Comparative Evaluation of Karanjin and Extracts of *Karanja* (*Pongamia glabra* Vent.) and *Neem* (*Azadirachta indica* L.) Seeds for Retardation of Nitrification of Urea in Soil

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Abstract : *Ability of alcohol extracts of* karanja (Pongamia glabra *Vent.*) *and* neem (Azadirachta indica *L.*) *seeds to retard nitrification of urea was compared with that of karanjin in an incubation experiment. Treatment of urea with the extracts at the rate of 30 percent of the N rate was comparable to karanjin applid at 5 and 10 per cent concentration. The extracts were effective nitrification up to 45 days while karanjin was effective up to 60 days. The different of inhibition of nitrification observed with* karanja *and* neem *seed extracts suggest that their mixture may be a better material for retardation of nitrification in soil.* (Key words : *Karanja* ; *neem* ; karanjin ; nitrapyrin ; nitrification inhibition pattern)

It has been recognized that nitrification inhibitors hold promise for improving the efficiency of ammonium and ammonium forming fertilizers by reducing the losses due to denitrification and leaching under situations where such losses are high (Prasad *et al.* 1971 ; Sahrawat 1978, 1979). However, for nitrification inhibitors to be popular for practical usage, it is essential that they must be cheap in addition to being effective at reasonable rates of application (Sahrawat 1978).

Earlier the use of some indigenous materials for retardation of nitrification in soils fertilized with urea and ammonium sulphate has been reported (Sahrawat *et al.* 1974; Sahrawat & Parmar 1975; Sahrawat & Mukerjee 1977; Sahrawat *et al.* 1977). Karanjin a furanoflavonoid from *Pongamia glabra* seeds was comparable to Nitrapyrin (N-serve) as nitrification inhibitor in laboratory and greenhouse studies with rice crop (Sahrawat & Mukerjee 1977).

The objective of this study was to compare the ability of alcohol extract of *karanja* (*Pongamia glabra*) and *neem* (*Azadirachta indica*) seeds with that of karanjin to retard nitrification of urea in soil. It has been recognized that the nonedible seeds such as *karanja* and *neem* have biologically active minor non-fatty constituents that impart nitrification inhibitory property to them (Sahrawat *et al.* 1974 ; Sahrawat & Parmar 1975 ; Sahrawat & Mukerjee 1977).

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EXPERIMENTAL

The soil used was a sandy clay loam (61% sand, 15% silt and 24% clay) alluvial soil collected from the Indian Agricultural Research Institute Farm, New Delhi. The soil analysed: pH 7.7 ; organic carbon 0.60 per cent ; total N 0.07 per cent ; cation exchange capacity (CEC) 11.6 m.e./100g and water holding capacity (WHC) 38.4 per cent. Soil analysis was done as described earlier (Sahrawat 1977).

Alcohol extracts of Pongamia glabra *and* Azadirachta indica *seeds:* Seeds were defatted by extraction with hot petroleum ether and the defatted material was then extracted with boiling 95 per cent ethanol. The solvent was removed and the extracts soluble in acetone were used (Sahrawat *et al.* 1974 ; Sahrawat & Parmar 1975).

Karanjin : Karanjin (3-methoxy furano-2′, 3′: 7,8-flavone) was isolated from *karanja* seeds and oil as described earlier (Sahrawat & Mukerjee 1977).

Samples of 200g soil were transferred to 500 ml beakers and treated with 200μg N/g of soil from aqueous solution of urea. Alcohol extracts of *karanja* and *neem* seeds were added to soil at the rate of 20 and 30 per cent of the applied nitrogen. Karanjin was added at the rate of 5 and 10 per cent of the fertilizer nitrogen. Controls without any amendments and with 200 ppm urea N were also included. The fertilizer and the inhibitors were mixed together and applied to soil. Soil was then properly mixed. Enough water was added to bring the soil moisture to 1/3 WHC. The beakers covered with polythene sheets were incubated at room temperature for 75 days.

