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Indian Coconut Journal
February 2020
Message from the Chairperson’s desk

Dear Readers,

The coconut sector of the country has been going through a tough phase during the previous few years due to the recurring drought, cyclones, flood, incidence of various pests and diseases and higher domestic prices making export non-competitive. But the recent production estimates indicate an upward trend in the production of coconut in the forthcoming year showing a recovery phase for the coconut farming and industry in the country.

While this positive trend definitely offers a prospective ray of hope for the stakeholders, it is disheartening to notice that the recurrent occurrence of the whitefly disease in coconut is posing a serious threat to coconut farming. Coconut Development Board is assessing the loss and is coming out with an immediate protocol. The negative propaganda against the multifarious goodness of coconut and its various products which began in the seventies is also still continuing. The global market has been placing coconut oil and virgin coconut oil as a premium product and is being classified as a super food by the consumers. But since the last few years, there have been few instances where the studies of American Heart Association and the Harvard has been making specific agenda against the health effects of coconut products. Recently another study funded by the American Heart Association has been published on the cardio vascular risk factors of the effect of coconut oil consumption.

This is a situation which warrants the cooperation of all coconut growing countries across the world. It is happy to note that the International Coconut Community has taken serious note of the same and has come up with a strong rebuttal against the new campaign that has been launched. This issue of the journal is publishing few papers published against such false information. Many clinical studies have already proved the various nutritive and health benefits of coconut products. This could be the reason for the concerted lobbying by the competitive oil producers against coconut oil.

I request the united and wholehearted cooperation of the stakeholders in publicizing the various health effects of coconut products and thereby safeguarding the interests of the coconut sector in the country.

G Jayalakshmi IAS
Chairperson
Dear Sir,

Subject: Statement from the International Coconut Community (ICC) on the recent article published in the American Heart Association (AHA) Journal Circulation, entitled “The Effect of Coconut Oil Consumption on Cardiovascular Risk Factors” (Neelakandan, Seah & Van Dam, 2020)

Greetings from the Secretariat of International Coconut Community in Jakarta, Indonesia

The American Heart Association has recently published an article entitled “The Effect of Coconut Oil Consumption on Cardiovascular Risk Factors” (Neelakandan, Seah & Van Dam, 2020) in their Journal Circulation which is another attack on Coconut Oil. The International Coconut Community which represents 20 coconut producing countries refutes the facts of the article contrary to the truth, assailed coconut oil for raising LDL-C levels in selected feeding studies, without considering whether the LDL-C levels that resulted were unhealthy or not. The paper’s conclusion was based on the singular objective to lower LDL-C, ignoring the more important result of whether the overall lipid profiles were unhealthy in the first place and disregarding the role of coconut oil in increasing the level of HDL-C, the so-called “good type of cholesterol” for heart. Healthy coconut oil can give favourable ratios of total cholesterol to HDL-C consumption of Coconut oil did not result in unhealthy LDL-C.

Misleading conclusion

The Van Dam paper focused on whether there is a link between consumption of coconut oil alone and heart disease and concluded that: Coconut Oil consumption results in significantly higher LDL-C Cholesterol than non-tropical vegetable oils’.

The reason showing the misleading conclusion is attached herewith critique by Dr. Fabian M Dayrit, Department of Chemistry, Ateneo de Manila University, Philippines & Chair, Scientific Advisory Committee for Health, International Coconut Community and by Dr. Mary T. Newport MD, Spring Hill Neonatology, Inc. Florida, USA.

It would be appreciated and advised that the Country Governments shall create proper awareness to the general public through the public media and issue the necessary declarations and analyses supporting the misleading studies done at different levels.

I thank you very much for your time and we look forward to hear from you

With my best regards

Periodically since the early 1960s, the American Heart Association has published a report or advisory on the effects of dietary fats particularly critical of coconut and other tropical oils based on flawed science and old clinical trials. The latest example of this published in Circulation in January 2020, is a review article entitled, “The effect of coconut oil consumption on cardiovascular risk factors: A systematic review and meta-analysis of clinical trials,” by Neelakantan, et al. Their main motivation in performing this analysis and writing this article is based on concerns that coconut oil has greatly increased in popularity due to its purported health effects. They are concerned that coconut oil is very high in saturated fat, that saturated fat increases LDL cholesterol, and that dietary guidelines generally recommend the restriction of saturated fat intake. The basic premise of this study is flawed, in that it has not been proven definitively that either increased intake of saturated fat or elevated LDL cholesterol, in and of itself, causes cardiovascular disease. It is not difficult to find studies showing increased or decreased cardiac risk for both of these factors. It must also be considered that the vast majority of such studies are epidemiological studies, which by their own nature, show only associations and do not prove causation.

My greatest concern with this study is that of the available 873 potential studies they could include in their analysis they chose only 17 trials, which suggests the possibility of cherry picking to make their point. It is well known, and has been written about many times, that the original study by Ancel Keys upon which the American Heart Association’s “lipid-heart hypothesis” is based, reported data for just 6 countries when 22 data points were available. Keys’ incomplete data appeared to show that the higher the percentage of fat eaten in a country the higher the rate of cardiac deaths, however, when all 22 countries are plotted there is a random pattern, and it is very easy to pick out six other points that show the exact opposite results.
The following are just some of the shortcomings of this meta-analysis review, as determined from the tables in the publication:

- The authors analyzed only 17 of 873 potential trials which is less than 2% of the total.

- This meta-analysis did not look at any direct effect of coconut oil on the heart or report on cardiac events that may have occurred during the studies.

- 9 of the 17 studies were published more than 20 years ago.

- There is no indication that the studies the authors selected further differentiate LDL into large and small particle LDL which appears to be more important than total LDL cholesterol.

- 12 of the 17 studies were “industry sponsored” or not reported, but they do not mention which industry.

- There were only 730 participants combined for all 17 trials, averaging just 43 people per study. 4 studies had just 9 to 12 people and only 4 of 17 studies had more than 45 people.

- Five of the 17 trials were men only and sex was not reported in 4 other trials.

- 11 of 17 studies wherein people age is 45 years or less and none were in people greater than 60 years old.

- 16 out of 17 studies were very short-term, only 3 to 5 weeks in 10 studies, 6 to 8 weeks in 5 studies, one study was 12 weeks duration, and just one was a relatively long-term study at 104 weeks. The inclusion of mostly very short-term studies is based on the premise by the authors that lipid biomarkers stabilize in as little as 2 weeks after starting a dietary intervention. When a new oil or any other type of intervention, such as medication, is introduced there may be a short-term bump in certain biomarkers, but, as the metabolism readjusts, it may take months for these biomarkers to stabilize. In fact, in the largest study by Vijaykumar, et al., included in this meta-analysis, with 200 participants, and the only long-term study conducted over 104 weeks, coconut oil reduced LDL cholesterol below the baseline by -2.90 on average compared to sunflower oil. Even HDL cholesterol was slightly below baseline levels for coconut oil after 104 weeks. In the next longest 12-week study by Assunção with 40 participants, the LDL cholesterol dropped by an astounding -21.73 points from baseline for coconut oil when compared with soybean oil. The second largest study of 96 people by Khaw, et al., of 4 weeks duration showed a slightly lower than baseline LDL for coconut oil compared to butter and virgin olive oil.

- Many of the studies were in healthy volunteers with normal lipid profiles and other studies were in people with hypercholesterolemia. They do not report the baseline levels for total cholesterol, LDL or HDL cholesterol for the participants in these studies. This leads to the question, if LDL cholesterol increased by 10 or 20 points, were the subjects still within the “normal” range? Likewise, if HDL increased related to taking coconut oil, did this push the participant from below normal into the normal range?

- Even though the studies compared, coconut oil to butter and other types of oils, which varied from study to study, and results varied greatly from study to study, the authors pooled the participants to try to show that LDL increased more with eating coconut oil than “non-tropical” oils even though the fatty acid compositions of those oils would be very different from each other as well as different from coconut oil.

- In the discussion, they dismiss the average increase in HDL cholesterol by 4 points as possibly the result of “publication bias” and state without documentation of their source of this information that “efforts to reduce CVD risk by increasing HDL-cholesterol have been unsuccessful”.

- To ascertain the effects of coconut oil on inflammation they looked at just five studies that included C-reactive protein as a biomarker, and 3 of these 5 studies were in healthy volunteers, who would presumably already have had normal C-reactive protein at baseline, but this is not reported either way. They do not
report significant decreases in C-reactive protein, but, on the other hand, they do not report the baseline measurement for C-reactive protein in the participants of these studies. C-reactive protein is a crude biomarker of inflammation and does not indicate the source of inflammation. There are much more sensitive and specific tests available for inflammation in recent years looking closely at metabolomics, up regulation and down regulation of genes, and effects on enzymes and other substances related to inflammation, but these apparently were not studied. Also, reduction in inflammation is a gradual process and it would likely take well beyond the average duration of the studies in this meta-analysis to see a significant change in C-reactive protein.

Likewise, they do not report the baseline values for blood glucose to make it possible for the reader to determine if the lack of significant change in glycemic control was studied in people who had abnormal values or were already normal at baseline. They do not mention if any of these studies looked at HbA1C or fasting insulin levels which would be much more sensitive markers of glycemic control. HgA1C is used as a screening test for diabetes and pre-diabetes and is a measure of the average blood glucose spanning about three months. Red blood cells carry glucose, which live on average 120 days and the amount of glucose in the cell reflects the blood glucose at the time the red cell appeared in circulation. Thus, reduction in fasting blood glucose would likely take well beyond the average duration of the studies in this meta-analysis.

The authors admit in their discussion that several of the studies they included had “poor trial design, conduct, and data presentation, and these low-quality trials may have introduced bias into [their] results”. They reported in Table 1 the Jadad Score for each study, which is an indicator of the effectiveness of blinding in the study, with 0 indicating “very poor” and 5 “rigorous”. None of the studies they selected rated a score of 5, and 6 of the 17 studies rated a score of 0 or 1. The Jadad scores of the five studies that looked at C-reactive protein had low scores between 0 and 3.

They note in the discussion that many of the trials did not provide all meals to assure compliance. Thus, they would not have been able to ascertain whether other unknown dietary factors might have potentially affected the biomarkers they were studying.

The authors state that “more evidence from cohort studies and clinical trials on the effect of coconut oil consumption on cardiovascular disease is thus desirable”.

