Effect of Sulphur application on Rapeseed: A review

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Abstract

Rapeseed is an important oilseed crop, has high demand for sulphur because of its high Sulphur requirement. Sulphur fertilizers available as ammonium sulfate and gypsum or in liquid formulations. It is likely that optimum Sulphur required for maximum vegetative growth which will have a direct bearing on yield potential. The response of rapeseed was the highest when S fertilizer was applied in split doses.

Key words: Rapeseed, Sulphur, yield

Introduction

Rapeseed (*Brassica napus* L.) is an important oilseed crop, next to sunflower. It seed has 28-36% protein content with a high nutritive value. It is a winter (*Rabi*) season crop that requires relatively cool temperature, a fair supply of soil moisture during the growing season and a dry harvest period. It is cultivated both under irrigated (79.2%) and rainfed (20.8%) condition. It requires well-drained sandy loam soil. Rapeseed-mustard has a low water requirement (240 – 400 mm) which fits well in the rainfed cropping systems. Nearly 20% area under these crops is rainfed. The rapeseed-mustard group includes brown sarson, raya and toria crops (Shekhawat *et al*. 2012).

Effective management of natural resources, integrated approach to plant-water, nutrient and pest management and extension of rapeseed-mustard cultivation to newer areas under different cropping systems will play a key role in further increasing and stabilizing the productivity and production of rapeseed-mustard. All the major nutrient *viz.* nitrogen, phosphorus and sulphur play important role in increasing the yield and quality of rapeseed. Nitrogen is known to activate most of metabolic activities and transformation of energy. Phosphorus is essential role of cell division and meristematic growth of tissue. Sulphur is essential role of increasing oil content (%) and oil yield. Sulphur application greatly influenced chlorophyll synthesis, carbohydrate as well as protein metabolism. It is essential for synthesis of amino acids, proteins, oils, 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. Sulphur is also a constituent of vitamins biotin and thiamine (B_1) and also of iron sulphur proteins called ferrodoxins. Sulphur is associated with the production of oilseed crops of superior nutritional and market quality. On average, the sulphur absorbed per tonnes of grain production is 4 kg in cereals, 8 kg in pulses, and 12 kg in oilseeds. Soils, which are deficient in sulphur, cannot on their own provide adequate sulphur to meet crop demand resulting in sulphur deficient crops and sub-optimal yields. The application of sulphur at the rate 30 kg ha^{-1} give best result under split application in term of number of pods $plant^{-1}$ and grain yield (Anjum *et al.* 2016). The application of N @ 120 kg ha^{-1} and sulphur @ 40 kg ha^{-1} show increase in yield as well as oil content in rapeseed (Kumar *et al.* 2016).

Review of literature

A review of sulphur effects on rapeseed is being presented under the following sub-heads:

1. Effect of sulphur on growth of crop
2. Effect of sulphur on yield and yield attributes of crop
3. Economics viability of crop

Effect of sulphur on growth of crop

Singh and Saran (1993) reported that application of sulphur at the rate of 30 kg has significantly increased the plant height and leaf-area index of toria. However, in these parameters no significant difference was recorded with sulphur at 30 and 60 kg ha^{-1}.

Kumar *et al.* (2001) reported that plant height, primary and secondary branches $plant^{-1}$ were significantly higher with the application of sulphur at the rate of 40 kg ha^{-1} as compared to the control and sulphur at the rate of 20 kg ha^{-1}.

Chaudhary *et al.* (2003) reported that application of sulphur significantly increased the mustard seed and stover yield up to sulphur at the rate of 60 kg ha^{-1} and the highest yield of seed and stover where obtained with sulphur at the rate of 60 kg ha^{-1}.

Singh and Singh (2003) reported that the source of sulphur did not affect the growth, yield attributes and quality of produce. Mahadhan benedulf produced significantly more seed and gave significantly higher yield and quality of mustard.

Kumar and Kumar (2008) reported that the effect of different doses of sulphur (0, 20, 40 and 60 kg ha^{-1}) on various developmental characters of mustard and observed that 50% flowering and 50% podding were started significantly earlier in the plots fertilized with sulphur as compared to the control, but the days taken to maturity were not affected due to sulphur application.

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

Kokani *et al.* (2014) reported from NAU, Navsari that the growth parameters *viz.* plant height, no. of branches per plant increased with increase in rate of S from 0 kg S ha^{-1} to 20 kg S ha^{-1} in summer black gram.

Anjum *et al.* (2016) conducted field experiment at Amir Muhmmad Khan Campus, Mardan and concluded that application of sulphur at the rate 30 kg ha^{-1} give best result under split application in term of number of pods plant^{-1} and grain yield.

Kumar *et al.* (2016) conducted field experiment at DRMR Sewar, Rajasthan and concluded that application of N at the rate of 120 kg ha^{-1} and sulphur at the rate of 40 kg ha^{-1} show increase in yield as well as oil content in rapeseed.

Effect of sulphur on yield and yield attributes of crop

Raut *et al.* (1999) work from Akola observed that application of sulphur at rate of 40 kg ha^{-1} resulted in highest dry matter production. The chlorophyll and soluble protein concentration and rate of photosynthesis were highest with 100 kg nitrogen and 50 kg sulphur ha^{-1}.

