

A REVIEW OF COCONUT RESEARCH & DEVELOPMENT

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INTRODUCTION

By looking at the titles of articles published in CORD since it began, in 1985, it should be possible to assess what areas of coconut research and development are important. This is so, because CORD is intended for a select group of readers - those who know about coconuts. The writers of articles for CORD, unlike authors of articles in specialist scientific or economic journals, do not have to compete for space with reports on the cutting-edge of science or with predictions about world-market economic forces. Which is a pity, because if they did it would mean that coconut was back in the position of the world's leading source of vegetable oil that it held for half a century. There are other technical and scientific journals, as well as national language publications, to which coconut R&D specialist can, and do, submit articles, but CORD is the one location where both the writer and the reader should be on the same wavelength.

For the purposes of this review the titles have been grouped into sub-sets to give some idea of the relative degree of interest or apparent importance of different topics (assuming that the title reflects the content accurately). It is also unavoidable that some titles might be placed into more than one category. For example "Genetic & seasonal variation in coconut production" is either agronomy or breeding. The present review reflects this author's prejudices. Other readers can make their own groupings from the lists of titles contained in the tables that follow. Within each sub-set the articles are listed chronologically and the authors' names, the volume, issue number and year of publication are also given. It is hoped that this will help and encourage new readers to find earlier articles which they may not have seen.

TABLE 1: Sub-group topics & number of articles per sub-group.

Topic	Number of articles
Germplasm, hybrids and breeding	18
Marketing & economics (including "health")	15
Agronomy, fertilizer	15
Agronomy, general	14
Processing (except timber)	13
Diseases(excluding physiological conditions)	13
Pests (including weeds)	12
Timber	12
Technology & biotechnology	8
General research & development	7
Smallholders	5
Extension & training	1

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There have been twenty-nine issues of *CORD* (one in 1985 and two every year thereafter) with 132 articles, two book reviews - one on "How To Process Coconut Palm Wood" (V (1)1989), the other on "Coconut Cultivation" (VIII (1) 1992) - and an editorial introduction to one of the special numbers. There have been three such special numbers; one devoted to the Pacific (III (2)1987), accounting for five of the twelve articles that have come from that region; one on Palm Wood Utilization (V (1) 1989), with six out of eleven papers on that subject); and one celebrating the Platinum Jubilee of Coconut Research and Development in India (VII (2) 1991) with just six of thirty-four articles from that sub-continent.

Not unexpectedly, most of the articles concern the main coconut producing countries (Philippines 32 & Indonesia 17) or come from countries with strong coconut research capabilities (India 34 & Sri Lanka 21). Some articles come from authors based in developed countries (Australia 2, France 1 & UK 8) but Africa is hardly represented (2) and nothing at all has come from the American continent. The General Editor, Dr Punchihewa, explains that "Outside the APCC region, we have regular subscribers from a number of countries including Nicaragua, Costa Rica, Brazil. We also have some from China and USA. Except for invitation for contribution on special edition of the journal, APCC does not undertake formal soliciting of articles. So researchers/research institutes are free to submit articles and as a policy, their suitability for publication is subject to the approval of the Board of Editorial Consultants. But the recent provision for other coconut producing countries outside the region to become associate members of the APCC, might pave the way for more contributions from these parts of the world".

TABLE 2 Germplasm, hybrids and breeding

Proposals for international cooperation in the collection of planting material and in comparative trials of coconut hybrid (de Nucé de Lamothe & Le Saint, 1(1)1985)

Early yield performance of hybrids in Western Samoa (Mendoza & Efu, III (2) 1987)

Coconut seed gardens: a review (Liyanage, IV (1)1988)

Coconut bisexual flowers & their significance for hybrid seed gardens (Davis et al, IV (1)1988)

Short term in-vitro preservation of coconut seed material: a method to facilitate field collection and transport of coconut germplasm (Karunaratne, IV(2) 1988)

Flowering and yield characteristics of macapuno-bearing dwarf x tall coconut hybrids (Nunez & de Paz, VI(1) 1990)

Thinking about coconut breeding programmes (Harries, VI(2) 1990)

Impact of prepotency and hybrid vigour in coconut productivity (Nampoothiri, VII (2) 1991)