In spite of admitting that they did not look at effects of coconut oil on actual disease, that they included many poor-quality studies, that compliance was questionable in some of the studies, that they might have had a “publication bias” issue, they nevertheless conclude that “coconut oil should not be viewed as a healthy oil for CVD risk reduction and limiting coconut oil consumption because of its high saturated fat content is warranted”. And, in spite of the authors’ admitted significant limitations, the American Heart Association inexplicably published their study anyway.

It is very disappointing that the American Heart Association would publish such a poorly executed review and meta-analysis to justify their continued vilification of coconut oil. This is in keeping with their previous scheme of leaning on old, small, flawed studies to perpetuate their unproven view that saturated fat, and especially coconut oil, has something to do with increased risk of heart disease. Even though the overwhelming majority of people in the USA who suffer and die from heart disease do not eat coconut oil now and have likely never eaten coconut oil on any regular basis, it has become an unfair target for the AHA, and points up the failure of this organization to identify and focus on the true causes of heart disease.

Unfortunately, it also seems that members of many media outlets settle for the AHA propaganda on coconut oil and resort to sensationalistic reporting after reading only the summaries and final conclusions of articles such as this. They fail to carefully analyze the entire contents of the published article and they interview “experts” who come in with a clear bias that supports their story. Even worse, some reporters simply pass on the poorly researched information published by other media outlets, perpetuating the myths and misinformation about coconut oil without evidence to support their baseless claims.

Given their own admission of significant limitations, it is unconscionable for the authors of this paper to draw the conclusions they have and for the American Heart Association to publish this review.
Consider weight management: should your goal be to simply lose weight or to achieve your ideal weight? Clearly, the right goal is the latter. Your ideal weight depends on your body type, genetics, sex and age, among others. Unfortunately, media and advertising have made people focus on simply losing weight. The same can be said about advice on low-density lipoprotein-cholesterol (LDL-C) levels.

Another attack on coconut oil has came out now. Published in the American Heart Association (AHA) journal Circulation, the article entitled, “The Effect of Coconut Oil Consumption on Cardiovascular Risk Factors” (Neelakantan, Seah & van Dam, 2020) assailed coconut oil for raising LDL-C levels in selected feeding studies, without considering whether the LDL-C levels that resulted were unhealthy or not. The paper’s conclusion was based on the singular objective to lower LDL-C, ignoring the more important result of whether the overall lipid profiles were unhealthy in the first place. Like many misleading weight management campaigns, the focus was on lowering LDL-C alone.

This paper was published simultaneously with a supporting commentary by the former president of the AHA (Sacks, 2020) and a news item that appeared in the tctmd.com website, which obtains its funding from medical device and pharmaceutical companies.

The coconut diet is healthy

To put this paper into perspective, a recent meta-analysis on 8 clinical trials and 13 observational studies concluded that coconut-based diets are not linked to an increase in the risk of CVD (Eyres, 2016). A number of Asian and Pacific island population consume significant amount of their calories from coconut. Because fresh coconut meat contains up to 35% coconut oil, this means coconut oil provides up to 15% of their calories. Yet these populations have a low incidence of heart disease and atherosclerosis. So, a coconut diet is not linked to heart disease. What about coconut oil itself?

Misleading conclusion

The van Dam paper focused on whether there is a link between consumption of coconut oil alone and heart disease and concluded that: “Coconut oil consumption results in significantly higher LDL-cholesterol than nontropical vegetable oils.” This is a misleading conclusion for several reasons.

• First, this conclusion focused exclusively on changes in LDL-C levels but ignored the more important point regarding whether the resulting LDL-C levels were unhealthy; they were not. In fact, consumption of coconut oil did not result in unhealthy levels of LDL-C.
• Second, this paper downplayed the beneficial changes in lipid parameters that were due to
coconut oil. In particular, coconut oil raised high-density lipoprotein-cholesterol (HDL-C) levels and gave favorable ratios of total cholesterol to HDL-C. HDL-C, the so-called “good cholesterol,” is associated with heart health.

- Third, this paper mixed ten studies on normal healthy volunteers with six studies on subjects with health conditions, such as obese volunteers on low calorie diets, hyper cholesterolemic patients on statins, and post menopausal women, without considering the differences in their health and physiologic conditions. They mixed the results of the healthy with the unhealthy, and the young (20-40 years old) with the old (41-60 years old). Thus, the pooled average value that they calculated is confusing and meaningless.

- Fourth, this paper compared coconut oil against ten “nontropical” unsaturated vegetable oils, but erroneously – or knowingly? – included four studies using palm oil which is a tropical oil.

**Conflict of interest**

The van Dam paper included declarations of the studies regarding industry funding, with the intention of showing potential conflicts of interest (COI). This is good practice. This paper was published in the journal Circulation, which is owned by the American Heart Association. Should we not subject AHA to scrutiny for its own conflict of interest? In fact, the AHA has numerous concerns of conflict of interest.

Unfortunately for the AHA, the truth is not on their side. The American public is now realizing that coconut oil is, in fact, healthy. With the beneficial effects of coconut oil, lauric acid, and the ketogenic diet being experienced by a health-conscious population, the AHA may have felt the need to launch another attack to keep the public from the truth.

**References**


Neelakantan N, Seah JYH, van Dam RM (2020). The Effect of Coconut Oil Consumption on Cardiovascular Risk Factors. Circ. DOI: 10.1161/CIRCULATIONAHA.119.043052


Sacks FM (2020). Coconut Oil and Heart Health: Fact or Fiction? Circ. DOI: 10.1161/CIRCULATIONAHA.119.044687
The genetic resources in coconut are widely exploited through selection and hybridization for a number of desirable traits and have resulted in the development of many varieties in India. Breeding efforts are mostly confined to conventional approaches such as mass selection and hybridization, besides attempts to use individual palm selection for novel traits. Crop improvement research, encompassing enrichment of coconut genetic resources, characterization, utilization and evaluation of germplasm/hybrids has resulted in development of improved coconut varieties. Based on multi-location trials, superior lines have been selected and released for cultivation in different parts of the country. Till date, about 48 improved varieties of coconut, including 20 high yielding hybrids have been released for cultivation in India, with yield potential of 84-167 nuts/palm/year or 1.8-4.6 tonnes of copra/ha/year. In coconut with its perennial nature, heterozygosity, long juvenile phase and lack of technologies for mass propagation of palms with targeted traits are the challenges in breeding efforts.

To develop coconut hybrid with high nut yield, tender nut-water content, copra recovery and oil yield, 14 cross combinations involving high-yielding parents were evaluated since 1986 in different centres of the All-India Coordinated Research Project (AICRP) on Palms. This resulted in the identification of a superior high-yielding cross combination, LCOT × CCNT, at the AICRP-Palms Centre, Veppankulam (TNAU, Tamil Nadu). It is a Tall × Tall combination; first of its kind in the country as well as in the South Asia. The hybrid LCT x CCNT at the age of 28 years had grown to a height of 13.4 m with a girth of 98 cm with circular crown shape and have the potential to produce 12 leaves per year. Nut characteristics of LCT x CCNT revealed that whole nut weight (1052g), dehusked nut weight (567g), kernel
Variety

The hybrid LCT x CCNT has a crown view indicating its distinct growth pattern. The performance of this hybrid at AICRP-Palms Centre, Veppankulam is detailed in the table below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nut yield / palm / year</td>
<td></td>
<td>161</td>
</tr>
<tr>
<td>Whole nut weight (g)</td>
<td></td>
<td>1052</td>
</tr>
<tr>
<td>De-husked nut weight (g)</td>
<td></td>
<td>567</td>
</tr>
<tr>
<td>Copra content (g/nut)</td>
<td></td>
<td>149.8</td>
</tr>
<tr>
<td>Copra yield (kg/palm/year)</td>
<td></td>
<td>24.12</td>
</tr>
<tr>
<td>Copra out turn (t/ha/year)</td>
<td></td>
<td>4.22</td>
</tr>
<tr>
<td>Oil content (%)</td>
<td></td>
<td>70.0</td>
</tr>
<tr>
<td>Volume of tender nut water (ml)</td>
<td></td>
<td>300.0</td>
</tr>
<tr>
<td>TSS (o Brix)</td>
<td></td>
<td>5.5</td>
</tr>
<tr>
<td>Total Sugars (g/100 ml)</td>
<td></td>
<td>5.8</td>
</tr>
<tr>
<td>Copra yield (kg/palm/year)</td>
<td></td>
<td>24.12</td>
</tr>
<tr>
<td>Copra out turn (t/ha/year)</td>
<td></td>
<td>4.22</td>
</tr>
<tr>
<td>Oil content (%)</td>
<td></td>
<td>70.0</td>
</tr>
</tbody>
</table>

The hybrid has a thickness of 1.17 cm, kernel weight of 275 g, shell weight of 145 g, and copra weight of 149.8 g. The average nut yield recorded over twelve years from 2001 to 2014 indicated that hybrids on an average produce 161 nuts per palm per year and with respect to copra out turn, it produces 24.12 kg/palm and it works out to 4.2 t/ha of coconut garden. The tender nut water quantity is 300 ml per nut with TSS of 5.50 Brix, total sugar content of 5.8 g/100 ml. The mean nut yield of the hybrid during the stabilized bearing period was 161 nuts/palm/year, which was higher than ECT, VHC 2 and VHC 3 by 62.6, 43.8 and 11.0 %, respectively. This hybrid was released in May 2015 as VHC 4 for Tamil Nadu during the 24 Annual Group Meeting of the AICRP, held at the ICAR-Central Coastal Agricultural Research Institute, Goa.

Shri. Saradindu Das, CCDO, CDB hoisting the National flag during the Republic Day celebration at CDB, HQ premises.
Integrated management of whitegrubs in coconut garden

Prathibha P S.
ICAR- Central Plantation Crops Research Institute, Kasaragod

Coconut provides livelihood security to millions of people in India. Crop loss due to incidence of pests adversely affects coconut production. Being a perennial crop, it is attacked by an array of insect pests, among which root eating grubs/white grubs are polyphagous key pests of national importance. Palm white grub complex include closely related three species of genus Leucopholis viz., Leucopholis coneophora Burmeister, Leucopholis burmeisteri Brenske and Leucopholis lepidophora Blanchard (O: Coleoptera, F. Scarabaeidae, SF: Melolonthinae). Among these, L. coneophora is known as “coconut white grubs” as it is found associated with coconut based cropping systems along coastal belts and in plains which was first reported by Nirula et al. in 1952. The population is restricted up to an altitude up to 200 m from MSL and has annual life cycle. Though it is known as coconut white grubs, it feeds on root of areca palms as well and a menace to tuber crops and rhizomatous intercrops raised in coconut garden. The other two species viz., L. burmeisteri and L. lepidophora are found associated with arecanut based cropping system in high ranges or Ghat region at an altitude of >200 m above MSL and are known as “arecanut white grubs”. It also feeds on roots of coconut / intercrops in coconut gardens in high ranges. Unlike coconut white grub, these species have biennial life cycle. Above mentioned three white grubs species require rain water to trigger adult emergence, hence it occurs during monsoon season.

