GROWTH AND YIELD OF KOHLRABI AS INFLUENCED BY ORGANIC AND CHEMICAL SOURCES OF POTASSIUM AND SEEDLING AGE AT TRANSPLANT

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JUNE, 2021

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REGISTRATION NO.: 14-06190

A Thesis
Submitted to the Faculty of Agriculture,
Sher-e-Bangla Agricultural University, Dhaka-1207,
In partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE (MS)

IN

HORTICULTURE

SEMESTER: JANUARY-JUNE, 2021

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CERTIFICATE

*This is to certify that the thesis entitled **'GROWTH AND YIELD OF KOHLRABI AS INFLUENCED BY ORGANIC AND CHEMICAL SOURCES OF POTASSIUM AND SEEDLING AGE AT TRANSPLANT'** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS)** in **HORTICULTURE**, embodies the result of a piece of bona fide research work carried out by **TAHIRA BEGUM**, Registration number: **14-06190,** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

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ACKNOWLEDGEMENTS

*Alhamdulillah, all praises are due to The Almighty **Allah Rabbul Al-Amin** for His gracious kindness and infinite mercy in all the endeavors the author to let her successfully completing the research work and the thesis leading to Master of Science degree.*

*The author would like to express her heartfelt gratitude and most sincere appreciations to her Supervisor **Prof. Dr. Tahmina Mostarin**, Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, for her valuable guidance, advice, immense help, encouragement and support throughout the study. Likewise grateful appreciation is conveyed to Co-supervisor **Prof. Dr. Khaleda Khatun**, Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, for her constant encouragement, cordial suggestions, constructive criticisms and valuable advice to complete the thesis.*

*It is highly appreciating words for **Prof. Dr. Khaleda Khatun**, Chairman, Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka along with faculties of the Department of Horticulture, Sher-e-Bangla Agricultural University for their rendered novel services towards me as their student.*

The author would like to express her deepest respect and boundless gratitude to all the respected teachers of the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, for their valuable teaching, sympathetic co-operation, and inspirations throughout the course of this study and research work.

The author wishes to extend her special thanks to her classmates and friends for their keen help as well as heartiest co-operation and encouragement during experimentation.

The author is deeply indebted and grateful to her parents and relatives; without whose love, affection, inspiration and sacrifice this work would have not been completed.

Finally the author appreciates the assistance rendered by the staff members of the Department of Horticulture, Horticulture Farm staff, Dhaka, who have helped her during the period of study.

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GROWTH AND YIELD OF KOHLRABI AS INFLUENCED BY ORGANIC AND CHEMICAL SOURCES OF POTASSIUM AND SEEDLING AGE AT TRANSPLANT

ABSTRACT

The experiment was carried out at the "Horticulture Farm" of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during October 2019 to January 2020 to study the effect of different organic and chemical sources of potassium and seedling age at transplant on growth and yield of kohlrabi. The experiment consisted of two factors. Factor A: Four organic and chemical sources of potassium *viz*., K_1= 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost and Factor B: Three seedling ages *viz*., S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data were recorded on growth, yield components and yield of kohlrabi and significant variation was observed for most of the studied characters. Under this investigation, it was revealed that the highest yield (38.44 t ha^{-1}) with net return (Tk. 200,800) and BCR (2.09) was obtained from the treatment combination K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings). On the other hand, the lowest yield (19.78 t ha^{-1}) with net return (Tk. 55,000) and BCR (1.39) was obtained from the treatment combination of K_1S_1 (100% vermicompost + 20 days age of seedlings). So, economic analysis revealed that the K_2S_2 treatment combination appeared to be best for achieving the higher growth, yield and economic benefit of kohlrabi.

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LIST OF ACRONYMS

Acronym		Full meanings
AEZ	=	Agro-Ecological Zone
%	=	Percent
^0C	=	Degree Celsius
BARI	=	Bangladesh Agricultural Research Institute
cm	=	Centimeter
CV%	=	Percentage of coefficient of variance
cv.	=	Cultivar
DAS	=	Days after sowing
et al.	=	And others
FAO	=	Food and Agriculture Organization
G	=	Gram
ha^{-1}	=	Per hectare
kg	=	Kilogram
LSD	=	Least Significant Difference
MoP	=	Muriate of Potash
N	=	Nitrogen
No.	=	Number
NPK	=	Nitrogen, Phosphorus and Potassium
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Resources and Development Institute
T	=	Ton
TSP	=	Triple Super Phosphate
viz.	=	Videlicet (namely)
Wt.	=	Weight

CHAPTER I

INTRODUCTION

Kohlrabi (*Brassica oleraceae* var. *gongylodes*) is a cole crop belongs to the Brassicaceae family. Its edible portion is the expanded stem (knob). Kohlrabi is well known for its high nutritional and medicinal value due to its high content of vitamins (A, B_1, B_2, B_5, B_6 and E), minerals (Ca, Mg, Zn and Fe) and antioxidant substances that prevent the formation of cancer-causing agents (Beecher, 1994). Kohlrabi is widely grown in Europe and North America (Choil *et al.*, 2010). In Bangladesh, it is still grown in a few scattered areas and the total cultivated area is unknown.

Kohlrabi is an excellent vegetable if used before it becomes tough and fibrous. It contains a lot of minerals and vitamins A and C. One hundred gram of edible portion of kohlrabi contains 92.7 g moisture, 1.1 g protein, 0.2 g fat, 0.7 g minerals, 1.5 g fiber, 3.8 g carbohydrates, 25 cal. Energy, 20 mg calcium, 18 mg magnesium, 10 mg oxalic acid, 35 mg phosphorus, 0.4 mg iron, 0.12 mg sodium, 37 mg potassium, 0.09 mg copper, 143 mg sulphur, 36 I. U. vitamin A, 0.12 mg riboflavin, 0.5 mg nicotinic acid, 0.05 mg Thiamin and 85mg Vitamin C (Nagar, 2016).

Many factors influence kohlrabi production, including seed quality, variety, plant spacing, fertilizer and proper management practices (Sultana *et al.*, 2012). Kohlrabi production has not spread much beyond Bangladesh's agricultural farms (BBS, 2014). In terms of growth and yield, kohlrabi responds strongly to major essential nutrients such as N, P, K, and organic fertilizer. Bangladesh produced 35 thousand tons of kohlrabi per year from 7.29 thousand hectares of land in 2012-2013 with an average yield of 4.80 t ha^{-1}, which is very low in comparison to the potential yield (BBS, 2014).

Plants require food in the form of proper NPK doses for growth and development. Nitrogen promotes the transformation of carbohydrates into proteins and the formation of protoplasm (Kachari and Korla, 2009). Nitrogen supplementation promotes vegetative growth, whereas nitrogen deficiency causes stunted growth with small yellow leaves and low production (Khan *et al.*, 2002). Phosphorus plays a vital role in several key physiological processes, *viz.* photosynthesis, respiration, energy storage and transfer, cell division and cell enlargement. It stimulates root growth, blooming and fruit setting (Sharma and Kumar, 2015). Potassium is considered essential in photosynthesis, sugar translocation, nitrogen metabolism, enzyme activation, stomatal opening, water relation and growth of meristematic tissue. It acts as chemical traffic policeman, root booster, stalk strengtheners, protein builder and breathing regulator and retards diseases (Hossain *et al*., 2011).

Potassium is thought to be necessary for photosynthesis, sugar translocation, nitrogen metabolism, enzyme activation, stomatal opening, water relation and meristematic tissue growth (Gianguinlo and Borin, 1996). It acts as a chemical traffic cop, root booster, stalk strengthener, protein builder, breathing regulator, and disease retardant. However, potassium is ineffective without co-factors such as N and P. (Chandra, 1989). Potassium deficiency can impair many physiological processes, including respiration, photosynthesis, and chlorophyll development, as well as reduce leaf water content, which is directly related to plant growth and yield. Inorganic fertilizers are very expensive, and they are not always available on the market. As a result, farmers fail to apply the proper amount of inorganic fertilizer to the crop field. On the other hand, organic fertilizer i.e. vermicompost, mushroom spent compost are widely available to farmers and is less expensive than inorganic fertilizers. Crop production costs are roughly comparable to organic and inorganic fertilizer costs (Haque, 2000).

Seedling age is an important phenomenon for the production of any crops especially vegetables (Bose and Som, 1986). Young seedlings required very intensive care for adjustment with the newly transplanted environmental condition, while aged seedlings reached more injury during uprooting and required more time for adjustment (Anon, 1992). In case of both the situation yield may be hampered. On the other hand optimum aged seedlings are easily adjusted within short period in new environment. So, there were no or minimum injury period of optimum aged transplanted seedlings. When transplanted the seedling in actual aged it ensured highest yield and also quality yield with maximum growth and yield (Thompson and Kelly, 1957).

Therefore, it is clear that the growth and yield of kohlrabi can be increased by judicious application of potassium fertilizer from best organic and chemical sources and optimum aged seedlings. But only a little information on kohlrabi research regarding potassium fertilization and age of seedlings is available in Bangladesh.

Keeping the above facts in view the present experiment was undertaken with following objectives:

i. To investigate the effect of organic and chemical sources of potassium on vegetative growth and yield of kohlrabi.

ii. To observe the influence of seedling age on growth and yields of kohlrabi.

iii. To find out the suitable combination of organic and chemical sources of potassium and age of seedlings for better growth and higher yield of kohlrabi.

CHAPTER II

REVIEW OF LITERATURE

The yield of kohlrabi may be increased through appropriate combination of different organochemical sources of potassium and age of seedlings. Though kohlrabi is cultivated in many parts of our country, very little research work has so far been conducted on the appropriate organochemical sources of potassium with suitable age of seedlings. Research findings regarding the growth and yield of kohlrabi as influenced by different organochemical sources of potassium and age of seedlings under Bangladesh condition is very limited. With the above background, some of the pertinent works have been reviewed in this chapter.

2.1 Effect of different organic and chemical sources of potassium

Islam *et al.* (2020) carried out a field experiment to investigate the effect of different manures and fertilizers on the growth and yield of knol-khol (*Brassica oleracea* var. *gongylodes*) at Dr. Purnendu Gain Field Laboratory of Agrotechnology Discipline, Khulna University, Khulna from November 2014 to February 2015. The single factor experiment comprised of different types of fertilizers and manures viz., T_0 (Control), T_1 (Recommended doses of NPK), T_2 (Cow dung), T_3 (Vermicompost), T_4 (Poultry manure), T_5 (50 % Cow dung + 50 % NPK), T_6 (50 % Vermicompost + 50 % Cowdung), T_7 (50% Vermicompost + 50 % Poultry manure) and T_8 (25 % Cowdung + 25 % Vermicompost + 25 % Poultry manure + 25 % NPK). The Experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. The maximum plant height was obtained from the treatment T_1 at 25, 35 and 45 Days after transplanting (DAT). The maximum spread of canopy was 36.75 cm, 52.50 cm and 66.05 cm from the treatment T_3, T_7 and T_2, respectively. The maximum economic yield (21.92 t ha^{-1}) and biological yield (40.083 t ha^{-1}) were found in the treatment T_1 and T_7, respectively. Highest benefit cost ratio (3.07) was obtained from the treatment T_1 while the minimum (0.57) was obtained from T_3 which indicates that high cost of vermicompost affect net return severely. Although, T_1 produced maximum benefit cost ratio, the treatment T_4 and T_2 are very close to T_1 and also statistically similar. So, we can consider poultry manure and cow dung for our soil health, environmental benefits and ecological safety.

Sharma and Kumar (2015) assessed the response of three levels of nutrients, i.e. F_1 (125 % of recommended dose of NPK), F_2 (100 % recommended dose of NPK) and F_3 (75 % of recommended dose of NPK). Results revealed that a comparison of data among nutrient levels indicated that leaf N contents increased consistently with nutrient levels. Among nutrient levels, uptake of N, P and K increased under F_1 which was at par with F_2 and increased significantly over F_3 and increased to the tune of 41.5-44.4, 41.8-44.8 and 41.4-44.1 % under F_1 and F_2 over F_3, respectively. A comparison among nutrient levels revealed foliage weight to the tune of 44.3 and 41.9 % higher under F_1 and F_2, respectively over F_3. Curd weight and curd yield increased significantly with increasing nutrient levels. The nutrient level F_1 (125 % of recommended dose of nutrients) registered highest curd weight and curd yield (695.7 g plant^{-1} and 231.9 q ha^{-1}) which were at par with F_2 (675.4 g plant^{-1} and 225.1 q ha^{-1}) and increased over F_3 (489.9 g plant^{-1} and 163.3 q ha^{-1}) to the tune of 37.8-42.0 %.

Singh *et al.* (2015) studied seven different treatments including control to examine the optimum doses of NPK and boron for broccoli. The results revealed significant response on growth and yield of broccoli for different treatments. Application of 120 kg N + 60 kg P_2O_5 + 40 kg K_2O + 15 kg B ha^{-1} gave maximum plant height plant^{-1} (65.33 cm), number of leaves plant^{-1} (18.26), length of longest leaf (52.99 cm), width of longest leaf (17.98 cm), spread of plant (55.53 cm) and stem diameter (4.47 cm), whereas in control was minimum pronounced plant height plant^{-1} (58.66 cm), number of leaves plant^{-1} (12.33), length longest leaf (42.70 cm), width of longest leaf (14.18 cm), spread of plant and stem diameter (3.04 cm). Similar, pattern on the curd diameter (13.69 cm), length of curd (16.33 cm), weight of curd plant^{-1} (286.89 g), weight of sprout plant^{-1} (126.89 g), weight of curd and sprout plant^{-1} (0.390 kg) and total yield Curd + sprout (148.51 q ha^{-1}) was recorded with the application of 120 kg N + 60 kg P_2O_5 + 40 kg K_2O +15 kg B ha^{-1} and minimum was under control treatment.

Mishra *et al.* (2014) carried out an experiment during *Rabi* 2012-13 to evaluate the effect of integrated nutrient management on yield, quality and economics of knolkhol. The experiment comprised of 11 treatments replicated three times in a Randomized Block Design. Of the eleven treatments seven comprised of 100 % NPK with or without organic nutrient supplements, two treatments with 50 % NPK + organic nutrient supplements, one treatment with no nutrients (T_1- control) and one treatment with only biofertilizers. The T_7 which comprised of 100 % NPK (150-38-63 kg NPK ha^{-1}) application along with vermicompost (2.5 t ha^{-1}), biofertilizer (2 kg ha^{-1} each of *Azotobacter*, *Azospirillum* and PSB) recorded significantly higher values for total dry weight per plant (77.8 g), yield (420.0 q ha^{-1}), chlorophyll content (56.96 %) TSS (3.1°Brix), ascorbic acid content (55.2 mg/100 g) and protein content (44.2 g/100 g) followed by T_6. The treatment T_6 had same nutrients as T_7 except, FYM instead of vermicompost. But the T_6 proved to be most economical treatment with a benefit: cost ratio of 2.7.

Talukder *et al.* (2013) conducted experiment to determine optimum dose of N, P, K and S for yield maximization of knolkhol during the Rabi season. Treatments comprising four levels of N (0, 50, 100, 150 kg ha^{-1}), P (0, 25, 50, 75 kg ha^{-1}), K (0, 40, 80, 120 kg ha^{-1}) and S (0, 10, 20, 30 kg ha^{-1}) along with a blanket dose of zinc 5 kg, boron 1 kg and cow dung 5 t ha^{-1} were arranged in a randomized complete block design with three replications. The combined effect of NPKS significantly increased yield and yield attributes of knolkhol. The highest edible stem yield of 25.08 t ha^{-1} showing 291 % increase over control during 2010-11 and of 34.23 t ha^{-1} showing 184% increase over control during 2011-12 was obtained from T_3 ($N_{100}P_{50}K_{80}S_{20}$ kg ha^{-1}) treatment. From the regression analysis, it was observed that nitrogen 106.36 kg, phosphorous 57.86 kg, potassium 78.78 kg and sulphur 22.14 kg during 2010-11 and nitrogen 105.20 kg, phosphorous 53.14 kg, potassium 80.25 kg and sulphur 20.92 kg per hectare during 2011-12 was found optimum for knolkhol production in Grey Terrace Soil of Gazipur.

Choudhary *et al.* (2012) conducted an experiment to evaluate the effect of different organic sources and fertility levels on the growth, yield, quality and economics of sprouting broccoli under semi-arid conditions of Rajasthan. Significant increase in plant height, number of leaves, leaf area, volume and diameter of head, total head yield, crude protein and chlorophyll content in head was recorded under various levels of organic sources and fertility levels. Growth, yield and quality attributes were recorded maximum under treatment combination of vermicompost 5.0 t ha^{-1} along with 125 % recommended dose of fertilizers (NPK 100, 80 and 60 kg ha^{-1}), which was at par with poultry manure 5.0 t ha^{-1} and 100% recommended dose of fertilizers, respectively. Furthermore, it also registered maximum net return and B:C ratio (4.09) than rest of the treatments.

