Response of Sulphur and Molybdenum on growth and yield attributes of Field Pea (*Pisum Sativum* L.)

Abstract:

A field experiment was conducted during *Rabi* 2022 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice based on one year of experimentation. 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).

Keywords: Field pea, Molybdenum, Sulphur, Yield parameters.

Introduction:

The field pea (Pisum sativum L.) is a cool-season annual vegetable crop grown during the winter month. It is a widely spread legume belonging to the sub-family Papilionaceae under the family Leguminosae. The field pea is grown mainly for green seeds and it can be eaten without any cooking process due to its sweet taste. Pea is highly nutritious containing a high percentage of digestible protein along with carbohydrates and vitamins. It is also 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-product can also be used as fodder. It is used as green manure as well. As a nitrogen-fixing crop with a high assimilating capacity of the roots, it utilizes the chemical compound, which is in solubility and is rarely accessible to cereals from the cultivated soil layers. Field pea is the crop rotation that helps in the improvement of soil fertility and yield of succeeding crops. The average is only 0.77 t ha-1, which is much lower compared to other pea-growing countries. It is the third most important pulse crop at the global level, after dry bean and chickpea and the third most popular Rabi pulse of India after chickpea and lentil. It occupies a unique position in Indian agriculture. The major field pea-producing states in India like Karnataka, Madhya Pradesh, Rajasthan, West Bengal, Punjab, Assam, Haryana, and Uttar

Pradesh. Uttarakhand, Himachal Pradesh, Bihar and Orissa. It produced 143.6 lakh tones from 76.3 lakh ha with an average productivity of 1884 kg ha (Ministry of Agriculture and Farmer Welfare, Annual report, 2017-18).

Field pea is a principal winter season grain legume crop largely confined to cooler temperate zones. This crop serves as a source of food, feed and vegetable. It is the third most important pulse crop at the global level and the third most popular rabi pulse of India after chickpea and lentil. A proper and better nutrient management practice is important in field peas to achieve higher productivity and production. A favourable response to fertilizer application has been observed in field peas. However, the continuous use of chemical fertilizers in modern agricultural practices has led to an adverse effect on soil health and the population of native beneficial soil microorganisms. Biofertilizers are organic products of living cells of different types of microorganisms which could convert nutritionally important elements from unavailable to available forms through biological processes **(Itelima *et. al.*, 2018)**. Bio-fertilizers are natural fertilizers which contain micro-organisms and help in increasing crop productivity by the processes of biological nitrogen fixation or solubilizing the insoluble phosphate or zinc and other growth regulators which are also required by plants for proper growth and development. In this context, nutrient management along with biofertilizers is emerging as an economically viable and ecologically sound means of fertilization **(Kaur and Purewal, 2019)**.

Sulphur is now recognized as a major plant nutrient. It is essential for the growth and development of all crops, without exception. Most of the plant's requirement of sulphur is absorbed through the roots in the form of sulphate (SO4-2). Sulphur deficiency is becoming more critical with each passing year which is severely restricting crop yield, produce quality, nutrient use efficiency and economic returns on millions of farms. Like any essential nutrient, sulphur has certain specific functions to perform in the plant. Thus, sulphur deficiencies can only be corrected by the application of sulphur fertilizer. Sulphur is an important constituent of sulphur containing amino acids cystine, cysteine and methionine and plays a vital role in regulating the metabolic and enzymatic process.

Molybdenum (Mo) and very low microbial activity **(S. K. Mukhi. *et al.*, 2019)**. Legume vegetable crops such as peas are sensitive to soil acidity and liming is the only option for increasing yield in such soil conditions. molybdenum has taken an important place in the list of trace elements essential for plant growth and its use as a fertilizer has been widely recognized, especially in pulse crop cultivation. So, balanced N application to the garden pea plant is a prerequisite condition for obtaining the optimum potentiality of the pea plant. Hence, there is an urgent need to maximize pea production by applying different nutrients like N and Mo to the soil.

Thus, an attempt was made in a field trial to observe the effect of nitrogen and molybdenum on the growth and yield of field peas.

Material and Methods:

The experiment conducted to know the **Response of Sulphur and Molybdenum on the growth and yield attributes of Field Pea (*Pisum Sativum* L.)** was carried out at Crop Research Farm of Sam Higginbottom University, Prayagraj, Uttar Pradesh in 2022. The experiment was laid out in an RBD (Randomized Block Design) consisting of Ten treatments including Control with 3 replications, The Field pea seeds were sown at a spacing of 30 cm row to row and 10 cm plant to plant with a seed rate of 75 - 100 kg/ha^{-1}. The growth parameters like plant height, dry weight, number of nodules per plant and yield contributing characters such as the number of pods per plant, number of seeds per pod, and test weight were recorded at the time of harvest and averages were calculated and the data were statistically analyzed using the ANOVA technique.

Results

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.

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.

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.

Discussions:

Sulfur 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.,* 2013. Sulphur content also increases due to the rapid absorption and translocation of sulphur by plants with adequate sulphur from the soil (Shrivastava *et al.,* 2000) 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*., (2012), Ramawtar *et al*., (2013) and Raiger *et al*., (2017). 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.,* (2001).

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.

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

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