of 24.0 tonnes per ha per year, followed by the application of 1800-900-1800 g of N, P_2O_5 and K_2O per palm per year with FFB yield of 23.6 tonnes per ha per year.

The fertilizer dose of 1500-750-1500 g of N, P_2O_5 and K_2O per palm per year was found to be optimum to produce maximum fresh fruit bunch yield of 16.27 tonnes per ha per year during 1999-2000. The aforesaid NPK schedule gave a maximum fresh fruit bunch yield of 24.0 tonnes per ha per year with palm height of 7.4m, palm basal girth of 3.0m, number of leaves per palm of 37.0, number of female inflorescence of 29.6 and number of FFB of 23.8 per palm per year during 2000-2001, followed by the application of 1800-900-1800 g of N, P_2O_5 and K_2O per palm per year with FFB yield of 23.6 tonnes per ha per year.

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Research Notes

Influence of irrigation methods on soil properties under sodic soil conditions

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In India, problem soils constitute nearly 25M ha of which saline soils occupy 5.5M ha while alkaline soils occupy 2.5M ha. Better economic exploitation of these soils can be possible by tree cultivation (Tripathi and Hazra, 1996). The tree species with rapid growth, deep rooting, dense foliage producing, good coppiceability, good green leaf manure value and ability to fix nitrogen can be integrated with crops for effective utilization of wastelands. Naturally growing and resistant trees like neem, pungam, subabul, casuarina, etc. have been identified for each agroclimatic zones for cultivation under alkaline or salt affected soil conditions (Panjab Singh, 1996). Planting of salt loving trees like neem, pungam, subabul etc. can make the best use of the sodic soil environment (Tripathi an Hazra, 1996). Hence, an experiment was carried out to study the impact of agro-forestry tree species and irrigation methods on the soil properties.

A field experiment was conducted during November 1996 to October 1998 at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirapalli, Tamil Nadu in randomized block design with four replications. The treatments consisted to three irrigation methods (drip, pitcher and surface basin) in four tree species (neem, casuarina, pungam and subabul). Pits of uniform size (0.45 x 0.45 x 0.45 m^3) were dug and filled with FYM, sand and red earth mixture. The tree species were planted at a spacing of 2m in a row and the rows

able 1. Influence of irrigation methods on soil properties under sodic soil conditions

oil roperty	Soil depth (cm)	Drip irrigation		Pitcher irrigation		Surface basin irrigation	
		Initial	After 3 years	Initial	After 3 years	Initial	After 3 years
H	0-15	8.8	8.6	8.8	8.7	8.8	8.5
	15-30	8.9	8.7	8.9	8.8	8.9	8.8
	30-60	9.0	8.9	9.0	8.9	9.0	8.8
	60-90	9.2	9.1	9.1	9.0	9.2	9.1
C	0-15	1.92	1.53	1.90	1.78	1.90	1.60
	15-30	1.82	1.50	1.82	1.60	1.92	1.55
	30-60	1.80	1.53	1.80	1.72	1.78	1.68
	60-90	1.73	1.45	1.73	1.78	1.73	1.52
SP	0-15	20	19	20	19	20	19
	15-30	21	19	21	20	21	20
	30-60	22	20	20	19	22	21
	60-90	22	22	22	21	21	20
AR	0-15	18	17	18	18	18	17
	15-30	19	18	19	19	19	18
	30-60	20	19	20	19	20	19
	60-90	20	20	20	20	20	19

	pH		EC		ESP		SAR	
	SEd	CD (P=0.05)	SEd	CD (P=0.05)	SEd	CD (P=0.05)	SEd	CD (P=0.05)
Irrigation methods (I)	0.050	0.104	0.22	0.47	0.38	0.79	0.28	0.58
Depth of soil layer (D)	0.057	0.118	0.07	0.15	1.39	2.89	0.44	0.92
DxI	0.064	0.134	0.03	0.06	0.24	0.50	0.49	1.01

were formed at 4m interval. The soil of the experimental field was sandy clay loam with pH of 8.9, EC of 1.9 dSm^{-1} and ESP 20. The initial nutrient status of the soil revealed that it was low in available nitrogen, medium in available phosphorus and potassium. The water used for irrigation was sodic with a pH of 9.2, EC 1.2 dSm^{-1} and RSC 12 meq l^{-1}. All the trees were manured only with FYM @ 50 kg pit^{-1} applied through pot mixture. Intercrops were grown as rainfed during the first year of study for effective utilization of the inter space till the trees had established. Though the mean annual rainfall of the study area is 940 mm, the annual rainfall received during the first year was 581.3 mm and during the second year 942 mm. The soil properties *viz.* pH, EC, ESP and SAR were measured at the end of the experiment.

Irrespective of the irrigation methods there was a significant decrease in pH, EC, SAR and ESP of the sodic soil under study, over a period of three years as shown in Table 1. The soil pH decreased an year after tree growth. The agro-forestry system improved the soil to the extent that pH of soil in the top 15 cm layer was significantly reduced from 8.8 to 8.5 under surface basin method, 8.6 under drip and 8.7 under pitcher method of irrigation at the end of the study. This might

be due to the ameliorative nature of the tree species and their leaf fall, inter crop residues added to the soil through ploughing and incorporation in the alleys. There existed a significant interaction between the depth of soil and irrigation methods. The rate of decrement was less as the depth advanced which might be due to the native high soil pH in the subsoils with sodicity.

Salt dynamics study showed that EC decreased from 1.9 to 1.53 dSm^{-1} after three years especially under drip irrigation in the top 0-15 cm soil layer. Interaction between irrigation methods and soil showed that there is a significant reduction in EC as the depth of soil increased. Among the irrigation methods drip irrigation had recorded significantly low EC levels when compared to surface basin and pitcher methods of irrigation. The minimal water usage through drip under sodic soil coditions might have minimized the problems of salt accumulation even when the irrigation water is sodic. This is inline with the observations of Panjab Singh (1996) and Sivanappan (1994).

Similarly the ESP of the soil decreased from 20 to 19 in the top layer but not significantly as the soil depth increased. The SAR values decreased significantly at different so depths irrespective of the irrigation metho at the end of three years. There was no significar interaction between different treatments on ES or SAR values.

Among the irrigation methods drip irrigatio performed better with an overall water savin upto 60 percentage. The drip system suits we to neem, pungam and casuarina with slightl saline water under sodic soil conditions.

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Research Notes

Response of chickpea to soil and foliar application of DAP

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Chickpea (*Cicer arientinum* L.) is one of the foremost *rabi* pulse crops of Maharashtra and premier pulse of India. With the advent of new high yielding varieties responsive to fertilizer nutrients, it is necessary to test three varieties with different fertilizer levels under protective irrigation. Phosphate fertilizers when added to soil undergo chemical reactions and get fixed with soil and thereby become unavailable to plants. Foliar application of P using water soluble fertilizers is one possible way to avoid such temporary fixation. Even small quantities of fertilizers applied through foliage 2-3 time at different growth stages of crops would mee out the nutrient requirements of the crops an thus productivity could be enhanced with lo input cost. With this consideration in viev the present investigation was undertaken.

A field experiment consisting of thre DAP levels (i. 100, ii. 150 and iii. 200 k ha^{-1} and three levels of 2% foliar spray c DAP (i. control, ii. once (50% flowering) an iii. twice (one week after first spray) was conducte