Bio-ecology and behaviour of coconut white grub chafer

Studies conducted in ICAR- CPCRI indicated that, the adult emergence of L. coneophora commenced with the summer shower in April. Delay in summer shower delayed the emergence. After a pause in May, the emergence resumed with setting of South West monsoon. This pause was due to rise in soil temperature followed by summer shower. Soil temperature played a direct role on the emergence of beetles. There was no beetle emergence during the dry spells between the rainy days due to rise in soil temperature. Daily the emergence starts when the light intensity reaches 124.37 ± 75.5 l in the evening hours and remained active till illuminance fall to 1.2 ± 0.4 l (ie., between 6.45 to 7.15 IST). The males emerged prior to the females and then locate the females by fluttering in soil in inverted position directing antennae down. They also congregate in the spots where females are about to emerge. There was a strong competition among males for mating during female emergence, which was indicated by a wider operational sex ratio in the initial period (1:10.11) that narrowed down to 1:4.33 in later days. When female protrudes its head, the males pull it out and attempt to mate. Male mounted on female, after establishing the union, fell upside down on the ground without breaking the union. It remained in mating position for a long time. Towards the end,
the female went back to soil by digging and dragging
the male behind. Adult activity prolonged for a
maximum period of three weeks during each season.
During emergence period birds were found to be
predating on cock chafers and their activity noticed
up to 100 l illuminance. But, maximum swarming
of beetles occurred at 32.6 ± 15.1 l illuminance i.e.,
just before female emergence. It is an ecological or
ethological adaptation by the beetle to ward-off
predators. The beetles did not orient to the light
trap. They could be collected by handpicking which
could be an effective management strategy. The
beetles exhibited sexual dimorphism with respect
antennal and hind tibial characters. Size of terminal
club forming segments of antenna is comparatively
smaller in females than that of males. A pair of spines
present at the posterior end of hind tibia are broad
and flattened in females but in males it is circular in
cross section (Fig. 1).

Adults are non-pestiferous which feed on leaves
of cashew, mango and a few weed plants. It lay the
eggs in soil that hatch in 23 days (Fig 2). Emerging
grubs are whitish in colour with well sclerotized head
and mouth parts (Fig 3). It has three larval instars
with first instar stage feeding on organic matter
and grass roots. By August – September, second larvae
will be in second instar stage, move towards the root
zone and start feeding on fibrous roots of palms.
Which in turn results in impairing conduction of
water and nutrient that leads to general yellowing
of fronds, poor production of inflorescence and yield
loss. It tunnels bole and collar region of seedlings
and severe incidence leads to seedling mortality (Fig
4 and 5). Being a polyphagous pest, larval stages
feed on a wide array of crops viz., sweet potato,
tapioca, yams, colocasia, elephant foot yam, banana,
fodder grass, cocoa, rubber etc. As the soil moisture
depletes after rainy season the larvae move down
to deeper layers of soil. By October the larvae will
be in third instar stage which are voracious feeder
of subterranean parts (Fig. 6). The larval period is
the longest period in the life cycle which extends for
260 -270 days. During summer months it pupate
in deeper layer of soil and pupal period prolongs
for 25.3 to 25.7 days. During next monsoon season
adults emerge and continue the life cycle.

Natural enemy complex associated with coconut white grub

An array of natural enemies are recorded on
coconut white grubs. On emergence, the beetles
are predated by birds viz., domestic crow (Corvus
splendens), jungle crow (C. macrorhynchosL.),
common egret (Ardea alba L.), and raptors like king
fisher (Alcedo atthis L.) and brahmini kite (Haliastur
indusL.). Larval stage are parasitized by solitary
internal parasitoid, Campsomeriella collaris collaris
(Hymenoptera: Scoliidae) (Fig. 7), Prosena sp. nr.
Siberita (Diptera : Tachinidae) in organic coconut
garden (Fig. 8). Natural infection (4.2 %) of amber
disease due to bacterial entomopathogen, Serratia
spp. was recorded on third instar coconut white
grub (Fig. 9 and 10). Mycosis observed were due to
Cordyceps spp. (3.8 %) and due to green muscardine
fungus, Metarhizium spp. (0.18 %) (Fig. 11 and 12).
Two potential entomopathogenic nematodes found
associated with coconut white grubs are Steinernema
carpocapsae and Heterorhabditis indica. Bioassays
indicated that, Steinernema sp. was more potential
pathogen to L. coneophorahaving LT50 of 5.104
days at with 8000 infective juveniles (ijs). Whereas,
Heterorhabditis indica recorded an LT50 of 14.576
days at 8073 ijs.

Integrated management of coconut white grub

A set of refined strategies are suggested for the
effective management

Hand picking and destruction of adults during peak emergence period. Generally, in plains (i.e., along west coast) emergence begins with the commencement of South West monsoon (i.e., last week of May / first week of June) which prolongs till middle of June. Adult beetles can be located by buzzing sound during swarming. Mechanical collection and destruction of beetles from ground is possible as they congregate in soil. It is to be done regularly for first 15-20 days with the setting of south west monsoon daily during evening hours between 6.30 to 7.15pm IST continuously (Fig 13)

Patch application of any one of the following insecticides in the interspaces where grasses are dried due to damage caused by early instar root grubs during July – Aug second week when the grubs are in early instar stage

- Imidacloprid 17.8 SL @ 0.7 ml/ Litre of water, 3-4 L of spray solution / m2 area
- Bifenthrin 10 EC @ 3 ml/ litre, 3-4 L of spray solution / m2 area
- Chlorpyriphos 20 EC @ 3 ml/ litre @ 3-4 L spray solution / m2 area

- Drenching of Entomo Pathogenic Nematode suspension (EPN), Steinernema carpocapsae @ 1.5 billion infective juveniles / ha. For this, loosen the soil around the base of the palm to a depth of 5-10 cm and drench with EPN, suspension during August in plains. Approximately 40 to 50 lakh infective juveniles to be applied / palm basin. Based on the availability of EPN number of treatments can be increased. It can be applied along with imidacloprid @ 0.25 ml/litre. EPN can be introduced by direct application of EPN multiplied cadaver of Giant wax moth larvae. EPN require thin film of water to be biologically active. Hence, care to be taken to conserve soil moisture once the EPN is introduced in the garden. EPN culture is available at crop protection division in ICAR - CPCRI Kasaragod.

- Need based second round root zone application of insecticide during second week of October

For this, either of the following insecticide can be used

- Imidacloprid 17.8 SL @ 4 ml/palm in 10 L of water
- Bifenthrin 10 EC @ 30 ml/Palm
- Chlorpyriphos 20 EC @ 30 ml/palm

- Repeated ploughing / soil raking from October - December (i.e., when the grubs are in second- third instar stage) to expose the root grubs for predation by raptors and other birds like, common crow, egrets, kingfisher, kite etc. Moreover, it also helps to improve the soil structure for better root development. It is difficult to locate eggs and first instar grubs in the field as they are small in size and are randomly distributed in field. Late second and third instar grubs move towards the rhizosphere and start feeding on roots of the palms. Hence, digging (forking) around the palm basins and interspaces up to 20-30 cm depth during October - December enables handpicking and destruction of grubs. Intercrops raised in palm garden (viz., banana, colocasia, sweet potato, elephant foot yam, fodder grass etc.,) serve as alternate hosts for this pest.

- Application of powdered neem cake @ 1 kg/palm in the palm basin helps in rejuvenation of roots and to ward off insect pests to some extend

These IPM strategies are to be continued for three years for the effective management of white grubs in coconut gardens.
Abstract

Coconut is a member of palm family and is widely acclaimed as “Kalpavriksha or Gift from Heaven” because of it’s a great boon for healthy life of mankind in terms of nutritional and economical benefits. India is the third largest producer among the top four coconut producing countries. The country ranks first in productivity among all member countries of Asian and Pacific Coconut Community (APCC). The wide scope of application of coconut oil offering new opportunities to coconut oil market tends to verify its growth potential in India as well as globally. Global coconut oil market is anticipated to grow at the CAGR of 6.37% from 2018 to 2025. However, it is expected that the global virgin coconut oil market will be growing steadily at a CAGR of around 10% by 2021. Key factor influencing this growth is the increasing interest in nourishing lifestyle. Though India has huge domestic demand of coconut and coconut products in line with higher productivity, extensive efforts are still lacking for its effective utilization. Integrated development of cultivation as well as industry only would lead to the growth of coconut sector sustainably.

Introduction

Coconut is a versatile crop coupled with numerous nutritional benefits. In addition to its abundance of nutritional profiling, it is an absolute source of food, medicine, cosmetics and natural fiber. Its by-products are utilized for producing various other varieties...
of goods. Therefore, it is a boon crop for farmers which not only help in generating better revenue but improve the socio-economic life with its fruits throughout the year. Coconut plays an important role in contributing to India’s GDP of about Rs. 15,000 crore India contributes significantly high percentage of world’s total production and the productivity of the country is also high. In India, Tamil Nadu tops in the productivity of coconut, but production is high in Karnataka and Kerala tops in the area under coconut cultivation.

Table 1: Area, Production, Productivity of Coconut in India (2016-17)

<table>
<thead>
<tr>
<th>Area (*000 ha)</th>
<th>Production (million nuts)</th>
<th>Productivity (nuts/ ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India 2082.11</td>
<td>23904.10</td>
<td>11481</td>
</tr>
<tr>
<td>Tamil Nadu 461.06</td>
<td>6570.63</td>
<td>14251</td>
</tr>
</tbody>
</table>

Source: Coconut Development Board

The global production of coconut is significantly high, wherein Indonesia, Philippines and India are three major coconut producing countries. Indonesia and Philippines tops in coconut production, while India occupies a premier position, ranked at 3rd position, as is depicted in table 2.