Sultana *et al.* (2012) carried out an experiment at the Horticulture Farm of the Bangladesh Agricultural University, Mymensingh during the period from November 2010 to January 2011 to study the effects of cowdung and potassium on growth and yield of Kohlrabi. The experiment consisted of three levels of cowdung (0, 20 and 40 t ha^{-1}) and four levels of potassium (0, 20, 50, 80 kg ha^{-1}). The experiment was laid out in randomized complete block design with three replications. All the parameters were significantly influenced by application of cowdung and potassium. The highest plant height (44.65 cm), number of leaves per plant (12.11), length of largest leaf (37.54 cm), and breadth of largest leaf (18.66 cm) were obtained from the highest dose of cowdung and potassium applied (40 t cowdung + 80 kg K ha^{-1}) while the lowest plant height (33.64 cm), number of leaves (9.01), length of largest leaf (27.94 cm) and breadth of largest leaf (11.00 cm) were obtained from control treatment combination. The highest fresh weight of leaves (49.33 g), fresh weight of knob (328.66 g) and fresh weight of roots (66.55 g) per plant were also recorded under the treatment combination of 40 t cowdung + 80 kg K ha^{-1} while the lowest fresh weight of leaves (22.11 g), fresh weight of knob (136.00 g) and fresh weight of roots (23.33 g) were obtained from control treatment combination. Similarly, the dry weight of leaves (19.34 %), knob (15.19 %) and roots (32.75%) were highest under the same treatment combination of 40 t cowdung + 80 kg K ha^{-1} and the lowest dry weight of leaves (11.71%), dry weight of knob (7.38%) and dry weight of roots (15.29%) were obtained from control treatment combination C_0K_0. The marketable yields of knob per plot (7.86 kg) and per hectare (39.58 tons) were also the highest under the treatment combination 40 t cowdung ha^{-1} and 80 kg potassium ha^{-1}.

Hossain *et al*. (2011) conducted an experiment to evaluate the response of cabbage variety Autumn Queen to added N, P, K and S nutrients in respect of growth, dry matter production and yield, nutrient contents in loose and heading leaves of the crop. Treatment receiving 240 kg N, 45 kg P, 180 kg K and 45 kg S ha^{-1} performed best in recording plant height, root length, number of loose and heading leaves, leaf length and breadth, thickness and diameter of head and yield. However, the optimum doses of N, P, K and S for maximum number of heading leaves (85.41/plant) and yield (87.09 t ha^{-1}) were 232.50, 35.85, 165.80 and 35.35 kg ha^{-1} and 202.30, 36.16, 69.17 and 34.18 kg ha^{-1}, respectively. Treatment receiving 320 kg N, 45 kg P, 180 kg K and 30 kg S ha^{-1} performed best in recording nitrogen content both in loose (7.36 %) and heading (5.80 %). Nitrogen, phosphorus, potassium and sulphur contents in loose leaves were the highest in treatments receiving 240 kg N, 60 kg P, 180 kg K, 30 kg S; 240 kg N, 45 kg P, 240 kg K, 30 kg S and 240 kg N, 45 kg P,180 kg K, 60 kg S ha^{-1}, respectively.

Islam *et al.* (2010) conducted an experiment at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh during October, 2004 to March, 2005 to study the effect of phosphorus and potassium on curd yield and profitability of broccoli. The experiment consisted of three levels of phosphorus (0, 100 and 200 kg P_2O_5 ha^{-1}) and four levels of potassium (0, 100, 200 and 300 kg K ha^{-1}). Results revealed that application of phosphorus and potassium at different levels influenced independently and also in combination on the yield and yield contributing characters of broccoli. Phosphorus had significant effect on the days required to curd initiation, diameter and weight of primary curd, number and weight of secondary curds per plant. Similarly, potassium significantly influenced most of the characters. The yield was also significantly influenced either independently or in combination of phosphorus and potassium. The highest curd yield of broccoli 8.05 t ha^{-1} and 8.26 t ha^{-1} was obtained from 200 kg P_2O_5 ha^{-1} and 200 kg K ha^{-1}, respectively. The treatment combination of 200 kg P_2O_5 ha^{-1} and 200 kg K ha^{-1} was found to produce the highest yield (9.37 t/ha). The economic analysis depicted that the treatment combination of 200 kg P_2O_5 ha^{-1} and 200 kg K ha^{-1} gave the highest net return (Tk. 75731.82) and maximum benefit cost ratio (2.16).

A field trial with a local variety of Chinese cabbage was carried out by Li *et al*. (2010) in Fuzhou, Fujian, China in 2007 to investigate effects of different NPK applied rates on its yield. Eleven treatments were designed, with N, P and K at four different levels, respectively. The average contribution rate of soil fertility to the yield of Chinese cabbage was 47.4%. The yields of Chinese cabbages treated by N, P and K were increased by 41.26, 14.90 and 25.53% on average, respectively. The effects on yield increase was ranked as N>K>P. The output/input ratios of N, P and K were 13.8, 13.2 and 9.7, respectively. The recommended applied rates of NPK fertilizers for the Chinese cabbages in Fuzhou were 232.0 kg N, 70.5 kg P_2O_5 and 209.6 kg K_2O ha^{-1}, respectively.

Uddin *et al.* (2009) conducted an experiment at Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during October-December, 2007 to study the effect of different organic manures on growth and yield of kohlrabi plant. Three types of organic manures *viz.* were compared with control (no manure) in the experiment. The maximum plant height (36.50 cm), plant canopy (63.50 cm), leaf length (30.42 cm), leaf breadth (14.25 cm), fresh leaves weight per plant (131.10 g), diameter of knob (8.23 cm), Knob weight (366.60 g), yield per hectare (22.90 t ha G) were found in poultry manure application. Only the maximum number of leaves (20.00) was 1 found in control treatment. On the other hand, the minimum plant height (32.25 cm), plant canopy (55.75 cm), leaf length (24.92 cm), leaf breadth (10.75 cm), fresh leaves weight per plant (86.97 g), diameter of knob (7.95 cm), Knob weight (177.50 g) and yield per hectare (15.40 t ha G) were found in control treatment.

Maurya *et al.* (2008) conducted a field experiment in Pantnagar, Uttaranchal, India to study the effects of the recommended fertilizer and farmyard manure on broccoli (cv. Fiesta): recommended fertilizers (RF; 120:60:60 kg NPK ha^{-1}), farmyard manure (FYM) at 20 t ha^{-1}, FYM at 10 t ha^{-1} + 50 % RF, neem cake at 5 quintal ha^{-1}, neem cake at 2.5 quintal ha^{-1} + 50 % RF, vermicompost at 5 t/ha, vermicompost at 2.5 t ha^{-1} + 50 % RF, poultry manure at 5 t ha^{-1} and poultry manure at 2.5 t ha^{-1} + 50 % RF. Poultry manure + 50 % RF and FYM + 50 % RF resulted in the greatest plant height in 2005-06. In 2006-07, poultry manure + 50 % RF, vermicompost + 50 % RF, RF and poultry manure gave the tallest plants, the number of fully opened leaves in both years was highest for poultry manure + 50 % RF. Leaf length was greatest for poultry manure + 50 % RF and vermicompost + 50 % RF. The greatest leaf weight per plant was recorded for poultry manure + 50 % RF, FYM + 50% RF and vermicompost + 50 % RF in 2005-06 and for poultry manure + 50 % RF, RF, FYM + 50% RF and vermicompost + 50 % RF in 2006-07. Poultry manure + 50 % RF, FYM + 50 % RF and vermicompost + 50 % RF registered the greatest head weight in 2005-06, whereas poultry manure + 50 % RF was superior for this trait in 2006-07.The highest yields were obtained with poultry manure + 50 % RF.

2.2 Effect of seedling age

Dhital *et al.* (2018) conducted a research to find out the significance of different nutrient sources and seedling age as a pot culture experiment on horticulture field of HASERA Agriculture Research and Training Center, Nepal during winter season of 2017/18. Research consisted of two factorial treatments. Five sources of nitrogen viz. i) Control, ii) Farm Yard Manure, iii) Poultry manure, iv) Goat manure and v) Chemical and two different seedling age viz. i) 14 days and ii) 28 days were replicated four time. The amount of each sources of nitrogen was adjusted to supply 2 g of nitrogen per plant. No significant effect of sources of nitrogen was found in growth (Height, Leaves, Swelling initiation and Cracking) and yield (Knob weight and Circumference) of Kohlrabi. Considering ecological consequences and nutrient release rates (33% vs 93%) organic sources are found better than chemical sources. Knob weight and circumference was significantly higher in 28 days seedling (79 g, 17.68 cm) than 14 days seedling (60 g, 15.4 cm). Cracking in knob was significantly higher in 28 days seedling (20%) than in 14 days seedling (0%). 14 days seedling was found better in places where winter cracking is problem. No significant interaction effect was found between sources of nutrient and seedling age at transplant.

Todorova (2009) conducted an experiment and the investigation was carried out in the Institute of Agriculture, Kyustendil during the period 2007-2009 in a field experiment of late production of four hybrids broccoli. The main purpose was to establish the dependence between transplant age and some of productive behaviors. As a result of the study it was established that hybrid Parthenon F1 produced the highest yield 2546.7 kg ha^{-1} average the period using 30 days transplants. The lowest yields was obtained from Fiesta F1 (1145.0 kg/da) using 45-days transplants. 30 days transplant age obtained better results for all the hybrids.

Krezel and Kolota (2008) carried out two parallel experiments in two factorial design using the method of random sub-blocks in four replications in 2002-2004 at the experimental Station of the Horticulture Department of University of Environmental and Life Sciences in Wroclaw. The effect of seedlings age (3, 4, 5-weekly) and diameter of pots (25, 32, 44, 55 mm) on the yield of Chinese cabbage cultivar Optiko grown in spring and autumn was evaluated. The highest marketable yield in spring and autumn during the harvest from all objects at the same time was obtained from 5-

weekly seedlings grown in pots with a diameter of 55 mm. The use of younger seedlings from pots with smaller diameters was decreased the yielding of cabbage and influenced on forming the smaller heads. Spring cultivation period in comparison to autumn was allowed to obtain higher marketable yield of Chinese cabbage with a smaller share of not fully-grown head cabbage in total yield but a greater share of decay head.

Yarali *et al.* (2007) suggested that using young transplants resulted in higher yield and quality. They suggested that 30 days is a reasonable target age for transplanting broccoli to have better yield and the oldest transplants reduced yield of broccoli.

Cristiaini *et al.* (2005) conducted the experiment from November/2000 to April/2001, in Sao Manuel, Sao Paulo State, Brazil. The effect of cell size of two polyestyrene trays and age of seedling at transplanting date was observed on the production of cauliflower hybrid Shiromaru II. Trays with 128 and 288 cells, corresponding to 34.6 and 9.7 cm^3/cell, respectively, were used with seedlings transplanted at 27, 34, 41 and 48 days after sowing date. The treatments were arranged in a factorial 2×4 in a randomized block design with five replications. Leaf number and area, fresh and dry weight of the seedlings at transplanting date was evaluated. The experimental plot was represented by ten plants. The commercial curd production (%), leaf number, curd weight and diameter were evaluated after harvest. Total yield represents the sum of the fresh weight of all commercial curds. Seedlings produced in 128 cells tray resulted in greater commercial curd percentage (64 %) when compared to trays with 288 cells (45 %), greater curd weight (337 g and 247 g when produced in trays with 128 or 288 cells, respectively) and greater total commercial curds (36.9 t ha^{-1} and 19.9 t ha^{-1} when produced in 128 or 288 cells trays). Seedlings transplanted 34 days after planting date resulted in plants with the greatest curd weight (319 g). Based on the obtained results, it is recommended to produce cauliflower seedlings in trays with 128 cells.

Staugaitis and Viskelis (2005) carried out an experiment in Lithuania to evaluate the changes of the macro-element amounts and the influence of seedling age in the heads and plant residues of Chinese cabbage. The Chinese cabbage crop was supplied with $P_{90}K_{150}$ and N rates as follows: N_0, N_{45}, N_{90}, N_{135}, N_{180}, and N_{225}. Chinese cabbage hybrid Manoko F1 was planted in the last ten days of July. The soil texture was loamy sand on light loam. On the average, there were 3.87 % N, 0.67 % P, 4.40 % K, 0.82 % Ca and 0.20 % Mg in the dry matter of Chinese cabbage. The amounts of the different nutrients were influenced by the climatic conditions and N application. N amount depended mostly on the rate of N fertilizer; the amounts of P, K, Ca and Mg were most influenced by the climatic conditions. N_0 to N_{225} increased the amounts of N, Ca and Mg but had little influence on the amounts of P and K. The optimum N rate for Chinese cabbage was N_{135} because the higher rates did not increase the yield of heads. The crop planted with 30 days old seedling produced 44 t ha^{-1} yields and total plant mass was 76.60 t ha^{-1}.

Kaymak *et al.* (2004) conducted an experiment at Atatürk University, College of Agriculture, Erzurum, Turkey in 2003 and 2004 on Effect of transplant age on growth and yield of broccoli (*Brassica oleracea* var. *italica*). They transplanted seedling at the age of 30, 40 and 50 days. Transplant age affected growth, harvest time and yield of broccoli significantly. While the highest main head weight (385.1 g), diameter (9.3 cm), length (8.8 cm) and total yield (6054.0 g/lot); lateral shoots number (650.3), weight (39.6 g), diameter (6.4 cm) and length (5.7 cm) were obtained from 30 day-old transplants, the lowest values were obtained from 50 days old transplants in both the years. The effect of transplant age varied with cultivars. Results suggest that 30 days may be a reasonable target age for transplanting broccoli.

Arin *et al.* (2003) carried out a research to determine the yield and quality of kohlrabi (*Brassica oleracea* L. var. *gongylodes*) under unheated glasshouse conditions during the spring and autumn growing periods in 2000. In each period, three kohlrabi varieties, two seedling ages and three planting dates, with respect to yield and quality characteristics, were evaluated. The autumn variety 'Express Forcer' and the spring variety 'Lahn' were more suitable than other cultivars. In autumn, seedling age of four weeks gave best results, while in spring the highest yield was obtained from six weeks-old seedlings. It is concluded that planting should not be delayed in both seasons.

Wlazo and Kunicki (2003) carried out a field experiment in Poland to find out the effects of transplanting age (4, 6, 8 and 10 week old) and transplanting date (11 July and 6 August) on the yield and quality of broccoli cv. Lord F1. The marketable yield of broccoli was highest with July planting, whereas the dry matter and ascorbic acid content in broccoli heads were highest with August planting. Ten week old, and 4 and 8 week old transplants recorded the highest marketable yield in 2000 and 2001, respectively. Dry matter and ascorbic acid content were highest in 6 and 4 week old transplants, respectively.

Babik (2000) conducted an experiment on transplanting age of broccoli. Broccoli cv. Cruiser F (RS) was sown in 10-day intervals in order to obtain transplants at age of 20, 30, 40 and 50 days. Yield and mean weight of the central head of broccoli was influenced by time of head formation. Earliness of broccoli was affected by transplant age and method of plant raising. The earliest, but lowest yield was obtained from the oldest transplants (50 days old) grown on a seedbed. Shorter growing periods of 30 or 20 days delayed harvest but increased yield and head weight. A 20-day growing period was not sufficient for raising well developed transplants on a seedbed.

Damato *et al*. (1994) used three cultivars of broccoli in a study with transplants 5, 6, and 7 weeks old for fall production in Italy. These authors find a linier decrease in individual head weight with increasing age, but treatment effect on head weight was not significant when tested via mean separation, time to first harvest increased significantly with increasing age, however the incidence of hollow stem lessened with increasing age in this study.

From the above review of literature it is evident that different organochemical sources of potassium fertilizers and age of seedlings has a significant influence on growth and yield of kohlrabi plant. The literature suggests that lower or higher doses of potassium fertilization than optimum doses could reduce the yield of kohlrabi plant. From the above review of literature it is evident that seedling age itself influenced the growth and yield of kohlrabi plant. The literature revealed that accurate knowledge of the optimum doses of potassium fertilizer for any particular kohlrabi variety at a particular area is critical to achieve a higher yield of kohlrabi plant.

CHAPTER III

MATERIALS AND METHODS

This chapter describes the materials and methods which were used in the field to conduct the experiment entitled “Growth and yield of kohlrabi as influenced by organic and chemical sources of potassium and seedlings age at transplant” during the period from October 2019 to January 2020. The materials and methods that were used for conducting the experiment have been presented in this chapter. It comprises a short description of experimental site, soil and climate, variety, growing of the crops, experimental design and treatments and collection of data presented under the following headings:

3.1 Description of the experimental site

The research work was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, during the period from October 2019 to January 2020. The location of the site was 23°74′ N Latitude and 90°35′ E Longitude with an elevation of 8.2 meters from the sea level (Anon, 1987) and presented in Appendix I.

3.2 Soil characteristics

The texture of the soil in the experimental field was silty loam. The soil in the experimental area is part of the Modhupur Tract (UNDP, 1988) and belongs to AEZ No. 28. Before conducting the experiment, a soil sample from the experimental plot was obtained from a depth of 0-30 cm and examined at the Soil Resources Development Institute (SRDI), Soil Testing Laboratory, Khamarbari, Dhaka which is shown in Appendix II.

3.3 Climate and weather

The climate of the experimental site was under the subtropical climate with three distinct seasons: winter from November to February, pre-monsoon or hot season from March to April, and monsoon season from May to October (Edris *et al.*, 1979). The Bangladesh Meteorological Department, Agargoan, Dhaka, provided details of the meteorological data collected during the experiment, which are presented in Appendix III.

3.4 Crop/plating material

The "Korist F1" cultivar of Kohlrabi was used in the experiment. The seed was collected from Masud Seed Company, 174, Siddique Bazar, Dhaka-1000.

3.5 Treatments under the investigation

The experiment consisted of two factors *viz.* different organic and chemical sources of potassium and age of seedlings.

