GROWTH AND YIELD OF FOUR SESAME VARIETIES UNDER VARYING LEVELS OF POTASSIUM

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CERTIFICATE

This is to certify that thesis entitled, "Growth and yield of four sesame varieties under varying levels of potassium" 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 AGRONOMY****, embodies the result of a piece of bona fide research work carried out by Md. Mahbubul Alam, Registration No.: 18-09245 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Dated: December, 2020
Place: Dhaka, Bangladesh

(Professor Dr. Md. Shahidul Islam)
Supervisor

Dedicated to My Beloved

Father Moinul Haque

and

Mother Farida Khatun

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ABSTRACT

An experiment was conducted at Sher-e-Bangla Agricultural University farm, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from March to July, 2019 to determine the effect of potassium and variety on growth and yield of sesame. The experiment consisted of two factors having 3 levels of potassium (30, 37.5 and 45 kg K_2O ha^{-1}) as factor-A and 4 varieties (BARI Til 3, BARI Til 4, Binatil 3, Binatil 4) as factor-B, which are laid out in Spilt Plot design with three replications. Relative water content, total dry matter weight, capsule length, seed per capsule, 1000-seed weight, seed yield and harvest index were varied significantly with increasing K level up to 37.5 kg K_2O ha^{-1} (K_2). The seed yield and harvest index were 1.16 t ha^{-1} and 22.91%, respectively when applied 37.5 kg K_2O ha^{-1}. But the highest stover yield (3.94 t ha^{-1}) was recorded with 30 kg K_2O ha^{-1}. On the other hand, relative water content, leaf dry weight, total dry matter weight, capsule number, capsule length, 1000-seed weight, seed weight per plant, seed yield and stover yield were increased significantly in V_2 (BARI Til 4). The maximum seed yield (1.09 t ha^{-1}) and stover yield (4.02 t ha^{-1}) was observed at V_2 (BARI Til 4). The highest seed yield was recorded from the combination of K_2V_2 (37.5 kg K_2O ha^{-1} and BARI Til 4) and the combination of K_1V_1 (30 kg K_2O ha^{-1} and BARI Til 3) produced the highest stover yield.

LIST OF ABBREVIATED TERMS

ABBREVIATION	FULL NAME
AEZ	Agro-Ecological Zone
et al.	and others
BBS	Bangladesh Bureau of Statistics
cm	Centimeter
^{0}C	Degree Celsius
DAS	Days After Sowing
etc	Etcetera
FAO	Food and Agriculture Organization
g	Gram
ha	Hectare
hr	Hour
kg	Kilogram
m	Meter
mm	Millimeter
Mo	Month
MoP	Muriate of potash
no.	Number
%	Per cent
m^2	Square meter
TSP	Triple super phosphate

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CHAPTER I

INTRODUCTION

Sesame is known to 'the queen of oils' for outstanding cosmetic and skincare characteristics. Sesame (*Sesamum indicum* L.) is a member of the family Pedaliaceae (Wang *et al.,* 2012). Sesame probably originating in Asia or East Africa is considered to be one of the ancient crops widely grown in tropics and subtropics (Kafiriti and Mponda, 2013). Sesame is deeply rooted and well adapted to dry conditions. The crop is grown under a variety of environments, possibly affecting its efficiency (Purseglove, 1978). Sesame is grown extensively in Asia and Africa (Johnson *et al.,* 1979). Sesame is estimated to rank eighth on the world market for oilseed crops (Bodoira *et al.,* 2017). India, Sudan, China, Myanmar, and Tanzania constitute 80 percent of world production. The main users are China, India, Taiwan, Vietnam and Mexico (FAO, 2018). Sesame derives its value from the fact that it is a food crop, an industry raw material, livestock feed and an export crop (Purseglove, 1978).

Sesame has excellent qualities such as drought tolerance, high oil content, a short (90 day) growing season, a 350 Mb diploid genome and a broad coefficient of propagation (3000-10,000 seeds per plant) (Wei *et al.,* 2017) Sesame seeds are rich in oil (50%) and protein (20%–25%), and the remainder are composed of mineral ash (6%), crude fiber (4.5%), oxalates (2.5%), and liquefiable carbohydrates and phytate (12.5%) (Johnson *et al.*, 1979). The oil usually contains 35 percent monounsaturated fatty acids and 44 percent polyunsaturated fatty acids (Hansen, 2011). Seeds also have a wide range of phenolic compounds with heavy antioxidant activity (Bodoira *et al.,* 2017). Ryu *et al.* (1992) reported that sesame oil contains *sesamolin* and sesame that is used as insecticide synergist and the oil, which contains a high content of oleic (47%) and linoleic (39%), does not turn rancid unlike other edible oils due to the presence of an antioxidant. Sesame oil is used mainly as edible oil. It is also used for salad and margarine and for the manufacture of soaps, paints, perfumes, pharmaceuticals and insecticides. Sesame seeds aroma and taste are mild and nut-like. Upon backing, decorated seeds are often dotted with different roles (Metkalf and Elkins, 1980). Sesame oil cake is a very good feed for cattle as it contains high biological value, protein and large phosphorus and potassium amounts, also cake is used as manure (Malik *et al.*, 2003).

In Bangladesh, sesame is the fourth-largest source of edible oil after mustard, soybean and groundnut. The oil seed occupied 5.5% of total cropped area. Among these mustards covered 60.9%, sesame covered 7.7%, groundnut covered 8% and soybean covered 14.1% (BBS, 2019). In 2018-19, sesame covered an area of 84,526 acres in Bangladesh with a total production of 31,613 metric ton (BBS, 2019).

Sesame is grown in all regions of Bangladesh. In Bangladesh, agro-ecological situation is favorable for this crop, too. For being a short duration crop, it's grown in both the Kharif (summer) and rabi (winter) seasons and suitable to grow in different cropping sequence. But in Bangladesh, it is one of the most important oilseed crops that are cultivated mainly during the Kharif season (Mid-February to June).

The crop is grown in wide range of environment extending from semi-arid tropics and sub-tropics to temperate region. For optimum production, sesame needs a constant, high temperature ranging from 26 to 30°C. Sesame needs minimum rainfall of 300–400 mm (Carlsson *et al.*, 2008). In this country, black and brown colored sesame seeds are traditionally grown. The area of Khulna, Faridpur, Pabna, Barisal, Rajshahi, Jashore, Cumilla, Dhaka, Patuakhali, Rangpur, Sylhet and Mymensingh are major sesame producing region in

Bangladesh (BARI, 2004). In Bangladesh, the yield per unit area is lowest compared to other countries in the world. Sesame yield in Bangladesh 927 $kgha^{-1}$, Colombia 1000 $kgha^{-1}$, China 1395 $kgha^{-1}$, Nigeria 1062 $kgha^{-1}$, Egypt 1294 $kgha^{-1}$, Italy 1579 $kgha^{-1}$ (FAO, 2018).

The yield and quality of seeds of sesame are poor in Bangladesh. The low yield which is about 0.924 ton per hectare national average of sesame in Bangladesh (BBS, 2019). Nevertheless, this is not an indication of this crop's low yield capacity, but may be due to a number of reasons, viz. lack of high-yielding quality seed, poor fertilizer management, disease and insect infestation, and cultivar susceptibility to water-logging along with inadequate irrigation facilities. Deficiency in soil nutrients is now seen as one of the major constraints of upland crop production in Bangladesh (Islam and Noor, 1982). To attain considerable production and quality yield for any crop it is necessary to proper management ensuring the availability of essential nutrients in proper doses. In general, a large amount of fertilizer is required for vegetable crop growth and development (Opena *et al.*, 1988). The specific reason identified for the low yield of sesame in Bangladesh is due to its cultivation under marginal and sub-marginal lands without giving the importance of the choice of high yielding varieties, nutrient management, and new agro practices. Fertilization is the most important factor deciding the yield of sesame among management practices (Subramanyam and Arulmozhi, 1999). Long-term studies have shown a decline in efficiency in the absence of potash treatment.

Potassium is one of the essential nutrients and the presence of an adequate amount of K in the soil can enhance growth, yield and quality of cotton (Pettigrew, 2008) by improving the effectiveness of photosynthesis process, resistance to diseases, and water utilization efficiency (Jiang *et al.* 2011). Some studies indicated that plant K availability was related to soil water content, which highly influenced the mass flow and diffusion rates of K in soils (Doussan *et al.* 2003). In crop production, potassium is referred to as the ‘price factor’. It contributes to the production of a good and stable root system and to the productivity of other nutrients. Potassium plays an important role in the activation of enzymes and resistance to cold, disease, water stress, and other adverse conditions. Potassium is essential for the production of adenosine triphosphate (ATP). ATP is an important source of energy for many chemical processes which occur in plant problems. Potassium plays an important role in water control (osmoregulation) in plants. Both uptakes of water through plant roots and its loss through the stomata are affected by potassium. A strong positive relationship between K fertilizer input and grain yield has been shown (Pettigrew, 2008). Excessive K levels, however, responsible for deficiencies in other nutrients such as magnesium and calcium.

On the basis of the above facts, the present study was undertaken to maximize the seed yield of sesame with K fertilizer with the following objectives:

i. To find out the effect of K on the growth and yield of sesame.
ii. To observe the effect of variety on yield maximization in sesame.
iii. To find out the suitable combination of sesame variety and K level for better growth and yield.

CHAPTER II

REVIEW OF LITERATURE

In Bangladesh and in many countries of the world, sesame is an important and most valuable oil crop. The crop has conventional less attention by the researchers on various aspects because normally it grows without care or management practices. Based on this very few research works related to growth, yield and development of sesame have been carried out in our country. Optimum K fertilizers play an important role in improving sesame yield. But research works related to K fertilizer on sesame are limited in Bangladesh. Some of the significant and insightful research results relevant to sesame K have, however, been reviewed in this chapter under the following headings.

2.1 Effect of potassium

A field test was carried out at Agronomy Research Farm, Agricultural University Peshawar, Khyber Pakhtunkhwa during Kharif season, 2017 by Ahmad *et. al.* (2018). It shows that the amount of K significantly increased the yield characteristics, such as plant height, number of branches per plant, number of capsules per plant, capsule length, seeds number per capsule, 1000 seed weight. The application of K i.e. 50 kg K_2O ha^{-1} contributed maximum plant height, higher number of capsules per plant, length of capsule and thousand seed weight, maximum seed and stover yield.

Balamurughan and Venkatesan (1983) in Bhavanisagar taken field trials during summer and winter season on two soils, the results revealed that fertilizer application @ 30 kg K_2O ha^{-1} was the best for increasing branching, capsule number and seed yield as well as net returns in sesame.

A field experiment was conducted by Bhosale (2009) on medium black calcareous soil at the instructional farm, Junagadh Agricultural University (Gujrat) during the kharif season of 2008 to study the effect of varying levels of K viz., no potash, 25, 50 kg K_2O ha^{-1} on growth and yield of sesame. He reported that significantly higher plant height (90.71 cm), number of branches per plant (3.43), number of capsules per plant (39.17), number of seed per capsule (57.13) and test weight (2.96g) as well as seed (813 kg ha^{-1}) and stover yield (1165 kg ha^{-1}) of sesame was obtained with application of 50 kg K_2O ha^{-1}.

Dasamahapatra *et al.* (1990) conducted studies at Mohanpur (West Bengal) indicated that there was a positive correlation (r = 0.99) between the levels of K and yield of sesame and K fertilization had significant influence on the growth parameters viz., number of branches, dry matter accumulation and yield attributes viz., seed yield, oil content. Further, the favorable influence of K on these was observed with K application @ 80 kg K_2O ha^{-1}. The highest number of capsules was observed with K application @80 kg K_2O ha^{-1}.

Jadav *et al.* (2010) conducted a field experiment on medium black calcareous soil at Agronomy Research Farm, Junagadh Agricultural University, Junagadh. They observed that the increase in level of K significantly increased the plant and yield attributing characters like plant height, number of branches per plant, number of capsules per plant, length of capsule, seed number per capsule, 1000-seed weight of sesame. The application of 40 kg K_2O ha^{-1} gave higher number of capsules per plant, length of capsule and 1000-seed weight. However, it was at par with 20 and 60 kg K_2O ha^{-1} in respect of all yield attributing characters.

A study was conducted by Jat *et al.* (2017) at the Agronomy farm, S.K.N. College of Agriculture, Jobner, Rajasthan. The plant and yield attributing characters like as plant height, number of branches per plant, number of capsules per plant, number of seeds per capsule and 1000-seed test weight rise in K levels by up to 50 kg of K_2O ha^{-1} was substantially different. Treatment K_{50} was equivalent to treatment K_{75}, with a substantial maximum seed yield of 818 q ha^{-1} and stalk yield of 1199 q ha^{-1} over control. The percent increase in seed yield of crop was recorded as 27.81 percent and stalk yield 23.22 percent higher over control with the application of K @ 50 kg K_2O ha^{-1} (K_{50}).

Khan *et al.* (2004) carried out an experiment to assess the influence of different levels of K fertilization on seed yield of canola. The results showed that with K @ 150 kg/ha, the highest seed yield was achieved, which was, however, at par with treatments where 50, 75, 100 and 125 kg K ha^{-1} were applied while the minimum seed yield was recorded in case of control.

Lal *et al.* (1995) revealed that seed yield of sesame was recorded significantly higher under application of K @ 60 kg ha^{-1} as compared to control on silty clay-loam soil.

Mandal *et al.* (1990) reported that the significantly higher seed yield was obtained with application of K @ 60 kg K_2O ha^{-1} as compared to 20, 40, 80 kg K_2O ha^{-1}.