Coconut genetic resources (Nair, VIII(1) 1992)

Hermaphroditism in coconut collections of VisCA Leyte, Philippines (Nunez, X(1) 1994)

Variability of some mechanical properties of San Ramon Tall variety of coconut (Palomar, X(1) 1994)

Development of Khina series coconut varieties in Indonesia (Liyanage, X(2) 1994)

Xenia effect & hybrid vigour in coconuts (Satyabalan, XI (1) 1995)

Comparative investment analysis of recommended coconut hybrids/ cultivars for the national planting/ replanting programme in the Philippines (Santos et al, XI (2) 1995)

Dikiri-Pol: fallacies, facts and the future (Perries, XI (2) 1995)

King coconut (Ediriweera, XII (2) 1996)

*Evaluation of genotypes arising from F2 generation segregations in dwarf x tall crosses of *Cocos nucifera* by (Fernando & Perera, XIII (2) 1997)*

Toddy production models of PB-121 & Khina-1 coconut hybrids (Rumokoi & Akuba, XIV (2) 1998)

Germplasm, hybrids and breeding often seem to generate most interest, perhaps because there is always a hope that new varieties will overcome pests, diseases and economic constraints. So it is not surprising that hybrids account for half of the titles in this sub-set; there are papers on Khina hybrids, PB-121 and macapuno hybrids. Yet, despite the early interest in international cooperation in hybrid testing and a subsequent article on coconut genetic resources, there is nothing about the establishment of the Coconut Genetic Resources Network (COGENT) or of the results of COGENT's efforts to carry out multi-location variety trials. Also, despite articles about well-known varieties such as the San Ramon, Dikiri-Pol and King coconut it is disappointing that none of the COGENT participants have informed CORD readers about the progress in setting up international or regional germplasm collections. A recent spate of glossy covered IPGRI documents and the announcement that a COGENT newsletter has been produced (six years after COGENT was established) may signal more open information from that group but is hardly likely to increase the number of articles submitted to CORD with information about the practical results of COGENT activities.

TABLE 3 marketing & economics (including "health")

Coconut marketing issues for a threatened industry (Bastin, II (2) 1986)

Export floor prices in coconut products, Sri Lanka experience (Maligaspe, II (2) 1986)

An economic analysis of government intervention measures in the coconut industry in Sri Lanka (de Silva, I(1) 1985)

Production response to prices in the coconut industry of Papua New Guinea (de Silva et al, III (2) 1987)

The coconut industry - Solomon Islands (Smith, III (2) 1987)

Aspects of copra production & marketing in Vanuatu (Fowler, III (2) 1987)

Production response to prices in the coconut industry of Papua New Guinea: a comment on the methodology & re-estimation (Gunawardana, IV (1) 1988)

A policy perspective on coconut processing in the South Pacific islands (Etherington, IV (2) 1988)

Coconut production in Seychelles (Fowler, IV (2) 1988)

World market conditions government policy and the coconut industry in the Philippines (Hyman, VI (I) 1990)

Price behaviour in India's coconut sector (Das, VII (1) 1991)

The economics of coconut replanting & associated cropping in Fiji (Muma, VIII (1) 1992)

Prospects for the expansion of the world market for desiccated coconut (Hone et al, VIII (2) 1992)

Health hazards of coconut oil - a myth or reality? (Champakan, VIII (2) 1992)

With CAP reforms and GATT: greater market access for coconut products (Regalado, X (2) 1994)

As might be expected, from APCC's strong economic approach to coconut R&D, marketing and economics are also well represented, with fifteen articles. An article on "health" aspects is included in this set because the attack on "tropical oils" was caused by economic pressures from soybean growers in the USA. It is unfortunate that the title of that paper puts such a negative tone on the subject. Likewise, the very first title in this sub-set, "issues for a threatened industry" also strikes a defeatist note. Perhaps this is because economics is known as the "dismal science". The last paper in this sub-set did have a more positive title, but it is dated 1994. Perhaps it is time for another article on marketing and economics that can help encourage more positive attitudes.

