Influence of potassium and sulfur fertilizer on disease management and fibre productivity in sunnhemp (*Crotalaria juncea L.*)

S.K. SARKAR

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Department of Botany,
University of Calcutta,
Kolkata 700 019, India

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Influence of potassium and sulfur fertilizer on disease management and fibre productivity in Sunnhemp (*Crotalaria juncea* L.)

S.K. SARKAR
Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata 700120

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Field experiment on effect of potassium (K) and sulfur (S) fertilizer on management of vascular wilt (Fusarium udum f.sp crotalariae), interveinal chlorosis and fibre productivity of sunnhemp (Crotalaria juncea) was carried out in calcarious soil at Sunnhemp Research Station, Pratapgarh, Uttar Pradesh. The result indicated that the interaction of potassium and sulfur (@ 40 kg K/ha and 60 kg S/ha) resulted in 26% reduction of wilt incidence over the control. Combined application of potassium @20 kg/ha and sulfur 40 kg/ha reduced the interveinal chlorosis to the tune of 22.5%. The highest fibre yield (7.81q/ha) was achieved with combined application of 40 kg potash and 40 kg sulfur/ha which was 40% higher than the control – 5.53q/ha. Application of potassium @ 20kg/ha or 40kg/ha increased the nodulation to the tune of 37% and 31 % respectively.

Key words: Potassium, sulfur, *crotalaria juncea*, vascular wilt, interveinal chlorosis, nodulation

INTRODUCTION

Sunnhemp (*Crotalaria juncea L.*) is an important fabacious bast fibre crop. The fibre is mostly used as the source of raw material in cottage industry for the preparation of strings, ropes, twines, tat patties etc. Apart from fibre purpose it is widely cultivated as green manure as well as fodder purpose because of its nitrogen fixing capacity. India is the largest producer of sunnhemp followed by Bangladesh and Brazil. During 1960s it was a premiere crop . But after green revolution and subsequent development in the field of agriculture, its area has been gradually declined and presently it is in the hand of small and marginal farmer of traditional areas.

With the growing concern of soil and environment degradation, sunnhemp will again play a pivotal role in cropping system. Low fertility status of soil in cultivated area and high incidence of diseases like vascular wilt (*Fusarium* and *udum f.sp crotalariae*) and interveinal chlorosis are the major constraints of sunnhemp cultivation particularly in monsoon crop. Further, because of low return crop, farmers generally do not apply any fertilizer. Even in food crop like wheat or rice, farmers are reluctant to follow integrated nutrient management due to high cost of fertilizer. Thus nutrient deficiency is a common phenomenon in subsistent agriculture. This is more in case of low return crops like sunnhemp. In addition to yield reduction, deficiency of nutrients (especially potassium and sulfur) has a direct bearing on host susceptibility to different kinds of diseases. Severity of interveinal chlorosis is more in monsoon sown crop than April sown crop. The symptoms of the disease appears to be viral origin but its nature and uniform occurrence cannot ignore the possibility of nutritional deficiency. Initial studies on boron zinc, iron and manganese do not show any conclusive result on interveinal chlorosis. Number of reports on nutrient management in relation to fibre productivity are available,(Maira *et al*. 2008, Tripathi *et al.* 2009,) but very little information is available on effect of potassium and sulfur in relation to diseases management in sunnhemp. Under these background field experiment has been carried out to study the

*Corresponding author : surjapath@gmail.com

effect of potassium and sulfur on sunnhemp diseases and its productivity.

MATERIALS AND METHODS

A field experiment at Sunnhemp Research Station, Pratapgarh, Uttar Pradesh (Longitude, 81^{0}19'-82^{0}27', latitude, 25^{0}35'-26^{0}11') was undertaken on response of sunnhemp to sulfur and potassium in relation to fibre yield and management of sunnhemp diseases. Sixteen treatment combinations consisting of four levels of potassium (0, 20, 40, & 60 kg/ha) and four levels of sulfur (0, 20, 40, & 60 kg/ha) replicated thrice in split plot design with plot size 3m x 4m were tested. Sowing of the crop was done in mid-May. Soil of the experimental plot is calcarious sandy loam (clay-28%, silt-24% and sand-56%) having pH 7.8, organic carbon 4.1g/kg, bulk density 1.43 g/cc, calcium carbonate 7-9g/kg and available nitrogen, phosphorus and potassium are 170.4, 15.0 and 135.8 kg/ha respectively. Environmental condition during May to August: maximum temperature 40.2^{0}C, minimum temperature 26.2-24.7^{0}C, relative humidity 64.9-88.1% and rainfall 428.0 mm. The rainfall was mostly received after in later part of the crop season. The test crop, sunnhemp (cv-K-12 yellow) was raised under normal agronomic practices [(seed rate - 40kg/ha, spacing - 25 cm (row to row) 5 cm (plant to plant), one hand weeding at 25 days after sowing)]. Basal application of 5.0 ton FYM/ha, 20 kg N/ha (in the form of urea), 40 kg P_2O_5/ha (in the form single super phosphate) were done at final stage of land preparation. Potassium and sulfur were also applied as basal dose in the form of muriate of potash and elemental sulfur respectively. Elemental sulfur was applied at least 21 days before sowing for proper oxidation. The crop was harvested at 90 days after sowing and plant height, basal diameter and dry weight were recorded randomly from 10 plant. The incidence of vascular wilt and interveinal chlorosis was

