3.1. Experimental Site

The research work was carried out at the central Farm of Sher-e-Bangla Agricultural University, Dhaka, during the period from October 2010 to December 2010. The experimental site was located in the Madhupur Tract (23°41′ North latitude and $90^0$22′East longitude) having an elevation of 8.2 m above sea level.

3.2. Climate and weather

The area had sub tropical climate. It was characterized by high temperature (28^0-32^0C) accompanied by moderately high rainfall during Kharif (April-September) season and low temperature (15^0-20^0C) in the Rabi (October-March) season. The weather data of experimental site was collected during the period of experiment from the Bangladesh Meteorological Department (Climate Division), Agargoan,Dhaka and have been presented in Appendix-I

3.3. Soil

The soil was belonging to the “Modhupur Tract”, AEZ-28 (FAO, 1988). Top soils were clay loam in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. Soil pH ranges from 5.4-5.6 and have organic carbon

0.82%. The chemical analysis of the soil of the experimental field were determined in the SRDI, Soil Testing Laboratory, Khamarbari, Dhaka and have been presented in Appendix-II.

3.4. Plant Materials Used

BARI Mula-1 (popular name Tasakisan) , BARI Mula-2 (popular name Pinky) and BARI Mula-3 (popular name Druti) were selected for investigation. Seeds of all radish varietics were collected from the Citrus and Vegetable Seed Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur.

3.5. Land Preparation

The land was ploughed and cross-ploughed quite a few times by tractor, followed by harrowing and laddering until a good tilth was achieved. Spading shaped the corner of the experimental plot. Almost all the big clods were broken into pieces. Weeds

and stubbles were removed as far as possible. The land was laid out according to the design of the experiment.

3.6. Experimental Design

The experiment was laid-out in two factorial randomize completely block design (RCBD) with three replications.

Factor A: Different levels of potassium

K_0 = 0 kg K_2O/ha

K_1 = 80 kg K_2O/ha

K_2 = 100 kg K_2O/ha

K_3 = 120 kg K_2O/ha

Factor B: Different radish cultivars

V_1 = BARI Mula-1 (Tasakisan)

V_2 = BARI Mula-2 (Pinky)

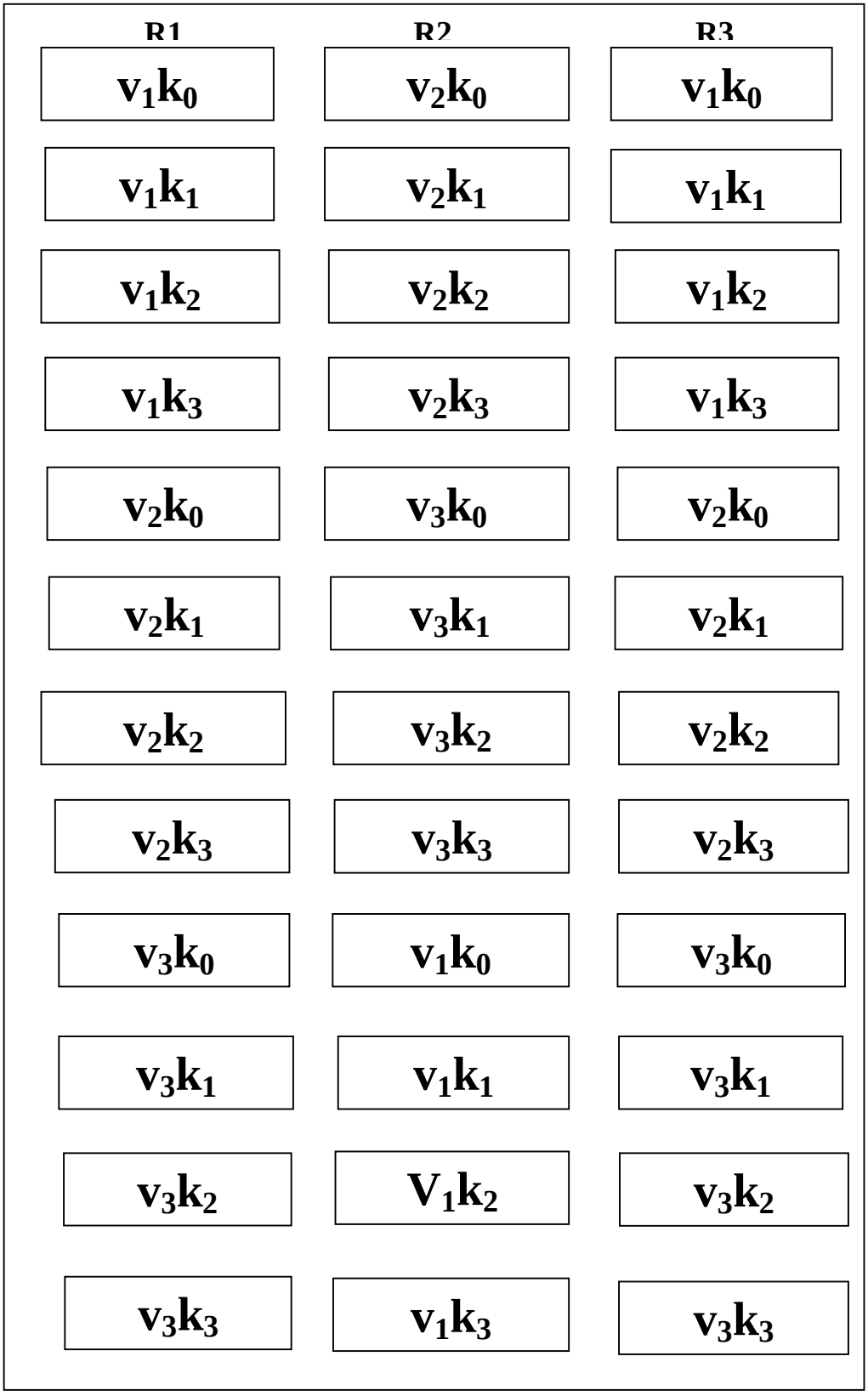
V_3 = BARI Mula-3 (Druti)

3.7 Design and layout of the experiment

The experiment was laid out in a Randomized Complete Block Design (RCBD). Each treatment was replicated for three times. The total field was divided into three equals blocks each containing 12 unit plots. The treatments combination was randomly assigned to each unit plot as to all of one treatment combination only once in each block. The size of each unit plot was 1.5 m ×1.5 m.

Layout of the experiment:

Randomized Complete Block Design (RCBD)



Legend

Area=25.5 m X 7.5 m
= 191.25 m^2
Plot size=1.5 mX1.5 m
Spacing = 50cmX 30cm
V= Variety
K= Potassium
R= Replication

Factor A:
K_0 =0 kg K_2O/ha
K_1= 80 kg K_2O/ha
K_2 = 100 kg K_2O/ha
K_3 = 120 kg K_2O/ha
Factor B:

V_1=BARI Mula-1(Tasakisan)

V_2=BARI Mula-2

(Pinky)

V_3=BARI Mula-3 (Druti)

Fig 1. Lay out of the experimental plot

3.8. Manuring and Fertilization

Crop was fertilized with the following doses of manure and fertilizers as recommended in a report of (Krishi Projukti Hat Boi) Banglaesh Agricultural Research Institute (BARI).

Manures and fertilizer	Dose/ha	Dose/plot
Cowdung	10 (ton)	30 kg
Urea	350 kg	225 g
TSP	300 kg	200 g
MoP	As per treatment	As per treatment

Urea, triple super phosphate and muriate of potash were used as sources of nitrogen, phosphorus and potassium, respectively. Moreover, well-decompose cowdung was applied to the plots.

Total amount of cowdung and TSP, and 50% of urea and muriate of potash were applied as basal dose during land preparation. They were mixed with the soil by spading. The rest quantity of urea top dressed after 25 and 30 days after sowing the seeds.

6.9. Date of sowing

The date of sowing was 12 October 2010

3.10. Irrigation

At dry season radish need regular irrigation and considering this fact irrigation was done at ten (10) days interval.

3.11. Weeding

Weeding was done three times, first on at the 7 days after sowing, second on at 25 days after sowing and third on at 35 days after sowing.

3.12. Pesticide application

There was no incidence of insects and diseases.

3.13. Harvesting

Randomly selected five plants were harvested from each plot for data collection . First harvest was done at 30 DAS (Days after Sowing) and second at 40 DAS, third 50 DAS and finally at 60 DAS. The soil adhering to the roots after harvest was rubbed odd and the roots were cleaned before weighting. The leaves were separated from the roots by a sharp knife and weight of leaves and roots was taken separately.

3.14. Methods of Data Collection

Data were recorded on the following parameters from the sample plants during the course of experiment. Five plants were sampled randomly from each unit plot for the collection of data. The plants in the outer rows and at the extreme end of the middle rows were excluded from the random selection to avoid the border effect.

3.14.1. Plant height

Plant height of five randomly selected plants were measured in centimeter (cm) by a meter scale at 30, 40, 50 and 60 days after sowing (DAS) from the bottom of root to the tip of the longest leaf.