Table 2: Top four coconut producing countries in 2017

<table>
<thead>
<tr>
<th>Countries</th>
<th>Production (tonnes)</th>
<th>Area Harvested (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>18983378</td>
<td>3260015</td>
</tr>
<tr>
<td>Philippines</td>
<td>14049131</td>
<td>3612304</td>
</tr>
<tr>
<td>India</td>
<td>11469837</td>
<td>2081000</td>
</tr>
<tr>
<td>Brazil</td>
<td>2342942</td>
<td>215683</td>
</tr>
</tbody>
</table>

Source: FAO.org/FAO/STAT With an annual production of around 17,000 million nuts, coconut

Import & Export Trend of Coconut Sector

As we all aware various forms of coconut based products available in market tends to play a vital role in the growth of Indian market economy. It has been anticipated that the export of India’s coconut product would be above Rs. 2000 crore by FY 2019. Among diverse range of coconut products, 80,467 tonnes of activated carbon, valued at Rs. 1,123.64 crore has been exported till January while Rs. 1,812.55 crore total exports has been reported in this year. Year on year, soaring demand is recorded for coconut products. The elevated demand of activated carbon leads to fetching higher price of Rs.140/kg in FY2019 vis-a-vis Rs.100/kg in FY2018, and this is specifically attributed to its utilization for purification of gold, water & air. However, the trend is not positive for export of raw coconut and its few products. Coconut product exports stood at Rs.2,300 crore two years ago.

With the continuous efforts of Coconut Development Board to improve the overall productivity and product diversification, exports have been poised to reach upto Rs. 20617 million till 2017. The more elaborative data of incessant growth has been recorded for every year as enlisted below:

<table>
<thead>
<tr>
<th>Year</th>
<th>Export value (Rs. million)</th>
<th>Import Value (Rs. million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-08</td>
<td>690.1</td>
<td>559.3</td>
</tr>
<tr>
<td>2008-09</td>
<td>1798.0</td>
<td>1030.8</td>
</tr>
<tr>
<td>2009-10</td>
<td>2197.5</td>
<td>1071.6</td>
</tr>
<tr>
<td>2010-11</td>
<td>4959.2</td>
<td>1207.7</td>
</tr>
<tr>
<td>2011-12</td>
<td>9432.9</td>
<td>2098.8</td>
</tr>
<tr>
<td>2012-13</td>
<td>10223.6</td>
<td>1919.0</td>
</tr>
<tr>
<td>2013-14</td>
<td>11561.2</td>
<td>2311.1</td>
</tr>
<tr>
<td>2014-15</td>
<td>13123.8</td>
<td>4216.6</td>
</tr>
<tr>
<td>2015-16</td>
<td>14502.4</td>
<td>3832.6</td>
</tr>
<tr>
<td>2016-17</td>
<td>20617.0</td>
<td>2705.9</td>
</tr>
</tbody>
</table>

Source: Coconut Development Board

Coconut Market Growth Potential

Coconut Oil Market is poised to touch USD 8,403.3 million by 2025 at an impressive 6.37% CAGR during the forecast period (2018-2025). Rising demand for edible oils in Europe and North America combined with its scope across industrial sectors such as cosmetics & personal care, biofuels, and pharmaceuticals can spur the market demand over the forecast period. Inspite of its increasing demand in all sector, there is a challenge of higher level of saturated fatty acid which is a greater concern among international organization. This concern display impact on Indian coconut market. Coconut Development Board has been providing immense support for producers and providing platform for disseminating awareness about its health benefits.

Based on the processing method, refined and virgin are classified into two major segments to determine forecasting valuation. As Market Research Future Report 2019, virgin oil segment is expected to reach to US 2,413.6 million and quantity demanded is upto 1,750.4 KT which is attributed to the high purity level of virgin edible oil. The major drive for ever increasing growth of segment is the supportive government policies and capital addition by value added producers that leads to overall encouragement of production.
Diversified Market of Coconut

Wide range of coconut based products are available in the market which can be derived from each and every part of coconut tree. Its roots can be used for extracting dye stuff while trunk can be used for make lumber and furniture. Coconut shell is usually being discarded, which can be utilized for decoration items, or can be converted into shell powder to be used for making desired mesh size of sieving machine. The same shell can also be transformed into coconut shell charcoal and activated carbon, used in the filtration system.

Apart from the non edible portion, the edible portion is also utilized to manufacture. Various edible products from coconut like coconut milk, dried coconut or copra, desiccated coconut, coconut oil, coconut water, Nate-de-coco, coconut flour, vinegar, jaggery etc. Coconut is considered as food and also as an oil seed crop.

Dried Products

This category is segmented into a number of products among which desiccated coconut is the most popular one, obtained by separating the white kernel from brown testa which is being followed by the process of drying of shredded, ground coconut. The final moisture content present in desiccated coconut is 1.3-2.5%.

Application of Desiccated coconut: It is used to add flavor to curries or for food decoration. It is widely used in Indian dishes; especially in South Indian. The shredded coconut can be used to make coconut burfi, coconut biscuits, cookies, candies, coconut based toffees or chocolates.

Coconut chips is another lip smacking product being produced using coconut meat by slicing it thinly, cooked in syrup and then dried to obtain either sweetened or salted snack.

Coconut milk based Yoghurt is a fermented product made from coconut. Streptococcus thermophiles and Lactobacillus delbrueckii spp. Bulgaricus. are the lactic acid bacteria used for fermentation process of coconut milk to obtain yoghurt. The yoghurt does not contain lactose and is rich in various vitamins and minerals transformed from coconut milk.
Therefore, this can be even used as a best alternative to cater to lactose intolerant people.

Similar to dairy milk, Coconut milk is an oil-water emulsion obtained from the aqueous extract of coconut meat, which can be used as a substitute for cow milk. Coconut milk is also available in another form which is called skimmed coconut milk.

**Fresh coconut water** is obtained from freshly opened shell while coconut water concentrate is produced using spray evaporation techniques which reduces the moisture content.

**Coconut Cream** is the fat portion of coconut milk. The total fat content is approximately 23%. Unlike other fat sources, coconut cream does not contain trans fatty acids, but consists of monoglycerides. Monoglycerides are readily digested and absorbed by body. Since it gets converted into energy immediately after consuming in short while; it does not transform into bad cholesterol.

**Coconut flour** is a gluten free alternative of wheat, rice and potato flour. It is considered as a healthy source of dietary fiber, loaded with numerous nutrients.

**Nata-de-coco** is a fermented food which is chewy, translucent, jelly like food stuff. This is commonly consumed as sweetened candy or dessert, and can be added with various stuffs like drinks, ice cream, puddings and fruit mixes. Coconut water is fermented using culture Acetobacter xylinum which produces microbial cellulose for gel formation.

**Coconut vinegar** is obtained from fermenting coconut water. Similar to synthetic vinegar, it involves alcoholic as well as acetic fermentation of sugar enriched coconut water. It can be a substitute of synthetic vinegar. And it can also be used for other applications as a preservative or flavoring agent in pickles and sauces and is used for improving the quality of cooked fish and meat.

**Tender Coconut Water** is a refreshing drink obtained from freshly opened shell. Coconut water is also known to be a rich source of dietary fiber, enzymes, vitamin C, amino acids, minerals such as magnesium and potassium. However, it doesn't add calories into diet and is recommended for heart patients as it has low cholesterol level as compared to other dairy products. Coconut water is a new generation energy drink that helps keep hydrated by balancing electrolyte in blood. The tender coconut water has several other health benefits such as anti-carcinogenic, antimyocardial infarction, hepatoprotective, antioxidant, antiageing, and anti-thrombotic effects.

**Coconut Oil & Virgin Coconut Oil:** Coconut oil is extracted from copra and virgin coconut oil is the oil produced from the kernel of coconut by mechanical or natural means with or without application of heat. If virgin coconut oil is subjected to high temperatures, solvents or refining process and therefore retains the fresh scent and taste of coconuts. The virgin coconut oil can be produced from fresh coconut meat or milk. It can be extracted from fresh meat by grating, drying and pressing.

Irrespective of the process being followed to manufacture coconut oil or virgin coconut oil, lauric acid is the fatty acid being present significantly.
Coconut oil: It mainly contains medium chain fatty acids which are not covered under fat as a stored fat, while it burn easily and release energy. Hence, coconut oil in either forms are associated with health benefits. Further, the shelf life is extended, since it contains more amounts of saturated fat leading slow down of oxidation process resulting resistant to rancidity.

Coconut based protein powder: This protein powder is obtained through the process of enzyme treatment followed by centrifugation. The coconut milk from fresh and mature coconut undergoes protease treatment. Enzyme-treated milk is subjected to centrifugation at 7,000 rpm to obtain cream, coconut skim milk, and solid protein. In place of skim milk protein, coconut based protein powder is an alternative option, which has good emulsifying properties and also has more water retention and swelling capacity than other dietary fibers.

Neera & Toddy: The vascular sap obtained from immature unopened coconut inflorescence is popularly known as Neera in fresh form. It is a rich source of sugar, minerals, and vitamins which makes it an ideal energy drink. Neera is the unfermented form while Coconut toddy is the fermented form obtained from young coconut inflorescence. Treacle is another product manufactured from sweet toddy. It is obtained by boiling toddy. Alcoholic content of toddy is about 4-6%. Alcoholic liquid prepared from toddy is called coconut arrack, which is generally distilled between 33% and 50% alcohol by volume.

Coconut Jaggery: Unfermented coconut sap is collected and undergoes the process of evaporation, which results into a concentrated form. After evaporation, a thick mass is obtained, which on further heating leads to crystallization and on cooling sets to a solid form. Coconut Jaggery which can be used in place of sugarcane based jaggery, is a rich source of calcium, iron and many other vitamins and minerals.

Coconut Refined Sugar: coconut sap is treated with lime to remove aluminous unwanted impurities, followed by the process of filtration to get the clarified liquid which is evaporated to the extent of 75% sugar content. Thereafter crystallization changes it to crystal sugar. Coconut sugar is considered to be healthier than refined cane sugar, which has low glycemic index. Therefore, coconut sugar is an ideal sugar for the control of diabetes mellitus. Likewise, coconut palm sugar or jaggery can be obtained from coconut palm syrup.

Coconut Jam & Coconut Syrup: Similarly as fruit jam is produced, coconut jam is prepared by boiling the coconut pulp with other ingredients, preservatives, coloring, and flavoring materials to a consistency firm enough to hold the fruit tissues in position and no water syneresis is observed. Coconut syrup is a liquid form obtained from coconut milk which is heated along with sugar and citric acid till the sufficient consistency is obtained. These products are sugar based products which can be used as bread spread or for other applications.

