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Response of Sulphur and Molybdenum on Growth and Yield Attributes of Field Pea (*Pisum sativum* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

During Rabi 2022, a field trial was conducted at the SHUATS Agriculture Crop Research Farm in Prayagraj. The soil in the experimental plot was sandy loamy, with a near-neutral soil response (pH 7.1), low organic carbon content (0.36%), available nitrogen (171.48 kg/ha), available phosphorus (15.2 kg/ha), and had an effective soil. K (232.5 kg/ha). The experiment was set up with a randomized block design in which he repeated nine treatments three times, based on a one-year experiment. The treatments are T_1: Sulphur 20 kg/ha^{-1} + Mo 0.5 kg/ha^{-1}, T_2: Sulphur 20 kg/ha^{-1} + Mo 1.0 kg/ha^{-1}, T_3: Sulphur 20 kg/ha^{-1} + Mo 1.5 kg/ha^{-1}, T_4: Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1}, T_5: Sulphur 30 kg/ha^{-1} + Mo 1.0 kg/ha^{-1}, T_6: Sulphur 30 kg/ha^{-1} + Mo 1.5 kg/ha^{-1}, T_7: Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1}, T_8: Sulphur 40 kg/ha^{-1} + Mo 1.0 kg/ha^{-1}, T_9: Sulphur 40 kg/ha^{-1} + Mo 1.5 kg/ha^{-1}, T_{10}: Control are used. The application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1}, recorded significant Plant height (56.25 cm), Number of nodules/plant (9.00), Plant dry weight (22.13 g/plant), maximum pods/plant (19.00), Seeds/pod (8.21), Test weight (35.45 g), Seed yield (2.29 t/ha).

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1. INTRODUCTION

Peas (*Pisum sativum* L.) are winter-grown annual cool-season vegetable crops. It is a widely spread leguminous plant belonging to the subfamily Papilio family of the legume family. Peas are grown primarily for their green seeds, which are sweet and can be eaten without cooking. Peas are highly nutritious and contain a high percentage of digestible protein in addition to carbohydrates and vitamins. In addition, it is very rich in minerals. Peas contain 15-35% protein, 20-50% starch, 4-10% sugar, 0.6-1.5% fat and 2-4% minerals. This crop and its by-products can also be used as fodder. It is also used as green manure. As nitrogen-fixing crops with high root uptake capacity, we use compounds from the cultivated soil layer that are soluble in grains and rarely available. Peas are crop rotations that improve soil fertility and subsequent crop yields. The average is only 0.77 t ha-1, significantly less than other pea-producing countries. It is the third most popular legume in the world after dried beans and chickpeas, and rabbi sayah is the third most popular in India after chickpeas and lentils. It occupies a unique position in Indian agriculture. The states where peas are mainly grown in India are Karnataka, Madhya Pradesh, Rajasthan, West Bengal, Punjab, Assam, Haryana and Uttar Pradesh. Himachal, Uttarakhand, Bihar and Orissa. The 76.3 million hectares produced 143.6 million tons, with an average productivity of 1884 kg hectares (Ministry of Agriculture and Farmer Welfare, Annual Report, 2017-18).

Peas are a major winter legume crop and are mainly confined to cool temperate regions. This crop serves as a food, fodder and vegetable source. This is his third most important legume on a global scale and in India he is the third most popular rabbi pod after chickpeas and lentils. In peas, proper and better nutritional management is important to achieve higher productivity and productivity. A positive response to fertilization was observed in field peas. However, the continued use of chemical fertilizers in modern agricultural practices has adversely affected soil health and beneficial indigenous soil microbial populations. Biofertilizers are organic products of living cells of various types of microorganisms that can convert nutritionally important elements from inaccessible to usable forms through biological processes [1]. Biofertilizers are natural fertilizers containing micro-organisms that enhance plant production through processes of biological nitrogen fixation and dissolution of insoluble phosphates, zinc and other growth regulators that plants need for proper growth and development. helps improve sexuality. In this context, nutrient management combined with organic fertilizers is developing as an economically viable and sensible solution. Environmentally friendly fertilizers [2].