3.14.2. Number of leaves per plant:

Numbers of leaves of ten randomly selected plants were counted at 30, 40, 50 and 60 DAS. All the leaves of each plant were counted separately. Only the smallest young leaves at the growing point of the plant were excluded from counting. The average number of leaves of ten plants gave the number of leaves per plant.

3.14.3. Root length

Root length of five randomly selected plants was measured in centimeter at harvest by a triple beam balance. The average length of roots of ten plants gave the length of roots per plant in centimeter .

3.14.4. Root Diameter

Root diameter of five randomly selected plants was measured in centimeter at harvest by a virnear scale. The average diameter of roots of ten plants gave the root diameter per plant in centimeter .

3.14.5. Fresh weight of root

Underground modified radish roots of the ten selected plants were detached by a knife and after cleaning soil and fibrous root fresh weight was taken by a balance

in gm. The average weight of roots of ten plants gave the weight of root per plant in gram (g).

3.14.6. Root Yield (kg/plot)

The yield of roots per plot was calculated in kg by converting the total yield of roots per plot.

3.15. Statistical analysis:

The data obtained from the experiment were analyzed statistically using MSTAT computer package program to find out the significance of the difference among the treatments. The significance of the differences among the pairs of treatment means was estimated by the Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984) for the interpretation of results.

3.16 . Cost and return analysis

Cost and return analysis in detail was done according to the procedure of Alam *el. al.* (1989). The cost production was analyzed in order to finds out most economic value of radish. All input cost and interest on fixed (land) and running capital were considered for computing the cost of production.

CHAPTER IV

RESULTS AND DISCUSSION

The present study was conducted to investigate the effects of potassium on growth and yield of different radish varieties. The analysis of variance (ANOVA) of the data on different yield contributing characters and yield of radish as influenced by different varieties and potassium presented in Appendix-I-VII, Figure-1-14 and Table-1-4. The results on main and combined effect of different varieties and fertilizer management practices and their interactions have been presented and discussed in this chapter.

4.1 Plant height

Plant height was recorded at 30 DAS, 40 DAS, and 50 DAS and at harvest. The plant height was significantly influenced due to the different varieties at different days after sowing. From the evidence fig. 1, at 30 DAS the tallest plant (34.51 cm) was obtained from V_2 (BARI Mula-2) and the shortest plant (27.76 cm) was obtained from V_3 (BARI Mula-3) treatment. At 40 DAS the tallest plant (38.01 cm) was obtained from V_2 and the shortest plant (29.96 cm) was obtained from V_3 treatment. At 50 DAS the tallest plant (40.11 cm) was obtained from V_2 and the shortest plant (32.11 cm) was obtained from V_3 treatment. At harvest the tallest plant (42.18 cm) was obtained from V_2 (BARI Mula-2) and the shortest plant (34.36 cm) was obtained from V_3 (BARI Mula-3) treatment(Appendix iv).

The plant height was significantly varied due to the different level of potassium at different days after sowing and at harvest (Appendix-IV). The tallest plant

(33.89cm) was obtained from K_2 (100 kg K_2O/ha) and the shortest plant (29.33 cm) was obtained in K_0 (Control) treatment at 30 DAS (Fig. 2). At 40 DAS the tallest plant (36.57cm) was obtained from K_2 (100 kg K_2O/ha) and the shortest plant (31.92 cm) was obtained in K_0 (Control) treatment. At 50 DAS, the tallest plant (39.10 cm) was obtained from K_2 (100 kg K_2O/ha) and the shortest plant (33.94 cm) was observed in K_0 (Control) treatment. At harvest the tallest plant (41.45 cm) was obtained from K_2 (100 kg K_2O/ha) and the shortest plant (38.54 cm) was foun from K_0 (Control) treatment. Plant height showed a general trend of increase with the increasing levels of potassium. The tallest plant at the highest dose of potassium was obtained due to the fact that plant received more potassium which along with nitrogen might have encouraged mire vegetative growth. The results in respect of plant height showed in accordance with those of Deshi et al. (1964) who reported significant increase in plant height due to increase in the rate of potassium at certain levels.

Combined effect of different varieties and different levels of potassium found significant effect on plant height (Appendix-IV). The tallest plant (36.66 cm) was obtained from the treatment combination of V_2K_2 (BARI Mula-2 with 100 kg K_2O/ha) while the shortest plant (24.66 cm) was observed in V_3 K_0 (BARI Mula-3 (Druti) with control) treatment at 30 DAS(Table 1). At 40 DAS the tallest plant (39.50 cm) was obtained from the treatment combination of V_2K_2 while the shortest

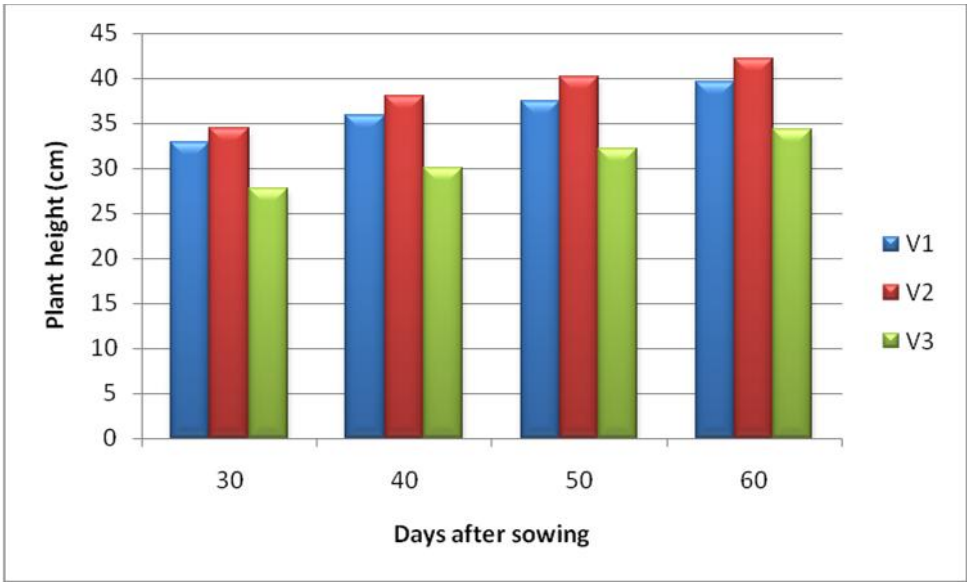


Figure 1 Effect of variety on plant height at different days after sowing

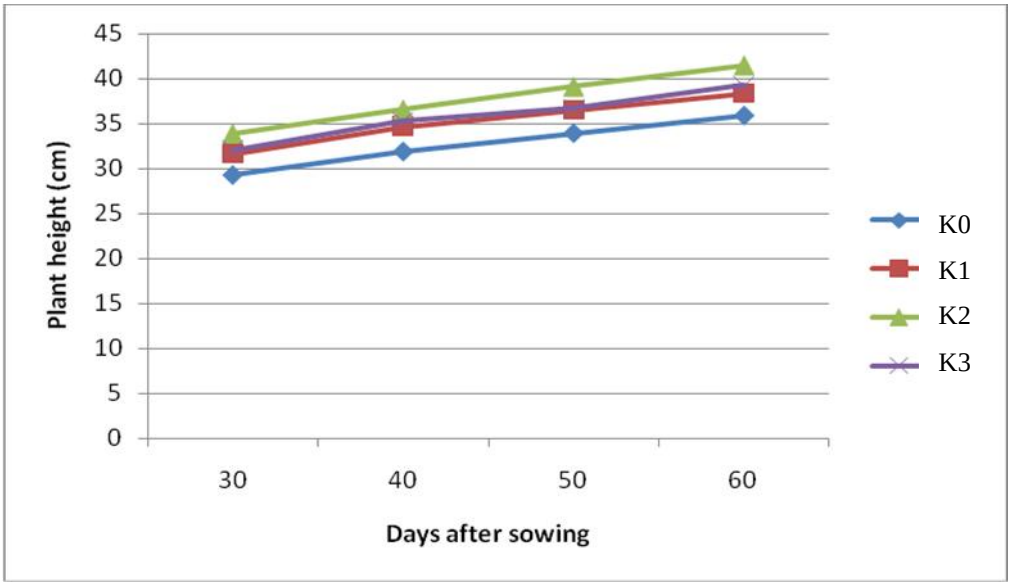


Figure 2 Effect of different levels of potassium on plant height at different days after sowing

Table 1 Combined effect of varieties and potassium on plant height at days after sowing of Radish

Treatment	Plant height							
	30 DAS		40 DAS		50 DAS		At harvest	
V_1K_0	30.72	de	34.44	ef	36.39	cd	37.77	cd
V_1K_1	32.78	cd	35.77	cde	37.28	c	38.94	cd
V_1K_2	34.67	abc	37.61	bc	39.55	b	42.38	b
V_1K_3	33.50	bc	35.66	cde	36.66	cd	39.55	c
V_2K_0	32.61	cd	35.33	de	36.66	cd	37.94	cd
V_2K_1	33.50	bc	36.94	cd	40.11	b	42.61	ab
V_2K_2	36.66	a	39.50	ab	42.66	a	44.77	a
V_2K_3	35.28	ab	40.27	a	41.00	ab	43.38	ab
V_3K_0	24.66	g	26.00	i	28.77	f	31.94	f
V_3K_1	28.65	ef	31.35	gh	32.04	e	33.52	ef
V_3K_2	30.35	e	32.60	fg	35.08	d	37.21	d
V_3K_3	27.39	f	29.88	h	32.55	e	34.78	e
$LSD_{(0.05)}$	1.99		1.97		1.77		2.11	
CV(%)	5.17		6.38		5.28		5.23	

(26.00 cm) was observed in V_3 K_1. At 50 DAS, the tallest plant (42.66 cm) was obtained from V_2K_2 while the shortest plant (28.77 cm) was found from V_3 K_0. The tallest plant (44.77 cm) was obtained from K_3V_2 while the shortest plant (31.94 cm) with V_3 K_0 treatment at harvest.

