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EFFECT OF MOLYBDENUM ON PHYSIOLOGY AND BIOCHEMISTRY OF BLACK GARAM

Seetu Balhara

Research Scholar, Baba Mastnath University, Rohtak

Dr. Brijesh Shivhare

Assistant Professor, Baba Mastnath University

ABSTRACT

Even when seeded on soils lacking in molybdenum (Mo), seeds may still contain enough Mo to avoid molybdenum (Mo) shortage in the crop. But neither the origins nor the timing of Mo redistribution during seed development are well understood. The redistribution of molybdenum inside black gramme from full flowering to seed maturity was studied in a glasshouse experiment that controlled for Mo supply and nitrogen source. Two types of nitrogen fixation were used in the treatments, along with two amounts of molybdenum supply: zero (-Mo) and 0.64 mg Mo kg−1 soil (+Mo). There were four harvests total: full flowering, early pod setting, late pod filling, and seed maturity. By tracking the variations in Mo concentration among plant components at each development stage, we were able to analyse the redistribution of Mo in black gramme. The redistribution of molybdenum to the seed was significantly impacted by the plant's development stage and the amount of molybdenum available. There was no net gain in whole plant Mo from full blooming till maturity in −Mo plants that relied on symbiotic N 2 fixation, thus Mo redistributed from roots, stems, and leaves was the only source of Mo for reproductive growth. In −Mo plants, the roots were the primary source of Mo for pod and early seed development. Nodules, rather than roots, were the primary source of Mo for seed fill in −Mo plants during late pod filling. Mo that is taken up from the soil after full blooming might have provided approximately half of the seed Mo for +Mo plants that depend on symbiotic N 2 fixation. In early podding, the leaves of the middle stem provided the majority of the Mo for seed filling in +Mo plants. In late podding, the middle stems and pod walls were the primary sources of Mo.

Keyword: - *Molybdenum, Physiology, Biochemistry, Black Garam.*

INTRODUCTION

Molybdenum (Mo) is a trace element that is essential to the survival of almost all living things, including plants and animals. In soil, the most prevalent form of molybdenum is the molybdate oxyanion, which is denoted by the chemical formula MoO_4^{2-}. When molybdate is taken by the roots of a plant, it does not become physiologically active again until it forms a complex with a particular pterin known as the molybdenum cofactor (Moco). This complex is how molybdate becomes physiologically active. Many different types of apoproteins, including Na^+ ion oxidase, sulfite oxidase, xanthine oxidase, and nitrate reductase, are among the apoproteins that Moco interacts with. It was found that the molybdenum concentrations in agricultural soils ranged from 0.2 to 5 mg kg-1 on average. It is only possible for molybdenum to live in an aerobic environment in its anionic state. At pH levels between 5 and 6, the molybdenum ion concentration is at its greatest. The concentration of molybdenum in the soil solution is found to be between 2 and 10 microgrammes per litre. MoO4 2- is transported across the plasma membrane in a way that is not specific by anion carriers, particularly those of phosphates and sulphates. Both the xylem and the phloem of plants are capable of transporting molybdenum quickly and easily across large distances. There is currently a lack of clarity on the form that this element is transported in; nevertheless, based on its chemical properties, it is most likely the MoO4 2-, and not a complex form. Molecular movement across the xylem, on the other hand, was proposed as a potential contributor to complex formation. As a co-factor, molybdenum is present in higher plant enzymes, in addition to the structural and catalytic functions that it plays in the plant community.

Despite the fact that molybdenum does not directly take part in the process of nitrogen metabolism, a number of studies have shown that it has a considerable stimulating influence on the production of nitrogen. Despite the fact that stress-induced amino acids such as serine, alanine, proline, and threonine exhibit recurrent increases, the molybdenum content of plants and their nitrogen-fixing activity are dramatically decreased when molybdenum is not available. Foliar nutrients are the cause of a reduction in plant growth, and a deficiency in molybdenum inhibits enzymes that are involved in primary nitrogen absorption. These enzymes include nitrate reductase (NR), glutamine synthetase (GS), and glutamine: 2-oxyoglutarate aminotransferase (GOGAT). Foliar nutrients are necessary for plant development. Molybdenum deficiency causes a decrease in the activity of nitrate reductase, which in turn hinders the reduction of nitrates and slows down the pace at which plants absorb nitrogen. Within the context of refined sand, the primary emphasis of this study is on the impact of changing Mo supply on the metabolism and reproduction of black gramme plants throughout stages of maturity. Both the changes in seed quality and the changes in metabolism that occur at various Mo stages during the development of the seedling are included.