Majumdar *et al.* (1988) observed that K application @ 60 kg K_2O ha^{-1} to lateritic acidic soil was found beneficial in increasing the plant height, number of branches per plant, number of seeds per capsule, 1000-seed weight and seed yield of sesame.

In a field experiment on mustard cv. RW-351, sesame cv. B-67 and groundnut cv. JL-24 were applied 0-80 kg K_2O ha^{-1} at Kalyani, West Bengal. Sesame seed yield increased with increasing K rate, while seed yield of mustard and pod yield of groundnut were higher with application of 60 kg K_2O ha^{-1} (Mondal *et al.*, 1997).

In an experiment conducted by Mekki (2015) National Research Centre, Dokki (Egypt) to study the yield and yield components of groundnut in response to soil and foliar application of K. It was reported that plant height, number of pods per plant, LAI, highest pod weight, number of pods per plant, seed yield and number of seeds per pod were highest with the combined application of foliar and soil applied K at rate of 1% spray and 35 kg K per hectare as basal application.

In Zahak, Iran, Mollashahi *et al.* (2013) carried out an experiment to research the impact of different doses of N and K on sunflower yield and yield components. Result showed that the seed yield and biological yield significantly higher with 150 kg K.

Rajiv *et al.* (2012) at Kanpur a field conducted study and observed that increasing K_2O level up to 30 kg ha^{-1} resulted in significantly higher seed yield, yield attributes and growth parameters except 1000-seed weight was not greatly affected by the application of K.

A field experiment was carried out at Joydebpur in the early summer season of 1991-92 by Roy *et al.* (1995) and they reported that the seed yield of sesame was increased with applied K, with no significant difference between application rates of 33.2 and 66.4 kg K ha^{-1}.

Sarkar and Pal (2005) conducted a field experiment in gangetic alluvial soil in Baruipur, West Bengal during the summer seasons of 2001 and 2002 and noted that higher fertility with application of 49.8 kg K ha^{-1} increased the growth parameters viz., leaf area index, biomass production, crop growth rate, relative growth rate, net assimilation of sesame. They also found that application of 75 kg N along with 25.8 kg P and 49.8 kg K ha^{-1} increased yield attributes and finally seed yield of sesame than lower levels of fertility.

Shehu *et al.* (2010), during the dry spell of 2005, conducted a pot experiment to test N, P and K nutrition on the productivity of sesame (*Sesamum indicum* L.) in the screen house at the FAO/TCP farm of Adamawa State University, Mubi. They reported that K fertilizer application had significant influence on the plant height, number of leaves and number of pods per plant. The number of branches, number of seeds per pod, seed yield and yield of dry matter were not significantly affected by the application of K fertilizer. Application of K at 45 kg ha^{-1} significantly retard plant height than control.

Singh *et al.* (1997) found that the order of yield response to K was sesame, linseed, mustard. The yields were increased more by K_2SO_4 than KCl. In general, yields increased up to 90 kg K ha^{-1} and then yield decreased.

A field trial was conducted at Kanpur (Uttar Pradesh) during the kharif season in 2000 to investigate the effects of K at 0, 20, 40 and 60 kg ha^{-1} on the growth and yield of groundnut. The effects of K on dry matter accumulation were measured at 40, 80 and 120 DAS. Increasing K rate resulted in increasing total dry matter per plant (Saxena *et al.*, 2003).

An experiment carried out by Thakur *et. al.* (2015) at Jagdalpur (Chhatisgarh) revealed that the application of potassium fertilizer at 30 kg K ha^{-1} reported significantly higher plant height, number of branches and leaves than the rest of the K levels during both years of experimentation.

Thakur and Patel (2004) found that an application of 24.9 kg K ha^{-1} significantly increased the yield attributes and seed yields as compared to application of 12.4 kg K ha^{-1}. On an average, the application of 24.9 kg K ha^{-1} resulted in seed yield of 583 kg ha^{-1}.

Vaghani et al. (2010) performed a field experiment on clayey soil at Amreli (Gujrat) and recorded that both K levels (40 and 80 kg/ha) increased plant height, number of branches per plant, number of capsules per plant, 1000-seed weight and sesame seed and stock significantly over no K application.

2.2 Effect of variety

Golla (2020) conduct a field experiment at Zuria-Dansha, in optimum moisture areas of western Tigray to evaluate yield performance of sesame varieties at different levels of plant population. The result revealed that varieties and plant population significantly differed in yield and yield related traits. The variety Gida-Ayana recorded maximum fertile capsules per plant, thousand seed weight, seed per capsule and oil content (%) while the local variety Hirhr recorded the least.

Two field experiments were conducted by Ali *et al.* (2020) in 2014-2015 and 2015-2016. Three varieties were planted at four rows spacing [5(control), 10, 20 and 30cm]. There were significant differences between row spacing, varieties and interaction between row spacing and varieties for all parameters except the 1000-seeds weight. Moreover, Abo Nama variety has recorded the highest plants, number of branches and number of capsules per plant, while the abo Radom recorded the highest number of seeds per capsule and seed yield, and abo sofa had the highest weight of 1000 seeds.

To gauge new sesame varieties under field condition, an experiment was conducted by Ismaan *et al.* (2020) during the summer (Hagaa) season (July-September) 2016 at the experimental farm of Somali Agriculture Technical Group (SATG), Afgoye, Somalia. Yield and yield contributing characters of the varieties were observed during the trial. A complete of six sesame varieties were used for the trial. The new varieties were Setit, Yemeni variety, Nigerian variety, Humeera, and Abasen while the local variety was used as a control. Results from the experiment revealed that plant height, number branches, number of capsules , capsule length, capsule height, seed yield and Straw yield were significantly different among varieties. The tallest plant height (95.25 cm) was found in local variety while all-time low plant height (67.00 cm) was observed in Abasena variety. It had been observed that Local and Yemen had the foremost branches plant (4.25) while the lowest number of branches plant was found in Setit variety (3.00). It had been also witnessed that Nigerian variety showed the very best number of capsules Plant while Abasena variety gave lowest Number of capsules Plant (30.50). The very best capsule length was found in Humera and Setit varieties (3.50 cm) while the lowest capsule length was found in Abasena variety (2.75 cm). The very best first capsule height was detected at Local variety (47.00 cm) while the lowest first capsule height was found at Humera variety (24.00 cm). It had been detected that Yemen variety showed the absolute best yield (1877 kg ha^{-1}). The remarkable growth and yield performance of sesame from summer season (Hagaa) trial was observed at Yemeni varieties. Those variety overall showed significant growth and yield and appear to be promising variety for the country.

Kashani *et al.* (2015) conduct a study to evaluate the "Response of various sesame (*Sesamum indicum* L.) varieties under the influence of nitrogen and phosphorus doses'' was carried out at Oilseeds Section, Agriculture Research Institute, Tandojam during Kharif 2013. Among sesame varieties, S-17 resulted in maximum plant height (91.89 cm), branches plant (15.11), capsules plant (37.06), seeds capsule (50.56), seed weight plant (32.00 g), seed index (2.63 g) and seed yield (682.11 kg ha^{-1}), whereas variety Pr-125 resulted in minimum traits, particularly seed yield (657.56 kg ha^{-1}).

Field experiment was carried by Kumar *et al.* (2016) during the kharif season 2013 and 2014 at Agricultural Research Farm of ICAR Nagaland Centre, Jharnapani to evaluate the growth and yields potential of 14 sesame lines. Result indicated that significant variations were observed in growth and yield attributes of sesame lines during the experimentation. All the sesame lines showed the better performance and produced outstanding seed yield as compared to local lines (check). However, the sesame lines IAVT-14-1 produced significantly higher seed yield (708.33 kg ha^{-1}) as compared to the other lines.

Field experiment was conducted by Naim *et al.* (2012) to determine the effects of four different seed rates on the growth, yield and yield components of three sesame varieties. Three varieties of sesame (*Sesamum indicum* L), Elobeid1, Promo (recently improved cultivars) and Hirhri (an old traditional cultivar) were used. The three cultivars had relative similarities in final seed yield (ton ha^{-1}).

Balasubramaniyan *et al.* (1995) observed that Sesamum varieties displayed substantial differences in growth characteristics; TMV 3 grew taller and developed more dry matter plant^{-1} among the two varieties tested (TMV 3 and VS350), but VS 350 produced a greater number of plant branches^{-1} compared to TMV 4.

The growth characters of Sesamum varieties viz., Punjab1, T85, Phule 1 were observed by Patil *et al.* (1990) and showed significant variations between the varieties in mean plant height, number of leaves plant^{-1} and dry matter plant^{-1}.

Valiki *et al.* (2015) performed a field experiment to analyse the effects of plant density on the growth and yield of three sesame cultivars (*Sesamum indicum* L.). The Yekta cultivar was the best for plant height among the three sesame cultivars (Naz, Yekta and Oltan). The results showed that cultivar treatments have a major impact on characteristics such as capsule number per plant, yield per plant, weight of 1000 seeds, harvest index, percentage of seed oil, yield of seed, percentage of seed protein and yield of protein. The results indicated that the Yekta cultivar was the best cultivar for parameters such as the number of capsules per plant, the number of seeds per capsule, the yield of seeds, the yield of oil and the yield of protein. The highest yield and harvest index observed by the Naz cultivar per plant.

An experiment was conducted by Chongdar *et al.* (2015) to research the impact of sowing dates and improved cultivars on summer sesame growth and yield in North Bengal. Three improved sesame (Rama, Savitri and Tillotama) cultivars have been used. The Rama variety reported higher plant height, dry matter accumulation, leaf area index and crop growth rate compared to the improved sesame cultivars. Cultivar Rama recorded highest seed yield 17.70% and 12.06% during 2013 and 2014, respectively followed by Savitri and Tillotama. Rama produced the higher values with respect to number of capsules, number of seed and test weight. Irrespective of cultivars, Rama (V1) gave significantly higher economic return as compared to Savitri and Tillotama during 2013 and 2014, respectively.

An experiment was carried out by Yahaya *et al.* (2014) to investigate the features and efficiency of all accession entries on seed-oil and yield parameters. For the experiment, 12 accessions of sesame were used. Accessions NG-03, NG-04, NA-01 and BE-02 had the lowest mean with plant flowers number^{-1} and plant capsules number^{-1}.

Ali and Jan (2014) performed an experiment with various sowing dates (20 June, 10 and 30 July) and nitrogen levels on the output of sesame cultivars (*Sesamum indicum* L.) (Local black and local white) (0, 40, 80 and 120 kg N ha^{-1}). More capsules of plant^{-1} (71), seed capsule^{-1} (61), seed yield (696 kg ha^{-1}), stover yield (4297 kg ha^{-1}) and harvest index were used for the local black cultivar.

Deshmukh *et al.* (2005) reported that all ten varieties tested were developed by variety RT 54 and substantial differences in yield attributes were further observed. Experiments were conducted with nine varieties and concluded that the highest seed yield and capsule number were reported significantly by the varieties RT 46, Gowri and CO 1.

Palaniappan *et al.* (1993) evaluated genotypes in farmers' fields under different conditions (viz., TMV 3, TMV 4, TMV 5, TMV 6, CO 1, VS 117, VS 339 and VS 350) and reported that the performance of TMV3 and VS350 was superior to that of other varieties

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted at the Agronomy field of Sher-e-Bangla Agricultural University, Dhaka during March to July, 2019 on growth and yield of four sesame varieties under varying levels of potassium. This chapter deals with a brief description on experimental site, climate, soil, land preparation, layout, experimental design, intercultural operations, data recordings and their analyses.

3.1 Site description

The experiment was conducted at the research field of Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka under the Agro-ecological zone of Modhupur tract, AEZ-28. The land was situated at 23°41′ N latitude and 90°22′ E longitude at an altitude of 8.6 meter above sea level. The soil had a texture of sandy loam with a pH varying from 5.47 to 5.63.

3.2 Climate

The experimental area was characterized by high temperatures, high humidity and heavy rainfall in sub-tropical regions with occasional raging winds in the Kharif season (March to July) coupled with moderately low temperatures during the Rabi season (October to March) (Appendix II).

3.3 Soil

The soil of the experiment at field belongs to the general soil type, shallow red brown terrace soil under Tejgaon series. Top soils are silty clay in texture, olive-gray with common fine to medium distinct dark yellowish-brown mottles. With an irrigation and drainage system available, the experiment area was flat. During the experimental period, the land was above flood level and ample sunlight was available. Soil samples from 0 to 15 cm depth were collected from experimental field.

3.4 Planting material

Four sesame varieties viz., BARI Til 3, BARI Til 4, Binatil 3 and Binatil 4 were used as planting materials. BARI Til 3 and BARI Til 4 were developed by Bangladesh Agricultural Research Institute (BARI) and Binatil 3 and Binatil 4 were developed by Bangladesh Institute of Nuclear Agriculture (BINA). All are high yielding varieties were collected from Bangladesh Agricultural Research Institute (BARI) and Bangladesh Institute of Nuclear Agriculture (BINA).