Factor A: Organic and chemical sources of potassium (4 levels)
K_{1}= 100% vermicompost
K_2= 50% MoP + 50% vermicompost
K_3= 50% MoP + 50% mushroom spent compost and
K_4= 50% vermicompost + 50% mushroom spent compost

Factor B: Age of seedlings (3 types)
S_1= 20 days age of seedlings
S_2= 25 days age of seedlings and
S_3= 30 days age of seedlings

There are 12 treatment combinations such as K_1S_1, K_1S_2, K_1S_3, K_2S_1, K_2S_2, K_2S_3, K_3S_1, K_3S_2, K_3S_3, K_4S_1, K_4S_2 and K_4S_3.

3.6 Design and layout of the experiment

The two-factorial experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The total area of the experimental plot was divided into three equal blocks. Each block was divided into 12 plots where 12 treatments combination were distributed randomly. There were 36 unit plots altogether in the experiment. The size of each plot was 1.00 m × 0.90 m. The distance maintained between two blocks and two plots were 50 cm and 40 cm, respectively. The plots were raised up to 10 cm. In the plot with maintaining distance between row to row and plant to plant were 30 cm and 20 cm, respectively.

3.7 Seedbed preparation

Seedbed was prepared on 1st week of October 2019 for raising seedlings of kohlrabi and the size of the seedbed was 3 m × 1 m. For making seedbed, the soil was well ploughed to loosen friable and dried masses to obtained good tilth. Weeds, stubbles and dead roots were removed from the seedbed. Cowdung was applied to prepared seedbed. The soil was treated by Sevin 50WP @ 5kg ha^{-1} to protect the young plants from the attack of mole crickets, ants and cutworm.

3.8 Seed treatment

Seeds were treated by Provax 200WP @ 3g kg^{-1} seeds to protect some seed borne diseases.

3.9 Seed sowing

Seeds were sown on 15 October, 20 October and 25 October 2019 in the seedbed. Sowing was done thinly in lines spaced at 5 cm distance. Seeds were sown at a depth of 2 cm and covered with a fine layer of soil before being lightly watered with a water can. Following that, the beds were covered with dry straw to keep the required temperature and moisture levels. The dry straw cover was removed as soon as the seed sprout emerged. When the seeds germinated, white polythene was used to provide shade to protect the young seedlings from the scorching sun and rain. Seedlings were uprooted from 3 different seedbeds counting the seedling ages.

3.10 Raising of seedlings

Light watering and weeding were done several times. No chemical fertilizers were applied for raising of seedlings. Seedlings were not attacked by any kind of insects or diseases. 20, 25 and 30 days old healthy seedlings were transplanted into the experimental field on 15 November 2019.

3.11 Land preparation

The plot selected for the experiment was opened with a power tiller in the 1st week of November 2019 and left exposed to the sun for a week. To achieve good tilth, the land was harrowed, ploughed, and cross-ploughed several times after one week, followed by laddering. Weeds and stubbles were removed and a desirable tilth of soil was obtained for seedling transplanting. Drainage channels were built around the land to prevent water logging caused by rainfall during the study period. When the plot was finally ploughed, the soil was treated with Furadan 5G @ 15 kg ha^{-1} to protect the young seedlings from cut worm attack.

3.12 Application of manures and fertilizers

Manures and fertilizers were applied as per the treatment. Organic manure and inorganic fertilizer was used as the source of nitrogen, phosphorus and potassium. Total amount of organic manure was applied during final land preparation as per treatment. The following doses of fertilizers and manures were used in this experiment:

Fertilizers	Manures	Doses (ha^{-1})	Composition
Urea		300 kg	
TSP		300 kg	
MoP		250 kg	K- 50%
	Cowdung	10 t	
	Vermicompost	7.81 t (100%)	K- 1.6%
		3.91 t (50%)	
	Mushroom spent compost	5.73 t (50%)	K- 1.09%

3.13 Transplanting of seedlings

The seedbed was watered before uprooting the seedlings to minimize the damage of roots. 20, 25 and 30 days old healthy seedlings were transplanted at the spacing of 30 cm × 20 cm in the experimental plots on 15 November 2019 as per treatment. Planting was done in the afternoon. For better establishment, light irrigation was applied immediately after transplanting around each seedling. Watering was done for up to five days until they could establish their own root system.

3.14 Intercultural operations

3.14.1 Gap filling

Very few seedlings were damaged after transplanting and new seedlings from the same stock were replaced these.

3.14.2 Weeding

The plants were kept under careful observation. Weeding was done at two times. First weeding was done two weeks after transplanting. Another weeding was done after 30 days of first weeding.

3.14.3 Irrigation

For better establishment, light irrigation was applied immediately after transplanting around each seedling. Watering was done for up to five days until they could establish their own root system. Irrigation was given based on the moisture content of the soil. During the crop period, irrigation was performed four times.

3.14.4 Insects and diseases management

The crop was attacked by cutworms, mole cricket and field cricket during the early stage of growth of seedlings in the month of December. This insect was controlled by spraying Dursban 20 EC @ 0.1%.

3.14.5 General observation

The field was frequently observed to notice any changes in plants, pest and disease attack and necessary action was taken for normal plant growth.

3.15 Harvesting

Whole plants with knobs were harvested at proper matured time. Main knobs were harvested when the plants formed compact knobs. The final harvesting was done on 20 January 2020.

3.16 Collection of data

The data pertaining to following characters were recorded from five plants randomly selected from each plot except yield of knobs which was recorded plot wise. The following parameters were studied for the present experiment.

3.16.1 Plant height

Plant height was recorded at 25, 35 days after transplanting (DAT) and harvest by using meter scale. Height was measured from ground level to the tip of the largest leaf of an individual plant. Thus mean value of the five selected plants per plot was considered as the height of the plant and was expressed in centimeter.

3.16.2 Number of leaves per plant

Number of leaves per plant was counted at 25, 35 days after transplanting (DAT) and at harvest from five randomly selected plants. Fallen leaves were counted on the basis of scar marks on the stem introduced by the petiole of the leaves.

3.16.3 Largest leaf Length

Length of largest leaf was measured at 25, 35 days after transplanting (DAT) and at harvest from the base of the petiole to the tip of leaf with a meter scale and was recorded in centimeter.

3.16.4 Largest leaf breadth

Breadth of largest leaf was measured at 25, 35 days after transplanting (DAT) and at harvest from the widest part of the lamina by a meter scale and was expressed in centimeter.

3.16.5 Spread of plant canopy per plant

Crown spread was measured in centimeter at 25 days after transplanting and harvest by taking the mean diameter of the canopy of an individual plant in several directions.

3.16.6 Fresh weight of leaves per plant

Fresh weight of leaves per plant was recorded at harvest in gram with a beam balance from the average of five randomly selected plants.

3.16.7 Fresh weight of knob per plant

Fresh weight of the edible part per plant was recorded and expressed in gram.

3.16.8 Total weight of plant

Fresh weight of the plant was recorded and expressed in gram.

3.16.9 Fresh weight of roots per plant

Fresh weight of root was measured at harvest in gram.

3.16.10 Average length of root per plant

A distance between the bases to the tip of the root was measured in cm at harvest with the help of' scale for determining the length of root.

3.16.11 Number of lateral roots per plant

After harvesting the main root was pulled out of soil carefully and the soil was washed out by water and then the number of roots per plant was counted.

3.16.12 Diameter of knob per plant

Selected five knobs were sectioned in the middle vertically with a sharp knife. The diameter of the knob was measured in cm with a scale as the horizontal distance from one side to another side of the sectioned knob.

3.16.13 Dry weight percentage of leaves per plant

At first 100 g fresh leaf from selected plants was collected, cut into pieces and dried under sunshine for a few days and then dried in oven at 70℃ for 72 hours. The sample was then transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. The dry weight percentage of the leaf was computed by the simple calculation from the weight recorded by the following formula:

Dry weight percentage of leaves (%) = $\frac{\text{Dry weight}}{\text{Fresh weight}} \times 100$

3.16.14 Dry weight percentage of knob per plant

At first 100 g fresh knob from selected plants was collected, cut into pieces and dried under sunshine for a few days and then dried in oven at 70℃ for 72 hours. The sample was then transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. The dry weight percentage of the knob was computed by the simple calculation from the weight recorded by the following formula:

Dry weight percentage of knob (%) = $\frac{\text{Dry weight}}{\text{Fresh weight}} \times 100$

3.16.15 Dry weight percentage of roots per plant

At first 100 g fresh roots from selected plants was collected, cut into pieces and dried under sunshine for a few days and then dried in oven at 70℃ for 72 hours. The sample was then transferred into desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. The dry weight percentage of the roots was computed by the simple calculation from the weight recorded by the following formula:

$$\text{Dry weight percentage of root (\%)} = \frac{\text{Dry weight}}{\text{Fresh weight}} \times 100$$

3.16.16 Yield per plot

Yield per unit plot was calculated by adding the yields of all plants of each unit plot and expressed in kilogram (kg).

3.16.17 Gross yield per hectare

Gross yield of a kohlrabi was measured as the whole plant weight including the leaves of all the plant of a plot and gross yield per hectare was calculated by converting the weight of the kohlrabi plant of plot into hectare and expressed in t ha^{-1}.

3.17 Economic analysis

Cost of production was analyzed in order to find out the most economic return under different treatment combinations. All input costs, including the cost for lease of land and interest on running capital were considered for computing the cost of production. The interests were calculated @ 15% per year for 6 month. The cost and return analyses were done in details according to the procedure followed by Alam *et al.* (1989). The Benefit Cost Ratio (BCR) was calculated as follows:

$$\text{Benefit Cost Ratio (BCR)} = \frac{\text{Gross return per hectare (Tk.)}}{\text{Total cost of production per hectare (Tk.)}}$$

3.18 Data analysis technique

The collected data were compiled and tabulated. Statistical analysis was done on various plant characters to find out the significance of variance resulting from the experimental treatments. Data were analyzed using analysis of variance (ANOVA) technique with the help of computer package program MSTAT-C (software) and the mean differences were adjudged by least significant difference test (LSD) as laid out by Gomez and Gomez (1984).

CHAPTER IV

RESULTS AND DISCUSSION

This chapter comprises of the presentation and discussion of the results obtained from the present study. The results have been presented, discussed and possible interpretations were given in tabular and graphical forms. The results obtained from the experiment have been presented under separate headings and sub-headings as follows:

4.1 Plant height

There was marked variation was observed on plant height at 25, 35 DAT and at harvest due to different organic and chemical sources of potassium under the experiment (Fig. 1 and Appendix XIV). At harvest, the highest plant height (40.24 cm) was obtained from K_2 (50% MoP + 50% vermicompost) treatment and the lowest plant height (35.65 cm) was revealed from K_1 (100% vermicompost) treatment. It was revealed that the plant height increased with the increase in days after transplanting (DAT) i.e., 25, 35 DAT and at harvest. It also revealed that the plant height increased with different sources of potassium as well. Sultana *et al.* (2012) observed the similar trends of result. They reported that highest plant height was obtained from the highest dose of cowdung and potassium applied (40 t cowdung + 80 kg K ha^{-1}). Maurya *et al.* (2008) revealed that the greatest plant height was obtained from poultry manure + 50 % RF, vermicompost + 50 % RF as well as RF and poultry manure. Uddin *et al.* (2009) reported that the plant height significantly influenced by organic manures.

Age of seedlings showed significant influence on the height of kohlrabi plants at 25, 35 DAT and at harvest (Fig. 2 and Appendix XV). At harvest, the highest plant height (40.17 cm) was observed from S_2 (25 days age of seedlings) treatment. On the other hand the lowest plant height (36.05 cm) was observed from S_1 (20 days age of seedlings) treatment. The findings of the experiment were in coincided with the findings of Kaymak *et al.* (2004) and Arun *et al.* (2012). They reported that seedling age of four weeks gave best results.

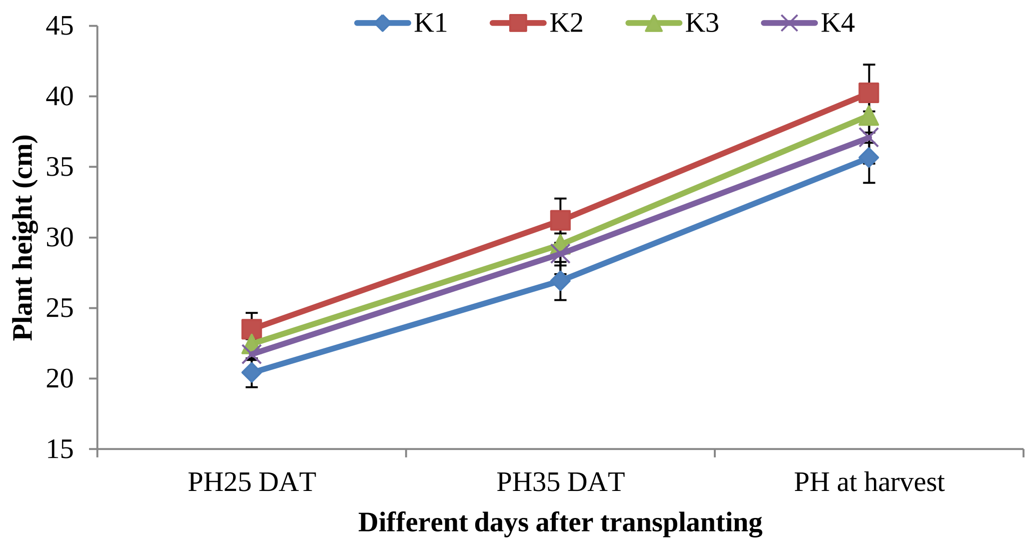

Fig. 1. Effect of different organic and chemical sources of potassium on plant height at different days after transplanting of kohlrabi

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

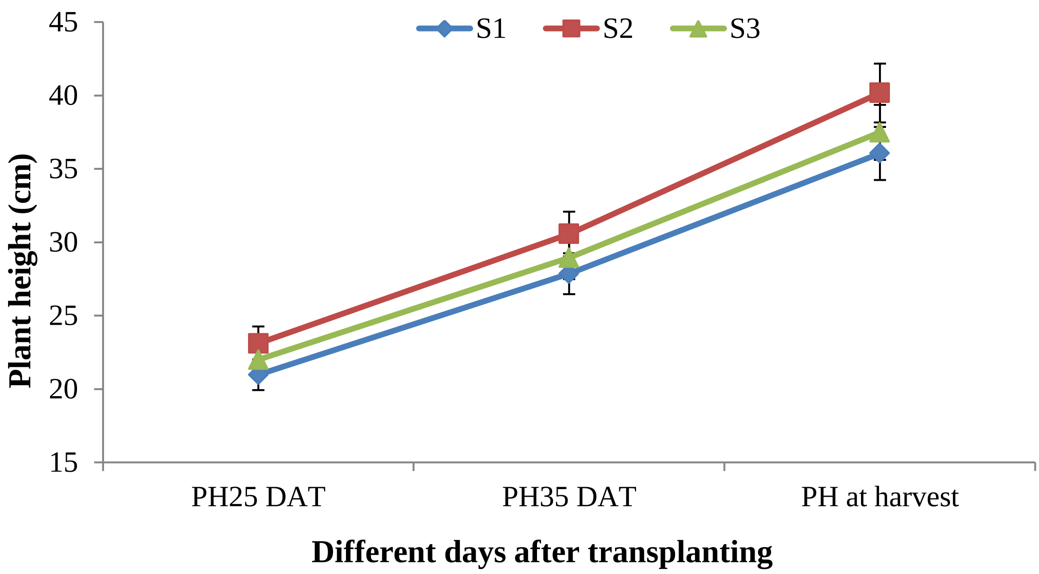

Fig. 2. Effect of age of seedlings on plant height at different days after transplanting of kohlrabi

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Significant influence was observed on plant height due to the combined effect of different organic and chemical sources of potassium and age of seedlings (Table 1 and Appendix V). From the results of the experiment showed that the highest plant height at harvest (42.93 cm) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the lowest plant height at harvest (33.12 cm) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 1. Combined effect of different organic and chemical sources of potassium and age of seedlings on plant height of kohlrabi at different days after transplanting

Treatment Combinations	Plant height (cm) at		
	25 DAT	**35 DAT**	**At harvest**
K_1S_1	19.10 f	25.05 h	33.12 h
K_1S_2	21.66 de	28.21 efg	37.72 def
K_1S_3	20.51 ef	27.51 fg	36.12 fg
K_2S_1	22.21 bcd	29.27 cde	38.21 cde
K_2S_2	24.88 a	32.79 a	42.93 a
K_2S_3	23.39 abc	31.55 ab	39.57 bcd
K_3S_1	21.45 de	28.11 efg	37.07 efg
K_3S_2	23.63 ab	30.82 bc	40.15 b
K_3S_3	22.27 bcd	29.56 cde	38.69 bcde
K_4S_1	21.11 de	28.96 def	35.81 g
K_4S_2	22.23 bcd	30.42 bcd	39.87 bc
K_4S_3	21.81 cde	27.13 g	35.55 g
$LSD_{(0.05)}$	**1.6000**	**1.7106**	**1.8838**
CV%	**4.29**	**3.47**	**2.94**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.2 Number of leaves per plant

Significant variation was exerted on number of leaves per plant of kohlrabi at 25, 35 DAT and at harvest due to different organic and chemical sources of potassium under the experiment (Table 2 and Appendix VI). At harvest, the maximum number of leaves per plant (16.99) was obtained from K_2 (50% MoP + 50% vermicompost) treatment where minimum number of leaves per plant (11.44, respectively) was revealed from K_1 (100% vermicompost) treatment. It was revealed that the number of leaves per plant increased with the increase in days after transplanting (DAT) i.e., 25, 35 DAT and at harvest. It also revealed that the number of leaves per plant increased with different sources of potassium as well. The findings of the experiment was in coincided with the findings of Sultana *et al.* (2012) who reported that dose of cowdung and potassium applied (40 t cowdung + 80 kg K ha^{-1}) significantly influenced the number of leaves per plant of kohlrabi.

