

**Research Article****Effect of microgranular sulphur on nutrient uptake, soil properties and yield of banana**

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**Summary**

The field experiment to study the effect of microgranular sulphur (Cosavet Ferits WG) on soil properties, nutrient uptake, growth and yield parameters of banana was undertaken at Banana Research Station, Jalgaon during the years 2007 to 2009. Application of sulphur @ 12 g plant<sup>-1</sup> through Cosavet Fertis (WG) in two splits recorded significantly higher no. of hands per bunch, maximum bunch weight and yield over control. Application of sulphur @ 9 g plant<sup>-1</sup> through Cosavet Fertis (WG) in two splits recorded 137 fingers per bunch, 19.6 kg bunch weight and 87.0 t ha<sup>-1</sup> yield which was found at par with application of sulphur @ 12 g plant<sup>-1</sup> through Cosavet Fertis in two splits. Lower soil pH and EC were reported in the treatments where sulphur was applied through Cosavet Fertis (WG). Higher nutrient uptake was recorded in the treatment of sulphur @ 12 g plant<sup>-1</sup> through Cosavet Fertis (WG) in two splits.

**Key words :** Banana, Sulphur, Nutrient uptake

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**Introduction**

The sulphur is now recognized as the 4<sup>th</sup> major plant nutrient, along with nitrogen, phosphorus and potassium. Sulphur is crucial for the formation of amino acids like methionine and cystine, which involved in protein synthesis. Sulphur is actively redistributed in plant body of banana from old to young leaves. The most rapid uptake of sulphur occurs between the sucker and shooting stage. After shooting, the rate is reduced and sulphur needed for fruit growth comes from the leaves and pseudostem (Shikhamany and Patil, 2007). One ton of banana is estimated to remove 0.8-1.4 kg S for satisfactory production (Bhalerao, 2009).

Presently, sulphur deficiency is widespread in Indian soils and is rising continuously. In banana, sulphur deficiency causes stunted growth and smaller bunch size. Management practices such as increased cropping intensity, introduction of high yielding varieties, use of sulphur free fertilizers like

urea, DAP, MOP, lack of organic manure addition, lesser crop residue recycling etc. are causing much adverse effects on the availability of sulphur and have lead to greater removal and depletion of sulphur from soil. A balanced fertilizer management practice is thus, imperative to mitigate the effect of sulphur deficiency. Information regarding use of sulphur for banana under Maharashtra condition is very scanty. Hence, the present investigation was undertaken to study the effect of microgranular sulphur (Cosavet Ferits WG) on soil properties, nutrient uptake, growth and yield parameters of banana cv. GRAND NAINA.

**Resources and Research Methods**

A field experiment was conducted during 2007-2008 and 2008-2009 at Banana Research Station, Jalgaon. The soil was medium black having pH 8.16, electrical conductivity (EC) 0.36 dSm<sup>-1</sup>, organic carbon 0.40 per cent, available nitrogen 230 kg

ha<sup>-1</sup>, available phosphorus 20.2 kg ha<sup>-1</sup>, available potassium 621 kg ha<sup>-1</sup> and available sulphur 7.96 mg kg<sup>-1</sup>. Experiment was laid out in randomized block design comprising of nine treatments replicated thrice. Tissue cultured plantlets of banana cv. Grand Naine were planted in pair row system at 0.9 x 1.5 x 2.1 m spacing (4,444 plants ha<sup>-1</sup>) with inline drip irrigation system. Nitrogen was applied @ 200 g plant<sup>-1</sup> through different sources of inorganic fertilizers in seven splits at 30, 75, 120, 165, 210, 255 and 300 days after planting as per the treatments. Phosphorous was applied @ 40 g plant<sup>-1</sup> at planting and potassium was applied @ 200 g plants<sup>-1</sup> in four equal splits at planting 165, 255 and 300 days after planting, 10 kg FYM plant<sup>-1</sup> was applied at the time of planting. Treatment details were as below:

