able 2). *Rhizobium* seed treatment + Microsol pray 15,30 and 45 DAS (T_{13}) recorded significantly igher N (110.5 and 105.4 kg ha^{-1}), P (24.65 nd 21.30 kg ha^{-1}) and K (93.5 and 85.6 kg a^{-1}) uptake in the first and second crop, spectively. Nutrients applied through foliage ould have easily absorbed and translocated the plant without any loss. This was in greement with the earlier findings of Rajendran 1991) in greengram.

rotein content

Rhizobium seed treatment and foliar pplication of macro and chelated micronutrients howed significant influence on protein content Table 3). Maximum protein content of 24.52 nd 24.33 per cent in grain during the first nd second crop, respectively were recorded nder the treatment of *Rhizobium* + Microsol pray at 15,30 and 45 DAS (T_{13}). *Rhizobium* ould have helped the plants by fixing atmospheric itrogen and as a result, the nitrogen content turn the protein in grain was increased. The esult was inline with the findings of Bhalu *t al.* (1995). Foliar application of macro and micronutrients enhanced the protein content of grain. This might be due to increase in the efficiency of fixing of nitrogen and nitrate reductase activity by molybdenum. Similar view was expressed by Sharma and Minhas (1990) in soybean.

Thus, it is concluded that *Rhizobium* seed inoculation and foliar application of N,P,K and chelated micronutrient mixture (Microsol) thrice at 15,30 and 45 DAS increased the grain yield, haulm yield, NPK uptake and protein content in the grain of rice-fallow blackgram.

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References

Bhalu, V.B., Sadaria, S.G., Kaneria, B.B. and Khanpara, V.D. (1995). Effect of nitrogen phosphorus and *Rhizobium* inoculation on yield and quality, N and P uptake and economics of blackgram (*Phaseolus mungo*). *Indian J. Agron.* **40**: 316-318.

Gopal Singh, B. and Sudhakar, P. (1991). Effect of inoculation and phosphorus fertilization on DMP, N and P composition and yield in blackgram. *Indian J. Plant Physiol.* **34**: 297-301.

Humphries, E.C. (1956). Mineral components and ash analysis. Modern methods of plant analysis. Springer-Verlag. Berlin 1, pp.468-502.

Rajendran, R. (1991). Response of greengram (CO 4) to soil and foliar nutrition. *Madras Agric. J.* **78**: 453-455.

Revathy, M., Krishnasamy, R. and Chitdeswari, T. (1997). Chelated micronutrients on the yield and nutrient uptake by groundnut. *Madras Agric. J.* **84**: 659-662.

Sharma, C.M. and Minhas, R.S. (1990). Effect of molybdenum application on nitrogen and protein content of soybean (*Glycine max*). *Madras Agric. J.* **77**: 243-244.

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Research Notes

Nutrient management on growth and yield of Deli. Ekona oil palm plantation

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Oil palm, a relatively new oil yielding crop, is cultivated in about 5,000 acres in Tamil Nadu. A range of soil nutrient content and fertility exist in the oilpalm growing soils of Tamil Nadu. An oil palm plantation producing 25 tonnes of fresh fruit bunches per hectare per year remove about 93.5, 91.0, 92.7, 19.3 and 20.3 kg per ha of N,P,K,Mg and Ca respectively

Table 1. Influence of fertilizer levels on growth of oil palm during 1999-2000

Fertilizer level of N - P_2O_5 - K_2O (g/palm/year)	Palm height (m)	Palm basal girth (m)	No. of leaves per palm	Leaf length (m)	Leaflet width (cm)
T_1 900-450-900	5.89	2.67	31.83	4.78	2.89
T_2 1200-600-1200	6.30	2.73	34.59	4.64	2.90
T_3 1500-750-1500	7.03	2.75	39.47	4.63	2.78
T_4 1800-900-1800	6.85	2.76	39.10	4.50	2.81
T_5 2100-1050-2100	7.37	2.85	38.43	4.73	2.75
Mean	6.69	2.75	36.68	4.66	2.83
SEd	0.17	0.07	1.83	0.07	0.05
CD (P=0.05)	0.38	0.16	3.99	0.16	0.11

(Turner and Gillbanks, 1988). Oilpalm has a high K and N demand, and if these requirements are met, can produce 25-30 mt (fresh-fruit bunches) per hectare per year (Yaacob and Sulaiman, 1992). The young palms only utilized about 10-20% of the total nutrient uptake that is mostly found in the fronds (Khalid *et al.* 2000). The data showed that oilpalm require heavy manuring for maximum sustainable production of fresh fruit bunches. A fertilizer dose of 1200-600-1200 g of N, P_2O_5 and K_2O per palm per year was recommended for oilpalm from third year onwards (Rethinam and Varghese, 1998). Information on nutrient management has to be generated for well established grown up oilpalm plantations.

With this view, an experiment was conducted with objectives to fix optimum fertilizer schedule for oil palm after five years and to study its effect on growth and yield of oilpalm The oilpalm trees were planted at Sugarcane Research Station, Sirugamani during April, 1994 The experiment was started in April 1999. The experiment was conducted in randomised block design with three replications each having seven palms per plot. The oilpalm was planted with 9m x 9m spacing in square planting method. The soil is a clayey loam with a pH 8.5. The treatments imposed were T_1=900-450-900, T_2=1200-600-1200, T_3=1500-750-1500, T_4=1800-900-1800 and T_5=2100-1050-2100 g of N, P_2O_5 and K_2O per palm per year respectively. Pressmud @ 100 kg per palm per year was applied uniformly to all palm trees. The control with no NPK was not included because the fertilizer level of 1200-600-1200 g N, P_2O_5 and K_2O per palm per year is recommended as blanket dose for young oilpalm plantation.