3.5 Treatment

There were two factors in the experiment namely potassium level and variety as mentioned below:

Factor: A (Potassium level- 3)

1) K_1 = 30 kg K_2O ha^{-1}
2) K_2 = 37.5 kg K_2O ha^{-1}
3) K_3 = 45 kg K_2O ha^{-1}

Factor: B (Variety- 4)

1) V_1 = BARI Til 3
2) V_2 = BARI Til 4
3) V_3 = Binatil 3
4) V_4 = Binatil 4

Treatment combination

The treatment combination is given bellow:

K_1V_1	K_2V_1	K_3V_1
K_1V_2	K_2V_2	K_3V_2
K_1V_3	K_2V_3	K_3V_3
K_1V_4	K_2V_4	K_3V_4

3.6 Experimental Design and Layout

The experiment was planned with three replications in a two-factor split-plot configuration. The layout of the experiment was prepared for distributing the treatments in each plot of each block. Each block was divided into 12 plots where 12 treatment combinations were allotted randomly. In the experiment, there were 36-unit plots altogether. The size of the unit plot was 2.70 m×1.50 m. The distance between two blocks 50 cm and two plots was 50 cm each.

3.7 Land preparation

The experimental field was first open on March 17, 2019 with the help of a power tiller and prepared by three successive plowing and cross-plowing. Each plow was followed by a ladder to provide a fine tilth that was desirable. The noticeable larger clods were split into small bits. All sorts of weeds and residues from previous crops were removed from the field. With the support of a wooden plank, individual parcels were washed and eventually levelled.

3.8 Fertilizer application

The recommended doses of Urea, TSP, Gypsum were 125, 150, 110 kg ha^{-1} (BARI, 2004). All the fertilizer except urea were applied as basal dose. Fifty percent urea were applied as basal and rest half dose of urea was applied at 25 DAS. Potassium (K_2O) were applied as per treatment dose.

3.9 Seed sowing

Seeds were sown at the rate of 7.5 kg ha^{-1} in the furrow on 20 March, 2019 and the furrows were covered with the soils soon after seeding. The line to line (furrow to furrow) distance was maintained as 30 cm with continuous sowing of seed in the line.

3.10 Intercultural operations

3.10.1 Irrigation

Immediately after the emergence of seedlings, light overhead irrigation was provided with a watering can. Irrigation also provided at 10 and 25 days after seed sowing.

3.10.2 Thinning

Thinning was done carefully for better growth of the germinated plants and it was done manually after 16 days of sowing. Care was taken to maintain equal population of plants per plot.

3.10.3 Gap filling

To ensure optimum plant population, gap filling was done where uniform germination was not taken.

3.10.4 Weeding

Weeding was done at 25 and 50 days after seed sowing followed by irrigation.

3.10.5 Plant Protection

The crop was protected from the attack of fungal disease by spraying autostin.

3.11 Harvesting and sampling

The crop was harvested when 80% of the capsules became matured. Samples were collected at random from different places of each plot leaving undisturbed plant in the center. The harvested crops were tied into bundles and carried to the threshing floor. The crop bundles were sun dried by spreading those on the threshing floor. The seeds were separated, cleaned and dried in the sun 4 to 6 consecutive days for achieving safe moisture of seed.

3.11.1 Threshing

The crops harvested were bound into bundles and taken to the threshing floor. Seeds were separated from plants by beating the bundles with bamboo sticks.

3.11.2 Drying, cleaning and weighing

The seeds thus collected were dried in the sun for reducing the moisture in the seeds to a constant level (12.5%). Washed and measured the dried seeds and straw.

3.12 Collection of data

The data were recorded on the following parameters:

Crop growth parameters

a. Plant height at 15 days interval started from 30 DAS.

b. Stem weight at 15 days interval started from 30 DAS.

c. Leaf weight at 15 days interval started from 30 DAS.

d. Days to flowering.

e. Total dry matter at 15 days interval started from 30 DAS.

f. Days to maturity.

Water relation traits

a. Relative water content at 30, 45 and 60 DAS.

Yield parameters

a. Number of capsule plant^{-1}

b. Length of capsule

c. Number of seeds capsule^{-1}

d. Weight of 1000-seeds.

e. Seed weight plant^{-1}

f. Seed yield

g. Stover yield

h. Biological yield

i. Harvest index

The procedure of data collection of different parameters is given bellow-

3.12.1 Plant height plant^{-1}

The height of plant was recorded at 30, 45, 60 DAS and at harvest by using a meter scale. The height was measured from the ground level to the tip of the plant of an individual plant. Mean value of five (5) selected plants was calculated for each unit plot and expressed in centimeter (cm).

3.12.2 Stem weight plant^{-1}

Stem of selected three plants in each unit plot were separated and then dried in oven at 60–70°C for 72 hours and weight was taken carefully by an electronic balance. Mean value of these selected plants was calculated and expressed in gram (g).

3.12.3 Leaf weight plant^{-1}

For measuring the leaf weight plant^{-1}, the leaf of selected three plants in each unit plot were separated and then dried in oven at 60–70°C for 72 hours and weight was taken carefully by an electronic balance. Mean value of these selected plants was calculated and expressed in gram (gm).

3.12.4 Total Dry matter weight plant^{-1}

The sum of the above ground plant parts viz. Stem, leaf, reproductive matter constituted the total dry matter of a single plant.

3.12.5 Days to flowering

Days to flowering were recorded when 80% plants of the plots were flowered.

3.12.6 Days to 80% maturity

Days to maturing were recorded when 80% plants of the plots were matured.

3.12.7 Relative water content (%)

For the calculation of the relative water content (RWC), leaf tissue was used as follows: a composite sample of leaf is taken from three leaves of comparable physiological maturity and the fresh weight is determined, accompanied by water flotation for up to 24 hours under normal ambient light and temperature. Then the turgid weight is registered, and the leaf tissue at about 85℃ is then oven-dried to constant weight. RWC was calculated according to formula (Barr and Weatherley, 1962).

$$\text{RWC (\%)} = \frac{(FW - DW)}{(TW - DW)} \times 100$$

Where,

FW is fresh weight,

DW is dry weight

TW is turgid weight.

3.12.8 Number of capsule plant^{-1}

Numbers of capsule were counted from 10 randomly selected plants as harvested from each unit plot and the mean number was recorded.

3.12.9 Length of capsule

Length of capsule was measured from 10 randomly selected capsule as harvested from each unit plot and mean value was recorded as per treatment

3.12.10 Number of seeds capsule^{-1}

The number of seeds was counted from randomly taking 10 capsules from each sample of each plot and recorded as per treatment.

3.12.11 Weight of 1000 seeds

One thousand cleaned and dried seeds were counted randomly from each of the harvested samples and weighed by using a digital electric balance and the mean weight was expressed in gram.

3.12.12 Seed yield plant^{-1}

Mature capsules were harvested from 10 randomly selected plants from each unit plot and seeds were separated from capsule and mean weight was recorded.

3.12.13 Seed yield

Mature capsules were harvested from each plot (1 m^2 at the center) and seeds were separated from capsule and weight was recorded. The seed yield per m^2 was finally converted to ton and expressed in ton per hectare (t ha^{-1}) at 8 % moisture level.

3.12.14 Stover yield

Mature sesame plants were harvested from each plot and after threshing, seeds and stover were separated and sun dried and the stover weight was recorded. The stover yield per m^2 was finally converted to ton and expressed in ton per hectare (t ha^{-1}).

3.12.15 Biological yield

Biological yield was calculated by summing up of seed yield and above ground stover yield. Biological yield = Seed yield + Stover Yield.

3.12.16 Harvest index (%)

The harvest index was calculated on the ratio of grain yield to biological yield and expressed in terms of percentage. It was calculated by using the following formula.

Harvest Index (%) = $\frac{Seed\ Yield}{Biological\ yield}$ x 100

CHAPTER IV

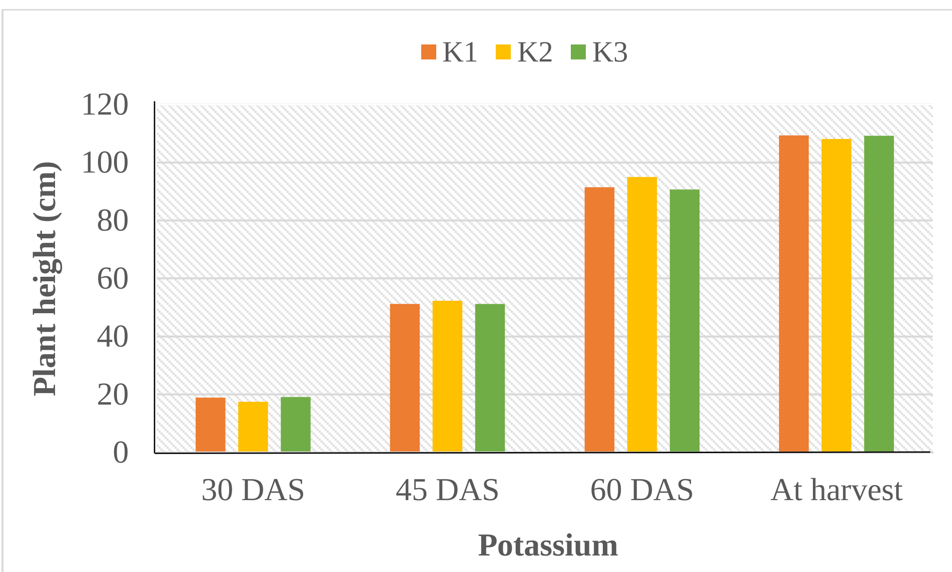
RESULTS AND DISCUSSION

Data on different growth and yield were recorded to find out the optimum level of Potassium for four sesame varieties and their interaction effect have been presented and discussed in this chapter.

4.1 Plant height

4.1.1 Effect of potassium

Statistically no significant variation in plant height of sesame was recorded for Potassium. Highest plant height (109.37 cm) was found in K_1 (30 kg K_2O ha^{-1}) treatment at harvest. Lowest plant height (108.15 cm) was found in K_2 (37.5 kg K_2O ha^{-1}) treatment at harvest. The effect of potassium on plant height was shown in Figure 1.

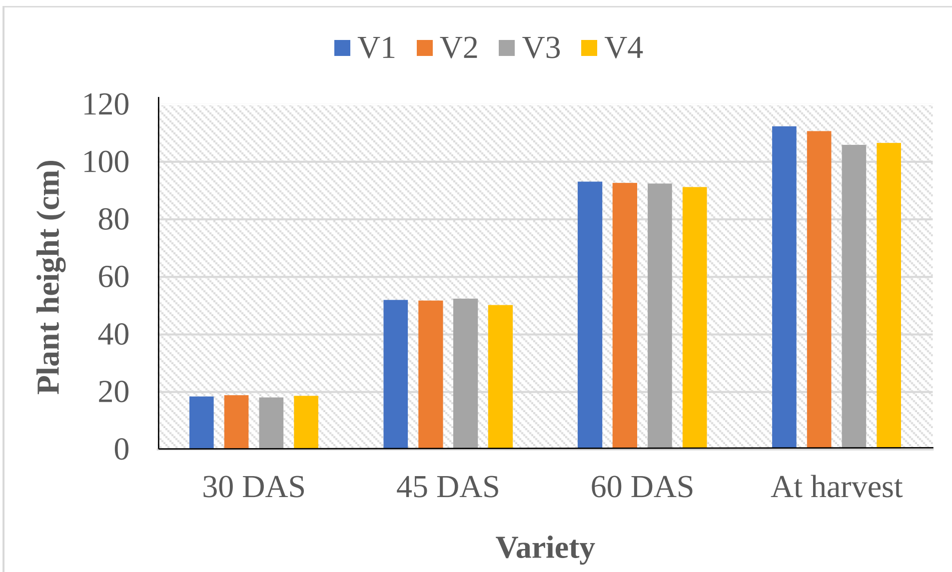


K_1 = 30 kg K_2O ha^{-1} K_2 = 37.5 kg K_2O ha^{-1} K_3 = 45 kg K_2O ha^{-1}

Figure 1. Effect of Potassium on plant height of sesame at different days after sowing ($LSD_{0.05}$ = 2.54, 6.42, 4.46 and 2.80 at 30, 45, 60 DAS and at harvest, respectively).

4.1.2 Effect of Variety

Statistically significant variation in plant height of sesame was recorded for Variety (Fig 2). Maximum plant height (112.36 cm) was found in V_1 (BARI Til 3) at 45 DAS and at harvest which was statistically similar with V_2 (BARI Til 4). Minimum plant height (105.94 cm) was found in V_3 (Binatil 3) which was statistically similar with V_4 (Binatil 4).



V_1 = BARI Til 3 V_3 = Binatil 3
V_2 = BARI Til 4 V_4 = Binatil 4

Figure 2. Effect of variety on plant height of sesame at different days after sowing ($LSD_{0.05}$ = 2.93, 7.42, 2.64 and 5.36 at 30, 45, 60 and at harvest, respectively.

4.1.3 Interaction effect of potassium and variety

Significant difference was recorded for the interaction effect of potassium and variety in terms of plant height at 45, 60 DAS and at harvest (Table 1). The maximum plant height (124.68 cm) was found in K_1V_1 treatment combination at harvest. On the other hand, minimum plant height (99.34 cm) was found in K_1V_4 treatment combination. BARI Til 3 with 30 kg K_2O ha^{-1} potassium gives highest plant height and Binatil 4 with 30 kg K_2O ha^{-1} potassium gives lowest plant height (Table 1).