Coconut Honey & Coconut Candy: Similar to coconut syrup, coconut honey is a free-flowing viscous liquid, prepared by blending skimmed coconut milk, refined sugar, and glucose. The mixture is heated till the TSS of coconut honey reaches to 75%. The final product is a golden
coloured thick viscous liquid with nutty flavor.

**Coconut candy** is another product for which coconut milk/cream along with sugar and malt syrup is heated for caramelization of the liquid. The thick mass is transferred to the mould and then cools it to get the candies in their shapes.

**Activated Carbon & Shell Charcoal:** Activated carbon is obtained by burning coconut shells which is mainly produced by the steam activation process. The process enhances the adsorptive capacity of the activated carbon. However, coconut shell charcoal is obtained by burning the shell of fully matured coconuts with a limited supply of air so that they do not burn away to ash but are only carbonized.

Coconut which is abundant with beneficial components, holds numerous health benefits. Lauric acid present in higher proportion in coconut acts as antiviral and antibacterial agent. 10 to 20 grams of lauric acid per day is considered an appropriate amount which can be obtained from roughly 6 to 12 ounces of good quality coconut milk.

**Conclusion**

India is a leading producer of coconut which is having high demand in the country as well as International markets. In the era of modernization, coconut product market is shifted to value added product market with the diversified option of coconut products. India is a leading producer of coconut and coconut is having high demand in India as well as in the International markets. In the era of modernization, coconut product market is shifted to value added market with the diversified option of coconut products. Taking into consideration the wide range of coconut products, coconut product market has great potential for growth of Indian economy. Coconut industry is well supported by various government
agencies such as Coconut Development Board, Kerafed, State Trading Corporation, Kerela State Marketing Federation and Karnataka State Marketing Federation etc. Coconut Development Board provides support for the continuous improvement of coconut industry. Though well developed coconut market is a strength, there is always scope to improve further and explore new technologies to cater to the demand of domestic as well as international consumer.

The versatile use of coconut palm (Cocos nucifera L.) in providing food, drink, medicine, fuel, fibre and shelter to the mankind has established its importance as “Kalpavriksha”. In view of its importance, use and regularity in cropping, coconut is grown in many Asian and Pacific countries in the world. Coconut palm is a crop of future in view of its carbon sequestration potential in the context of climate change.

Coconut Scenario in Odisha

Coconut cultivation in Odisha has undergone tremendous transformation in the past few decades due to spread of cultivation from traditional area to non-traditional belts of the state. Coconut farming, however, in the state is frequently damaged by the cyclonic hits like Super cyclone in October 1999, Phailin in October 2013 and Hudhud in October 2014 as a result of which the area and production of coconut are considerably fluctuating. The cyclonic storm “FANI” with a wind speed of around 200-250km/hr wreaked massive damage to perennial horticultural crops in the state on 3rd May 2019. Among all the horticultural crops, coconut plantations were severely damaged in six districts particularly in Puri, Khordha, Cuttack, Jagatsinghpur, Jajpur and Kendrapada. Due to “FANI” hit out of 26151 ha under coconut plantation in above six districts about 7930 ha plantation was affected comprising uprooted/broken trunk and palms with severe crown damage in 5544 ha and palms with partial crown damage in 2386 ha. Though the maximum area coverage and production are confined to ten coastal districts, the cultivation of coconut has now been extended to all the thirty districts of Odisha. The contribution of Odisha in coconut farming in the country is quite significant as it has occupied 5th position in area and 6th position in production in the national scenario. Now, coconut is being grown in an area of 50,910 hectares with an annual production of 342.1 million nuts and productivity of 6719 nuts/ha (2018-19).
Coconut Plantation in Littoral sand

A large chunk of coconut plantation in coastal Odisha stands on the littoral sand. The productivity status of such plantations maintain a low profile the reasons of which are: poor nutritional status, low CEC (0.4-0.54me/100g) and low organic carbon content of soil. The problem of low productivity is also aggravated by the loss of organic matter due to hot and humid climate. Besides Odisha, similar situation also occurs all along the coastal tract of the east and west coasts of the peninsular India lying mostly in Andhra Pradesh, Tamil Nadu, Kerala, Karnataka and Maharashtra. The normal weather condition prevailing along the coasts is fabulous for coconut farming. But the productivity of coconut in coastal sand is very low ranging from 20-40 nuts/palm/year. As coconut palm is committed to soil for many decades regular improvement of physico-chemical properties of such soil is absolutely necessary to improve the yield level of the palm. Some past studies, however, indicated that the productivity of littoral sand could be improved by adopting various methods for better health of palms which includes development of adequate drainage system, application of coir dust in palm basins, use of garden soil and sufficient organic manures along with inorganic manures through integrated approach in palm basis. Accordingly, attempts have been made to improve the health of coconut palms grown in littoral sand of Odisha at Coconut Research Station, Konark, and Puri presently functioning under AICRP on Palms. The physico-chemical properties of littoral sand of Coconut Research Station, Konark, and Puri depicted in table-1 clearly revealed the poor nutrient status of the soil. The low productivity of coconut (17.5nuts/palm/year) under littoral sand of Konark during 1997-98 was mainly attributed to poor water holding capacity, excessive infiltration due to the porosity of sands, easy leaching of nutrients leading to low availability of NPK and micronutrients and low organic carbon content.

The results of the work carried out at Coconut Research Station, Konark, Puri to improve the health of palm and productivity are discussed here under.

<table>
<thead>
<tr>
<th>Content</th>
<th>0-30</th>
<th>30-60</th>
<th>60-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand (%)</td>
<td>89.5</td>
<td>89.2</td>
<td>89.0</td>
</tr>
<tr>
<td>Silt (%)</td>
<td>3.4</td>
<td>3.6</td>
<td>3.9</td>
</tr>
<tr>
<td>Clay (%)</td>
<td>7.1</td>
<td>7.2</td>
<td>7.1</td>
</tr>
<tr>
<td>pH</td>
<td>5.58</td>
<td>5.50</td>
<td>5.30</td>
</tr>
<tr>
<td>Organic carbon (%)</td>
<td>0.12</td>
<td>0.09</td>
<td>0.04</td>
</tr>
<tr>
<td>Electrical conductivity</td>
<td>0.076</td>
<td>0.071</td>
<td>0.064</td>
</tr>
<tr>
<td>Available nitrogen (kg/ha)</td>
<td>65.75</td>
<td>41.75</td>
<td>36.4</td>
</tr>
<tr>
<td>Available phosphorus (kg/ha)</td>
<td>32.70</td>
<td>28.10</td>
<td>27.50</td>
</tr>
<tr>
<td>Available potassium (kg/ha)</td>
<td>64.50</td>
<td>63.80</td>
<td>62.40</td>
</tr>
<tr>
<td>Soil moisture (%)</td>
<td>2.87</td>
<td>3.58</td>
<td>5.95</td>
</tr>
<tr>
<td>Bulk density (g/cc)</td>
<td>1.68</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Adoption of integrated nutrient management practices to improve soil and plant health in littoral sand

A study was conducted in littoral sandy soil at Coconut Research Station, Konark, Odisha to assess 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 horse gram on equal nutrient basis. The studies revealed that the integrated manuring practices had no noticeable impact on the height and girth of 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.
2. Basin management with application of coir dust, garden soil and inorganic & organic manures

Coconut Research Station, Konark, Puri operating under AICRP on Palms was shifted to Bhubaneswar during 2003 due to super cyclonic hit during 1999 and as a result the existing plantation was abandoned since the last 15 years. Again in the year 2014 attempt was taken to improve the health of coconut palms and to sustain the plantation in the littoral sand. Priority was given on management of basins with application of coir dust @ 25kg per palm. Coir dust was covered with garden soil around the palm basin. Adequate quantities of nutrients were added in two splits annually with neemcake @ 2.0kg/palm, FYM@50kg/palm, urea@1.0kg/palm, SSP@2.0kg/palm, OP@2.0kg/palm, MgSO₄@300g/palm and micronutrient mixture 200g/palm in the palm basin of 1.8m radius. In situ green manuring was practiced to supplement additional nutrients and to improve physical condition of the soil.

3. Water management through drip system

Drip irrigation system was installed in the Research Station for efficient management of water to irrigate palms in littoral sand. Daily 16 liters of water was provided to individual palm except during rainy season through 4 drippers placed around the trunk within 1.8m radius.

4. Development of drainage channels

Adequate drainage channels were developed in between each two rows of the plantation to avoid water stagnation during rainy season and to conserve moisture during post monsoon period. The effect was realized after three years of operation in terms of growth and gradual increase in yield (table-2).

Table 2: Performance of palms after adoption of integrated management practices in littoral sand

<table>
<thead>
<tr>
<th>Characters</th>
<th>Local tall (41 years old)</th>
<th>Hybrids (25 years old) of packages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before adoption</td>
<td>After three years</td>
</tr>
<tr>
<td>Number of functional leaves</td>
<td>22.7</td>
<td>30.6</td>
</tr>
<tr>
<td>Number of inflorescences</td>
<td>8.3</td>
<td>11.7</td>
</tr>
<tr>
<td>Number of nuts/ Palm/year</td>
<td>28</td>
<td>58</td>
</tr>
</tbody>
</table>

5. Development of coconut based cropping system in littoral sand

An attempt was taken to develop integrated cropping system in littoral sand with the objectives along with 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 (44.0 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 24.1 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.
to increase yield and income and sustain coconut farming in littoral sand. The crops like pineapple, sapota and cowpea as vegetable crop were raised in the interspaces available in the coconut plantation. The impact of raising cowpea (as vegetable), pineapple and sapota on coconut productivity revealed gradual complementary effect of intercrops.

The experiment was initiated in the littoral sand at Coconut Research Station, Konark during January, 2016. The cropping system was developed by planting intercrops like pine apple and sapota during rainy season in 2016. Besides sapota and pineapple the other intercrop, cowpea was raised only in rainy season. Observations on growth in terms of functional leaves and yield and yield attributing traits of coconut palms were recorded in all the treatments. The initial soil samples were analyzed for the nutrient contents at the beginning. The result revealed that after two years of imposition of treatments, there was significant variation among the palms under different cropping systems as well as under different nutrient management practices for number of leaves, rate of production of leaves, inflorescences, female flowers and nut yield. However, the interaction effect of cropping system and nutrient management was significant only for number of female flowers and nut yield (Table-3). Significantly maximum nut yield (57.7 nuts/palm/yr.) was recorded in cropping system plot. The intercrop, sapota was in vegetative stage. The yield of pineapple (10803.3kg/ha) as well as cowpea (4356.6kg/ha) was maximum in plots receiving soil test based NPK nutrients (N2). Except sapota, income was derived from all the crops in the system and maximum net return was Rs.1, 87,971/ha compared to Rs. 29450/- per ha from coconut monocropping.