OBJECTIVE

1. To molybdenum affects black garam's physiology and biochemistry.
2. To Evaluate the Function of Molybdenum in Enzyme Activation.

MATERIAL METHODS

An experiment was conducted in the field by the Agronomic Research Area at the University of Agriculture in Faisalabad in the spring of 2012. The purpose of the experiment was to determine the effect that molybdenum, when used as a seed treatment, had on the yield and quality of mashbeans. A Randomised Complete Block design (RCBD) with three replicates was used in the process of establishing the experiment. Arooj, a crop variety mash released in 2010, served as the test crop. The net plot size for each treatment was 1.5 meters by 5 meters. The trial consisted of the following modalities of treatment:

T_1= No seed treatment (control), T_2 = 0.5 g Mo kg $^{-1}$ of seed, T_3 = 1.0 g Mo kg $^{-1}$ of seed, T_4 = 1.5 g Mo kg $^{-1}$ of seed, T_5 = 2.0 g Mo kg $^{-1}$ of seed, T_6 = 2.5 g Mo kg $^{-1}$ of seed' T_7 = 3.0 g Mo kg $^{-1}$ of seed, T_8 = 3.5 g Mo kg $^{-1}$ of seed, T_9 = 4.0 g Mo kg $^{-1}$ of seed, T_{10}= 4.5 g Mo kg $^{-1}$ of seed, T_{11}= 5.0 g Mo kg $^{-1}$ of seed, T_{12}= 5.5 g Mo kg $^{-1}$ of seed, and T_{13}= 6.0 g Mo kg $^{-1}$ of seed.

The experimental soil was subjected to a series of measurements, which included the following: pH, organic matter, available phosphorus, available nitrogen, available potassium, available iron, saturation, texture (loam), SAR, ESP, and EC. The values that were obtained were 16.7 mg/L, 0.052 mg/L, 234 mg/L, and 3 mg/L, from left to right. At the time when the crop was being seeded, the fertilisers that were applied to it were urea (23 kg ha-1) and diammonium phosphate (57 kg ha-1). A single-row manual drill was used to plant the crop in rows on a seedbed that had been well prepared. The seed rate that was employed was 25 kilogrammes per hectare. Thirty centimetres were used to divide the rows, and ten centimetres were used to divide each individual plant. There were no modifications made to any of the other agricultural methods, such as hoeing, irrigation, or the use of insects for pest control. An analysis of variances approach developed by Fisher was used in order to carry out statistical analysis on the data that was obtained about the various parameters. At a probability threshold of 5%, comparisons were done between the means of the treatments being administered using LSD.

RESULTS AND DISCUSSION

The process of applying molybdenum as a seed treatment has a significant effect on the height of the plant. Treatment 9, which included treating the seed with 4 grammes of molybdenum per kilogramme of seed, produced the tallest plants (55.30 centimetres), whereas the control plants reached the lowest height (40.83 centimetres). When compared to the control group, it was found that the application of molybdenum and phosphorus resulted in a significant increase in the height of the mungbean plant. The number of nodules that were formed by each plant was significantly impacted by the application of molybdenum to the seeds via treatment. An average of 6.8 nodules were found on each plant in the control group, whereas the treatment group, which was given 4 grammes of molybdenum per kilogramme of seed, had an average of 11.17 nodules per plant. demonstrated that the number of nodules that were produced by each mung bean plant grew as the amount of molybdenum that was administered to the plant increased. The application of molybdenum to seeds has a significant impact on the number of pods that produce branches for each plant. According to the statistics, treatments T9–T12 were more productive than T13, which had the maximum number of pod-bearing branches per plant.

