



Studies on the influence of integrated nutrient management on growth and yield of young coconut palm

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Abstract

Integrated nutrient management includes the intelligent use of organic, inorganic and online biological resources (BNF) so as to sustain optimum yields, improve or maintain soil's chemical and physical properties and provide crop nutrition packages which are technically sound, economically attractive, practically feasible and environmentally safe.

An experiment was taken up during 1997 to 2006 on coconut seedlings (var-ECT) in AICRP on Palms plantation at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia. The coconut palms were spaced at 7.5m x 7.5m with the treatment T₁-Control, T₂-Recommended chemical fertilizers (500:320:1200g NPK/palm/year), T₃-100% N as Composted coir pith +balance P&K as chemical fertilizer, T₄-50% N as CCP + balance NPK as chemical fertilizer and T₅-Neem cake + Bone meal + Ash (on equivalent nutrient basis) in RBD with 4 replications. The average growth and yield parameters of last five years are statistically analyzed. Application of recommended chemical fertilizer registered maximum height (61.2 cm) and number of leaves (13.8) per palm followed by 58.25cm height and 13.12 number of leaves in T₄ 50% CCP+50% chemical fertilizer. Palms under control recorded lowest height (50.5cm) and number of leaves (11.3). Maximum number of nuts/palm /year (32.15) was recorded

under recommended dose of chemical fertilizers. Though growth and yield parameters were marginally superior at the treatment T₂ *ie.* Recommended chemical fertilizers. The NPK contents of both leaf and soil under different treatments increased over the initial status indicating beneficial effect of integrated nutrient management. Hence it can be recommended for integrated nutrient management with 50% CCP+50% chemical fertilizer for sustainable productivity in coconut in the long run.

Introduction

Integrated nutrient management includes the intelligent use of organic, inorganic and online biological resources (BNF) so as to sustain optimum yields, improve or maintain soil's chemical and physical properties and provide crop nutrition packages which are technically sound, economically attractive, practically feasible and environmentally safe (Tandon, 1990). Agriculture has been traditionally organic base dependent. However, for meeting the growing demand of mankind for food and raw materials for industry, use of

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synthetic fertilizers and plant protection chemicals made an entry in the production scenario since the middle of the last century. The constant and many times indiscriminate use of the hazardous chemicals has adversely affected the food chain, environment and health of humanity. Organic horticulture is a farming system of raising horticultural crops and/or producing food and food products with a commitment to respect biological and ecological processes. The concept covers the socio-economic aspects of agriculture leading to the production of zero-defect horticultural produce for consumption. Organic farming system avoids genetically Modified Organisms (GMO) products thereof, the use of synthetic harmful fertilizers, pesticides, growth hormones/regulators irradiation, antibiotics, food additives and harmful inorganic chemicals. The techniques in OA lies in the adoption of good agricultural practices (GAP), crop rotations, use of green manures/green leaf manures, composts/vermicompost, animal manures, de-oil cakes, bio-fertilizers, wood ash etc. Eco-friendly plant nutrient management system and plant protection measures are mandatory in organic farming.

Coconut (*Cocos nucifera* L.) is one of the most beautiful and useful palms in the world which under suitable condition yields fruit almost at monthly interval throughout its long span of life. The coconut palm rightly eulogised as *Kalpavriksha* or 'Tree of heaven', yields more products of use to the human race than any other tree of God's creations. It provides not only edible

products but also fuel, shelter, medicine and employment to the millions of people in the tropics, playing vital role in the socio-economic condition of India. Coconut per se produces large quantities (approximately 11.2 million tones, Biddappa *et. al.* 1996) of biomass viz. husk, dried leaves, besides coir dust from de-fibering industries and biomass from component crops etc. that can be effectively recycled back into the system to reduce the nutrient requirement of the crop through chemical fertilizers. The recycling of the coconut waste will add 0.79, 0.076 and 0.49 million tonnes of N, P₂O₅ and K₂O respectively (Nair *et. al.* 1996). Central Plantation Crops Research Institute perfected the technology of composting of coconut wastes in cement tanks using earthworm (Prabhu *et. al.*, 1998).

Improved agro techniques including balance supply of nutrient is essential for good growth and attaining potential yield of the crop. The constraints in productivity of coconut gardens will continue to remain and shall be the major issue to be addressed in the years to come (Nampoothiri and Khan, 2002). Nutrient management assumes significance due to the fact that coconut and component crops in the system requires continuous supply of nutrients throughout their life period for higher productivity. In sustainable agriculture, the integrated nutrient management, which lays emphasis on improving and maintaining soil fertility for sustained productivity, forms one of its crucial pillars (Khan *et al.*, 2000). Considering these the present

investigation was undertaken to study the effect of different organic manures on the growth and yield of coconut. The objective of this experiment is to evolve appropriate technology to supplement chemical fertilizers with organics as a source of nutrients.