Sulphur is considered an important plant nutrient. Essential for the growth and development of all crops without exception. Most of the sulphur needed by plants is absorbed by the roots in the form of sulphate (SO4-2). Sulphur deficiency is becoming more severe each year, severely limiting crop yields, product quality, nutrient utilization efficiency and economic benefits on millions of farms. Like other essential nutrients, sulphur performs certain specific functions within plants. Therefore, sulphur deficiency can only be resolved by using sulphur fertilizers. Sulphur is an important component of the sulphur-containing amino acids cystine, cysteine and methionine, which play an important role in regulating metabolic and enzymatic processes.

Molybdenum (Mo) and very low microbial activity [3] Legumes such as peas are sensitive to soil acidity and liming is the only way to increase yield in such soil conditions. Molybdenum occupies an important place in the list of trace elements essential for plant growth and is widely recognized for its use as a fertilizer, especially in the cultivation of legumes. A balanced nitrogen supply to peas is therefore a prerequisite for achieving optimal pea performance. Therefore, there is an urgent need to add various nutrients such as nitrogen and molybdenum to the soil to maximize pea production. Therefore, we attempted to observe the effects of sulphur and molybdenum on the growth and yield of peas in field experiments.

2. MATERIALS AND METHODS

Experiments conducted to investigate the response of sulphur and molybdenum to the growth and yield characteristics of field peas (*Pisum sativum* L.) were conducted at the Sam Higginbottom University Crop Research Farm, Prayagraj,Uttar Pradesh in 2022. The experiment was an RBD (randomized block design) consisting of 10 treatments, including 3 replicate controls, in which field pea seeds were planted at a distance of 30 cm between rows and 10 cm

between plants at a seeding rate of 75-100 kg/ha sowing -1. Growth parameters such as plant height, dry weight, number of nodules per plant, and yield-determining traits such as number of pods per plant, number of seeds per pod, and test weight were recorded at harvest and averaged. value has been calculated. Data were determined using the ANOVA method and statistically analyzed techniques.

3. RESULTS

3.1 Response of Sulphur and Molybdenum on Growth Attributes of Field Pea

The perusal of the data of the plant height, plant dry weight and number of nodules per plant was recorded at harvest, which is presented in Table 1. The data reveals that there was a significant effect among different treatments.

Plant height: At 80 DAS, there was a significant difference among the treatments. However, highest plant height (56.25 cm) was recorded with the application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha, whereas minimum plant height (48.89 cm) was recorded with the treatment Control 20:40:20 kg/ha^{-1} and Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} (55.41 cm), Sulphur 40 kg/ha^{-1} + Mo 1.0 kg/ha^{-1} (53.43 cm) were statistically at par with T7.

Plant dry weight: The highest dry weight (22.13 gm) was recorded with the application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1}, whereas the minimum dry weight (20.73 gm) was recorded with the treatment Control 20:40:20 kg/ha$^{-1,}$ there was a significant difference among the treatments, and Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} (21.94 gm) was statistically at par with T7.

Number of nodules per plant: There was a significant difference among the treatments. However, the highest number of nodules per plant (9.00) was recorded with the application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1}, whereas the minimum number of nodules per plant (4.00) was recorded with the treatment Control 20:40:20 kg/ha^{-1} and Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} (8.00) was statistically at par with T7.

3.2 Response of Sulphur and Molybdenum on Yield Attributes of Field Pea

The perusal of the data of the Number of Pods/plants, seeds per pod, and test weight was recorded at harvest, which is presented in Table 2. The data reveals that there was a significant effect among different treatments.