4.2 Number of leaves per plant

Number of leaves per plant was recorded at 30 DAS, 40 DAS, and 50 DAS and at harvest. The number of leaves per plant was significantly influenced due to the different varieties at different days after sowing (Appendix v). At 30 DAS, the maximum number of leaves per plant (7.18) was obtained from V_3 ((BARI Mula-3) and the minimum number of leaves per plant (5.62) was obtained from V_1 (BARI Mula-1) treatment. At 40 DAS, the maximum number of leaves per plant (8.51) was obtained from V_3 treatment and the minimm number of leaves per plant (7.25) was obtained from V_1 treatment. At 50 DAS, the maximum number of leaves per plant (12.25) was counted from V_3 treatment and the minimum number of leaves per plant (10.29) was obtained from V_1 treatment. At harvest the maximum number of leaves per plant (13.74) was obtained from V_3 (BARI Mula-3) and the minimum number of leaves per plant (34.36 cm) was obtained from V_1 (BARI Mula-1) treatment.

The number of leaves per plant was significantly varied due to the application of different levels of potassium at different days after sowing and at harvest (Appendix-V). The highest number of leaves per plant (7.26) was obtained from K_2 (100 kg K_2O/ha) and the lowest number of leaves per plant (5.78) was obtained from K_0 (control) treatment at 30 DAS (Fig. 4). At 40 DAS, the highest number of

leaves per plant (8.63) was obtained from K_2 (100 kg K_2O/ha) and the lowest plant (7.07) was obtained with K_0 (control) treatment. At 50 DAS, the highest number of leaves per plant (13.04) was obtained from K_2 (100 kg K2O/ha) and the lowest number of leaves per plant (9.79) was obtained from K_0 (Control) treatment. At harvest, the highest number of leaves per plant (15.49) was obtained from K_2 (100 kg K_2O/ha) and the lowest number of leaves per plant (11.81) was found from K_0 (Control) treatment. The number of leaves per plant increased significantly with increase the levels of potassium. The results of this experiment were in accordance with those of Deshi *et al.* (1964) who noticed significant effect of potassium on leaf number per plant.

Combined effect of different varieties and different levels of potassium had showed significant variation on number of leaves per plant (Appendix-V). The highest number of leaves per plant (7.90) was counted from V_3K_2 (BARI Mula-3 with 100 kg K_2O/ha) while the lowest number of leaves per plant (4.94) was observed in V_1K_0 (BARI Mula-3 with control) treatment at 30 DAS (Table 2). At 40 DAS, the highest number of leaves per plant (10.09) was obtained from V_3K_3 treatment while the lowest (6.33) was observed from V_1K_0 treatment. At 50 DAS the highest number of leaves per plant (14.74) was obtained from the treatment combination of V_3K_2 while the lowest number of leaves per plant (8.61) was observed form V_1K_0 treatment combination. The highest number of leaves per plant (17.53) was obtained from V_3K_2 while the lowest number of leaves per plant (10.67) with V_1K_0 treatment combination at harvest.

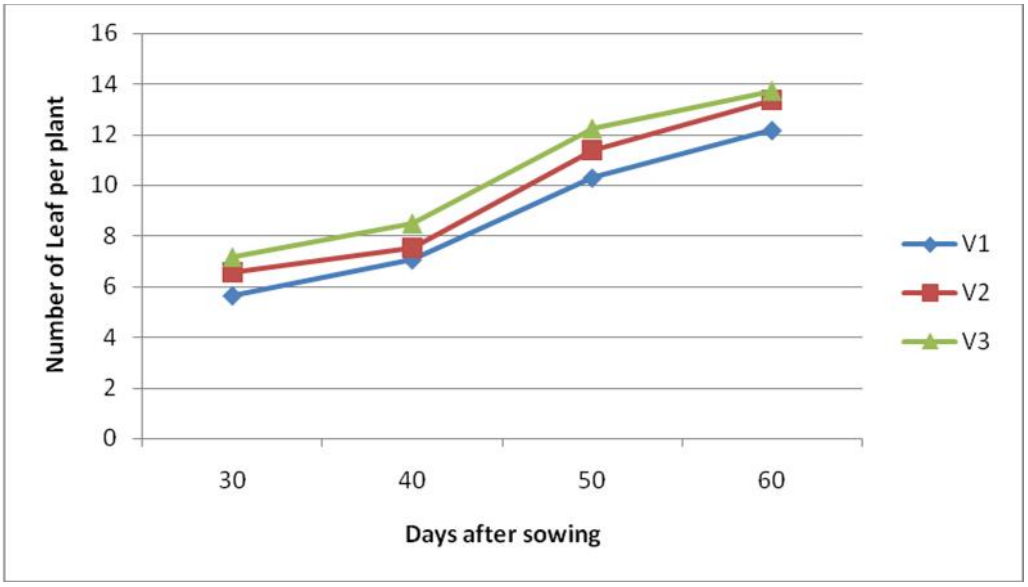


Fig. 3 Effect of variety on number of leaves per plant at different days after sowing

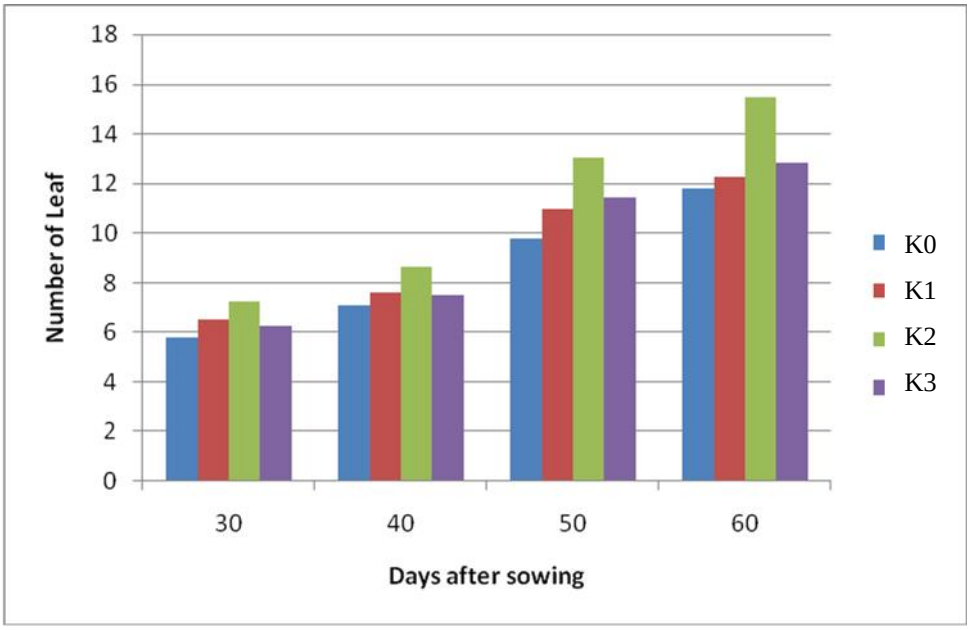


Fig. 4 Effect of potassium on number of leaves per plant at different days after sowing

Table 2 Combined effect of varieties and potassium on number of leaves at days after sowing of radish

Treatment	Number of leaves per plant			
	30 DAS	40 DAS	50 DAS	At harvest
V_1K_0	4.94 g	6.77 c	8.60 g	10.67 d
V_1K_1	5.55 g	6.94 c	10.55 e	12.05 cd
V_1K_2	6.38 de	7.60 b	11.61 cd	13.77 bc
V_1K_3	5.61 fg	6.88 c	10.38 e	12.21 cd
V_2K_0	5.27 g	6.33 c	9.717 f	12.27 cd
V_2K_1	6.60 cde	7.75 b	11.05 de	12.44 c
V_2K_2	7.49 ab	8.16 b	12.77 b	15.16 b
V_2K_3	6.88 bcde	7.88 b	12.00 c	13.55 bc
V_3K_0	7.14 abcd	8.11 b	11.05 de	12.50 c
V_3K_1	7.36 abc	8.18 b	11.31 cd	12.21 cd
V_3K_2	7.90 a	10.09 a	14.74 a	17.53 a
V_3K_3	6.32 ef	7.66 b	11.89 c	12.72 c
$LSD_{(0.05)}$	0.72	0.58	0.66	1.56
CV(%)	6.63	8.42	5.97	7.06

4.3 Length of root

It was observed that the effect of different varieties on length of root was statistically significant (Appendix VI). BARI Mula-3 produced the maximum (27.81 cm) and BARI Mula-1 produced the minimum (24.63 cm) length of root (Fig. 7).