Table 1. Interaction effect of potassium and variety on plant height of sesame at different days after sowing (DAS)

Interaction	Plant height (cm) at			
	30 DAS	45 DAS	60 DAS	Harvest
K_1V_1	19.31a	57.53 a	98.88 a	124.68 a
K_1V_2	20.28a	50.08 ab	86.72 e	107.53 b-f
K_1V_3	18.79a	53.89 ab	93.08 b-d	105.92 d-f
K_1V_4	17.46a	43.60 b	87.02 e	99.34 f
K_2V_1	18.01a	51.82 ab	93.58 a-d	107.43 c-f
K_2V_2	15.71a	51.02 ab	95.78 a-c	108.65 b-e
K_2V_3	16.64a	49.74 ab	93.25 a-d	101.08 ef
K_2V_4	19.52a	56.94 a	97.62 ab	115.44 bc
K_3V_1	18.09a	46.54 ab	86.86 e	104.96 d-f
K_3V_2	20.57a	54.35 ab	95.56 a-c	116.01 b
K_3V_3	18.79a	53.86 ab	91.10 c-e	110.83 b-d
K_3V_4	19.08a	49.98 ab	89.22 de	104.96 d-f
$LSD_{(0.05)}$	NS	12.85	5.91	8.49
CV (%)	11.95	11.49	5.43	4.98

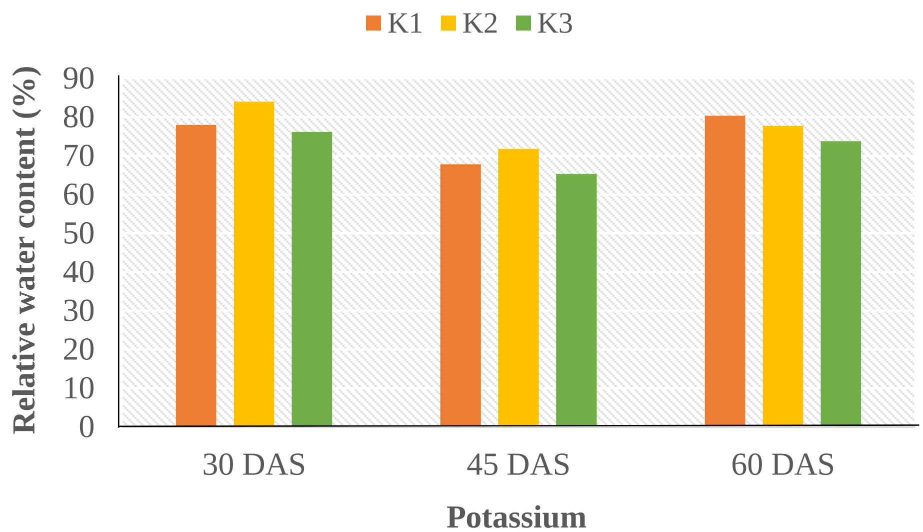
K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

4.2 Relative water content

4.2.1 Effect of potassium

Statistically significant variation in relative water content of sesame was recorded for Potassium. Maximum relative water content (84.05%) was found in K_2 (37.5 kg K_2O ha^{-1}) treatment at 30 DAS and minimum relative water content (76.13%) was found in K_3 (45 kg K_2O ha^{-1}) treatment at 45 DAS. The effect of potassium on relative water content was shown in Figure 3.

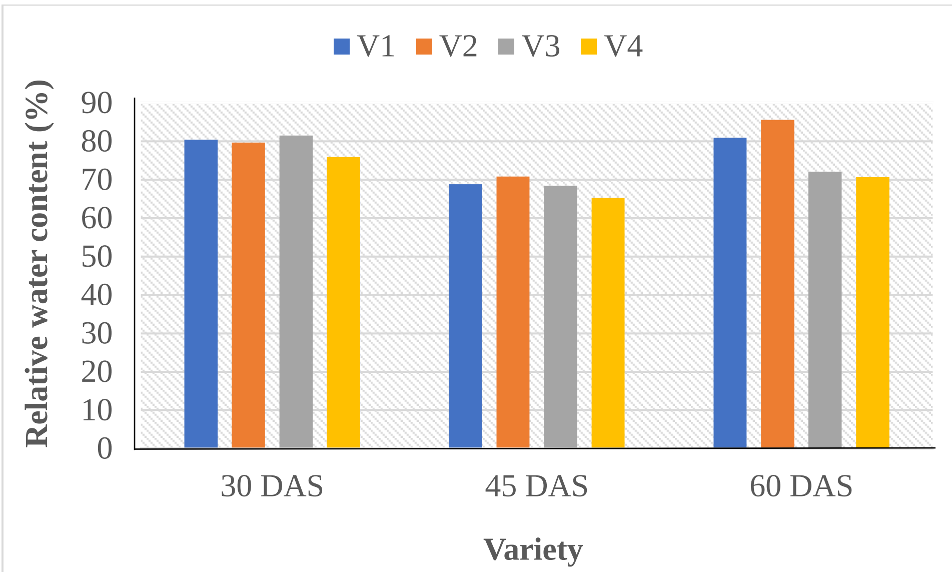


K_1 = 30 kg K_2O ha^{-1} K_2 = 37.5 kg K_2O ha^{-1} K_3 = 45 kg K_2O ha^{-1}

Figure 3. Effect of Potassium on Relative water content of sesame at different days after sowing ($LSD_{0.05}$ = 1.78, 6.19 and 14.53 at 30, 45 and 60 DAS, respectively).

4.2.2 Effect of variety

Significant variation in relative water content of sesame was recorded for variety at 30 and 60 DAS. At 30 DAS, maximum relative water content (81%) was found in V_3 (Binatil 3) which was statistically similar with V_1 and V_2 and minimum relative water content (75.93%) was found in V_4 (Binatil 4). At 60 DAS, maximum relative water content (85.61%) was found in V_2 (BARI Til 4) which was statistically similar with V_1 and minimum relative water content (70.63%) was found in V_4 (Binatil 4) which was statistically similar with V_3. No significant result was found at 45 DAS. The effect of varieties on relative water content was shown in Figure 4.



V_1 = BARI Til 3 V_3 = Binatil 3
V_2 = BARI Til 4 V_4 = Binatil 4

Figure 4. Effect of variety on Relative water content of sesame at different days after sowing ($LSD_{0.05}$ = 3.71, 6.93 and 8.92 at 30, 45 and 60, respectively).

4.2.3 Interaction effect of potassium and variety

Non-significant difference was recorded for the interaction effect of potassium and variety in relative water content. The maximum relative water content 86.91%, 75.08% and 89.01% was recorded at 30, 45 and 60 DAS, respectively. On the other hand, minimum relative water content 70.58%, 62.14% and 60.37%

was recorded at 30, 45 and 60 DAS, respectively. Highest relative water content was found in K_2V_2 combination (86.91%) at 30 DAS where lowest relative water content was found in K_3V_4 combination (60.37%) at 60 DAS.

Table 2. Interaction effect of potassium and variety on relative water content of sesame at different days after sowing (DAS)

Interaction	Relative water content (%) at		
	30 DAS	**45 DAS**	**60 DAS**
K_1V_1	82.14 a-c	68.27 ab	85.96 ab
K_1V_2	76.55 c-e	70.78 ab	83.36 ab
K_1V_3	79.18 b-e	68.95 ab	76.49 a-c
K_1V_4	74.18 ef	63.37 ab	75.89 a-c
K_2V_1	82.69 ab	70.47 ab	73.92 a-c
K_2V_2	86.91 a	75.08 a	89.01 a
K_2V_3	83.56 ab	71.50 ab	72.36 bc
K_2V_4	83.03 ab	70.21 ab	75.65 a-c
K_3V_1	76.52 c-f	67.73 ab	82.85 ab
K_3V_2	75.52 d-f	66.68 ab	84.46 ab
K_3V_3	81.92 a-d	64.84 ab	67.42 bc
K_3V_4	70.58 f	62.14 b	60.37 c
$LSD_{(0.05)}$	5.83	12.03	19.57
CV (%)	4.72	10.25	11.66

K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

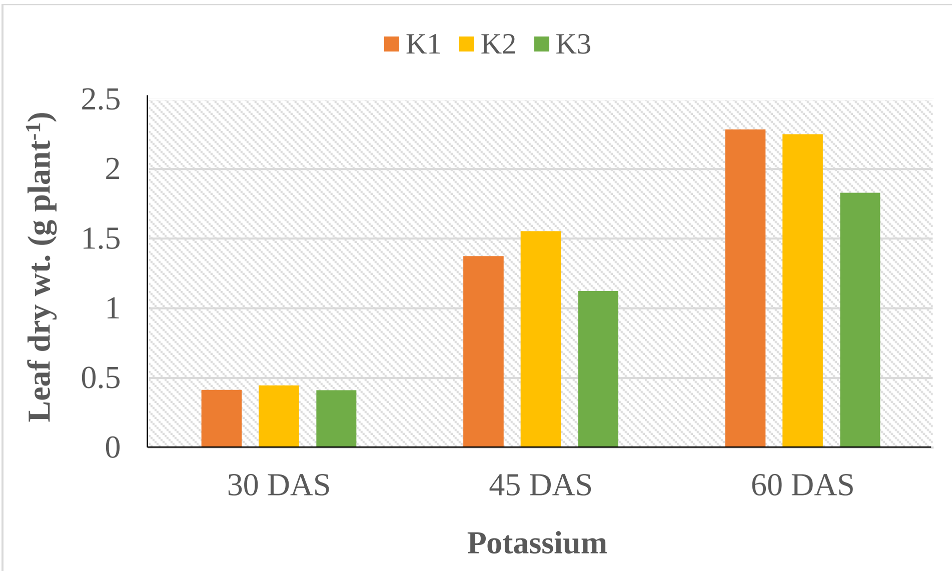
V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

4.3 Leaf dry weight plant^{-1}

4.3.1 Effect of potassium

Significant variation in leaf dry weight of sesame was recorded for Potassium at 45 and 60 DAS. At 45 DAS, maximum leaf dry weight (1.55 g) was found in K_2

(37.5 kg K_2O ha^{-1}) treatment and minimum leaf dry weight (1.12 g) was found in K_3 (45 kg K_2O ha^{-1}). At 60 DAS, maximum leaf dry weight (2.28 g) was found in K_1 (30 kg K_2O ha^{-1}) treatment which was statistically similar with K_2 (2.25 g) and minimum leaf dry weight (1.83 g) was found in K_3 (45 kg K_2O ha^{-1}). The effect of potassium on leaf dry weight was shown in Figure 5.

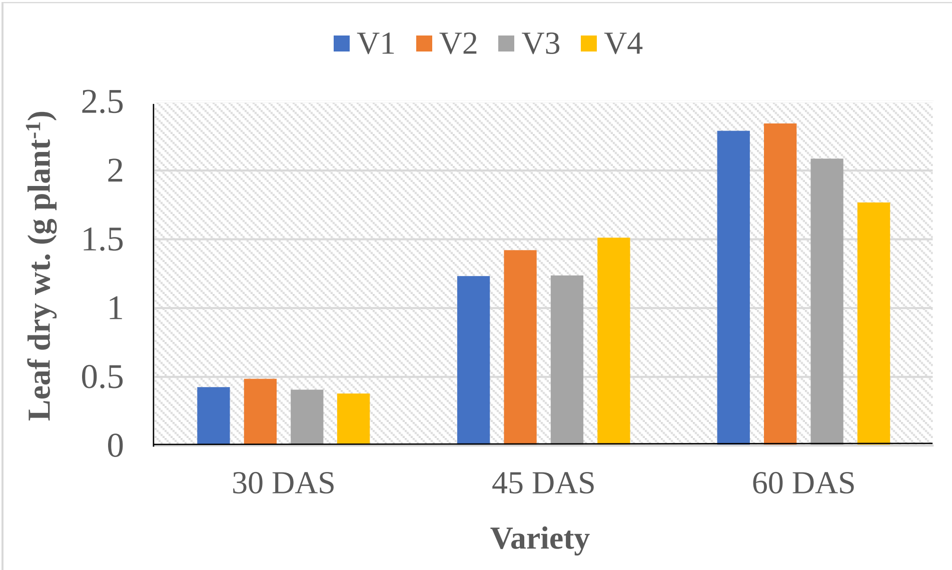


K_1 = 30 kg K_2O ha^{-1} K_2 = 37.5 kg K_2O ha^{-1} K_3 = 45 kg K_2O ha^{-1}

Figure 5. Effect of Potassium on leaf dry weight of sesame at different days after sowing ($LSD_{0.05}$ = 0.04, 0.16 and 0.26 at 30, 45, and 60 DAS, respectively).

4.3.2 Effect of variety

In terms of variety, significant difference was recorded at 30 and 60 DAS. Maximum leaf dry weight (0.48 g) was found in V_2 (BARI Til 4) and minimum leaf dry weight (0.37 g) was found in V_4 (Binatil 4) at 30 DAS which was statistically similar with V_1 (BARI Til 3) and V_3 (Binatil 3). At 60 DAS, maximum leaf dry weight (2.28 g) was found in V_2 (BARI Til 4) which was statistically similar with V_1 (BARI Til 3) and V_3 (Binatil 3) and minimum leaf dry weight (1.76 g) was found in V_4 (Binatil 4). The effect of varieties on leaf dry weight was shown in Figure 6.



V_1 = BARI Til 3 V_3 = Binatil 3
V_2 = BARI Til 4 V_4 = Binatil 4

Figure 6. Effect of variety on leaf dry weight of sesame at different days after sowing ($LSD_{0.05}$ = 0.05, 0.26 and 0.35 at 30, 45 and 60 DAS, respectively).

