Seed Yield and Nutrient Contents of Soybean as Influenced by the Application of Potassium and Molybdenum Fertilizers

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Abstract- Potassium and molybdenum are essential plant nutrients that are required in almost all the processes necessary for plant growth and development. Therefore, the aim of the study was to investigate the influence of potassium and molybdenum on the growth, yield, and nutrient content of soybean. The experiment was conducted at the Sher-e-Bangla Agricultural University research field, Dhaka, Bangladesh, during the period of December 2013 to April 2014. The experiment comprised two factors: factor A: four levels of potassium (K_0: 0 kg K_2O ha^{-1}, 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 factor B: three levels of molybdenum (Mo_0: 0 kg Mo ha^{-1}, Mo_1: 1.0 kg Mo ha^{-1}, Mo_2: 1.5 kg Mo ha^{-1}). The experiment was laid out in a randomized complete lock design (RCBD) with three replications. The result showed that the highest seed yield (2.0 t ha^{-1}) and oil content (26.2%) of soybean were recorded from the application of 40 kg K_2O ha^{-1} (K_2). The maximum concentrations of N (2.4%), P (0.51%), K (1.01%), S (0.51%), and Mo (0.09%) in soybean seeds were also found in the K_2 treatment. Whereas the lowest value for all the parameters was obtained from the control treatment. Molybdenum 1.5 kg Mo ha^{-1} produced the highest seed (2.1 t ha^{-1}) and stover yield (3.6 t ha^{-1}), while the control treatment provided the lowest yields. The highest oil content (23.9%) and maximum concentrations of N (2.4%), P (1.05%), K (0.45%), S (0.46%), and Mo (0.08%) in seeds were obtained at 1.5 kg Mo ha^{-1} application, whereas the lowest values were found in the control treatment. In interaction, the highest seed yield (2.4 t ha^{-1}), oil content (28.2%), N (2.9%), P (1.51%), K (0.68%), S (0.62%), and Mo (0.14%) concentrations in soybean seed were found from the application of 40 kg K_2O and 1.5 kg Mo ha^{-1}, while the lowest result was observed in the control treatment. Therefore, applying K_2O at 40 kg ha^{-1} and Mo at 1.5 kg ha^{-1} could enhance the seed yield and nutrient content of soybean.

Index Terms- Potassium, Molybdenum, Soybean, Seed yield, Seed composition

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 are under cultivation for soybean, and annual production is approximately 191,933 million tons [1]. In Bangladesh, out of the 0.44 million ha of total oil cropped area, soybean occupies 0.051 million ha and produces 0.091 million tons [2]. Soybean is a good source of protein, oil, fatty acids, minerals like Ca and P, as well as vitamins A, B, C, and D [3]. Its seeds contain 42–45% best quality protein, 20–22% edible oil, 24–26% carbohydrate, and 3.3–6.4% ash [4]. Most of the soybean crops are processed for oil and meal. It is the only plant food that contains complete protein, which includes all essential amino acids required for human health [5]. It provides around 60% of the world's supply of vegetable protein and 30% of the oil [6].

The yield of soybean is very low in Bangladesh, and such a low yield is not an indication of the low yielding potentiality of this crop. To achieve the crop's potential production, fertilizer applications must be balanced with the required nutrients. Potassium (K) is the second most abundant essential plant nutrient that helps to regulate water balance and is crucial for plant growth. As well, plants experiencing stress from drought, extreme heat, pests, and diseases can recover quickly with the application of potassium fertilizer [7]. But a larger amount of potassium is absorbed and removed from the soil by soybean crops than any other nutrient [8]. Potassium application has been proven to enhance the number of pods in soybeans and to have a positive effect on keeping pods till harvest [9].

Most biological species, including plants, need molybdenum for their proper growth and development [10]. It is an essential micronutrient that is related to symbiotic nitrogen fixation in legumes. Molybdenum is also important for the development of the nitrate reductase enzyme, which converts nitrate to nitrite during the protein synthesis process [11, 12]. It enhanced the vegetative growth, yield quality, and nodule formation of leguminous crops [13]. Potassium, phosphorus, and crude protein in soils are also increased as a result of the addition of molybdenum [14]. However, there is limited information on the effect of potassium and molybdenum on the growth, seed yield, oil content and nutrient content of soybean in Bangladesh. Considering the above facts, the present study was conducted to investigate the (i) effect of potassium and molybdenum on the growth and seed yield of soybean and (ii) effectiveness of

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potassium and molybdenum fertilizer on the oil content and nutrient content of soybean.

