EFFECT OF POTASSIUM AND MOLYBDENUM ON THE GROWTH, YIELD AND OIL CONTENTS OF BARI SOYBEAN-5

MD. SHOAIB AL ANSARY

DEPARTMENT OF SOIL SCIENCE
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

JUNE, 2014

EFFECT OF POTASSIUM AND MOLYBDENUM ON THE GROWTH, YIELD AND OIL CONTENTS OF BARI SOYBEAN-5

BY

MD. SHOAIB AL ANSARY

REG. NO. : 08-02724

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

MASTER OF SCIENCE (MS)
IN
SOIL SCIENCE

SEMESTER: JANUARY-JUNE, 2014

APPROVED BY:

Prof. Mst. Afrose Jahan
Supervisor

Prof. Dr. Alok Kumar Paul
Supervisor

Dr. Mohammad Issak
Chairman
Examination Committee

DEPARTMENT OF SOIL SCIENCE
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

This is to certify that the thesis entitled **'Effect of Potassium (K) and Molybdenum (Mo) on the Growth, Yield and Oil Contents of Bari Soybean-5'** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfilment of the requirements for the degree of **Master of Science** in **Soil Science**, embodies the result of a piece of bonafide research work carried out by **Md. Shoaib Al Ansary**, Registration number: **08-02724** 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.

Dated:
Dhaka, Bangladesh

Prof. Mst. Afrose Jahan
Department of Soil Science
Sher-e-Bangla Agricultural University
Dhaka-1207

DEDICATED

TO

MY BELOVED PARENTS

ACKNOWLEDGEMENT

All praises to Almightly and Kindfull faith on to "Omnipotent Allah" for His never-ending blessing. The author deems it a great pleasure to express his profound gratefulness to his respected parents, who entiled much hardship inspiring for prosecuting his studies, receiving proper education.

The author likes to express his deepest sense of gratitude to his respected supervisor Professor Mst. Afrose Jahan, Department of Soil Science, Sher-e-Bangla Agricultural University (SAU), Dhaka, for her scholastic guidance, support, encouragement, valuable suggestions and constructive criticism throughout the study period and gratuitous labor in conducting and successfully completing the research work and in the preparation of the manuscript writing including data analysis.

The author also expresses his gratefulness to his respected Co-Supervisor Professor Dr. Alok Kumar Paul, Department of Soil Science, SAU, Dhaka for his scholastic guidance, helpful comments and constant inspiration, inestimatable help, valuable suggestions throughout the research work and in preparation of the thesis.

The author expresses his sincere gratitude towards the sincerity of the Chairman, Dr. Mohammad Issak, Associate Professor, Department of Soil Science, SAU, Dhaka for his valuable suggestions and cooperation during the study period. The author also expresses heartfelt thanks to all the teachers of the Department of Soil Science, SAU, for their valuable suggestions, instructions, cordial help and encouragement during the period of the study.

The author expresses his sincere appreciation to his brother, sisters, relatives, well wishers and friends for their inspiration, help and encouragement throughout the study period.

The Author

EFFECT OF POTASSIUM AND MOLYBDENUM ON THE GROWTH, YIELD AND OIL CONTENTS OF BARI SOYBEAN-5

ABSTRACT

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from December, 2013 to April 2014 to study the effect of potassium and molybdenum on the growth, yield and oil content of BARI soybean 5. The experiment comprised of two factors; Factor A: Levels of potassium (4 levels)- K_0: 0 kg K_2O ha^{-1} (control); K_1: 30 kg K_2O ha^{-1}, K_2: 40 kg K_2O ha^{-1}, K_3: 50 kg K_2O ha^{-1} and Factors B: Levels of molybdenum (3 levels)- Mo_0: 0 kg Mo ha^{-1} (control), Mo_1: 1.0 kg Mo ha^{-1}, Mo_2: 1.5 kg Mo ha^{-1}. The two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. For potassium fertilizer, the highest seed yield (2.01 t ha^{-1}) was observed from K_2 and the lowest seed yield (1.60 t ha^{-1}) was observed from K_0. The highest oil content (26.15%) was observed from K_2 (40 kg K_2O ha^{-1}) and the lowest oil content (16.64%) from K_0. The maximum concentration in seed for N (2.39%), P (0.506%), K (1.005%), S (0.507%) and Mo (0.086%) was found from K_2, while the minimum (1.57%), P (0.238%), K (0.382%), S (0.189%) and Mo (0.066%) was found from K_0. In case of molybdenum, the highest seed yield (2.11 t ha^{-1}) was recorded from Mo_2, whereas the lowest seed yield (1.58 t ha^{-1}) from Mo_0. The highest oil content (23.89%) was recorded from Mo_2, whereas the lowest oil content (21.10%) from Mo_0. The maximum concentration in seed for N (2.40%), P (1.045%), K (0.448%), S (0.461%) and Mo (0.078%) was observed from Mo_2 and the minimum concentration in seed for N (1.64%), P (0.541%), K (0.302%), S (0.269%) and Mo (0.052%) was recorded from Mo_0. Due to the interaction effect of different levels of potassium and molybdenum, the highest seed yield (2.43 t ha^{-1}) was found from K_2Mo_2, while the lowest (1.43 t ha^{-1}) was found from K_0Mo_0. The highest oil content (28.19%) was found from K_2Mo_2, while the lowest oil content (15.16%) from K_0Mo_0. The maximum concentration in seed for N (2.85%), P (1.509%), K (0.679%), S (0.623%) and Mo (0.140%) was observed from K_2Mo_2, whereas the minimum concentration in seed for N (1.21%), P (0.360%), K (0.173%), S (0.164%) and Mo (0.041%) was found from K_0Mo_0. Application of 40 kg K_2O ha^{-1} & 1.5 kg Mo ha^{-1} can be more beneficial for the farmers to get maximum yield and as well as economic return from the cultivation of BARI soybean 5.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

Soybean (*Glycine max* L.) belongs to the family leguminosae, sub-family papilionidae is an important and well recognized oil and protein containing crop of the world' particularly in the tropical to the mid temperate zones. About 73,444 thousand hectares of land in the world is under cultivation of soybean and annual production is approximately 191,933 million tons (FAO, 2008). Soybean is a good source of protein, unsaturated fatty acids, minerals like Ca and P including vitamin A, B, C and D (Rahman, 1982). It seeds contain 42-45% best quality protein and 20-22% edible oil (Wahhab, 2001), 24-26% carbohydrate (Gowda and Kaul, 1982) and 3.3-6.4% ash (Purseglove, 1984).

Soybean is the second largest crop in cash sales. The majority of soybean crops are processed for oil and meal, and soybean is the only plant food that contains complete protein that provides all essential amino acids required for human health. Soybean seed also contains carbohydrate, fatty acids, and minerals. Polyunsaturated fatty acids in diet have been shown to actively lower serum cholesterol levels (Hegstad, 2008). As a grain legume crop it is gaining an important position in the agriculture of tropical countries including India, Sri Lanka, Thailand and Bangladesh. Besides, it also contains various vitamins and minerals. It provides around 60% of the world supply of vegetable protein and 30% of the oil (Fehr, 1989). Furthermore, soybean oil is cholesterol free and is easily acceptable in our daily diet. On an average, about 8-10% of the protein intake in Bangladesh diet originates from animal sources (Begum, 1989) and the rest can be met from plant sources especially from the pulse crops like soybean. Soybean is originating from the hot areas of South-East Asia, but more than 50% of its production today comes from the United States and South America. Per hectare yield of soybean in Bangladesh is only 1.2 t ha^{-1} (BARI, 2007) as compared to other soybean producing countries of the world like USA with seed yield of 3.5 t ha^{-1} (James *et al*., 1999).

Yield of soybean is very low in Bangladesh and such low yield however is not an indication of low yielding potentiality of this crop, but may be attributed to a number of reasons, viz., unavailability of seeds of high yielding varieties with indicative quality, delayed sowing, fertilizer management, disease and insect infestation, modern cultivation and improper or limited irrigation facilities. There are 17 essential elements, among them some elements required in relatively high amounts, are called macronutrients and some in trace amounts are called micronutrients. Potassium play an important role in increasing yield of pulses and oilseed legumes and micronutrients are required in relatively smaller quantities if any element is lacking in the soil or not adequately balanced, growth suppression or even complete inhibition may result (Mengel *et al.,* 2001). Most importantly, micronutrients are involved in the key physiological processes of photosynthesis and respiration and their deficiency can impede vital physiological processes thus limiting yield (Marschner, 1995).

Potassium (K) is an essential nutrient involved in regulating water balance (Mehdi, 2007) and enhancing water uptake. Potassium is involved in nearly all processes needed to sustain plant life besides its role in conferring pest and disease resistance. Soybean crop takes up and removes large amounts of potassium from soil than any other nutrient (Tiwari, 2001). Potassium application have shown to increase the number of pods as well as exerted a beneficial influence on retaining pods until harvest in soybean (Coale and Grove, 1990). Potassium fertilization can be either applied to soil or as foliar spray to plants. Soil application is the standard form of application and has its own advantages unless soil pH and other factors affect the movement and uptake from soil to the plants. Foliar application can rapidly help plants to recover from stress due to drought, high heat, pests and diseases. The conventional way to apply K to the soil is before planting (pre-planting), and larger quantity may improve soil fertility for subsequent crops (Fernandez, 2012). Previous research has focused on foliar fertilization of soybeans at late reproductive stages and produced inconsistent and insignificant results (Weir, 1998). Studies have shown that both pre-plant and foliar K applications can increase soybean yields with low to medium soil K levels (Nelson *et al*., 2007). Although soil application of K fertilizers have been used to maintain optimum level of nutrients in crop (Hiller, 1995).

Molybdenum is an important co-factors components of key enzymes of assimilatory nitrogen metabolism, nitrogen fixation, nitrate uptake (Gupta and Lipsett, 1981; Campbell, 1999). It is an essential micronutrient and required for the formation of the nitrate reductase enzyme and in legume is directly involved in symbiotic nitrogen fixation (Williams and Fraustoda Silva 2002; Roy *et al.,* 2006). Application of molybdenum into the soils has increased the contents of potassium, phosphorus and crude protein (Anonymous, 2005). Molybdenum is required for growth of most biological organisms including plants (Graham and Stangoulis, 2005). Moreover, Mo is an element that is translocated with low mobility inside plants, which is the main reason for its low utilization by plant organs during the period of starvation (Gupta and Lipsett, 1981). Molybdenum has a positive effect on yield quality and nodules forming in legume crops and molybdenum increased plant height, number of branches and pods plant^{-1}, number of seeds plant^{-1} and seeds yield (Togay *et al*., 2008). Effects of molybdenum and boron on legumes have been reported by many scientists (Bhuiyan *et al*., 1998; Verma *et al*., 1988; Tiwari *et al*., 1989; Zaman *et al*., 1996).

Considering the above all situation a study was conducted with different levels of potassium and molybdenum on BARI soybean 5 with the following objectives:

a. To find the effect of potassium and molybdenum on growth and yield of BARI soybean 5;
b. To determine the yield and yield contributing characters of BARI soybean 5 due to the effect of different level of potassium and molybdenum; and
c. To assess the concentration of different nutrients in seeds and stover due to the application of different levels of potassium and molybdenum.

CHAPTER II

REVIEW OF LITERATURE

Soybean is well recognized oil and protein containing crop has conventional less attention by the researchers on various aspects of production technology because normally this crop grows with minimum care or minimum agronomic and management practices for that a very few research have been carried out in our country. However, researches in home and abroad trying to maximize the yield of soybean with different management practices especially on NPK fertilizer, spacing, variety, weeding, biofertilizers etc, but not other macro and micro nutrients. Potassium and molybdenum play an important role in improving soybean growth and yield. But research works related to potassium and molybdenum are limited in Bangladesh context. However, some of the important and informative works and research findings related to the potassium and molybdenum so far been done at home and abroad have been reviewed in this chapter under the following headings-

2.1 Potassium on plant growth, yield attributing characters and yield

Semina *et al*. (2014) carried out and experiment to study aimed to evaluate the production and physiological quality of soybean seeds (cv. Monsoy 9350) in Piaui Cerrado under the influence of times and doses of potassium and, the treatments consisted of the combination of five doses of potassium (30, 60, 90, 120 and 150 kg K_2O ha^{-1}) + additional treatment (zero kg ha^{-1}). The yield and harvest index of grain, thousand seed weight, seedling length, seedling dry weight, rate of germination, germination and first count. Except for the germination and germination speed index, all other parameters were significantly influenced by K rates. The length and seedling dry weight increased with the increasing use of K, showing greater seed vigor. Doses of 80 to 95 kg ha^{-1} K_2O provide the best results for all parameters evaluated.

Experiments were carried out by Batistella *et al*. (2013) in two growing seasons, with five levels of phosphorus (0, 40, 80, 120, and 160 kg ha^{-1} P_2O_5 as triple superphosphate), three of potassium (0, 50, and 100 kg ha^{-1} K_2O as potassium chloride) and reported that potassium fertilization do not influence yield or K concentration in the seeds, but may improve germination, without interfering in vigor.

A field experiment was conducted by Xiang *et al*. (2012) to determine the effect of Phosphorus (P) application and Potassium (K) application (0, 37.5, 75.0 and 112.5 kg ha^{-1}) on growth and yield of soybean (*Glycine max* (L.) Merr.) and found that by applying K from 0 to 112.5 kg K ha^{-1}, plant height, lodging rate, unfilled pod ratio, and 100 seeds weight were significantly reduced, while pods per plant, seeds per pod, and harvest index remarkably increased.

A field experiment was conducted by Farhad *et al*. (2010) at the Sher-e-Bangla Agricultural University Farm, Dhaka 1207 during the period from December 2008 to April 2009 to study the role of potassium and sulphur on the growth, yield and oil content of soybean (*Glycine max* var. BARI Soybean-5). The experimental soil was clay loam in texture having pH of 6.3. The experiment included four levels of potassium viz. 0, 20, 40 and 70 kg K ha^{-1} and four levels of sulphur viz. 0, 10, 20 and 40 kg S ha^{-1}. Potassium showed significant effect on yield and yield attributes of soybean. Application of potassium @ 40 kg ha^{-1} produced the highest plant height, seed yield, 1000-seed weight and straw yield.

Habibzadeh *et al.* (2004) conducted a field experiment during the 2001 summer season in Mazandaran on the yield and yield components of soybean cv. BP 692. The treatments comprised: 0, 75, 150 and 225 kg K ha^{-1}; The K fertilizer rates had significant effect on yield, number of pods $plant^{-1}$ and 1000-seed weight. The highest yield (2962.5 kg ha^{-1}) and 1000-seed weight (146.6 g) were obtained with 225 kg K ha^{-1}.

Menaria *et al.* (2004) conducted a field experiment during at Udaipur, Rajasthan, India to study the effect of chemical fertilizer K on the yield attributes and both seed and stover yields of soybean. Application of 40 kg K ha^{-1} significantly increased all yield attributes and both seed and stover yields.

Nita *et al.* (2002) carried out a field experiment during the summer of 1998-99 study the effect of K at 0, 20 and 40 kg ha^{-1} on the growth and productive attributes of soybean in West Bengal, India. They reported that leaf area index, plant height, nodule $plant^{-1}$, nodule dry weight, pods $plant^{-1}$, seed yield, harvest index and net production value increased with increasing rates of potassium.

Yin and Vyn (2002) conducted a field experiment to evaluate the effects of potassium application rates (0, 42 and 84 kg ha^{-1}) on soybean. They found that average soybean yield significantly increased with the application of 84 kg K ha^{-1}.

Prakash *et al*. (2002) a field experiment in India were evaluated during 2000 to assess the yield response of soybean cv. Bragg. The average yield data for 27 years should that significant response to applied K resulting in 69.9% increased in the yield of soybean.

Wang *et al*. (2002) conducted an experiment to determine the effects of K humate (2000 and 1250 mg kg^{-1}) foliar application on soybean crop yield, the average yield increased by 14.06% (3699.9 kg $hm2^{-1}$) compared to the control.

Mondal *et al.* (2001) conducted field trails of soybean with 3 K rates (0, 33 and 66 kg ha^{-1}) in west Bangle, India during the rainy and summer seasons. They observed that yield of soybean was high with 66 kg ha^{-1} application.

Sangakkara *et al*. (2001) carried out a field experiment to determine the benefits of potassium in overcoming water stress in soybean. They found that potassium increased shoot growth, root growth and as a significant factor in overcoming soils moisture stress in tropical cropping systems.

Bansal (2001) conducted a field experiment from 1993 to 1996 in 10 fields Sesore, Madhya Pradesh, India to study the effect of K fertilizer on the yield of soybean. Five treatments were tested, consisting of 3 levels of KCl (0, 50 and 100 kg ha^{-1}). They found that K fertilizer rate at 50 kg K ha^{-1} resulted in the highest yield of soybean (25.9 q ha^{-1}).

Gurkirpal and Singh (2001) conducted a field experiment during the Kharif season in Punjab, India, to evaluate the response of soybean to the application of K (30 and 60 kg K ha^{-1}). The growth attributes and grain yield of soybean significantly increased with the application of the fertilizers. The highest number of pods $plant^{-1}$, seed yield and 100-seed weight were obtained at 60 kg K_2O.

Novo and Tanaka (2001) studied the effect of K on crop yield of soybean were evaluated in 1991 to 1993 at experimental stations in Mococa, Ribeirao Preto and Botuporanga. Soybeans cv. IAC-8 and IAC-14 were given 0, 30 and 60 kg ha^{-1} and potassium chloride. Potassium application increased the yield of soybean.