TABLE 4 Agronomy, fertilizer

Soil properties & nutrient element status of coconut leaves under different cropping patterns (Tarigan, IV (1)1988)

Detailed analysis of 30 fertilizer demonstrations in Southern Thailand (Dootson, VI (1)1990)

The chlorine needs of coconuts (Magat & Margate, VI (1)1990)

Development of computerized fertilizer recommendation for coconut (based on foliar analysis) using Lotus 123 software package system (Margate, PCA VIII (1) 1992)

Residual effect of sodium chloride (common salt) fertilizers on yield and leaf nutrients of coconuts grown on an island soil of Davao (Magat et al, VIII (2) 1992)

Effects of organic and inorganic nitrogen on the productivity of coconut grown on three important soil types in Leyte, Philippines (Baliad, IX (1) 1993)

Biomass production & nodulation of green manure legumes in coconut basins in laterite soil and their influence on soil fertility (Thomas & Shantaram, IX (1) 1993)

Beneficial microorganisms in the root region soils of coconut palm under different cropping systems - a review (Bopaiah, X (1) 1994)

Diagnosis & recommendation integrated system (IDRIS) a better approach to coconut nutrition (Mathewkutty & Tajuddin, XII (1) 1996)

Crop fertilizer use efficiency analysis (CFE): a tool in identifying appropriate planting materials of coconut in different agro-climatic conditions (Magat XII (2) 1996)

Integrated soil fertility management of hybrid coconut grown in different agro-climatic conditions of the Philippines (Margate, XIII (1) 1997)

Net N mineralization in coconut/ nitrogen fixing tree based system (Tannakoon & Liyanage, XIII (1) 1997

Response of coconut and coffee to fertilizers applied on either or both crops in an intercropping system (Margate, X (2) 1994)

A review of fertilizer trials in Tuvalu & Kiribati (Trewen, X (2) 1994)

Coconut yield improvement in farmers' fields through research-based fertilization management in the Philippines (Magat, XIII (2) 1997)

Agronomy covers all aspects of the cultivation of the crop but it is split into two sub-sets here because far and away the most numerous articles are those on fertilizer use. Or, that is to say, on fertilizer recommendations. Perhaps this is because purchasing and applying fertilizer is the greatest costs a coconut farmer has to meet. In an age of "organic farming", when the use of artificial fertilizer is sometimes frowned upon (by those who have access to sophisticated marketing and distribution systems), how closely are the fertilizer recommendations followed by farmers? Coconut is reputed to grow best where it hears the sound of the human voice and in any crop it is well known that the best fertilizer is the farmer's foot. Is so much research still needed into fertilizer use on coconuts?

TABLE 5 Agronomy, general

Variations in the field of coconuts, as influenced by the pattern of rainfall and duration of dry spell (Mathew et al, IV (2) 1988)

Water in tidal swampy areas for coconut cultivation (Sutarta, VI (2) 1990)

Physiological & biochemical bases of coconut production (Rajagopal et al, VII (2) 1991)

Drought management of coconut holdings (Liyanage, IX (2) 1993)

Sequential coconut toddy (sap) and nut production (Imaravilla & Magat, IX (2) 1993)

Management of tapering disorder in coconut (Thirumalaiswamy et al, X (1) 1994)

Response of coconut to increasing levels of leaf pruning and its implementation on farm productivity (Magat, X (2) 1994)

Coconut tapping in the Philippines: enigmas & observations (Santiago & Virtudazo, XII (1) 1996)

The spacing requirement of coconut on atolls: results from four systematic spacing trials in Kiribati (Barr & Trewen XII (1) 1996)

Effect of weather factors on coconut & copra production in Kerala, India (Satyabalan, XIII (1) 1997)

Water relation, gas exchange & dry matter production of coconut (Cocos nucifera L) under unirrigated and irrigated conditions (Bai et al, XIII (2) 1997)

An evaluation of different mulches used in soil moisture conservation of coconut lands (Arachchi, XIV (2) 1998)

Genetic & seasonal variation in coconut production (Satyabalan, XIV (2) 1998)

The remaining, general, agronomy titles tend to confirm that coconut is grown in difficult locations and that weather, over which there is not much control, is the limiting factor. Manipulations of the factors that are under the farmer's control, from intercropping to toddy tapping, are well represented in CORD articles.