<table>
<thead>
<tr>
<th>Cropping System</th>
<th>Gross return (Rs./ha)</th>
<th>Cost of production (Rs./ha)</th>
<th>Net return (Rs./ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut + Sapota + Vegetable cowpea</td>
<td>1,73,816</td>
<td>96,021</td>
<td>77,931</td>
</tr>
<tr>
<td>Coconut + Sapota + Pineapple</td>
<td>2,83,587</td>
<td>1,12,767</td>
<td>1,71,441</td>
</tr>
<tr>
<td>Coconut (Sole crop)</td>
<td>79,056</td>
<td>49,340</td>
<td>29,750</td>
</tr>
</tbody>
</table>

### Conclusion

Performance of coconut palms grown under littoral sand is generally low and they produce only 20-40nuts/palm/year. Such plantations can be made more viable and sustainable through adoption of different agro-techniques in an integrated manner to improve physical, chemical and biological conditions of soil. CPCRI, Kasaragod, Kerala has developed lot of technologies to improve production and productivity of palms grown in coastal sand including development of different cropping systems, conservation of moisture using husk or coir pith and alley cropping of Glyricidia. Adoption of above proven technologies is needed to maintain the health of coconut palm grown in littoral sand for more yield and income.

Coconut based cropping system with coconut + pineapple + Sapota + Cowpea of multispecies intercropping under littoral sandy soil of Konark, Odisha is more remunerative in the yield stabilizing phase of coconut in costal Odisha condition with a net income of Rs.1.88 lakhs/ha/year.
Shri Pranajit Singha Roy, Hon’ble Agriculture Minister, Govt. of Tripura laid the foundation stone for the Administrative Building cum Farmers Training Centre of CDB DSP Farm Hichachara, Tripura on 12th February 2020. A workshop on coconut cultivation and its prospects and value addition was also organized during the occasion. In his presidential address, Shri Pranajit Singha Roy, Hon’ble Agriculture Minister, Govt. of Tripura spoke on the importance of coconut cultivation and its utility for improving the income of farming community. He emphasized the need to promote coconut cultivation in the state in scientific way and to adopt different technologies for value addition in coconut so that more income of the farmers per unit area can be improved. He assured the Board all sorts of help and co-operation for the development of the DSP Farm Hichachara, Tripura.

Shri Saradindu Das, Chief Coconut Development Officer, Coconut Development Board, Kochi in his welcome address spoke on the importance of coconut cultivation as well as value addition in Tripura for the up-lifting of the livelihood and for doubling the income of small and marginal farmers of the state. He also briefed about the global coconut scenario and the position of India as well as Tripura and stressed on the need for value addition and marketing of coconut.

Shri Lungher Obed, Director, Coconut Development Board, Regional Office, Guwahati who spoke during the occasion briefed on Board’s schemes, activities and the scenario of coconut cultivation and prospects in the North East region of the country.

Shri Debpriya Bardhan, IAS, District Magistrate South Tripura District addressed the gathering. He assured to take the initiative for taking up more coconut area under cultivation in his district for the economic development of the farming community area under. He also offered all possible help for implementing various programmes of Coconut Development Board in the district.

Shri Tarit Kanti Chakma, IAS, Sub-Divisional Magistrate, Sabroom, Dr. Biswajit Das, Joint Director, ICAR, NE Regional Centre, Lembucherra and Shri Rupankar Dey, Vice Chairman, Satchand Panchyat Smiti spoke during the occasion. The inaugural session was concluded with vote of thanks by Shri B. Chinnaraj, Farm Manager.

A technical session was followed after the inaugural session chaired by Sri L. Obed, Director, CDB Guwahati, Dr. Biswajit Das, Joint Director, ICAR, spoke on coconut cultivation and pest and disease management. Smt. Jayashree, Dev. Officer, CDB, Kochi briefed on value addition in coconut and Shri B. Chinnaraj, Farm Manager, spoke on the schemes of the Board. More than 300 farmers and officials from the district of Gomati and South Tripura were present in the function.
Coconut Development Board conducted a Farmer’s Conclave on Invasive whitefly on 3rd February 2020 at TNAU, Coimbatore. Shri Naveen Patle, Deputy Commissioner, Ministry of Agriculture and Farmers Welfare, who delivered special address during the occasion stated that any research activity for managing the whitefly attack by the research institutes as well as State Agriculture Universities shall be supported by Govt. of India through Coconut Development Board. Dr. N. Kumar, Vice Chancellor, TNAU in his address informed that whitefly has evolved as a serious pest in southern states and hence the matter is to be addressed seriously. He pointed out that farmers have to take up the management practices in a joint way so that the pest attack is controlled in an efficient manner. He also assured all support of TNAU in this regard.

Smt. G. Jayalakshmi IAS, Chairperson, CDB in her special address pointed out that this workshop is being organised based on the assessment of field situation during the visit of Hon. Agri Minister to the affected areas and as directed by the Ministry, so that views of farming community and the practicing farmers can be discussed in an open platform for formulating strategies for integrated management of the pest as well as arriving at a protocol for management of the whitefly in discussion with research institutions. She said that CDB is extending financial support to various research organizations and Agricultural Universities for mass multiplication of parasites and predators for controlling this invasive pest. Chairperson added that this workshop is expected to bring insights that would help to develop a contingency plan to make the bio control agent available to the coconut farmers at an affordable cost. CDB shall be taking up a supportive role in assisting the farming community to adopt the prescribed scientific way to control whiteflies. She requested for the united and concerted efforts are expected of all stake holders.
Shri. Saradindu Das, Chief Coconut Development Officer delivered the welcome address. Dr. Anitha Karun, Director, CPCRI Kasargod chaired the technical session on Status papers on whitefly infestation and practices followed and Dr. L. Pugalendhi, Dean (Hort.), HC&RI, Coimbatore chaired the session on R&D in Whitefly. Dr. Selvaraj, Scientist, NBAIR presented the efforts made at NBAIR to tackle the menace of rugose spiraling whitefly and Dr. Rajamanickam, Professor (Adjunct) from CRS, Aliyarnagar Tamil Nadu highlighted the importance of pest in particular to Tamil Nadu, nature of damage, distribution and spread of the pest since 2016 and the research work being done at CRS, Aliyarnagar to curtail the menace. Dr. Madhu Subramanian, Professor KAU presented the status of RSW in Kerala since 2017 till date. Dr. Chandrashekar G.S. Scientist, HRES, Arskere presented the status of RSW in Karnataka. Dr. Chalapathi Rao, Scientist, Dr.YSR Horticulture University presented the incidence of RSW in Andhra Pradesh and the efforts being made to curtail the same. Dr. Krishnakumar, Regional Director, Bioversity International gave a suggestion to work on ecological balances prevailing in pest predator population, insecticide resistance and also usage of Pongamia oil for the management of pest.

In the session on R&D in Whitefly Dr. Joseph Rajkumar, Principal Scientist, CPCRI, Kayankulam spoke on Invasive whiteflies on Coconut: Research updates and the way forward. Dr. Alagar, Assistant Professor, CRS, Aliyarnagar, Tamil Nadu in his presentation, highlighted the morphology, the assessment of the occurrence of parasitoids and predators. Dr. Ramadevi, Senior Scientist & Head (PP), Dr. YSR Horticulture University, Venkataramannagudem explained antagonistic fungi, Isaria fumosorosea and its rice grain formulation of new strain pfu5 mother culture obtained from NBAIR, Bengaluru.

The panel discussion was chaired by Smt. G. Jayalakshmi, IAS, Chairperson, CDB and co chaired by Dr. Kumar Nallur Krishna, Regional representative, South and Central Asia, Bioversity International and Dr. Maheswarappa, Coordinator (Palms), AICRP (Palms), CPCRI. Smt. G. Jayalakshmi, IAS emphasized that a standard protocol (POP) is to be developed by the research institutes urgently considering the variation in the pest behavior in different states. Co chairman Dr. Kumar Nallur Krishna, regional representative indicated that all the five species are to be compared and DNA to be coded and R&D and DNA fingerprinting facilities must be improved to anticipate and avoid the dangers before the invasive pest entry in the country. Since there is a pan India responsibility on this issue the policies for effective quarantine also should be made.

At the plenary discussion, considering the vast spread of the menace being a potential threat to the coconut industry, the participants agreed on an urgent need for quick management measures. Conservation of biological control and health management strategies could be area-wide implemented through farmer-participatory and in community mode by all stakeholders to tackle the pest.
Capacity development programme for farmers/entrepreneurs/Farmer Producer Organizations on Quality planting material production in coconut sponsored by Coconut Development Board was conducted at ICAR-Central Plantation Crops Research Institute, Kasaragod during 17 and 19 February 2020.

Thematic areas related to planting material production in coconut such as improved varieties of coconut, mother palm selection, seed nut collection and storage, selection of nursery site, preparation of nursery bed and sowing, providing shade, weeding and irrigation in nursery, pest and disease management in nursery, hybridization technique in coconut, quality assurance mechanism to be implemented in coconut seedlings, concept and practice of participatory decentralised planting material production in coconut, support to FPOs for coconut seedling production by CDB etc were covered under the capacity development programme.

17 selected farmers, entrepreneurs and office bearers of coconut FPOs from different parts of Karnataka state including Mandya, Tiptur, Davengere, Kundapura, Kumta and Sullya participated in the programme.

The programme was inaugurated by Dr. Anitha Karun, Acting Director, CPCRI. Dr. H.P. Maheswarappa, Project Co-ordinator, AICRP on Palms welcomed the gathering. Dr. Thamban, C., Principal Scientist and Course Co-ordinator briefed about the capacity development programme and Dr. K. Samsudeen, Principal Scientist proposed vote of thanks.

Dr. K. Muralidharan, Head, Division of Social Sciences distributed certificates to the participants in the valedictory programme.