Prassad *et al.* (2000) conducted a pot experiment to study the effect of potassium on yield, water used efficiency and K-uptake by summer soybean. They observed that total biomass production, grain yield, water use efficiency and K-uptake significantly increased with 20 and 30 kg K ha^{-1} as compared to other level of potassium.

Chawdhury and Mohamood (1999) laid out a field experiment to study the effect of optimum potassium levels on growth, yield and quality of soybean and reported that 50 kg K_2O gave the highest seed yield (832 kg ha^{-1}) and the optimum level of K_2O was between 50 to 100 kg ha^{-1}.

Costa and Akanda (1999) conducted a field experiment in Bangladesh to evaluate the response of 3 cultivars of soybean (Bragg, Davis, Sohag) to 3 levels of K (0, 20 and 40 kg K_2O ha^{-1}), during the rabi season. Application of K_2O up to 40 kg ha^{-1} significantly increased the yield of soybean.

Abd-el-lateef *et al.* (1998) carried out a field experiment with 0 or 24 kg K_2O feddan^{-1} (0.42 ha^{-1}) and observed that seed yield increased by the application of K.

Sushil *et al.* (1997) conducted an experiment to study the effect of potassium supply (25 and 100 mM) on seed protein of soybean. They reported that the amount of globulin and albumin were increased with increasing concentration of K. Tryptophan in all the protein fractions also increased with higher K levels.

Asghar *et al.* (1996) conducted a field experiment to study the influence of various doses of potassium on yield and quality of soybean. They reported that the number of pods plant^{-1}, number of seeds pod^{-1}, seed yield ha^{-1} and seed protein contents were influence significantly by potassium application and the highest seed yield (1.67 t ha^{-1}) was obtained with application of 75 kg K_2O ha^{-1}.

Singh *et al*. (1993) conducted a field experiment to study the response of potassium. The reported that application of potassium improved plant productivity and enhanced the grain yields of green gram significantly. They also reported that response to K_2O was recorded up to 40 kg ha^{-1}.

Dinata *et al*. (1992) studied the effect of 0, 12.5, 25, 37.5, 50 and 75 kg K_2O ha^{-1} and reported that application of potassium significantly increased the entire yield contributing characters, grain yield and dry matter with increasing levels of potassium.

Sangakkara (1990) carried out a field experiment to study the effects of 0-120 kg K_2Oha^{-1} on growth, yield parameters and seed quality of soybean and reported that K application increased plant growth rate, flowers plant^{-1}, percentage pod set, seeds pod^{-1}, 100-seed weight and yield plant^{-1}.

Sardana and Verma (1987) made a field trial in Delhi. India, with application of potassium fertilizers and reported that plant height, leaf surface area, number and length of pods, 100-grain weight and yield of green gram were significantly increased.

2.2 Molybdenum on plant growth, yield attributing characters and yield

This study examined by Ting Sun *et al*. (2013) the effects of molybdenum (Mo) and boron (B) on the rhizosphere microorganisms and the soil enzyme activities of soybean. The soybeans were treated with seven different Mo and B supplements (control: without Mo and B) Mo1 (0.0185 g kg^{-1}), B1 (0.08 g kg^{-1}), Mo1 + B1 (0.0185 + 0.08 g kg^{-1}), Mo2 (0.185 g kg^{-1}), B2 (0.3 g kg^{-1}) and Mo2 + B2 (0.185 + 0.3 g kg^{-1}) throughout the plants' four growth stages. The results showed that Mo, B, and combined Mo and B treatments increased the soil microbial populations, stimulated the rhizosphere metabolisms, and improved the soil enzyme activities as well as yield.

A field trial was carried out by Zahoor *et al*. (2013) to evaluate the response of soybean to micronutrients viz. iron (Fe), molybdenum (Mo) and cobalt (Co). Results indicated that iron applied at the rate of 400 g ha^{-1} and molybdenum @ 20 g ha^{-1} had a significant effect on shoot length, shoot dry weight, number of nodules $plant^{-1}$, nodules fresh weight and thousand seed weight. The highest seed yield 42.28% over control, dry matter yield, seed nitrogen and seed protein content was recorded by combined application of Fe at the rate of 400 g ha^{-1} and Mo @ 20 g ha^{-1}.

Liu Peng *et al*. (2005) carried out experiment in pot culture with three cultivars (Zheehun no. 3, Zheehum of Mo and/or B sufficiently increased the absorption of Mo and B by soybean. High supply of Mo enhanced Mo absorption and content. Combined application of proper Mo and B levels led to more Mo absorption by soybean and hence higher Mo content, than single application of proper Mo level at early stage but less at later stage. The Mo absorbed by soybean mainly accumulated in seeds.

Meschede *et al*. (2004) conducted a field experiment in Brazil, to investigate the effect of Mo and Co as foliar application and seed treatment on grain yield, seed protein content and agronomic traits of soybean cv. BRS 133. The treatments consisted of combination of seed treatment with and without Mo and Co (Comol;

12% Mo and 2% Co) and foliar application at different stages at development with the following commercial products; Comol at V_4 stage, Bas-Citrus (10% N, 4% Zn, 3.7% S, 3% Mn and 0.5% B) at V_4 stage, A control without Mo and Co application was included. The seed treatment with Mo and Co increased the seed protein content and grain yield.

Masto *et al.* (2004) conducted a pot experiment during rabi season in Hyderabad using soybean as the test crop. The treatment used in the study consisted of two levels of liming (0 and 3.5 tons ha^{-1} based on lime requirement), two levels of P (0 and 10 mg P kg^{-1}) and three levels of Mo (0, 0.25 and 0.5 mg Mo kg^{-1}). It was observed that liming at 3.5 tons ha^{-1} and phosphorus applied at 10 mg P kg^{-1}, both combine with 0.5 mg Mo kg^{-1} resulted to maximum values of phosphorus and molybdenum better than all other treatments and control.

Mahapatra (2003) carried out a field experiment to evaluated the performance of soybean as influenced by S and Mo. The experiment comprised four levels of sulphur and molybdenum viz. 0, 6, 12, 18 kg S ha^{-1} and 0, 1, 2, 3 kg Mo ha^{-1} as gypsum and ammonium molybdate, respectively. Highest biological yield and most of the yield attributes were obtained for the treatment combination of 12 kg S ha^{-1} and 2 kg Mo ha^{-1} Grain yield was found to be significantly and positively correlated with effective pod and seed $plant^{-1}$.

Billore and Joshp (2000) conducted a field experiment to study direct and residual effect of integrated micronutrient application on soybean-wheat cropping system. The seed treatment with sodium molybdate @ 4 g Mo kg^{-1} seed was found most remunerative in soybean-wheat cropping system.

Sfredo *et al.* (1997) assessed the effectiveness of products containing trace elements applied to the seed on yield and protein contain of soybean seeds. They found that application of Mo significantly increased seed yield up to 0.48 t ha^{-1} and increased seed protein content by up to 60 g kg^{-1}.

Bukhoriev (1997) conducted a field trails on dark soil low in B and Mo, irrigated soybean were given no trace elements or 1 kg B at sowing and/or 50 g Mo as an ammonium molybdate seed treatment. Application of B + Mo increased the number and weight of nodules ha^{-1} by 24 and 29%, respectively. Applying either B or Mo gave smaller increases. Seed yields were 2.60 t ha-1 in the control, 2.72 t with B, 2.76 t with Mo and 2.95 t with B + Mo. Seed protein content and protein yield were highest with the application of B + Mo.

Razmjoo and Henderlong (1997) conducted a field experiment and revealed that plant K, Mg and Ca contents and yield were not significantly affected by Mo application. Combination of K, S, B and Mo fertilizer had variable effects and the effect was dependent on the combination of fertilizer sources and levels.

Dwivedi *et al*. (1996) carried out a field experiment to study the influence of phosphorus and molybdenum application on nutrient status in various plant parts of soybean. The reported that 1.0 kg Mo ha^{-1} enhanced the absorption of all the nutrients and their accumulation in various plant parts including seed.

Srivastava and Ahlaeat (1995) observed that molybdenum application at 0.5 kg ha^{-1} significantly increased nodule number, pod $plant^{-1}$ and 1000-grain weight. Application of Mo increased N uptake.

Gupta and Vyas (1994) conducted a field trails at kota, Rajasthan to determine the effect of phosphorus, zinc and molybdenum on the yield and quality of soybean. They applied 0, 40, 80 kg P_2O_5 ha^{-1} as superphosphate, 0, 15, 30 kg $ZnSO_4$ ha^{-1} and 0, 0.5 kg Na^2MoO^4 ha^{-1} and reported that seed yield was highest by the application of Mo with 40 kg P_2O_5 and 15 kg $ZnSO_4$ ha^{-1}. Seed protein content was increased by P, Zn and Mo application while oil content was increased by Zn application only.

Kumar *et al.* (1993) reported that seed yield of lentil increased with increasing Mo and P rates and was highest with the combine application of Mo and P at the highest 2 ppm Mo and 50 P rates. P and Mo concentration and uptake in seed and straw increased with increasing Mo and P rates.

Haque and Bundu (1980) observed that inoculation with Rhizobium-N Mo and mulch increased the number and weight of nodules of soybean compared with the control. Seed yield was increased by all treatment, notably 360 and 279% for N + Mo + inoculation and for N + inoculation, respectively, seed protein content was also increased by all treatment, especially 18.6% by N + Mo + inoculation and 16.8% by inoculation + mulch.

Subbian and Ramiah (1982) observed that redgram (*Cajanus cajan*) CV-3 with and without rhizobial inoculation and seed treated with 1% sodium molybdate were grown with 0, 25 and 50 kg P_2O_5 ha^{-1} . Phosphorus affected the growth and yield of the crop significantly but rhizobial inoculation and soil or seed treatment with sodium molybdate did not affect.

Ibupoto and Kotecki (1994) observed that application of Mo or Mo + B to soybean increased the number of seeds plant and seed yield. They observed that application of 1 kg B ha^{-1} to peas and soybeans and treating seeds with the equivalent of 50 gm ammonium molybdate increased nodule weight, atmospheric N-fixation and seed yield.

Chowdhury and Das (1998) observed that P, S and Mo application significantly increased the canopy, nodule count, yield of rain fed black gram, yield of succeeding safflower and reduced splash loss and conserved more soil water.

Bhuiyan *et al*. (1998) conducted a field experiment on grey terrace soil of Gajipur to observe the effect of rhizobial inoculam, Mo and B on the nodulation, yield and agronomic performances of chickpea. *Rhizobiom inoculam* along with phosphorus, potash, boron and molybdenum gave significantly higher nodule number, nodule weight, stover yield and seed yield.

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted during the period from December, 2013 to April 2014 to study the effect of potassium and molybdenum on the growth, yield and oil content of BARI soybean 5. This chapter includes materials and methods that were used in conducting the experiment are presented below under the following headings:

3.1 Experimental site

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh. The experimental site is situated between $23^{0}74^{/}$N latitude and $90^{0}35^{/}$E longitude (Anon., 1989).

3.2 Soil

The soil of the experimental site belongs to Tejgaon series under the Agro-ecological zone, Madhupur Tract (AEZ-28), which falls into Deep Red Brown Terrace Soils. Soil samples were collected from the experimental plots to a depth of 0-15 cm from the surface before initiation of the experiment and analyzed in the laboratory. The soil was having a texture of sandy loam with pH 5. The morphological characteristics of the experimental field and physical and chemical properties of initial soil are given in Appendix I (Khatun, 2014).

3.3 Climate

The climate of experimental site is subtropical, characterized by three distinct seasons, the monsoon from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October. The monthly average temperature, humidity and rainfall during the crop growing period were collected from Weather Yard, Bangladesh Meteorological Department, and presented in Appendix II.

3.4 Planting material

The variety BARI soybean 5 was used as the test crops. The seeds were collected from the Agronomy Division of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. BARI collected some lines from Taiwan and among the variety 'RANSOM' produced the highest yield in regional trial. In 2002, this line is released as variety BARI soybean 5, which was recommended by the national seed board. The life cycle of this variety ranges from 90-100 days. Maximum seed yield is 1.6-2.0 t ha^{-1}.

3.5 Land preparation

The land was irrigated before ploughing. After having 'zoe' condition the land was first opened with the tractor drawn disc plough. Ploughed soil was brought into desirable fine tilth by 3 ploughing and cross-ploughing, harrowing and laddering. The stubble and weeds were removed. The first ploughing and the final land preparation were done on 23th and 25th December, 2013, respectively. Experimental land was divided into unit plots following the design of experiment.

3.6 Treatments of the experiment

The experiment comprised of two factors

Factor A: Levels of potassium (4 levels)

i) K_0: 0 kg K_2O ha^{-1} (control)

ii) K_1: 30 kg K_2O ha^{-1}

iii) K_2: 40 kg K_2O ha^{-1}

iv) K_3: 50 kg K_2O ha^{-1}

Factors B: Levels of molybdenum (3 levels)

i) Mo_0: 0 kg Mo ha^{-1} (control)

ii) Mo_1: 1.0 kg Mo ha^{-1}

iii) Mo_2: 1.5 kg Mo ha^{-1}

There were total 12 (4×3) treatment combinations as K_0Mo_0, K_0Mo_1, K_0Mo_2, K_1Mo_0, K_1Mo_1, K_1Mo_2, K_2Mo_0, K_2Mo_1, K_2Mo_2, K_3Mo_0, K_3Mo_1 and K_3Mo_2.

3.7 Fertilizer application

Urea, Triple super phosphate (TSP), Muriate of potash (MoP), gypsum, boric acid and sodium molybdate were used as a source of nitrogen, phosphorous, potassium, sulphur, boron and molybdenum, respectively. The fertilizers urea, TSP, sulphur and boric acid were applied at the rate of 60, 175, 40 and 10 kg hectare^{-1}, respectively following the Bangladesh Agricultural Research Institute (BARI) recommendation (BARI, 2011). Potassium and molybdenum were applied as per treatment of the experiment. All of the fertilizers were applied in broadcast during final land preparation.

3.8 Experimental design and layout

The two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. An area of 25.5 m × 12.4 m was divided into blocks. The size of the each unit plot was 2.8 m × 1.5 m. The space between two blocks and two plots were 1.0 m and 0.5 m, respectively. The layout of the experiment is shown in Figure 1.

3.9 Sowing of seeds in the field

The seeds of soybean were sown on December 25, 2013 in solid rows in the furrows having a depth of 2-3 cm and row to row distance was 30 cm and plant to plant 5-6 cm.

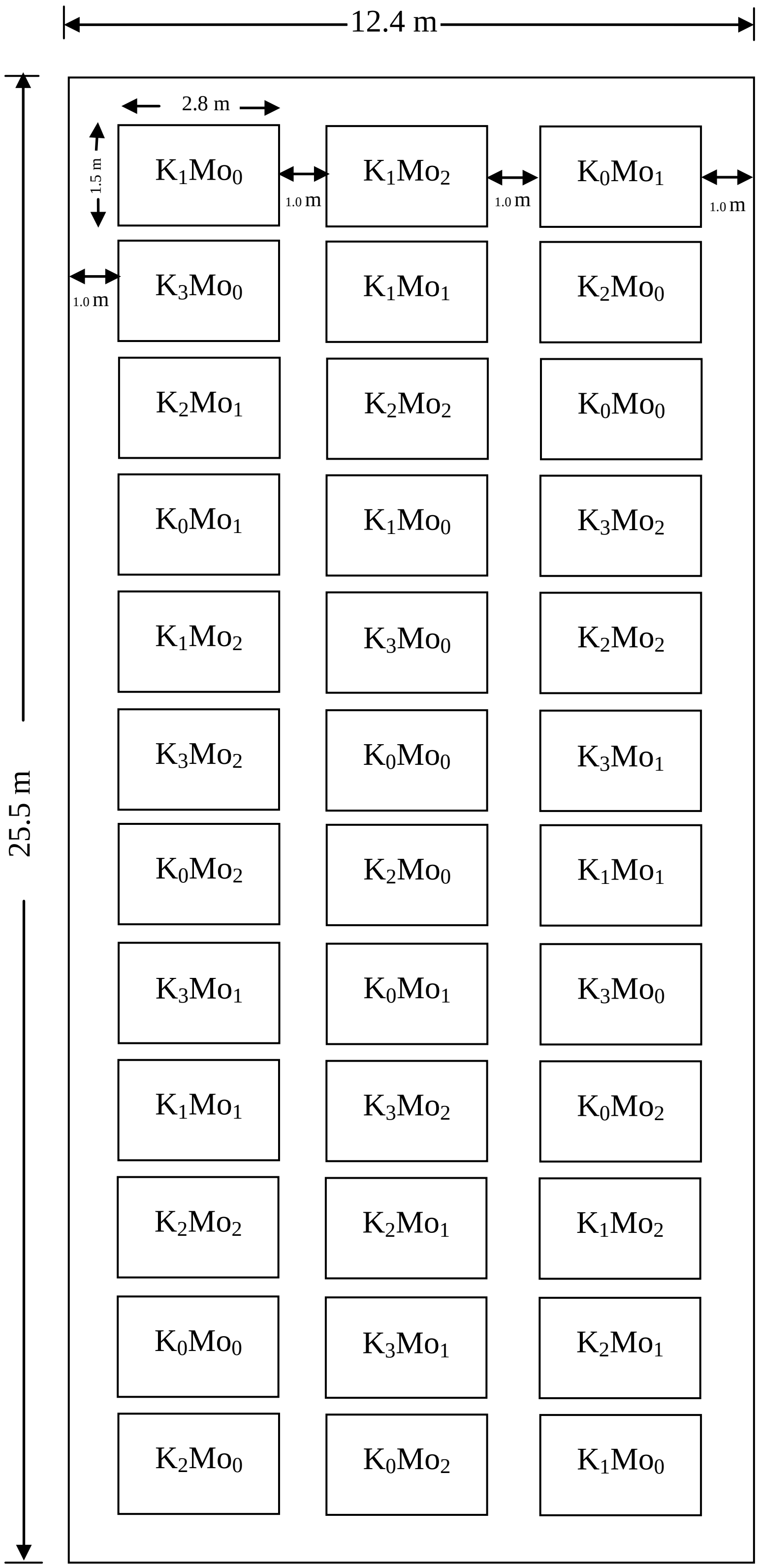
3.10 Intercultural operations

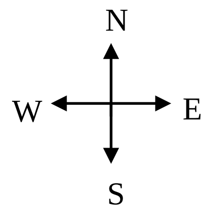
3.10.1 Thinning

Seeds started germination within four days after sowing (DAS). Thinning was at 25 DAS to maintain optimum plant population in each plot.