4.3.3 Interaction effect of potassium and variety

Significant difference was recorded for the interaction effect of potassium and variety on leaf dry weight at 30, 45 and 60 DAS. At 30 DAS, maximum leaf dry weight (0.6 g) was found in K_1V_1 combination which are statistically similar with K_2V_2 and minimum leaf dry weight (0.33 g) was found in K_3V_1 combination which was statistically similar with K_1V_3, K_2V_1 and K_2V_4. At 45 DAS, maximum leaf dry weight (1.90 g) was found in K_2V_4 combination which was statistically similar with K_2V_2 and K_1V_3 combination and minimum leaf dry weight (1.03 g) was found in K_3V_2 and K_3V_3 combination. At 60 DAS, maximum leaf dry weight (3.24 g) was found in K_1V_1 combination which was statistically similar with

K_2V_2 and minimum leaf dry weight (1.53 g) was found in K_3V_1 combination (Table 3).

Table 3. Interaction effect of potassium and variety on leaf dry weight of sesame at different days after sowing (DAS)

Interaction	Leaf dry weight (g plant^{-1}) at		
	30 DAS	**45 DAS**	**60 DAS**
K_1V_1	0.60 a	1.33 bc	3.24 a
K_1V_2	0.45 bc	1.38 bc	2.40 bc
K_1V_3	0.35 d	1.47 ab	1.94 cd
K_1V_4	0.23 e	1.30 bc	1.54 d
K_2V_1	0.33 de	1.25 bc	2.08 cd
K_2V_2	0.54 ab	1.85 a	2.85 ab
K_2V_3	0.47 bc	1.20 bc	2.10 cd
K_2V_4	0.43 cd	1.90 a	1.95 cd
K_3V_1	0.33 d	1.10 bc	1.53 d
K_3V_2	0.45 bc	1.03 c	1.76 cd
K_3V_3	0.38 cd	1.03 c	2.21 bc
K_3V_4	0.46 bc	1.33 bc	1.80 cd
$LSD_{(0.05)}$	0.09	0.42	0.66
CV (%)	13.72	19.86	16.86

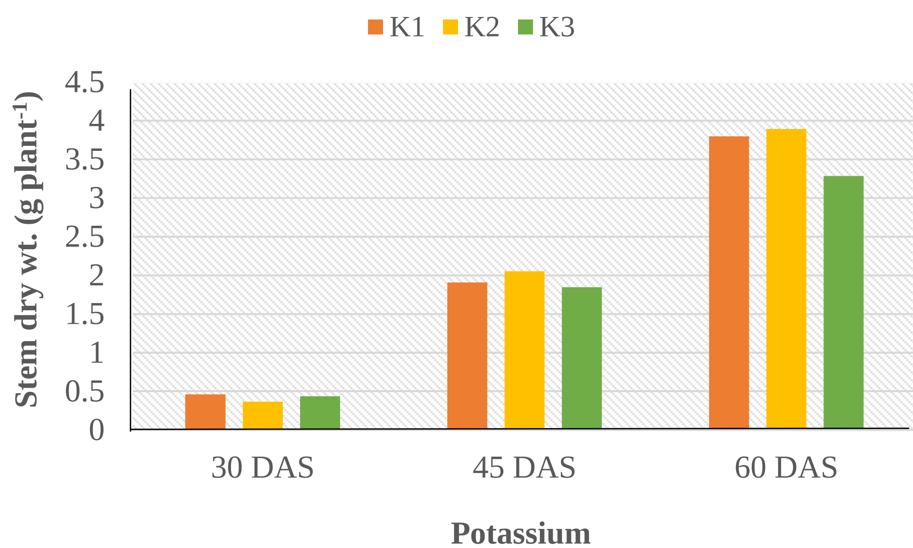
K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

4.4 Stem dry weight plant^{-1}

4.4.1 Effect of potassium

Stem dry weight of sesame was significantly influenced by Potassium at 30, 45 and 60 DAS. At 30 DAS, maximum stem dry weight (0.46 g) was found in K_1 (30 kg K_2O ha^{-1}) which was statistically similar with K_3 (45 kg K_2O ha^{-1}) and minimum stem dry weight (0.36 g) was found in K_3 (45 kg K_2O ha^{-1}). At 45 DAS, maximum stem dry weight (2.08 g) was found in K_2 (37.5 kg K_2O ha^{-1}) and minimum stem dry weight (1.84 g) was found in K_3 (45 kg K_2O ha^{-1}) which was statistically similar with K_1 (30 kg K_2O ha^{-1}). At 60 DAS, maximum stem dry weight (3.89 g) was found in K_2 (37.5 kg K_2O ha^{-1}) which was statistically similar with K_1 (30 kg K_2O ha^{-1}) and minimum stem dry weight was (3.28 g) found in K_3 (45 kg K_2O ha^{-1}). The effect of potassium on stem dry weight was shown in Figure 7.



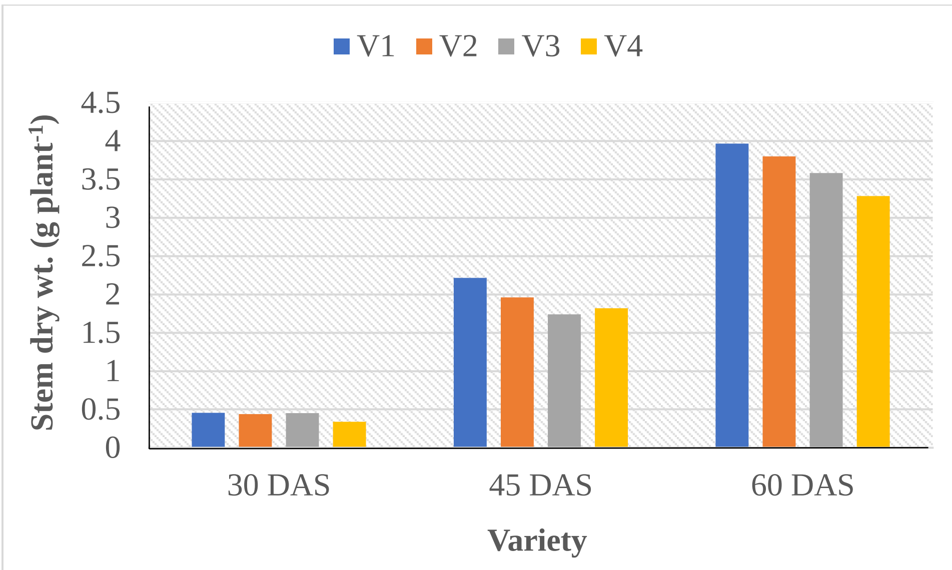
K_1 = 30 kg K_2O ha^{-1} K_2 = 37.5 kg K_2O ha^{-1} K_3 = 45 kg K_2O ha^{-1}

Figure 7. Effect of Potassium on stem dry weight of sesame at different days after sowing ($LSD_{0.05}$ = 0.05, 0.11 and 0.28 at 30, 45 and 60 DAS, respectively).

4.4.2 Effect of variety

Variety has significant difference that was recorded at 30 and 45 DAS. Maximum stem dry weight (0.45 g) was found in V_1 (BARI Til 3) which was statistically similar with V_2 (0.43 g) and V_3 (0.45 g) and minimum leaf dry weight (0.34 g) was found in V_4 (Binatil 4) at 30 DAS. At 45 DAS, maximum stem dry weight

(2.21 g) was found in V_1 (BARI Til 3) and minimum stem dry weight (1.74 g) was found in V_3 (Binatil 3) which was statistically similar with V_2 (1.96 g) and V_4 (1.82 g) and minimum leaf dry weight (1.76 g) was found in V_4 (Binatil 4). Highest value at 60 DAS was obtained from V_1 (3.96 g) variety and lowest value from V_4 (3.28 g) variety. The effect of varieties on leaf dry weight was shown in Figure 8.



V_1 = BARI Til 3 V_3 = Binatil 3
V_2 = BARI Til 4 V_4 = Binatil 4

Figure 8. Effect of variety on stem dry weight of sesame at different days after sowing ($LSD_{0.05}$ = 0.03, 0.24 and 0.57 at 30, 45 and 60 DAS, respectively).

4.4.3 Interaction effect of potassium and variety

Significant difference was recorded for the interaction effect of potassium and variety on stem dry weight at 30, 45 and 60 DAS. At 30 DAS, maximum stem dry weight (0.57 g) was found in K_1V_1 combination which was statistically similar with K_2V_2 and minimum stem dry weight (0.31 g) was found in K_1V_4 combination which was statistically similar with K_2V_1, K_2V_4, K_2V_2, K_3V_2

combination. At 45 DAS, maximum stem dry weight (2.39 g) was found in K_1V_1 combination which was statistically similar with K_2V_2 and K_2V_1 combination and minimum stem dry weight (1.39 g) was found in K_1V_4 combination which was statistically similar with K_2V_3 and K_3V_3. At 60 DAS, maximum stem dry weight (4.52 g) was found in K_1V_1 combination which was statistically similar with K_1V_2, K_1V_3, K_2V_1, K_2V_2, K_2V_3 and minimum leaf dry weight (2.49 g) was found in K_1V_4 combination which was statistically similar with K_3V_3 and K_3V_1 (Table 4).

Table 4. Interaction effect of potassium and variety on stem dry weight of sesame at different days after sowing (DAS)

Interaction	Stem dry weight (g plant^{-1}) at		
	30 DAS	45 DAS	60 DAS
K_1V_1	0.57 a	2.39 a	4.52 a
K_1V_2	0.46 b-d	1.96 b-e	3.99 a-c
K_1V_3	0.49 bc	1.88 c-e	4.19 ab
K_1V_4	0.31 e	1.39 f	2.49 e
K_2V_1	0.33 e	2.32 ab	4.19 ab
K_2V_2	0.52 ab	2.09 a-d	3.86 a-c
K_2V_3	0.47 bc	1.61 ef	3.68 a-d
K_2V_4	0.32 e	2.18 a-c	3.83 a-c
K_3V_1	0.45 cd	1.92 c-e	3.18 c-e
K_3V_2	0.33 e	1.83 c-e	3.55 b-d
K_3V_3	0.38 de	1.73 d-f	2.88 de
K_3V_4	0.38 de	1.88 c-e	3.51 b-d
$LSD_{(0.05)}$	0.08	0.38	0.91
CV (%)	9.16	12.72	15.99

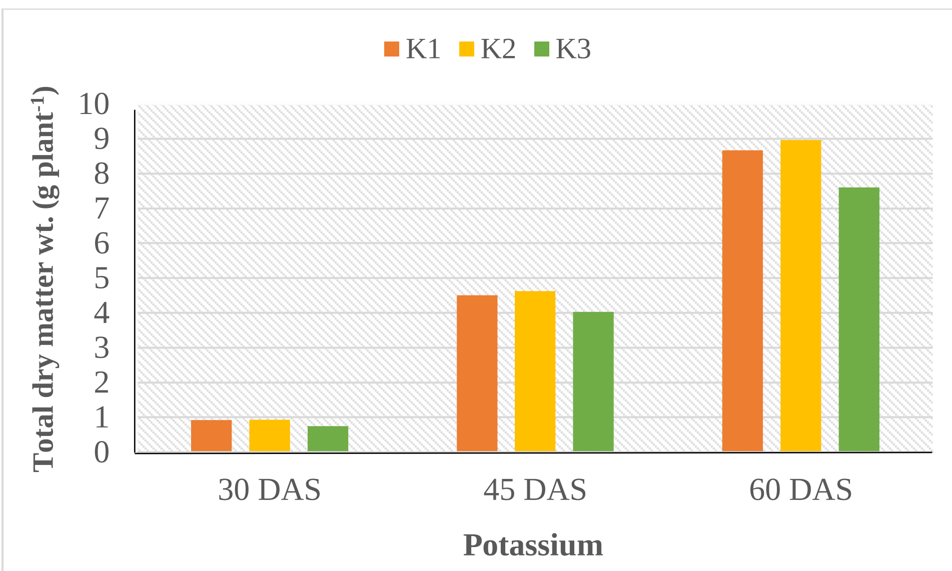
K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

4.5 Total dry matter weight plant^{-1}

4.5.1 Effect of potassium

Significant variation in total dry matter weight of sesame was recorded for potassium at 30, 45 and 60 DAS. At 30 DAS, maximum total dry matter weight (0.93 g) was found in K_2 (37.5 kg K_2O ha^{-1}) which was statistically similar with K_1 (30 kg K_2O ha^{-1}) and minimum total dry matter weight was found in K_3 (0.74 g). At 45 DAS, maximum total dry matter weight (4.62 g) was found in K_2 (37.5 kg K_2O ha^{-1}) which was statistically similar with K_1 (30 kg K_2O ha^{-1}) and minimum total dry matter weight (4.03 g) was found in K_3 (45 kg K_2O ha^{-1}). At 60 DAS, maximum total dry matter weight (8.96 g) was found in K_2 (37.5 kg K_2O ha^{-1}) which was statistically similar with K_1 (30 kg K_2O ha^{-1}) and minimum total dry matter weight (7.60 g) was found in K_3 (45 kg K_2O ha^{-1}). The effect of potassium on total dry matter weight was shown in Figure 9.