Table 2. Influence of fertilizer levels on yield of oil palm during 1999-2000.

Fertilizer level of N - P_2O_5 - K_2O (g/palm/year)	No.of male inflorescence per palm	No.of female inflorescence per palm	Male/female inflorescence ratio	No.of FFB per palm	FFB yield (kg ha^{-1})
T_1 900-450-900	1.47	2.08	0.41	13.70	12001
T_2 1200-600-1200	1.51	1.70	0.91	15.11	14246
T_3 1500-750-1500	1.60	1.74	1.05	14.87	16266
T_4 1800-900-1800	1.49	2.23	0.66	11.74	11817
T_5 2100-1050-2100	1.72	2.39	0.85	11.91	13397
Mean	1.56	2.03	0.77	13.46	13545
SEd	0.27	0.49	0.22	1.27	1288
CD (P=0.05)	0.58	1.06	0.48	2.82	2805

ble 3. Effect of fertilizer levels on growth of oil palm during 2000-2001.

tilizer level of P_2O_5 - K_2O palm/year)	Palm height (m)	Palm basal girth (m)	No. of leaves per palm	Leaf length (m)	Leaflet width (cm)
900-450-900	6.7	2.7	36.6	4.4	2.8
1200-600-1200	6.9	2.8	36.2	4.7	2.8
1500-750-1500	7.4	3.0	37.0	4.8	2.8
1800-900-1800	7.2	3.0	38.1	4.8	2.7
2100-1050-2100	7.6	3.0	35.3	4.9	2.8
ean	7.1	2.9	36.6	4.7	2.8
:d	0.26	0.05	1.12	0.17	0.07
) (P=0.05)	0.59	0.11	2.59	0.40	0.17

The influence of fertilizer levels on growth id yield attributes of oilpalm during 1999-)00 are furnished in Table 1 and 2. The ghest palm height of 7.37m and basal girth 2.85m were recorded in T_5. The maximum imber of leaves of 39.47 per palm was observed T_3, which was comparable with T_4 and The leaf length and width behaved eratically ith the different fertilizer levels. Generally, e number of male and female inflorescence er palm was found to increase with higher rtilizer levels. The highest male and female iflorescence ratio of 1.05 was recorded in which was comparable with T_2. The highest umber of fresh fruit bunches per palm per ear of 15.11 was recorded in T_2, followed y T_3 with 14.87. The maximum fresh fruit unch yield of 16.27 tonnes per hectare per ear was recorded in T_3, followed by T_2 with 14.25 tonnes per ha.

The highest palm height of 7.6 m was recorded with application of 2100-1050-2100 g of N, P_2O_5 and K_2O per palm per year which was on par with application upto 1500-750-1500 g of N, P_2O_5 and K_2O per palm per year during 2000-2001 (Table 3). A similar trend was noticed in palm basal girth. There was no significant difference in number of leaves per palm due to fertilizer levels. However, the highest number of leaves per palm of 38.1 was recorded with application of 1800-900-1800g of N, P_2O_5 and K_2O per palm per year. There was no difference in leaflet width due to fertilizers level. Effect of fertilizer level on yield parameters of oilpalm is presented in Table 4. There was no difference in number of male and female inflorescence per palm per year. Application of 1500-750-1500 g of N, P_2O_5 and K_2O per palm per year recorded the maximum fresh fruit bunches (FFB) yield

Table 4. Effect of fertilizer levels on yield of oil palm during 2000-2001.

Fertilizer level of N - P_2O_5 - K_2O (g/palm/year)	No.of male inflorescence per palm	No.of female inflorescence per palm	No.of FFB per palm	FFB yield (kg ha^{-1})
T_1 900-450-900	5.3	27.3	21.8	18.5
T_2 1200-600-1200	5.1	27.8	23.6	20.2
T_3 1500-750-1500	4.8	29.6	23.8	24.0
T_4 1800-900-1800	5.3	29.1	23.6	23.6
T_5 2100-1050-2100	4.3	26.3	22.0	22.2
Mean	5.0	28.0	23.0	21.7
SEd	0.72	2.69	3.40	1.83
CD (P=0.05)	1.67	6.21	7.84	4.23

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.

References

Khalid, H., Zakaria, Z.Z. and Anderson, J.M. (2000) Nutrient cycling in an oilpalm plantation: the effects of residue management practices during replanting on dry matter and nutrient uptake of young palms. *J. Oilpalm Res.* **12**: 29-37.

Rethinam, P. and Varghese, P.T. (1998). Agronomic aspects of oilpalm production. pp.25-37. In: Rethinam, P. and Suresh, K. (eds.), Oilpalm research and development, National Research Centre for Oilpalm, Pedavgi-534 450, India

Turner, P.D. and Gillbanks, R.A. (1988). Oilpalm cultivation and management (1988 reprinting). Incorp. Soc.Planters,Kuala Lumpur.

Yaacob, O. and Sulaiman, W.H.W. (1992). The management of soils and fertilizers for sustainable crop production in Malaysia. Extension Bulletin-ASPAC, Food and Fertilizer Technology, No.354, pp.1-11.

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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