Table 2. Effect of different organic and chemical sources of potassium on number of leaves per plant at different days after transplanting of kohlrabi

Treatments	Leaves number per plant at		
	25 DAT	**35 DAT**	**Harvest**
K_1	8.29 c	8.98 c	11.44 d
K_2	10.28 a	11.84 a	16.99 a
K_3	9.08 b	10.07 b	14.37 c
K_4	9.00 b	10.27 b	16.13 b
$LSD_{(0.05)}$	**0.4201**	**0.6657**	**0.7150**
CV%	**4.69**	**6.62**	**4.96**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Statistically age of seedlings showed significant variation on number of leaves per plant of kohlrabi at 25, 35 DAT and at harvest (Table 3 and Appendix VI). At harvest, the maximum number of leaves per plant (16.11) was observed from S_2 (25 days age of seedling) treatment. On the other hand the minimum number of leaves per plant (13.72) was observed from S_1 (20 days age of seedling) treatment. Similar result was also found by Dhital *et al.* (2018) who reported that 28 days seedling increases the number of leaves per plant.

Table 3. Effect of different age of seedlings on number of leaves per plant at different days after transplanting of kohlrabi

Treatments	Number of leaves per plant at		
	25 DAT	**35 DAT**	**Harvest**
S_1	8.71 c	9.57 c	13.72 c
S_2	9.59 a	11.10 a	16.11 a
S_3	9.18 b	10.20 b	14.38 b
$LSD_{(0.05)}$	**0.3638**	**0.5765**	**0.6192**
CV%	**4.69**	**6.62**	**4.96**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by number of leaves per plant (Table 4 and Appendix VI). At harvest, the maximum number of leaves per plant (18.52) was achieved from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the minimum number of leaves per plant (10.44) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 4. Combined effect of different organic and chemical sources of potassium and age of seedlings on number of leaves per plant at different days after transplanting of kohlrabi

Treatment Combinations	Number of leaves per plant at		
	25 DAT	35 DAT	Harvest
K_1S_1	7.45 f	8.02 e	10.04 f
K_1S_2	8.99 de	9.76 d	12.91 d
K_1S_3	8.42 e	9.14 de	11.37 e
K_2S_1	9.87 bc	10.13 cd	16.12 bc
K_2S_2	10.96 a	13.44 a	18.52 a
K_2S_3	10.01 b	11.93 b	16.33 bc
K_3S_1	9.12 de	10.23 cd	13.10 d
K_3S_2	8.92 de	10.07 cd	15.92 bc
K_3S_3	9.21 cd	9.91 d	14.10 d
K_4S_1	8.40 e	9.88 d	15.60 c
K_4S_2	9.51 bcd	11.12 bc	17.08 b
K_4S_3	9.10 de	9.81 d	15.70 c
$LSD_{(0.05)}$	**0.7276**	**1.1530**	**1.2384**
CV%	**4.69**	**6.62**	**4.96**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.3 Largest leaf length

Length of largest leaf of kohlrabi showed significant variation at 25, 35 DAT and at harvest due to different organic and chemical sources of potassium under the experiment (Table 5 and Appendix VII). At harvest, the maximum length of largest leaf per plant (32.34 cm) was obtained from K_2 (50% MoP + 50% vermicompost) treatment where the minimum length of largest leaf per plant (27.21 cm) was revealed from the K_1 (100% vermicompost) treatment. It was revealed that the length of leaves per plant increased with the increase in days after transplanting (DAT) i.e., 25, 35 DAT and at harvest. It also revealed that the length of largest leaf per plant increased with different sources of potassium as well. Sultana *et al.* (2012) and Singh *et al.* (2015) found the similar result.

Table 5. Effect of different organic and chemical sources of potassium on largest leaf length per plant at different days after transplanting of kohlrabi

Treatments	Length of largest leaf (cm) at		
	25 DAT	35 DAT	Harvest
K_1	19.01 d	23.03 c	27.21 d
K_2	26.72 a	30.02 a	32.34 a
K_3	24.25 c	26.87 b	30.15 c
K_4	25.21 b	26.58 b	31.15 b
$LSD_{(0.05)}$	0.7390	1.1830	0.9706
CV%	3.18	4.54	3.29

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Significant variation on leaf length per plant of kohlrabi was observed at 25, 35 DAT and at harvest due to age of seedlings (Table 6 and Appendix VII). At harvest, the maximum leaf length per plant (32.19 cm) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the minimum leaf length per plant (28.41 cm) was observed from S_1 (20 days age of seedling) treatment. Kaymak *et al.* (2004) also found the similar results in broccoli plant.

Table 6. Effect of different age of seedlings on largest leaf length per plant at different days after transplanting of kohlrabi

Treatments	Leaf length (cm) per plant at		
	25 DAT	35 DAT	Harvest
S_1	21.99 c	24.67 c	28.41 c
S_2	25.31 a	28.20 a	32.19 a
S_3	24.09 b	27.01 b	30.03 b
$LSD_{(0.05)}$	0.6400	1.0245	0.8406
CV%	3.18	4.54	3.29

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by length of largest leaf per plant of kohlrabi due to the (Table 7 and Appendix VII). At harvest, the maximum length of largest leaf per plant (34.73 cm) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination which was statistically identical to K_4S_2 (50% vermicompost + 50% mushroom spent compost + 25 days age of seedling) treatment combination. On the other hand the minimum length of largest leaf (24.29 cm) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 7. Combined effect of different organic and chemical sources of potassium and age of seedlings on largest leaf length per plant at different days after transplanting of kohlrabi

Treatment Combinations	Leaf length (cm) per plant at		
	25 DAT	**35 DAT**	**Harvest**
K_1S_1	17.17 g	20.55 g	24.29 e
K_1S_2	20.95 e	25.64 e	29.45 cd
K_1S_3	18.91 f	22.91 f	27.89 d
K_2S_1	25.75 bc	30.66 ab	30.98 bc
K_2S_2	27.92 a	31.50 a	34.73 a
K_2S_3	26.49 b	27.89 cd	31.32 b
K_3S_1	21.90 de	23.13 f	30.18 bc
K_3S_2	25.91 bc	29.27 bc	30.77 bc
K_3S_3	24.94 c	28.22 cd	29.49 cd
K_4S_1	23.15 d	24.34 ef	28.20 d
K_4S_2	26.47 b	26.39 de	33.80 a
K_4S_3	26.01 bc	29.01 bc	31.43 b
$LSD_{(0.05)}$	**1.2800**	**2.0489**	**1.6811**
CV%	**3.18**	**4.54**	**3.29**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.4 Largest leaf breadth

Leaf breadth of kohlrabi showed significant variation at 25, 35 DAT and at harvest due to different organic and chemical sources of potassium (Table 8 and Appendix VIII). At harvest, the maximum leaf breadth (13.12 cm) was obtained from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand the minimum leaf breadth (10.67 cm) was revealed from K_1 (100% vermicompost) treatment. It was revealed that the breadth of leaves per plant increased with the increase in days after transplanting (DAT) i.e., 25, 35 DAT and at harvest. It also revealed that the breadth of leaves per plant increased with different organic and chemical sources of potassium as well. Sultana *et al.* (2012) found the similar result.

Statistically marked variation on leaf breadth per plant at 25, 35 DAT and at harvest was observed due to age of seedlings (Table 9 and Appendix VIII). At harvest, the maximum leaf breadth per plant (13.05 cm) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the minimum leaf breadth per plant (10.94 cm) was observed from S_1 (20 days age of seedling) treatment. Todorova (2009) observed the similar trends in broccoli plant and revealed that 30 days transplants seedling showed the best performance.

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by leaf breadth per plant (Table 10 and Appendix VIII). At harvest, the maximum leaf breadth per plant (14.38 cm) was achieved from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the minimum leaf breadth per plant (9.05 cm) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 8. Effect of different organic and chemical sources of potassium on leaf breadth per plant at different days after transplanting of kohlrabi

Treatments	Leaf breadth (cm) at		
	25 DAT	35 DAT	Harvest
K_1	7.42 c	9.11 c	10.67 c
K_2	10.60 a	11.96 a	13.12 a
K_3	9.62 b	10.39 b	11.83 b
K_4	9.77 b	10.90 b	12.14 b
$LSD_{(0.05)}$	**0.8081**	**0.7447**	**0.8158**
CV%	**8.84**	**7.19**	**6.99**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, $K_{1=}$ 100% vermicompost, K_2= 50% MP + 50% vermicompost, K_3= 50% MP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Table 9. Effect of different age of seedlings on leaf breadth per plant at different days after transplanting of kohlrabi

Treatments	Leaf breadth (cm) at		
	25 DAT	35 DAT	Harvest
S_1	8.49 c	9.72 b	10.94 c
S_2	10.32 a	11.96 a	13.05 a
S_3	9.23 b	10.10 b	11.84 b
$LSD_{(0.05)}$	**0.6998**	**0.6450**	**0.7065**
CV%	**8.84**	**7.19**	**6.99**

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced at 25, 35 DAT and at harvest by leaf breadth per plant of kohlrabi (Table 10 and Appendix VIII). At harvest, the maximum leaf breadth per plant (14.38 cm) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the minimum leaf breadth per plant (9.05 cm) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 10. Combined effect of different organic and chemical sources of potassium and age of seedlings on leaf breadth per plant at different days after transplanting of kohlrabi

Treatment Combinations	Leaf breadth (cm) per plant at		
	25 DAT	**35 DAT**	**Harvest**
K_1S_1	6.48 f	8.29 f	9.05 e
K_1S_2	8.42 de	9.93 de	11.95 bcd
K_1S_3	7.35 ef	9.10 ef	11.01 d
K_2S_1	9.81 bcd	10.87 cd	12.04 bcd
K_2S_2	11.74 a	13.88 a	14.38 a
K_2S_3	10.24 bc	11.14 bcd	12.95 b
K_3S_1	8.82 d	9.50 ef	11.52 cd
K_3S_2	10.27 b	11.71 bc	12.84 bc
K_3S_3	9.77 bcd	9.97 de	11.14 d
K_4S_1	8.87 cd	10.22 de	11.16 d
K_4S_2	10.87 ab	12.30 b	13.02 ab
K_4S_3	9.57 bcd	10.17 de	12.25 bcd
$LSD_{(0.05)}$	**1.3996**	**1.2899**	**1.4131**
CV%	**8.84**	**7.19**	**6.99**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.5 Spread of canopy per plant

Significant variation on spread of canopy per plant of kohlrabi was observed at 25 DAT and at harvest due to different organic and chemical sources of potassium (Table 11 and Appendix IX). At harvest, the maximum spread of canopy per plant (62.66 cm) was obtained from K_2 (50% MoP + 50% vermicompost) treatment. The minimum spread of canopy per plant (41.57 cm) was revealed from K_1 (100% vermicompost) treatment. It also revealed that the spread of canopy per plant increased with different organic and chemical sources of potassium as well. Singh *et al.* (2015) found the similar result.

Table 11. Effect of different organic and chemical sources of potassium on spread of canopy per plant at different days after transplanting of kohlrabi

Treatments	Spread of canopy (cm) per plant at	
	25 DAT	Harvest
K_1	28.69 d	41.57 d
K_2	42.28 a	62.66 a
K_3	38.81 c	59.14 c
K_4	40.44 b	60.93 b
$LSD_{(0.05)}$	**1.3026**	**1.7279**
CV%	**3.55**	**3.15**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Statistically marked variation on spread of canopy per plant of kohlrabi was observed at 25 DAT and at harvest due to age of seedlings (Table 12 and Appendix IX). At harvest, the maximum spread of canopy per plant (58.74 cm) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the minimum spread of canopy per plant (52.96 cm) was observed from S_1 (20 days age of seedling) treatment. Yarali *et al.* (2007) observed the similar types of results in broccoli.

Table 12. Effect of different age of seedlings on spread of canopy per plant at different days after transplanting of kohlrabi

Treatments	Spread of canopy (cm) per plant at	
	25 DAT	Harvest
S_1	36.14 b	52.96 c
S_2	39.26 a	58.74 a
S_3	37.26 b	56.53 b
$LSD_{(0.05)}$	**1.1281**	**1.4964**
CV%	**3.55**	**3.15**

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

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by spread of canopy per plant of kohlrabi at different days after transplanting (Table 13 and Appendix IX). At harvest, the maximum spread of canopy per plant (65.23 cm) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination which was statistically similar to K_4S_2 (50% vermicompost + 50% mushroom spent compost + 25 days age of seedlings) treatment combination. On the other hand the minimum spread of canopy per plant (36.14 cm) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 13. Combined effect of different organic and chemical sources of potassium and age of seedlings on spread of canopy per plant at different days after transplanting of kohlrabi

Treatment Combinations	Spread of canopy (cm) per plant at	
	25 DAT	**Harvest**
K_1S_1	26.08 e	36.14 f
K_1S_2	30.73 d	44.29 e
K_1S_3	29.27 d	44.29 e
K_2S_1	41.44 b	60.67 bc
K_2S_2	43.97 a	65.23 a
K_2S_3	41.43 b	62.08 b
K_3S_1	38.11 c	57.25 d
K_3S_2	40.17 bc	62.12 b
K_3S_3	38.14 c	58.06 cd
K_4S_1	38.95 c	57.80 cd
K_4S_2	42.17 ab	63.31 ab
K_4S_3	40.19 bc	61.68 b
$LSD_{(0.05)}$	**2.2562**	**2.9928**
CV%	**3.55**	**3.15**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.6 Fresh weight of leaves per plant

Statistically significant variation was observed on fresh weight of leaves per plant of kohlrabi due to different organic and chemical sources of potassium (Fig. 3 and Appendix XVI). Results of the experiment showed that the maximum fresh weight of leaves per plant (86.02 g) from K_2 (50% MoP + 50% vermicompost) treatment while the minimum fresh weight of leaves per plant (40.62 g) was revealed from K_1 (100% vermicompost) treatment. It was revealed that the fresh weight of leaves per plant increased with the different organic and chemical sources of potassium. Sultana *et al.* (2012) and Singh *et al.* (2015) also observed the similar results.

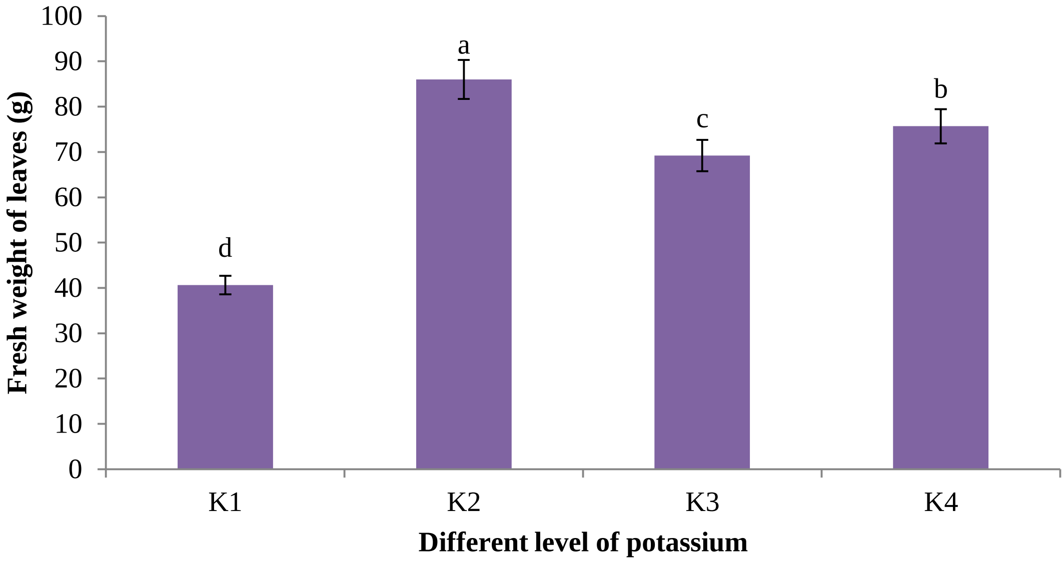

Fig. 3. Effect of different organic and chemical sources of potassium on fresh weight of leaves per plant of kohlrabi

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Significant difference on fresh weight of leaves per plant of kohlrabi was observed due to age of seedlings (Fig. 4 and Appendix XVII). It was revealed that the maximum fresh weight of leaves per plant (73.65 g) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the minimum fresh weight of leaves per plant (61.62 g) was observed from S_1 (20 days age of seedling) treatment. The results of the experiment were in coincided with the findings of Cristiaini *et al.* (2005). They reported that seedlings transplanted 34 days after planting date resulted in plants growth and yield of cauliflower.