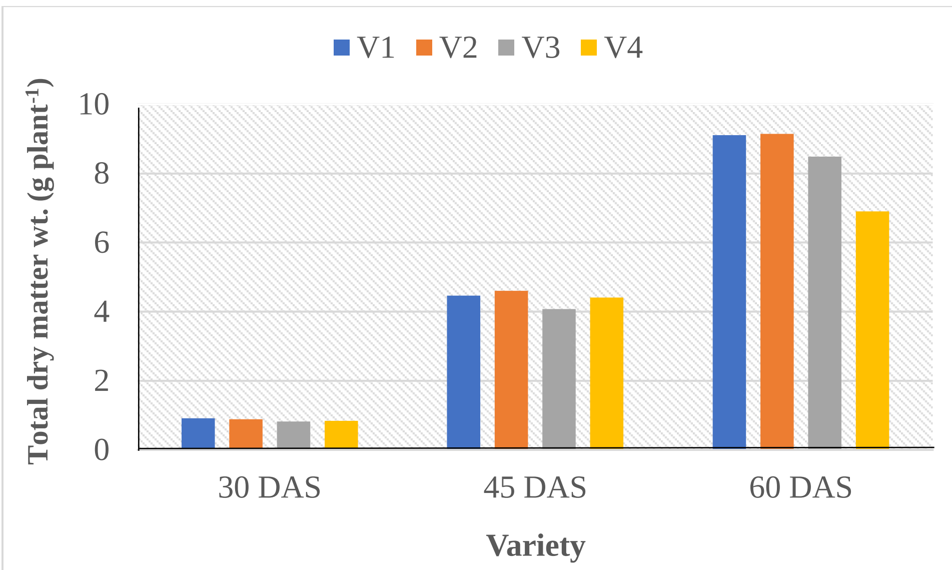


K_1 = 30 kg K_2O ha^{-1} K_2 = 37.5 kg K_2O ha^{-1} K_3 = 45 kg K_2O ha^{-1}

Figure 9. Effect of Potassium on total dry matter weight of sesame at different days after sowing ($LSD_{0.05}$ = 0.06, 0.18 and 0.79 at 30, 45 and 60 DAS, respectively).

4.5.2 Effect of variety

Variety has significant difference that was recorded at 45 and 60 DAS. Maximum total dry matter weight (4.60 g) was found in V_2 (BARI Til 4) which was statistically similar with V_1 (4.46 g) and V_4 (4.40 g) and minimum total dry matter weight (4.07 g) was found in V_3 (Binatil 4) at 45 DAS. Highest value at 60 DAS was obtained from V_2 (9.14 g) variety which was statistically similar with V_1 (9.11 g) and V_3 (8.48 g) and lowest value from V_4 (6.89 g). The effect of varieties on total dry matter weight was shown in Figure 10.



V_1 = BARI Til 3 V_3 = Binatil 3
V_2 = BARI Til 4 V_4 = Binatil 4

Figure 10. Effect of variety on total dry matter weight of sesame at different days after sowing ($LSD_{0.05}$ = 0.08, 0.35 and 0.79 at 30, 45 and 60 DAS, respectively).

4.5.3 Interaction effect of potassium and variety

Significant difference was recorded for the interaction effect of potassium and variety on total dry matter weight at 30, 45 and 60 DAS. At 30 DAS, maximum total dry matter weight (1.18 g) was found in K_1V_1 combination which was statistically similar with K_2V_2 and minimum total dry matter weight (0.66 g) was found in K_3V_1 and K_3V_3 combination. At 45 DAS, maximum total dry matter weight (5.37 g) was found in K_2V_2 combination and minimum total dry matter weight (3.67g) was found in K_3V_3 combination. At 60 DAS, maximum total dry matter weight (10.64 g) was found in K_1V_1 combination which was statistically similar with K_1V_3, K_2V_2 and K_2V_1 where minimum total dry matter weight (7.14 g) was found in K_3V_1 combination (Table 5).

Table 5. Interaction effect of potassium and variety on total dry matter weight of sesame at different days after sowing (DAS)

Interaction	Total dry matter weight (g plant^{-1}) at		
	30 DAS	45 DAS	60 DAS
K_1V_1	1.18 a	5.21 ab	10.64 a
K_1V_2	0.88 c-e	4.36 d-f	9.21 b-d
K_1V_3	0.85 c-e	4.62 b-d	9.27 a-d
K_1V_4	0.75 ef	3.84 fg	5.54 g
K_2V_1	0.76 ef	4.44 c-e	9.55 a-c
K_2V_2	1.10 ab	5.37 a	10.33 ab
K_2V_3	0.95 bc	4.38 d-f	8.80 c-e
K_2V_4	0.91 cd	5.00 a-c	7.17 f
K_3V_1	0.66 f	3.75 g	7.14 f
K_3V_2	0.79 d-f	4.06 d-g	7.90 d-f
K_3V_3	0.66 f	3.67 g	7.38 ef
K_3V_4	0.85 c-e	3.92 e-g	7.97 d-f
$LSD_{(0.05)}$	0.14	0.56	1.41
CV (%)	9.90	8.24	9.49

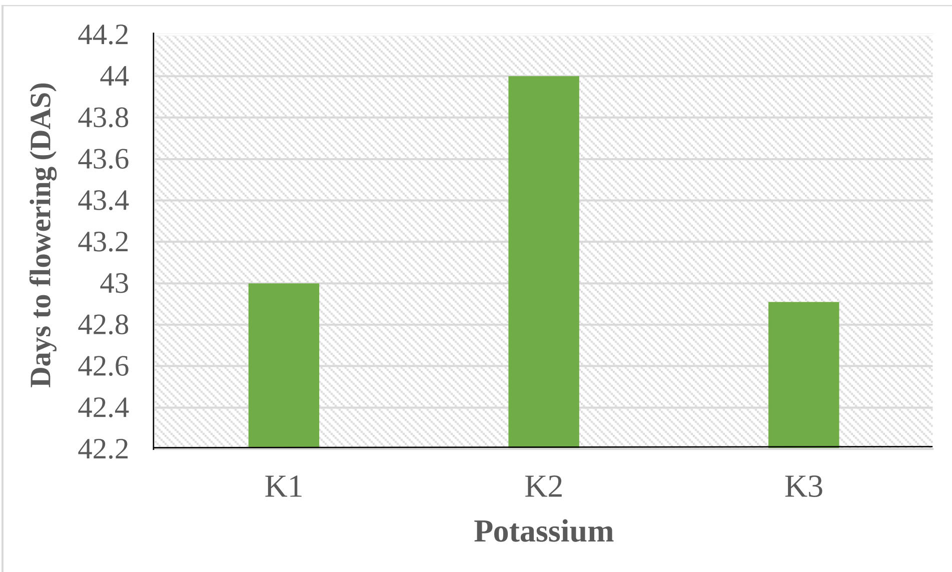
K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

4.6 Days to flowering

4.6.1 Effect of potassium

There was significant variation of potassium in terms of days to 80% flowering. K_3 (45 kg K_2O ha^{-1}) gets earlier flowering (42.91 DAS) which was statistically similar with K_1 (30 kg K_2O ha^{-1}) and K_2 (37.5 kg K_2O ha^{-1}) get late flowering (44 DAS). The effect of potassium on days to 80% flowering was shown in Figure 11.

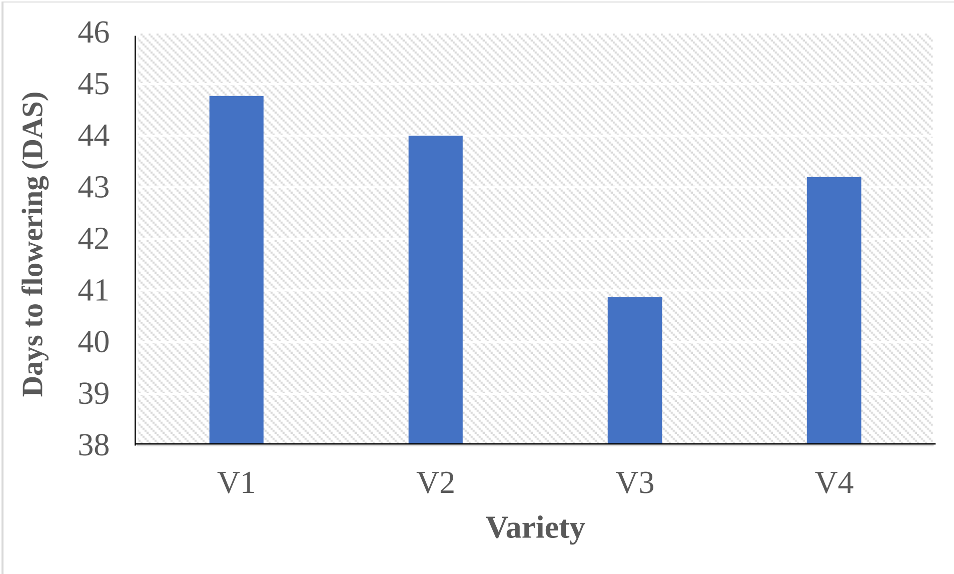


K_1 = 30 kg K_2O ha^{-1} K_2 = 37.5 kg K_2O ha^{-1} K_3 = 45 kg K_2O ha^{-1}

Figure 11. Effect of Potassium on days to flowering of sesame ($LSD_{0.05}$ = 0.46).

4.6.2 Effect of variety

There was significant variation of variety in terms of days to 80% flowering. V_3 (Binatil 3) gets earlier flowering (40.88 DAS). V_1 (BARI Til 3) gets late flowering (44.77 DAS) which was statistically similar with V_2 (BARI Til 4). The effect of varieties on days to 80% flowering was shown in Figure 12.



V_1 = BARI Til 3 V_3 = Binatil 3
V_2 = BARI Til 4 V_4 = Binatil 4

Figure 12. Effect of variety on days to flowering of sesame ($LSD_{0.05}$ = 1.31).

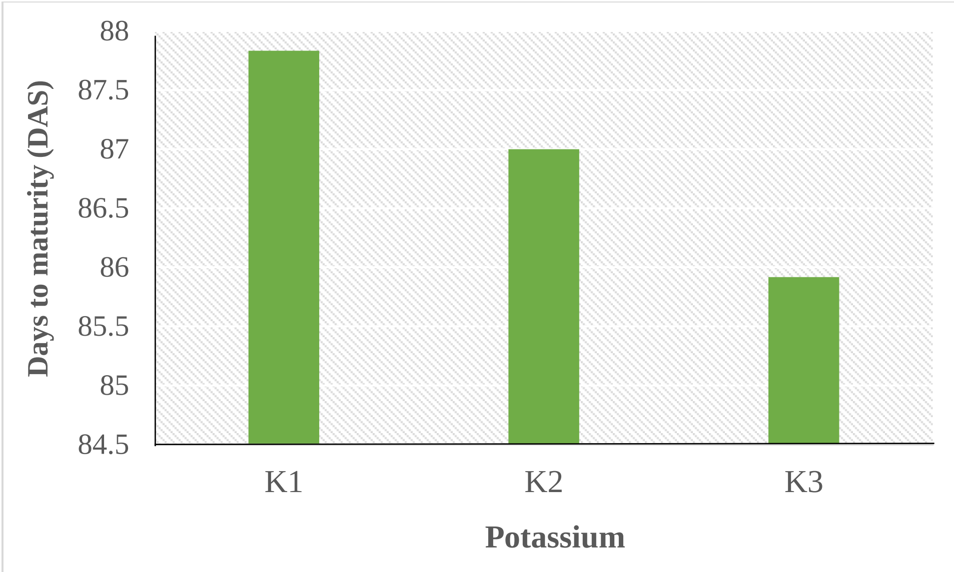
4.6.3 Interaction effect of potassium and variety

There was significant influence on interaction effect of potassium and variety in days to 80% flowering. K_3V_3 gets early flowering (40 DAS) and K_1V_1 and K_2V_2 gets late flowering (45 DAS) (Table 6).

4.7 Days to maturity

4.7.1 Effect of potassium

There was no significant variation of potassium in terms of days to 80% maturity. K_3 (45 kg K_2O ha^{-1}) gets earlier maturity (85.91 DAS) and K_1 (30 kg K_2O ha^{-1}) get late maturity (87.83 DAS). The effect of potassium on days to 80% maturity was shown in Figure 13.

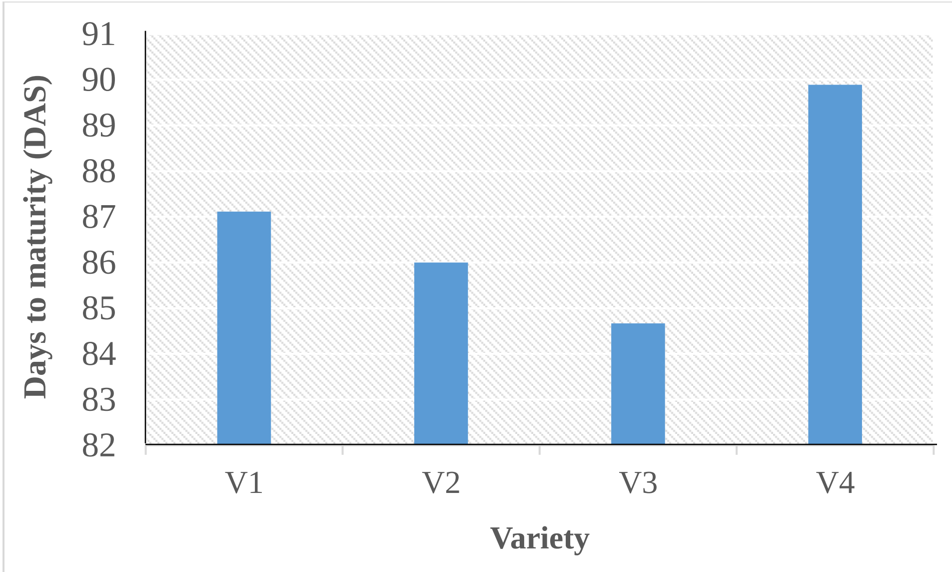


K_1 = 30 kg K_2O ha^{-1} K_2 = 37.5 kg K_2O ha^{-1} K_3 = 45 kg K_2O ha^{-1}

Figure 13. Effect of potassium on days to maturity of sesame ($LSD_{0.05}$ = 5.48).