Saraswat and Singh (2007) reported that crop responded significantly up to 25 and 60 kg ha^{-1} of S and N, respectively.

Kumar and Kumar (2008) reported that the effect of different doses of sulphur (0, 20, 40 and 60 kg ha^{-1}) on various developmental characters of mustard and observed that 50% flowering and 50% podding were started significantly earlier in the plots fertilized with sulphur as compared to the control, but the days taken to maturity were not affected due to sulphur application.

Thuan and Rana (2010) reported from IARI, New Delhi application of sulphur at rate of 40 kg ha^{-1} produced 19.3% higher seed yield than control plot.

Piri (2012) reported that application of sulphur at rate 45 kg S ha^{-1} along with two irrigations give highest growth and yield over control.

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.

Kokani *et al*. (2014) reported from NAU, Navsari that the yield parameters *viz.* no. of pods per plant, no. of seed per pod and test weight increased with increase in rate of S from 0 kg S ha^{-1} to 20 kg S ha^{-1} in summer blackgram.

Anjum *et al.* (2016) conducted field experiment at Amir Muhmmad Khan Campus, Mardan and concluded that application of sulphur at the rate 30 kg ha^{-1} give best result under split application in term of number of pods plant^{-1} and grain yield.

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Kokani *et al*. (2014) reported from NAU, Navsari that the seed yield and stover yield increased with increase in rate of S from 0 kg S ha^{-1} to 20 kg S ha^{-1} in summer blackgram.

Singh and Kumar (2014) reported that application of nitrogen at the rate of 120 kg ha^{-1} and sulphur at rate of 45 kg ha^{-1} was the best combination for getting higher seed yield, siliquae plant^{-1}, siliqua length, number of seed siliqua^{-1}and harvest index.

Economic viability of crop

Singh and Singh (2007) reported that net returns increased with the increase in Sulphur dose up to 60 kg ha^{-1} and this dose resulted in the highest net returns. The benefit: cost ratio in sulphur fertilizer was 1.75, 1.84 and 1.96 due to application of sulphur at rate of 20, 40 and 60 kg ha^{-1}, respectively.

Kumar and Yadav (2007) reported that highest net return of Rs.13734 ha^{-1} was recorded with sulphur at rate of 45 kg ha^{-1}. However, B: C ratio was highest (1.18) at 30 kg ha^{-1}. The increase in the levels of sulphur increased the cost of cultivation. Net returns were also higher with increasing sulphur levels.

Virendra *et al.* (2008) reported that application of sulphur (20 and 40 kg ha^{-1}) through gypsum as soil application, thio-urea at 0.05 and 0.10% and sulphuric acid at 0.15% as foliar application, net return and benefit cost ratio were higher with basal application of 20 S ha^{-1} through gypsum + foliar application of thio-urea (0.05 %), closely followed by spray of 0.15 per cent. Sulphuric acid and soil application of gypsum to supply of sulphur at rate of 40 kg ha^{-1}.

Kumar and Trivedi (2011) worked at Gwalior and found that the maximum net return (Rs 25098 ha^{-1}) and B: C ratio (3.73) was recorded at sulphur at the rate 40 kg ha^{-1}. Further, in respect of sources of Sulphur, Ammonium sulphate produced higher net return (Rs.23469 ha^{-1}) and B: C ratio (3.58) as compared to gypsum, SSP and pyrite.

Pachauri *et al.* (2012) reported that the highest net return of Rs 42,018 ha^{-1} was recorded with the application of sulphur at rate of 90 kg ha^{-1}. However, B: C ratio of 4.34 was obtained with sulphur at rate of 60 kg ha^{-1}.

Verma *et al.* (2012) conducted a field experiment at Kanpur to evaluate the effect of sulphur (0, 20, 40 and 60 kg ha^{-1}), zinc (0, 5 and 10 kg ha^{-1}) and boron (0, 0.5 and 1.0 kg ha^{-1}) levels on quality, economics and uptake of nutrients by mustard (*Brassica juncea* L.). On economic basis, the highest profit was recorded with combined use of 60 kg S +5 kg Zn and 1.0 kg B ha^{-1}.

Sah *et al.* (2013) reported that application of sulphur at rate of 45 kg ha^{-1} gave maximum net return (Rs.25599 ha^{-1}) which was followed by sulphur at rate of 30 kg ha^{-1} (Rs.23365 ha^{-1}) and 15 kg ha^{-1} (Rs.19221 ha^{-1}) and gave highest maximum B: C ratio of 3.89.

Kokani *et al*. (2014) reported from NAU, Navsari that the net return (Rs.58873) and B: C ratio (4.58) increased with increase in rate of S from 0 kg S ha^{-1} to 20 kg S ha^{-1} in summer blackgram.

Conclusion

Considerable research work has been carried out on sulphur effects on brassicas during past several years. However, still a lot of work remains to be done which is summarized below and need to be investigated-the response of sulphur fertilizer on different groups of brassicas, other macro and micronutrient need to be supplied or not, effect of sulphur application on photosynthesis and economic feasibility under different agro-climatic conditions.

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