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Role Of Sulphur On Growth, Yield And Yield Attributing Character's Of Mustard Crop: A Review

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Abstract

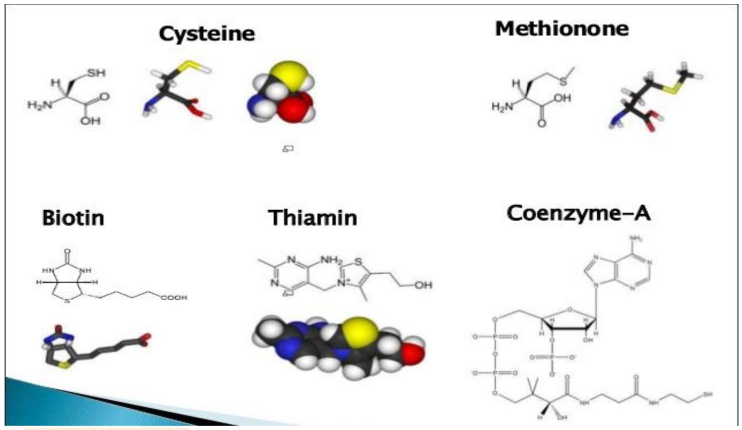
Sulphur is an essential nutrient for all the plants. It is constituent of essential amino acids (cysteine, cystine and methionine), several coenzymes (biotin, coenzyme A, thiamine pyrophosphate, lipoic acid and thioredoxin) and sulpholipids. Application of sulphur fertilizers to rapeseed and mustard can lead to increased glucosinolate, protein and glucoside. It has important role in improving the quality and marketability of produce (seed & oil). The quality decides the market price and output of the end product i.e. Oil per unit of economic yield. Sulphur application increases plant height, leaves per plant, dry matter production besides increasing yield attributes and yield of mustard. Rapeseed and mustard are the third most important edible oilseed crops of India after soybean and ground nut. Importance of mustard as sources of both fats, proteins is well known the annual requirement of oilseed in India. In India, a variety of oilseed such as groundnut, sesamum, mustard, soybean, safflower etc. are grown. However, about 88% of edible oils are derived from soybean, groundnut, mustard crops. The nutrient which plays multiple role in the nutrition of oilseed cops is sulphur. It is an essential constituent of Sulphur containing amino acids, protein as well as several fatty acids (oils).

Keywords: Sulphur, Mustard, Growth, Yield, Yield attributes, Conclusion, Future thrust.

Introduction

Rapeseed mustard is the second-most important oilseed crop in India, next only to soybean, with almost one-fourth share in both area and production (Jat *et al.*, 2019). It is cultivated in an area of 6.3 million hectares with a production of 8.0 million tonnes yielding 1324 kg ha^{-1}, whereas in Uttar Pradesh, mustard is grown in the area of about 6.79 lakh hectares with an annual production of approximately 9.45 lakh tonnes (DOAC 2017). There exists a huge gap between the global productivity (20.47 q ha^{-1}) and India's productivity (13.24 q ha^{-1}) which need to be bridged with the expansion of area under high yielding varieties (hybrids) due to their improved genetic potential (Rana *et al.*, 2019).

Sulphur is the fourth major plant nutrient after nitrogen, phosphorus and potassium for Indian agriculture. It is essential for synthesis of amino acids, proteins, oils, and a component of vitamin A and activates enzyme system in plant. Three amino acids viz. methionine (21% S), cysteine (26% S) and cystine (27%S) contain S which are the building blocks of proteins about 90% of sulphur is present in these amino acids. Sulphur is also involved in the formation of chlorophyll, glucosides and glucosinolates (mustard oils), activation of enzymes and sulphydryl (SH-) linkages that are the source of pungency in oilseeds. Adequate sulphur is therefore very much crucial for oilseed crops (Manoj and Pawan 2018).



Growth attributing character's

Dhankar *et al.,* (1993) reported that dry matter production increased with increasing rate of sulphur application upto 60 ppm in both shoot and root.

Gill and Palaskar (1992) in a pot culture experiment observed that Brassica compestris produced highest green fodder yield with application of 50 ppm N + 25 ppm P_2O_5 + 25 ppm K_20 + 40 ppm sulphur through gypsum which was 51.3 per cent higher than NPK with out sulphur.