The length of root was significantly influenced by different levels of potassium. Treatment K_3 produced maximum length of root (28.56 cm) and the minimum (23.40 cm) length of root was recorded in K_1 treatment (Fig. 8). The root length per plant increased significantly with increase in the levels of potassium. But Sarker (1989) and Farazi (1983) obtained no significant effect of potassium on root length.

The interaction effects of different varieties and different levels of potassium treatment were found significant in respect of length of root per plant (Appendix VI). The maximum length of root (30.95 cm) was observed from V_3K_2. The minimum length of root (21.36 cm) was observed from V_1K_0 treatment combination (Table 3).

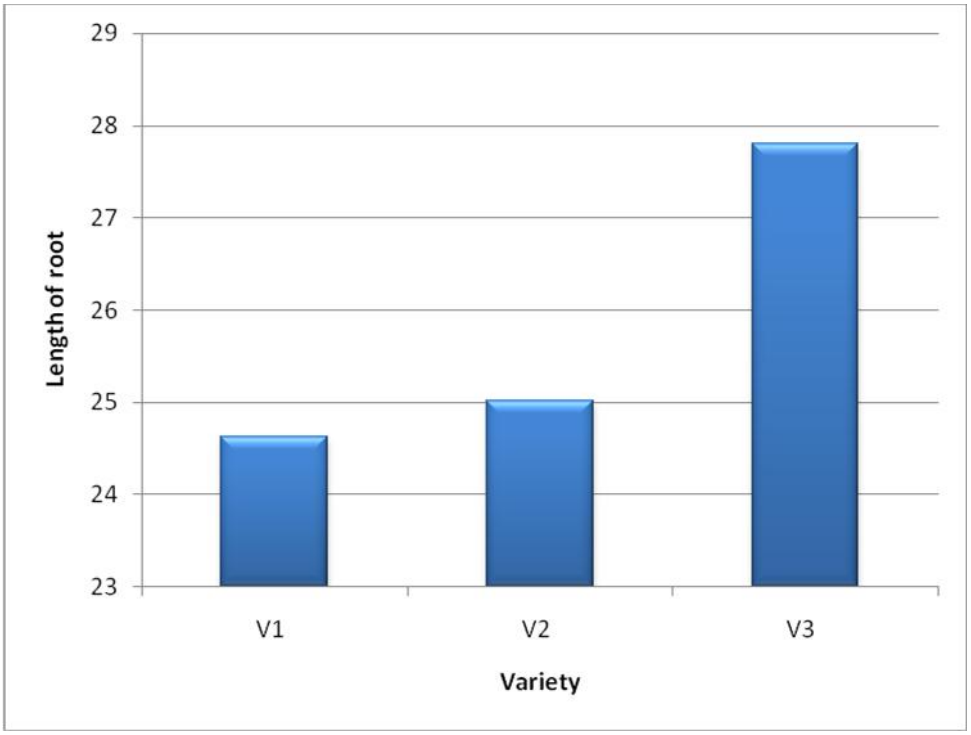


Fig. 5 The effect of variety on length of root

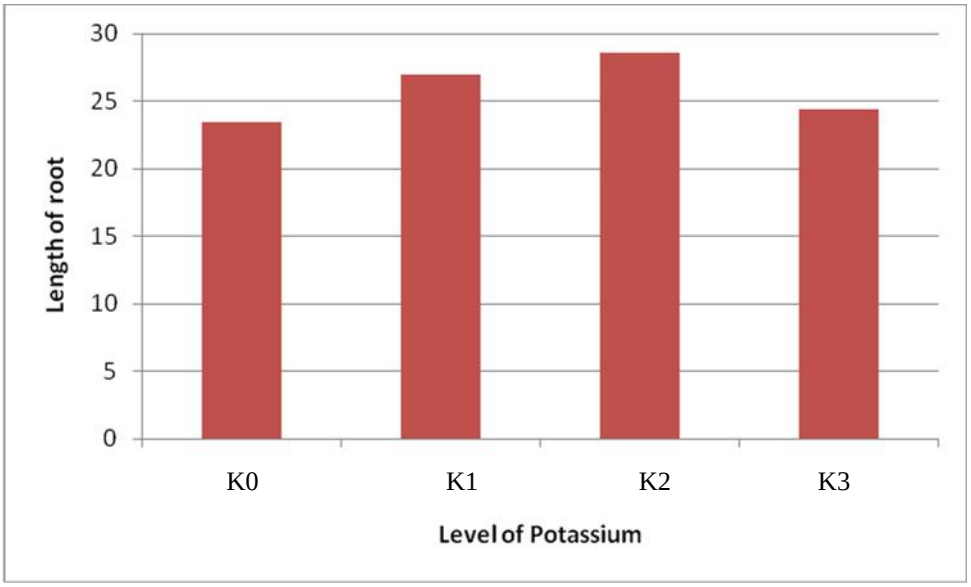


Fig. 6 The effect of potassium on the length of root

4.4 Diameter of root

Different varieties were not significantly influenced on the diameter of root (Appendix VII). The maximum diameter of root (14.01cm) was found in V_3 (BARI Mula-3) and the minimum diameter of root (13.35 cm) was observed in the varieties BARI Mula-1 , respectively (Fig. 7).

The diameter of root was significantly influenced by the different levels of potassium (Appendix VI). Treatment K_2 produced maximum diameter of root (15.34 cm) and the minimum diameter of root(13.09 cm) was recorded in K_0 treatment (Fig. 6). The root diameter of radish increased with increase in the levels of potassium. Sarker (1989) and Farazi (1983) also reported that potassium had significant effect on the root diameter.

The combined effects of different varieties and different levels of potassium showed significant effect on diameter of root (Appendix VI). The maximum diameter of root (16.55 cm) was observed from V_3K_2. The minimum diameter of root (12.34 cm) was observed from V_1K_0 (Table 3).

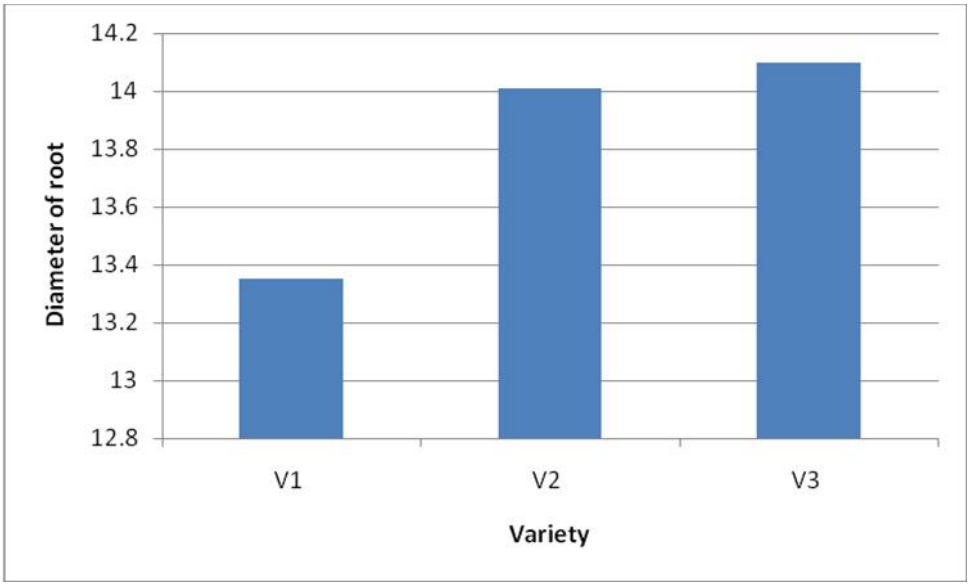


Fig. 7 The effect of variety on diameter of root

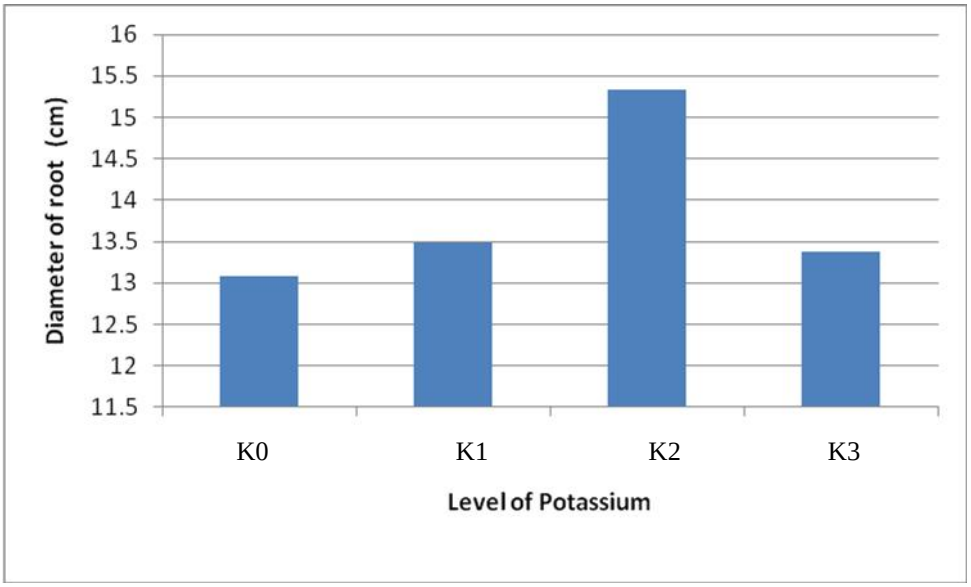


Fig.8 The effect of potassium on the diameter of root

Table 3 Interaction effect of variety and potassium on the length and diameter of root of radish

