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Influence of integrated nutrient management on the performance of coconut palm in littoral sand

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Abstract

An experiment was conducted in littoral sandy soil at Coconut Research Station, Konark, Orissa during 1997-98 and 1998-99 to asses the effect of integrated nutrient management practices on local tall palms taking fifteen treatment combinations of organic manures (neem cake, mustard cake, FYM and poultry manure) and NPK fertilizers with or without *in situ* green manuring of cowpea and horsegram on equal nutrient basis. The studies revealed that the integrated manuring practices had no noticeable impact on the height and girth of the adult bearing palms. The mean number of functional leaves per palm as well as the rate of production of leaves and inflorescences, however, significantly increased by the application of FYM alongwith NPK fertilizers and also by *in situ* green manuring with cowpea in the palm basin. There was also significant increase in the production of number of female flowers (137.13/palm/ year), fruit set (36.71%) and nut yield (44.00 nuts / palm/year) under the treatment wherein FYM and NPK fertilizers were applied along with *in situ* green manuring with cowpea compared to the corresponding values of 88.00/palm/year, 34.35% and 24.13 nuts/ palm/year in the respective characters under NPK fertilizers alone treated as control. The integrated nutrient package also influenced the pH, organic carbon content, available N,P and K contents of the concerned soil and the leaf NPK contents of the palms under study.

Key words: Littoral sand, integrated nutrient management, *in situ* green manuring

Introduction

A large extent of coconut plantation in coastal Orissa stands on the littoral sand. The productivity status of such plantations maintains a low profile the reasons of which are not far to seek: poor nutritional status, low CEC (0.4-0.54 me/ 100g) and low organic carbon content (0-0.46%) of soil (Khan *et al.*, 1994). Also the problem of low productivity is aggravated by the loss of organic matter due to hot and humid climate. Some past studies, however, indicated that the productivity of the littoral sand could be improved by the combined use of organic manures, green manuring crops and inorganic fertilisers. In the present study, an attempt has been made to develop a location specific integrated nutrient management package by involving both organic and inorganic sources of plant nutrients so as to improve the productivity status of the soil of palm basins, which in turn could influence the performance of the coconut palm grown under such conditions.

Materials and Methods

The study was carried out at the Coconut Research Station, Konark (OUAT) during 1997-98 and 1998-99 to find out the effect of integrated nutrient management on the performance of coconut palm in littoral sand. Before taking up the experiment, the soil of the Research Station was analysed to assess the physico-chemical characters. The results revealed that the soil was very low in water holding capacity and high in rate of infiltration. The soil was also low in organic carbon content (0.04-0.12%) and available nitrogen (36-66 kg/ ha.) and medium in phosphorus content (28-33 kg/ha.). The study was conducted following a Factorial Randomized Block Design with 15 different treatment combinations of Factor A and Factor B which are replicated twice. Factor A comprised of F_1 (chemical fertilisers(NPK) adjusted to meet the recommended dose.500g N, 320 g P and 1200 g K per palm per year) as control, F_2 (Neem cake(5kg/palm/year) + chemical

Table 1. Effect of integrated nutrient management on the growth characters of Coconut Palm