Jat *et al.,* (2012) reported that application of 20 kg S ha^{-1} significantly increased in plant height over control at all the stages of growth except at 30 days after sowing but the highest plant height was observed at 60 kg S ha^{-1}.

Khatkar *et al.,* (2009) reported that highest plant height and maximum plant dry weight were recorded with higher doses of S fertilization. Kapur *et al.,* (2010) reported that plant height of mustard was recorded significantly higher with application of 60 kg S ha^{-1} but it was at par with 45 kg S ha^{-1} and 30 kg S ha^{-1} levels.

Makeen *et al.,* (2008) reported that the impact of different levels of sulphur on the dry weight of mustard resulted in increase in dry weight with the most favorable response was 60 kg S ha^{-1}.

Pachauri *et al.,* (2012) reported that various levels of sulphur significantly influenced the growth parameters viz., plant height and dry weight of plant. The plant height increased significantly with each increment in the dose up to 60 kg ha^{-1}. However, the difference in plant height due to further increase in the dose of sulphur was not significant. Application of 60 kg S ha^{-1} produced more dry weight of plant at 90 DAS as compared to control and 30 kg S ha^{-1} . Better nutrition to plant resulted in more height and number of branches and other growth parameters, which resulted in higher dry weight of plant.

Upasani and Sharma (1986) found that application of sulphur @ 60-90 kg ha^{-1} significantly increased plant height of mustard.

Ray *et al.*, (2014) reported that application of sulphur @ 60 kg ha^{-1} had significant beneficial effect on various growth parameters of mustard. This treatment was at par with 45 kg S ha^{-1} for plant height at 75 DAS and at harvest and for LAI at 40 DAS. But there were no significant difference among 30, 45 and 60 kg S ha^{-1} in increasing the LAI at 75 DAS, dry matter accumulation at 40 and 75 DAS and number of primary branches plant $^{-1}$. Application of 60 kg S ha^{-1} attained appreciable more crop growth than 20 to 40 kg S ha^{-1}. Dry matter production increased with the age of plant and increase was accelerated between 45 and 90 DAS.

Rao *et al.*, (2013) reported that application of sulphur significantly increased the plant height. Addition of sulphur at 45 kg ha^{-1} through gypsum recorded the highest plant height. However, it was at par to application of sulphur at 30 kg ha^{-1} through elemental sulphur and sulphur bentonite.

Sah *et al.*, (2013) reported that application of sulphur resulted into significant variation in the growth characters of mustard. Plant height was significantly improved under 15 kg S ha^{-1} over control and remained unaffected with further increased up to 45 kg S ha^{-1}.

Solanki and Sharma (2016) reported that plant height was increased with S application and the maximum plant height was recorded in plots where 60 kg S ha^{-1} was applied.

Steffenson (1954) stated that height of shoot increased by sulphur application and he attributed this to the stimulatory effect of sulphur in cell division. Importance of sulphur in cell division.

Yield and yield attributes

The higher yield and oil content with a greater application of sulfur have also attributed the synthesis of proteins and enzymes, as it is a component of sulfur-containing amino acids, namely methionine, cysteine , and cystine (Kumar *et al.*, 2011).

Chandel *et al.*, (2002) obtained higher seed yield of mustard upto 30kg S ha-1. Jaggi (1998) and Ahmed *et al.*, (1998) also recorded similar observations.

Debnath *et al.*, (2014) reported from Kalyani (West Bengal) that the seed yield on average was 14.5% higher in elemental S over the control which further increased to 30.6% along with inoculated S oxidizers.

Faujdar *et al.*, (2008) reported that sulphur fertilization at 40 kg S ha^{-1} remained at par with 60 kg S ha^{-1} and significantly increased the seed and stover yield to the tune of 26.2 and 12.4% and 18.5 and 8.5%, respectively over control and 20 kg S ha^{-1}.

Joshi *et al.*, (1973) reported that sulphur application @ 50 kg ha^{-1} increased seed and stover yields of mustard.

Jyoti *et al.*, (2012) worked at North 24 Parganas, West Bengal on Inceptisol (pH 6.67) observed that the highest seed and stover yield of rapeseed (cv 'B-9') was 910 and 4320 Kg ha^{-1}, respectively found under the application of 30 Kg S ha^{-1} through SSP, resulting in a 41.9 and 18.9% increase in the yield over that of the control during both of the years.