Treatment	Length of root	Diameter of root
V_1K_0	21.36 f	12.34 f
V_1K_1	26.00 bcde	13.49 de
V_1K_2	28.22 abc	14.57 bc
V_1K_3	22.94 ef	12.65 f
V_2K_0	23.22 ef	14.24 bcd
V_2K_1	25.88 bcde	12.91 ef
V_2K_2	26.50 bcd	14.89 b
V_2K_3	24.50 de	14.00 cd
V_3K_0	25.62 cde	12.68 f
V_3K_1	28.85 ab	14.02 cd
V_3K_2	30.95 a	16.55 a
V_3K_3	25.83 bcde	13.51 de
$LSD_{(0.05)}$	2.85	0.72
CV(%)	6.52	6.40

4.5 Fresh weight of root per plant

The effect of variety was found statistically significant in respect of fresh weight of root per plant (Appendix-VII). The highest fresh weight of root per plant (605.90 g) was obtained from the variety BARI Mula-3 and the lowest (541.90 g) fresh weight of root was found from the variety BARI Mula-1 respectively (Fig. 9).

Different level of potassium was significantly influenced on The fresh weight of root per plant (Appendix- VII). Treatment K_2 produced maximum fresh weight of root per plant (618.90 g) and the minimum (534.00 g) fresh weight of root per plant was recorded in K_0 treatment combination (Fig. 10). Potassium significantly increased the root weight.

The interaction effects of different varieties and different levels potassium treatment were significant on fresh weight of root (Appendix VII). The highest fresh weight of root per plant (651.10 g) was found the treatment combination V_3K_2 (BARI Mula-3 with 100 kg K_2O/ha). The lowest (487.20 g) was obtained from treatment combination of V_1K_0 (BARI Mula-1 with control) (Table 4).

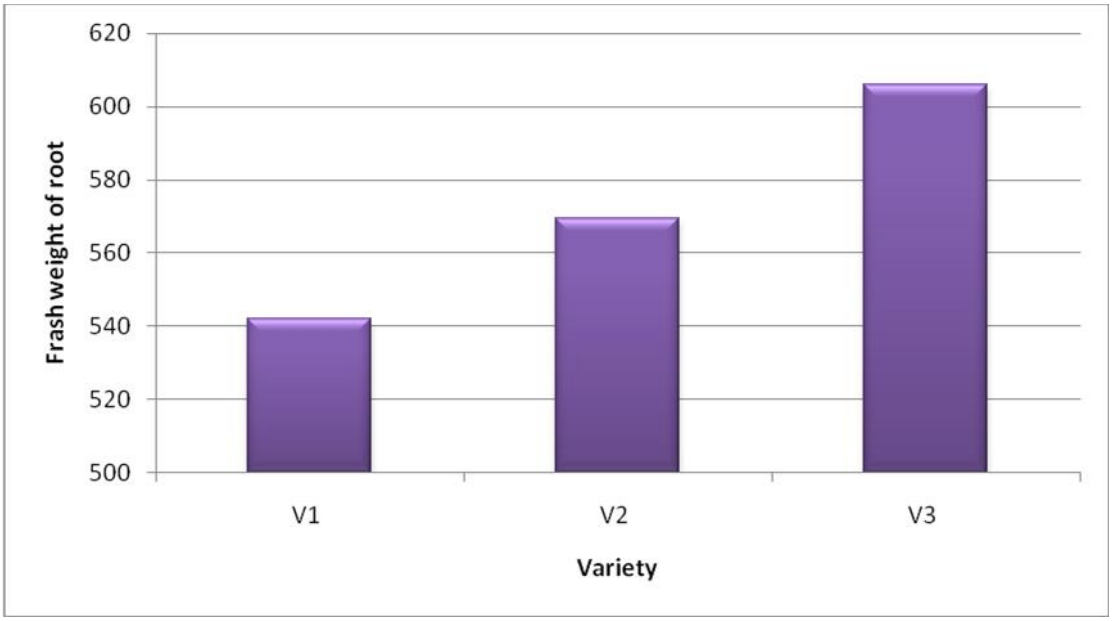


Fig. 9 The effect of variety on fresh weight of root per plant of radish

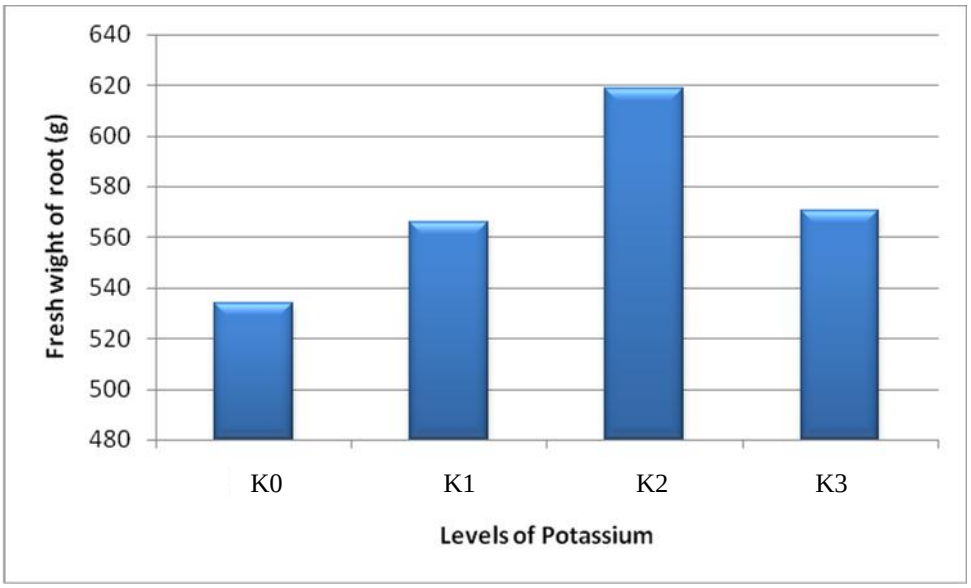


Fig. 10 The effect of potassium on fresh weight of root per plant of radish

Table 4 Interaction effect of variety and potassium on the yield and yield contributing character of radish

Treatment	Fresh weight		Root weight		Yield (kg/plot)		Yield (t/ha)	
V_1K_0	487.20	e	338.90	e	3.48	f	15.50	f
V_1K_1	544.40	d	388.90	c	4.32	c	19.20	c
V_1K_2	602.80	b	419.40	b	4.66	b	20.72	b
V_1K_3	533.30	d	313.90	f	3.76	e	16.73	e
V_2K_0	540.60	d	369.40	d	4.10	d	18.25	d
V_2K_1	550.50	d	416.80	b	4.63	b	20.58	b
V_2K_2	602.80	b	425.20	b	4.72	b	21.00	b
V_2K_3	583.30	bc	411.10	b	4.56	b	20.30	b
V_3K_0	574.30	c	347.20	e	3.85	e	17.15	e
V_3K_1	603.30	b	426.10	b	4.73	b	21.04	b
V_3K_2	651.10	a	495.60	a	5.50	a	24.47	a
V_3K_3	595.00	bc	391.70	c	4.35	c	19.34	c
$LSD_{(0.05)}$	20.90		17.94		0.20		0.88	
CV(%)	7.16		6.68		5.28		5.68	

4.6 weight of roots per plant

From the experimental result the effect of variety was found significant in this respect (Appendix- VII). The maximum weight of roots per plant (415.10 g) was measured from BARI Mula-3, while the minimum weight of roots per plant (365.3 g) was recorded from BARI Mula-1 (Fig-11).

The weight of root per plant was significantly influenced by different levels of potassium (Appendix VII). Treatment K_2 produced maximum weight of root per plant (446.7 g) and the minimum (351.80 g) weight of root per plant was recorded in K_0 treatment (Fig. 12). The result in respect of weight of radish root showed in accordance with those of Sarker (1989) who reported that potassium significantly increased the root weight.

The interaction effects of different varieties and different levels of potassium treatment were significant in this regard (Appendix IX). The highest weight of roots per plant (495.6 g) was found the treatment combination V_3K_2. The lowest (338.90 g) was obtained from treatment combination of V_1K_0 (Table 4).