3.10.2 Irrigation and weeding

Irrigation was provided two times at 25 DAS and 55 DAS for all experimental plots equally. The crop field was weeded at 25 DAS and 55 DAS.





Plot size: 2.8 m × 1.5 m

Plot spacing: 0.50 m

Between block: 1.00 m

Factor A: Levels of potassium (4 levels)

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Factors B: Levels of molybdenum (3 levels)

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

Figure 1. Layout of the experimental plot

3.10.3 Protection against insect and pest

At early stage of growth few worms (*Agrotis ipsilon*) infested the young plants and at later stage of growth pod borer (*Maruca testulalis*) attacked the plant. Ripcord 10 EC was sprayed at the rate of 1 mm with 1 litre water for two times at 15 days interval after seedlings germination to control the insects.

3.11 Crop sampling and data collection

Five plants from each treatment were randomly selected and marked with sample card. Plant height and number of branches plant^{-1} were recorded from selected plants at an interval of 10 days started from 25 DAS to 55 DAS and at harvest.

3.12 Harvest and post harvest operations

Harvesting was done when 90% of the pods became brown in color**.** The matured pods were collected by hand picking from the area of 4.2 m^2 of each plot.

3.13 Data collection

The following data were recorded

i. Plant height
ii. Number of leaves plant^{-1}
iii. Days required from sowing to harvest
iv. Number of pods plant^{-1}
v. Pod length (cm)
vi. Number of seeds pod^{-1}
vii. Weight of 100 seeds (g)
viii. Seeds yield hectare^{-1}
ix. Stover yield hectare^{-1}
x. N, P, K, S and Mo concentration of seeds and stover sample
xi. pH, organic matter, exchangeable K and Mo in post harvest soil

3.14 Procedure of data collection

3.14.1 Plant height

The plant height was measured at 25, 35, 45, 55 DAS and at harvest with a meter scale from the ground level to the top of the plants and the mean height was expressed in cm.

3.14.2 Number of leaves plant^{-1}

The total number of leaves plant^{-1} was counted from each selected plant. Data were recorded as the average of 5 plants selected at random of each plot at 25, 35, 45, 55 DAS and at harvest

3.14.3 Days required from sowing to harvest

Each plant of the experiment plot was kept under close observation to count days to harvest of soybean. Total number of days from the date of sowing to the harvest was recorded.

3.14.4 Pod length

Pod length was taken of randomly selected ten pods and the mean length was expressed on pod^{-1} basis.

3.14.5 Number of pods plant^{-1}

Numbers of total pods of selected plants from each plot were counted and the mean numbers were expressed as plant^{-1} basis. Data were recorded as the average of 10 plants selected at random from the inner rows of each plot.

3.14.6 Number of seeds pod^{-1}

The number of seeds pods^{-1} was recorded from randomly selected 10 pods at the time of harvest. Data were recorded as the average of 10 pods from each plot.

3.14.7 Weight of 100 seeds

One hundred cleaned, dried seeds were counted from each harvest sample and weighed by using a digital electric balance and weight was expressed in gram (g).

3.14.8 Seed yield hectare^{-1}

The seeds collected from 4.2 (2.8 m ×1.5 m) square meter of each plot was cleaned. The weight of seeds was taken and converted the yield in t ha^{-1}.

3.14.9 Stover yield hectare^{-1}

The stover collected from 4.2 (2.8 m ×1.5 m) square meter of each plot was sun dried properly. The weight of stover was taken and converted the yield in t ha^{-1}.

3.14.10 Oil content in seed

The oil content of soybean seed was determined by Folch method (Folch, *et al.*, 1957). One gram soybean seed was taken in a mortar. The seeds were completely ground with a pestle. Thirty milliliter Folch reagent (chloroform: methanol = 2: 1) was added to it. After through mixing, the melt was filtered through Whatman No. 42 filter paper and the filtrate taken in a beaker. The filtrate was allowed to stand for about six hours for air drying and then dried in an oven for about half an hour to determine total oil. Proper care was taken so that chloroform and methanol mixture completely had dried out. Oil content was calculated by the following formula:

$$\text{Oil content (\%)} = \frac{\text{Weight of extract (g)}}{\text{Sample weight (g)}} \times 100$$

3.15 Chemical analysis of seeds and stover samples

3.15.1 Collection of samples

Seeds and stover samples were collected after threshing and finely ground by using a Wiley-Mill with stainless contact points to pass through a 60-mesh sieve. The samples were stored in plastic vial for analyses of N, P, K, S and Mo.

3.15.2 Preparation of samples

The seeds and stover samples were dried in an oven at 70^{0}C for 72 hours and then ground by a grinding machine to pass through a 20-mesh sieve. The seeds and stover samples were analyzed for N, P, K, S and Mo concentrations as follows:

3.15.3 Digestion of samples with sulphuric acid for N

For the determination of nitrogen an amount of 0.2 g oven dry, ground sample were taken in a micro kjeldahl flask. 1.1 g catalyst mixture (K_2SO_4: $CuSO_4$. $5H_2O$: Se in the ratio of 100: 10: 1), and 5 ml conc. H_2SO_4 were added. The flasks were heating at 120^0C and added 2.5 ml 30% H_2O_2 then heated was continued at 180^0C until the digests became clear and colorless. After cooling, the content was taken into a 100 ml volumetric flask and the volume was made up to the mark with de-ionized water. A reagent blank was prepared in a similar manner. Nitrogen in the digest was estimated by distilling the digest with 10 N NaOH followed by titration of the distillate trapped in H_3BO_3 indicator solution with 0.01N H_2SO_4.

3.15.4 Digestion of samples with nitric-perchloric acid for P, K, S and Mo

A sub sample weighing 0.5 g was transferred into a dry, clean 100 ml digestion vessel. Ten ml of di-acid (HNO_3: $HClO_4$ in the ratio 2:1) mixture was added to the flask. After leaving for a while, the flasks were heated at a temperature slowly raised to 200^0C. Heating were stopped when the dense white fumes of $HClO_4$ occurred. The content of the flask were boiled until they were became clean and colorless. After cooling, the content was taken into a 100 ml volumetric flask and the volume was made up to the mark with de-ionized water. P, K, B and Mo were determined from this digest.

3.15.5 Determination of P, K, S and Mo from samples

3.15.5.1 Phosphorus

Phosphorus was digested from the plant sample (seeds and stover) determined by using 1 ml for grain sample and 2 ml for straw sample from 100 ml extract was then determined by developing blue color with reduction of phosphomolybdate complex and the color intensity were measured colorimetrically at 660 nm wavelength and readings were calibrated with the standard P curve (Page *et al*., 1982).

3.15.5.2 Potassium

Five milli-liter of digest sample for the grain and 10 ml for the straw were taken and diluted 50 ml volume to make desired concentration so that the absorbance of sample were measured within the range of standard solutions. The absorbance was measured by atomic absorption flame photometer.

3.15.5.3 Sulphur

Sulphur content was determined from the digest of the plant samples (seeds and stover) with $CaCl_2$ (0.15%) solution as described by (Page *et al.*, 1982). The digested S was determined by developing turbidity by adding acid seed solution (20 ppm S as K_2SO_4 in 6N HCl) and $BaCl_2$ crystals. The intensity of turbidity was measured by spectrophotometer at 420 nm wave lengths (Hunter, 1984).

3.15.5.4 Molybdenum

For Mo, the extractant of $CaH_4(PO_4)_2$, HCl and phenol was used (Hunter, 1984). Molybdenum concentration was measured by adding 2 ml Curcumin solution plus 0.5 ml concentrated H_2SO_4 and 15 ml Methanol (Meth: water = 3:2) solution before taking reading. The concentration in extract was read at 555 nm wave length in a double beam spectrophotometer (Model No. 200-20, Hitachi, Japan).

3.16 Post harvest soil sampling

After harvest of crop soil samples were collected from each plot at a depth of 0 to 15 cm. Soil samples of each plot was air-dried, crushed and passed through a two mm (10 meshes) sieve. The soil samples were kept in plastic container to determine the physical and chemical properties of soil.

3.17 Soil analysis

Soil samples were analyzed for both physical and chemical characteristics viz. pH, organic matter K and Mo contents. The soil samples were analyzed by the following standard methods as follows:

3.17.1 Soil pH

Soil pH was measured with the help of a glass electrode pH meter, the soil water ratio being maintained at 1: 2.5 as described by Page *et al.*, 1982.

3.17.2 Organic matter

Organic carbon in soil sample was determined by wet oxidation method. The underlying principle was used to oxidize the organic matter with an excess of 1N $K_2Cr_20_7$ in presence of conc. H_2SO_4 and conc. H_3PO_4 and to titrate the excess $K_2Cr_20_7$ solution with 1N $FeSO_{4.}$ To obtain the content of organic matter in soil sample was calculated by multiplying the percent organic carbon by 1.73 (Van Bemmelen factor) and the results of organic matter content in post harvest soil expressed in percentage (Page *et al.*, 1982).

3.17.3 Exchangeable potassium

Exchangeable K was determined by 1N NH_4OAc (pH 7) extraction methods and by using flame photometer and calibrated with a standard curve (Page *et al*., 1982).

3.17.4 Available Molybdenum

Available Mo content was determined by extracting the soil with $BaCl_2$ solution as described by Page *et al*., 1982. The digested Mo was determined by developing turbidity by adding $BaCl_2$ solution. The intensity of turbidity was measured by spectrophotometer at 420 nm wavelengths (Hunter, 1984).

3.18 Statistical analysis

The data obtained for different parameters were statistically analyzed to find out the significant difference of different levels of potassium and molybdenum on soybean. The mean values of all the characters were calculated and analysis of variance was performed by the 'F' (variance ratio) test. The significance of the difference among the treatment means was estimated by the Least Significant Difference (LSD) at 5% level of probability (Gomez and Gomez, 1984).

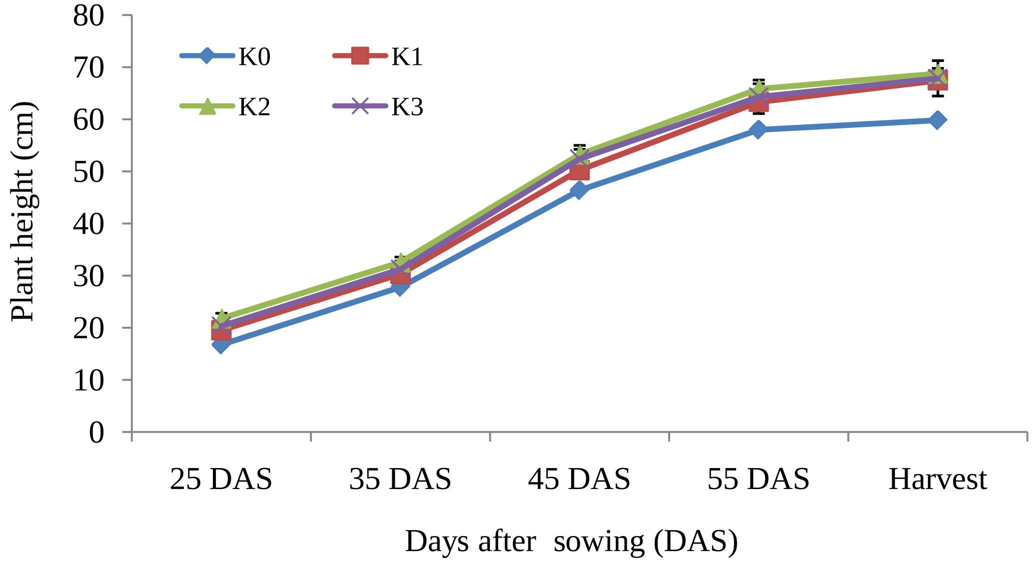
CHAPTER IV

RESULTS AND DISCUSSION

The experiment was conducted at the farm condition of Sher-e-Bangla Agricultural University, Dhaka to find out the effect of potassium and molybdenum on growth, yield and oil content of BARI soybean 5. Data on different growth parameter, yield, oil content, nutrient concentration in seed & stover, and soil nutrients status of post harvest soil was recorded. The analyses of variance (ANOVA) of the data on different recorded parameters are presented in Appendix III-VIII. The findings of the experiment have been presented and discusses with the help of Table and Graphs and possible interpretations were given under the following headings:

4.1 Plant height

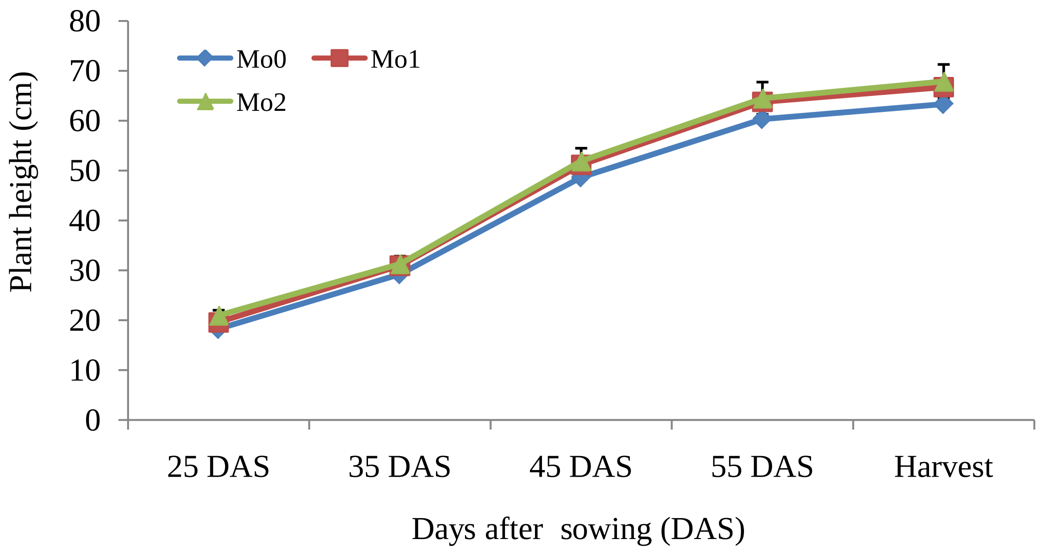
Plant height of BARI soybean 5 showed statistically significant variation due to different levels of potassium at 25, 35, 45, 55 days after sowing (DAS) and at harvest (Appendix III). At 25, 35, 45, 55 and at harvest, the tallest plant (21.78, 32.56, 53.22, 65.80 and 68.75 cm, respectively) was recorded from K_2 (40 kg K_2O ha^{-1}), which were statistically similar (20.30, 31.22, 52.36, 64.30 and 67.84 cm, respectively) with K_3 (50 kg K_2O ha^{-1}), whereas the shortest plant (16.78, 27.83, 46.37, 57.97 and 59.79 cm, respectively) was found from K_0 (0 kg K_2O ha^{-1}) treatment (Figure 2).). It was revealed that as a necessary element of potassium for the growth and development of soybean and with the increase of potassium fertilizer, plant height increased upto a certain level then decreases. Potassium fertilizer application can rapidly help plants to recover from stress due to drought, high heat, pests and diseases. Sangakkara *et al*. (2001) found that potassium increased shoot growth and as a significant factor in overcoming soils moisture stress in tropical cropping systems. Nita *et al.* (2002) reported that plant height increased with increasing rates of potassium.



K_0: 0 kg K_2O ha^{-1} (control) K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1} K_3: 50 kg K_2O ha^{-1}

Figure 2. Effect of different levels of potassium on plant height of BARI soybean 5. Vertical bars represent LSD value.



Mo_0: 0 kg Mo ha^{-1} (control) Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

Figure 3. Effect of different levels of molybdenum on plant height of BARI soybean 5. Vertical bars represent

Different levels of molybdenum differed significantly in terms of plant height of BARI soybean 5 at 25, 35, 45, 55 DAS and at harvest (Appendix III). At 25, 35, 45, 55 DAS and at harvest, the tallest plant (20.95, 31.27, 51.88, 64.50 and 67.87 cm, respectively) was found from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically identical (19.59, 30.95, 51.15, 63.76 and 66.69 cm, respectively) with Mo_1 (1.0 Mo ha^{-1}), while the shortest plant (18.24, 29.21, 48.61, 60.28 and 63.29 cm, respectively) was observed from Mo_0 (0 kg Mo ha^{-1}) treatment (Figure 3). Mahapatra (2003) recorded plant height was highest with 2 kg Mo ha^{-1}.

Interaction effect of different levels of potassium and molybdenum showed statistically significant variation on plant height of BARI soybean 5 at 25, 35, 45, 55 DAS and at harvest (Appendix III). At 25, 35, 45, 55 DAS and at harvest, the tallest plant (24.04, 33.96, 56.30, 69.07 and 73.48 cm, respectively) was recorded from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}) and the shortest plant (16.20, 27.14, 44.61, 56.77 and 59.10 cm, respectively) was observed from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 1).