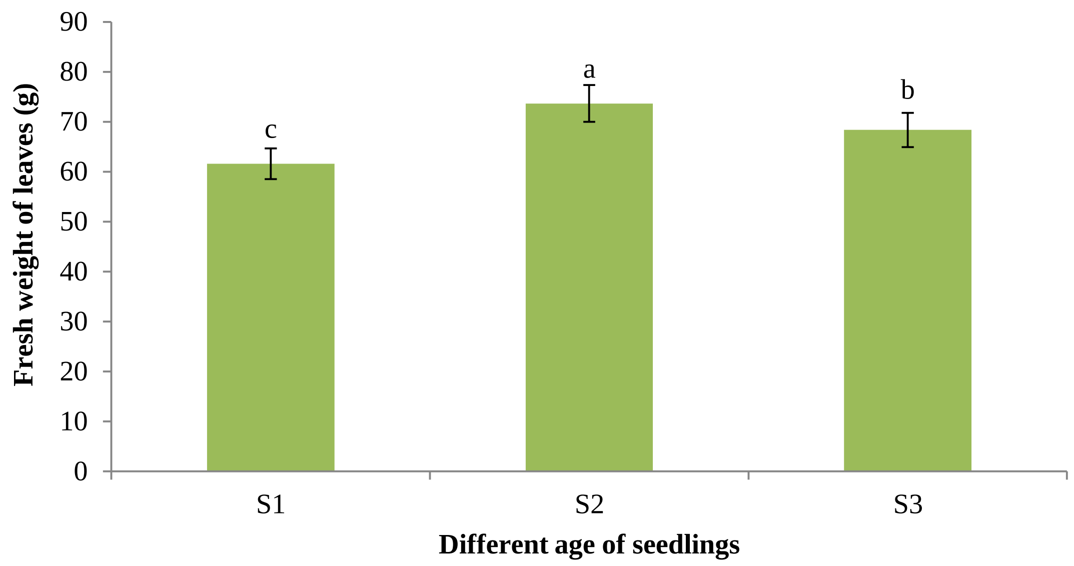

Fig. 4. Effect of different age of seedlings on fresh weight of leaves per plant of kohlrabi

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Marked variation was observed on fresh weight of leaves per plant of kohlrabi due to the combined effect of different organic and chemical sources of potassium and age of seedlings (Table 14 and Appendix X). From the results of the experiment showed that the maximum fresh weight of leaves per plant (91.17 g) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the minimum fresh weight of leaves per plant (34.50 g) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

4.7 Fresh weight of knob per plant

Fresh weight of knob per plant of kohlrabi showed significant variation due to different organic and chemical sources of potassium (Fig. 5 and Appendix XVI). The maximum fresh weight of knob per plant (249.10 g) was obtained from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand the minimum fresh weight of knob per plant (151.95 g) was achieved from K_1 (100% vermicompost) treatment. It was revealed that the fresh weight of knob per plant increased with the different organic and chemical sources of potassium as well. The result of the experiment was in coincided with the findings of Sultana *et al.* (2012).

Statistically significant difference on fresh weight of knob with leaves per plant of kohlrabi was observed due to age of seedlings (Fig. 6 and Appendix XVII). The maximum fresh weight of knob with leaves per plant (218.07 g) was revealed from S_2 (25 days age of seedling) treatment while the minimum fresh weight of knob with leaves per plant (191.24 g) was observed from S_1 (20 days age of seedling) treatment. Dhital *et al.* (2018) observed the similar trends of result and reported that knob weight and circumference was significantly higher in 28 days seedling than 14 days seedling.

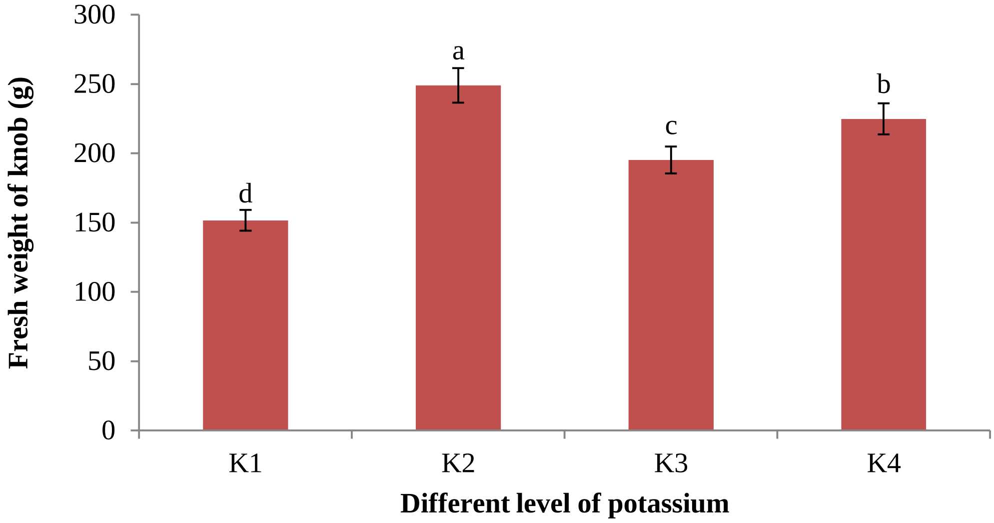

Fig. 5. Effect of different organic and chemical sources of potassium on fresh weight of knob per plant of kohlrabi

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

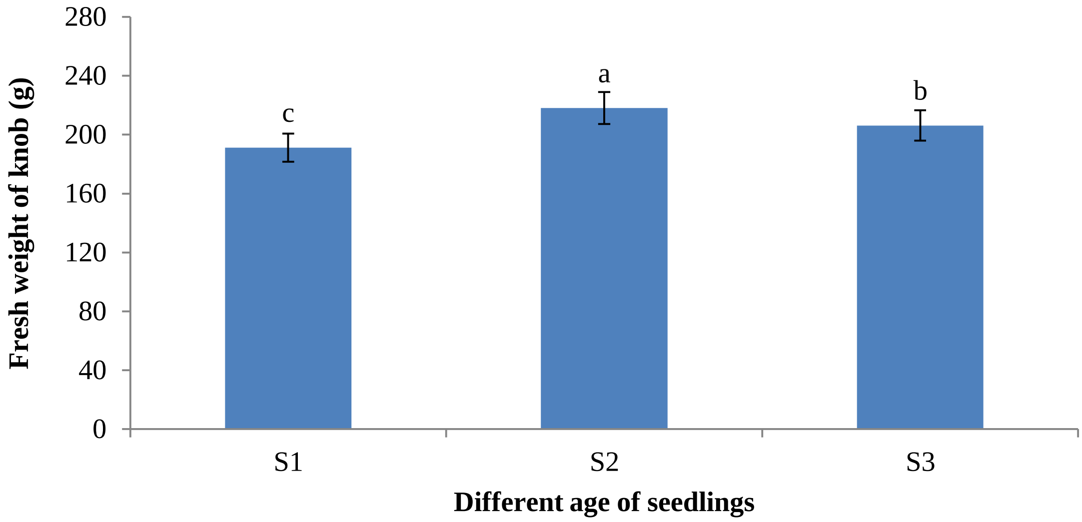

Fig. 6. Effect of different age of seedlings on fresh weight of knob per plant of kohlrabi

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by fresh weight of knob with leaves per plant (Table 14 and Appendix X). From the results of the experiment revealed that the maximum fresh weight of knob with leaves per plant of kohlrabi (259.81 g) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the minimum fresh weight of knob with leaves per plant of kohlrabi (141.90 g) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

4.8 Total weight of plant

Significant variation on total weight of plant of kohlrabi was observed due to different organic and chemical sources of potassium (Fig. 7 and Appendix XVI). The maximum total weight of plant (337.28 g) was obtained from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand the minimum total weight of plant (194.41 g) was obtained from K_1 (100% vermicompost) treatment. It was revealed that the total weight of plant increased with the different organic and chemical sources of potassium as well. Uddin *et al.* (2009) observed the similar result.

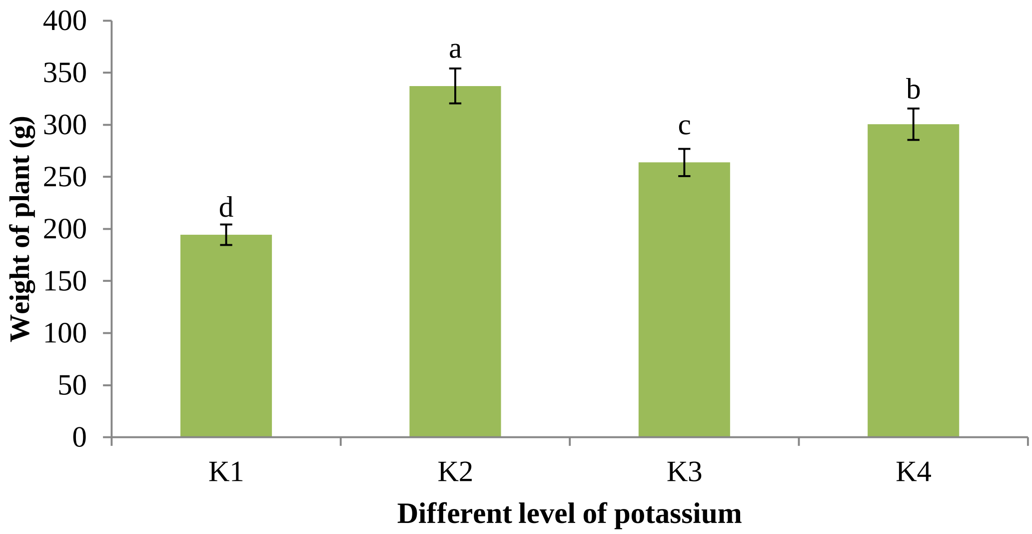

Fig. 7. Effect of different organic and chemical sources of potassium on total weight of plant of kohlrabi

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Marked variation on total weight of plant of kohlrabi was observed due to age of seedlings (Fig. 8 and Appendix XVII). It was revealed that the maximum total weight of plant (291.33 g) was obtained from S_2 (25 days age of seedling) treatment. On the other hand the minimum total weight of plant (262.48 g) was observed from S_1 (20 days age of seedling) treatment. Dhital *et al.* (2018) reported that the similar trends of result. They revealed that knob weight and circumference was significantly higher in 28 days seedling than 14 days seedling.

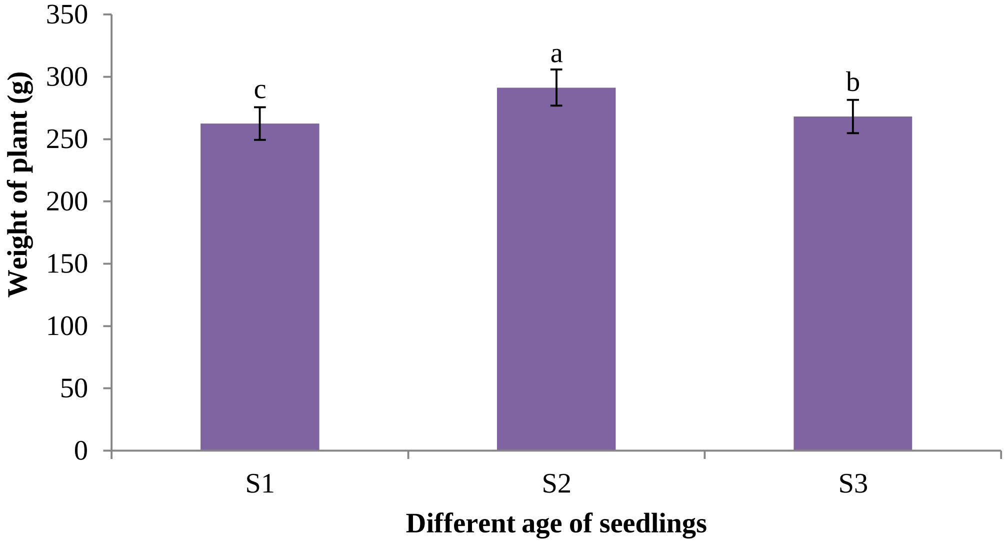

Fig. 8. Effect of different age of seedlings on total weight of plant of kohlrabi

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Marked influence was observed on total weight of plant of kohlrabi due to the combined effect of different organic and chemical sources of potassium and age of seedlings (Table 6 and Appendix X). From the results of the experiment revealed that the maximum total weight of plant of kohlrabi (350.98 g) was observed from the treatment combination K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings). On the other hand the minimum total weight of plant of kohlrabi (177.50 g) was observed from the treatment combination K_1S_1 (100% vermicompost + 20 days age of seedlings).

Table 14. Combined effect of different organic and chemical sources of potassium and age of seedlings on fresh weight of leaves per plant, fresh weight of knob per plant and total weight of plant of kohlrabi

Treatment Combinations	Fresh weight of leaves per plant (g)	Fresh weight of knob per plant (g)	Total weight of plant (g)
K_1S_1	34.50 h	141.90 h	177.50 i
K_1S_2	46.20 g	160.21 g	206.41 h
K_1S_3	41.17 g	152.81 g	199.31 h
K_2S_1	82.51 bc	246.61 b	326.54 bc
K_2S_2	91.17 a	259.81 a	350.98 a
K_2S_3	84.37 b	240.88 bc	334.31 b
K_3S_1	60.68 f	175.61 f	236.29 g
K_3S_2	75.36 d	211.70 d	285.49 e
K_3S_3	71.50 de	198.15 e	269.65 f
K_4S_1	68.80 e	200.84 e	309.58 d
K_4S_2	81.87 bc	240.56 bc	322.43 c
K_4S_3	76.41 cd	233.17 c	269.61 f
$LSD_{(0.05)}$	**6.2478**	**8.4610**	**11.189**
CV(%)	**5.44**	**2.44**	**2.41**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.9 Fresh weight of roots per plant

Statistically significant variation on fresh weight of root per plant of kohlrabi was exerted due to different organic and chemical sources of potassium (Table 15 and Appendix XI). The maximum fresh weight of roots per plant (5.82 g) was observed from K_2 (50% MoP + 50% vermicompost) treatment while the minimum fresh weight of roots per plant (2.89 g) was obtained from K_1 (100% vermicompost) treatment. It was revealed that the fresh weight of roots per plant increased with the different organic and chemical sources of potassium. The result of the experiment was in coincided with the findings of Singh *et al.* (2015).

Marked difference on fresh weight of leaves per plant of kohlrabi was observed due to age of seedlings (Table 16 and Appendix XI). It was revealed that the maximum fresh weight of roots per plant (5.07 g) was obtained from S_2 (25 days age of seedling) treatment. On the other hand the minimum fresh weight of roots per plant (3.86 g) was observed from S_1 (20 days age of seedling) treatment. This result supports the findings of Dhital *et al.* (2018).

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by fresh weight of roots per plant of kohlrabi (Table 17 and Appendix XI). From the results of the experiment revealed that the maximum fresh weight of roots per plant of kohlrabi (6.50 g) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the minimum fresh weight of roots per plant of kohlrabi (2.13 g) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

4.10 Average length of root per plant

Significant influence was observed on average length of root per plant of kohlrabi due to different organic and chemical sources of potassium (Table 15 and Appendix XI). The highest average length of root per plant (7.59 cm) was observed from K_2 (50% MoP + 50% vermicompost) treatment where the lowest average length of root per plant (4.70 cm) was obtained from K_1 (100% vermicompost) treatment. It was revealed that the average length of root per plant increased with the increase of different sources of potassium. The result supports the findings of Hossain *et al.* (2011).

There was marked variation on average length of root per plant of kohlrabi was observed due to age of seedlings (Table 16 and Appendix XI). The highest average length of root per plant (7.37 cm) was obtained from S_2 (25 days age of seedling) treatment. On the other hand the lowest average length of root per plant (5.86 cm) was observed from S_1 (20 days age of seedling) treatment which was statistically identical with S_3 (30 days age of seedling) treatment. Arin *et al.* (2003) observed the similar trends of result.

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by average length of root per plant of kohlrabi (Table 17 and Appendix XI). From the results of the experiment showed that the highest length of root per plant of kohlrabi (8.96 cm) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination which was statistically similar to K_4S_2 (50% vermicompost + 50% mushroom spent compost + 25 days age of seedling) treatment combination. On the other hand the lowest length of root per plant of kohlrabi (4.17 cm) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination which was statistically similar to K_1S_3 (100% vermicompost + 30 days age of seedlings) treatment combination.

4.11 Number of lateral roots per plant

Significant variation was observed on number of lateral roots per plant of kohlrabi due to different organic and chemical sources of potassium under the experiment (Table 15 and Appendix XI). The maximum number of lateral roots per plant (28.93) was obtained from K_2 (50% MoP + 50% vermicompost) treatment where the minimum number of lateral roots per plant (13.36) was observed from K_1 (100% vermicompost) treatment. It was revealed that the number of lateral roots per plant increased with the increase of different sources of potassium. Maurya *et al.* (2008) found the similar results.

Statistically age of seedlings showed significant variation on number of lateral roots per plant of kohlrabi (Table 16 and Appendix XI). It was revealed that the maximum number of lateral roots per plant (26.26) was observed from S_2 (25 days age of seedling) treatment. On the other hand the minimum number of lateral roots per plant (22.97) was observed from S_1 (20 days age of seedling) treatment. Kaymak *et al.* (2004) observed the similar trends in broccoli.