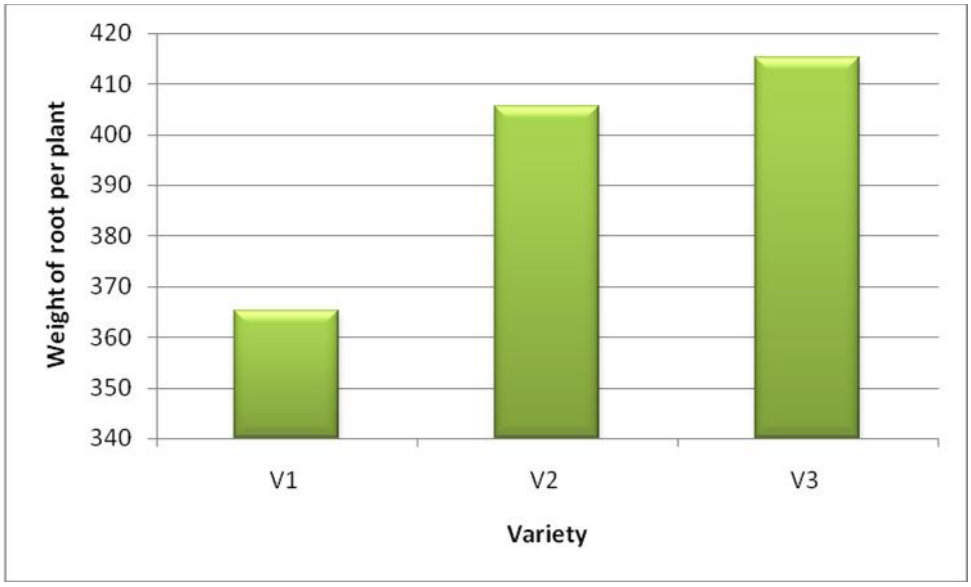


Fig. 11 The effect of variety on weight of root per plant of radish

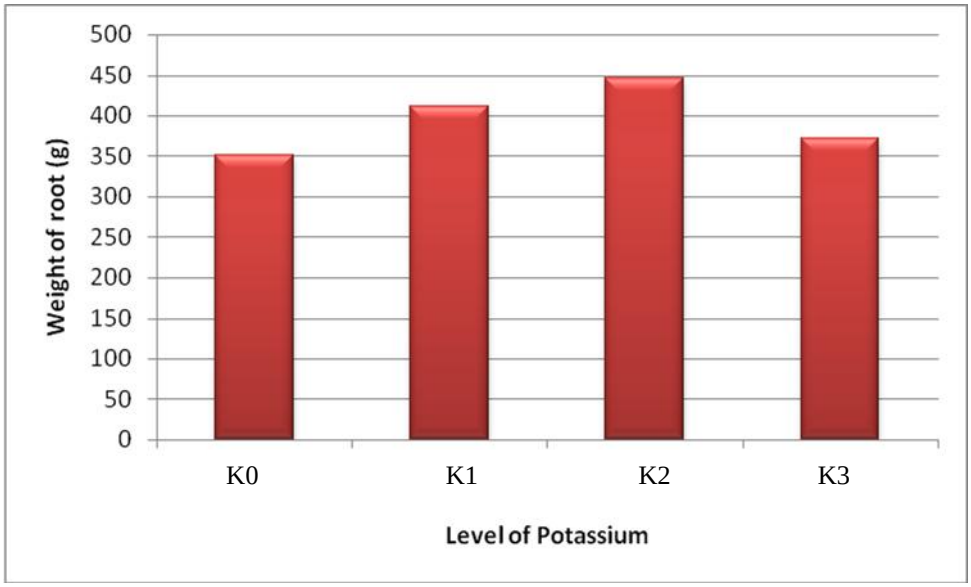


Fig.12 The effect of potassium on weight of root per plant of radish

4.7 Yield

4.7.1 Yield (Kg/plot)

The results of different varieties showed significant effect on yield of radish per plot. The maximum gross yield per plot (4.61 kg/plot) was recorded from the variety BARI Mula-3 (V_3), while the lowest yield (4.06 kg/plot) was observed from BARI Mula-1 (V_1) variety (Fig. 13).

The yield of radish was significantly affected due to the different levels of potassium. The maximum yield of radish (4.96 kg/plot) was obtained from K_2 (100 kg K_2O/ha) and the minimum yield of radish (3.91 kg/plot) was obtained in K_0 (control) (Fig. 14). It was clearly observed that yield increased with the increasing level of potassium. Polach (1982) reported that application of potassium at 196 kg/ha gave the best yield and quality carrots.

The interaction effects of different varieties and different levels potassium treatment were found to be significant for yield of radish per plot. It was found that V_3K_2 treatment produced the maximum yield per plot (5.51 kg/plot). The minimum yield per plot (3.49 kg/plot) was obtained from the V_1K_0 treatment combination (Table 4).

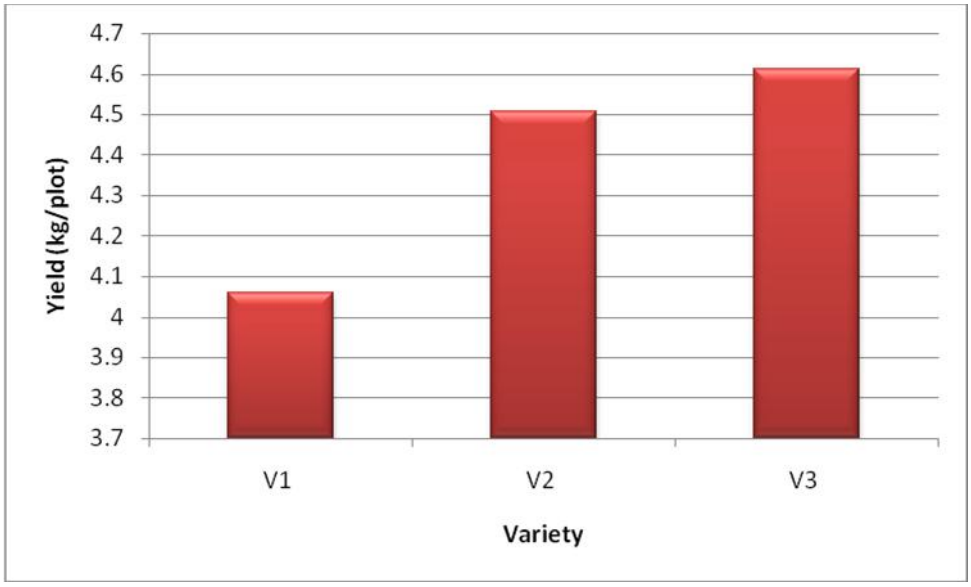


Figure 13 Effect of variety on yield per plot of Radish

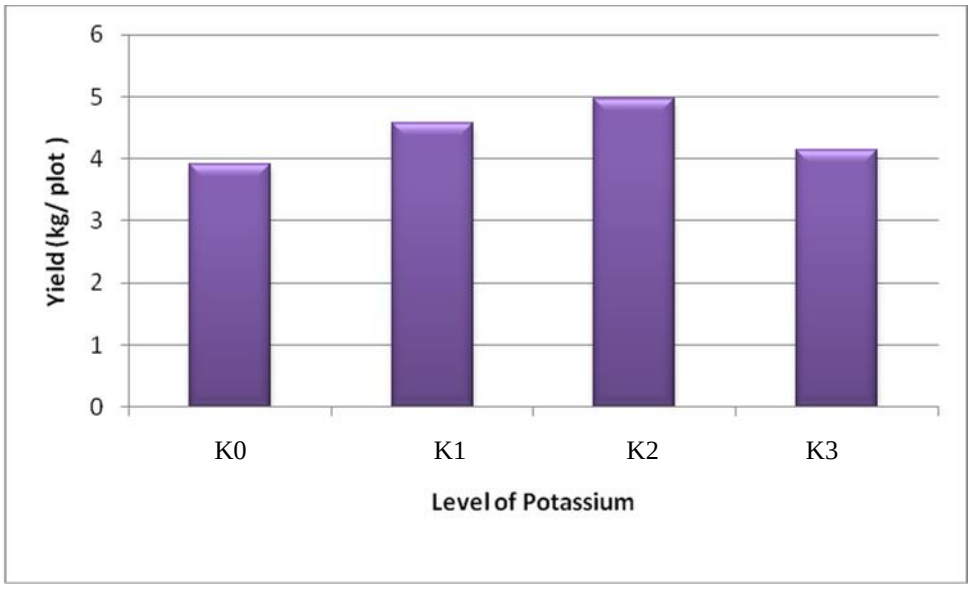


Figure 14 Effect of potassium on yield per plot of Radish

4.7.2 Yield (t/ha)

The results of different varieties showed significant effect on yield of radish. The maximum gross yield (20.50 t/ha) was recorded from the variety BARI Mula-3 (V_3), while the lowest yield (18.04 t/ha) was observed from BARI Mula-1 (V_1) variety (Fig. 15).

The yield of radish was significantly affected due to the different levels of potassium. The maximum yield of radish (22.06 t/ha) was obtained from K_2 (100 kg K_2O/ha) and the minimum yield of radish (17.38 t/ha) was obtained in K_0 (control) (Fig. 14). It was clearly observed that yield increased with the increasing level of potassium at certain level. Different doses of potassium produced significantly different yields. But Burleson (1957) and Sein (1975) reported that potassium did not show any significant effect of the yield of carrot roots. Polach (1982) reported that application of potassium at 196 kg/ha gave the best yield and quality carrots.