4.2 Number of leaves plant^{-1}

Statistically significant variation was recorded in terms of number of leaves plant^{-1} of BARI soybean 5 due to different levels of potassium at 25, 35, 45, 55 DAS and at harvest (Appendix IV). At 25, 35, 45, 55 DAS and at harvest, the maximum number of leaves plant^{-1} (5.20, 8.49, 14.38, 22.60 and 25.61, respectively) was observed from K_2 (40 kg K_2O ha^{-1}), which were statistically similar (4.96, 8.11, 13.82, 21.58 and 24.21, respectively) with K_3 (50 kg K_2O ha^{-1}), while the minimum number of leaves plant^{-1} (4.00, 5.98, 12.28, 19.07 and 22.17, respectively) was recorded from K_0 (0 kg K_2O ha^{-1}) treatment (Figure 4).

Table 1. Effect of potassium and molybdenum on plant height at different days after sowing (DAS) of BARI soybean 5

Treatment	Plant height (cm) at				
	25 DAS	35 DAS	45 DAS	55 DAS	Harvest
K_0Mo_0	16.20 f	27.14 f	44.61 e	56.77 g	59.10 e
K_0Mo_1	16.97 ef	27.79 ef	47.71 c-e	59.80 e-g	59.34 e
K_0Mo_2	17.18 ef	28.56 d-f	46.79 e	57.34 fg	60.93 de
K_1Mo_0	17.77 ef	29.21 c-f	47.05 de	60.22 d-g	63.89 c-e
K_1Mo_1	19.10 c-e	30.18 c-e	50.71 b-d	62.73 b-e	67.55 bc
K_1Mo_2	21.66 b	31.52 bc	52.93 ab	67.02 ab	70.85 ab
K_2Mo_0	20.24 b-d	30.84 b-d	50.98 bc	62.63 b-e	63.76 c-e
K_2Mo_1	21.07 bc	32.88 ab	52.38 b	65.71 a-c	69.02 a-c
K_2Mo_2	24.04 a	33.96 a	56.30 a	69.07 a	73.48 a
K_3Mo_0	18.74 de	29.65 c-e	51.78 b	61.51 c-f	66.43 b-d
K_3Mo_1	21.23 bc	32.95 ab	53.82 ab	66.78 ab	70.84 ab
K_3Mo_2	20.93 b-d	31.05 b-d	51.49 bc	64.60 a-d	66.25 b-d
$LSD_{(0.05)}$	2.042	2.239	3.546	4.211	5.274
Level of significance	0.05	0.05	0.05	0.05	0.05
CV(%)	5.58	4.34	4.14	5.96	4.72

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

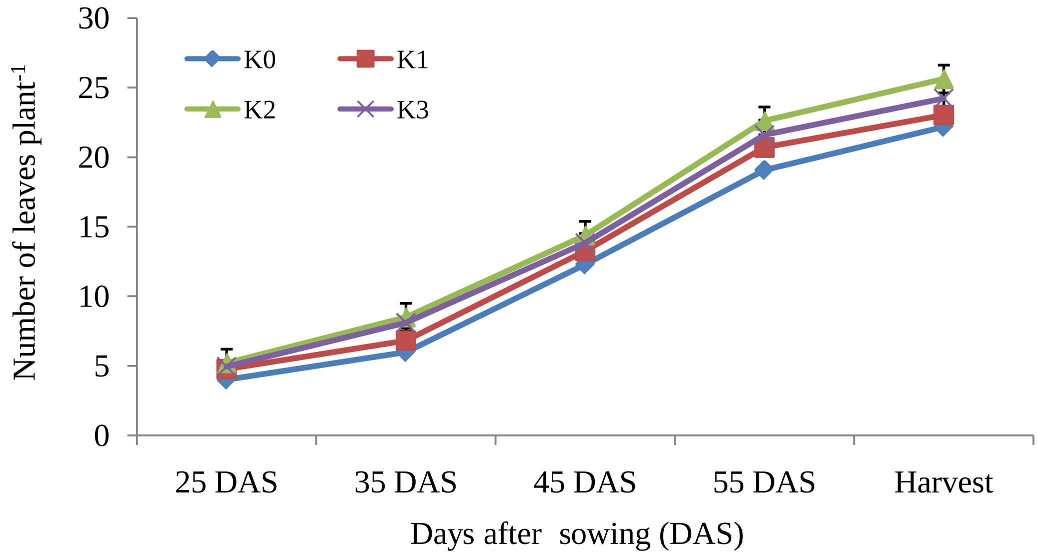
K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

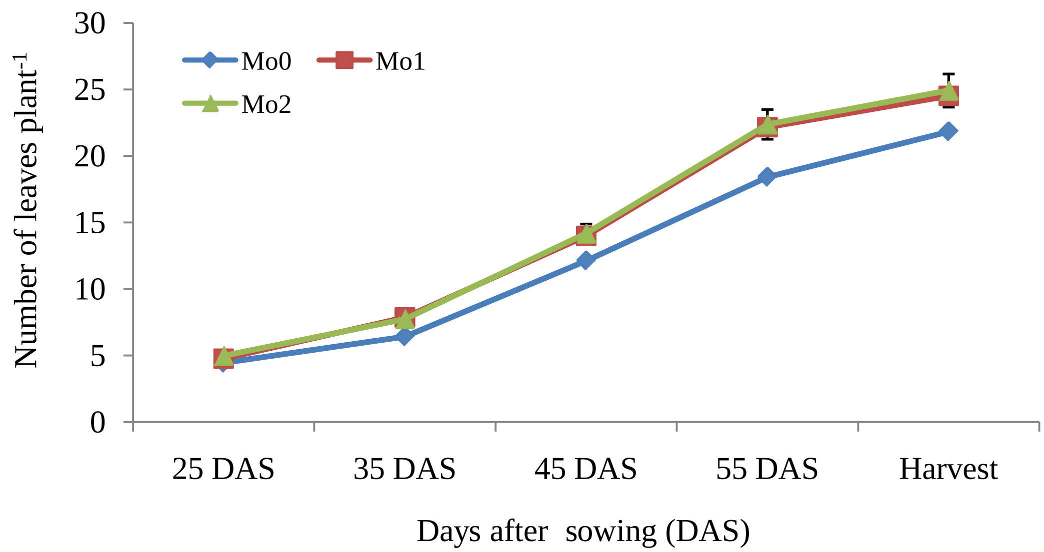
Mo_2: 1.5 kg Mo ha^{-1}



K_0: 0 kg K_2O ha^{-1} (control) K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1} K_3: 50 kg K_2O ha^{-1}

Figure 4. Effect of different levels of potassium on number of leaves $plant^{-1}$ of BARI soybean 5. Vertical bars represent LSD value.



Mo_0: 0 kg Mo ha^{-1} (control) Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

Figure 5. Effect of different levels of molybdenum on number of leaves $plant^{-1}$ of BARI soybean 5. Vertical bars

Number of leaves $plant^{-1}$ of BARI soybean 5 varied significantly due to different levels of molybdenum at 25, 35, 45, 55 DAS and at harvest (Appendix IV). At 25, 35, 45, 55 DAS and at harvest, the maximum number of leaves $plant^{-1}$ (4.97, 7.73, 14.17, 22.37 and 24.91, respectively) was found from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically similar (4.77, 7.87, 13.99, 22.17 and 24.52, respectively) with Mo_1 (1.0 Mo ha^{-1}) and the minimum number (4.45, 6.43, 12.13, 18.42 and 21.83, respectively) was observed from Mo_0 (0 kg Mo ha^{-1}) treatment (Figure 5).

Number of leaves $plant^{-1}$ of BARI soybean 5 at 25, 35, 45, 55 DAS and at harvest showed statistically significant differences due to the interaction effect of different levels of potassium and molybdenum (Appendix IV). At 25, 35, 45, 55 DAS and at harvest, the maximum number of leaves $plant^{-1}$ (5.40, 9.67, 14.80, 23.86 and 27.37, respectively) was found from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), while the minimum number (3.67, 5.60, 10.87, 16.80, 20.90, respectively) from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 2).

4.3 Days required for sowing to harvest

Days required for sowing to harvest of BARI soybean 5 showed statistically significant variation due to different levels of potassium (Appendix V). The minimum days required for sowing to harvest (89.56) was found from K_2 (40 kg K_2O ha^{-1}), which was closely followed (92.44) with K_3 (50 kg K_2O ha^{-1}), while the maximum days required for sowing to harvest (94.67) was observed from K_0 (0 kg K_2O ha^{-1}) treatment (Figure 6).

Different levels of molybdenum varied significantly in terms of days required for sowing to harvest of BARI soybean 5 (Appendix V). The minimum days required for sowing to harvest (90.75) was observed from Mo_1 (1.0 kg Mo ha^{-1}) which were statistically similar (92.67) with Mo_2 (1.5 kg Mo ha^{-1}), whereas the maximum days required for sowing to harvest (94.17) was recorded from Mo_0 (0 kg Mo ha^{-1}) treatment (Figure 7).

Table 2. Effect of potassium and molybdenum at different days after sowing (DAS) on number of leaves plant^{-1} of BARI soybean 5

Treatment	Number of leaves plant^{-1} at				
	25 DAS	35 DAS	45 DAS	55 DAS	Harvest
K_0Mo_0	3.67 g	5.60 d	10.87 d	16.80 d	20.90 f
K_0Mo_1	4.07 f	5.80 cd	12.30 cd	19.13 cd	22.23 def
K_0Mo_2	4.27ef	6.33 cd	12.20 cd	18.80 cd	21.77 ef
K_1Mo_0	4.53 de	6.07 cd	11.60 d	17.40 cd	20.80 f
K_1Mo_1	4.73 cd	7.27 bc	13.93 ab	22.20 ab	24.20 bcd
K_1Mo_2	5.00 bc	7.07 bcd	14.20 ab	22.47 ab	24.07 cde
K_2Mo_0	4.93 bc	8.27 ab	13.73 bc	20.20 bc	23.10 cdef
K_2Mo_1	5.27 ab	8.47 ab	14.60 ab	23.73 a	26.37 ab
K_2Mo_2	5.40 a	9.67 a	14.80 ab	23.86 a	27.37 a
K_3Mo_0	4.67 cd	5.80 cd	12.33 cd	19.27 cd	22.50 def
K_3Mo_1	5.00 bc	8.73 a	15.13 ab	23.60 a	25.30 abc
K_3Mo_2	5.20 ab	9.07 a	15.47 a	24.34 a	26.43 ab
$LSD_{(0.05)}$	0.308	1.348	1.508	2.700	2.083
Level of significance	0.05	0.01	0.01	0.01	0.01
CV(%)	5.82	10.84	6.63	7.60	5.18

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

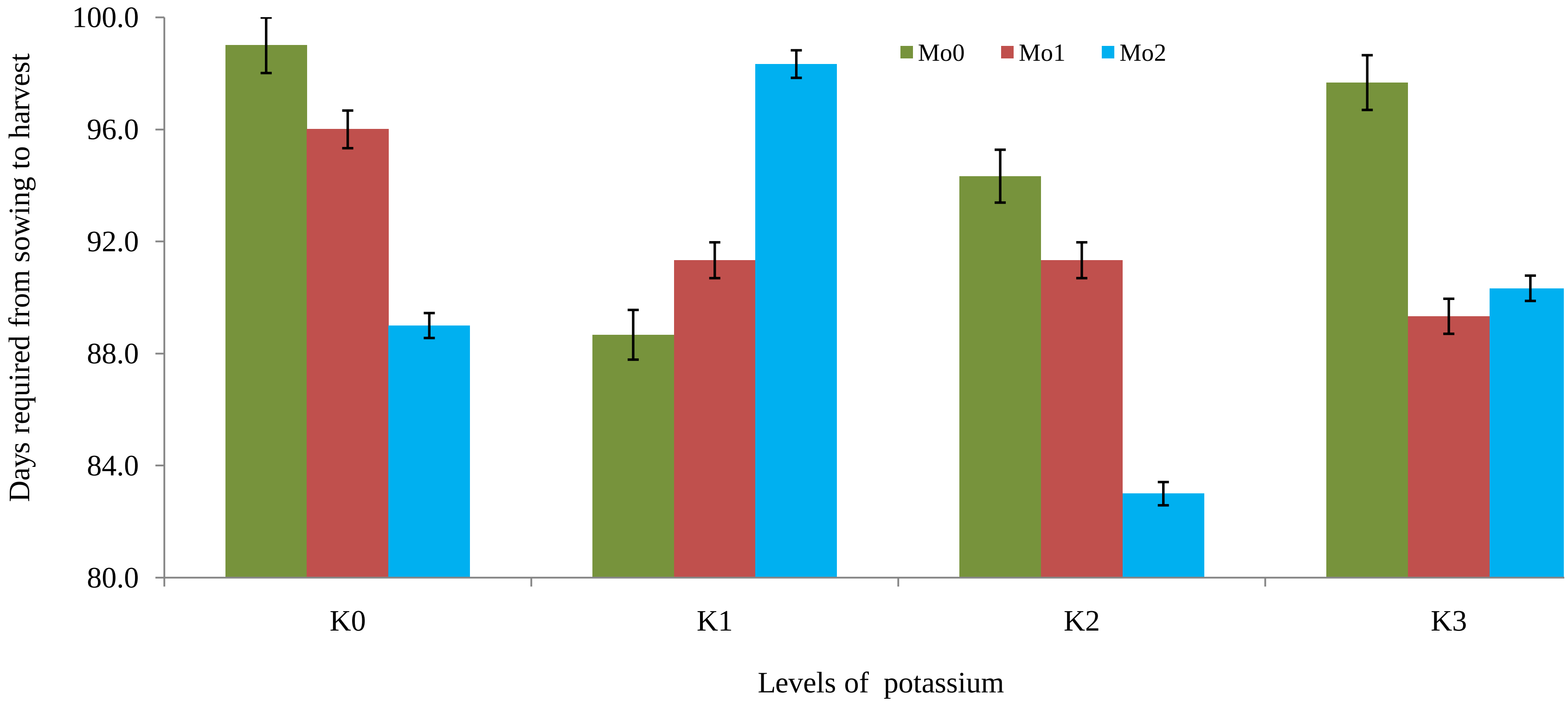
K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}



K_0: 0 kg K_2O ha^{-1} (control) K_1: 30 kg K_2O ha^{-1} Mo_0: 0 kg Mo ha^{-1} (control) Mo_1: 1.0 kg Mo ha^{-1}

K_2: 40 kg K_2O ha^{-1} K_3: 50 kg K_2O ha^{-1} Mo_2: 1.5 kg Mo ha^{-1}

Figure 8. Interaction effect of different levels of potassium and molybdenum on days required from sowing to harvest of BARI soybean 5. Vertical bars represent LSD value.

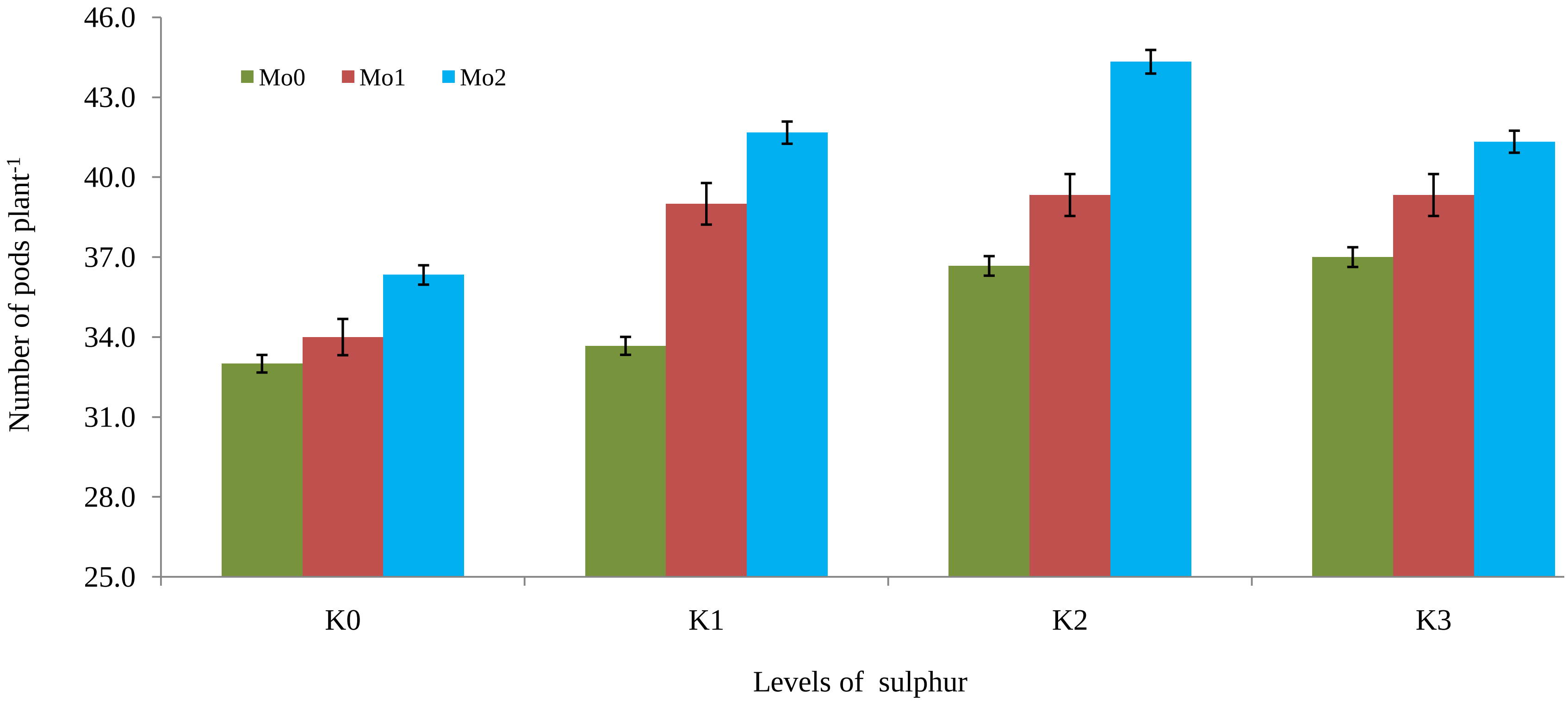
Statistically significant variation was recorded due to the interaction effect of different levels of potassium and molybdenum on days required for sowing to harvest of BARI soybean 5 (Appendix V). The minimum days required for sowing to harvest (99.00) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}), again the maximum days required for sowing to harvest pod (83.00) was found from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}) treatment combination (Figure 8).