The treatment of molybdenum seeds had a significant impact on the number of pods that were generated by each individual plant. Plants that were subjected to Treatment 9 (seed that was treated with 4 grammes of molybdenum per kilogramme of seed) produced the largest number of pods per plant (27.70), while plants that were not subjected to any treatment produced the lowest number of pods per plant (16.30). After being treated with seed, the soil may have been able to make better use of the molybdenum resources, which resulted in an increase in the number of pods produced by each plant. Boron and molybdenum added to the soil had a significant influence on the yield as well as the components of the yield, such as the pod density and the weight of one thousand seeds. The treatment with molybdenum seed had a significant effect on the ratio of carbohydrates to total carbohydrates. When compared to the control, which did not receive any treatment, Treatment 9 (seed treated with 4 g Mo kg-1 of seed) had the greatest carbohydrate content (59.53%), while the control had the lowest (50.30%). According to the findings of a study that investigated the effects of micronutrient delivery on the nutritional absorption of mash beans and the total carbohydrate content of the beans grown in greenhouses, the latter rose. Whether or not molybdenum seeds are treated has a significant impact on the amount of protein they contain. The protein concentration of the control group was the lowest, coming in at 18.63%, while the treatment (T9), which comprised treating the seeds with 4 g Mo kg-1, had the greatest protein content, coming in at 24.53%.

Table 1: Effect of molybdenum seed treatment on yield and quality of Black gram

Treatments	Plant height (cm)	Number of nodules per plant	Number of pod bearing branches	Number of pods per plant	Carbohydrate Content (%)	Protein content (•)
T1 Control (No seed treatment)	40.831	6.801	7.57cd	16.30g	49.30g	18.63g
T2 0.5 g Mo kg "seed	45.53de	7.43ef	7.47cd	16.60fg	52.801	19.831g
T3 1.0 g Mo kg "seed	44.67e	6.93f	7.30d	17.43fg	54.I3ef	19.80fg
T4 1.5 g Mo kg "'seed	45.73cde	7.50ef	8.00bcd	16.63fg	55.50de	I9.83fg
Ts 2.0 g Mo kgaseed	47.50cde	8.36def	8.03bcd	I8.56de	57.10bcd	20.20ef
T6 2.5 g Mo kg -Iseed	46.70cde	9.4 lcd	8.30bcd	19.9d	56.23bcd	23.40abc

T7 3.0 g Mo kg "seed	49.03bcd	9.27cd	10.53abc	21.26d	55.73de	21.70de
Ts 3.5 g Mo kg1seed	51.966	10.13c	6.93d	23.80c	58.00ab	21.56de
Ts 4.0 g Mo kg "'seed	55.30a	11.17a	I I.67a	27.70a	59.53a	24.53a
T10 4.5 g Mo kg "'seed	49.36bc	8.70cde	12.00a	25.40bc	57.00bcd	/"). I Dad
T11 5.0 g Mo kg "seed	52.206	10.33bc	10.73ab	24A7c	57.80abc	22.004:41
T12 5.5 g Mo kg "seed	47.96cde	9.73cd	II.63a	25.53bc	57.23bcd	22.33bcd
T13 6.0 g Mo kg "seed	47.33cde	10.83ab	13.43a	26.20ab	55.97cde	23.67ab
LSD (5%)	3.79	1.67	2.19	2.00	1.97	0.78

Table 2: Effect of molybdenum seed treatment on yield and quality of Black gram

Treatments	Number of seed per pod	Pod length (cm)	1000-seed weight (g)	Seed yield (kg ha")	Biological yield (kg ha')	Harvest index (%)
Control(No seed treatment)	6.33d	5.42e	34.53cde	915.1d	5978.8f	15.33k
T2 0.5 g Mo kg "'seed	8.00bc	5.80de	35.87c4	959.6cd	5988.8ef	15.55k
T3 1.0 g Mo kg "seed	7.33cd	5.95bcde	31.53f	%3.4bcd	6052.2ef	15.12k
T4 1.5 g Mo kg "seed	7.67bc	6.67abc	33.43def	968.9bcd	6259.2bcbe	15.67k