The interaction effects of different varieties and different levels potassium treatment were found to be significant for yield of radish. It was found that V_3K_2 treatment produced the maximum yield (24.47 t/ha). The minimum yield (15.5 t/ha) was obtained from the V_1K_0 treatment combination (Table 4).

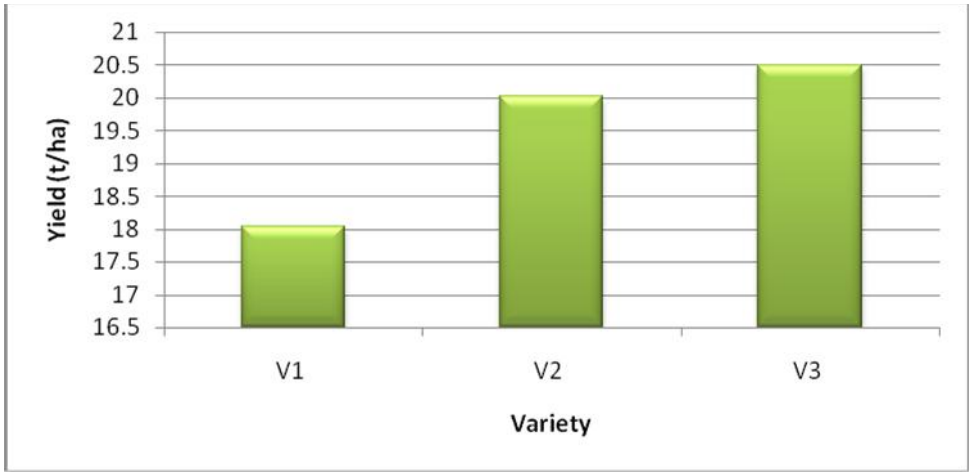


Figure 15 Effect of variety on yield of radish

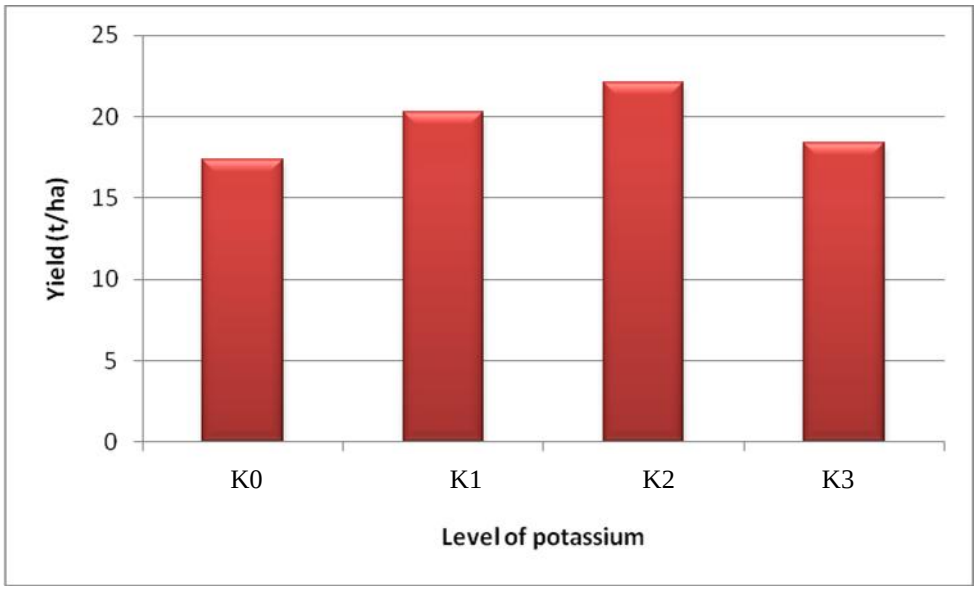


Figure 16 Effect of different levels of potassium on yield of radish

4.8 Cost and Return Analysis

Materials, non-material and over head costs were recorded for all the treatments for unit plot and were calculated per hectare basis. The price of radish roots at the local market was also noted. The cost and return analysis were done and have been presented in table 5 and appendix IV.

Cost of production varied due to price of seed of different varieties. The lowest and highest production cost (45998.80 Tk/ha) was same the different treatment combination.

Highest gross return of (192745 Tk/ha) was obtained from the treatment V_3K_2. Lowest gross return of (87175 Tk/ha) was obtained from the treatment combination of V_1K_0. On the other hand, highest net return of (146746 Tk/ha)was obtained from V_3K_3 and the lowest net return of (41176.20 Tk/ha) was obtained from the treatment combination of V_1K_0.

Benefit cost ratio (BCR) was found to be the highest (4.19) in the treatment combination V_3K_3. Lowest BCR (1.90) was recorded from V_1K_1 treatment. Thus, the BARI Mula-3 (Druti) with 120 kg K_20/ha was economically beneficial than the treatment combination of BARI Mula-1 (Tasakisan) and 0 kg K_2O/ha.

Table 5. Cost and return of Radish due to variety and potassium

Treatment	Marketable yield t/ha	Gross return (GR) TK/ha	Total cost Tk/ha	Net return (NR) Tk/ha	BCR*
V_1K_0	3.48	87175	45998.80	41176.20	1.90
V_1K_1	4.32	108075	45998.80	62076.20	2.35
V_1K_2	4.66	116500	45998.80	70501.20	2.53
V_1K_3	3.76	94175	45998.80	48176.20	2.05
V_2K_0	4.10	123090	45998.80	77091.20	2.68
V_2K_1	4.63	138900	45998.80	92901.20	3.02
V_2K_2	4.72	141810	45998.80	95811.20	3.08
V_2K_3	4.56	137010	45998.80	91011.20	2.98
V_3K_0	3.85	134995	45998.80	88996.20	2.93
V_3K_1	4.73	165795	45998.80	119796.20	3.60
V_3K_2	5.50	192745	45998.80	146746.20	4.19
V_3K_3	4.35	152250	45998.80	106251.20	3.31

- BCR= GR/BR, GR- Tasakisan 25000TK/t, Pinky-30000 tk/t and Duti-35000 Tk/t.

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the central farm, Sher-e-Bangla Agricultural University (SAU), Dhaka during the period from October, 2010 to January, 2011 to study the effect of postassium on growth and yield of different radish cultivars. In the experiment, the treatment consisted of three varieties of viz. V_1: BARI Mula-1, V_2: BARI Mula-2, V_3: BARI Mula-3 and four different potassium level, viz. K_0 (Control), K_1 (80 kg K_2O/ha), K_2 (100 kg K_2O) and K_3 (120 kg K_2O/ha). The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. Seeds were sown in the experimental plots on October 12, 2010. Data were collected on different parameters of radish.

The effect of variety demonstrated that, the variety BARI Mula-2 (Pinky) produced the tallest plant (34.51, 38.01, 40.11and 42.18 cm at 30, 40, 50 DAS and at harvest, respectively). The maximum number of leaves (7.18, 8.51, 12.25 and 13.74 at 30, 40, 50 DAS and at harvest, respectively) was obtained from the variety BARI Mula-3. The maximum (14.01cm) diameters were observed in the varieties BARI Mula-3. BARI Mula-3 produced the maximum (27.81 cm) produced length of root. The highest (605.90 g) fresh weight of root was found from the variety BARI Mula-3. The maximum weight of roots per plant (415.10 g) was measured from BARI Mula-3. The results of different varieties showed significant effect on yield of radish per plot due to different varieties. The maximum gross yield per plot (4.61 kg/plot) was recorded from the variety BARI Mula-3. The maximum gross yield (20.50 t/ha) was recorded

from the variety BARI Mula-3 (V_3), while the lowest yield (18.04 t/ha) was observed from BARI Mula-1 (V_1) variety.

The plant height was significantly affected due to the different level of potassium at different days after sowing and at harvest. The tallest plant height (33.89, 36.57, 39.1 and 41.45 cm at 30, 40, 50 DAS and at harvest, respectively) was obtained from K_2 (100 kg K_2O/ha). The number of leaves per plant counted at different days was significantly influenced by potassium. Treatment K_2 produced maximum number of leaves (7.26, 8.625, 13.04 and 15.49 at 30, 40, 50 DAS and at harvest, respectively). The diameter of root was significantly influenced by different levels of potassium. Treatment K_2 produced maximum diameter of root (15.34 cm). The length of root was significantly influenced by different levels of potassium. Treatment K_2 produced maximum length of root (28.56 cm). Different level of potassium was significantly influenced on the fresh weight of root per plant. Treatment K_2 produced maximum fresh weight of root per plant (618.90 g). Treatment K_2 produced maximum weight of root per plant (446.7 g). The yield of radish was significantly affected due to the different levels of potassium. The maximum yield of radish (4.96 kg/plot) was obtained from K_2 (100 kg K_2O/ha).The maximum yield of radish (22.06 t/ha) was obtained from K_2 (100 kg K_2O/ha) and the minimum yield of radish (17.38 t/ha) was obtained in K_0 (control).