II. MATERIALS AND METHODS

Experimental design, treatment and data collection

A field experiment was carried out during the period of December 2013 and March 2014 at the research field of Sher-e-Bangla Agricultural University, Dhaka. The experimental site had a height of 4.0 meters above sea level and was situated between $23^0 74'$N latitude and $90^0 35'$E longitude. The temperature during the cropping period ranged between 12.8ºC to 31.7ºC, the humidity was 57% to 78%, and very little rainfall was recorded. The soil (0–15 cm) had a texture of silty clay with sand 27%, silt 43%, clay 30%, pH 5.6, organic matter 0.78%, total nitrogen (N) 0.043%, available phosphorus (P) 18.0 mg/kg, available potassium (K) 0.41 cmol/kg, and available sulphur (S) 0.25 mg/kg. The BARI soybean-5 variety was used as a test crop. The experiment comprised two factors with four levels of potassium (K_0: 0 kg K_2O ha^{-1}, 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 three levels of molybdenum (Mo_0: 0 kg Mo ha^{-1}, Mo_1: 1.0 kg Mo ha^{-1}, Mo_2: 1.5 kg Mo ha^{-1}). There was a total of 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, which 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 each unit plot was 2.8 m × 1.5 m. The space between two blocks and two plots was 1.0 m and 0.5 m, respectively. The fertilizers were applied in the form of urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, boric acid, and sodium molybdate as a source of nitrogen, phosphorous, potassium, sulphur, boron, and molybdenum, respectively. Urea, TSP, sulphur and boric acid were applied at the rate of 60, 175, 40 and 10 kg hectare^{-1}, respectively, as per the recommended dose [15]. Muriate of potash and sodium molybdate were applied as per treatment. One-third of urea and all other fertilizers were applied during final land preparation, and the rest of urea was applied in two equal splits. The soybean seeds were sown on December 25, 2013 in rows maintaining row-to-row and plant-to-plant distances of 30 cm and 5–6 cm, respectively. Thinning was done 25 days after sowing (DAS) to maintain an optimum plant population in each plot. Regular observations were performed to monitor the crop's growth stages. Five plants from the inner rows of each plot were randomly selected and marked with a sample card. Plant height and number of branches per plant were recorded from the selected plants at an interval of 10 days, starting from 25 DAS to 55 DAS, and at harvest. When 90% of the pods become brown, the crop is considered mature. Prior to harvest, five sample plants were taken from each plot to collect data on yield attributes (pod length, number of seeds per pod, 100 seeds weight). The mature pods were harvested by placing quadrates in the area of 1 m^2 of each plot for recording yield data.

Oil content analysis

The oil content of soybean seed was determined by the Folch method [16]. One gram of soybean seed was taken into a mortar. The seeds were completely ground with a mortar and pestle. Thirty milliliters of Folch reagent (chloroform: methanol = 2:1) were added to it. After thorough mixing, Whatman No. 42 filter paper was used to filter the melt, and the filtrate was collected 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 the chloroform and methanol mixture completely dried out. Oil content was calculated by the following formula:

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

Nutrient content analysis

The seed and stover samples were washed in deionized water, dried in an oven at 60°C until a constant weight was achieved, and subsequently ground. The seeds and stover samples analysis was performed using sulfuric acid digestion for N and nitric-perchloric acid digestion for P, K, S, and Mo. Nutrient contents in both seeds and stover were determined by the Kjeldahl method for N, phosphomolybdate colorimetry for P, flame photometry for K, turbidimetry as barium sulfate for S, and spectrophotometry for Mo [17].

Statistical analysis

The MSTAT-C computer package program was used to statistically analyze the data to determine the level of significance. The Least Significant Difference (LSD) was used to compare the significant differences between the treatment means at 5% level of probability [18].