4.4 Pod length

Statistically significant variation was recorded due to different levels of potassium in terms of pod length of BARI soybean 5 (Appendix V). The longest pod (5.56 cm) was observed from K_2 (40 kg K_2O ha^{-1}), which were statistically identical (5.38 cm) with K_3 (50 kg K_2O ha^{-1}) closely followed (5.22 cm) by K_1 (30 K_2O S ha^{-1}), while the shortest pod (4.38 cm) was found from K_0 (0 kg K_2O ha^{-1}) treatment (Table 3). Menaria *et al.* (2004) reported that application of 40 kg K ha^{-1} significantly increased all yield attributes and both seed and stover yields of soybean.

Different levels of molybdenum varied significantly in terms of pod length of BARI soybean 5 (Appendix V). The longest pod (5.43 cm) was recorded from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically similar (5.25 cm) with Mo_1 (1.0 kg Mo ha^{-1}) and the shortest pod (4.72 cm) from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 3). Mahapatra (2003) recorded longest pod with 2 kg Mo ha^{-1}.

Pod length of BARI soybean 5 showed statistically significant variation due to the interaction effect of different levels of potassium and molybdenum (Appendix V). The longest pod (6.00 cm) was recorded from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), whereas the shortest pod (4.20 cm) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 4).



K_0: 0 kg K_2O ha^{-1} (control) K_1: 30 kg K_2O ha^{-1} Mo_0: 0 kg Mo ha^{-1} (control) Mo_1: 1.0 kg Mo ha^{-1}

K_2: 40 kg K_2O ha^{-1} K_3: 50 kg K_2O ha^{-1} Mo_2: 1.5 kg Mo ha^{-1}

Figure 11. Interaction effect of different levels of potassium and molybdenum on number of pods $plant^{-1}$ of BARI soybean 5. Vertical bars represent LSD value.

Table 3. Effect of potassium and molybdenum on yield contributing characters and yield of BARI soybean 5

Treatment	Pod length (cm)	Number of seeds pod^{-1}	Weight of 100 seeds (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
K_0	4.38 c	2.13 b	11.72 b	1.60 c	2.68 b
K_1	5.22 b	3.22 a	12.20 b	1.84 b	3.19 a
K_2	5.56 a	3.33 a	14.26 a	2.01 a	3.51 a
K_3	5.38 ab	3.18 a	14.13 a	1.96 a	3.57 a
$LSD_{(0.05)}$	0.292	0.362	1.059	0.112	0.438
Level of significance	0.01	0.01	0.01	0.01	0.01
Mo_0	4.72 b	2.55 b	12.29 b	1.58 c	2.65 b
Mo_1	5.25 a	3.07 a	13.26 a	1.86 b	3.48 a
Mo_2	5.43 a	3.28 a	13.68 a	2.11 a	3.59 a
$LSD_{(0.05)}$	0.253	0.313	0.917	0.097	0.380
Level of significance	0.01	0.01	0.01	0.01	0.01
CV(%)	5.81	12.49	8.28	6.26	10.59

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

Table 4. Interaction effect of potassium and molybdenum on yield contributing characters and yield of BARI soybean 5

Treatment	Pod length (cm)	Number of seeds pod^{-1}	Weight of 100 seeds (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
K_0Mo_0	4.20 g	2.00 e	11.16 e	1.43 g	2.21 e
K_0Mo_1	4.53 e-g	2.33 e	11.76 e	1.59 e-g	2.54 e
K_0Mo_2	4.40 fg	2.07 e	11.26 e	1.79 de	2.44 e
K_1Mo_0	4.67 e-g	2.47 de	11.51 e	1.55 fg	2.35 e
K_1Mo_1	5.27 b-d	3.33 bc	12.30 de	1.91 cd	3.57 b-d
K_1Mo_2	5.73 ab	3.87 ab	12.79 c-e	2.05 bc	3.65 a-d
K_2Mo_0	5.07 c-e	2.67 c-e	14.37 a-c	1.59 e-g	2.95 de
K_2Mo_1	5.60 a-c	3.33 bc	13.90 b-d	2.00 bc	3.76 a-d
K_2Mo_2	6.00 a	4.00 a	14.51 a-c	2.43 a	3.81 a-c
K_3Mo_0	4.93 d-f	3.07 cd	12.12 de	1.75d-f	3.06 c-e
K_3Mo_1	5.60 a-c	3.27 bc	15.08 ab	1.94 cd	4.04 ab
K_3Mo_2	5.60 a-c	3.20 bc	16.14 a	2.18 b	4.45 a
$LSD_{(0.05)}$	0.505	0.627	1.834	0.193	0.759
Level of significance	0.05	0.05	0.01	0.05	0.01
CV(%)	5.81	12.49	8.28	6.26	10.59

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

4.5 Number of pods plant^{-1}

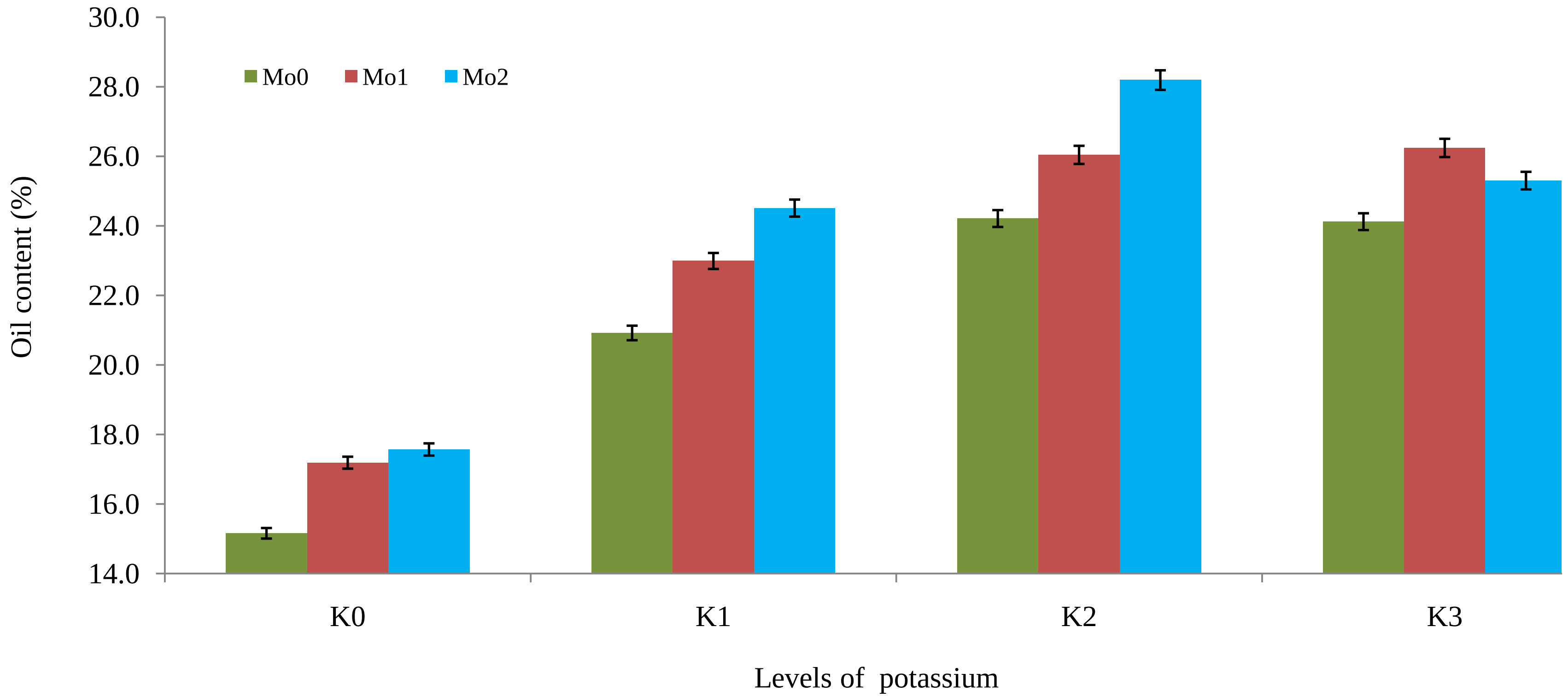
Different levels of potassium showed statistically significant variation on number of pods plant^{-1} of BARI soybean 5 (Appendix V). The maximum number of pods plant^{-1} (40.11) was recorded from K_2 (40 kg K_2O ha^{-1}), which were statistically identical (39.22 and 38.11) with K_3 (50 kg K_2O ha^{-1}) and K_1 (30 kg K_2O ha^{-1}), whereas the minimum number (34.44) from K_0 (0 kg K_2O ha^{-1}) treatment (Figure 9). Nita *et al.* (2002) reported that pods plant^{-1} increased with increasing rates of potassium. Gurkirpal and Singh (2001) reported that the growth attributes and grain yield of soybean significantly increased with the application of the fertilizers and the highest number of pods plant^{-1} were obtained at 60 kg K_2O.

Number of pods plant^{-1} BARI soybean 5 varied significantly due to different levels of molybdenum (Appendix V). The maximum number of pods plant^{-1} (40.92) was recorded from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically similar (39.23) with Mo_1 (1.0 kg Mo ha^{-1}), while the minimum number (35.33) from Mo_0 (0 kg Mo ha^{-1}) treatment (Figure 10). Srivastava and Ahlaeat (1995) observed that molybdenum application at 0.5 kg ha^{-1} significantly increased pod plant^{-1}.

Interaction effect of different levels of potassium and molybdenum varied significantly in terms of number of pods plant^{-1} of BARI soybean 5 (Appendix V). The maximum number of pods plant^{-1} (44.33) was found from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}) and the minimum number (33.00) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Figure 11).

4.6 Number of seeds pod^{-1}

Different levels of potassium showed statistically significant variation on number of seeds pod^{-1} of BARI soybean 5 (Appendix V). The maximum number of seeds pod^{-1} (3.33) was found from K_2 (40 kg K_2O ha^{-1}), which were statistically identical (3.22 and 3.18) with K_1 (30 kg K_2O ha^{-1}) and K_3 (50 kg K_2O ha^{-1}), while the minimum number (2.13) was recorded from K_0 (0 kg K_2O ha^{-1}) treatment (Table 3). Menaria *et al.* (2004) reported that application of 40 kg K ha^{-1} significantly increased all yield attributes of soybean.



K_0: 0 kg K_2O ha^{-1} (control) K_1: 30 kg K_2O ha^{-1} Mo_0: 0 kg Mo ha^{-1} (control) Mo_1: 1.0 kg Mo ha^{-1}

K_2: 40 kg K_2O ha^{-1} K_3: 50 kg K_2O ha^{-1} Mo_2: 1.5 kg Mo ha^{-1}

Figure 14. Interaction effect of different levels of potassium and molybdenum on oil content of BARI soybean 5. Vertical bars represent LSD value.

Number of seeds pod^{-1} BARI soybean 5 varied significantly due to different levels of molybdenum (Appendix V). The maximum number of seeds pod^{-1} (3.28) was recorded from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically similar (3.07) with Mo_1 (1.0 kg Mo ha^{-1}), while the minimum number (2.55) from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 3).

Statistically significant variation was recorded due to the interaction effect of different levels of potassium and molybdenum on number of seeds pod^{-1} of BARI soybean 5 (Appendix V). The maximum number of seeds pod^{-1} (4.00) was observed from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}) and the minimum number (2.00) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 4).

4.7 Weight of 100 seeds

Weight of 100 seeds of BARI soybean 5 varied significantly due to different levels of potassium under the present trial (Appendix V). The highest weight of 100 seeds (14.26 g) was observed from K_2 (40 kg K_2O ha^{-1}), which were statistically identical (14.13 g) with K_3 (50 kg K_2O ha^{-1}) and closely followed (12.20 g) by K_1 (30 kg K_2O ha^{-1}), while the lowest weight (11.72 g) was attained from K_0 (0 kg K_2O ha^{-1}) treatment (Table 3). Gurkirpal and Singh (2001) reported that the growth attributes and grain yield of soybean significantly increased with the application of the fertilizers and the highest 100-seed weight were obtained at 60 kg K_2O.

Statistically significant variation was recorded in terms of weight of 100 seeds of BARI soybean 5 due to different levels of molybdenum (Appendix V). The highest weight of 100 seeds (13.68 g) was found from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically similar (13.26 g) with Mo_1 (1.0 kg Mo ha^{-1}), again the lowest weight (12.29 g) from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 3). Srivastava and Ahlaeat (1995) observed that molybdenum application at 0.5 kg ha^{-1} significantly increased 1000-grain weight.

Interaction effect of different levels of potassium and molybdenum showed statistically significant variation in terms of weight of 100 seeds of BARI soybean 5 (Appendix V). The highest weight of 100 seeds (16.14 g) was observed from K_3Mo_2 (50 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), whereas the lowest weight (11.16 g) was attained from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 4).

4.8 Seed yield hectare^{-1}

Seed yield hectare^{-1} of BARI soybean 5 varied significantly due to different levels of potassium (Appendix V). The highest seed yield (2.01 t ha^{-1}) was observed from K_2 (40 kg K_2O ha^{-1}), which were statistically identical (1.96 t ha^{-1}) with K_3 (50 kg K_2O ha^{-1}) and followed (1.84 t ha^{-1}) by K_1 (30 kg K_2O ha^{-1}). On the other hand, the lowest seed yield (1.60 t ha^{-1}) was observed from K_0 (0 kg K_2O ha^{-1}) treatment (Table 3). Menaria *et al.* (2004) reported that application of 40 kg K ha^{-1} significantly increased all yield attributes and seed yields of soybean. Nita *et al.* (2002) reported that seed yield value increased with increasing rates of potassium. Yin and Vyn (2002) found that average soybean yield significantly increased with the application of 84 kg K ha^{-1}. Gurkirpal and Singh (2001) reported that the growth attributes and grain yield of soybean significantly increased with the application of the fertilizers and the highest seed yield were obtained at 60 kg K_2O.

Levels of molybdenum varied significantly in terms of seed yield hectare^{-1} of BARI soybean 5 (Appendix V). The highest seed yield (2.11 t ha^{-1}) was recorded from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically similar (1.86 t ha^{-1}) with Mo_1 (1.0 kg Mo ha^{-1}), whereas the lowest seed yield (1.58 t ha^{-1}) from Mo_0 (0 kg Mo ha^{-1}) (Table 3). Sfredo *et al.* (1997) found that application of Mo significantly increased seed yield up to 0.48 t ha^{-1}.

Statistically significant variation was recorded due to the interaction effect of different levels of potassium and molybdenum on seed yield hectare of BARI soybean 5 (Appendix V). The highest seed yield (2.43 t ha^{-1}) was found from

K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), while the lowest seed yield (1.43 t ha^{-1}) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 4).

4.9 Stover yield hectare^{-1}

Different levels of potassium varied significantly on stover yield hectare^{-1} of BARI soybean 5 (Appendix V). The highest stover yield (3.57 t ha^{-1}) was found from K_3 (50 kg K_2O ha^{-1}), which were statistically identical (3.51 t ha^{-1} and 3.19 t ha^{-1}) with K_2 (40 kg K_2O ha^{-1}) and K_1 (30 kg K_2O ha^{-1}), whereas the lowest stover yield (2.68 t ha^{-1}) from K_0 (0 kg K_2O ha^{-1}) treatment (Table 3). Menaria *et al.* (2004) reported that application of 40 kg K ha^{-1} significantly increased all yield attributes and stover yields of soybean.

Stover yield hectare^{-1} of BARI soybean 5 varied significantly due to different levels of molybdenum (Appendix V). The highest stover yield (3.59 t ha^{-1}) was observed from Mo_2 (1.5 kg Mo ha^{-1}) which were statistically similar (3.48 t ha^{-1}) with Mo_1 (1.0 kg Mo ha^{-1}), while the lowest stover yield (2.65 t ha^{-1}) was recorded from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 3).

Interaction effect of different levels of potassium and molybdenum showed statistically significant variation in terms of stover yield hectare of BARI soybean 5 (Appendix V). The highest stover yield (4.45 t ha^{-1}) was observed from K_3Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}) and the lowest stover yield (2.21 t ha^{-1}) from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 4).

4.10 Oil content in seeds

Oil content of seeds of BARI soybean 5 varied significantly due to different levels of potassium (Appendix V). The highest oil content (26.15%) was observed from K_2 (40 kg K_2O ha^{-1}), which was closely followed (25.22%) by K_3 (50 kg K_2O ha^{-1}). On the other hand, the lowest oil content (16.64%) was observed from K_0 (0 kg K_2O ha^{-1}) treatment (Figure 12).

Levels of molybdenum varied significantly in terms of oil content of BARI soybean 5 (Appendix V). The highest oil content (23.89%) was recorded from Mo_2 (1.5 kg Mo ha^{-1}) which was followed (23.12%) by Mo_1 (1.0 kg Mo ha^{-1}), whereas the lowest (21.10%) from Mo_0 (0 kg Mo ha^{-1}) treatment (Figure 13).