Table 1 : Effect of potassium and sulfur on diseases of sunnhemp

Treatment	K_0	K_{20}	K_{40}	K_{60}	Mean
			Vascular wilt(%)*		
S_0	15.7	15.6	13.1	16.4	15.2
S_{20}	15.7	13.0	14.1	13.8	14.1
S_{40}	16.2	12.7	13.4	15.7	14.5
S_{60}	16.1	13.9	11.6	14.5	14.0
Mean	15.9	13.7	13.1	15.1	
CD. P=0.05	K=NS	S=NS	KxS=NS		
			Incidence of interveinal chlorosis(%)*		
S_0	31.0	26.7	25.4	28.2	27.8
S_{20}	31.7	27.2	28.0	30.8	29.4
S_{40}	27.3	24.0	30.6	24.7	26.6
S_{60}	32.0	25.9	27.6	27.0	28.1
Mean	30.5	25.9	27.9	27.6	
CD. P=0.05	K=NS	S=NS	KxS=NS		
			Severity of interveinal chlorosis(%)*		
S_0	30.9	31.0	29.3	27.8	29.7
S_{20}	30.7	30.8	30.3	28.7	30.1
S_{40}	29.4	29.4	28.1	29.6	29.1
S_{60}	29.8	28.6	28.3	29.1	28.9
Mean	30.2	30.0	29.0	28.8	
CD. P=0.05	K=NS	S=NS	KxS=NS		

*data are presented in angular transformed values

Table 2 : Effect of potassium and sulfur on fibre yield , yield attributes and nodulation insunnhemp

Treatment	K_0	K_{20}	K_{40}	K_{60}	Mean
			Fibre yield (q/ha)		
S_0	5.53	6.78	5.90	5.46	5.92
S_{20}	6.01	7.01	7.19	5.48	6.42
S_{40}	6.39	6.80	7.81	5.85	6.71
S_{60}	6.29	6.30	7.08	5.47	6.28
Mean	6.05	6.72	6.99	5.55	
CD. P=0.05	K=NS	S=0.32	KxS=NS		
			Plant height (cm)		
S_0	218.3	214.3	222.6	220.6	219.0
S_{20}	223.6	230.0	231.3	215.3	225.1
S_{40}	222.0	224.0	217.3	216.3	219.9
S_{60}	213.0	215.0	229.6	218.6	219.2
Mean	219.2	221.1	225.0	217.7	
CD. P=0.05	K=NS	S=NS	KxS=NS		
			Basal diameter (mm)		
S_0	9.4	9.2	9.3	8.8	9.2
S_{20}	9.06	9.26	9.7	8.5	9.1
S_{40}	8.9	9.8	9.9	9.1	9.4
S_{60}	9.1	9.4	9.0	9.4	9.1
Mean	9.1	9.4	9.4	8.9	
CD. P=0.05	K=NS	S= NS	KxS=NS		
			Nodule count		
S_0	18.4	21.6	18.1	22.0	20.0
S_{20}	13.2	25.6	23.6	15.7	19.5
S_{40}	14.9	25.1	24.3	20.7	20.3
S_{60}	19.1	24.2	20.3	12.6	18.2
Mean	16.4	22.4	21.5	17.8	
CD. P=0.05	K=NS	S=NS	KxS=NS		

recorded at harvesting on net plot basis. Severity of interveinal chlorosis was calculated on the basis of number of leaves/plant affected. The per cent data were transformed in to angular value and presented and statistical analysis was carried out in MSTATC version 2.1 (Michigan State University, USA).

RESULTS AND DISCUSSION

Incidence of diseases

The result indicated that potassium and sulfur has no significant effect on vascular wilt of sunnhemp but application of 40 kg potassium/ha reduces the wilt to the tune of 18% whereas application of 60 kg sulfur/ha reduces the wilt to the tune of 5% than the control plot (K_0S_0). The interaction of potassium and sulfur had no significant reduction of wilt but $K_{40}S_{60}$ resulted in 26% reduction of wilt incidence over the control (Table 2). Incidence of interveinal chlorosis was reduced to the tune of 15% with application of 20 kg K_{20}/ha. Interaction of potassium and sulfur dose not have any significant effect on interveinal chlorosis. Combined application of potassium @20/ha and sulfur 40 kg/ha reduced the interveinal chlorosis to the tune of 22.5%. Similar trend in severity of interveinal chlorosis was observed due to application of both the fertilizer. Potassium is required in high concentration for synthesis of proteins which helps to impart disease resistance as well as photosynthesis (Marschner, 1995). Similarly sulfur deficiency retards cholophyll synthesis that lead to chlorosis (Anjana *et al.* 2009). Therefore, application of sulfur and potassium in deficient calcareous soil improve host resistance.

Sunnhemp fibre yield and yield attributes

The result indicated that individual application of sulfur @ 40kg/ha and potassium @ 40kg/ha augmented the fibre yield to the tune of 13% and 15% respectively as compared to the control plot (K_0S_0). The highest fibre yield (7.81q/ha) was achieved with combined application of 40 kg potash and 40 kg sulfur/ha which was 40% higher than the control – 5.53q/ha (Table 1). Although no significant effect of potassium and sulfur was recorded on yield attributes, maximum plant height, basal diameter and dry matter yield was recorded either in $K_{40}S_{20}$ or in K40S40. Potassium and sulfur has no significant bearing on nodulation but application of potassium @ 20kg/ha or 40/kg/ ha increased the nodulation to the tune of 37% and 31 % respectively (Table1). Potassium plays a significant role for growth and yield of legumes by increasing the number and improving the efficiency of root nodules (Premarantne and Oertli, 1994). This phenomenon might be supported by the fact that fibre yield and N accumulation in legume are very responsive to potassium fertilizer (Grewal and Willium, 2002).

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