III. RESULTS AND DISCUSSION

Vegetative parameters, yield components and yields of soybean

The vegetative parameter of soybean showed significant variation due to different levels of potassium at harvest. The tallest plant (68.8 cm) and the maximum number of leaves per plant (25.6) were recorded in 40 kg K_2O ha^{-1} (K_2), which were statistically similar with 50 kg K_2O ha^{-1}, whereas the shortest plant (59.8 cm) and the minimum number of leaves per plant (22.2) were found in the control treatment (Table 1). It was revealed from the results that with the increase in potassium fertilizer, the plant height and the number of leaves per plant increased up to a certain level, then decreased. This finding was in close conformity with the findings of earlier studies, who reported that potassium significantly increased the plant height and number of leaves of soybean with increasing rates of potassium [19, 20].

Likewise, the application of various levels of potassium resulted in a considerable difference in soybean yield and yield components. The application of K_2O 40 kg ha^{-1} (K_2) gave the longest pod (5.6 cm), the highest number of seeds per pod (3.3), the weight of 100 seeds (14.3 g), the highest seed yield (2.0 t ha^{-1}) and stover yield (3.5 t ha^{-1}) of soybean, whereas all the yield components exhibited the lowest values in the control treatment (Table 1). Significant influences of potassium on yield and yield contributing characters of soybean were also described by another study [21], who stated that application of 40 kg K ha^{-1} significantly increased all the yield attributes and seed yields of soybean. Significant influences of potassium on seed yield and yield attributes of soybean were also reported elsewhere [20, 22, 23].

Table 1 Effect of potassium and molybdenum on vegetative parameters, yield contributing characters and yield of soybean

Treatments	**Plant height (cm)**	**Number of leaves per plant**	**Pod length (cm)**	**Number of seeds per pod**	**Weight of 100 seeds (g)**	**Seed yield ($t\ ha^{-1}$)**	**Stover yield ($t\ ha^{-1}$)**
Level of potassium							
K_0	59.8c	22.2c	4.4 c	2.1 b	11.7 b	1.6 c	2.7 b
K_1	67.4b	23.0b	5.2 b	3.2 a	12.2 b	1.8 b	3.2 a
K_2	68.8a	25.6a	5.6 a	3.3 a	14.3 a	2.0 a	3.5 a
K_3	67.8ab	24.2a	5.4 ab	3.2 a	14.1 a	1.9 a	3.6 a
Level of significance	**	**	**	**	**	**	**
Level of molybdenum							
Mo_0	63.3b	21.8b	4.7 b	2.6 b	12.3 b	1.6 c	2.6 b
Mo_1	66.7a	24.5a	5.3 a	3.1 a	13.3 a	1.9 b	3.5 a
Mo_2	67.9a	24.9a	5.4 a	3.3 a	13.7 a	2.1 a	3.6 a
Level of significance	**	**	**	**	**	**	**
CV (%)	4.72	5.38	5.81	12.49	8.28	6.26	10.59

In a column means having dissimilar letter(s) differ significantly at 0.05 level of probability
** = Significant at 1% level of probability, * = Significant at 5% 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}

Various levels of molybdenum application significantly influenced the vegetative features of soybean. The tallest plant (67.9 cm) and the maximum number of leaves per plant (24.9) were found in the treatment where 1.5 kg ha^{-1} Mo (Mo_2) was applied, while the shortest plant (63.3 cm) and the minimum number of leaves per plant (21.8) were observed in the control treatment (Table 1). Similar results were found by earlier studies who described that application of molybdenum significantly influences the vegetative characteristics of soybean [24].

The yield and yield components of soybean were also significantly varied due to the application of different levels of molybdenum. The longest pod (5.4 cm), the maximum number of seeds per pod (3.3), the 100-seed weight (13.7 g), the highest seed yield (2.1 t ha^{-1}) and the stover yield (3.6 t ha^{-1}) were recorded in Mo_2 (1.5 kg Mo ha^{-1}), and the lowest values were found in control (Table 1). Comparable outcomes were obtained from the previous studies [24, 25].

All the studied growth parameters at harvest were significantly influenced by the interaction effect between different levels of potassium and molybdenum. The tallest plant (73.5 cm) was recorded in the $K_2 \times Mo_2$ treatment (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), while the shortest one (59.1 cm) was observed in the K_0Mo_0 (control) treatment. The maximum number of leaves per plant (27.4) was found in the K_2Mo_2 treatment, and the minimum number (20.8) was obtained from the $K_1 \times Mo_0$ treatment combinations (Table 2).