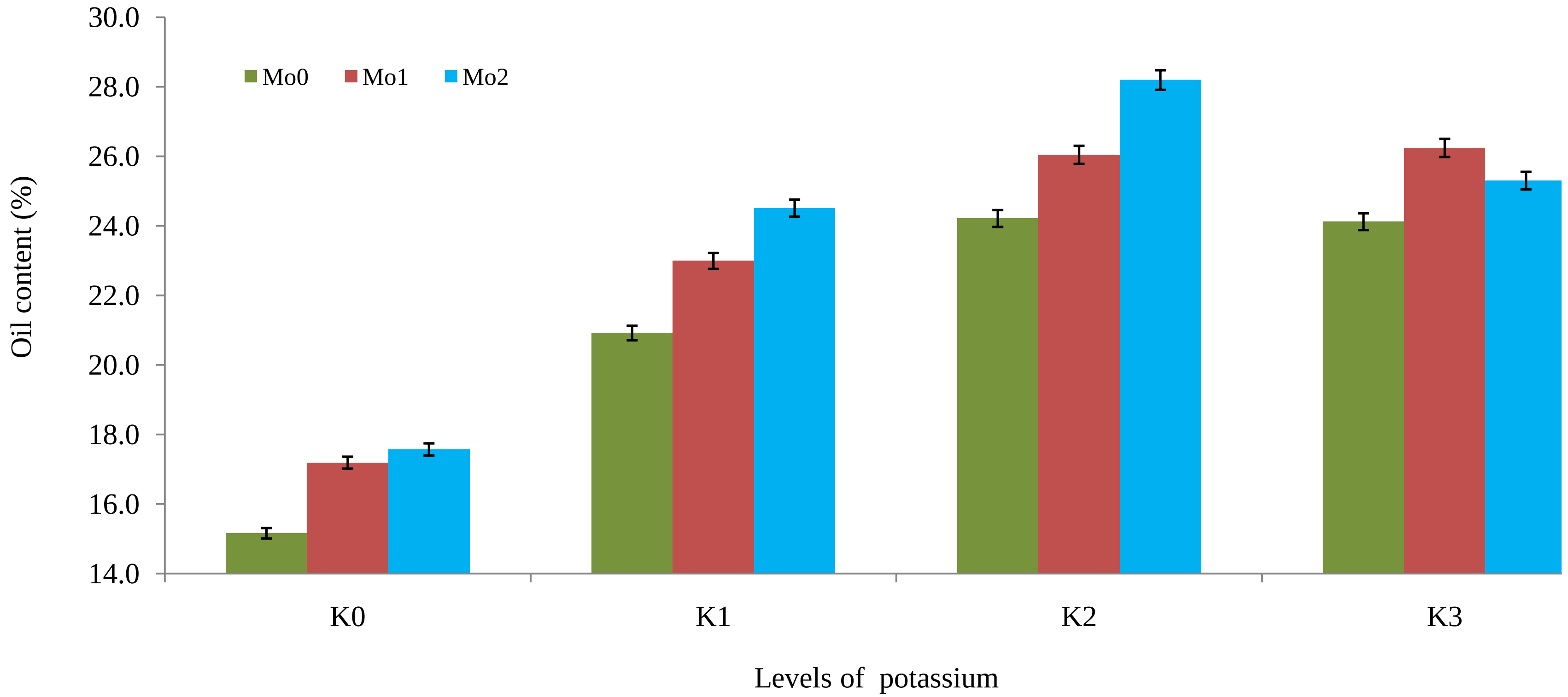
Statistically significant variation was recorded due to the interaction effect of different levels of potassium and molybdenum on oil content of BARI soybean 5 (Appendix V). The highest oil content (28.19%) was found from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), while the lowest oil content (15.16%) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Figure 14).

4.11 N, P, K, S and Mo concentration in seed

Significant variation was found for N, P, K, S and Mo concentration in seed due different levels of potassium (Appendix VI). The maximum concentration in seed for N (2.39%), P (0.506%), K (1.005%), S (0.507%) and Mo (0.086%) was found from K_2 (40 kg K_2O ha^{-1}), while the minimum (1.57%), P (0.238%), K (0.382%), S (0.189%) and Mo (0.066%) from K_0 (0 kg K_2O ha^{-1}) treatment (Table 5).

N, P, K, S and Mo concentration in seed showed statistically significant variation due to different levels of molybdenum (Appendix VI). The maximum concentration in seed for N (2.40%), P (1.045%), K (0.448%), S (0.461%) and Mo (0.078%) was observed from Mo_2 (1.5 kg Mo ha^{-1}) and the minimum concentration in seed for N (1.64%), P (0.541%), K (0.302%), S (0.269%) and Mo (0.052%) was recorded from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 5).

Statistically significant variation was recorded due to the interaction effect of potassium and molybdenum in terms of N, P, K, S and Mo concentration in seed (Appendix VI). The maximum concentration in seed for N (2.85%), P (1.509%), K (0.679%), S (0.623%) and Mo (0.140%) was observed from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), whereas the minimum concentration in seed for N (1.21%), P (0.360%), K (0.173%), S (0.164%) and Mo (0.041%) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 6).



K_0: 0 kg K_2O ha^{-1} (control) K_1: 30 kg K_2O ha^{-1} Mo_0: 0 kg Mo ha^{-1} (control) Mo_1: 1.0 kg Mo ha^{-1}

K_2: 40 kg K_2O ha^{-1} K_3: 50 kg K_2O ha^{-1} Mo_2: 1.5 kg Mo ha^{-1}

Figure 14. Interaction effect of different levels of potassium and molybdenum on oil content of BARI soybean 5. Vertical bars represent LSD value.

Table 5. Effect of potassium and molybdenum on N, P, K, S and Mo concentration in seed of BARI soybean 5

Treatment	Concentration (%) in seed				
	N	P	K	S	Mo
K_0	1.57 c	0.238 c	0.382 c	0.189 c	0.066 b
K_1	2.29 a	0.505 a	0.962 a	0.492 a	0.066 b
K_2	2.39 a	0.506 a	1.005 a	0.507 a	0.086 a
K_3	2.07 b	0.674 b	0.337 b	0.329 b	0.061 b
$LSD_{(0.05)}$	0.157	0.083	0.063	0.077	0.065
Level of significance	0.01	0.01	0.01	0.01	0.01
Mo_0	1.64 c	0.541 c	0.302 c	0.269 c	0.052 c
Mo_1	2.19 b	0.793 b	0.354 b	0.408 b	0.066 b
Mo_2	2.40 a	1.045 a	0.448 a	0.461 a	0.078 a
$LSD_{(0.05)}$	0.136	0.072	0.054	0.066	0.053
Level of significance	0.01	0.01	0.01	0.01	0.01
CV(%)	5.13	4.65	8.20	4.47	4.98

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

Table 6. Interaction effect of potassium and molybdenum on N, P, K, S and Mo concentration in pods of BARI soybean 5

Treatment	Concentration (%) in pods				
	N	P	K	S	Mo
K_0Mo_0	1.21 g	0.360 e	0.173 g	0.164 e	0.041 e
K_0Mo_1	1.65 f	0.464 b	0.186 fg	0.215 e	0.053 d
K_0Mo_2	1.84 def	0.605 fgh	0.215 fg	0.187 e	0.107 b
K_1Mo_0	1.64 f	0.718 ef	0.4425 c	0.329 d	0.042 e
K_1Mo_1	2.52 b	1.078 c	0.467 c	0.537 b	0.054 d
K_1Mo_2	2.71 ab	1.231 b	0.534 b	0.610 a	0.056 d
K_2Mo_0	1.69 ef	0.560 gh	0.358 d	0.358 d	0.058 d
K_2Mo_1	2.64 ab	0.968 cd	0.471 c	0.541 b	0.059 d
K_2Mo_2	2.85 a	1.509 a	0.679 a	0.623 a	0.140 a
K_3Mo_0	2.01 cd	0.525 gh	0.234 f	0.223 e	0.059 d
K_3Mo_1	1.97 cde	0.662 fg	0.292 e	0.340 d	0.058 d
K_3Mo_2	2.21 c	0.836 de	0.365 d	0.425 c	0.068 d
$LSD_{(0.05)}$	0.271	0.144	0.109	0.133	0.087
Level of significance	0.01	0.05	0.01	0.05	0.05
CV(%)	5.13	4.65	8.20	4.47	4.98

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

4.12 N, P, K, S and Mo concentration in stover

N, P, K, S and Mo concentration in stover showed statistically significant variation due different levels of potassium (Appendix VII). The maximum concentration in stover for N (1.89%), P (0.230%), K (1.457%), S (0.255%) and Mo (0.013%) was observed from K_2 (40 kg K_2O ha^{-1}), whereas the minimum concentration in stover for N (1.46%), P (0.221%), K (1.444%), S (0.211%) and Mo (0.010%) was found from K_0 (0 kg K_2O ha^{-1}) treatment (Table 7).

Statistically significant variation was recorded in terms of N, P, K, S and Mo concentration due to different levels of molybdenum (Appendix VII). The maximum concentration in stover for N (1.93%), P (0.260%), K (1.474%), S (0.252%) and Mo (0.012%) was recorded from Mo_2 (1.5 kg Mo ha^{-1}), while the minimum concentration in stover for N (1.23%), P (0.214%), K (1.427%), S (0.217%) and Mo (0.010%) was observed from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 7).

Interaction effect of potassium and molybdenum showed statistically significant variation in terms of N, P, K, S and Mo concentration in stover (Appendix VII). The maximum concentration in stover for N (2.58%), P (0.335%), K (1.482%), S (0.270%) and Mo (0.015%) was observed from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), again the minimum concentration in stover for N (1.12%), P (0.205%), K (1.403%), S (0.176%) and Mo (0.008%) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 8).

4.13 pH

Different levels of potassium showed statistically significant variation in terms of pH in post harvest soil (Appendix VIII). The highest pH in post harvest soil (7.43) was observed from K_2 (40 kg K_2O ha^{-1}), which was closely followed (6.62) by K_3 (50 kg K_2O ha^{-1}) and K_1 (30 kg K_2O ha^{-1}), while the lowest pH (6.37) was found from K_0 (0 kg K_2O ha^{-1}) treatment (Table 9).

Table 7. Effect of potassium and molybdenum on N, P, K, S and Mo concentration in stover of BARI soybean 5

Treatment	Concentration (%) in stover				
	N	P	K	S	Mo
K_0	1.46 bc	0.221 b	1.444 b	0.211 c	0.010 b
K_1	1.67 ab	0.228 b	1.450 ab	0.247 ab	0.011 b
K_2	1.89 a	0.230 b	1.457 a	0.255 a	0.013 a
K_3	1.31 c	0.271 a	1.460 a	0.239 b	0.013 a
$LSD_{(0.05)}$	0.284	0.031	0.010	0.010	0.01
Level of significance	0.01	0.01	0.01	0.01	0.01
Mo_0	1.23 c	0.214 b	1.427 c	0.217 b	0.010 b
Mo_1	1.59 b	0.238 ab	1.458 b	0.244 a	0.012 a
Mo_2	1.93 a	0.260 a	1.474 a	0.252 a	0.012 a
$LSD_{(0.05)}$	0.246	0.027	0.009	0.009	0.09
Level of significance	0.01	0.01	0.01	0.01	0.01
CV(%)	6.25	7.54	2.34	6.30	4.56

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

Table 8. Interaction effect of potassium and molybdenum on N, P, K, S and Mo concentration in stover of BARI soybean 5

Treatment	Concentration (%) in stover				
	N	P	K	S	Mo
K_0Mo_0	1.12 e	0.205 b	1.403 e	0.176 e	0.008
K_0Mo_1	1.59 bcde	0.234 b	1.467 abc	0.228 d	0.014
K_0Mo_2	1.67 bcde	0.246 b	1.463 abc	0.229 d	0.011
K_1Mo_0	1.27 cde	0.216 b	1.421 d	0.232 cd	0.012
K_1Mo_1	1.74 bcd	0.225 b	1.450 c	0.249 bc	0.014
K_1Mo_2	2.00 b	0.221 b	1.481 a	0.260 ab	0.013
K_2Mo_0	1.34 cde	0.222 b	1.430 d	0.235 cd	0.010
K_2Mo_1	1.76 bc	0.256 b	1.458 bc	0.259 ab	0.012
K_2Mo_2	2.58 a	0.335a	1.482 a	0.270 a	0.015
K_3Mo_0	1.19 de	0.213 b	1.455 bc	0.226 d	0.008
K_3Mo_1	1.26 cde	0.238 b	1.456 bc	0.241 bcd	0.010
K_3Mo_2	1.48 bcde	0.238 b	1.470 ab	0.250 bc	0.011
$LSD_{(0.05)}$	0.491	0.054	0.017	0.017	0.017
Level of significance	0.01	0.01	0.05	0.01	NS
CV(%)	6.25	7.54	2.34	6.30	4.56

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

K_0: 0 kg K_2O ha^{-1} (control)
K_1: 30 kg K_2O ha^{-1}
K_2: 40 kg K_2O ha^{-1}
K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)
Mo_1: 1.0 kg Mo ha^{-1}
Mo_2: 1.5 kg Mo ha^{-1}

Table 9. Effect of potassium and molybdenum on pH, organic matter, exchangeable K and available Mo of post harvest soil of BARI soybean 5

Treatment	pH	Organic matter (%)	Exchangeable K (me%)	Available Mo (ppm)
K_0	6.37 b	1.26 c	0.23 c	0.20 d
K_1	6.62 b	1.36 b	0.28 b	0.26 b
K_2	7.43 a	1.57 a	0.39 a	0.27 a
K_3	6.62 b	1.36 b	0.26 bc	0.25 c
$LSD_{(0.05)}$	0.442	0.083	0.031	0.010
Level of significance	0.01	0.01	0.01	0.01
Mo_0	6.61 b	1.32 b	0.22 c	0.22 c
Mo_1	6.62 b	1.38 ab	0.30 b	0.24 b
Mo_2	7.05 a	1.45 a	0.35 a	0.27 a
$LSD_{(0.05)}$	0.383	0.072	0.027	0.009
Level of significance	0.01	0.01		0.01
CV(%)	5.36	6.93	4.98	6.32

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

Statistically significant variation was recorded for pH in post harvest soil due to different levels of molybdenum (Appendix VIII). The highest pH in post harvest soil (7.05) was recorded from Mo_2 (1.5 kg B ha^{-1}), whereas the lowest pH (6.61) from Mo_0 (0 kg Mo ha^{-1}) treatment which was statistically similar (6.62) with Mo_1 (1.0 kg Mo ha^{-1}) (Table 9).

Interaction effect of different levels of potassium and molybdenum showed significant variation on pH in post harvest soil (Appendix VIII). The highest pH in post harvest soil (7.57) was observed from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}) and the lowest pH in post harvest soil (5.96) was found from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 10).

4.14 Organic matter

Organic matter in post harvest soil showed statistically significant variation due to different levels of potassium (Appendix VIII). The highest organic matter in post harvest soil (1.57%) was recorded from K_2 (40 kg K_2O ha^{-1}), which was closely followed (1.36%) with K_1 (30 kg K_2O ha^{-1}) and K_3 (50 kg K_2O ha^{-1}), whereas the lowest organic matter (1.26%) was observed from K_0 (0 kg K_2O ha^{-1}) treatment (Table 9).

Different levels of molybdenum varied significantly in terms of organic matter in post harvest soil (Appendix VIII). The highest organic matter in post harvest soil (1.45%) was found from Mo_2 (1.5 kg B ha^{-1}) which was statistically similar (1.38%) with Mo_1 (1.0 kg Mo ha^{-1}), while the lowest organic matter (1.32%) from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 9).

Statistically significant variation was recorded on organic matter in post harvest soil due to the interaction effect of different levels of potassium and molybdenum (Appendix VIII). The highest organic matter in post harvest soil (1.65%) was observed from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), again the lowest organic matter in post harvest soil (1.22%) was recorded from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 10).

Table 10. Interaction effect of potassium and molybdenum on pH, organic matter, exchangeable K and available Mo of post harvest soil of BARI soybean 5

Treatment	pH	Organic matter (%)	Exchangeable K (me%)	Available Mo (ppm)
K_0Mo_0	5.96 d	1.22 e	0.16 g	0.17 g
K_0Mo_1	6.17 cd	1.25 de	0.22 ef	0.20 f
K_0Mo_2	6.96 abc	1.30 cde	0.29 cd	0.23 e
K_1Mo_0	6.35 cd	1.25 de	0.17 fg	0.23 e
K_1Mo_1	6.78 abcd	1.41 bcd	0.34 bc	0.27 b
K_1Mo_2	6.74 abcd	1.40 bcd	0.33 bc	0.27 bc
K_2Mo_0	7.38 ab	1.53 ab	0.34 bc	0.24 de
K_2Mo_1	7.34 ab	1.52 ab	0.37 b	0.28 b
K_2Mo_2	7.57 a	1.65 a	0.45 a	0.30 a
K_3Mo_0	6.55 bcd	1.29 cde	0.19 fg	0.25 cd
K_3Mo_1	6.40 cd	1.34 cde	0.27 de	0.22 e
K_3Mo_2	6.91 abc	1.44 bc	0.31 cd	0.26 bc
$LSD_{(0.05)}$	0.765	0.144	0.054	0.017
Level of significance	0.05	0.05	0.01	0.01
CV(%)	5.36	6.93	4.98	6.32

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

K_0: 0 kg K_2O ha^{-1} (control)

K_1: 30 kg K_2O ha^{-1}

K_2: 40 kg K_2O ha^{-1}

K_3: 50 kg K_2O ha^{-1}

Mo_0: 0 kg Mo ha^{-1} (control)

Mo_1: 1.0 kg Mo ha^{-1}

Mo_2: 1.5 kg Mo ha^{-1}

4.15 Exchangeable Potassium

Different levels of potassium showed statistically significant variation in terms of exchangeable potassium in post harvest soil (Appendix VIII). The highest exchangeable potassium in post harvest soil (0.39 me%) was found from K_2 (40 kg K_2O ha^{-1}), which was followed (0.28 me%) by K_1 (30 kg K_2O ha^{-1}), while the lowest exchangeable potassium (0.23 me%) was found from K_0 (0 kg K_2O ha^{-1}) treatment (Table 9).