TABLE 6 Processing (except timber)

A technical & economic evaluation of a small-scale coconut oil expeller operation in the Cook Islands (Barrett et al, III (2) 1987)

Fresh & preserved coconut milk (Hagenmaier, IV (1) 1988)

Rubberized coir industry: an introduction (Mathew, IV (1) 1988)

The batch carbonization of coconut shell with waste heat recovery (Breag et al, V (2) 1989)

Village-level energy utilization of copra production by products in Eastern Visayas (Sudaria, V (2) 1989)

Production of coconut oil directly from fresh coconut meat using the waste heat recovery technology: a new oil process (Breag et al, VII (1) 1991)

Coconut products and their diversification - Indian experience (Thampan, VII (2) 1991)

Processing of coir: a biological approach to retting of coconut husks (Ravindranath, VII (2) 1991)

Three improved methods for coconut oil extraction (Suhardiyono et al, IX (1) 1993)

Design and development of semi-direct type copra dryer (Sudaria, IX (1) 1993)

Quasi-static mechanical properties of coconut shell of dehusked mature nuts (Sudaria, X (1) 1994)

Some relationships associated with the brown fibre industry of Sri Lanka (Ratnayake, XI (1) 1995)

Bio-inoculants for coir retting (Ravindranath & Sarma, XI (1) 1995)

Processing is the most important aspect of the coconut industry because, without proper processing there is virtually no industry. The thirteen papers on processing (excluding timber) represent 10% of all titles and cover many areas, regions and countries. Desiccated coconut is not included (although this does appear in the marketing sub-section). Value added products, and non-traditional processing need full discussion and CORD is the best forum to present such information.

TABLE 7 Diseases (excluding physiological conditions)

The effects of stem bleeding disease on the flowering & fruit setting of coconut hybrid PB-121 (Brahmana, II (2) 1986)

Important diseases of coconut in India (Nambiar & Iyer, IV (2) 1988)

Bud-rot disease on PB-121 coconut at Bangun Purba PTP VI, North Sumatra (Brahmana & Kelana, IV (2) 1988)

Identification of root (wilt) diseased coconut palms before visual symptom expression (Rajagoval et al, V (2) 1989)

An improved method for isolation of Theilaviopsis paradoxa from stem bleeding affected coconut palms (Kumar et al, VII (1) 1991)

Current status of research on the stem bleeding of coconut in India (Nambiar & Iyer, VII (2) 1991)

Uptake, translocation and persistence of carbendazim in coconut in relation to control of stem bleeding disease (Kuman et al, VIII (2) 1992)

Biological controls of basal stem rot disease (Bhaskaran et al, IX (1) 1993)

Identification of Colletorichum gloeosporioides, Exserohilum rostratum and Gliocladium vermoeseni associated with leaf rot disease of coconut in India (Srinivasan, X (1) 1994)

New record of Cochliobos hawaiiensis Alcron associated with button shedding and premature nutfall in India (Karthikeyan & Bhaskaran, XII (1) 1996)

Field control of leaf rot disease of coconut with fungicides (Srinivasan & Gunasekaran, XII (2) 1996)

Host resistance in coconut leaves against leaf blight disease caused by Pestalotiopsis palmarum (Cooke) Stey (Karthikeyan & Bhaskaran, XIII (2) 1997)

On the common origin in Southeast Asia of phytoplasma associated diseases of coconut (Harries XIV (1) 1998)

Diseases are an obvious area for publication of information as there are always new diseases or new outbreaks and, hopefully, new control measures. Physiological conditions such as stem tapering are excluded in this sub-group but it must be admitted that many diseases might be less severe if the coconuts were not growing under stress situations caused by drought, high temperature or poor soil. The emphasis is on fungal and foliar diseases and on stem rot, rather than on viruses or viroids. Only the last paper listed touches on the huge area of research into lethal yellowing type diseases in America and Africa. The recent identification of phytoplasma in Southeast Asia is not unexpected, since that is where resistant varieties are also found.