The interaction effect between different levels of potassium and molybdenum also had a considerable effect on all the yield components and seed yields of soybean. The longest pod (6.0 cm), highest number of seeds per pod (4.0), 100-seed weight (14.5 g), and seed yield (2.4 t ha^{-1}) were recorded from the interaction of $K_2 \times Mo_2$ (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}) (Table 2). While the highest stover yield (4.5 t ha^{-1}) was found in K_3Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}). All the yield components showed the lowest values in the control treatment. The most probable reason is that increasing potassium levels up to a certain limit caused more carbohydrates and proteins to accumulate and transfer to the productive organs, which in turn improved all yield-related characteristics, resulting in increased seed yields. Also, the addition of molybdenum promotes various metabolic processes, resulting in more productive organs, which in turn improves all yield-attributing characteristics and seed yields. A comparable outcome was obtained elsewhere [26, 27].

Table 2. Interaction effect of potassium and molybdenum on yield contributing characters and yield of soybean

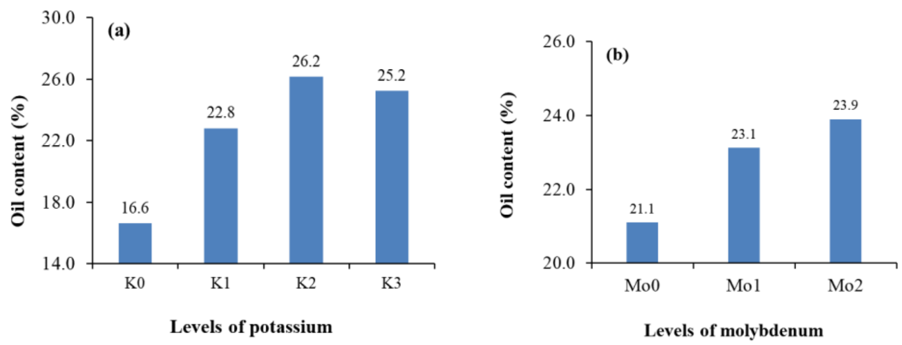
Treatments	Plant height (cm)	No. of leaves per plant	Pod length (cm)	Number of seeds per pod	Weight of 100 seeds (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
K_0Mo_0	59.1 e	20.9 f	4.2 g	2.0 e	11.2 e	1.4 g	2.2 e
K_0Mo_1	59.3 e	22.2 d-f	4.5 e-g	2.3 e	11.8 e	1.6 e-g	2.5 e
K_0Mo_2	60.9 de	21.8 ef	4.4 fg	2.1 e	11.3 e	1.8 de	2.4 e
K_1Mo_0	63.9 c-e	20.8 f	4.7 e-g	2.5 de	11.5 e	1.6 fg	2.4 e
K_1Mo_1	67.5 bc	24.2 b-d	5.3 b-d	3.3 bc	12.3 de	1.9 cd	3.6 b-d
K_1Mo_2	70.8 ab	24.1 c-e	5.7 ab	3.9 ab	12.8 c-e	2.1 bc	3.7 a-d
K_2Mo_0	63.8 c-e	23.1 c-f	5.1 c-e	2.7 c-e	14.4 a-c	1.6 e-g	2.9 de
K_2Mo_1	69.0 a-c	26.4 ab	5.6 a-c	3.3 bc	13.9 b-d	2.0 bc	3.7 a-d
K_2Mo_2	73.5 a	27.4 a	6.0 a	4.0 a	14.5 a-c	2.4 a	3.8 a-c
K_3Mo_0	66.4 b-d	22.5 d-f	4.9 d-f	3.1 cd	12.1 de	1.8d-f	3.1 c-e
K_3Mo_1	70.8 ab	25.3 a-c	5.6 a-c	3.3 bc	15.1 ab	1.9 cd	4.0 ab
K_3Mo_2	66.3 b-d	26.4 ab	5.6 a-c	3.2 bc	16.1 a	2.2 b	4.5 a
Level of significance	*	**	*	*	**	*	**
CV (%)	4.72	5.38	5.81	12.49	8.28	6.26	10.59

In a column means having dissimilar letter(s) differ significantly at 0.05 level of probability
** = Significant at 1% level of probability, * = Significant at 5% 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