Significant variation was recorded for exchangeable potassium in post harvest soil due to different levels of molybdenum (Appendix VIII). The highest exchangeable potassium in post harvest soil (0.35 me%) was recorded from Mo_2 (1.5 kg B ha^{-1}) which was followed (0.30 me%) by Mo_1 (1.0 kg Mo ha^{-1}), whereas the lowest exchangeable potassium (0.22 me%) from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 9).

Interaction effect of different levels of potassium and molybdenum showed significant variation on exchangeable potassium in post harvest soil (Appendix VIII). The highest exchangeable potassium in post harvest soil (0.45 me%) was observed from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), whereas the lowest exchangeable potassium in post harvest soil (0.16 me%) was attained from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 10).

4.16 Available Molybdenum

Statistically significant variation was recorded due to different levels of potassium sin terms of available molybdenum in post harvest soil (Appendix VIII). The highest available molybdenum in post harvest soil (0.27 ppm) was recorded from K_2 (40 kg K_2O ha^{-1}), which was closely followed (0.26 ppm) by K_1 (30 kg K_2O ha^{-1}). On the other hand, the lowest available molybdenum (0.20 ppm) was recorded from K_0 (0 kg K_2O ha^{-1}) which was closely followed (ppm) by K_0 (0 kg K_2O ha^{-1}) treatment (Table 9).

Different levels of molybdenum showed statistically significant variation in terms of available molybdenum in post harvest soil (Appendix VIII). The highest available molybdenum in post harvest soil (0.27 ppm) was observed from Mo_2 (1.5 kg B ha^{-1}) which was closely followed (0.24 ppm) by Mo_1 (1.0 kg Mo ha^{-1}), while the lowest available molybdenum (0.22 ppm) from Mo_0 (0 kg Mo ha^{-1}) treatment (Table 9).

Available molybdenum in post harvest soil showed significant variation due t o the interaction effect of different levels of potassium and molybdenum (Appendix VIII). The highest available molybdenum in post harvest soil (0.30 ppm) was observed from K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), whereas the lowest available molybdenum in post harvest soil (0.17 ppm) was recorded from K_0Mo_0 (0 kg K_2O ha^{-1} and 0 kg Mo ha^{-1}) treatment combination (Table 10).

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, Bangladesh during the period from December, 2013 to April 2014 to study the effect of potassium and molybdenum on the growth, yield and oil content of BARI soybean 5. The variety BARI soybean 5 was used as the test crops. The experiment comprised of two factors; Factor A: Levels of potassium (4 levels)- K_0: 0 kg K_2O ha^{-1} (control); K_1: 30 kg K_2O ha^{-1}, K_2: 40 kg K_2O ha^{-1}, K_3: 50 kg K_2O ha^{-1} and Factors B: Levels of molybdenum (3 levels)- Mo_0: 0 kg Mo ha^{-1} (control), Mo_1: 1.0 kg Mo ha^{-1}, Mo_2: 1.5 kg Mo ha^{-1}. The two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Data on different growth parameter, yield, oil content, nutrient concentration in seed & stover, and soil nutrients status of post harvest soil was recorded and significant variation was observed for different treatment.

For potassium fertilizer, at 25, 35, 45, 55 and at harvest, the tallest plant (21.78, 32.56, 53.22, 65.80 and 68.75 cm, respectively) was recorded from K_2, whereas the shortest plant (16.78, 27.83, 46.37, 57.97 and 59.79 cm, respectively) was found from K_0. At 25, 35, 45, 55 DAS and at harvest, the maximum number of leaves $plant^{-1}$ (5.20, 8.49, 14.38, 22.60 and 25.61, respectively) was observed from K_2, while the minimum (4.00, 5.98, 12.28, 19.07 and 22.17, respectively) from K_0. The minimum days required for sowing to harvest (89.56) was found from K_2, while the maximum days required for sowing to harvest (94.67) was observed from K_0. The longest pod (5.56 cm) was observed from K_2 (40 kg K_2O ha^{-1}), while the shortest pod (4.38 cm) was found from K_0. The maximum number of pods $plant^{-1}$ (40.11) was recorded from K_2, whereas the minimum number (34.44) was attained from K_0. The maximum number of seeds pod^{-1} (3.33) was found from K_2, while the minimum number (2.13) was recorded from K_0. The highest weight of 100 seeds (14.26 g) was observed from K_2, while the lowest weight (11.72 g) was attained from K_0. The highest seed yield (2.01 t ha^{-1}) was observed from K_2 and the lowest seed yield (1.60 t ha^{-1}) was observed from K_0. The highest stover yield (3.57 t ha^{-1}) was found from K_3, whereas the lowest stover yield (2.68 t ha^{-1}) from K_0. The highest oil content (26.15%) was observed from K_2 (40 kg K_2O ha^{-1}) and the lowest oil content (16.64%) from K_0.

The maximum concentration in seed for N (2.39%), P (0.506%), K (1.005%), S (0.507%) and Mo (0.086%) was found from K_2, while the minimum (1.57%), P (0.238%), K (0.382%), S (0.189%) and Mo (0.066%) was found from K_0. The maximum concentration in stover for N (1.89%), P (0.230%), K (1.457%), S (0.255%) and Mo (0.013%) was observed from K_2, whereas the minimum concentration in stover for N (1.46%), P (0.221%), K (1.444%), S (0.211%) and Mo (0.010%) was found from K_0. The highest pH in post harvest soil (7.43) was observed from K_2, while the lowest pH (6.37) was found from K_0. The highest organic matter in post harvest soil (1.57%) was recorded from K_2, whereas the lowest organic matter (1.26%) was observed from K_0. The highest exchangeable potassium in post harvest soil (0.39 me%) was found from K_2, while the lowest exchangeable potassium (0.23 me%) was found from K_0. The highest available molybdenum in post harvest soil (0.27 ppm) was recorded from K_2 and, the lowest available molybdenum (0.20 ppm) was recorded from K_0.

In case of molybdenum, at 25, 35, 45, 55 DAS and at harvest, the tallest plant (20.95, 31.27, 51.88, 64.50 and 67.87 cm, respectively) was found from Mo_2, while the shortest plant (18.24, 29.21, 48.61, 60.28 and 63.29 cm, respectively) was observed from Mo_0. At 25, 35, 45, 55 DAS and at harvest, the maximum number of leaves $plant^{-1}$ (4.97, 7.73, 14.17, 22.37 and 24.91, respectively) was found from Mo_2 and the minimum number (4.45, 6.43, 12.13, 18.42 and 21.83, respectively) was observed from Mo_0. The minimum days required for sowing to harvest (90.75) was observed from Mo_1, whereas the maximum days required for sowing to harvest (94.17) was recorded from Mo_0. The longest pod (5.43 cm) was recorded from Mo_2 (1.5 kg Mo ha^{-1}) and the shortest pod (4.72 cm) from Mo_0 (0 kg Mo ha^{-1}) treatment. The maximum number of pods $plant^{-1}$ (40.92) was recorded from, while the minimum number (35.33) from Mo_0. The maximum number of seeds pod^{-1} (3.28) was recorded from Mo_2, while the minimum number (2.55) from Mo_0. The highest weight of 100 seeds (13.68 g) was found from Mo_2, again the lowest weight (12.29 g) from Mo_0. The highest seed yield (2.11 t ha^{-1}) was recorded from Mo_2, whereas the lowest seed yield (1.58 t ha^{-1}) from Mo_0. The highest stover yield (3.59 t ha^{-1}) was observed from Mo_2, while the lowest stover yield (2.65 t ha^{-1}) was recorded from Mo_0. The highest oil content (23.89%) was recorded from Mo_2, whereas the lowest oil content (21.10%) from Mo_0.

The maximum concentration in seed for N (2.40%), P (1.045%), K (0.448%), S (0.461%) and Mo (0.078%) was observed from Mo_2 and the minimum concentration in seed for N (1.64%), P (0.541%), K (0.302%), S (0.269%) and Mo (0.052%) was recorded from Mo_0. The maximum concentration in stover for N (1.93%), P (0.260%), K (1.474%), S (0.252%) and Mo (0.012%) was recorded from Mo_2, while the minimum concentration in stover for N (1.23%), P (0.214%), K (1.427%), S (0.217%) and Mo (0.010%) was observed from Mo_0. The highest pH in post harvest soil (7.05) was recorded from Mo_2, whereas the lowest pH (6.61) from Mo_0. The highest organic matter in post harvest soil (1.45%) was found from Mo_2, while the lowest organic matter (1.32%) from Mo_0. The highest exchangeable potassium in post harvest soil (0.35 me%) was recorded from Mo_2, whereas the lowest exchangeable potassium (0.22 me%) from Mo_0. The highest available molybdenum in post harvest soil (0.27 ppm) was observed from Mo_2, while the lowest available molybdenum (0.22 ppm) from Mo_0.

Due to the interaction effect of different levels of potassium and molybdenum at 25, 35, 45, 55 DAS and at harvest, the tallest plant (24.04, 33.96, 56.30, 69.07 and 73.48 cm, respectively) was recorded from K_2Mo_2 and the shortest plant (16.20, 27.14, 44.61, 56.77 and 59.10 cm, respectively) was observed from K_0Mo_0. At 25, 35, 45, 55 DAS and at harvest, the maximum number of leaves plant^{-1} (5.40, 9.67, 14.80, 23.86 and 27.37, respectively) was found from K_2Mo_2, while the minimum number (3.67, 5.60, 10.87, 16.80, 20.90, respectively) from K_0Mo_0. The minimum days required for sowing to harvest (99.00) was found from K_0Mo_0, again the maximum days required for sowing to harvest pod (83.00) was found from K_2Mo_2. The longest pod (6.00 cm) was recorded from K_2Mo_2, whereas the shortest pod (4.20 cm) was found from K_0Mo_0. The maximum number of pods plant^{-1} (44.33) was found from K_2Mo_2 and the minimum number (33.00) was found from K_0Mo_0. The maximum number of seeds pod^{-1} (4.00) was observed from K_2Mo_2 and the minimum number (2.00) was found from K_0Mo_0. The highest weight of 100 seeds (16.14 g) was observed from K_3Mo_2, whereas the lowest weight (11.16 g) was attained from K_0Mo_0. The highest seed yield (2.43 t ha^{-1}) was found from K_2Mo_2, while the lowest seed yield (1.43 t ha^{-1}) was found from K_0Mo_0. The highest stover yield (4.45 t ha^{-1}) was observed from K_3Mo_2 and the lowest stover yield (2.21 t ha^{-1}) from K_0Mo_0. The highest oil content (28.19%) was found from K_2Mo_2, while the lowest oil content (15.16%) from K_0Mo_0.

The maximum concentration in seed for N (2.85%), P (1.509%), K (0.679%), S (0.623%) and Mo (0.140%) was observed from K_2Mo_2, whereas the minimum concentration in seed for N (1.21%), P (0.360%), K (0.173%), S (0.164%) and Mo (0.041%) was found from K_0Mo_0. The maximum concentration in stover for N (2.58%), P (0.335%), K (1.482%), S (0.270%) and Mo (0.015%) was observed from, again the minimum concentration in stover for N (1.12%), P (0.205%), K (1.403%), S (0.176%) and Mo (0.008%) was found from K_0Mo_0. The highest pH in post harvest soil (7.57) was observed from K_2Mo_2 and the lowest pH in post harvest soil (5.96) was found from K_0Mo_0. The highest organic matter in post harvest soil (1.65%) was observed from K_2Mo_2 again the lowest organic matter in post harvest soil (1.22%) was recorded from K_0Mo_0. The highest exchangeable potassium in post harvest soil (0.45 me%) was observed from K_2Mo_2, whereas the lowest exchangeable potassium in post harvest soil (0.16 me%) was attained from K_0Mo_0. The highest available molybdenum in post harvest soil (0.30 ppm) was observed from K_2Mo_2, whereas the lowest available molybdenum in post harvest soil (0.17 ppm) was recorded from K_0Mo_0.

Conclusion

It may be concluded that application of 40 kg K_2O ha^{-1} & 1.5 kg Mo ha^{-1} can be more beneficial for the farmers to get maximum yield from the cultivation of BARI soybean 5.

REFERENCES

Abd-el-lateef, E.M., Behairy, T.G. and Ashour, N.I. (1998). Effect of phosphatic potassic fertilization on yield and its components. *Arab Univ. Agric. Sci.*, **6**: 1.

Anonymous. (2005). Food and Agriculture organization of the United Nations. http/www.fao.org.

Anonymous. (1989). Annual Report 1987-88. Bangladesh Agricultural Research Council. p. 45.

Asghar, A., Malik, M.A., Rashid, A. and Atif, T.S. (1996). Response of soybean (*Glycine max*) to potassium fertilization. *Pakistan J. Agric. Sci.*, **33**(1-4): 44-45.

Bansal, S.K., Dixit, A.K. and Imas, P. (2001). The effect of potassium application on yield and quality of soybean and wheat in Madhya Pradesh. *Fertilizer Association New Delhi, India*. **46**(11): 45-48.

BARI (Bangladesh Agricultural Research Institute). (2007). Oil Seed Research Center, BARI, Gazipur, 57.

BARI (Bangladesh Agricultural Research Institute). (2011). Krishi Projukti Hatboi, 5th edition, 1st part. December 2011. p. 484.

Batistella, F., Ferreira, M.E., Vieira, R.D., Cruz, M.C.P., Centurion, M.A.P.C., Sylvestre, T.B., Ruiz, J.G.C.L. (2013). Phosphorus and potassium fertilization for yield and quality of soybean seeds. *Pesquisa Agropecuaria Brasileira*. **48**(7): 783-790.

Begum, N.S.R. (1989). Response of soybean to Rhizobium inoculation and Urea-N application under rainfed and irrigated condition.

Bhuiyam, M.A.H.; Kabir, M.S. and Khanam, D. (1998). Effect of boron, molybdenum and rhizobial inoculants on nodulation and yield of lentil. Bangladesh. *J. Seed Sci. and Tech.*, **2**(1 & 2): 39-44.

Billore. S.D and Joshp. O.P. (2000). *American. J. Soc. Agron*., **92**: 261-268.

Bukhoriev, T.A. (1997). Effectiveness of applying boron and molybdenum to soybean crops on serojem soils in the Gisser valley. *Lzvestiya Timiry azevskoi Set skokhzyasistvennoi Akademii*. **2**: 1992-1997.

Campbell, W.H., (1999). Nitrate reductase structure, function and regulation. Binding the gap between biochemistry and physiology, *Ann. Rev. Plant Physiol. Plant Molec. Biol*., **50**: 277-303.

Chawdhury, A.U. and Mohamood, R. (1999). Determination of optimum level of potassium and its effects in yield and quality of three mungbean (*Vigna radiate L.*) cultivars. *Pakistan J. Biol. Sci*., **2**(2): 449-451.

Chowdhury, A.K.M.S.H. and Das, M.A.H. (1998). Effect of sulphur and method of zinc application on the yield and yield contributing character of BR-11 rice. *Pakistan J. Sci. Indus. Res*., **33**(5-6): 231-233.

Coale, F.J. and Grove, J.H. (1990). Root Distribution and Shoot Development in No-Till Full Season and Double-Crop Soybean. *Agron. J.*, **82**: 606-612.

Costa, D.J., Akanda, M.G. and Samanta, S.C. (1999). Response of soybean to different levels of phosphorus and potassium. *Bangladesh J. Scientific and Ind. Res*., **34**(20): 223-225.

Dinata, K.K.Sudrata, W., Swara, M. and Sulastri, N.M. (1992). Response of soybean varieties to potassium fertilizer. Report of Research Results of Malang Research Institute of food Crops. Malang, Indonesia. p. 346-352.

Dwivedi, S.K., Singh, M., Nigam, P.K., Patek, R.S. and Agrawal, V.K. (1996). Nutrient status in various plant parts of soybean (*Glycine max L.*) as influenced by phosphorus and molybdenum application. *Crop Res. Hisar*. **12**(3): 375-382.

FAO (Food and Agricultural Organization). (2008). FAO yearbook production. Food and Agricultural Organization of the United Nations, Rome. **54**: 115.

Farhad, I.S.M., Islam, M.N., Hoque S. and Bhuiyan, M.S.I. (2010). Role of Potassium and Sulphur on the Growth, Yield and Oil Content of Soybean (Glycine max L.). *Academic J. Plant Sci*., **3**(2): 99-103

Fehr, W.R., Robbelin, G., Downey, R.K., Ashri, A.M. (1989). Soybean, Oil crops of the world. McGraw-Hill publishing Company, London.

Fernandez, F. (2012). Corn, Soybean Showing Signs of Potassium Deficiency. Corn and Soybean Digest Newsletter.

Folch, J.M., Less, Y. and Sloane Stanley, G.H. (1957). A simple method for isolation and purification of total lipids from animal tissue. *J. Biol., Chem.,* **26**: 497.

Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedure for Agricultural Research (2^{nd} edn.). Int. Rice Res. Inst., A Willey Int. Sci., p. 28-192.