TABLE 8 Pests (including weeds)

Pest problems of coconut hybrid production in Indonesia with special reference to SCDP (Benigno, I(1)1985)

Root absorption as a method of introducing insecticides into coconut palms for the control of leaf-feeding caterpillars (Ginting & de Chenon, III (1)1987)

Weed control - understory weed management in coconut lands (Liyanage, VIII (1) 1992)

Biology and mass rearing of Eucanthecona firucellata Wolf (Hemiptera: Pentatomidae) a potential polyphagous predator and its effect on field population of white slug caterpillar, Parasa philepida in Cababaram Agusan del Norte, Philippines (Gallego et al, IX (1) 1993)
Neem products against coconut insect pests (Sadakathulla, IX (2) 1993)

Studies on Hidari irava leaf consumption in relation to warning system in the control of coconut pest (Baringbing, IX(2) 1993)

Studies on host preference of Parasa lepida on some cultivars of hybrid coconut in swampy area (Baringbing, X (2) 1994)

The distribution, importance, biology and control of Chromolaena odorata (L.) K&R a major weed species of coconut plantation in Sri Lanka (Gunasekara, XI (2) 1995)

Effects of environment condition on the population of Brontispa longissima Gestro and its predator Chelisoche spp, in North Lampung (Barimbing & Baringbing, XII (2) 1996)

Studies on Chelonus sp the parasite of the coconut moth Batrachedra arenosella Walker (Baringbing, XIII (1) 1997)

Biotypical variability among four populations of red palm weevil Rhynchophorus ferrugineus Fab/Oliv. from different parts of India (Ramachandran, XIV (1) 1998)

Studies on pests in four coconut cultivars in Lampung Province, Indonesia (Baringbing XIV (1) 1998)

Pests (including weeds) are also an area where many publications are generated but there are areas of interest that have yet to be mentioned in CORD - the red ring nematode and the phytomonas flagellate in America, the fascinating interaction between ants and the Pseudotheraptus fruit bug in east Africa, the continuing spread of the Eriophyes fruit mite. These are American and African problems which is perhaps why they do not feature in CORD. The recent movement of Eriophyes into Sri Lanka shows that pests and diseases know no boundaries and, like coconut itself, can be reported in most parts of the (tropical) world.

TABLE 9 Timbers

Preservation of sawn coconut timber by boron diffusion treatment (Palomar, II (1)1986)

Marine exposure tests of coconut timber (Palomar, III (1)1987)

Machining properties of coconut palm wood (Juson, III (1)1987)

Evaluation of some chemicals for the control of blue stain fungus and pinhole borer on freshly-sawn coconut timber (Palomar, V (1)1989)

The production & properties of coconut stem charcoal in Thailand (Dootson et al, V (1)1989)

Coconut stems utilization in Indonesia (Sumardjan, V (1) 1989)

Coconut stems utilization in Sri Lanka (Mahindapala, V (1)1989)

Design & development of coconut palm roof shingles (Siriban & Gosmundo, V (1)1989)

Exposure tests of surface treated sawn coconut timber (Palomar et al, V (1)1989)

Performance of coconut timber under field & service conditions (Palomar & Sulk, VI (1)1990)

Roof & side wall shingles from coconut palm wood (Sulk, VI (2) 1990)

Coconut processing, is often thought only to cover what is done the fruit after harvesting. Coconut timber utilisation is part of processing and is only separated here because it provided a substantial number of papers to CORD, mainly in the special number. When properly carried out, harvesting the entire palm to use the stem for timber (and the crown for "millionaire's salad) can be also a way to remove under-productive, over-aged palms. Legislation that attempts to set limits to the felling of coconut palms might be counter-productive if it does not allow for, and even encourage, intelligent removal. This becomes an issue of sustainability if, by putting some of the money generated from felling back into the crop, suitable areas can be replanted with improved material.

TABLE 10 Technology & biotechnology

Low cost technology for the development of coconut smallholders (Liyanage, II (1)1986)

The microcomputer revolution and the economic evaluation of coconut farming systems (Etherington, II (1)1986)

Forecasting the crop yield of a coconut estate (Peiris, V (2) 1989)

Forecast of annual yield of coconuts based on biometrical characters (Mathew et al, VII (1) 1991)

Physicochemical, functional and sensory properties of protein extracted from desiccated coconut (Rayid & Hansen, IX (2) 1993)

Effects of water quality, pH and state of the medium on growth & development of coconut embryos in vitro (Areza et al, XI (1) 1995)

Some miscellaneous experiments with coconut embryo culture (Ashburner et al, XII (1) 1996)

Effect of different brands of activated carbon on growth & development of coconut embryos in vitro (Bonaobra et al, XIV (2) 1998)

The eight papers on technology range from appropriate technology for smallholders to advanced biotechnology; from crop forecasting to microcomputers; and from desiccated coconut to in vitro propagation. The range shows how widely diverse is the CORD readership.