- Control (without sulphur)
  - Sulphur @ 9 g/pl through SSP at the time of planting (Conventional practice)
  - Sulphur @ 9 g/pl through 80% WP at the time of planting
  - Sulphur @ 9 g/pl through 80% WP at planting and 165 DAP
  - Sulphur @ 3 g/pl through Cosavet Fertis WG in 2 splits at planting and 165 DAP
  - Sulphur @ 6 g/pl through Cosavet Fertis WG in 2 splits at planting and 165 DAP
  - Sulphur @ 9 g/pl through Cosavet Fertis WG at planting
  - Sulphur @ 9 g/pl through Cosavet Fertis WG in 2 splits at planting and 165 DAP
  - Sulphur @ 12 g/pl through Cosavet Fertis WG in 2 splits at planting and 165 DAP
- (\*DAP: Days after planting)

Soil samples were collected initially and after harvest of

each plant crop. Dry and processed soil samples were used to determine chemical properties *i.e.* pH, EC, organic carbon, available nitrogen, phosphorus, potassium and sulphur by using standard procedures. Plant samples were analysed for total nutrient uptake as per methods given by Parkinson and Allen (1975).

## Research Findings and Discussion

The results of the present study as well as relevant discussions have been presented under following sub heads:

### Effect on growth and yield parameters :

The plant height, stem girth and days to harvest as influenced by the graded doses of sulphur through different sources are presented in Table 1. The application of sulphur @ 9 g plant<sup>-1</sup> in two splits at planting and at 165 days after planting through Cosavet Fertis (WG) recorded the highest plant height (181.9), stem girth (71.4 cm) and minimum days to harvest (388 days).

The yield and yield contributing characters were significantly influenced by the application of Cosavet Fertis (WG). Application of sulphur @ 12 g plant<sup>-1</sup> through Cosavet Fertis (WG) in two splits (*i.e.* at planting and 165 days after planting) recorded significantly higher no. of hands per bunch (9.4), bunch weigh (19.9 kg) and yield (88.1 t ha<sup>-1</sup>) over control *i.e.* application of sulphur through SSP. Application of sulphur @ 9 g plant<sup>-1</sup> through Cosavet Fertis (WG) in two splits (*i.e.* in planting and 165 days after planting) found at par with application of sulphur @ 12 g plant<sup>-1</sup> through Cosavet Fertis which recorded 137 fingers per bunch, 19.6 kg bunch weight and 87.0 t ha<sup>-1</sup> yield (Table 2). The increase in bunch weight might be attributed to the higher dry matter and starch accumulation promoted by sulphur. Similar results were also

Tr. No.	Treatments	Plant height (cm)	Stem girth (cm)	Days to harvest
1.	Control (without sulphur)	177.7	67.3	400
2.	S @ 9 g/pl - SSP at planting	179.2	68.2	396
3.	S @ 9 g/pl - 80% WP at planting	181.0	70.2	393
4.	S @ 9 g/pl - 80% WP at pl. and 165 DAP	180.7	70.4	394
5.	S @ 3 g/pl - Cosavet Fertis WG at pl. and 165 DAP	179.4	67.3	394
6.	S @ 6 g/pl - Cosavet Fertis WG at pl. and 165 DAP	180.4	69.5	393
7.	S @ 9 g/pl - Cosavet Fertis WG at planting	181.3	71.4	389
8.	S @ 9 g/pl - Cosavet Fertis WG at pl. and 165 DAP	181.9	71.4	388
9.	S @ 12 g/pl - Cosavet Fertis WG at pl. and 165 DAP	181.5	71.3	389
	SE+	0.60	0.89	1.94
	CD at 5%	1.95	2.90	6.31

reported by Kumar and Kumar (2008).

#### Effect on soil properties and nutrient uptake :

Lower pH and EC was reported in the treatments where sulphur was applied through Cosavet Fertis (WG). There was non-significant change in organic carbon content of soil (Table 3). Soil available N, P and K content at harvest of banana was lower as compared to control in all the treatments where sulphur was applied (Table 4).