Materials and methods

An experiment was taken up during 1997 to 2006 on coconut seedlings (var-ECT) in AICRP on Palms Plantation at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia. The coconut palms were spaced at 7.5m x 7.5m with the treatment T₁-Control, T₂-Recommended chemical fertilizers (500:320:1200gNPK/palm/year), T₃-100%N as Composted coir pith +balance P&K as chemical fertilizer, T₄-50%N as CCP + balance NPK as chemical fertilizer and T₅-Neem cake + Bone meal + Ash (on equivalent nutrient basis) in RBD with 4 replications. The average growth and yield parameters of last five years are statistically analyzed. Number of leaves produced per palm was counted twice in a year at six months interval, through addition of scar marks and number of leaves in the palm. Numbers of nut per bunch were counted during harvesting and total nuts produced in a year was worked out. The soil samples were collected by core auger from coconut basins at a depth of 0-25 cm. The leaf samples were collected from the index leaf before initiation and after completion of the experiment. The samples were analysed for nitrogen, phosphorus and potassium.

Results and discussion

Growth and yield of coconut

Variations with respect to plant height, annual leaf production, bunch and nut production were recorded under different treatment (Table 1). Application of recommended chemical fertilizer registered maximum height (61.25 cm) and number of leaves (13.87) per palm followed by 58.25cm height and 13.12 number of leaves in T₄ ie 50% N form CCP+rest NPK from chemical fertilizer. Palms under control recorded lowest height (50.57cm). Plant girth recorded maximum 110.3 cm in recommended chemical fertilizer doze followed by 100.1 cm in 50% N as CCP + rest NPK as chemical fertilizer doze. Number of leaves (13.12) in 50%N as CCP + rest NPK as chemical fertilizer doze.

Table 1. Mean growth and yield characters of coconut

Treatments	Height (cm)	Girth(cm)	Number of leaves/palm	Nut yield / palm /year
T ₁ (CONTROL)	50.57	85.2	11.32	19.32
T ₂ (Recommended chemical fertilizers)	61.25	110.3	13.87	32.15
T ₃ (100%NasCCP+rest P&K as chemical fertilizer)	52.92	90.1	12.87	26.57
T ₄ (50%NasCCP+restNPK as chemical fertilizer)	58.25	100.1	13.12	29.43
T ₅ (Neemcake+bone meal+ ash on equivalent nutrient basis)	53.62	94.9	12.41	23.42
S Em	0.509	0.943	0.319	0.769
C.D.	1.66	3.07	1.04	2.508

Maximum number of nuts/palm / year (32.15) was recorded under recommended dose of chemical fertilizers followed by 29.43 in T₄ treatment. Growth and yield parameters were marginally superior at the treatment T₂ ie. Recommended chemical fertilizers over T₄ 50% Nas CCP+rest NPK as chemical fertilizer

but integrated nutrient management with 50% CCP + rest NPK as chemical fertilizer is more beneficial for sustainable productivity in coconut in the long run. The NPK contents of both leaf and soil under different treatments increased over the initial status indicating beneficial effect of integrated nutrient management.

Impact of cropping system on leaf and soil nutrient status

The nutrient content of leaf of coconut was higher as compared to the initial status of the leaf (Table 2). The leaf N contents were maximum in plants (2.36%) under T₂ followed by 2.31% in T₅. The leaf P contents were maximum in plants (0.26%) under T₂ followed by 0.24% in T₅. K contents were maximum in plants (2.06%,) under T₂ followed by T₄. These findings

suggest the beneficial effect of INM in improving the soil physical, chemical and biological environment which favoured the higher uptake from the nutrients pool in the soil. The nut yield also increased concomitant with improved nutritional status of the palms and improvement in the soil nutrient availability status. Plant nutrient status of the soil from the coconut plantation under different treatments is given in Table 3. Total nitrogen content at 0–25 cm depth (0.119%, was maximum under T₂. The maximum available potassium contents were 151.6 ppm under T₂. The minimum values for the nitrogen, phosphorus and potassium at 0–25 cm depth were observed in control . The NPK contents under different treatments increased over the initial status.