Treatment	Increase in plant height (%)		Increase in girth of palm (%)		No. of functional leaves per palm		Number of leaves produced/ palm/year	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Factor A								
F_0	1.25	1.67	2.86	3.06	20.83	21.67	8.54	10.38
F_1	1.83	1.86	3.26	4.60	22.21	24.46	9.38	11.04
F_2	1.89	1.72	2.22	4.95	22.29	23.46	9.21	10.75
F_3	1.69	2.62	3.13	5.17	23.79	26.42	10.46	11.38
F_4	1.50	2.02	2.49	4.52	23.04	25.54	10.04	10.92
CD.(0.05)	NS	0.50	0.65	1.41	0.54	1.65	1.23	0.50
Factor B								
G_0	1.42	1.82	2.28	3.10	22.18	23.63	8.83	10.48
G_1	1.76	1.95	3.54	4.98	22.70	24.93	10.20	11.28
G_2	1.72	2.16	2.55	5.30	22.43	24.38	9.55	10.93
CD.(0.05)	NS	NS	0.50	1.09	NS	0.50	0.18	0.39
Interaction (Factor A x Factor B)								
F_0G_0	1.04	1.25	2.35	2.05	20.63	21.38	8.13	10.00
F_0G_1	1.40	1.96	4.05	4.02	21.13	22.00	8.88	10.63
F_0G_2	1.32	1.81	2.17	3.11	20.75	21.63	8.63	10.50
F_1G_0	1.77	2.06	2.25	2.65	22.00	23.88	8.63	10.50
F_1G_1	2.00	1.20	4.66	5.95	22.25	24.88	10.00	11.25
F_1G_2	1.72	2.32	2.86	5.22	22.38	24.63	9.50	11.38
F_2G_0	1.33	1.53	2.25	2.67	22.13	22.50	8.63	10.50
F_2G_1	1.54	1.90	2.03	4.50	22.38	24.00	9.88	11.25
F_2G_2	2.80	1.71	2.38	7.68	22.38	23.88	9.13	10.50
F_3G_0	1.87	2.27	2.40	4.62	23.38	25.50	9.63	11.00
F_3G_1	2.08	2.68	3.97	5.31	24.25	27.38	11.38	11.88
F_3G_2	1.12	2.90	3.02	5.59	23.75	26.38	10.38	11.25
F_4G_0	1.08	1.99	2.17	3.50	22.75	24.88	9.13	10.38
F_4G_1	1.80	2.03	2.97	5.15	23.50	26.36	10.88	11.38
F_4G_2	1.64	2.05	2.31	4.90	22.88	25.38	10.13	11.00
CD.(0.05)	NS	NS	NS	NS	NS	NS	0.39	NS

fertilisers(NPK) adjusted to meet the recommended dose), F_3 (Mustard cake(5kg/palm/year) + chemical fertilisers(NPK) adjusted to meet the recommended dose), F_4 (FYM(25kg/palm/year) + chemical fertilisers(NPK) adjusted to meet the recommended dose) and F_5(Poultry manure(10kg/palm/year) + chemical fertilisers(NPK) adjusted to meet the recommended dose). Factor B comprised of G_0 (no green manuring), G_1(*in situ* manuring with cowpea (*Vigna unguiculata)* and G_2(*in situ* manuring with horsegram (*Macrotyloma uniflorum).* Observations on plant height, girth, rate of leaf production, number of leaves/palm/year, number of inflorescences/palm/year, number of female flowers/ palm/year, fruit set (%), nut yield, nut weight and copra weight per nut were recorded at the end of June of the respective years. Soil and leaf tissue samples were also collected from all the treatments and analyzed to study the nutrient status of palm basins as well as the NPK contents of palm leaves.

Results and Dicussion

A careful analysis of the data presented in Table 2 indicated that the highest nut yield/palm/year was recorded under the treatment F_4 wherein combined application of Farm Yard Manure and chemical fertilisers adjusted to meet the recommended dose was made. This treatment was found to be statistically superior to the rest of the combinations tried. Among the green manuring crops grown in the basin area with an objective of improving the productivity status of the soil, *in situ* green manuring with cowpea (*Vigna unguiculata*) was found to the best during both the years of study. It was quite interesting to observe the interaction effect of both the factors green manuring crops and organic manures + NPK fertilisers on nut yield per palm per year. The highest nut yield per palm per year during both the years of study was recorded under the treatment F_4G_1 wherein FYM + chemical fertilisers adjusted to meet the recommended dose was made along with *in situ* green manuring with

Table 2. Effect of integrated nutrient management on the reproductive behaviour and yield characters of Coconut Palm