Nutrient uptake was significantly influenced by the application of different sources of sulphur. Application of sulphur @ 12 g plant<sup>-1</sup> through Cosavet Fertis (WG) in two

splits (*i.e.* at planting and 165 days after planting) recorded highest nitrogen uptake of 660 kg ha<sup>-1</sup>, phosphorus uptake of 122.2 kg ha<sup>-1</sup>, potassium uptake of 1293 kg ha<sup>-1</sup> and sulphur uptake of 110.2 kg ha<sup>-1</sup>. However, it was at par with application of sulphur @ 9 g plant<sup>-1</sup> through Cosavet Fertis (WG) in two splits (*i.e.* at planting and 165 days after planting), which recorded nitrogen, phosphorus, potassium and sulphur uptake of 651, 120.6, 1273 and 108.9 kg ha<sup>-1</sup>, respectively (Table 5). Increased nitrogen and phosphorus uptake due to sulphur application is also reported by Lahav *et al.* (1978). Mingxian Fan (2006) also reported enhanced nutrient uptake and fertilizer use efficiency through interaction of sulphur with other

**Table 2 : Effect of Cosavet Fertis WG (Sulphur) on yield parameter of banana**

Tr. No.	Treatments	No. of hands bunch <sup>-1</sup>	Bunch weight (kg)	Yield (t ha <sup>-1</sup> )
1.	Control (without sulphur)	8.5	17.0	75.6
2.	S @ 9 g/pl - SSP at planting	8.9	17.9	79.4
3.	S@ 9 g/pl - 80% WP at planting	9.0	18.5	82.2
4.	S @ 9 g/pl -80% WP at pl. and 165 DAP	9.0	18.7	83.0
5.	S @ 3 g/pl - Cosavet Fertis WG at pl. and 165 DAP	8.5	17.5	77.7
6.	S @ 6 g/pl - Cosavet Fertis WG at pl. and 165 DAP	9.0	18.4	82.2
7.	S @ 9 g/pl - Cosavet Fertis WG at planting	9.0	19.3	85.9
8.	S @ 9 g/pl through Cosavet Fertis WG at pl. 165 DAP	9.0	19.6	87.0
9.	S @ 12 g/pl - Cosavet Fertis WG at pl. and 165 DAP	9.4	19.9	88.1
	S.E.±	0.19	0.16	0.64
	C.D. (P=0.05)	0.61	0.52	2.09

**Table 3 : Effect of Cosavet Fertis WG (Sulphur) on soil properties of banana**

Tr. No.	Treatments	pH	EC (dSm <sup>-1</sup> )	O. C (%)
1.	Control (without sulphur)	8.16	0.36	0.40
2.	S @ 9 g/pl - SSP at planting	8.16	0.37	0.41
3.	S @ 9 g/pl - 80% WP at planting	8.15	0.37	0.41
4.	S @ 9 g/pl -80% WP at pl. and 165 DAP	8.14	0.36	0.42
5.	S@ 3 g/pl - Cosavet Fertis WG at pl. and 165 DAP	8.13	0.36	0.42
6.	S@ 6 g/pl - Cosavet Fertis WG at pl. and 165 DAP	8.15	0.37	0.41
7.	S @ 9 g/pl - Cosavet Fertis WG at planting	8.13	0.35	0.42
8.	S@ 9 g/pl - Cosavet Fertis WG at pl. and 165 DAP	8.13	0.34	0.42
9.	S @ 12 g/pl - Cosavet Fertis WG at pl. and 165 DAP	8.13	0.33	0.42
	S.E.±	0.004	0.002	0.004
	C.D. (P=0.05)	0.013	0.007	0.012

Table 4 : Effect of Cosavet Fertis WG (Sulphur) on soil Av. nutrients at harvest					
Tr. No.	Treatments	Av. nutrients (kg ha <sup>-1</sup> )			S (kg ha <sup>-1</sup> )
		N	P	K	
	Initial	230	20.2	621	7.96
1.	Control (without sulphur)	221	20.0	661	7.78
2.	S @ 9 g/pl - SSP at planting	220	19.8	657	7.95
3.	S @ 9 g/pl - 80% WP at planting	214	19.3	652	7.88
4.	S@ 9 g/pl -80% WP at pl. and 165 DAP	213	19.2	653	7.95
5.	S@ 3 g/pl - Cosavet Fertis WG at pl. and 165 DAP	220	19.8	657	7.95
6.	S @ 6 g/pl - Cosavet Fertis WG at pl. and 165 DAP	217	19.5	657	7.99
7.	S @ 9 g/pl - Cosavet Fertis WG at planting	213	19.1	649	8.05
8.	S @ 9 g/pl - Cosavet Fertis WG at pl. and 165 DAP	211	19.1	650	7.94
9.	S @ 12 g/pl - Cosavet Fertis WG at pl. and 165 DAP	212	19.0	648	8.09
	S.E.±	0.49	0.07	0.96	0.06
	C.D. (P=0.05)	1.58	0.22	3.13	0.19

nutrients in different crops.