4.7.2 Effect of variety

There was significant variation of variety in terms of days to 80% maturity. V_3 (Binatil 3) gets earlier maturity (84.66 DAS) which was statistically similar with V_1 (87.11 DAS) and V_2 (86 DAS) where V_4 (Binatil 4) get late maturity (89.88 DAS). The effect of varieties on days to 80% maturity was shown in Figure 14.



V_1 = BARI Til 3 V_3 = Binatil 3
V_2 = BARI Til 4 V_4 = Binatil 4

Figure 14. Effect of variety on days to maturity of sesame ($LSD_{0.05}$ = 3.04).

4.7.3 Interaction effect of potassium and variety

There was significance influence on interaction effect of potassium and variety in days to 80% maturity. K_3V_3 combination gets early maturity (83 DAS) and K_2V_4 gets late maturity (91 DAS) (Table 6).

Table 6. Interaction effect of potassium and variety on days to flowering and days to maturity of sesame.

Interaction	Days to flowering (DAS)	Days to maturity (DAS)
K_1V_1	45.66 a	90.33 ab
K_1V_2	43.66 a-c	85.66 a-c
K_1V_3	40.66 de	86.66 a-c
K_1V_4	42.33 b-d	88.66 a-c
K_2V_1	44.33 ab	85.00 bc
K_2V_2	45.33 a	87.00 a-c
K_2V_3	42.00 c-e	84.33 bc
K_2V_4	44.33 ab	91.66 a
K_3V_1	44.33 ab	86.00 a-c
K_3V_2	43.66 a-c	85.33 a-c
K_3V_3	40.00 e	83.00 c
K_3V_4	43.66 a-c	89.33 ab
$LSD_{(0.05)}$	2.02	7.07
CV (%)	3.07	3.54

K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

4.8 Length of capsule (cm)

4.8.1 Effect of potassium

Significant difference was recorded for potassium on length of capsule per plant of sesame (Table 7). The longest capsule (3.03 cm) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas shortest (2.71) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.8.2 Effect of variety

Significant variation was recorded for variety on length of capsule per plant of sesame (Table 7). The longest capsule (3.00 cm) was obtained from V_2 (BARI Til 4), whereas shortest (2.87) was recorded from V_4 (Binatil 4).

4.8.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on length of capsule per plant (Table 7). The longest capsule (3.28 cm) was obtained from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} with BARI Til 4), whereas shortest (2.57) was recorded from K_3V_1 treatment combination (45 kg K_2O ha^{-1} with BARI Til 3). The result is also in accordance with the finding of Jadav *et al.* (2010).

4.9 Number of capsules per plant

4.9.1 Effect of potassium

Significant difference was recorded for potassium on number of capsules per plant of sesame (Table 7). The maximum capsule (62.02) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas minimum (55.93) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.9.2 Effect of variety

Significant variation was recorded for variety on number of capsules per plant of sesame (Table 7). The maximum capsule (60.96) was obtained from V_2 (BARI Til 4) followed by V_1 (BARI Til 3), whereas minimum (57.21) was recorded from V_4 (Binatil 4).

4.9.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on number of capsules per plant (Table 7). The maximum capsule (64.92) was obtained from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} with BARI Til 4), whereas minimum (53.27) was recorded from K_3V_4 treatment combination (45 kg K_2O ha^{-1} with Binatil 4) which was statistically similar with K_3V_3.

4.10 Number of seeds per capsule

4.10.1 Effect of potassium

Significant difference was recorded for potassium on number of seed per capsule of sesame (Table 7). The maximum seed (56.67) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas minimum (49.72) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.10.2 Effect of variety

Significant variation was recorded for variety on number of seed per capsule of sesame (Table 7). The maximum seed (58.16) was obtained from V_1 (BARI Til 3), whereas minimum (49.44) was recorded from V_4 (Binatil 4).

4.10.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on number of seed per capsule (Table 7). The maximum seed (62.44) was obtained from K_2V_2

treatment combination (37.5 kg K_2O ha^{-1} with BARI Til 4), whereas minimum (53.27) was recorded from K_3V_3 treatment combination (45 kg K_2O ha^{-1} with Binatil 3) which was statistically similar with K_3V_4. Jadav *et al.* (2010) also found similar result.

4.11 Weight of 1000 seeds

4.11.1 Effect of potassium

Significant difference was recorded for potassium on thousand seed weight of sesame (Table 7). The maximum thousand seed weight (3.17 g) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas minimum (2.65 g) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.11.2 Effect of variety

Significant variation was recorded for variety on thousand seed weight of sesame (Table 7). The maximum weight (3.09 g) was obtained from V_2 (BARI Til 3), whereas minimum (2.67 g) was recorded from V_4 (Binatil 4).

4.11.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on thousand seed weight (Table 7). The maximum weight (3.51 g) was obtained from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} with BARI Til 4), whereas minimum (2.33 g) was recorded from K_3V_4 treatment combination (45 kg K_2O ha^{-1} with Binatil 4).

Table 7. Effect of potassium, variety and their interaction on length of capsule, no. of capsule plant^{-1}, no. of seed capsule^{-1} and 1000-seed weight of sesame

Potassium	Length of capsule (cm)	No of capsule plant^{-1}	No of seed capsule^{-1}	1000-seed weight (g)
K_1	3.00 a	60.39 b	55.30 a	2.87 b
K_2	3.03 a	62.02 a	56.67 a	3.17 a
K_3	2.71 b	55.93 c	49.72 b	2.65 c
$LSD_{(0.05)}$	0.15	0.96	3.14	0.09
CV (%)	4.65	4.43	5.15	5.81
Variety				
V_1	2.90 b	60.87 a	58.16 a	3.06 a
V_2	3.00 a	60.96 a	56.16 a	3.09 a
V_3	2.88 b	58.73 b	51.83 b	2.77 b
V_4	2.87 b	57.21 c	49.44 c	2.67 b
$LSD_{(0.05)}$	0.09	1.24	2.32	0.10
CV (%)	3.26	5.11	4.35	6.66
Interaction				
K_1V_1	3.11 ab	62.91 ab	60.80 a	3.13 bc
K_1V_2	2.96 b-e	59.44 de	55.52 bc	2.93 d
K_1V_3	3.07 a-c	60.46 c-e	55.96 bc	2.73 e
K_1V_4	2.88 d-f	58.78 ef	48.93 d-f	2.70 e
K_2V_1	3.02 b-d	62.40 bc	58.83 ab	3.31 b
K_2V_2	3.28 a	64.92 a	62.46 a	3.51 a
K_2V_3	2.90 c-e	61.15 b-d	53.30 cd	2.87 de
K_2V_4	2.92 b-e	59.60 de	52.10 cd	3.00 cd
K_3V_1	2.57 g	57.32 f	54.86 bc	2.72 e
K_3V_2	2.76 ef	58.53 ef	50.50 de	2.84 de
K_3V_3	2.68 fg	54.59 g	46.23 f	2.71 e
K_3V_4	2.82 d-f	53.27 g	47.30 ef	2.33 f
$LSD_{(0.05)}$	0.20	2.08	4.64	0.18
CV (%)	3.26	5.11	4.35	6.66

K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

4.12 Seed weight per plant

4.12.1 Effect of potassium

Significant difference was recorded for potassium on seed weight per plant of sesame (Table 8). The maximum seed weight (10.47 g) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas minimum (8.25 g) was recorded from K_3 (45 kg K_2O ha^{-1}). Dasamahapatra *et al.* (1990) also found similar result.

4.12.2 Effect of variety

Significant variation was recorded for variety on seed weight per plant of sesame (Table 8). The maximum weight (10.1 g) was obtained from V_2 (BARI Til 3), whereas minimum (9.06 g) was recorded from V_4 (Binatil 4). The result is also in accordance with the finding of Haque *et al.* (2007).

4.12.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on seed weight per plant (Table 7). The maximum seed weight (11.81 g) was obtained from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} with BARI Til 4), whereas minimum (7.19 g) was recorded from K_3V_4 treatment combination (45 kg K_2O ha^{-1} with Binatil 4). Haque *et al.* (2007) found similar result in terms of variety and sulphur.

4.13 Seed yield

4.13.1 Effect of potassium

Significant difference was recorded for potassium on seed yield of sesame (Table 8). The highest yield (1.16 t ha^{-1}) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas lowest (0.86 t ha^{-1}) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.13.2 Effect of variety

Significant variation was recorded for variety on seed yield per hectare of sesame (Table 8). The highest yield (1.09 t ha^{-1}) was obtained from V_2 (BARI Til 3), whereas lowest (0.94 t ha^{-1}) was recorded from V_4 (Binatil 4).

4.13.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on seed yield per hectare (Table 8). The highest yield (1.34 t ha^{-1}) was obtained from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} with BARI Til 4), whereas lowest (0.77 t ha^{-1}) was recorded K_3V_4 treatment combination (45 kg K_2O ha^{-1} with Binatil 4). Dasamahapatra *et al.* (1990) also found similar result.

4.14 Stover yield

4.14.1 Effect of potassium

Significant difference was recorded for potassium on stover yield of sesame (Table 8). The highest yield (3.94 t ha^{-1}) was obtained from K_1 (30 kg K_2O ha^{-1}), whereas lowest (3.66 t ha^{-1}) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.14.2 Effect of variety

Significant variation was recorded for variety on stover yield per hectare of sesame (Table 8). The highest yield (4.02 t ha^{-1}) was obtained from V_2 (BARI Til 3), whereas lowest (3.54 t ha^{-1}) was recorded from V_4 (Binatil 4).

4.14.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on stover yield per hectare (Table 8). The highest yield (4.74 t ha^{-1}) was obtained from K_1V_1

treatment combination (30 kg K_2O $ha^{-1}$with BARI Til 3), whereas lowest (3.24 t ha^{-1}) was recorded K_3V_4 treatment combination (45 kg K_2O ha^{-1} with Binatil 4).

4.15 Biological yield

4.15.1 Effect of potassium

Significant difference was recorded for potassium on biological yield of sesame (Table 8). The highest yield (5.03 t ha^{-1}) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas lowest (4.53 t ha^{-1}) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.15.2 Effect of variety

Significant variation was recorded for variety on biological yield per hectare of sesame (Table 8). The highest yield (5.11 t ha^{-1}) was obtained from V_2 (BARI Til 3), whereas lowest (4.49 t ha^{-1}) was recorded from V_4 (Binatil 4).

4.15.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on biological yield per hectare (Table 8). The highest yield (6.01 t ha^{-1}) was obtained from K_1V_1 treatment combination (30 kg K_2O $ha^{-1}$with BARI Til 3), whereas lowest (4.01 t ha^{-1}) was recorded K_3V_4 treatment combination (45 kg K_2O ha^{-1} with Binatil 4).

4.16 Harvest index

4.15.1 Effect of potassium

Significant difference was recorded for potassium on harvest index of sesame (Table 8). The highest value (22.91%) was obtained from K_2 (37.5 kg K_2O ha^{-1}), whereas lowest (18.93%) was recorded from K_3 (45 kg K_2O ha^{-1}).

4.15.2 Effect of variety

Significant variation was recorded for variety on harvest index of sesame (Table 8). The highest value (21.94%) was obtained from V_3 (Binatil 3), whereas lowest (20.63%) was recorded from V_1 (BARI Til 3).

4.15.3 Interaction effect of potassium and variety

Interaction effect of potassium and variety was found significant on harvest index (Table 8). The highest value (24.49%) was obtained from K_2V_3 treatment combination (37.5 kg K_2O ha^{-1} with Binatil 3), whereas lowest (17.06%) was recorded from K_3V_2 treatment combination (45 kg K_2O ha^{-1} with BARI Til 4).

Table 8. Effect of potassium, variety and their interaction on seed weight plant^{-1}, seed yield ha^{-1}, stover yield ha^{-1}, biological yield ha^{-1} and harvest index (%) of sesame

Potassium	Seed weight (g plant^{-1})	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index (%)
K_1	10.07 a	1.08 a	3.94 a	5.02 a	21.40 b
K_2	10.47 a	1.16 a	3.86 a	5.03 a	22.91 a
K_3	8.25 b	0.86 b	3.66 b	4.53 b	18.93 c
$LSD_{(0.05)}$	0.97	0.15	0.13	0.18	1.31
CV (%)	8.97	12.83	3.20	4.19	5.50
Variety					
V_1	9.84 a	1.05 a	3.99 a	5.04 a	20.63 b
V_2	10.01 a	1.09 a	4.02 a	5.11 a	20.96 ab
V_3	9.48 ab	1.05 a	3.74 ab	4.80 ab	21.94 a
V_4	9.06 b	0.94 b	3.54 b	4.49 b	20.79 ab
$LSD_{(0.05)}$	0.71	0.09	0.31	0.33	1.25
CV (%)	7.53	9.49	8.34	7.21	5.99
Interaction					
K_1V_1	11.36 ab	1.27 ab	4.74 a	6.01 a	21.07 c-e
K_1V_2	10.30 bc	1.12 bc	3.87 bc	4.99 c	22.30 a-d
K_1V_3	8.68 de	0.97 c-e	3.86 bc	4.84 cd	20.17 d-f
K_1V_4	9.95 cd	0.94 de	3.30 de	4.24 ef	22.07 b-d
K_2V_1	10.17 bc	1.10 b-d	3.76 b-d	4.87 cd	22.49 a-c
K_2V_2	11.81 a	1.34 a	4.28 ab	5.62 ab	23.52 ab
K_2V_3	9.88 cd	1.09 b-d	3.31 de	4.40 d-f	24.49 a
K_2V_4	10.03 b-d	1.11 b-d	4.10 b	5.22 bc	21.14 c-e
K_3V_1	7.99 ef	0.78 e	3.46 c-e	4.25 ef	18.33 fg
K_3V_2	7.94 ef	0.81 e	3.90 bc	4.71 c-e	17.06 g
K_3V_3	9.88 cd	1.09 b-d	4.06 b	5.15 bc	21.15 c-e
K_3V_4	7.19 f	0.77 e	3.24 e	4.01 f	19.18 e-g
$LSD_{(0.05)}$	1.43	0.20	0.49	0.53	2.27
CV (%)	7.53	9.49	8.34	7.21	5.99

K_1 = 30 kg K_2O ha^{-1}
K_2 = 37.5 kg K_2O ha^{-1}
K_3 = 45 kg K_2O ha^{-1}

V_1 = BARI Til 3
V_2 = BARI Til 4
V_3 = Binatil 3
V_4 = Binatil 4

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at research field of Sher-e-Bangla Agricultural University farm located in Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh. Experiment was executed during the period of March to July, 2019. The objective of the experiment was to determine the effect of potassium and varieties on growth and yield. The experiment was consisted of two factors. Factor A: 3 levels of potassium, such as K_1: 30 kg, K_2: 37.5 kg, K_3: 45 kg ha^{-1} and Factor B: 4 varieties, viz., BARI Til 3, BARI Til 4, Binatil 3, Binatil 4 in a Split Plot design with three replications.