Duplicate 10 g soil samples were drawn and analysed every 15 days for NH_4^+, NO_2^- and NO_3^- following the method described by Sahrawat and Prasad (1975). From the values of NH_4^+, NO_2^- and NO_3^- the percentage inhibition of nitrification was calculated from nitrification rates as suggested earlier (Sahrawat 1980).

RESULTS AND DISCUSSION

As observed earlier (Sahrawat *et al* 1974; Sahrawat & Parmar 1975; Sahrawat & Mukerjee 1977) the extracts of *karanja* and *neem* seeds and karanjin retarded the conversion of NH_4^+ to NO_2^- without affecting the oxidation of NO_2^- to NO_3^- with the result, higher amounts of NH_4^+ accumulated in soil samples treated with the inhibitors (Table 1). The highest amount of NO_2^-

TABLE 1

Effects of karanjin and alcohol extracts of karanja *and* neem *seeds on ammonification of urea in soil*

Nitrification inhibitor	Amount of inhibitor added (% of N applied)	ppm of NH_4^+ after days of incubation				
		15	30	45	60	75
None	0	100	65	30	18	11
Karanjin	5	169	130	70	40	18
	10	173	141	81	59	27
Karanja seed extract	20	146	77	51	21	11
	30	144	100	62	23	9
Neem seed extract	20	125	118	70	28	21
	30	138	120	71	30	22

detected in the soil samples treated with and without inhibitors was only 3 ppm and usually it was very low or absent and so data on NO_2^- have not been reported.

Soil samples treated with nitrification inhibitors contained lower amounts of NO_3^- than the untreated samples during the 75 days of study though the effectiveness of the inhibitors to retard nitrate formation decreased with time (Table 2). Karanjin retarded nitrification of urea at 5 and 10 per cent concentration up to 60 days, the percentage inhibition of nitrification after 60 days was 31 and 43 per cent, respectively. The extracts of *karanja* and *neem* seeds were effective up to 45 days. The inhibition was 45 to 47 per cent at 30 per cent concentration and 38 per cent at 20 per cent concentration. The *neem* extract showed a slight inhibition of nitrification at 60 days also (Table 3).

There was a difference in the pattern of inhibition of nitrification by *karanja* and

TABLE 2

Effects

in soil fertilized with urea

Nitrification inhibitor	Amount of inhibitor added (% of N applied)	ppm of NO_3^- after days of incubation				
		15	30	45	60	75
None	0	15	41	93	120	160
Karanjin	5	8	20	45	60	91
	10	7	11	35	58	88
Karanja seed extract	20	6	40	46	111	146
	30	5	21	44	110	142
Neem seed extract	20	14	25	60	100	144
	30	10	20	46	69	112

TABLE 3

Comparison of inhibition of nitrification of urea by karanjin, and alcohol extracts of karanja *and* neem *seeds**

Nitrification inhibitor	Amount of inhibitor added (% of N applied)	% inhibition of nitrification after days				
		15	30	45	60	75
Karanjin	5	57	62	47	31	12
	10	64	77	59	43	18
Karanja seed extract	20	64	10	38	3	1
	30	71	54	45	5	0
Neem seed extract	20	21	51	38	10	7
	30	43	62	47	20	11

*Inhibition of nitrification was calculated from the nitrification rates obtained from the values of NH_4^+, NO_2^- and NO_3^- propuced in soil samples as suggested by Sahrawat (1980)

neem seed extracts in that while the *karanja* extract was more effective at 15 days, the *neem* seed extract was either at par or a better inhibitor of nitrification at 45 and 60 days (Table 3). These results suggest that perhaps a mixture of these materials may be a better inhibitor of nitrification for achieving sustained retardation of nitrification in soil.

These results further demonstrate that the lipid associates from *karanja* and *neem* seeds that impart nitrification inhibitory properties can be conveniently extracted by ethanol and could be used effectively for retardation of nitrification by preparing their formulations with the ammonium and ammonium forming fertilizers.

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