Interaction effect of different varieties and different level of potassium had a significant variation on all parameter. The tallest plant (36.66, 40.27, 42.66 and 44.77 cm at 30, 40, 50 DAS and at harvest, respectively) was obtained from

V_2K_2 treatment. The maximum number of leaves (7.9, 10.09, 14.74, and 17.53 at 30, 40, 50 DAS and at harvest, respectively) was obtained from V_3K_0 treatment. The maximum diameter of root (16.55 cm) was observed from V_3K_2. The maximum length of root (30.95 cm) was observed from V_3K_2. The highest fresh weight of root per plant (651.10 g) was found the treatment combination V_3K_2. The highest weight of roots per plant (495.6 g) was found the treatment combination V_3K_2. It was found that V_3K_2 treatment produced the maximum yield per plot (5.51 kg/plot). The minimum yield per plot (3.37 kg/plot) was obtained from the V_1K_0 treatment combination. The V_3K_2 treatment produced the maximum yield (24.47 t/ha). The minimum yield (15.5 t/ha) was obtained from the V_1K_0 treatment combination.

The economic analysis showed that the highest net return of (146746 Tk/ha) was obtained from V_3K_2 and the lowest net return of (41176.20 Tk/ha) was obtained from the treatment combination of V_1K_0. Benefit cost ratio (BCR) was found to be the highest (4.19) in the treatment combination V_3K_2

Considering the situation of the present study, further studies in the following areas may be suggested.

i. From the point of yield economic it may be suggested that higher yield could be obtained by cultivating the BARI Mula-3 (Druti) of radish with 100 kg K_2O/ha under the Madhupur tract (AEZ No-28) of Bangladesh.

ii. Further investigation may carry out in different agro ecological zones of Bangladesh before giving final recommendation.

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APPENDICES

Appendix I: **Soil characteristics of horticulture farm, Sher-e-Bangla Agricultural University are analyzed by soil Resources Development Institute (SRDI), Farmgate, Dhaka.**

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Horticulture farm, SAU, Dhaka
AEZ	Modhupur tract (28)
General soil type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	**N/A**

Source: SRDI

B. Physical and chemical properties of the initial soil

Characteristics	Value
Practical size analysis	
Sand (%)	16
Silt (%)	56
Clay (%)	28
Silt + Clay (%)	84
Textural class	Silty clay loam
pH	5.56
Organic matter (%)	0.25
Total N (%)	0.02
Available P (µgm/gm soil)	53.64
Available K (me/100g soil)	0.13
Available S (µgm/gm soil)	9.40
Available B (µgm/gm soil)	0.13
Available Zn (µgm/gm soil)	0.94

Available Cu (µgm/gm soil)	1.93
Available Fe (µgm/gm soil)	240.9
Available Mn (µgm/gm soil)	50.6

Source: SRDI

Appendix II. Monthly air temperature, rainfall and relative humidity of the experimental site during the study period (October, 2010 to January, 2011)

Year	Month	Air temperature (^{0}C)			Rainfall** (mm)	* Relative humidity (%)
		Max.	Min.	Mean		
20010	October	36.6	18.5	27.455	320	64.5
	November	30.8	15.8	24.3	14	67.0
	December	27.2	11.3	19.75	0.00	63.0
20011	January	28.0	10.5	19.75	23	61.5

* Monthly average

** Monthly total

Source: The Meteorological Department (Weather division) of Bangladesh, Agargoan, Dhaka

Appendix III. Production cost of Radish per hectare (a) Material cost (Tk.)

Treatment	Manures and Fertilizer*					Pesticide	Irrigation	Subtota (A)
	Seed 3kg/ha	Cowdung 10 t/ha	Urea 300 kg/ha	TSP 250 kg/ha	MP 215 kg/ha			
V_1K_1	1500	4000	2100	3250	2150	2000	1000	16000
V_1K_2	1500	4000	2100	3250	2150	2000	1000	16000
V_1K_3	1500	4000	2100	3250	2150	2000	1000	16000
V_1K_4	1500	4000	2100	3250	2150	2000	1000	16000
V_2K_1	1500	4000	2100	3250	2150	2000	1000	16000
V_2K_2	1500	4000	2100	3250	2150	2000	1000	16000
V_2K_3	1500	4000	2100	3250	2150	2000	1000	16000
V_2K_4	1500	4000	2100	3250	2150	2000	1000	16000
V_3K_1	1500	4000	2100	3250	2150	2000	1000	16000
V_3K_2	1500	4000	2100	3250	2150	2000	1000	16000
V_3K_3	1500	4000	2100	3250	2150	2000	1000	16000
V_3K_4	1500	4000	2100	3250	2150	2000	1000	16000

*Radish seed @TK 500/kg; cowdung @TK 0.40/kg; Urea @ TK. 7.00/ kg TSP @Tk 13.00/kg MP@Tk10.00/kg

Appendix IIIb. Production cost of Radish per hecter (a) Non Material cost* (Tk.)

Treatment	Land Preparation	Manures Fertilizer application	Irrigation practice	seed sowing cost	Intercultural operation	Harvesting	Subtotal (B)	Total Input cost (A)+ (B)
V_1K_1	7000	420	700	2800	1400	7000	19320	35320
V_1K_2	7000	420	700	2800	1400	7000	19320	35320
V_1K_3	7000	420	700	2800	1400	7000	19320	35320
V_1K_4	7000	420	700	2800	1400	7000	19320	35320
V_2K_1	7000	420	700	2800	1400	7000	19320	35320
V_2K_2	7000	420	700	2800	1400	7000	19320	35320
V_2K_3	7000	420	700	2800	1400	7000	19320	35320
V_2K_4	7000	420	700	2800	1400	7000	19320	35320
V_3K_1	7000	420	700	2800	1400	7000	19320	35320
V_3K_2	7000	420	700	2800	1400	7000	19320	35320
V_3K_3	7000	420	700	2800	1400	7000	19320	35320

V_3K_4	7000	420	700	2800	1400	7000	19320	35320

- Labour cost @150/day

Appendix IIIc. Overhead cost and Total cost of production (Tk.)

Treatment	Cost of use of land	Interest on running capital for 6 month (13% of total input cost)	Miscellaneous Cost (5% of total input cost)	Subtotal (Overhead cost)	Total cost of production (Tk/ha) Total input cost+ overhead cost
V_1K_1	7500	2295.8	883	10678.8	45998.8
V_1K_2	7500	2295.8	883	10678.8	45998.8
V_1K_3	7500	2295.8	883	10678.8	45998.8
V_1K_4	7500	2295.8	883	10678.8	45998.8
V_2K_1	7500	2295.8	883	10678.8	45998.8
V_2K_2	7500	2295.8	883	10678.8	45998.8
V_2K_3	7500	2295.8	883	10678.8	45998.8
V_2K_4	7500	2295.8	883	10678.8	45998.8
V_3K_1	7500	2295.8	883	10678.8	45998.8
V_3K_2	7500	2295.8	883	10678.8	45998.8
V_3K_3	7500	2295.8	883	10678.8	45998.8
V_3K_4	7500	2295.8	883	10678.8	45998.8

Appendix IV. Analysis of variance of the data on plant height of radish as influenced by varity and levels of potassium

Source of Variance	Degrees of Freedom	Plant height			
		30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	13.23	12.374	4.279	2.293
Factor A (variety)	2	149.326*	208.667*	199.132*	191.032*
Factor B (Potassium)	3	31.705*	34.506*	40.013*	47.734*
AB	6	1.853*	5.439*	2.758*	2.458*
Error	22	1.388	1.365	1.104	1.565

* = Significant at 5% level of probability

Appendix V. Analysis of variance of the data on number of leaf per plant of radish as influenced by varity and levels of potassium

Source of Variance	Degrees of Freedom	Number of Leaf per plant			
		30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	0.283	0.891	1.18	7.352
Factor A (variety)	2	7.408	6.64*	11.589*	7.984*
Factor B (Potassium)	3	3.404	3.878*	16.295*	24.56*
AB	6	0.787*	1.012*	1.108*	2.443*
Error	22	0.183	0.42	0.455	0.854

* = Significant at 5% level of probability

Appendix VI. Analysis of variance of the data on growth and yield of radish as influenced by varity and different levels of potassium.

Source of Variance	Degrees of Freedom	Fresh weight	Root weight	Yield (kg/plot)	Yield (t/ha)
Replication	2	144.463	259.952	0.032	0.633
Factor A (variety)	2	12374.66*	8410.691*	1.035*	20.52*
Factor B	3	11027.49*	15900.86*	1.97*	38.78*

(Potassium)					
AB	6	704.711*	2263.172*	0.279*	5.513*
Error	22	152.332	112.243	0.014	0.273

* = Significant at 5% level of probability

Appendix VII. Analysis of variance of the data on growth and yield of radish as influenced varity and different levels of potassium.

Source of Variance	Degrees of Freedom	Length of Root	Diameter of Root
Replication	2	34.405	0.898
Factor A (variety)	2	36.193*	2.037^{NS}
Factor B (Potassium)	3	49.475*	9.452*
AB	6	2.477*	2.254*
Error	22	2.833	0.782

* = Significant at 5% level of probability

NS = Non Significant