REFERENCES

GREGORION, C. and KUMAR, D. R. 1984. Effects of irrigation and mulching on shoot and root growth of avocado and mango. *Journal of Hort. Science* 59(1): 109–117.

GREWAL, S. S. and SINGH, N. T. 1974. Effect of organic mulches on the hydrothermal regime of soil and growth of potato crop in northern India. *Plant and Soil.* 40: 33–47.

RAO, K. R., GEORGE, C. J. and RAMASASTRI, K. S. 1971. Potential evapotranspiration over India. Sci. Rep. 136, India Meteorological Department, New Delhi, pp. 10.

RATAN LAL, 1974. Soil temperature, soil moisture and maize yield from mulched and unmulched tropical soils. *Plant and Soil.* 11 (1): 1–9,

VARADAN, K. M. and RAO, A. S. 1983. Effect of mulch on soil temperature in humid tropical latosole under coconut *(Cocos nucifera* L.) and Banana *(Musa paradasiaca). Agric. Meteorology.* 28: 375–386.

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Heavy Metal Pollution Through Cement Dust in Coconut Ecosystem *

The environmental pollution from cement factories is mainly through the emission of cement dust into the atmosphere which is carried away by the wind to a considerable distance. Though cement dust enriches the soil with certain essential plant nutrients such as N, P, K, Ca, Mg, Fe, Mn, Cu and Zn (Simakin, 1963; Panda, Nayak and Mohapatra, 1973; Nagarajan, Rethinam and Biddappa, 1988), it also contaminates the environment with heavy metals such as Cr, Co, Ni, Sr, Pb, Ag, Ba, Ti, V and Zr (Simakin, 1963; Dobrazanski, Glinski and Misztal, 1970). Some informations are available on the role of non–essential elements with special reference to coconut nutrition (Valesco, 1983; Biddappa et al. 1987) and the damage caused to coconut (Jayasuriya, Mathes and Liyanagama, 1983). In the present study an attempt has been made to evaluate the metal loading properties of cement dust on coconut and coconut

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soils around Chitradurga and Hamsundara cement factories located in Karnataka State, India.

Representative samples of raw materials for cement manufacture such as tile, gypsum, limestone, sand, clay and samples of clinker and cement were collected and analysed for Cr, Co, Bi, Sb, Ni and Pb. The metal concentrations in coconut growing soils and in plant tissues including coconut and other vegetations around the cement factories collected at distances ranging from 0.10 to 5 km away were also estimated (Silviera and sommers, 1977) using Atomic Absorption Spectrophotometer model AA-975 after cleaning and processing the samples.

The data presented in Table I depicts the heavy metal contents in different raw materials being used in cement manufacture. It is seen from the data that most of the raw materials barring sand and coke breeze contained fairly high concentration of metals. The concentration of Pb was in the range of 14.2 to 40.93 ppm, Ni trace to 152.56 ppm, Cr trace to 186.44 ppm, Cd trace to 5.68 ppm, Co trace to 82.03 ppm, Bi trace to 62.67 ppm and Sb trace to 25.64. The limestone, gypsum, clinkers and cement were found to contain most of the heavy metals except Bi and Sb in sand. The information of metal composition of raw materials gives the extent of heavy metal pollution that could occur in the vicinity of cement factories through cement dust.

The results summarised in Table II show the heavy metal contents in the soils around Vedamani and Hamsundara factories at Karnataka. In general, 0.1 N HNO_3 has extracted relatively higher concentration of metals than EDTA. The heavy metal concentration progressively decreased in the soil samples collected farther away from the factory. In the case of vedamani factory EDTA extraction accounted for more Sb, Ni and Pb whereas in acid extraction Pb, Sb and Co were higher than rest of the metals. It is also evident that soils collected at 2 km away from the factory had lower concentration of heavy metals than the soil samples collected from 100 and 200m distance. Moreover the heavy metal content was higher in the surface samples

Table I. *Heavy metal contents in raw materials, clinker and cement (ppm)*

Material	Cd	Cr	Co	Bi	Sb	Ni	Pb
Tile	4.60	16.95	23.44	T	T	71.79	17.79
Gypsum	2.44	42.37	1.95	17.24	T	25.90	14.57
Limestone (high grade)	5.14	76.27	15.63	62.67	19.23	35.90	32.03
Sand	T	T	T	T	T	T	23.13
Coke-breeze	T	16.95	T	T	T	11.54	14.24
Clay	1.89	186.44	82.03	T	T	152.56	21.35
Clinker	5.41	84.75	39.06	T	25.64	65.38	40.93
Cement	5.68	93.22	39.06	T	12.82	58.97	32.02

T. Trace

compared to sub surface samples (Table II).