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by number of lateral roots per plant of kohlrabi (Table 17 and Appendix XI). From the results of the experiment showed that the maximum number of lateral roots per plant of kohlrabi (30.85) was achieved from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the minimum number of lateral roots per plant of kohlrabi (10.15) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 15. Effect of different organic and chemical sources of potassium on fresh weight of root per plant, average length of root per plant and number of lateral roots per plant of kohlrabi

Treatments	Fresh weight of root per plant (g)	Average length of root per plant (cm)	Number of lateral roots per plant
K_1	2.89 c	4.70 c	13.36 c
K_2	5.82 a	7.59 a	28.93 a
K_3	4.28 b	6.72 b	27.49 b
K_4	4.86 b	6.77 b	27.97 b
$LSD_{(0.05)}$	**0.5935**	**0.6015**	**0.8925**
CV%	**13.60**	**9.55**	**3.74**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Table 16. Effect of different age of seedlings on fresh weight of root per plant, average length of root per plant and number of lateral roots per plant of kohlrabi

Treatments	Fresh weight of root (g)	Average length of root (cm)	Number of lateral roots
S_1	3.86 c	5.86 b	22.97 c
S_2	5.07 a	7.37 a	26.26 a
S_3	4.46 b	6.11 b	24.09 b
$LSD_{(0.05)}$	**0.5140**	**0.5210**	**0.7729**
CV%	**13.60**	**9.55**	**3.74**

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

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Table 17. Combined effect of different organic and chemical sources of potassium and age of seedlings on fresh weight of root per plant, average length of root per plant and number of lateral roots per plant of kohlrabi

Treatment Combinations	Fresh weight of root per plant (g)	Average length of root per plant (cm)	Number of lateral roots per plant
K_1S_1	2.13 g	4.17 h	10.15 f
K_1S_2	3.60 ef	5.27 fg	16.37 d
K_1S_3	2.95 fg	4.66 gh	13.57 e
K_2S_1	5.10 bcd	7.85 b	27.94 bc
K_2S_2	6.50 a	8.96 a	30.85 a
K_2S_3	5.85 ab	5.97 ef	28.01 bc
K_3S_1	3.80 ef	6.13 def	27.10 c
K_3S_2	4.95 bcd	7.33 bc	28.71 b
K_3S_3	4.10 de	6.69 cde	26.67 c
K_4S_1	4.41 cde	5.28 fg	26.69 c
K_4S_2	5.23 bc	7.93 ab	29.11 b
K_4S_3	4.95 bcd	7.11 bcd	28.11 bc
$LSD_{(0.05)}$	**1.0280**	**1.0419**	**1.5458**
CV(%)	**13.60**	**9.55**	**3.74**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.12 Diameter of knob per plant

Significant variation on diameter of knob per plant of kohlrabi was observed due to different organic and chemical sources of potassium (Fig. 9 and Appendix XVI). The highest diameter of knob per plant (8.55 cm) was obtained from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand the lowest diameter of knob per plant (5.63 cm) was obtained from K_1 (100% vermicompost) treatment. Uddin *et al.* (2009) revealed the similar trends of result.

Marked variation on diameter of knob per plant of kohlrabi was observed due to age of seedlings (Fig. 10 and Appendix XVII). The highest diameter of knob per plant (7.99 cm) was obtained from S_2 (25 days age of seedling) treatment and the lowest diameter of knob per plant (6.82 cm) was observed from S_1 (20 days age of seedling) treatment which was statistically identical with the treatment S_3 (30 days age of seedling). Cristiaini *et al.* (2005) found the similar result in cauliflower. Kaymak *et al.* (2004) reported that curd diameter (6.4 cm) was observed from 30 day-old transplants in cauliflower.

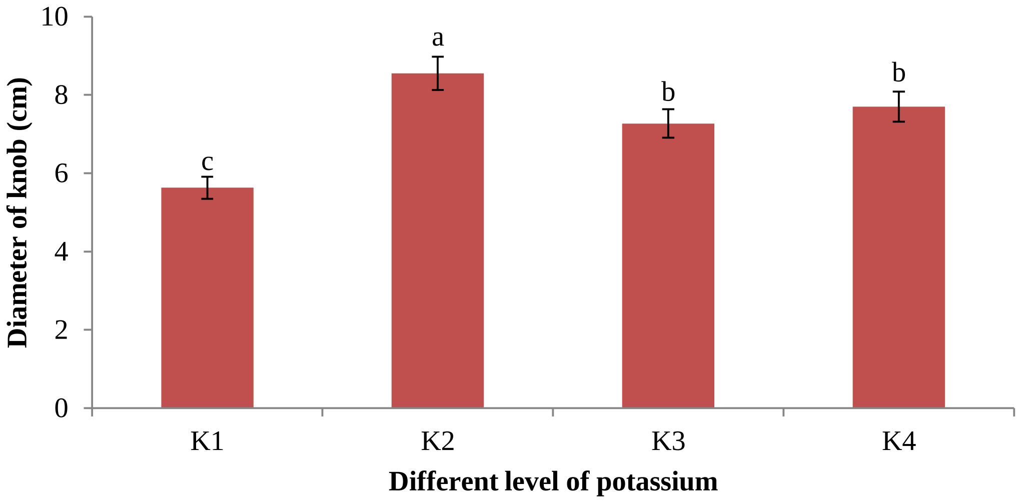

Fig. 9. Effect of different organic and chemical sources of potassium on diameter of knob per plant of kohlrabi

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

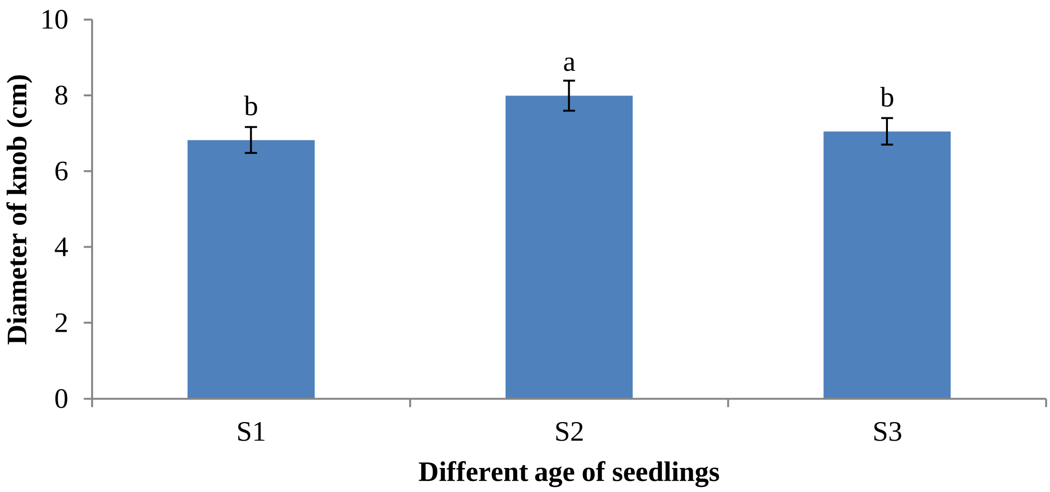

Fig. 10. Effect of different age of seedlings on diameter of knob per plant of kohlrabi

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by diameter of knob per plant of kohlrabi (Table 18 and Appendix XI). From the results of the experiment revealed that the highest diameter of knob per plant of kohlrabi (9.21 cm) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination which was statistically similar to K_4S_2 (50% vermicompost + 50% mushroom spent compost + 25 days age of seedling) treatment combination. The lowest diameter of knob per plant of kohlrabi (5.04 cm) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination which was statistically similar to K_1S_3 (100% vermicompost + 30 days age of seedlings) treatment combination.

Table 18. Combined effect of different organic and chemical sources of potassium and age of seedlings on diameter of knob per plant of kohlrabi

Treatment Combinations	Diameter of knob per plant (cm)
K_1S_1	5.04 h
K_1S_2	6.18 fg
K_1S_3	5.66 gh
K_2S_1	8.04 bc
K_2S_2	9.21 a
K_2S_3	8.41 b
K_3S_1	7.12 de
K_3S_2	8.02 bc
K_3S_3	6.67 ef
K_4S_1	7.07 de
K_4S_2	8.55 ab
K_4S_3	7.47 cd
$LSD_{(0.05)}$	**0.7971**
CV(%)	**6.46**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.13 Dry weight percentage of leaves

Significant variation on dry weight percentage of leaves was observed due to different organic and chemical sources of potassium (Table 19 and Appendix XII). The highest dry weight percentage of leaves (14.53) was obtained from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand the lowest dry weight percentage of leaves (11.40) was revealed from K_1 (100% vermicompost) treatment. This result supports the findings of Sultana *et al.* (2012).

Statistically significant influence on dry weight percentage of leaves was observed due to age of seedlings (Table 19 and Appendix XII). The highest dry weight percentage of leaves (13.84) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the lowest dry weight percentage of leaves (12.00) was observed from S_1 (20 days age of seedling) treatment. This result supports the findings of Cristiaini *et al.* (2005).

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by dry weight percentage of leaves (Table 19 and Appendix XII). From the results of the experiment revealed that the highest dry weight percentage of leaves (15.74) was observed from the treatment combination K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings). On the other hand the lowest dry weight percentage of leaves (10.10) was observed from the treatment combination K_1S_1 (100% vermicompost + 20 days age of seedlings).

4.14 Dry weight percentage of knob

Significant variation on dry weight percentage of knob was observed due to different organic and chemical sources of potassium (Table 19 and Appendix XII). From the results of the experiment showed that the highest dry weight percentage of knob (6.09) from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand the lowest dry weight percentage of knob (4.47) was revealed from K_1 (100% vermicompost) treatment. This result supports the findings of Sultana *et al.* (2012).

Statistically significant influence on dry weight percentage of knob was observed due to age of seedlings (Table 19 and Appendix XII). It was revealed that the highest dry weight percentage of knob (5.91) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the lowest dry weight of knob (4.84) was observed from

S_1 (20 days age of seedling) treatment. This result supports the findings of Cristiaini *et al.* (2005).

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by dry weight percentage of knob (Table 19 and Appendix XII). From the results of the experiment revealed that the highest dry weight percentage of knob (6.96) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the lowest dry weight percentage of knob (4.03) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

4.15 Dry weight percentage of roots

Significant influence on dry weight percentage of roots was observed due to different organic and chemical sources of potassium (Table 19 and Appendix XII). The highest dry weight percentage of roots (30.51) was obtained from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand the lowest dry weight percentage of roots (21.10) was revealed from K_1 (100% vermicompost) treatment. The result was also coincided with the findings of Sultana *et al.* (2012).

Statistically significant influence on dry weight percentage of roots was observed due to age of seedlings (Table 19 and Appendix XII). It was revealed that the highest dry weight percentage of roots (29.18) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the lowest dry weight of roots (25.02) was observed from S_1 (20 days age of seedling) treatment. Cristiaini *et al.* (2005) also observed the similar trends.

Combined effect of different organic and chemical sources of potassium and age of seedlings statistically influenced by dry weight percentage of roots (Table 19 and Appendix XII). From the results of the experiment revealed that the highest dry weight percentage of roots (32.84) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the lowest dry weight percentage of leaves (18.71) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

Table 19. Effect of different organic and chemical sources of potassium and age of seedlings on dry weight percentage of leaves, dry weight percentage of knob and dry weight percentage of roots per plant of kohlrabi

Treatments	Dry weight percentage of leaves	Dry weight percentage of knob	Dry weight percentage of roots
Different level of potassium			
K_1	11.40 c	4.47 c	21.10 d
K_2	14.53 a	6.09 a	30.51 a
K_3	12.57 b	5.21 b	26.97 c
K_4	13.32 b	5.43 b	28.46 b
$LSD_{(0.05)}$	**0.7794**	**0.3729**	**1.1166**
CV%	**6.15**	**7.20**	**4.27**
Different seedling age			
S_1	12.00 c	4.84 b	25.02 c
S_2	13.84 a	5.91 a	29.18 a
S_3	13.03 b	5.15 b	26.08 b
$LSD_{(0.05)}$	**0.6750**	**0.3230**	**0.9670**
CV%	**6.15**	**7.20**	**4.27**
Combinations of potassium and seedling age			
K_1S_1	10.10 e	4.03 g	18.71 h
K_1S_2	11.80 d	5.00 def	23.81 f
K_1S_3	12.31 cd	4.38 fg	20.77 g
K_2S_1	13.45 bc	5.51 bcd	28.20 cd
K_2S_2	15.74 a	6.96 a	32.84 a
K_2S_3	14.41 ab	5.80 bc	30.50 b
K_3S_1	12.51 cd	4.79 ef	24.06 f
K_3S_2	13.41 bc	5.56 bcd	29.51 bc
K_3S_3	11.80 d	5.27 cde	27.34 de
K_4S_1	11.95 d	5.02 def	29.12 bcd
K_4S_2	14.41 ab	6.11 b	30.55 b
K_4S_3	13.61 bc	5.15 de	25.72 ef
$LSD_{(0.05)}$	**1.3500**	**0.6460**	**1.9340**
CV%	**6.15**	**7.20**	**4.27**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.16 Yield per plot

Significant variation on yield per plot was observed due to different organic and chemical sources of potassium (Fig. 11 and Appendix XVIII). From the results of the experiment showed that the highest yield per plot (3.34 kg) from the treatment K_2 (50% MoP + 50% vermicompost). On the other hand the lowest yield per plot (1.91 kg) was revealed from the treatment K_1 (100% vermicompost). The result of the experiment also coincided with the findings of Uddin *et al.* (2009). They reported that the yield of kohlrabi significantly influenced by application of organic manure.

Statistically significant influence on yield per plot was observed due to age of seedlings (Fig. 12 and Appendix XIX). It was revealed that the highest yield per plot (2.82 kg) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the lowest yield per plot (2.63 kg) was observed from S_3 (30 days age of seedling) treatment. Wlazo and Kunicki (2003) also found the similar trends in broccoli. Todorova (2009) reported that highest yield 2546.7 kg ha^{-1} average the period using 30 days transplants in cauliflower. Yarali *et al.* (2007) reported that 30 days is a reasonable target age for transplanting broccoli to have better yield and the oldest transplants reduced yield of broccoli.

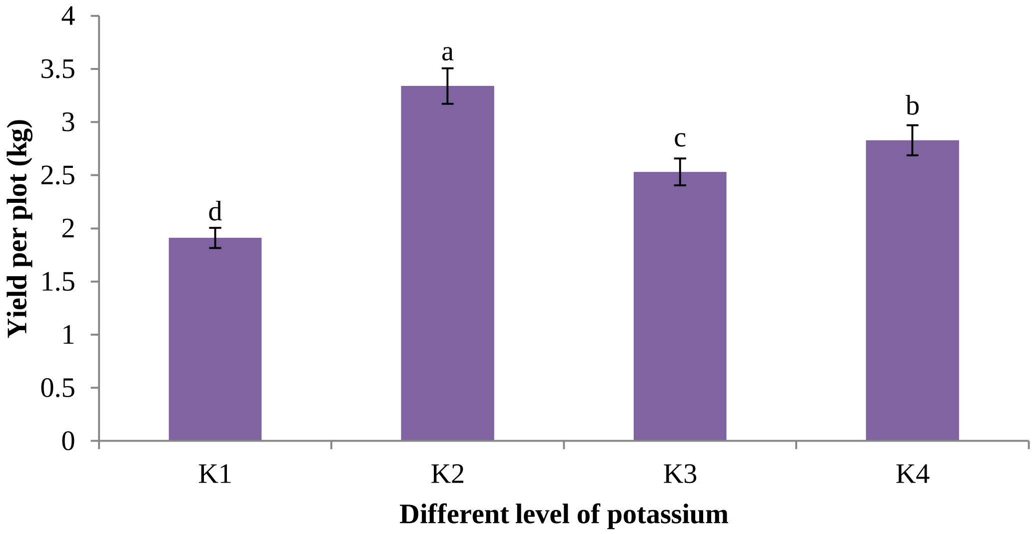

Fig. 11. Effect of different organic and chemical sources of potassium on yield per plot of kohlrabi

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

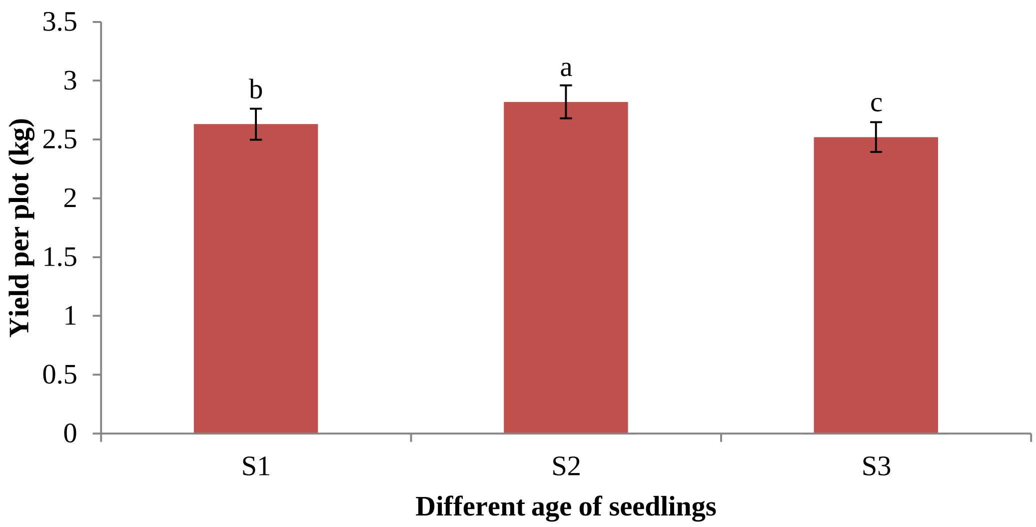

Fig. 12. Effect of different age of seedlings on yield per plot of kohlrabi

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Yield per plot showed marked influence due to the combined effect of different organic and chemical sources of potassium and age of seedlings (Table 20 and Appendix XIII). The highest yield per plot (3.46 kg) was observed from K_2S_2 (50% MP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the lowest yield per plot (1.78 kg) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

4.17 Yield per hectare

Significant variation was observed on yield per hectare due to different organic and chemical sources of potassium (Fig. 13 and Appendix XVIII). The highest yield per hectare (37.15 t) was obtained from K_2 (50% MoP + 50% vermicompost) treatment while the lowest yield per hectare (21.26 t) was revealed from K_1 (100% vermicompost) treatment. Similar trends was also observed by Talukder *et al.* (2013), Choudhary *et al.* (2012), Hossain *et al*. (2011) and Uddin *et al.* (2009).