Kumar and Yadav (2007) reported that a significant response of crop was observed up to 30 kg S ha^{-1} in seed and stover yields. Application of 30 kg S ha^{-1} produced more number of primary branches at 90 days after sowing as compared to control. Number of siliquae/plant significantly increased up to 30 kg S ha^{-1}. The highest number of siliquae of 334.2/plant was recorded with 45 kg S ha^{-1}. The highest number of seeds/siliqua was recorded at 45 kg S ha^{-1}, which was on a par with that of 30 kg S ha^{-1} and was significantly superior to the control and 15 kg S ha^{-1}. The maximum test weight of 4.63 g/1000 seeds was recorded with 45 kg S ha^{-1} and minimum in control (3.84 g/1000 seeds).

Makeen *et al.*, (2008) reported that number of siliqua plant $^{-1}$, number of grains siliqua-weight of 1000 seeds, seed yield and harvest index were significantly influenced by application of sulphur. Application of sulphur @ 60 kg ha^{-1} recorded the highest values with respect to these parameters. The seed yield increased to25.5 q ha^{-1} at 60 kg S ha-1 as compared to 11.1 q ha^{-1} at control.

Neha *et al.*, (2014) reported that application of 40 kg S ha^{-1} recorded significantly higher seed yield (19.6 q ha^{-1}) and stover yield (70.9 q ha^{-1}) over 20 kg S ha^{-1} and no sulphur higher to this level remained at par with each other.

Piri and Sharma (2006) reported that seed and straw yield increased significantly with increasing level of sulphur up to highest level of 45 kg S ha^{-1}. Application of 15, 30 and 45 kg S ha^{-1} increased the seed yield over the control by 9, 16 and 23%, respectively. All the yield attributes, seeds siliqua^{-1} , 1000-seed weight of Indian mustard increased significantly with increasing doses of sulphur up to 45 kg ha^{-1} , however, the differences between 0 and 15 kg S ha^{-1} for siliquae plant $^{-1}$ and 1000-seed weight and between 15 and 30 kg S ha^{-1} for seeds siliqua^{-1} and 1000-seed weight were not significant.

Sah *et al.*, (2013) reported that application of sulphur @ 45 kg ha^{-1} increased number of siliquae/plant, test weight, seed yield and straw yield. Fertilization of 45 kg S ha^{-1} produced the highest seed yield of 19.2 q ha^{-1} in comparison to 13.2 q ha^{-1} in control. Rao *et al.*, (2013) reported that sulphur application significantly influenced the yield attributing characters and yield over control regardless of the levels of sulphur.

Singh and Bairathi (1980) reported that the seed yield of mustard increased significantly with increasing levels of sulphur application upto 60 kg ha^{-1}.

Varenyiova *et al.*, (2017) reported that the highest yield of 3.96 t ha^{-1} was achieved with the application of 40 kg of sulfur ha^{-1}. An average oil content of 45.1, 45.5 and 44.0 percent were based on treatments in which doses of sulfur fertilizers of 15, 40 and 65 kg ha^{-1} were applied.

Conclusion

The increase in growth, productivity and oil content of mustard successive addition of sulphur up to 45 kg ha^{-1} irrespective of its sources viz; SSP, Gypsum and Elemental sulphur. However, the application of sulphur @ 60 kg ha^{-1} as SSP had significantly resulted in the highest oil content in the seed. The results of the above parameters for SSP as source of sulphur were very closely followed by Gypsum which in turn was followed by Elemental sulphur.

Future thrust

To minimize the gap between the demand and supply of oilseed crops, intensive efforts are being made to increase their production. As ever-increasing population and urbanization cannot allow increase in the land area under the cultivation of oilseeds anymore due to the pressure on land, hence, yield per unit area needs to be improved further. To achieve this objective, we have laid more emphasis on improving production of oilseeds through proper nutrition of the crops by evolving high yielding varieties and adopting improved agronomic practices as well as plant protection measures, etc. The most important constraints to crop growth are those caused by the shortage of plant nutrients. Sulphur (S) requirement of plants has become increasingly importance in India as well as world agriculture. However, to achieve high yields and rates of S fertilizer should be recommended on the basis of available soil S and crop requirement.

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