Oil content in soybean seeds

A general increasing trend was observed in the seed oil content of soybean compared to the control in the application of both potassium and molybdenum. The maximum oil content (26.2%) was recorded with the application of 40 kg K_2O ha^{-1} (K_2) and the lowest in control (Fig. 1a). The effect of different doses of molybdenum showed significant variation in the oil content of soybean seed. The maximum seed oil content, i.e., 23.9%, was recorded with the application of 1.5 kg Mo ha^{-1}, whereas the lowest was from the control treatment (Fig. 1b). A significant effect due to the combined application of potassium and molybdenum was observed on the oil content of soybean seed (Fig. 1c). The highest oil content (28.2%) was found in K_2Mo_2 (40 kg K_2O ha^{-1} and 1.5 kg Mo ha^{-1}), while the lowest value (15.2%) was found in control treatment.



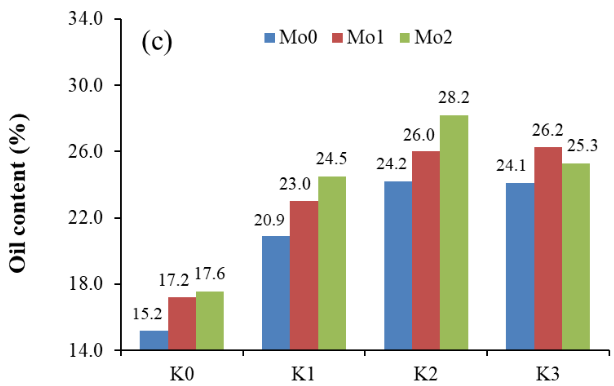


Fig. 1. Single (a, b) and interaction (c) effect of different levels potassium and molybdenum on oil content of soybean seeds

Nutrient concentrations in soybean seed and stover

The maximum concentration of N (2.4%), P (0.51%), K (1.01%), S (0.51%), and Mo (0.09%) in soybean seeds and the maximum concentration of N (1.9%), P (0.23%), K (1.46%), S (0.26%) and Mo (0.01%) in stover were found from the application of 40 kg K_2O ha^{-1} (K_2), while the minimum N, P, K, S, and Mo concentration was obtained from the control treatment (Table 3). Previous studies reported that the concentration of N, P, K and other micronutrients in the seeds and stover of soybean increased with the increasing rate of K fertilizer [7, 28].

Molybdenum application resulted in an increase in nutrient content in both seed and stover (Table 3). The maximum concentration of N (2.4%), P (1.05%), K (0.45%), S (0.46%) and Mo (0.08%) in seed and the highest concentration of N (1.9%), P (0.26%), K (1.47%), S (0.25%) and Mo (0.01%) in stover were recorded from Mo_2 (1.5 kg Mo ha^{-1}). The minimum concentration of all nutrients in seed and stover was recorded from the treatment where no molybdenum was applied.

Table 3 Effect of potassium and molybdenum on N, P, K, S, and Mo concentration in soybean seed and stover

Treatments	Concentration (%) in seed					Concentration (%) in stover				
	N	P	K	S	Mo	N	P	K	S	Mo
Level of potassium										
K_0	1.6 c	0.24 c	0.38 c	0.19 c	0.07 b	1.5 bc	0.22 b	1.44 b	0.21 c	0.01b
K_1	2.3 a	0.51 a	0.96 a	0.49 a	0.07 b	1.7 ab	0.23 b	1.45 ab	0.25 ab	0.01 b
K_2	2.4 a	0.51a	1.01 a	0.51 a	0.09 a	1.9 a	0.23 b	1.46 a	0.26 a	0.01 a
K_3	2.1b	0.67 b	0.34 b	0.33 b	0.06 b	1.3 c	0.27 a	1.46 a	0.24 b	0.01 a
Level of significance	**	**	**	**	**	**	**	**	**	**
Level of molybdenum										
Mo_0	1.6 c	0.54 c	0.30 c	0.27 c	0.05 c	1.2 c	0.21 b	1.43 c	0.22 b	0.01 b
Mo_1	2.2b	0.79 b	0.35 b	0.41 b	0.07b	1.6 b	0.24 ab	1.46 b	0.24 a	0.01 a
Mo_2	2.4 a	1.05 a	0.45 a	0.46 a	0.08 a	1.9 a	0.26 a	1.47 a	0.25a	0.01 a
Level of significance	**	**	**	**	**	**	**	**	**	**
CV (%)	5.13	4.65	8.2	4.47	4.98	6.25	7.54	2.34	6.3	4.56