Statistically significant influence on yield per hectare was observed due to age of seedlings (Fig. 14 and Appendix XIX). It was revealed that the highest yield per hectare (31.33 t) was revealed from S_2 (25 days age of seedling) treatment. On the other hand the lowest yield per hectare (27.97 t) was observed from S_3 (30 days age of seedling) treatment.

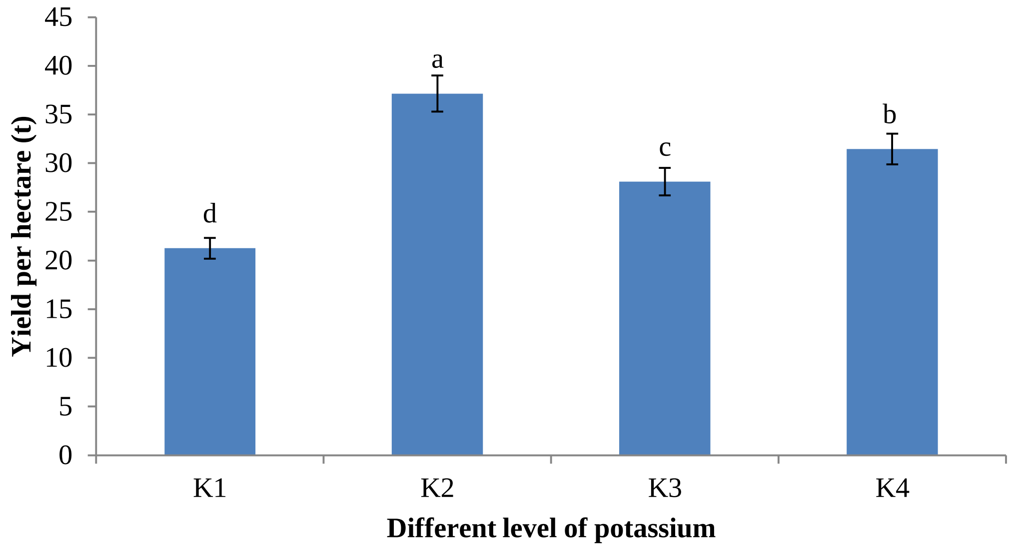

Fig. 13. Effect of different organic and chemical sources of potassium on yield per hectare of kohlrabi

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Fig. 14. Effect of different age of seedlings on yield per hectare of kohlrabi

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Yield per hectare showed marked influence due to the combined effect of different organic and chemical sources of potassium and age of seedlings (Table 20 and Appendix XIII). From the results of the experiment revealed that the highest yield per hectare (38.44 t) was observed from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand the lowest yield per hectare (19.78 t) was observed from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

It may be concluded that, K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination produced higher yield per hectare (38.44 t) over K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination. Because vermicompost contains lower amount of potassium (1.85-2.25%) where MP contains higher amount of potassium (39-61%) which directly related to photosynthesis, sugar translocation, nitrogen metabolism, enzyme activation, stomatal opening, water relation and meristematic tissue growth led higher yield of kholrabi. The result was in agreement with Haque (2000).

Table 20. Combined effect of different organic and chemical sources of potassium and age of seedlings on yield per plot and yield per hectare of kohlrabi

Treatment Combinations	Yield per plot (kg)	Yield per hectare (t)
K_1S_1	1.78 j	19.78 j
K_1S_2	2.04 h	22.67 h
K_1S_3	1.92 i	21.33 i
K_2S_1	3.25 b	36.11 b
K_2S_2	3.46 a	38.44 a
K_2S_3	3.32 b	36.89 b
K_3S_1	2.56 f	28.44 f
K_3S_2	2.75 e	30.56 e
K_3S_3	2.28 g	25.33 g
K_4S_1	2.91 d	32.34 d
K_4S_2	3.03 c	33.67 c
K_4S_3	2.55 f	28.33 f
$LSD_{(0.05)}$	**0.1091**	**1.2118**
CV(%)	**2.43**	**2.43**

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

4.18 Economic analysis

Input costs for land preparation, fertilizer, irrigation and manpower required for all the operations from seed sowing to harvesting of kohlrabi were recorded as per experimental plot and converted into cost per hectare. Price of kohlrabi was considered as per market rate (10,000 Tk. per ton). The economic analysis presented under the following headings-

4.18.1 Gross return

The combination of different organic and chemical sources of potassium and age of seedlings showed different value in terms of gross return under the study (Table 21). The highest gross return (Tk. 384,400) was obtained from the treatment combination K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination and the second highest gross return (Tk. 368,900) was found in K_2S_3. The lowest gross return (Tk. 197,800) was obtained from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination (Table 21).

4.18.2 Net return

Different value of net return was found from different organic and chemical sources of potassium and age of seedlings. Highest net return Tk. 200,800 was obtained from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination and second highest Tk. 191,300 was obtained from treatment combination K_2S_3. On the other hand lowest net return Tk. 55,000 was obtained from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination (Table 21).

4.18.3 Benefit cost ratio

Application of different organic and chemical sources of potassium and age of seedlings exerted the highest benefit cost ratio (2.09) was noted from the combination of K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment and the second highest benefit cost ratio (2.07) was estimated from the combination of K_2S_3 and the lowest benefit cost ratio (1.39) was obtained from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination (Table 21). From economic point of view, it is apparent from the above results that the combination of

K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) was more profitable treatment combination than rest of the combinations.

Table 21. Cost and return of kohlrabi cultivation as influenced by different organic and chemical sources of potassium and age of seedlings

Treatment combinations	Total cost of production (Tk./ha)	Yield (t/ha)	Gross return (Tk./ha)	Net return (TK./ha)	Benefit cost ratio
K_1S_1	142800	19.78	197800	55000	1.39
K_1S_2	148800	22.67	226700	77900	1.52
K_1S_3	146400	21.33	213300	66900	1.46
K_2S_1	174000	36.11	361100	187100	2.06
K_2S_2	183600	38.44	384400	200800	2.09
K_2S_3	177600	36.89	368900	191300	2.07
K_3S_1	159000	28.44	284400	125400	1.79
K_3S_2	160800	30.56	305600	144800	1.90
K_3S_3	152400	25.33	253300	100900	1.66
K_4S_1	163800	32.34	323400	159600	1.97
K_4S_2	168000	33.67	336700	168700	2.00
K_4S_3	157200	28.33	283300	126100	1.80

Selling price= 10,000 Tk. per ton

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was carried out at the "Horticulture Farm" of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during November 2019 to March 2020 to study the effect of different organic and chemical sources of potassium and seedling age at transplant on growth and yield of kohlrabi. The experimental field belongs to the Agro-ecological zone (AEZ) of "The Madhupur Tract", AEZ-28. The soil of the experimental field belongs to the General soil type, Deep Red Brown Terrace Soils under Tejgaon soil series. The experiment consisted of two factors. Factor A: Four organic and chemical sources of potassium *viz*., K_1= 100% vermicompost, K_2= 50% MoP + 50% vermicompost, K_3= 50% MoP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost and Factor B: Three seedling ages *viz.*, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings. There were 12 treatment combinations. The total numbers of unit plots were 36. The size of unit plot was 0.90 m^2 (1 m × 0.9 m). Data on different yield contributing characters and yield were recorded to find out the best organic and chemical sources of potassium and optimum seedling age at transplant for the potential yield of kohlrabi.

Data revealed that in case of different potassium sources, at harvest, the tallest plant height (40.24 cm), maximum number of leaves per plant (16.99), largest leaf length per plant (32.34 cm), largest leaf breadth per plant (13.12 cm), spread of canopy per plant (62.66 cm), fresh weight of leaves per plant (86.02 g), fresh weight of knob per plant (249.10 g), total weight of plant (337.28 g), fresh weight of roots per plant (5.82 g), average length of root per plant (7.59 cm), number of lateral roots per plant (28.93), diameter of knob per plant (8.55 cm), dry weight percentage of leaves (14.53), dry weight percentage of knob (6.09), dry weight percentage of roots (30.51), yield per plot (3.34 kg) and yield per hectare (37.15 t) were obtained from K_2 (50% MoP + 50% vermicompost) treatment. On the other hand, at harvest, the shortest plant height (35.65 cm), minimum number of leaves per plant (11.44), leaf length per plant (27.21 cm), leaf breadth per plant (10.67 cm), spread of canopy per plant (41.57 cm), fresh weight of leaves per plant (40.62 g), fresh weight of knob per plant (151.95 g), total weight of plant (194.41 g), fresh weight of roots per plant (2.89 g), average length of root per plant (4.70 cm), number of lateral roots per plant (13.36), diameter of knob per plant (5.63 cm), dry weight percentage of leaves (11.40), dry weight percentage of knob (4.47), dry weight percentage of roots (21.10), yield per plot (1.91 kg) and yield per hectare (21.26 t) were obtained from K_1 (100% vermicompost) treatment.

Age of seedlings significantly influence the growth, yield contributing characters and yield of kohlrabi. Data revealed that at harvest, the tallest plant height (40.17 cm), maximum number of leaves per plant (16.11), largest leaf length per plant (32.19 cm), largest leaf breadth per plant (13.05 cm), spread of canopy per plant (58.74 cm), fresh weight of leaves per plant (73.65 g), fresh weight of knob per plant (218.07 g), total weight of plant (291.33 g), fresh weight of roots per plant (5.07 g), average length of root per plant (7.37 cm), number of lateral roots per plant (26.26), diameter of knob per plant (7.99 cm), dry weight percentage of leaves (13.84), dry weight percentage of knob (5.91), dry weight percentage of roots (29.18), yield per plot (2.82 kg) and yield per hectare (31.33 t) were obtained from S_2 (25 days age of seedlings) treatment. On the other hand, the shortest plant height (36.05 cm), minimum number of leaves per plant (13.72), leaf length per plant (28.41 cm), leaf breadth per plant (10.94 cm), spread of canopy per plant (52.96 cm), fresh weight of leaves per plant (61.62 g), fresh weight of knob per plant (191.24 g), total weight of plant (262.48 g), fresh weight of roots per plant (3.86 g), average length of root per plant (5.86 cm), number of lateral roots per plant (22.97), diameter of knob per plant (6.82 cm), dry weight percentage of leaves (12.00), dry weight percentage of knob (4.84), dry weight percentage of roots (25.02) were obtained from S_1 (20 days age of seedlings) treatment. But in case of yield per plot (2.63 kg) and yield per hectare (27.97 t) were obtained from S_3 (30 days age of seedlings) treatment.

Combined effect of different organic and chemical sources of potassium and age of seedlings significantly influenced by the growth, yield contributing characters and yield of kohlrabi. Data revealed that at harvest, the tallest plant height (42.93 cm), maximum number of leaves per plant (18.52), leaf length per plant (34.73 cm), leaf breadth per plant (14.38 cm), spread of canopy per plant (65.23 cm), fresh weight of leaves per plant (91.17 g), fresh weight of knob per plant (259.81 g), total weight of plant (350.98 g), fresh weight of roots per plant (6.50 g), average length of root per plant (8.96 cm), number of lateral roots per plant (30.85), diameter of knob per plant (9.21 cm), dry weight percentage of leaves (15.74), dry weight percentage of knob (6.96), dry weight percentage of roots (32.84), yield per plot (3.46 kg) and yield per hectare (38.44 t) were obtained from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination. On the other hand, the shortest plant height (33.12 cm), minimum number of leaves per plant (10.44), leaf length per plant (24.29 cm), breadth of largest leaves per plant (9.05 cm), spread of canopy per plant (36.14 cm), fresh weight of leaves per plant (34.50 g), fresh weight of knob per plant (141.90 g), total weight of plant (177.50 g), fresh weight of roots per plant (2.13 g), average length of root per plant (4.17 cm), number of lateral roots per plant (10.15), diameter of knob per plant (5.04 cm), dry weight percentage of leaves (10.10), dry weight percentage of knob (4.03), dry weight percentage of roots (18.71), yield per plot (1.78 kg) and yield per hectare (19.78 t) were obtained from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

The highest gross return (Tk. 384,400) was obtained from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination and the second highest gross return (Tk. 368,900) was found in K_2S_3 treatment combination. The lowest gross return (Tk. 197,800) was obtained from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination. Highest net return Tk. 200,800 was obtained from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination and second highest Tk. 191,300 was obtained from treatment combination K_2S_3. On the other hand lowest net return Tk. 55,000 was obtained from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination. The highest benefit cost ratio (2.09) was noted from K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) treatment combination and the second highest benefit cost ratio (2.07) was estimated from K_2S_3 treatment combination and the lowest benefit cost ratio (1.39) was obtained from K_1S_1 (100% vermicompost + 20 days age of seedlings) treatment combination.

CONCLUSION

- This study revealed that different organic and chemical sources of potassium and seedlings age at transplant have a positive effect on growth and yield of kohlrabi.
- In case of yield of kohlrabi, the combination of sources of potassium K_2 (50% MoP + 50% vermicompost) along with seedling age S_2 (25 days age of seedlings) were given the better performance of all the yield contributing parameters and yield of kohlrabi than the other treatment combinations.
- In the consideration value for money concept, the treatment combination K_2S_2 (50% MoP + 50% vermicompost + 25 days age of seedlings) was more suitable than the other treatment combination. So, it can be repeated in different agro ecological zones of Bangladesh for better yield and consideration value for money concept.

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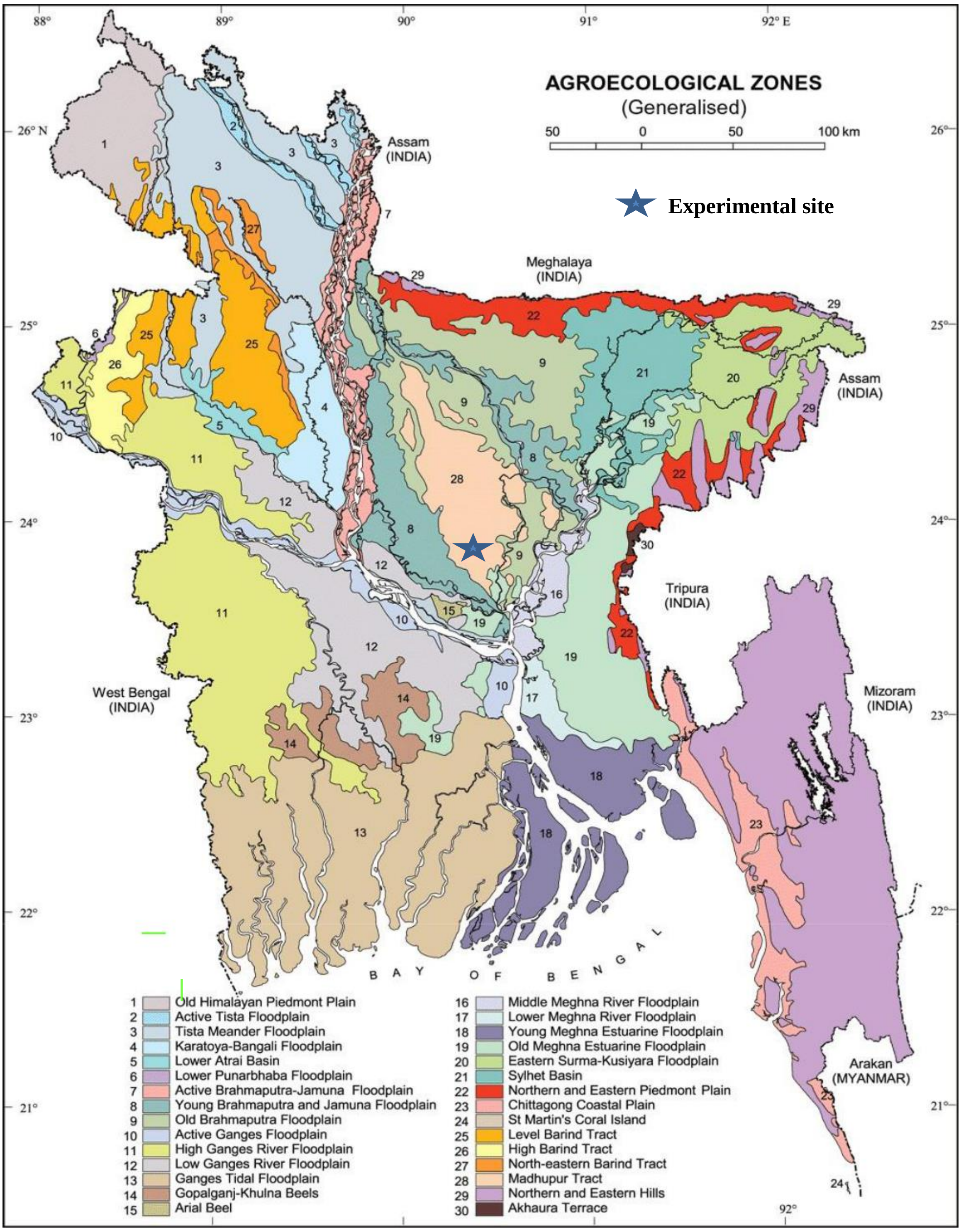
APPENDICES

Appendix I. Agro-Ecological Zone of Bangladesh showing the experimental location



Appendix II. Monthly records of air temperature, relative humidity and rainfall during the period from November 2019 to March 2020

Month and year	RH (%)	Air temperature (°C)			Rainfall
		Max.	*Min.*	*Mean*	(mm)
November, 2019	56.25	28.70	8.62	18.66	14.5
December, 2019	51.75	26.50	9.25	17.87	12.0
January, 2020	46.20	23.70	11.55	17.62	0.0
February, 2020	37.95	22.85	14.15	18.50	0.0
March, 2020	35.75	21.55	15.25	18.40	0.0

Source: Bangladesh Meteorological Department (Climate division), Agargaon, Dhaka-1212.