In the case of Hamsundara factory the EDTA extraction accounted for more of Ni, Sb and Co while HNO_3 has extracted more of Co, Ni and Sb. The metal concentration in the soils progressively decreased from 200 m to 5 km distance away from the factory. The concentration of metals in the soil profile at different locations also indicated downward mobility upto a depth of 50 cm. Incidentally it was observed that 25–50 cm depth was found to contain high concentration of Co and Sb when compared to other depths when sampled at 200m away from the factory.

Coconut leaf samples collected at 2 km away from the area around Vedamani factory did not contain Cd, Cr, Co and Pb whereas at 200m and 100m both coconut and wild bush samples were found possess Cd, Sb and Ni. However, samples collected at 100 m away from the factory had higher content of Pb, Sb and Ni (Table III).

The coconut tissue samples collected from Hamsundara at 5 km away showed only traces of all heavy metals except Ni. On the other hand both coconut and wild vegetation tissues collected at 200 m away recorded high concentration of Cd, Sb and Ni. This type of trend was also seen at 2 km away from the factory. However at 3 km both coconut and wild vegetation were found to contain Cd followed by Ni and other metals were almost trace. This indicated that from Hamsundara factory the extent of pollution was more (Table III).

Table II. *Heavy metal contents in the soils around cement factories (ppm)*

Location	Distance from the factory	Soil depth (cm)	0.1N EDTA extract						0.1N HNO_3 extract					
			Co	Cr	Cd	Sb	Ni	Pb	Co	Cr	Cd	Sb	Ni	Pb
Vedamani	100 m	0–10	1.92	3.39	0.23	10.59	3.02	2.35	8.23	5.17	0.35	9.05	7.63	9.46
	200 m	0–10	1.22	2.12	0.17	7.20	2.14	2.23	4.37	3.02	0.22	6.97	4.09	7.27
	2 km	0–25	0.92	0.69	0.13	5.08	1.13	1.32	3.56	1.16	0.06	3.45	2.44	5.99
		25–50	0.81	0.44	0.07	2.50	0.25	0.46	1.93	1.21	0.02	2.16	1.73	3.74
		50–100	0.31	0.48	0.07	2.12	0.31	T	0.61	0.86	0.01	1.32	1.41	3.56
Hamsundara	200 m	0–10	5.79	4.66	0.24	7.63	15.45	2.09	20.93	5.60	0.34	6.76	15.13	4.86
		10–25	6.20	3.81	0.20	9.32	11.43	2.37	21.75	4.31	0.22	7.76	9.81	4.69
		25–50	12.91	3.81	0.23	8.05	5.53	1.74	19.21	3.02	0.24	5.17	7.44	3.82
	2 km	0–10	2.14	2.54	0.13	6.36	3.02	1.33	18.09	5.17	0.14	3.54	7.56	3.91
		10–25	2.44	2.12	0.13	5.08	3.02	1.19	16.97	2.54	0.14	2.59	7.37	2.80
		25–50	1.32	1.70	0.10	4.25	2.16	1.05	13.11	2.16	0.12	1.72	3.31	2.00
	3 km	0–10	1.44	2.12	0.10	3.81	2.60	1.26	4.43	2.19	0.14	0.86	2.88	2.52
		10–25	1.03	2.12	0.09	3.61	1.76	0.98	4.69	2.59	0.30	0.43	2.37	2.26
		25–50	1.32	2.12	0.06	2.97	1.63	0.53	3.86	1.60	0.12	T	1.92	2.08
	5 km	0–25	0.92	1.69	0.05	1.27	1.13	0.40	1.93	1.29	0.06	0.83	1.03	0.68
		25–50	0.81	1.27	0.04	1.27	1.01	0.60	1.82	0.86	0.04	T	0.89	0.64

T. Trace

Table III. *Heavy metal contents (in ppm) in the tissues of coconut and other vegetations*