In a column means having dissimilar letter(s) differ significantly at 0.05 level of probability
** = Significant at 1% level of probability, * = Significant at 5% 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

The different nutrient contents of soybean seed and stover differ significantly due to the interaction effects of potassium and molybdenum (Table 4). Application of 40 kg K_2O and 1.5 kg Mo ha^{-1} (K_2Mo_2) showed the highest concentrations of N (2.9%), P (1.51%), K (0.68%), S (0.62%) and Mo (0.14%) in soybean seed. The highest concentrations of N (2.6%), P (0.34%), K (1.48%), S (0.27%), and Mo (0.015%) in stover were also obtained in 40 kg K_2O and 1.5 kg Mo ha^{-1} (K_2Mo_2). The treatment in which no fertilizer was applied (control) resulted in the lowest concentration of all nutrients in seed and stover.

Table 4 Interaction effect of potassium and molybdenum on N, P, K, S, and Mo concentration in soybean seed and stover

Treatments	Concentration (%) in seed					Concentration (%) in stover				
	N	P	K	S	Mo	N	P	K	S	Mo
K_0Mo_0	1.2 g	0.36 e	0.17 g	0.16 e	0.04 e	1.1 e	0.21 b	1.40 e	0.18 e	0.008
K_0Mo_1	1.7 f	0.46 b	0.19 fg	0.22 e	0.05 d	1.6 b-e	0.23 b	1.47 a-c	0.23 d	0.014
K_0Mo_2	1.8 d-f	0.61 f-h	0.22 fg	0.19 e	0.11 b	1.7 b-e	0.25 b	1.46 a-c	0.23 d	0.011
K_1Mo_0	1.6 f	0.72 ef	0.44 c	0.33 d	0.04 e	1.3 c-e	0.22 b	1.42 d	0.23 cd	0.012
K_1Mo_1	2.5 b	1.08 c	0.47 c	0.54 b	0.05 d	1.7 b-d	0.23 b	1.45 c	0.25 bc	0.014
K_1Mo_2	2.7 ab	1.23 b	0.53 b	0.61 a	0.06 d	2.0 b	0.22 b	1.48 a	0.26 ab	0.013
K_2Mo_0	1.7 ef	0.56 gh	0.36 d	0.36 d	0.06 d	1.3 c-e	0.22 b	1.43 d	0.24 cd	0.01
K_2Mo_1	2.6 ab	0.97 cd	0.47 c	0.54 b	0.06 d	1.8 bc	0.26 b	1.46 bc	0.26 ab	0.012
K_2Mo_2	2.9 a	1.51 a	0.68 a	0.62 a	0.14 a	2.6 a	0.34a	1.48 a	0.27 a	0.015
K_3Mo_0	2.0 cd	0.53 gh	0.23 f	0.22 e	0.06 d	1.2 de	0.21 b	1.46 bc	0.23 d	0.008
K_3Mo_1	2.0 c-e	0.66fg	0.29 e	0.34 d	0.06 d	1.3 c-e	0.24 b	1.46 bc	0.24 b-d	0.01
K_3Mo_2	2.2 c	0.84 de	0.37 d	0.43 c	0.07 d	1.5 b-e	0.24 b	1.47 ab	0.25 bc	0.011
Level of significance	**	*	**	*	*	**	**	*	**	NS
CV (%)	5.13	4.65	8.2	4.47	4.98	6.25	7.54	2.34	6.3	4.56

In a column means having dissimilar letter(s) differ significantly at 0.05 level of probability
** = Significant at 1% level of probability, * = Significant at 5% 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

IV. CONCLUSION

Results revealed that application of 40 kg K_2O ha^{-1} produced the highest seed yield, oil content, and nutrient concentration. Molybdenum application of 1.5 kg ha^{-1} significantly increased the seed yield, oil content, and nutrient concentration of soybean. Compared to other combinations, the application of 40 kg K_2O and 1.5 kg Mo ha^{-1} produced the best results in terms of all the studied parameters. Therefore, potassium and molybdenum at a rate of 40 kg and 1.5 kg, respectively, were found to be the most promising combination in terms of seed yield, oil content, and nutrient concentration of soybean.

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