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Effect of foliar application of nitrogen, phosphorus and sulphur on growth and yield of Gobhi Sarson (*Brassica napus* L.) in central Punjab

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Abstract

An experiment was conducted to study the effect of foliar application of nitrogen, phosphorus and sulphur on growth and yield of *Brassica napus* L. during *Rabi* season 2017 at Experimental Farm, Mata Gujri College, Shri Fatehgarh Sahib, Punjab. The maximum growth and yield attributing parameters were maximum with the application of T_7 - 2 per cent DAP foliar application + 2 per cent urea foliar application followed by T_6 - 0.5 per cent DAP foliar application + 0.5 per cent sulphur foliar application and T_5 - 0.5 per cent urea + 0.5 per cent sulphur spray at 60, 90 DAS and at harvest stage.

Key words*: Foliar application, growth parameters, yield attributes*

Oilseeds have prestigious place in Indian agriculture next to cereals. Oilseed crops form the second major group among agricultural crops after cereals in the country. Mustard 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 (Banerjee *et al.,* 2010). In India total area under mustard crop is 6652 thousand ha with production 7109 thousand tonnes (*Anonymous*, 2016-17). Foliar fertilization is gaining more importance in recent years due to availability of soluble fertilizers and is of great significance in rainfed areas and under changing climatic conditions. Foliar application of nutrients for increasing and exploiting genetic potential of the crop is considered as an efficient and economic method of supplementing the nutrient requirement. Application of inorganic nutrient spray will also enhance the nutrient availability, quick absorption and in turn increases the productivity. Foliar application of major and micronutrients like N, P, K, S and B was found to be more advantageous than soil application and also avoiding the depletion of these nutrients in leaves, thereby resulting in an increased photosynthetic rate, better nutrient translocation of these nutrients from the leaves to the developing seeds (Manonmani and Srimathi, 2009). Phosphorus is essential for cell division and meristematic growth of tissue. It also helps in seed and fruit development and stimulates flowering as well (Das, 2004). Sulphur application greatly influences chlorophyll synthesis, carbohydrate as well as protein metabolism and finally results in improvement in growth characters, contributing to higher dry matter accumulation in plants. Foliar spray treatment with the aqueous solution of nutrients (2 per cent DAP, 1 per cent K and 200 ppm NAA) gave maximum plant height, dry matter and number of leaves (Doss *et al.,* 2013). Foliar application of phosphorus concentration at 3000 mg P_2O_5 per L was superior by giving highest rate of plant height, branches per plant (Jasim *et al.,* 2016). Sulphur foliar spray of 2 per cent as aqueous solution of ammonium sulphate, significantly improved number of pods per plant, grain per pod, pod length (cm), grain weight (g) and grain oil content (per cent). Highest pods per plant (96), pods per plant (69), grains per pod (25.3) and oil content (36.5 per cent) were recorded in 2 per cent AS foliar application (Khalid *et al*., 2017).

A field experiment was conducted at Experimental Farm of Department of Agriculture, Mata Gujri College, Fatehgarh sahib, Punjab during *Rabi* season of 2016-2017. The experiment laid out in randomized block design with three replicated. The treatment details are as T_1 – control, T_2 – 2 per cent urea foliar application, T_3 – 2 per cent DAP foliar application, T_4 – 0.5 per cent sulphur foliar application, T_5 - 0.5 per cent urea + 0.5 per cent sulphur spray, T_6 – 0.5 per cent DAP foliar application + 0.5 per cent sulphur foliar application, T_7 – 2 per cent DAP foliar application + 2 per cent urea foliar application. The soil of experiment field gangetic alluvial having clay loam texture with pH (7.5), medium in organic carbon (0.45%), electrical conductivity (0.53 dS/m at 25 °C), available P_2O_5 (15.46 kg/ha), K_2O (173.15 kg/ha) and N (218.18 kg/ha). The pre-treated seed variety GSC-7 were sown by hand drilling in between the rows by using mustard seed at the rate of 4.00 kg/ha with a spacing of 30 cm on 25th November, 2016. The recommended dose of fertilizers of NPK for mustard is 70, 60, 40 kg/ha. Applied 1/3 dose of nitrogen and full dose P_2O_5 and K_2O as basal

Table 1: Effect of foliar application of N, P and S on growth attributes of *B. napus*

Treatments	Plant height (cm)				Dry matter accumulation (g/plant)				Number of primary branches			Number of secondary branches		
	30 DAS	60 DAS	90 DAS	Harvest Stage	30 DAS	60 DAS	90 DAS	Harvest Stage	60 DAS	90 DAS	Harvest Stage	30 DAS	60 DAS	Harvest Stage
T_1 - Control	11.29	34.29	112.52	173.6	1.27	6.29	16.56	22.33	2.12	3.67	5.37	2.34	4.75	7.69
T_2 - Urea FA @ 2 per cent	10.97	38.92	130.80	180.9	1.28	7.02	20.08	25.59	2.80	4.27	6.13	3.15	6.15	10.91
T_3 - DAP FA @ 2 per cent	12.74	43.56	134.68	183.9	1.47	7.10	20.50	26.13	3.07	4.78	6.56	3.21	6.96	11.23
T_4 - Sulphur FA @ 0.5 per cent	10.73	34.78	127.96	178.4	1.26	6.95	19.40	25.33	2.60	4.18	5.89	3.66	5.40	9.98
T_5 - Urea FA @ 0.5 per cent + Sulphur FA @ 0.5 per cent	11.70	46.03	144.61	193.6	1.42	7.70	21.74	27.27	3.33	5.29	7.32	3.79	7.64	12.41
T_6 - DAP FA @ 0.5 per cent + Sulphur FA @ 0.5 per cent	12.86	49.04	151.56	200.0	1.36	8.04	22.75	28.70	3.41	5.88	7.45	3.81	7.81	13.18
T_7 - Urea FA @ 2 per cent + DAP FA @ 2 per cent	12.08	50.66	158.36	206.6	1.35	8.30	23.26	29.97	3.85	6.18	7.81	4.25	8.49	14.01
SEm±	0.74	1.55	5.32	7.08	0.13	0.36	0.85	0.96	0.31	0.38	0.27	0.31	0.33	0.85
C.D. at 5%	NS	4.78	16.40	21.80	NS	1.11	2.62	2.97	0.94	1.19	0.84	0.97	1.01	2.62