Balance nutrition of the palms is one of the priority areas to be addressed in sustaining productivity. Plants should be provided with the correct balance of nutrients to increase crop yield, quality, farm income and productivity besides a safe guard from succumbing to diseases. Balanced fertilization is not just use of NPK alone but a combination of micronutrient use as well and use of organics as available. Young transplanted seedlings require adequate nutrients for better growth on all soils. With a very

Table 2. Leaf nutrient status of coconut under different nutrient management

Treatments	Percent dry weight					
	Pre-experiment			Post-experiment		
	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium
T ₁	1.91	0.16	1.82	2.01	0.20	1.87
T ₂	1.88	0.17	1.75	2.36	0.26	2.08
T ₃	1.93	0.19	1.72	2.28	0.23	1.96
T ₄	1.86	0.19	1.76	2.23	0.24	2.08
T ₅	1.98	0.19	1.70	2.31	0.23	1.89

Table 3. Soil nutrient status under different nutrient management practices

Treatments	Pre-experiment			Post-experiment		
	Nitrogen (%)	Phosphorus (ppm)	Potassium (ppm)	Nitrogen (%)	Phosphorus (ppm)	Potassium (ppm)
T ₁	0.087	58.3	116.6	0.091	60.4	119.6
T ₂	0.91	56.6	114.8	0.119	64.4	151.6
T ₃	0.084	63.4	115.2	0.115	79.2	145.4
T ₄	0.087	58.3	118.5	0.112	73.4	144.7
T ₅	0.086	57.2	114.7	0.110	62.3	128.2

active root system, they respond well to manuring, grow better and start bearing early. An enhanced rate of leaf production leading to larger number of leaves on the crown results in larger total leaf area, which may probably increase building up of adequate carbohydrate reserves in the stem. Since there is a correlation between chlorophyll content in the leaves, rate of apparent photosynthesis and annual yield, our efforts should be such that the vegetative phase is completed early managed by a good balanced nutrition.

Nelliath (1972) cited an interesting observation on the necessity to provide a balance nutrition to young palms from the time of planting in the main field. Since palms of the tall variety usually flower in about 5 years and as response to fertilizer in terms of yield of nuts is obtained only after 2 years of fertilizer application. The most important nutrient reservoir in soil is organic matter. Microbial biomass was high in the system where organic recycling is practical (Khan and Upadhyay 2002).

In the nutritional management of palms, an understanding of the nutrient removal by the palms, its partition to various parts etc will serve as a guide for approximating the quantity of nutrients and the

proportion in which they are to be applied. Coconut palm produces fronds and nuts throughout the year and hence demands continuous supply of nutrients from the soil. The necessity and importance of Integrated Nutrient Management (INM) is well conceived. INM practices play an important role in guiding a balanced nutrition to a crop by conserving the nutrients and improving the biodiversity of the soil. The coconut system offers excellent scope for INM practices in view of the biomass generated with in the system (Biddappa *et al.*, 1996; Hamed Khan, 2004). Thomas *et al.*, (2006) compiled the information on low cost technologies for sustainable coconut cultivation mostly employing organic resources available in the coconut growing system. Rethinam *et al.*, (1991) reported that integrated management increased the nut yield from 28 to 51 nuts per palm per year within 3 years in mildly affected area and 23.4 nuts per palm per year on an average in disease affected area. Integrated nutrient management practices coupled with growing intercrops in root (wilt) affected garden resulted in the improvement in growth of palms with reduction in the root (wilt) symptoms (Maheshwarappa *et al.*, 2003). Integrated nutrient management in fact is an integral part of coconut

based cropping system. While the main and component crops receive inorganic nutrients based on individual crop requirements, the organic addition brought through leaf litter recycling, nutrient addition through stem flow, through fall etc., lead to complementary interactions and biological activity bringing in all benefits of integrated nutrient management on productivity. A number of studies on response of coconut palms to fertilizer applications have shown poor bearers exhibiting greater response and the palms with nut yields exceeding 60 nut per year showing least/no response. Hence it can be recommended for integrated nutrient management with 50%N as CCP + rest NPK as chemical fertilizer for sustainable productivity in coconut in the long run.

References

- Bidappa, C.C., Upadhyay, A.K., Hegde, M.R. and Palaniswamy, C. 1996. Organic matter recycling in plantation crops. *J. Plantn Crops* 24(2): 71-85.
- Hamed Khan, H. 1993. Fertilizer management in Coconut. In: Tandon, H.L.S (Ed). 1993. *Fertilizer Management in Commercial Crops*. Fertilizer Development and Consultation Organisation, New Delhi, viii.
- Hameed Khan H, Upadhyay A.K. and Palaniswami C 2000 Integrated Nutrient Management of Plantation Crops. In plantation Crop Res. & Dev. Proc. Placrosym XIV, CDB Kochi pp 9-22.
- Hamed Khan, H. and Upadhyay A K 2002. Integrated Nutrient Management in coconut based cropping farming system for sustained productivity. In: *Strategic agenda to make coconut industry globally competitive*. Proc of the XXXIX COCOTECH Meeting. 1-5 July 2002, Pattaya, Thailand.
- Maheshwarappa, H.P., Anitha Kumari, P., Kamalakshi Amma, P.G. and Shanawas,

M. 2003. Influence of integrated nutrient management and high density multispecies cropping system on soil properties, plant nutrition and yield in root (wilt) affected coconut palms. *CORD*, 2003.