Treatment	Number of inflorescences per palm per year		Number of female flowers per palm per year		Setting percentage per palm per year	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Factor A						
F_1	6.25	6.96	78.79	95.13	36.02(34.59)	35.21(33.25)
F_2	7.42	10.00	115.04	120.92	35.05(32.98)	36.83(35.94)
F_3	6.63	8.63	94.88	119.21	36.56(35.48)	35.41(33.57)
F_4	8.00	10.63	125.96	130.88	36.28(35.02)	36.64(35.61)
F_5	7.00	9.00	111.96	128.67	35.25(33.31)	35.56(33.81)
CD.(0.05)	**0.19**	**0.21**	**1.91**	**2.98**	**0.91**	**0.43**
Factor B						
G_0	6.60	8.55	101.65	113.70	35.74(34.12)	35.71(34.06)
G_1	7.55	9.58	110.25	125.38	35.89(34.37)	35.93(34.43)
G_2	7.03	9.00	104.08	117.80	35.87(34.34)	36.16(34.82)
CD.(0.05)	0.15	0.16	1.48	2.31	NS	0.33
Interaction (factor A x factor B)						
F_1G_0	5.88	6.38	76.38	88.00	35.79(34.20)	34.35(31.84)
F_1G_1	6.50	7.63	81.63	105.75	36.22(34.91)	35.53(33.47)
F_1G_2	6.38	6.88	78.38	91.63	36.07(34.67)	35.76(34.15)
F_2G_0	6.88	9.63	109.63	112.88	35.13(33.12)	36.82(35.91)
F_2G_1	8.00	10.38	123.38	131.00	34.58(32.21)	36.87(36.00)
F_2G_2	7.38	10.00	112.13	118.88	35.44(33.62)	36.82(35.91)
F_3G_0	6.38	8.13	90.00	116.63	36.67(35.67)	35.19(33.21)
F_3G_1	6.88	9.13	100.50	121.63	36.47(35.34)	35.11(33.09)
F_3G_2	6.63	8.63	94.13	119.38	36.53(35.43)	35.92(34.42)
F_4G_0	7.38	10.25	122.75	125.38	36.09(34.70)	36.60(35.55)
F_4G_1	8.75	11.13	130.38	137.13	36.58(35.52)	36.71(35.73)
F_4G_2	7.88	10.50	124.75	130.13	36.18(34.85)	36.60(35.55)
F_5G_0	6.50	8.36	109.50	125.63	35.02(32.93)	35.55(33.80)
F_5G_1	7.63	9.63	115.38	131.38	35.60(33.89)	35.41(33.56)
F_5G_2	6.88	9.00	111.00	129.00	35.13(33.12)	35.72(34.08)
CD.(0.05)	0.32	NS	3.31	5.16	NS	0.74

Treatment	Number of nuts per palm per year		Weight of nut (g)		Weight of copra per nut (g)	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Factor A						
F_1	18.25	25.42	419.75	428.62	131.17	132.48
F_2	22.25	35.04	422.79	429.88	133.47	134.35
F_3	19.75	32.04	423.61	431.81	131.57	133.03
F_4	23.75	41.50	414.32	437.28	133.71	135.20
F_5	21.08	33.79	424.54	438.72	132.88	133.00
CD.(0.05)	0.81	0.59	4.85	3.95	1.62	1.65
Factor B						
G_0	20.20	31.93	417.13	429.95	132.06	133.07
G_1	22.05	35.65	424.74	435.70	133.07	134.08
G_2	20.80	33.10	421.14	434.14	132.55	133.68
CD.(0.05)	0.63	0.45	3.76	3.06	NS	NS
Interaction (Factor A x Factor B)						
F_1G_0	17.50	24.13	418.13	426.05	130.83	131.58
F_1G_1	19.38	26.75	420.25	429.68	131.53	132.46
F_1G_2	17.88	25.38	420.88	430.13	131.17	133.40
F_2G_0	21.00	32.75	416.75	427.08	133.60	135.05
F_2G_1	23.38	38.00	424.50	429.28	134.17	135.54
F_2G_2	22.38	34.38	427.13	433.30	132.64	132.46
F_3G_0	19.38	30.63	421.88	425.10	130.57	131.85
F_3G_1	20.13	33.63	428.00	435.63	132.77	134.20
F_3G_2	19.75	31.88	420.95	434.70	131.37	133.04
F_4G_0	22.63	39.75	406.78	432.48	134.35	135.18
F_4G_1	25.75	44.00	425.18	445.15	133.27	135.17
F_4G_2	22.88	40.75	411.00	434.23	133.53	135.27
F_5G_0	20.50	32.38	422.13	439.05	130.96	131.72
F_5G_1	21.63	35.88	425.75	438.75	133.63	133.04
F_5G_2	21.13	33.13	425.75	438.35	134.05	134.24
CD.(0.05)	NS	1.01	NS	NS	NS	NS

* Figures in parentheses represent corresponding angular values

Table 3. Effect of integrated nutrient management on N, P & K contents of coconut leaf in littoral sand