Appendix III. Characteristics of experimental soil analyzed at Soil Resources Development Institute (SRDI), Farmgate, Dhaka

A. Morphological characteristics of the experimental field

Morphological features	**Characteristics**
Location	Sher-e-Bangla Agricultural University, 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	Not Applicable

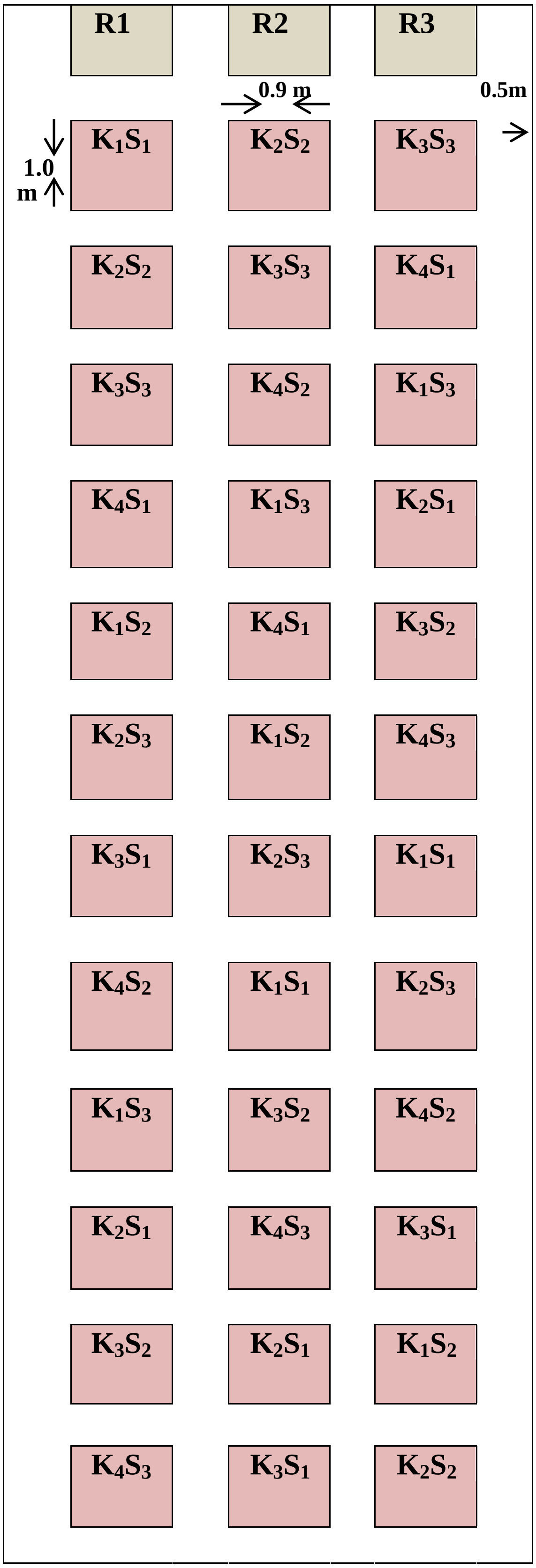
Source: Soil Resource Development Institute (SRDI)

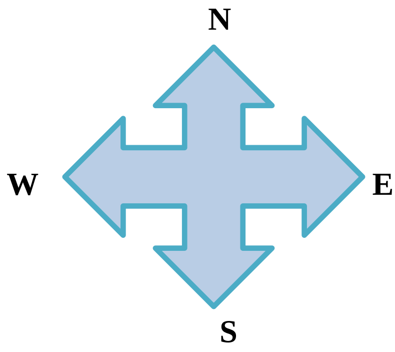
B. Physical and chemical properties of the initial soil

Characteristics	**Value**
Partical size analysis % Sand	27
%Silt	43
% Clay	30
Textural class	Silty Clay Loam
pH	6.2
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20
Exchangeable K (me/100 g soil)	0.1
Available S (ppm)	45

Source: Soil Resource Development Institute (SRDI)

Appendix IV. Layout of the experimental field





Plot size: 1.0 m × 0.90 m

Factor A: Different organic and chemical sources of potassium (4)

K_1= 100% vermicompost

K_2= 50% MoP + 50% vermicompost

K_3= 50% MoP + 50% mushroom spent compost

K_4= 50% vermicompost + 50% mushroom spent compost

Factor B: Age of seedlings (3)

S_1= 20 days age of seedlings

S_2= 25 days age of seedlings

S_3= 30 days age of seedlings

Appendix V. Mean square values of plant height at different days after transplanting of kohlrabi growing under the experiment

Sources of variation	Degrees of freedom	Mean square of plant height at		
		25 DAT	35 DAT	Harvest
Replication	2	0.2689	59.6472	0.3475
Factor A	3	14.9880**	28.1656**	35.1436**
Factor B	2	13.6489**	22.3710**	52.4385**
A × B	6	0.4178**	3.0462**	2.1395**
Error	22	0.8929	1.0206	1.2376

* significant at 5% level of significance
** significant at 1% level of significance

Appendix VI. Mean square values of number of leaves plant^{-1} at different days after transplanting of kohlrabi growing during experimentation

Sources of variation	Degrees of freedom	Mean square of number of leaves plant^{-1} at		
		25 DAT	35 DAT	Harvest
Replication	2	0.00084	2.4202	0.4377
Factor A	3	6.13770**	12.5063**	54.0067**
Factor B	2	2.35369**	7.1163**	18.3123**
A × B	6	0.50743**	1.7254**	0.4491**
Error	22	0.18463	0.4636	0.5349

* significant at 5% level of significance
** significant at 1% level of significance

Appendix VII. Mean square values of largest leaf length plant^{-1} at different days after transplanting of kohlrabi growing during experimentation

Sources of variation	Degrees of freedom	Mean square of largest leaf length plant^{-1} at		
		25 DAT	35 DAT	Harvest
Replication	2	5.797	2.9248	4.0547
Factor A	3	100.967**	73.3756**	43.3054**
Factor B	2	33.800**	38.6742**	43.0004**
A × B	6	1.139**	13.4231**	5.2695**
Error	22	0.571	1.4641	0.9856

* significant at 5% level of significance
** significant at 1% level of significance

Appendix VIII. Mean square values of largest leaf breadth plant^{-1} at different days after transplanting of kohlrabi growing during experimentation

Sources of variation	Degrees of freedom	Mean square of largest leaf breadth plant^{-1} at		
		25 DAT	35 DAT	Harvest
Replication	2	7.4989	2.5720	0.5798
Factor A	3	16.6349**	12.6493**	9.2061**
Factor B	2	10.1789**	17.2083**	13.4023**
A × B	6	0.1512**	0.5464**	0.7882**
Error	22	0.6832	0.5803	0.6964

* significant at 5% level of significance
** significant at 1% level of significance

Appendix IX. Mean square values of spread of canopy per plant at different days after transplanting of kohlrabi growing during experimentation

Sources of variation	Degrees of freedom	Mean square of spread of canopy per plant at	
		25 DAT	Harvest
Replication	2	7.179	56.347
Factor A	3	332.298**	859.862**
Factor B	2	29.944**	101.857**
A × B	6	1.859**	8.478**
Error	22	1.775	3.124

* significant at 5% level of significance
** significant at 1% level of significance

Appendix X. Mean square values of fresh weight of leaves per plant, fresh weight of knob per plant and total weight of plant of kohlrabi growing during experimentation

Sources of variation	Degrees of freedom	Mean square of		
		Fresh weight of leaves per plant	Fresh weight of knob per plant	Total weight of plant
Replication	2	132.05	1103.4	436.0
Factor A	3	3403.51**	15849.4**	33441.7**
Factor B	2	436.09**	2169.8**	2798.5**
A × B	6	10.88**	234.5**	839.6**
Error	22	13.61	25.0	43.7

* significant at 5% level of significance
** significant at 1% level of significance

Appendix XI. Mean square values of fresh weight of root per plant, average length of root per plant, number of lateral roots per plant and diameter of knob per plant of kohlrabi growing during experimentation

Sources of variation	Degrees of freedom	Mean square of			
		Fresh weight of root per plant	Average length of root per plant	Number of lateral roots per plant	Diameter of knob per plant
Replication	2	0.5111	0.1009	62.351	0.1472
Factor A	3	13.4742**	13.6359**	494.049**	13.5852**
Factor B	2	4.3923**	7.9159**	33.545**	4.6366**
A × B	6	0.0996**	2.1456**	3.909**	0.2029**
Error	22	0.3685	0.3786	0.833	0.2216

* significant at 5% level of significance
** significant at 1% level of significance

Appendix XII. Mean square values of dry weight percentage of leaves, dry weight percentage of knob and dry weight percentage of roots of kohlrabi growing during experimentation

Sources of variation	Degrees of freedom	Mean square of		
		Dry weight percentage of leaves	Dry weight percentage of knob	Dry weight percentage of roots
Replication	2	42.0835	1.32734	3.446
Factor A	3	15.5169**	4.01496**	147.293**
Factor B	2	10.1875**	3.63882**	55.975**
A × B	6	1.4913**	0.12458**	7.016**
Error	22	0.6356	0.14553	1.305

* significant at 5% level of significance
** significant at 1% level of significance

Appendix XIII. Mean square values of yield per plot and yield per hectare of kohlrabi growing under the experiment

Sources of variation	Degrees of freedom	Mean square of	
		Yield per plot	Yield per hectare
Replication	2	0.01066	1.316
Factor A	3	3.21047**	396.355**
Factor B	2	0.28213**	34.831**
A × B	6	0.05267**	6.503**
Error	22	0.00415	0.512

* significant at 5% level of significance
** significant at 1% level of significance

Appendix XIV. Effect of potassium sources on plant height at different days after transplanting of kohlrabi

Treatments	Plant height (cm)		
	25 DAT	35 DAT	Harvest
K_1	20.42 c	26.92 c	35.65 d
K_2	23.49 a	31.20 a	40.24 a
K_3	22.45 b	29.50 b	38.64 b
K_4	21.72 b	28.84 b	37.08 c
$LSD_{(0.05)}$	0.9238	0.9876	1.0876
CV%	4.29	3.47	2.94

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

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MP + 50% vermicompost, K_3= 50% MP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Appendix XV. Effect of age of seedlings on plant height at different days after transplanting of kohlrabi

Treatments	Plant height (cm)		
	25 DAT	35 DAT	Harvest
S_1	20.97 c	27.85 c	36.05 c
S_2	23.10 a	30.56 a	40.17 a
S_3	21.99 b	28.94 b	37.48 b
$LSD_{(0.05)}$	0.8000	0.8553	0.9419
CV%	4.29	3.47	2.94

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

Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Appendix XVI. Effect of potassium sources on fresh weight of leaves per plant, fresh weight of knob per plant, total weight of plant and diameter of knob per plant of kohlrabi

Treatments	Fresh weight of leaves per plant (g)	Fresh weight of knob per plant (g)	Total weight of plant (g)	Diameter of knob per plant (cm)
K_1	40.62 d	151.64 d	194.41 d	5.63 c
K_2	86.02 a	249.10 a	337.28 a	8.55 a
K_3	69.18 c	195.15 c	263.81 c	7.27 b
K_4	75.69 b	224.86 b	300.54 b	7.70 b
$LSD_{(0.05)}$	3.6072	4.8850	6.4598	0.4602
CV%	5.44	2.44	2.41	6.46

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, $K_{1=}$ 100% vermicompost, K_2= 50% MP + 50% vermicompost, K_3= 50% MP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Appendix XVII. Effect of age of seedlings on fresh weight of leaves per plant, fresh weight of knob per plant, total weight of plant and diameter of knob per plant of kohlrabi

Treatments	Fresh weight of leaves per plant (g)	Fresh weight of knob per plant (g)	Total weight of plant (g)	Diameter of knob per plant (cm)
S_1	61.62 c	191.24 c	262.48 c	6.82 b
S_2	73.65 a	218.07 a	291.33 a	7.99 a
S_3	68.36 b	206.25 b	268.22 b	7.05 b
$LSD_{(0.05)}$	3.1239	4.2305	5.5943	0.3986
CV%	5.44	2.44	2.41	6.46

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Appendix XVIII. Effect of potassium sources on yield per plot and yield per hectare of kohlrabi

Treatments	Yield per plot (kg)	Yield per hectare (t)
K_1	1.91 d	21.26 d

K_2	3.34 a	37.15 a
K_3	2.53 c	28.11 c
K_4	2.83 b	31.45 b
$LSD_{(0.05)}$	0.0630	0.6996
CV%	2.43	2.43

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, $K_{1=}$ 100% vermicompost, K_2= 50% MP + 50% vermicompost, K_3= 50% MP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

Appendix XIX. Effect of age of seedlings on yield per plot and yield per hectare of kohlrabi

Treatments	Yield per plot (kg)	Yield per hectare (t)
S_1	2.63 b	29.17 b
S_2	2.82 a	31.33 a
S_3	2.52 c	27.97 c
$LSD_{(0.05)}$	0.0545	0.6059
CV%	2.43	2.43

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
Here, S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

Appendix XX. Production cost of kohlrabi per hectare

A. Input cost (Tk./ha)

Treatment combinations	Labor cost (Tk.)	Ploughing cost (Tk.)	Seed cost (Tk.)	Insecticide cost (Tk.)	Irrigation cost	Manures and fertiliz	Subtotal (Tk.)

					(Tk.)	er cost (Tk.)	
K_1S_1	24000	15000	5000	4000	10000	16000	74000
K_1S_2	24000	15000	5000	4000	10000	21000	79000
K_1S_3	24000	15000	5000	4000	10000	19000	77000
K_2S_1	24000	15000	5000	4000	10000	42000	100000
K_2S_2	24000	15000	5000	4000	10000	50000	108000
K_2S_3	24000	15000	5000	4000	10000	45000	103000
K_3S_1	24000	15000	5000	4000	10000	29500	87500
K_3S_2	24000	15000	5000	4000	10000	31000	89000
K_3S_3	24000	15000	5000	4000	10000	24000	82000
K_4S_1	24000	15000	5000	4000	10000	33500	91500
K_4S_2	24000	15000	5000	4000	10000	37000	95000
K_4S_3	24000	15000	5000	4000	10000	28000	86000

Labor cost: 400 Tk. per person Seed cost: 3500 Tk. per kg

B. Overhead cost (Tk./ha)

Treatment combinations	Cost of lease of land for 6 months	Miscellaneous cost (Tk. 5% of the input cost)	Interest running capital for 6 months (Tk. 15% of cost/year	Subtotal (Tk.) (B)	Total cost of production (Tk./ha) [Input cost (A)+ overhead cost (B)]
K_1S_1	54000	3700	11100	68800	142800
K_1S_2	54000	3950	11850	69800	148800
K_1S_3	54000	3850	11550	69400	146400
K_2S_1	54000	5000	15000	74000	174000
K_2S_2	54000	5400	16200	75600	183600
K_2S_3	54000	5150	15450	74600	177600
K_3S_1	54000	4375	13125	71500	159000
K_3S_2	54000	4450	13350	71800	160800
K_3S_3	54000	4100	12300	70400	152400
K_4S_1	54000	4575	13725	72300	163800
K_4S_2	54000	4750	14250	73000	168000
K_4S_3	54000	4300	12900	71200	157200

Labor cost: 400 Tk. per person Seed cost: 3500 Tk. per kg

Here, $K_{1=}$ 100% vermicompost, K_2= 50% MP + 50% vermicompost, K_3= 50% MP + 50% mushroom spent compost and K_4= 50% vermicompost + 50% mushroom spent compost

S_1= 20 days age of seedlings, S_2= 25 days age of seedlings and S_3= 30 days age of seedlings

SOME PICTORIAL VIEW DURING EXPERIMENTATION

Plate 1. Photograph of experimental plot

Plate 2. Photograph of harvested kohlrabi during data collection (Treatment wise)

Plate 3. Photograph of harvested kohlrabi knob with leaves

Plate 4. Photograph of harvested kohlrabi knobs