Nampoothiri, K.U.K and Hameed Khan, H. 2002. *Towards sustainable coconut production*. In: *Souvenir, XXXVII COCOTECH meeting, International Coconut Conference, July 2004, Chennai, India, Pp1-7.*

Nelliath E. V. 1973. NPK nutrition of coconut - A review, *J Plantation crops Suppl.*(70-80).

Rethinam, P.Antony, K.J. and Muralidharan, A.1991. Management of coconut root (wilt) disease. Abstract of papers,pp.60. Second International Symposium of Coconut Research and Development. CPCRI, Kasaragod, India.

Thomas, V. George., Krishana Kumar, V., Dhanpal, R., Murali Gopal, and Alka Gupta, 2006. *Production technology for sustainable coconut cultivation*. Indian Cocon. J.37 (2): 2-9.

Prabhu, S. R., Subramanian, P., Biddappa, C.C. and Bopaiah, B. M. 1998. *Prospects of improving coconut productivity through vermicomposting*

technology. Indian coconut J. Aug. 1998: 79-84.

Tandon, H. L. S. 1990. Integrated nutrient management for sustainable agriculture. In: *Proceedings of the International Symposium on Natural Resources Management for a Sustainable Agriculture* (Ed. R.P. Singh). Vol. 1., 6th -10th February, 1990, New Delhi, pp 203-222.

Thomas, G.V., Prabhu, S.R., Subramanian, P and Rohini Iyer. 2001. *Organic farming technologies for coconut*. Central Plantation Crops Research Institute, Kasaragod, 14 p.

COCONUT SPECIALS OF GUJARAT

BHUNNA KHICHDI

Ingredients:

Coconut	- 2 cups
Basmati rice	- 2 cups
Moongdal	- one cup
Green peas(fresh)	- half cup
Cumin paste	- one tsp
Ginger paste	- one tsp
Red chilli paste	- half tsp
Turmeric powder	- one tsp
Garam masala	- one tsp
Whole cumin seeds	- half tsp
Ghee	- one tsp
Salt	- to taste
Oil	- 2 tbsp
Bay leaf	- 2 No.s
Cardamom	- 3 No.s
Sugar	- a pinch

Method : Dry roast the moongdal and keep aside. Wash and dry the rice. Add 3/4th cardamom and keep aside. Heat oil in a pan, add the bay leaves and whole cumin. When they start to splutter, add the ginger, cumin and chilli paste and fry well for a while. Add the rice and fry more. Add dal, no need to fry as dal has already been dry roasted. Mix well and add enough water to cook. THE dal MAY remain a little dry and not over cooked. Adjust water accordingly. Now add fresh peas. To this add 2 tsp of coconut, cut into julienne and fry in oil, so that they turn brownish. The rest of the coconut should be finely grated and added as well. Add seasoning, salt and sugar. Keep it covered on low heat for a while, adjusting the water from time to time. Add the rest from the cardamom. This dish has a pulao consistency. Before taking off the flame, add the ghee and garam masala paste.. Garnish with green chillies. Serve with pickle.

PINE APPLE RICE

Ingredients:

For the rice :	
Coconut milk	- 6 tbsp
Basmati rice	- 500 gms
Ghee	- 2 tbsp
Bay leaves	- 2
Rose water	- one tbsp
Cinnamon	- 4 sticks
Clove	- 10
Cardamom	- 2 small
Raisin, Cashew nuts	- 5 each
Saffron	- 2 strands
For the syrup:	
Pine apple	- one medium size
Sugar	- 300 gms
Cinnamon	- 4" stick
Clove	- 3
Saffron	- 2 strands
Lime	- 2
Garam masala	- for flavour

Method: Cut the pineapple into small cubes and steam. Keep aside. Prepare a syrup with sugar in one and a half cup of water adding garam masala., saffron, and juice of lime. Add the pineapple pieces. Take it from the flame when considerably thickened, set it to cool. In a large pot, heat ghee, bay leaves, whole garam masala, when they start to crackle, add the rice. Cook for about 3-4 minutes. Add coconut milk. Stir around the rice. Now add the syrups-about 3/4th cup and turn around the rice once again cook for about ten minutes in low heat. Just before taking it off the fire, add raisin, cashews and saffron. Mix well and keep covered till all the water is evaporated. Finally, arrange the rice over a dish and decorate with the cut pineapple pieces. You can add some more garam masala and sprinkle drops of rose water.

-Indu Narayan