TABLE 11 General Research & Development

Research & development in coconut - an overview (Bavappa, II (1)1986)

A review of the Tropical Development & Research Institute's contribution to the coconut industry (Adair et al, II (1)1986)

Coconut research & development in the Philippines (Gapasin, II (2) 1986)

Status of coconut research, development & utilization in Tanzania (Balingasa, V (2) 1989)

Current status of coconut research in Sri Lanka (Mahindapala, VII (1) 1991)

Coconut agriculture research in the Philippines: its history, technological advances & future targets (Magat VIII (1) 1992)

Twenty-five years with coconut research & development: a personal view of significant events from 1968-1993 (Harries, X (2) 1994)

The seven papers on coconut research and development are, unavoidably, general review papers. Major producers like Philippines and minor producers like Tanzania are included but R&D in Indonesia is missing. Time has affected some reports, like the one on the Tropical Development & Research Institute, which changed its name and virtually disappeared. Its reincarnation, as Natural Resources International, perhaps deserves a new article (and the same might be said for the disappearance, in name, of IRHO). Another organisation that should publish something in CORD is BuroTrop. And CORD would also be a very good outlet for articles about on-going and completed coconut development projects. Such projects could present extracts from their, otherwise unpublishable, internal reports to show what was planned, what was and is being done, what succeeded - and what did not.

TABLE 12 Smallholders

The economic impact of NPKMg fertilizers on smallholder coconuts: a case study in Indonesia (Asnawi & Darwis, I (1)1985)

An alternative development strategy for coconut smallholder sector in Sri Lanka (Fernando & de Silva, IV (1)1988)

Integration of pasture, fodder & cattle in coconut smallholdings (Liyanage, V (2) 1989)

Sustainable agriculture of the small coconut farmers (Liyanage, VI (2) 1990)

Irrigation investments in smallholder coconut farming in Kerala, India (Bastine & Palasisami, XI (1) 1995)

Only five out of 132 papers deal directly with smallholders' topics yet smallholders account for 90% of coconut production. Perhaps not many smallholders read CORD? The articles come from Sri Lanka (3), India and Indonesia (1 each) but there are none from the Philippines (where the plantation sector may still predominate) or from Oceania (where, in some territories, smallholders are important components of oil palm projects). African smallholders may never have had the same input into copra production, being more concerned with subsistence agriculture. Likewise American smallholders may have more interest in coffee or corn, than in coconuts.

TABLE 13 Extensions & training

A model for formal training in coconut extension, Sri Lanka's experience (Teoh & de Silva, III (1)1987)

The fact that Sri Lanka produced three of the five articles about smallholders may be understood when it is seen that Sri Lanka provides the only article directly to deal with extension. Why is agricultural extension so neglected? Any form of publication, from an article in CORD to a

handbill from a chemical company, delivers information and can be regarded as form of extension communication. Perhaps national extension services have been replaced by international consultants (for plantation scale cropping) or by NGO aid (for community-based rather than crop-based projects)? Having suggested that CORD articles are a form of extension, perhaps the other 131 articles, and especially the general agronomy papers and some of the germplasm and processing papers, cover topics that have an extension value. But the lack of a specific extension oriented approach is indicative of the problems faced by governments and by development projects.

CONCLUSION

The papers which have appeared in CORD since 1985 have covered a wide range of the interests of research and development workers in coconut and coconut farmers and coconut processors. In some respects, CORD has to compete with other scientific journals for original articles, except perhaps when the special issues are produced. From the analysis of the published titles since 1985 it seems that some areas are not well represented. Extension is the most notable shortfall, especially when set against the very high number of articles on fertilizer use. There may be other areas, such as tissue culture and DNA based biotechnology for instance, where scientists have to publish in specialist international journals. Otherwise, CORD can be an outlet for publications on subjects that may be hard to place elsewhere (such as minor pests and diseases). Finally, there is a need for authors in Africa and America to submit articles to CORD.

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