Report prepared by : Dr. Thamban, C., Principal Scientist (Agrl. Extension), ICAR-CPCRI, Kasaragod
**Krushi Odisha 2020**

Coconut Development Board participated in Krushi Odisha-2019 at Janta Maidan, Bhubaneswar from 20th to 24th January, 2020. Exhibition, Investors Meet, Farmer Scientist Interactions, Farmers Felicitations, Extension Functionaries Conferences and Cultural Programme were conducted as part of the programme. 224 stalls of different government as well as private organizations attended and showcased their products in the fair.

The programme was inaugurated by Honourable Chief Minister, Shri. Naveen Patnaik on 20th January, 2020 at Janta Maidan, Bhubaneswar in the presence of State Agriculture Minister Dr. Arun Sahoo, Chief Secretary of Odisha, Shri Asit Kumar Tripathy and Shri R. Raghu Prasad, IFS, Commissioner cum Secretary Fisheries & ARD, Odisha. The Coconut Development Board, State Centre, Pitapalli participated in "Krushi Odisha-2020 and showcased different value added products & the ongoing schemes of Coconut Development Board. Around 3000 visitors including 1600 farmers visited the stall of Coconut Development Board. Leaflets, Booklets & Journals were distributed among the visitors.

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**Sri Ramakrishna Mela & Exhibition**

Coconut Development Board, State Centre, Kolkata participated in Sri Ramakrishna Mela-cum-Exhibition and 53rd Annual Celebration of Ramakrishna Mission Lokasikha Parishad and Agricultural Training Centre at Ramakrishna Mission Ashram at Narendrapur held from 21st to 25th January, 2020.

Srimat Swami Suvinananda, General Secretary, Ramakrishna Math & Mission, Belur Math, Dr. Ashis Banerjee, Hon’ble Minister-In-Charge, Agriculture, Govt. of West Bengal, Sri B.P. Gopalika, IAS, Additional Chief Secretary, Dept. of Animal Resource Development, Govt. of WB, Dr. Pallab Das, Chairman, Rajpur- Sonarpur Municipality, Rashid Munir Khan, IPS, SP, Baruipur were present in the inaugural function of Sri Ramakrishna Mela-cum-Exhibition.

Coconut Development Board displayed various varieties of coconut convenience food, value added products from coconut kernel, coconut shell and coconut water, coconut shell/wood based handicrafts and by-products and various leaflets, books and publications on coconut & postures on the nutritional and health benefits of coconut in the stall and interacted with officers of the Board.

The valedictory session was conducted on 25th January 2020. Dr. Amarendra Mahapatra, President, West Bengal Council of Rabindra Open Schooling, Sri Amitava Bagchi, Secretary, West Bengal Council of Rabindra Open Schooling, Smt. Shaon Sen, Director, West Bengal Swarojgar Corporation Ltd and Shri. Rajeev Bhushan Prasad, Director, CDB, Regional Office, Patna, Bihar were present. South 24 Paraganas being a major coconut growing district of west Bengal, participation in the Mela-cum-Exhibition 2020 helped to create awareness on the goodness of coconut.
Cultivation practices for coconut -March

Collection and storage of seed nuts
Continue seed nut collection from the identified mother palms. Seed nuts should be carefully harvested and properly stored to prevent drying of nut water. Wherever the ground surface is hard, harvested bunch should be lowered to the ground using a rope.

Fertilizer application
In irrigated coconut gardens, apply one fourth of the recommended dose of chemical fertilizers to the coconut palms.

Nursery management
Continue irrigation for the seedlings in the nursery. Weeding has to be done wherever necessary. If termite infestation is noted in the nursery drenching with chlorpyriphos (2ml chlorpyriphos in one litre of water) should be done. Spiralling white fly infestation is observed in coconut nurseries in many localities. Spraying of water on the lower surface of leaves of seedlings can be done against spiralling white fly attack.

Irrigation
Irrigation has to be continued in coconut gardens. If basin irrigation method is adopted, provide irrigation once in four days @ 200 litres per palm. Drip irrigation is the ideal method of irrigation for coconut. The number of dripping points should be six for sandy soils and four for other soil types.

Moisture conservation
Scarcity of water for irrigation during the peak summer days will be a major problem in most of the coconut growing areas. Hence, it is imperative that
coconut growers judiciously use water for irrigation. Drip irrigation has to be adopted to save water. Mulching and other soil and moisture conservation practices should be adopted if not done earlier. In water scarce areas, wherever feasible, life saving/protective irrigation has to be provided to coconut palms. Mulched materials are to be removed in the basin before giving such life saving/protective irrigation and immediately after providing irrigation the basin should be covered again with the mulching materials.

Shading
Shade has to be provided for the newly planted seedlings, if not already provided.

Management of pests and diseases
The month of March remains dry throughout, however, some summer showers at random could reduce the heat intensity and accelerate some humidity favouring outbreak of pests. The sucking pests such as whiteflies as well as coconut eriophyid mite could increase during the period. The slug caterpillar endemic regions should be strictly monitored and precautions should be carried out to prevent expansive spread by destroying pest-laden older leaves. Rugose spiralling whiteflies will find weather conditions very conducive and therefore suitable health management approaches such as nutrition and watering is very critical to upkeep proper health so as to put forward extra foliage to counter pest attack. Coconut seedlings in nurseries should be strictly monitored for rugose spiralling whitefly and nesting whiteflies. The odour plumes of deteriorating palm residues in the cyclone affected areas of Andhra Pradesh and Tamil Nadu could orient the red palm weevil for egg laying in the standalone palms for which strict monitoring is warranted. Crop residue burning on the palm basin should be avoided or it may soften trunk issues paving entry of stem bleeding and basal stem rot pathogens. March is thus known for strict monitoring days for maintaining good palm health and evading pest attack.

Red palm weevil (*Rhynchophorus ferrugineus*)
Incidence of rhinoceros beetle, would subsequently induce the invasive potential of the killer native pest, viz., the red palm weevil, which needs an injury for the weevils to orient towards the palm cue and lay eggs. Yellowing of leaves in mid whorl region, oozing of brown fluid, presence of bore holes, choking of spindle region and gnawing sound of grubs heard along the trunk are some early symptoms for timely diagnosis of pest damage. Farmers fail to detect the pest damage at an early stage due to concealed habitat of the pest. Dwarf genotypes and palms aged between 5-15 years are relatively more susceptible. All life stages of the pest were noticed inside the infested palms. Being a fatal enemy of palms, 1% action threshold has been fixed.
leave out at least one metre from palm trunk when petioles are cut.

- Complete destruction of pest affected palms / crown topped palms immediately
- Crop geometry and correct spacing is very crucial to reduce pest attack.
- Timely and targeted spot application of imidacloprid 0.002% (1 ml per litre of water) or indoxocarb 0.04% (2.5 ml per litre of water) on infested palms would kill the feeding grubs and induces recovery of palms by putting forth new spear leaf.
- Crop-habitat diversification (Ecological Bio-engineering) through coconut based cropping system strategy inciting defenders and pollinators would diffuse the palm-linked volatile cues and encouraged pest suppression. Diversified cropping system reduced pest incidence than mono-cropping.

**Coconut eriophyid mite, Aceria guerreronis**

Coconut eriophyid mite is the invasive pest reported from our country during 1998 and has been on the rise during post-winter season. It belongs to the spider family with two pairs of legs, sub-microscopic (200-250 microns size), lays about 100-150 eggs and the life cycle completed in 7-10 days. Mites infests the developing nuts immediately after pollination and are confined within the floral bracts (tepals) and feeds on the meristematic tissues beneath the perianth. Appearance of elongated white streak below the perianth is the first visible symptom. Within few days, yellow halo appears round the perianth, which turns as warts and finally develops as cracks, cuts and gummosis. Shedding of buttons, immature nuts, malformation of nuts are other indications of mite damage.

**Management**

- Removal and destruction of dried spathes, inflorescence parts and fallen nuts to subdue the pest population
- Spraying 2% neem-garlic emulsion or azadirachtin 10000 ppm @0.004% or root feeding with neem formulation containing azadirachtin 10000 ppm at 10 ml with equal volume of water three times during March-April, October-November and December –January is recommended.
- Application of talc-based preparation of acaropathogen, Hirsutella thompsonii@ 20 g / litre/ palm containing 1.6 x 108cfu three times in synergy with neem formulation.
- Kalpaharitha (a selection from Kulasekharam Tall) was found field tolerant to mite damage.
- Application of recommended dose of fertilizers, recycling of biomass, raising of green manure crops in palm basin and incorporation during flowering, summer irrigation including soil and water conservation measures improve the palm health and reduce the pest attack.

**Rugose Spiralling Whitefly (Aleurodicus rugioperculatus)**

This period could also witness the establishment of the invasive rugose spiralling whitefly (Aleurodicus rugioperculatus) in new areas as well as re-emergence in already reported areas. The pest population is increasing very high due to favourable weather factors of high day temperature and fall in relative humidity. Presence of whitefly colonies on the under surface of palm leaflets and appearance of black coloured sooty mould deposits on the upper surface of palm leaflets are characteristic visual symptoms of pest attack. In severe cases, advancement in senescence and drying of old leaflets was observed. Leaflets, petioles and nuts were also attacked by the whitefly pest and a wide array of host plants including banana, bird of paradise, Heliconia sp. were also reported. Continuous feeding by whiteflies cause health deterioration in palms for which agronomic care is very critical.

**Management**

- In juvenile palms, spraying of water with jet speed could dislodge the whitefly and reduce the feeding as well as breeding potential of the pest.
- Ensure good nutrition based on soil-test recommendations and adequate watering to improve
the health of juvenile and adult palms. Agronomic health management of palms is very crucial including planting of intercrops wherever possible to diversify volatile cues and improve microclimate disfavouring flare up of whitefly.

- No insecticide should be used as this causes resurgence of the pest and complete kill of the natural aphelinid parasitoid, Encarsia guadeloupae. A pesticide holiday approach is advocated for the build up of the parasitoid.
- Installation of yellow sticky traps and conservatory biological control using E. guadeloupae could reduce the pest incidence by 70% and enhance parasitism by 80%.
- Habitat preservation of the sooty mould scavenger beetle, Leiochirinus nilgirianus could eat away all the sooty moulds deposited on palm leaflets and cleanse them reviving the photosynthetic efficiency of palms.
- A close scrutiny should be made for the presence of other whiteflies including the nesting whiteflies on coconut system.