Ts 2.0 g Mo kg "'seed	8.00k	5.90cde	32.39ef	993.2k	6192.7cdef	16.33ab
T6 2.5 g Mo kg "'seed	8.33k	6.87a	33.37def	989.1k	6165.1cdef	16.00abc
T, 3.0 g Mo kg "'seed	8.00k	6.60abcd	34.89cde	1016.4ab	6596.4a	15.33k
Ts 3.5 g Mo kg "'seed	8.66bc	6.75ab	36.34k	1007.93k	6259.0bcdef	16.00abc
T9 4.0 g Mo kg "seed	10.00a	6.29abc	40.18a	1049.2a	6344.1abcd	16.67a
Tea 4.5 g Mo kg 'seed	8.67k	6.70ab	38.64ab	995.4abc	6414.1abc	15.00c
T11 5.0g Mo kg "'seed	8.67 b	6.98a	39.04ab	993.3k	6366.0abcd	15.33k
T12 5.5 g Mo kg "'seed	8.00 bc	6.57abcd	36.54k	1009.1abc	6125.4def	16.33ab
T13 6.0 g Mo kg "seed	8.66b	6.67abc	36.33k	997.7abc	6480.0ab	I5.67k
LSD (5%)	1.07	0.8231	2.7303	83.46	280.23	1.2439

Here are the results, which are shown in Table 1. The treatment (T9), which consisted of treating the seeds with 4 grammes of molybdenum per kilogramme of seed, resulted in the maximum number of seeds per pod (10.00), while the control group resulted in the lowest number of seeds per pod (6.33). According to Landge et al. (2002), the application of phosphorus and molybdenum resulted in an increase in the production of seeds per pod of mungbean. The pods that were produced by the treatment (T11) with 5 g Mo kg-1 of seed were the longest (6.98 cm), whereas the pods produced by the control seed were the smallest (5.42 cm).

Using molybdenum as a seed treatment led to the development of pods that were longer in mash beans. The maximum 1000 seed weight (40.18 g) was achieved by the treatment (T9), which included treating the seeds with 4 g Mo kg1 of seed. Additionally, the control group had the lowest 1000 seed weight (31.53 g), indicating that the treatment was the most effective. It is well knowledge that molybdenum plays a necessary role in a number of physiological processes that occur in plants. Because of this, the weight of the seed that had been treated with molybdenum increased. This might be due to the fact that the seed had a greater quantity of phosphorus, which is present in both lipids and proteins. Molybdenum was added, which resulted in a significant increase in the component's weight throughout 1000 seeds. The treatment (T9) that treated the seeds with 4 grammes of molybdenum per kilogramme of seed generated the maximum seed production (1049.2 kg ha-1) compared to the control group, which produced the lowest seed yield (915.1 kg ha-1). An increase in seed production was seen in seeds that had been treated with molybdenum. Possibly, this is due to the fact that the plants generated a greater quantity of chlorophyll, which led to an improvement in their photosynthesis and, therefore, their seed output. Furthermore, Deo and Kothari (2002) found that the application of 3.5 grammes of sodium molybedate per kilogramme of seed resulted in an increase in the yield. The addition of molybdenum to the seeds had a significant influence on the biological output of the plant. The treatment (T13), which consisted of treating the seeds with 6 grammes of molybdenum per kilogramme of seed, resulted in the maximum biological yield (6480 kg ha-1), while the control group had the lowest biological yield (5978.8 kg ha-1). Molybdenum was added to seeds, which resulted in an increase in their biological output. This potential rise might be attributed to a more uniform plant growth or to improved germination. The plants that were treated with molybdenum and phosphorus had considerably bigger increases in growth rate, dry matter production, and mash bean grain yield as compared to the group that served as the control. The quantity of harvest index is significantly influenced by the molybdenum seed treatment. In contrast to the control group, which obtained the lowest harvest index (15.33%), the treatment (T9), which consisted of treating the seed with 4 grammes of molybdenum per kilogramme of seed, generated the greatest harvest index 16.67%. All of these results are shown in Table 2.

CONCLUSION

Molybdenum has been proven to have an influence on a variety of biological processes, as shown by the findings of studies that investigated its impacts on the physiology and biochemistry of black garlic. A better knowledge of the impact that molybdenum has on enzyme activity, growth and development, and antioxidant systems may be helpful in gaining a better understanding of the metabolic adaptations that fish have developed. In addition to bioaccumulation and toxicity, which may have negative effects at low concentrations, elevated levels offer dangers to haematological, reproductive, and behavioural health. These hazards are in addition to the fact that elevated levels represent risks to both. It is essential to have a thorough understanding of the molybdenum limitations in order to achieve maximum efficiency in aquaculture, safeguard the health of fish, and minimise environmental concerns. By contributing to the expanding body of knowledge, this work has the potential to assist aquaculturists in better managing nutrients and ensuring the long-term survival of Black Garam and other aquatic species that are connected to it.

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