and remaining dose of nitrogen was applied in two split at 30 DAS and 60 DAS. Foliar application of nutrients such as DAP, urea, sulphur was given to crop 30 days after sowing as per treatment. The major agronomical done as per requirement. Regular biometric observations were recorded at periodic intervals of 30 DAS, 60 DAS, 90 DAS and at harvest stage of five selected plant. Yield attributes parameters were recorded just before harvesting of crop. First of all border rows were harvested. Thereafter, plants from each net plot area were harvested carefully, bundled, tagged and were taken to threshing floor and kept separately.

Effect of foliar application of N, P and S on growth attributes

Among the foliar application treatments, maximum plant height, number of primary and secondary branches (Table 2) was recorded with the application of T_7 - 2 per cent urea FA+ 2 per cent DAP FA followed by T_6 - 0.5 per cent DAP FA + 0.5 per cent sulphur FA and T_5 - 0.5 per cent urea FA + 0.5 per cent sulphur FA which was significant over all the treatments at all the growth stages except 30 DAS. At 30 DAS the effect of treatment was non-significant because there was no foliar spray. Greater height of plant receiving adequate and balanced nutrition might be due to better metabolic activities performed by the crop. Control plots produced significantly lower plant height and dry matter of mustard. This was due to less availability of nutrients thereby reduction in dry matter of plants. Similar findings are given by Katiyar (2014), Aggarwal *et al*. (2015) and Jasim *et al.* (2016) also found the same results.

Effect of foliar application of N, P and S on yield attributes

Application of $T_{7\text{-}}$ 2 per cent urea FA+ 2 per cent DAP FA recorded higher yield attributes and were at par of treatment T_6 – 0.5 per cent DAP foliar application + 0.5 per cent sulphur foliar application and T_5 - 0.5 per cent urea + 0.5 per cent sulphur spray. Thus, the result indicated that increase in yield contributing characters of plots treated with application of $T_{7\text{-}}$ 2 per cent urea FA+ 2 per cent DAP FA was due to additional supply of nutrients through foliar application which might have increased nutrient uptake and better translocation of nutrients. Plant well supplied with sulphur will have relatively larger photosynthesizing area, consequently accumulating higher quantities of photosynthates which will be translocated to sink site that is pods and seeds. With higher quantities of photosynthates being accumulated in the siliquae and seeds, the size of siliquae, number of seeds per siliquae and test weight of seeds had increased.

Table 2: Effect of foliar application of N, P and S on yield attributes and yield of *B. napus*

Treatments	No. of siliquae per plant	No. of seeds per siliquae	Siliquae length (cm)	Test weight (g)	Grain yield (q/ha)	Stover yield (q/ha)	Biological yield (q/ha)	Harvest Index (%)
T_1 - Control	246.85	10.63	5.04	3.37	15.04	62.36	77.25	19.21
T_2 - Urea FA @ 2 per cent	278.55	13.46	5.35	4.21	17.25	69.12	86.41	19.83
T_3 - DAP FA @ 2 per cent	290.30	15.19	5.71	4.32	17.95	71.64	89.62	20.08
T_4 - Sulphur FA @ 0.5 per cent	263.46	12.23	5.18	4.19	16.75	67.62	84.41	19.67
T_5 - Urea FA @ 0.5 per cent + Sulphur FA @ 0.5 per cent	311.52	17.74	6.39	4.86	19.05	75.56	94.61	20.18
T_6 - DAP FA @ 0.5 per cent + Sulphur FA @ 0.5 per cent	337.77	18.45	6.56	5.07	19.86	77.85	97.78	20.45
T_7 - Urea FA @ 2 per cent + DAP FA @ 2 per cent	350.33	19.96	6.95	5.18	21.78	81.69	103.47	21.08
SEm±	13.74	1.10	0.31	0.23	0.95	3.11	3.92	1.45
C.D. at 5%	42.33	3.38	0.94	0.72	2.94	9.59	12.07	NS

Note: FA- Foliar application

Similar findings are given by Katiyar *et al*. (2014), Meena *et al.* (2017) and Khalid (2017).

Effect of foliar application of N, P and S on yield

The maximum grain and stover yield is recorded in T_7 - 2 per cent urea FA+ 2 per cent DAP FA which was closely followed by T_6 - 0.5 per cent DAP FA + 0.5 per cent sulphur FA and T_5 - 0.5 per cent urea FA + 0.5 per cent sulphur FA. The treatments with control recorded lowest grain yield. This was due to less availability of nutrients in control. Foliar application of nutrients increased nutrient uptake and better translocation of nutrients. Adequate availability of nutrients resulted in enhanced growth attributes and yield attributes. Sunewad *et al.* (2017) and Khalid *et al*. (2017) and Sinha *et al*. (2018) also reported the similar finding.

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