Location	Distance from the locality	Tissue samples	Cd	Cr	Co	Sb	Ni	Pb
Vedamani	100 m	Jack leaf	2.70	T	T	38.46	11.30	15.50
		Betel leaf	2.10	T	T	32.05	16.95	11.63
		Forest leaf	2.16	T	T	38.46	11.30	11.02
	200 m	Coconut leaf	4.33	T	T	19.23	8.47	T
		Wild bush	3.58	T	T	19.23	14.12	T
	2 km	Coconut						
		4th leaf	T	T	T	9.40	4.82	T
		14th leaf	T	T	T	3.33	2.82	T
Hamsundara	200 m	Coconut						
		4th leaf	4.32	T	T	19.23	11.30	T
		14th leaf	3.25	T	T	16.08	8.20	T
		Wild vegetation	3.16	22.57	T	32.05	28.25	11.63
	2 km	Coconut						
		14th leaf	2.06	T	T	9.23	5.65	T
		Wild vegetation	2.64	7.14	T	12.82	14.12	7.75
	3 km	Coconut						
		4th leaf	1.05	T	T	T	1.65	T
		14th leaf	1.16	T	T	T	T	T
		Wild vegetation	0.06	T	T	T	8.25	1.93
	5 km	Coconut						
		4th leaf	T	T	T	T	0.56	T
		14th leaf	T	T	T	T	T	T

T. Trace

The study indicated the extent of heavy metal pollution of soil and vegetation through the loading capacity of cement dust emitted from Vedamani and Hamsundara cement factories at Karnataka. Among the biotoxic metals which polluted these areas Ni, Sb, Cr, Co, Pb and Cd were prominent. The vegetation in the near vicinity of cement factory might suffer from metal toxic problem.

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REFERENCES

BIDDAPPA C. C., KHAN, H. H., JOSHY O. P. and MANIKANDAN, P. 1987. Effect of root feeding of heavy metals on the leaf concentration of P, K, Ca and Mg in coconut *(Cocos nucifera* L.) *Plant and Soil.* 101:295-297.

DOBRAZANSKI, B., GLINSKI, J. and MISZTAL, M. 1970. Effect of cement dust on some soil properties. *Roczniki Gleboznawcze.* 21 (2) : 409–420.

JAYASURIYA, V. U. De. S., MATHES D. T. and LIYANAGAMA, P. S. 1983. A study on the nature of damage to coconut palms around Puttalam cement factory caused by deposition of cement dust. A survey report p. 15. In *Coconis.* 20 : 1985.

NAGARAJAN, M., RETHINAM, P. and BIDDAPPA, C. C. 1988. Radial dispersion of micronutrients through cement dust into coconut ecosystem. *J. Plant. Crops.* 16 (11) : 52–54.

PANDA S. C., NAYAK, R. C. and MAHAPATRA, I. C. 1973. A note on effect of cement dust on soil fertility and crop growth around factory area of Rajgangpur (Orissa). *Indian J. Agron.* 18 (3) : 389–391.

SIMAKIN, A. I. 1963. Agro chemical properties of dust from cement factories. *Vestn. S. – Kh. Nanki.* No. 5, 62–64. In *Soils Fertil.* Abst. No. 2543. 26 (5) : 1963.

SILVIERA, D. J. and SOMMERS L. E. 1977. Extractability of copper, zinc, cadmium and lead in soils incubated with sewage sludge. *J. Environ. Qual.* 6 (1) : 47–51.

VELESCO, J. R. 1983. The non-essential elements with reference to coconut nutrition. *Indian cocon. J.* 13 (10) : 3–14.

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Effect of the Pollinating Weevil, *Elaeidobius kamerunicus* on the Incidence of Bunch Failure in Oil Palm Plantations of Little Andamans

Oil palm was introduced in Andamans in the early part of 20th century but the commercial cultivation started only during 1976. The area under oil palm in Andamans is about 1600 ha and is maintained by the Andamans and Nicobar Forest and Plantation Development Corporation (ANFPDC).

The islands receive, on an average, rainfall of 3000 mm distributed throughout the year. Temperature ranges from 18°–35° C and sunshine an average of 6 h/day. These are quite favourable for cultivation of oil palm.

Though the growth of palms is very