In case of potassium, the tallest plant (52.38 cm, 95.37cm, 112.24 cm) was observed from K_2 (37.5 kg K_2O ha^{-1}) where the shortest plant (51.18 cm, 90.60 cm and 106.90 cm) was recorded from K_3 treated plots (45 kg K_2O ha^{-1}) at 45 DAS, 60 DAS and at harvest respectively. Highest relative water content (84.05%) was found in K_2 (37.5 kg K_2O ha^{-1}) and lowest was (76.13%) was found in K_3 (45 kg K_2O ha^{-1}) at 30 DAS. The maximum number of capsules per plant (62.02) was obtained from K_2 (37.5 kg K_2O ha^{-1}) and the minimum number (55.93) was recorded from K_3 (45 kg K_2O ha^{-1}). The longest capsule (3.03 cm) was obtained from K_2 (37.5 kg K_2O ha^{-1}) whereas shortest (2.71 cm) was recorded from K_3 (45 kg K_2O ha^{-1}). The maximum number of seeds per capsule (56.67) was obtained from K_2 (37.5 kg K_2O ha^{-1}) and the minimum number (49.72) was recorded from K_3 (45 kg K_2O ha^{-1}). The maximum weight of 1000 seeds (3.17 g) were obtained from K_2 (37.5 kg K_2O ha^{-1}). The lowest weight (2.65 g) was recorded from K_3 (45 kg K_2O ha^{-1}). The highest seed yield (1.16 t/ha) was obtained from K_2 (37.5 kg K_2O ha^{-1}). The lowest seed yield (0.86 t/ha) was recorded from K_3 (45 kg K_2O ha^{-1}). The highest stover yield (3.94 t/ha) was obtained from K_1 (30 kg K_2O ha^{-1}). The lowest stover yield (3.66 t/ha) was recorded from K_3 (45 kg K_2O ha^{-1}).

In case of varieties, at 30, 60 DAS and harvest the tallest plant (18.85 cm, 92.69 cm, 114.96 cm) was recorded from V_2 (BARI Til 4). Highest Relative water content (70.51% and 84.94%) was found in V_2 (BARI Til 4) at 45 and 60 DAS. Lowest was (73.43% and 70.85%) was found in V_4 (Binatil 4) at 30 and 60 DAS. The maximum number of capsules per plant (60.96) was obtained from V_2 (BARI Til 4). The minimum number (57.21) was recorded from V_4 (Binatil 4). The longest capsule (3 cm) was obtained from V_2 (BARI Til 4). The shortest (2.87 cm) was recorded from V_4 (Binatil 4). The maximum weight of 1000 seeds (3.09g) was obtained from V_2 (BARI Til 4). The lowest weight (2.67g) was recorded from V_4 (Binatil 4). The highest seed yield (1.09 t/ha) was obtained from V_2 (BARI Til 4). The lowest seed yield (0.94 t/ha) was recorded from V_4 (Binatil 4). The highest stover yield (4.09 t/ha) was obtained from V_2 (BARI Til 4) and lowest yield (3.54 t/ha) was recorded from V_4 (Binatil 4).

In the interaction effect of potassium and variety, the tallest plant (57.3 cm, 98.88 cm and 124.68 cm) was recorded from K_1V_1 treatment combination (30 kg K_2O ha^{-1} and BARI Til 3) and the shortest plant (43.60 cm, 87.02 cm, 99.34 cm) was recorded from K_1V_4 treatment combination (30 kg K_2O $ha^{-1}$and Binatil 4). Highest relative water content recorded from (86.91%, 75.08% and 89.01%) K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} and BARI Til 4) and lowest (70.58%, 62.14% and 60.37%) from K_3V_4 treatment combination (45 kg K_2O ha^{-1} and Binatil 4). Highest total dry matter weight recorded from (1.18 g and 10.64 g) K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} and BARI Til 4) in 30 and 60 DAS where lowest (0.66 g and 7.14 g) from K_3V_1 treatment combination (45 kg K_2O $ha^{-1}$and BARI Til 3). The maximum number of capsules per plant (64.92) was recorded from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} and BARI Til

4) and the minimum number of capsules per plant (53.27) was recorded from K_3V_4 treatment combination (45 kg K_2O ha^{-1} and Binatil 4). The longest capsule (3.28 cm) was recorded from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} and BARI Til 4), which was statistically similar with K_1V_1 treatment combination (30 kg K_2O ha^{-1} and BARI Til 3). The shortest capsule (2.57cm) was recorded from K_3V_1 treatment combination (45 kg K_2O ha^{-1} and BARI Til 3) which was statistically similar with K_3V_3 treatment combination (45 kg K_2O ha^{-1} and Binatil 3). The maximum number of seeds per capsule (62.46) was recorded from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} and BARI Til 4), which was statistically similar with K_1V_1 treatment combination (30 kg K_2O ha^{-1} and BARI Til 3) and the minimum number of seeds per capsule (46.23) was recorded from recorded from K_3V_3 treatment combination (45 kg K_2O ha^{-1} and Binatil 3) which was statistically similar with K_3V_4 (45 kg K_2O ha^{-1} and Binatil 4). The highest seed yield (1.34 t/ha) was recorded from K_2V_2 treatment combination (37.5 kg K_2O ha^{-1} and BARI Til 4) and the lowest seed yield (0.77 t/ha) was recorded from K_3V_4 (45 kg K_2O ha^{-1} and Binatil 4) treatment combination. The highest stover yield (4.74 t/ha) was recorded from K_1V_1 treatment combination (30 kg K_2O ha^{-1} and BARI Til 3) and the lowest stover yield (3.24 t/ha) was recorded from K_3V_4 (45 kg K_2O ha^{-1} and Binatil 4) treatment combination.

From the above discussion, it may be concluded that the combination of K_2V_2 treatment combination *i.e.,* 37.5 kg K_2O ha^{-1} and BARI Til 4 is optimum for the maximum growth and yield of sesame. Under the consideration of the findings of this experiment, further studies may be suggested in different regions of Bangladesh for regional adaptability.

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Appendix I. Characteristics of soil of experimental field

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Sher-e-Bangla Agricultural University Research Farm, Dhaka.
AEZ	AEZ-28, Modhupur Tract
General soil type	Deep Red Brown Terrace Soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled

B. The physical and chemical characteristics of soil of the experimental site (0-15 cm depth)

Physical characteristics	
Constituents	**Percent**
Sand	26
Silt	4
Clay	29
Textural class	Silty clay
Chemical characteristics	
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total nitrogen (%)	0.03
Available P (ppm)	20.54
Exchangeable K (me/100 g soil)	0.10

Source: Soil Resource and Development Institute (SRDI), Farmgate, Dhaka

Appendix II. **Monthly average temperature, relative humidity and total rainfall of the experimental site during the period from April, 2019 to July, 2019**

Year	Month	Air Temperature (^{0}C)			Relative Humidity (%)	Total rainfall (mm)	Sunshine (Hour)
		Max	Min	Mean			
2019	**April**	37	28	33	54	225.1	294
	May	39	29	35	61	259.1	294.5
	June	36	29	33	67	273.6	226.5
	July	34	28	31	74	380.6	194

Appendix III. Analysis of variance of the data on plant height (cm) of sesame as influenced by potassium, variety and their interaction at different days after sowing

Source of variation	df	Mean square of plant height at days after sowing			
		30	45	60	At harvest
Replication	2	0.1938	305.166	619.659	1114.49
Factor A (Potassium)	2	10.0336	1.485	65.662	5.20
Error-I	4	32.4533	1.428	15.520	6.11
Factor B (Variety))	3	1.0186	16.827*	5.474	88.23*
Interaction (A x B)	6	7.3204	77.532*	73.808*	225.52*
Error-II	18	4.8970	1.567	7.134	1114.49

*Significant at 5% level

Appendix IV. Analysis of variance of the data on relative water content of sesame as influenced by Potassium, variety and their interaction at different days after sowing

Source of variation	df	Mean square of relative water content at days different after sowing		
		30	**45**	**60**
Replication	2	246.977	17.892	128.634
Factor A (Potassium)	2	205.215*	127.659	134.409
Error-I	4	2.492	29.871	164.469
Factor B (Variety))	3	53.489*	48.424	461.064*
Interaction (A x B)	6	28.910	7.407	102.947
Error-II	18	14.055	49.084	81.266

*Significant at 5% level

Appendix V. Analysis of variance of the data on leaf dry weight plant^{-1} of sesame as influenced by Potassium, variety and their interaction at different days after sowing

Source of variation	df	Mean square of leaf dry weight plant^{-1} at days different after sowing		
		30	**45**	**60**
Replication	2	0.20684	1.75380	5.40750
Factor A (Potassium)	2	0.00470	0.55937*	0.76767*
Error-I	4	0.00174	0.02072	0.13185
Factor B (Variety))	3	0.01922*	0.17243	0.61092*
Interaction (A x B)	6	0.04498**	0.16265*	0.86417*
Error-II	18	0.00338	0.07191	0.12798

*Significant at 5% level

Appendix VI. Analysis of variance of the data on stem dry weight plant^{-1} of sesame as influenced by Potassium, variety and their interaction at different days after sowing

Source of variation	df	Mean square of stem dry weight plant^{-1} at different days after sowing		
		30	45	60
Replication	2	0.17521	3.57234	11.8696
Factor A (Potassium)	2	0.02814*	0.13924*	1.2908*
Error-I	4	0.00255	0.01078	0.0622
Factor B (Variety))	3	0.02672**	0.38708*	0.7831
Interaction (A x B)	6	0.01949**	0.21687*	1.0295*
Error-II	18	0.00149	0.06062	0.3422

*Significant at 5% level

**Significant at 1% level

Appendix VII. Analysis of variance of the data on total dry matter weight plant^{-1} of sesame as influenced by potassium, variety and their interaction at different days after sowing

Source of variation	df	Mean square of total dry matter weight plant^{-1} at different days after sowing		
		30	45	60
Replication	2	0.77023	15.3069	66.3210
Factor A (Potassium)	2	0.13390*	1.1859*	6.1881*
Error-I	4	0.00376	0.0271	0.4935
Factor B (Variety)	3	0.01451	0.4495*	9.9948*
Interaction (A x B)	6	0.08553*	1.1904*	5.1125*
Error-II	18	0.00733	0.1307	0.6366

*Significant at 5% level

Appendix VIII. Analysis of variance of the data on length of capsule, no. of capsule plant^{-1}, no. of seed capsule^{-1} and 1000-seed weight of sesame of sesame as influenced by potassium, variety and their interaction

Source of variation	df	Mean Square			
		Length of capsule (cm)	No of capsule plant^{-1}	No of seed capsule^{-1}	1000-seed weight (g)
Replication	2	0.25360	248.856	566.645	1.55884
Factor A (Potassium)	2	0.38191*	119.358*	162.632*	0.82777*
Error-I	4	0.01839	0.723	7.701	0.00664
Factor B (Variety))	3	0.02925*	29.476*	142.190*	0.38762*
Interaction (A x B)	6	0.06627*	6.556*	22.247*	0.06875*
Error-II	18	0.00906	1.568	5.494	0.01130

*Significant at 5% level

Appendix IX. Analysis of variance of the data on seed weight plant^{-1}, seed yield ha^{-1}, Stover yield ha^{-1}, Biological yield ha^{-1} of sesame as influenced by potassium, variety and their interaction

Source of variation	df	Mean Square			
		Seed weight	Seed yield	Stover yield	Biological yield
Replication	2	160.546	0.83501	0.65935	2.75777
Factor A (Potassium)	2	16.853*	0.28031*	0.24364*	0.96635*
Error-I	4	0.741	0.01773	0.01496	0.02566
Factor B (Variety))	3	1.617*	0.03662*	0.44633*	0.70989*
Interaction (A x B)	6	4.214*	0.07162*	0.80157*	1.24798*
Error-II	18	0.523	0.00970	0.10188	2.75777

*Significant at 5% level