

Response of black pepper (*Piper nigrum*) to molybdenum nutrition\*S HAMZA<sup>1</sup> and A K SADANANDAN<sup>2</sup>

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Black pepper (*Piper nigrum* L.) is cultivated mainly in warm humid and high rainfall regions, especially on the slopes of Western Ghats in south India. The forest loamy soils of Western Ghats are generally shallow and well drained, having high organic matter content and medium to high in K. About 80% of total production of black pepper in India is from Kerala where soils are acidic, poor in Zn and Mo, but high in Cu (due to bordeaux mixture spray or copper fungicide drenching). Molybdenum acts as a metal component of enzymes nitrate reductase and nitrogenase that are closely related to N metabolism. Antagonistic interaction of Cu with Mo and acidic nature of soil aggravate the deficiency of Mo. Therefore, greenhouse and field experiments were conducted during 1997-99 to find out the effect of Mo on yield and quality of black pepper.

For greenhouse experiment, Mo deficient (available Mo 0.17 mg/kg) pepper growing soils from Pulpally area of Wynad, Kerala (Agri ustoll) was used. The soil was sieved and weighed 10 kg each and filled in earthen pots (30 cm diameter), lined with polyethylene sheet. Three-month-old seedlings of 'Karimunda' bush pepper were planted @ one each in all pots. After 2 months of establishment, Mo was applied @ 0, 0.25, 0.5, 1, 1.5 and 3 mg/kg as sodium molybdate. The completely randomized block design with 4 replications was adopted. The field trial was also laid out during 1997-99 at Boikeri in Coorg district of Karnataka. The soil (Paleustalf) was acidic, medium in P and K and low in Mo (0.20 mg/kg). Five-year-old uniform black pepper vines trailed on *Erythrina indica* were used for study. Six vines were selected for each treatment in randomized block design with 4 replications and were fertilized with NPK @ 100, 50, 150 g/vine. Molybdenum was applied @ 0, 0.5, 1, 1.5 and 2.0 kg Mo/ha (as sodium molybdate) as soil application at the base of vine with the onset of monsoon in June. The Mo availability in soil, leaf and berry concentrations of Mo was estimated during harvest (Tandon 1993). Yield of pepper was recorded at crop maturity. Black pepper quality (oleoresin and piperine content) was analysed as per the standard procedure (ASTA, New York 1968).

\*Short note

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Both under greenhouse and field conditions, application of Mo to black pepper were effective in increasing yield and quality of black pepper. The soil, leaf and berry Mo increased significantly with the increase in levels of Mo. Under greenhouse, maximum number of spikes and yield were recorded with 0.25 mg/kg level Mo but were on a par with 0.5 mg/kg. There was 21% increase in yield over the control with 0.25 mg/kg Mo application. Maximum piperine content (7.27%) was recorded with 1 mg/kg Mo but was on a par with 0.5 mg/kg. The oleoresin concentration was maximum (9.89%) with 2 mg/kg Mo being at par with 0.5 mg/kg level. Mo @ 0.25 and 0.5 mg/kg were at par for yield and benefit : cost ratio (Table 1). Under field condition, the yield, oleoresin and piperine content were maximum with 0.5 kg Mo/ha. There was 14, 6.1 and 7.5% increase in yield, oleoresin and piperine content, respectively over the control owing to Mo application @ 0.5 kg/ha.

Economic analysis (benefit : cost ratio) showed that out of all levels, Mo @ 0.5 kg/ha proved remunerative (Table 2). The response function was worked out as  $Y=1.289+0.296Mo-0.157Mo^2$ . From the response function, the economic optimum level worked out was 0.94 kg Mo/ha (Hamza and Sadanandan 2002).

The soil of Coorg where field experiment was conducted was acidic, low in base saturation and cation exchange capacity and deficient in Zn and Mo. Further acidic nature and high Cu status (owing to continuous drenching of copper fungicide against *Phytophthora* disease of black pepper) might have reduced the soil Mo availability and this might be the reason for getting higher yield/response to applied Mo. Applied Mo might have increased the uptake and hence growth and better N utilization for amino acid and protein synthesis and this might be the reason for enhancement of quality. The reduction in yield beyond 0.94 kg Mo/ha might be due to toxic effect of Mo at highest level as reported by Hunashikatti *et al.* (2000) in cabbage crop. Jongruaysup *et al.* (1994) also reported good response of blackgram to Mo in sandy loam soil. Significant increase in yield and quality (protein) owing to Mo application has also reported by other workers, Zade *et al.* (1998) in groundnut, Sharma and Minhas (1988), and Lalitlanmawia *et al.* (2004) in Soybean.

Table 1 Effect of Mo on soil, leaf and berry content of Mo, yield, oleoresin and piperine content of bush black pepper (greenhouse)

Mo (mg/kg)	Soil Mo (mg/kg)	Leaf Mo (mg/kg)	Berry Mo (mg/kg)	No. of spike	Yield (g/bush)	Oleoresin (%)	Piperine (%)	Benefit : cost ratio
0	0.17	2.1	2.5	20	84	9.10	7.09	1.3
0.25	0.38	2.8	2.9	23	102	9.49	7.02	1.6
0.50	0.46	3.0	4.0	23	98	9.84	7.20	1.6
1.0	0.64	3.6	4.4	21	89	9.82	7.27	1.4
1.5	1.08	4.0	4.8	22	84	9.41	7.07	1.3
2.0	1.27	4.2	5.4	19	83	9.89	7.15	1.3
3.0	1.51	4.8	6.4	20	71	9.71	7.14	1.1
CD (P = 0.05)	0.03	0.16	0.52	1.4	5.7	0.30	0.13	

Table 2 Effect of Mo on soil, leaf and berry content of Mo, yield, (pooled data of 1998-99) oleoresin and piperine content of black pepper (field experiment)

Mo (kg/ha)	Soil Mo (mg/kg)	Leaf Mo (mg/kg)	Berry Mo (mg/kg)	Yield (kg/vine)	Oleoresin (%)	Piperine (%)	Benefit : cost ratio
0	0.20	3.2	0.89	1.27	8.03	5.76	4.06
0.5	0.35	3.9	0.93	1.45	8.52	6.19	4.57
1.0	0.45	5.0	0.99	1.39	8.16	5.88	4.32
1.5	0.49	6.1	1.04	1.38	8.26	5.99	4.22
2.0	0.58	6.6	1.06	1.26	8.32	6.12	3.80
CD (P = 0.05)	0.02	0.14	0.10	0.10	0.16	0.19	

Thus, it can be concluded that in Mo deficient black pepper growing soils, application of Mo @ 0.25 mg/kg of soil for potted bush pepper and soil application of 0.94 kg/ha under field condition (as sodium molybdate) were optimum for increasing yield and quality of black pepper.

## SUMMARY

The experiment was conducted during 1997-99 to find out the response of black pepper (*Piper nigrum* L.) to Mo. An increase in Mo level increased the soil, leaf and berry Mo status both under greenhouse and field conditions. In Mo deficient soils Mo @ 0.25 mg/kg of soil for potted bush and Mo @ 0.94 kg/ha for field condition were found optimum of increasing the yield and improving quality of black pepper.

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