Number of Pods/plants: Significantly Maximum Number of Pods/plant (19.00) was recorded with the treatment of application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} over all the treatments, the minimum was reported in Control 20:40:20 kg/ha^{-1} (11.07). However, the treatment Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} (18.10) which was found to be statistically at par with T7.

Number of Seeds/Pod: Maximum Number of seeds/plant (8.21) was recorded with the treatment of the application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} over all the treatments, and the minimum was reported in Control 20:40:20 kg/ha^{-1} (5.10). However, the treatment Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} (7.90) was found to be statistically at par with T7, and there was a Significant change between the treatments.

Table 1. Response of sulphur and molybdenum on growth attributes and yield of field peas

Treatments	Plant height	Dry weight	Number of nodules per plant
T1	50.80	20.79	5.00
T2	51.67	21.06	7.00
T3	51.48	21.18	7.00
T4	55.41	21.94	8.00
T5	53.43	21.51	6.00
T6	52.50	21.29	6.00
T7	56.25	22.13	9.00
T8	53.83	21.62	8.00
T9	52.99	21.37	5.00
T10	48.89	20.73	4.00
Sem(±)	0.87	0.20	0.38
CD (p=0.05)	2.59	0.60	1.13

Table 2. Response of Sulphur and Molybdenum on Yield attributes and Yield of Field Pea

Treatments	Pods/plant (No)	Seed per pod (No)	Test weight (g)	Seed yield (t/ha)
T1	12.00	5.03	31.59	2.01
T2	12.07	5.02	32.00	2.07
T3	13.00	5.97	32.47	2.10
T4	18.10	7.90	35.03	2.21
T5	15.93	7.24	33.74	2.19
T6	14.07	6.05	32.78	2.15
T7	19.00	8.21	35.45	2.29
T8	17.93	7.15	33.92	2.20
T9	14.07	6.23	33.09	2.17
T10	11.07	5.10	31.47	2.00
Sem(±)	0.22	0.12	0.41	0.02
CD (p=0.05)	0.65	0.37	1.22	0.08

Test weight (g): Minimum was reported in Control 20:40:20 kg/ha^{-1} (31.47 g), Significantly Maximum test weight (35.45 g) was recorded with the treatment of the application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} over all the treatments. However, the treatment Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} (35.03 g) which was found to be statistically at par with T7.

Seed yield (t/ha): Significantly Maximum seed yield (2.29 t/ha^{-1}) was recorded with the treatment of the application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} over all the treatments, the minimum was reported in Control 20:40:20 kg/ha^{-1} (2.00 t/ha^{-1}). However, the treatment Sulphur 30 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} (2.21 t/ha^{-1}) which was found to be statistically at par with T7.

4. DISCUSSION

Sulphur application increased the rate of photosynthesis due to enhanced protein synthesis and maintenance of high chlorophyll content. Thus, it ultimately increases the plant growth parameter Prajapati et al. [4]. Sulphur content also increases due to the rapid absorption and translocation of sulphur by plants with adequate sulphur from the soil [5] leading to improved sulphur content and uptake by the crop. Fertilizing the crop with sulphur significantly increased yield attributes and yield of cluster bean crop over no sulphur application. This might be also due to the cumulative effect of improvement of growth parameters through efficient metabolic activity and increased rate of photosynthesis which might lead to the maximum expression of yield. The results of the present study corroborate with the findings of, Karche et al. [6], Ramawtar et al. [7] and Raiger et al. [8]. The improvement in crop growth, nodulation and yield attributes with the sulphur application could be ascribed to its pivotal role in the regulation of the metabolic and enzymatic processes including photosynthesis, respiration and legume-Rhizobium symbiotic nitrogen fixation reflected in increased yield. Similar results were also reported by Rao et al. [9].

5. CONCLUSION

The application of Sulphur 40 kg/ha^{-1} + Mo 0.5 kg/ha^{-1} was recorded significantly as compared to other treatments. Since, the finding based on the research done in one season.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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