#### Economics of fertilizer use :

Application of sulphur @ 9 g plant<sup>-1</sup> through cosavet fertis (WG) in two splits (*i.e.* at planting and 165 days after planting) recorded monetary return of Rs. 3,04,500 ha<sup>-1</sup>, net profit of Rs. 131250 ha<sup>-1</sup> and B:C ratio of 1.76. Similar B:C ratio of 1.76 was also reported by the treatment of application of sulphur @ 12 g plant<sup>-1</sup> through cosavet fertis (WG) in two splits. The control treatment *i.e.* application of sulphur @ 9 g

plant<sup>-1</sup> through SSP reported monetary returns of Rs. 2,77,900 ha<sup>-1</sup>, net profit of Rs. 1,10,774 ha<sup>-1</sup> and B:C ratio of 1.66 (Table 6). Jeyabaskaran and Mustaffa (2010) also reported increase in the net profit due to soil application of sulphur.

#### Conclusion :

Application of sulphur @ 9 g plant<sup>-1</sup> through cosavet fertis (WG) in two splits *i.e.* at planting and 165 days after planting was found beneficial in terms of higher banana yield and monetary returns.

Table 5 : Effect of Cosavet Fertis WG (Sulphur) on nutrient uptake by banana at harvest					
Tr. No.	Treatments	Nutrient uptake (kg ha <sup>-1</sup> )			
		N	P	K	S
1.	Control (without sulphur)	558	98.3	1067	91.4
2.	S @ 9 g/pl - SSP at planting	589	107.9	1134	96.9
3.	S @ 9 g/pl - 80% WP at planting	613	112.0	1185	101.6
4.	S @ 9 g/pl -80% WP at pl. and 165 DAP	619	113.7	1199	102.3
5.	S @ 3 g/pl - Cosavet Fertis WG at pl. and 165 DAP	577	103.7	1079	95.2
6.	S@ 6 g/pl - Cosavet Fertis WG at pl. and 165 DAP	612	112.9	1159	101.2
7.	S @ 9 g/pl - Cosavet Fertis WG at planting	642	119.4	1255	107.9
8.	S @ 9 g/pl - Cosavet Fertis WG at pl. and 165 DAP	651	120.6	1273	108.9
9.	S @ 12 g/pl - Cosavet Fertis WG at pl. and 165 DAP	660	122.2	1293	110.2
	S.E.±	5.19	1.04	12.18	1.15
	C.D. (P=0.05)	16.9	3.39	39.7	3.76

**Table 6: Monetary returns as influenced by Cosavet Fertis WG (Mean of 2 years)**

Tr. No.	Treatments	Yield (t ha <sup>-1</sup> )	Monetary Returns (Rs. ha <sup>-1</sup> )	Total cost (Rs. ha <sup>-1</sup> )	Net profit (Rs. ha <sup>-1</sup> )	B:C Ratio
1.	Control (without sulphur)	75.6	264600	168525	96075	1.57
2.	S @ 9 g/pl - SSP at planting	79.4	277900	167126	110774	1.66
3.	S @ 9 g/pl - 80% WP at planting	82.2	287700	170325	117375	1.69
4.	S @ 9 g/pl -80% WP at pl. and 165 DAP	83.0	290500	170325	120175	1.71
5.	S@ 3 g/pl - Cosavet Fertis WG at pl. and 165 DAP	77.7	271950	170100	101850	1.60
6.	S@ 6 g/pl - Cosavet Fertis WG at pl. and 165 DAP	82.2	287700	171675	116025	1.68
7.	S @ 9 g/pl - Cosavet Fertis WG at planting	85.9	300650	173250	127400	1.74
8.	S @ 9 g/pl - Cosavet Fertis WG at pl. and 165 DAP	87.0	304500	173250	131250	1.76
9.	S @ 12 g/pl - Cosavet Fertis WG at pl. and 165 DAP	88.1	308350	174825	133525	1.76
	S.E.±	0.64	2242	--	2242	0.013
	C.D. (P=0.05)	2.09	7314	--	7314	0.04

Selling rate of banana = Rs. 3.500 t<sup>-1</sup>

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