Treatment	N%		P%		K%	
	1997-98	1998-99	1997-98	1998-99	1997-98	1998-99
Factor A						
F_0	18.25	25.42	419.75	428.62	131.17	132.48
Factor A						
F_1	1.45	1.46	0.17	0.12	0.85	0.69
F_2	2.03	1.80	0.20	0.13	1.25	1.17
F_3	1.68	1.74	0.18	0.13	1.19	1.12
F_4	2.53	2.11	0.22	0.14	1.38	1.25
F_5	2.27	1.97	0.21	0.14	1.31	1.21
CD.(0.05)	**0.09**	**0.25**	**0.03**	**0.01**	**0.12**	**0.13**
Factor B						
G_1	1.67	1.56	0.18	0.12	1.08	0.96
G_2	2.13	2.00	0.20	0.14	1.29	1.21
G_3	2.17	1.89	0.20	0.14	1.23	1.10
CD.(0.05)	**0.07**	**0.19**	NS	**0.01**	**0.09**	**0.10**
Interaction (Factor A x Factor B)						
F_1G_1	1.26	1.30	0.15	0.11	0.72	0.54
F_1G_2	1.40	1.70	0.17	0.12	1.02	0.85
F_1G_3	1.68	1.39	0.18	0.14	0.82	0.67
F_2G_1	1.47	1.47	0.19	0.11	1.17	1.05
F_2G_2	2.38	2.05	0.21	0.12	1.32	1.28
F_2G_3	2.24	1.89	0.20	0.15	1.27	1.18
F_3G_1	1.40	1.51	0.16	0.12	1.02	0.96
F_3G_2	1.68	1.80	0.18	0.14	1.20	1.17
F_3G_3	1.96	1.91	0.20	0.12	1.35	1.23
F_4G_1	2.13	1.72	0.19	0.13	1.27	1.15
F_4G_2	2.80	2.50	0.24	0.15	1.51	1.40
F_4G_3	2.66	2.11	0.22	0.14	1.37	1.21
F_5G_1	2.10	1.80	0.20	0.12	1.20	1.10
F_5G_2	2.41	1.96	0.22	0.15	1.42	1.34
F_5G_3	2.30	2.15	0.21	0.13	1.32	1.19
CD.(0.05)	**0.16**	NS	NS	**0.02**	NS	NS

** Figures in parentheses represent corresponding angular values*

cowpea. The effect of interaction was, however, found to be statistically significant only during the second year of study. This kind of differential behaviour of the palm in respect of nut yield might be attributed to the cumulative effect of the integrated nutrient management of the basin area in due course.

In the present study, though the impact of the treatments tried, was not very conspicuous on the growth characters such as increase in plant height and girth of the palm, number of functional leaves per palm, was well reflected on the reproductive behaviour of the palms (Table 1 and 2). The rate of leaf production was significantly increased by the application of FYM along with chemical fertilization as well as by adoption of *in situ* green manuring with cowpea during both the years of study (Table 1). The results obtained in the present study are in line with the findings of Nambiar *et al., (1983)* and Nallathambi *et al.*,.(1988). Nallathambi *et al.* 1988 conducted an experiment on the effect of various organic manures with required quantity of chemical fertilisers on equal nutrient basis on the cultivar East Coast Tall at Veppankulum and observed that the treatment involving FYM and chemical fertilizers was superior to the remaining treatments and control except green manure treated palms for increasing the nut yield of coconut. The highest number of inflorescences and female flowers/ palm during both the years of study was recorded under the treatment F_4G_1. The study also revealed that the adoption of integrated nutrient management practices had very little impact on the weight of nut and copra yield per nut (Table 2).

Application of FYM along with NPK from inorganic sources and *in situ* green manuring with cowpea in littoral sandy soil considerably improved the soil pH, organic carbon content and ultimately the productivity status of the soil by making more of NPK available in

the soil. This in turn helped the palms in elevating the status of leaf NPK (Table 3) which ultimately influenced the reproductive behaviour of the palms under study, the reflection of which was well observed on the nut production. All these might have been possible only because of the gradual improvement in the status of the rhizosphere of palm basin and the quick response of the low yielding palms grown on the littoral sand which is unusually poor in its productivity status.

The findings of the present study could be well utilised by the coconut growers where the crop is being grown under the contemporary conditions to that of the experimental site. The impact of this kind of study could be more conspicuous in the long run.

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