Nesting whiteflies (Paraleyrodes bondari and Paraleyrodesminei)

In addition to the rugose spiralling whitefly, two more nesting whiteflies (Paraleyrodes bondari and Paraleyrodes minei) are found associated with palm leaflets. Nesting whiteflies are smaller in size (1.1 mm) than rugose spiralling whitefly (2.5 mm). The nymphs are flatter with fibreglass like strands emerging form dorsum whereas the nymphs of rugose spiralling whitefly are convex in shape. Adult nesting whiteflies construct bird's nest like brooding chamber and sustains in the chamber. P. bondari had X-shaped oblique black marking on wings with two minute projections on rod shaped male genitalia whereas P.minei is devoid of black markings on wings and possesses cock-head like genitalia. Nesting whiteflies compete with rugose spiralling whitefly and reduce the aggressiveness of rugose spiralling whitefly in many cases.

Management

- In juvenile palms, spraying of water with jet speed could dislodge the whitefly and reduce the feeding as well as breeding potential of the pest.
- Ensure good nutrition and adequate watering to improve the health of juvenile and adult palms
- Effective nitidulid predators belonging to Cybocephalus sp. were observed on the palm system and pesticide holiday is advised for conservation biological control.

Slug caterpillars (Darna nararia)

Emergence of slug caterpillar, Darna nararia is East Godavari district, Andhra Pradesh and Tumkur, Karnataka could happen as this period is quite conducive for the population build up especially on coconut palms planted along the river beds and brackish water zones. Several hundreds of caterpillars would congregate and feed from under surface of palm leaflets, causing glistening spots and in synergy with grey leaf blight disease complete scorching of leaflets could be observed. In severe cases, complete defoliation was realized and only midribs will be spared. High temperature and cool weather could be one of the triggering factors.

Management

- Complete destruction of affected palm leaflets with caterpillar at early stages of infestation should be made immediately so that the pest build up is
suppressed. Care should be taken as the caterpillars cause extreme itching when contacted with human skin due to the presence of poisonous scoli.

- Establishment of light traps and spraying *Bacillus thuringiensis* 5 g/litre was found effective along with inundative biological control using the eulophid larval parasitoid, *Pediobius imbrues*.

**Stem bleeding** (*Thielaviopsis (Ceratocystis) paradoxa*)

This disease is mostly confined in the acid soils of Kerala and becomes quite explicit during the period. Conspicuous exudation of reddish-brown gummy fluid is visible on the trunk which turns black on drying. It could be observed initially as small bleeding patch along the longitudinal crack, which later coalesce and form extensive lesion. The tissues underneath show tremendous discoloration and decay subsequently. In advanced stage of infection, outer whorls of leaves turns yellow, dry and shed prematurely affecting the overall health of the palm. Invasion by scolytid beetles such as *Diocalandra* and *Xyleborus* would further weaken the stem.

**Management**

- Avoid burning of trash and palm residues near the trunk to avoid trunk/root injury
- Adequate irrigation and adoption of soil and water conservation measures is advised.
- Application of 5 kg of neem cake enriched with *Trichoderma harzianum* and soil test based nutrition.
- Application of paste of *Trichoderma harzianum* talc formulation on the bleeding patches on the trunk was also found effective in preventing the spread of stem bleeding.

**Basal stem rot disease** (*Ganoderma spp.*)

It is a destructive disease observed in all coconut growing regions and found very severe in soils with higher pH and moisture stress condition. The pathogen invades the root system during early stages of infection that are not visibly noticed. Very severe in areas of Thanjavur, Tamil Nadu, parts of East Godavari, Andhra Pradesh and Ariskara, Karanataka. The outer whorl of leaves turn yellowish, then gradually become brown and droop from their point of attachment and hang vertically downwards to form a skirt around the trunk apex. In course of time, the apex of the trunk shows tapering with the advancement of the disease, and bleeding symptoms may appear on the bole region. At the base of the stem a characteristic reddish brown discoloration develops, accompanied by the exudation of a brown viscous gummy substance. These brownish patches may extend up to one metre from ground level and at times bark pealing was also observed. Sometimes fruiting bodies (basidiocarp) of the pathogen develop from the affected trunk.

**Management**

- Avoid burning of trash and palm residues near the trunk to avoid trunk/root injury
- Removal of dead palms and palms in advanced stage of the disease as well as destruction of the boles and root bits of the diseased palms to remove disease inoculums.
- Isolation of neighboring healthy palms, by digging isolation trenches (60 cm deep and 30 cm wide) around the affected palm (1.2 m away from the base of the trunk).
- Application of neem cake (5 kg) fortified with *Trichoderma harzianum* (CPTD 28) talc formulation (50 g) per palm per year at six monthly intervals reduced the disease intensity.
- Root feeding of hexaconazole @ 2% (100 ml solution per palm) and soil drenching with 0.2 % hexaconazole or with 40 l of 1% Bordeaux mixture in the coconut basin are recommended

Hence, sustained monitoring and prophylactic treatments would suppress the damage potential of pest and disease and suitable health management strategies need to be adopted at the appropriate time. Timely pest management strategies had to be implemented in March to upkeep sound palm health for ensuring sustained production and keep away from pest and disease infections.

(Prepared by: Thamban, C. and Subramanian, P., ICAR-CPCRI Kasaragod; Joseph Rajkumar ICAR-CPCRI,Regional Station, Kayangulam)
Market Review – January 2020

Domestic Price

Coconut Oil
During the month of January 2020 the price of coconut oil opened at Rs. 16200 per quintal at Kochi, Rs. 16200 per quintal at Alappuzha market and Rs. 17400 per quintal at Kozhikode market. During the month, price of coconut oil at Alappuzha, Kozhikode and Kochi markets expressed an upward trend.

The price of coconut oil closed at Rs. 16700 per quintal at Kochi, Rs. 16700 per quintal at Alappuzha market and Rs. 18100 per quintal at Kozhikode market with a net gain of Rs.500, Rs.500, Rs. 700 per quintal at Kochi, Alappuzha, and Kozhikode market respectively.

The price of coconut oil at Kangayam market in Tamilnadu, which opened at Rs. 12933 per quintal, expressed an upward trend during the month and closed at Rs.13467 per quintal with a net gain of Rs. 534 per quintal.

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<th>Weekly price of coconut oil at major markets Rs/Quintal</th>
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Milling copra
During the month, the price of milling copra opened at Rs.10500 per quintal at Kochi, Rs.10400 per quintal at Alappuzha market and Rs.10600 per quintal at Kozhikode market. The price of Copra at all three markets in Kerala expressed an upward trend during the month.

The prices closed at Rs.11000 at Kochi, Rs.10900 at Alappuzha market and Rs.11300 at Kozhikode market with a net gain of Rs.500, Rs.500, Rs. 700 per quintal at Kochi, Alappuzha, and Kozhikode market respectively.

At Kangayam market in Tamilnadu, the prices opened at Rs. 9300 per quintal and closed at Rs.9800 per quintal with a net gain of Rs.500 per quintal.

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Edible copra
The price of Rajpur copra at Kozhikode market opened at Rs. 13300 per quintal expressed a downward trend during the month and closed at Rs.12100 per quintal with a net loss of Rs.1200 per quintal.

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<th>Weekly price of edible copra at Kozhikode market (Rs/Quintal)</th>
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Ball copra
The price of ball copra at Tiptur market which opened at Rs.11500 per quintal expressed a mixed trend and closed at Rs.10500 per quintal with a net loss of Rs.1000 per quintal.

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<th>Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)</th>
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Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.10250 per quintal expressed a downward trend during the month. The prices closed at Rs.9850 per quintal with a net loss of Rs.400 per quintal and the price was almost steady during the month.

| Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal) |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| 01.01.2020      | 10250           |                 |                 |                 |
| 06.01.2020      | 10050           |                 |                 |                 |
| 13.01.2020      | 9850            |                 |                 |                 |
| 20.01.2020      | 9850            |                 |                 |                 |
| 27.01.2020      | 9850            |                 |                 |                 |
| 31.01.2020      | 9850            |                 |                 |                 |

Coconut

At Nedumangad market the price of partially dehusked coconut opened at Rs.16444 per thousand nuts and closed Rs.18000 per thousand nuts.

At Pollachi market in Tamil Nadu, the price of coconut opened at Rs.14000 per thousand nuts and closed at Rs.16000 with a net gain of Rs.2000 per thousand nuts during the month. At Bengaluru market, the price of partially dehusked coconut opened at Rs.15000 and closed at Rs.17500 with a net gain of Rs.2500 per thousand nuts during the month. At Mangalore market the price of partially dehusked coconut opened at Rs.24000 per thousand nuts and closed at Rs.25000 per thousand nuts during the month.

| Weekly price of coconut at major markets (Rs /1000 coconuts) |
|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | Nedumangad      | Pollachi        | Bangalore       | Mangalore       |
| 01.01.2020      | 16444           | 14000           | 15000           | 24000           |
| 06.01.2020      | 16444           | 14000           | 15000           | 24000           |
| 13.01.2020      | 16000           | 15000           | 15000           | 25000           |
| 20.01.2020      | 17000           | 15000           | 15000           | 25000           |
| 27.01.2020      | 18000           | 16000           | 17500           | 25000           |
| 31.01.2020      | 18000           | 16000           | 17500           | 25000           |

International price

Coconut

The price of coconut quoted at different domestic markets in Philippines, Indonesia, Srilanka and India are given below.

<table>
<thead>
<tr>
<th>Weekly price of dehusked coconut with water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>04.01.2020</td>
</tr>
<tr>
<td>11.01.2020</td>
</tr>
<tr>
<td>18.01.2020</td>
</tr>
<tr>
<td>25.01.2020</td>
</tr>
</tbody>
</table>

Coconut Oil

The domestic price of coconut oil in India and Sri Lanka expressed an upward trend during the month. Whereas international price as well as the domestic price of coconut oil in Philippines and Indonesia expressed a downward trend during the month.

The price of coconut oil quoted at different international/ domestic markets are given below.

<table>
<thead>
<tr>
<th>Weekly price of coconut oil in major coconut oil producing countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>04.01.2020</td>
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<tr>
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<tr>
<td>18.01.2020</td>
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<tr>
<td>25.01.2020</td>
</tr>
</tbody>
</table>

Copa

The domestic price of copra at Philippines and Indonesia expressed a downward trend and Srilanka and India expressed an upward trend during the month. The price of copra quoted at different domestic markets is given below.

<table>
<thead>
<tr>
<th>Weekly International price of copra in major copra producing countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
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<tr>
<td>25.01.2020</td>
</tr>
</tbody>
</table>

* Kangayam