Gowda, C.L.L., Kaul, A.K. (1982). Pulses in Bangladesh, BARI and FAO publication, 338-407.

Graham, R.D. and Stangoulis, J.R.S. (2005). Molybdenum and disease. In:Mineral nutrition and plant diseases (Dantoff L, Elmer W, Huber D.Eds) St. Paul, MN: APS Press.

Gupta, S.P., and Vyas, K.K. (1994). Effect of phosphorus, zinc and molybdenum on the yield and quality of soybean. *Legume Res*., **17**(1): 5-7.

Gupta, U.C. and Lipsett, J. (1981). Molybdenum in soil, plants, and animals, Adv. in Agronomy, **34**: 73-115.

Gurkirpal, P. and Singh, B.K. (2001). Growth attributes and grain yield of soybean . with the application of the fertilizers. *J. Agril. Sci*. **71**(1): 44-46.

Habibzadeh, F., Amini, I. and Mirnia, S.K. (2004). Effect of different potassium applications on yield and yield components of soybean. *J. Agron. Tehran, Iran*. 61: 18-24.

Haque, I. and Bundu, H.S. (1980). Effects of inoculation, N, Mo and mulch on soybean in Sierra Leone. *Communication in Soil Science Plant Analysis*. **11**(5): 477-483.

Hegstad, H.G. (2008) Nutritional and Health Benefits of Soybean. Soy Protein Quality Evaluation Report. Food and Agriculture Organization on the United Nations. Food and Nutrition, Rome, Paper No. 71.

Hiller, L.K. (1995). Foliar Fertilization Bumps Potato Yields in Northwest: Rate and Timing of Application, Plus Hostof Other Considerations, Are Critical in Applying Foliars to Potatoes. *Fluid Journal*, **10**: 28-30.

Hunter, A.H. (1984). Soil Fertility Analytical Service in Bangladesh. Consultancy Report BARC, Dhaka.

Ibupoto, A.A. and Kotecki, A. (1994). The effect of soil application nitrogen fertilizer and foliar application of trace elements on development and yield of soybeans. Biuletyn Instytutu Hodowlii Aklimatyzacji Roslin. **190**: 153-159.

James, W.J., Shrikant, S.J., Kenneth, J.B. (1999). Climate change: Implication for soybean and yield and management in the USA. University of Florida, Gainesville, Florida, USA.

Khatun, K. (2014). Improved production technologies for higher yield and quality of broccoli (*Brassica oleracea* var. *italica* L.). Ph. D. thesis. Department of Botany, Faculty of Biological Science, Jahangirnagar University, Savar, Dhaka. p. 341.

Kumar, D., Vinay-Singh, Kumar, N. and Singh, V. (1993). Interaction of P and Mo for yield and uptake of P, Mo and Fe in lentil. *Annals Agric. Res*., **14**(4): 392-395.

Liu., Peng. Wu. Jianzhi and Yang. YuAi. (2005). Effects of levels of molybdenum and boron supply on there absorption and distribution in soybean. China. J. Zhejianj. *Univ. Agric*., **31**(4): 399-407.

Mahapatra, C.K. (2003). Effect of sulfur and molybdenum on the yield and yield attributes and fat content of soybean cv Shohag (PB-1). M.S. Thesis, Dept. of Agric. Chem., Bangladesh Agric. Univ., Mymensingh.

Marschner, H. (1995). Mineral Nutrition of Higher Plants, 2nd edn. Academic Press, London, UK.

Masto, R.E., Raj. G.B., Babu. P.S. and Jayachandran. K.S. (2004). Effect of liming on available phosphorus and molybdenum status of the soil after soybean. *Indian Annals Agric. Res*., **15**(1): 164-166.

Mehdi, S.M., Sarfaraz, M. and Hafeez, M. (2007). Response of soybean to Potassium Application in Saline-Sodic Soil. *Pakistan J. Biol. Sci.*, **10**: 2935-2939.

Menaria, B.L. and Singh, Pushpendra. (2004). Effect of chemical and biofertilizers on yield attributing characters and yield of soybean. *Legume Res. Udaipur, India*. **27**(3): 231-232.

Mengel, K., Kirkby, E.A., Kosegarten, H., Appel, T. (2001). Principles of Plant Nutrition. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Meschede. D.K. Lucca-e-Braccini. Scapim and Schuab. (2004). Grain yield, seed's protein content and plant agronomic traits of soybean in response to foliar fertilization and molybdenum and cobalt seed treatment. Brazil. *Acta. Sci. Agron*., **26**(2): 139-145.

Mondal, S.S., Pramanik, C.K. and Das, J. (2001). Effect of nitrogen and potassium on oil yield, nutrient uptake and soil fertility in soybean. *Indian J. Agril. Sci*., **71**(1): 44-46.

Nelson, K.A., Motavalli, P.P. and Nathan, M. (2007). Mobility of Iron and Manganese within Two Citrus Genotypes after Foliar Applications of Sulfate and Manganese. *J. Plant Nutrition*, **30**: 1385-1396.

Nita, C., Mondal, S.S., Arup, G., Brahmachari, K., Pla, A.K., Chanda, N. and Ghosh, A. (2002). Effect of potassium on soybean (*Glycine max*) to growth, productivity and fertility build up of soil. *J. Interacademecia*. **6**(3): 266-271.

Novo, M.C., Tanaka, R.T. and Gallo, P.B. (2001). Response of soybean cultivars to nitrogen and potassium in autumn-winter crop. *Revista-de-Agric. Univ. Piracicaba, Brazil*. **76**(3): 339-366.

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, L.A. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate, U.S. Dept. Agric. Circ., p. 929.

Page, A.L., Miller, R.H. and Keeney, D.R. (1982). Methods of analysis part 2, Chemical and Microbiological Properties, Second Edition American Society of Agronomy, Inc., Soil Science Society of American Inc. Madson, Wisconsin, USA. p. 403-430.

Prakash, Ved., Kundu, S. and Ghosh, B.N. (2002). Yield response of soybean to potassium and change of potassium status in soil after long-term sequential cropping. *Indian J. Agric. Sci.*, **72**(9): 514-518.

Prassad, M.R., Singh, A.P. and Singh, B. (2000). Yield, water use efficiency and potassium uptake by summer mungbean as affected by varying levels of potassium and moisture stress. *J. Indian Soc. Soil Sci.*, **48**(4): 827-828.

Purseglove, J.W. (1984). Tropical crops-Dicotyledones vol. 1&2 combined. Longman group limited, England, 265-273.

Rahman, L. (1982). Cultivation of soybean and its uses. City press, Dhaka, pp: 5-7.

Razmjoo, K. and Henderlong, P.R. (1997). Effect of potassium, sulfur, boron and molybdenum fertilization on alfalfa production and herbage macronutrient contents. *Plant Nutri*., **20**(12): 1681-1696.

Roy R.N., Finck A., Blair G.J., Tandon H.L.S. (2006). Plant nutrition for food security. A guide for integrated nutrient management. FAO Fertilizer and Plant Nutrition Bulletin 16. FAO, Rome, Italy. 368 pp.

Sangakkara, U.R. (1990). Effect of potassium fertilizer in growth and yield of soybean (*Glycine max*). *J. Applied seed production*. 8: 33-38.

Sangakkara, U.R., Frehner, M. and Nosberger, N. (2001). Influence of soil moisture and fertilizer potassium in the vegetative growth of soybean (*Glycine max L.*). *J. Agron. Crop Sci*., **186**(2): 73-81.

Sardana, H.R. and Verma, S. (1987). Combined effect of insecticide and fertilizers on the growth and yield in soybean (*Glycine max L.*). *Indian J. Entom*., **49**(1): 64-68.

Semina, S. I., Ram, P.C. and Tandon H.L.S. (2014). Influence of times and doses of potassium on production and physiological quality of soybean seeds. *Plant Nutri*., **26**(12): 1681-1696.

Sfredo, G.J., Borkert, C.M., Neponuceno, A.L. and Oliveira. M.C.N.D. (1997). Effectiveness of products containing elements applied to the seed on yield and protein content of soybean seeds. Eficacia de products contendo micronutrients, aplicados via cemente, sobre productividade teroes the proteina da soja. *Revista Brasileira de Ciencia Do Solo*. **21**(1): 41-45.

Singh, A.P. Choughary, R.K. and Sharma, R.P.R. (1993). Effect of inoculation and fertilizer levels on yield, nutrient uptake and economics of summer pulses. *J. Potassium Res*., **9**(4): 176-178.

Srivastava, T.K. and Ahlaeat, I.P.S. (1995). Response of pea (*Pissum sativum*) to phosphorus, molybdenum and biofertilizers. *Indian J. Agron*., **40**(4): 630-635.

Subbian, P. and Ramiah, S. (1982). Infiuence of phosphorus, molybdenum and rhizobial seed inoculation on growth and grain yield of red gram. *Madras Agric. J.*, **69**(1): 23-32.

Sushil, P., Singh, A.P. and Pathak, A.N. (1997). Effect of potassium supply on seed protein of soybean. *Indian J. Agron*., **42**(1): 630-635.

Ting Sun, P.P., Xu, G.D. and Neponuceno, A.L. (2013). Effects of molybdenum (Mo) and boron (B) on the rhizosphere microorganisms and the soil enzyme activities of soybean. *Crop Res. Hisar*., **18**(1): 161-168.

Tiwari, S.P., Joshi O.P., Vyas, A.K. and Billore, S.D. (2001). Potassium Nutrition in Yield and Quality. 307-320. www.ipipotash.org

Tiwari, V.N., Lehri, L.K. and Pathak, A.N. (1989). *Rhizobium* inoculation of legumes as influenced by phosphorus and molybdenum fertilization *J. Indian Soc. Soil Sci.*, **37**: 712-716.

Togay, Y., Togay N. and Dogan, Y. (2008). Research on the effect of phosphorus and molybdenum applications on the yield and yield parameters in lentil (Lens culinaris Medic.). *African J. Biotech*., **7**(9): 1256-1260.

Verma, L.P., Ram, P.C. and Maurya, B.R. (1988). Response of chickpea to phosphorus and molybdenum in alluvium of Eastern Uttar Pradesh. Inter chickpea Newsletter. **18**, 31-33.

Wahhab, D.M., M.R.I Mondal, A.M. Akbar, S.M Alam, U.M Ahmed and F. Begam, (2001). Status of Oil crop Production in Bangladesh. Oil research centre BARI, Joydebpur, Gazipur-1701. p: 1-5.

Wang, Dongfang and Ding, Bingehun. (2002). Study on effect of applying potassium humate to soybean leaf for increase yield. Yan'an Institute *Agril. Sci. harbin, China*. **21**(40): 305-307.

Weir, B. (1998) Foliar Potassium Bumps Cotton Yields: California Researcher Reports Consistent Yield Increases to Foliar-Applied Potassium over a Period of Years in the San Joaquin Valley. *Fluid Journal*, **6**: 10-13.

Williams R.J.P and Frausto da Silva, J.J.R. (2002). The involvement of molybdenum in life. Bioch.and Biophy. *Res. Commun*. **292**: 293–299.

Xiang, D., Yong, T.W. Yang, W.Y., Wan, Y., Gong, W.Z., Liang, C. and Lei, T. (2012). Effect of phosphorus and potassium nutrition on growth and yield of soybean in relay strip intercropping system. *Scientific Research and Essays*. **7**(3): 342-351.

Yin, X.H. and Vyn, T.J. (2002). Residual effects of potassium placement and tillage systems for corn and subsequent no till soybean. J. Agron. Purdue Univ. West Lafayette, USA. **94**(5): 1112-1119.

Zahoor, F., Ahmed, M., Azim, Malik, M., Mubeen, Siddiqui, K.M.H. Rasheed, M., Ansar, R. and Mehmood, K. (2013). Soybean (*Glycine max* L.) response to Micro-Nutrients. *Turkish J. of Field Crops*, **18**(2): 134-138

Zaman, A.K.M.M, Alam, M.S., Biswas, B.K., Roy, B. and Beg, A.H. (1996). Effect of B and Mo application on mungbean. Bangladesh *J. Agril. Res.*, **21**: 118-124.

APPENDICES

Appendix I. Monthly average of air temperature, relative humidity and total rainfall of the experimental site during the period from December, 2013 to March, 2014

Month	*Air temperature (^oC)		*Relative humidity (%)	*Rainfall (mm) (total)
	Maximum	Minimum		
November, 2013	25.8	16.0	78	00
December, 2013	22.4	13.5	74	00
January, 2014	25.2	12.8	69	00
February, 2014	27.3	16.9	66	39
March, 2014	31.7	19.2	57	23

* Monthly average,

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

Appendix II. Characteristics of soil of experimental field

A. Morphological characteristics of the experimental field

Morphological features	Characteristics
Location	Agronomy field , SAU, Dhaka
AEZ	Madhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled

B. Physical and chemical properties of the initial soil

Characteristics	Value
% Sand	27
% Silt	43
% clay	30
Textural class	Silty-clay
pH	5.6
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20.00
Exchangeable K (me/100 g soil)	0.10
Available S (ppm)	45

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

Appendix III. Analysis of variance of the data on plant height of BARI soybean 5 at different days after sowing (DAS) as influenced by different levels of potassium and molybdenum

Source of variation	Degrees of freedom	Mean square				
		Plant height (cm) at				
		25 DAS	35 DAS	45 DAS	55 DAS	Harvest
Replication	2	0.378	0.528	4.025	3.175	6.097
Levels of potassium (A)	3	39.579**	35.807**	83.936**	104.547**	154.681**
Levels of molybdenum (B)	2	22.171**	14.775**	35.452**	60.852**	67.825**
Interaction (A×B)	6	2.645*	4.180*	8.738*	11.484*	20.950*
Error	22	1.454	1.748	4.386	6.184	9.699

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

Appendix IV. Analysis of variance of the data on number of leaves plant^{-1} of BARI soybean 5 at different days after sowing (DAS) as influenced by different levels of potassium and molybdenum

Source of variation	Degrees of freedom	Mean square				
		Number of leaves plant^{-1} at				
		25 DAS	35 DAS	45 DAS	55 DAS	Harvest
Replication	2	0.028	0.148	0.132	0.122	0.554
Levels of potassium (A)	3	2.416**	12.185**	7.242**	20.181**	20.150**
Levels of molybdenum (B)	2	0.814**	7.524**	15.237**	59.417**	33.875**
Interaction (A×B)	6	0.607*	2.874**	3.872**	9.981**	6.073**
Error	22	0.033	0.634	0.793	2.542	1.513

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

Appendix V. Analysis of variance of the data on yield contributing characters, yield and oil content of BARI soybean 5 as influenced by different levels of potassium and molybdenum

Source of variation	Degrees of freedom	Mean square			
		Days required from sowing to Harvest	Number of pods $plant^{-1}$	Pod length (cm)	Number of seeds pod^{-1}
Replication	2	0.778	0.444	0.223	0.010
Levels of potassium (A)	3	22.769*	55.806**	2.450**	2.816**
Levels of molybdenum (B)	2	47.444**	94.362**	1.664**	1.703**
Interaction (A×B)	6	9.296*	7.917*	0.127*	0.417*
Error	22	5.083	4.111	0.089	0.137

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

Appendix V. Contd'

Source of variation	Degrees of freedom	Mean square			
		Weight of 100 seeds (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Oil Content (%)
Replication	2	0.269	0.001	0.141	0.033
Levels of potassium (A)	3	15.383**	0.296**	1.481**	164.990**
Levels of molybdenum (B)	2	6.076**	0.850**	3.183**	24.863**
Interaction (A×B)	6	5.575**	0.038*	1.229**	1.724*
Error	22	1.173	0.013	0.201	0.553

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

Appendix VI. Analysis of variance of the data on N, P, K, S and Mo concentrations in seeds of BARI soybean 5 as influenced by different levels of potassium and molybdenum

Source of variation	Degrees of freedom	Mean square				
		Concentration (%) in seeds				
		N	P	K	S	Mo
Replication	2	0.003	0.005	0.002	0.003	0.121
Levels of potassium (A)	3	1.220**	0.627**	0.806**	0.817**	3.871**
Levels of molybdenum (B)	2	1.860**	0.763**	0.264**	0.476**	5.518**
Interaction (A×B)	6	0.203**	0.081**	0.046**	0.044**	0.098
Error	22	0.025	0.007	0.004	0.006	0.231

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

Appendix VII. Analysis of variance of the data on N, P, K, S and Mo concentrations in stover of BARI soybean 5 as influenced by different levels of potassium and molybdenum

Source of variation	Degrees of freedom	Mean square				
		Concentration (%) in stover				
		N	P	K	S	Mo
Replication	2	0.162	0.0001	0.0001	0.002	0.034
Levels of potassium (A)	3	0.583**	0.005**	0.0001*	0.003**	1.981**
Levels of molybdenum (B)	2	1.481**	0.006**	0.007**	0.004**	0.981**
Interaction (A×B)	6	0.154**	0.002*	0.001**	0.0001	0.891*
Error	22	0.082	0.001	0.0001	0.0001	0.398

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

Appendix VIII. Analysis of variance of the data on pH, organic matter, exchangeable K and available Mo of post harvest soil of BARI soybean 5 as influenced by different levels of potassium and molybdenum

Source of variation	Degrees of freedom	Mean square			
		pH	Organic matter (%)	Exchangeable K (me%)	Available Mo (ppm)
Replication	2	0.085	0.0001	0.001	0.0001
Levels of potassium (A)	3	1.917**	0.157**	0.045**	0.007**
Levels of molybdenum (B)	2	0.732*	0.047**	0.051**	0.005**
Interaction (A×B)	6	0.272*	0.005	0.003*	0.001**
Error	22	0.199	0.007	0.001	0.0001

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability