



Impact of changing rainfall pattern on coconut - Need to adopt mitigating measures

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Millions of families in India depend on coconut for their livelihood either directly or indirectly. As per the latest statistics available (2014-15), the annual coconut production in India is 20.44 billion nuts from an area of 1.98 million ha with an average productivity of 10345 nuts/ha. The four southern states viz., Kerala, Tamil Nadu, Karnataka and Andhra Pradesh are the major coconut producing states in India accounting for more than 90 per cent of area and production. Though economic life of coconut is considered to be around 60 years, it can survive in field for about 100 years. Hence, it is essential to provide congenial growth conditions to maintain the life of the palm for sustainable production. Coconut produces on an average one leaf and one inflorescence in every month when maintained under normal management practices. It takes about 44 months for an inflorescence bud to grow and develop to produce mature nuts. Since a palm produces an inflorescence every month, its crown has inflorescences at different stages of development throughout the year. The perennial nature of coconut and continuous production of leaves and inflorescences throughout the year requires maintenance of optimum soil moisture and adequate nutrient availability throughout the year to ensure survival of palms and sustainable yield. It has been

observed that changing patterns in climatic variables like rainfall and temperature result in the decline in yield and at times death of palms.

Rain fall distribution pattern in West coast region

In west coast regions coconut is grown mostly as rain fed crop compared to east coast regions where it is grown predominantly under irrigated conditions. Thus, in west coast regions, among the meteorological variables rain fall is considered as one of the important parameters which determine the survival of coconut palm and its productivity. Coconut prefers a well-distributed rainfall of 2000 mm/year. West coast region though receives high rain fall (>3000mm), its distribution is highly skewed. Analysis of rain fall data of 30 years (1985-2015) of Kudlu meteorological station, Kasaragod (west-coast high rainfall zone) revealed that 92% (3425.7mm) of the total rain fall is received during south west monsoon (June to September) and north east monsoon (October to December) and the remaining period January-April receive very small amount of rainfall (monthly average rainfall of 3, 5.6, 16.0 and 38 mm during January, February, March and April respectively). The month of May receives an average rainfall of 220 mm as pre-monsoon showers (Table I).

The rain fall distribution pattern indicates that

Table 1. Weather data of west coast high rain fall region as recorded at Kudlu, Kasaragod

Month	Wind speed (km/hr)			No of rainy days			Rain fall (mm)			
	Average (1985 to 2015)	Actual (June 2015 to May 2016)	Difference	Average (1985 to 2015)	Actual (June 2015 to May 2016)	Difference	Average (1985 to 2015)	Actual (June 2015 to May 2016)	Difference	% difference
June	3.69	3.1	-0.59	24	24	0	997.3	643.8	-353.5	35.5
July	3.02	1.7	-1.32	27	25	-2	897.2	806	-91.2	10.2
Aug	2.36	1.3	-1.06	24	20	-4	630.1	437.6	-192.5	30.6
Sept	2.33	1.6	-0.73	13	12	-1	279	224.4	-54.6	19.6
Oct	2.28	2	-0.28	11	13	2	221.4	357.2	135.8	61.3
Nov	2.13	1.5	-0.63	4	6	2	105.3	127.3	22	20.9
Dec	2.23	1.7	-0.53	1	2	1	11.99	22.2	10.21	85.2
Jan	2.43	1.8	-0.63	0	1	1	2.993	5.7	2.71	90.6
Feb	2.73	2	-0.73	0	0	0	5.643	0	-5.64	100
Mar	3.09	2.5	-0.59	1	0	-1	16.09	0	-16.09	100
Apr	3.31	2.6	-0.71	1	0	-1	38.81	0.2	-38.61	99.5
May	3.19	2.3	-0.89	7	8	1	219.9	154.2	-65.7	29.9

optimum soil moisture content is available for coconut growth from June to November and from there on wards the available soil moisture declines rapidly because of no rain or insignificant amount of rain received during the period from January to February. However, the rain received during March and April helps in the survival of palms grown under rain fed condition. From May onwards sufficient amount of pre monsoon showers are received which helps in survival of palms and improving the productivity of palms. Changes in rainfall distribution pattern at times results in reduction of amount of rainfall received during the south west and north east monsoons coupled with total failure of rain during summer months, especially during March and April. This kind of changes in the rainfall pattern adversely affects coconut palms and there were reports of widespread crop loss during current year from many localities in North Kerala.

Changes in rainfall pattern and impact of moisture stress on coconut

In response to the reports received from coconut farmers and extension personnel of State Department of Agriculture, a team of scientists from ICAR-CPCRI Kasaragod conducted diagnostic field visits to different localities in Kozhikode, Kannur and Kasaragod districts. The damage to coconut palms was attributed to unknown diseases. However, after the careful examination of damaged palms, the reason for drying and mortality of coconut palms was diagnosed as severe moisture stress prevailed during March, April and May. Some of the palms affected by moisture stress also succumbed to Ganoderma /Thanjavur wilt. In the affected localities yellowing of lower leaves of coconut palms was observed during the first fortnight of February. Subsequently the leaves dried and their petioles were broken. By the first



fortnight of March all these dried leaves had fallen leaving few green leaves on the crown. These symptoms were initially perceived to be due to the incidence of Ganoderma wilt disease. But in majority of the palms the petiole was broken which is the symptom of moisture stress. Further, in these palms the lower dried leaves fell off and subsequently the top leaves also fell off even in the event of low wind velocity.

The analysis of rain fall data recorded at Kasaragod, the northern most district of Kerala, for the period June 2015 to May 2016, revealed that out of 2800 mm rain received during the period, 2111.8 mm of rain was received from south west monsoon from June to September and 506.7 mm during the post monsoon season from October to December. The period from January to May 15th received only 4.8 mm of rain that too on a single day i.e 23rd January 2016. Afterwards there were no rains till May 15th 2016. The data on rainfall distribution clearly indicated that the palms were subjected to severe moisture stress during the long dry spell. This stress situation adversely affected the palms which lead to the yellowing followed by drying and shedding of leaves (Fig. 1). The rainfall data for the region also brought out the fact that there was a deficiency of 19 per cent in the total rainfall received during the season from June to December in 2015 when compared to the 30 years average of rainfall for the same season. From February to May 15th there was no rain, and the coconut palms exposed to water stress also experienced severe nutrient stress as nutrient uptake was also affected badly. It was also observed that majority of coconut growers have not adopted the integrated nutrient management practices required for coconut. Most of them applied only organic manures and that too not in sufficient quantity and frequency. Deficiency of potassium in the soil is known to make palms more susceptible to moisture stress, diseases and pest attack. It is clear that survival of coconut palms under rain fed situation heavily depends on the receipt of normal monsoon along with receipt of summer showers especially during the months of March and April in the west coast region.

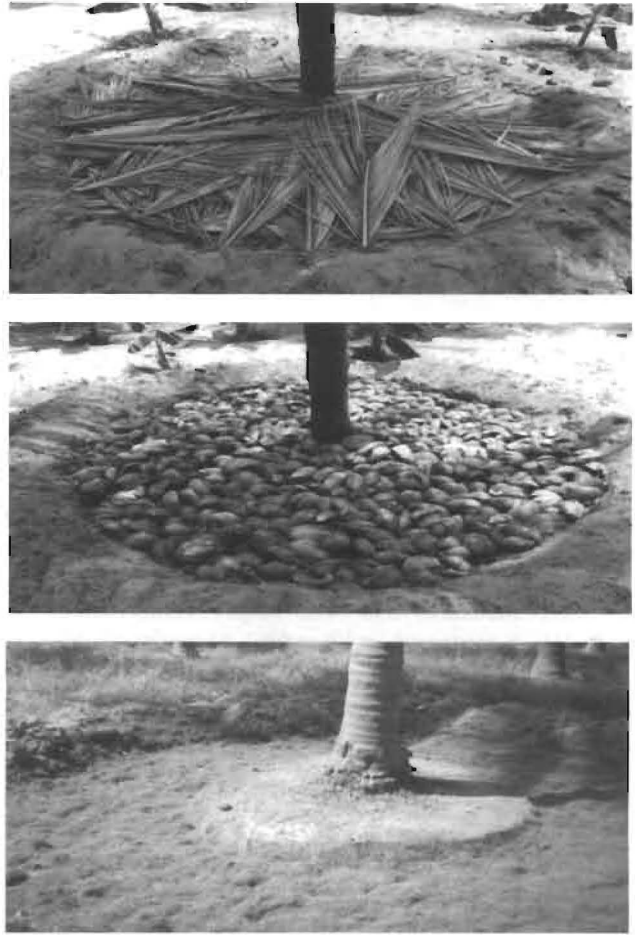


Fig- 2

To mitigate the adverse impact of change in the rainfall pattern in the west coast region, especially in localities where coconut palms are maintained under rain fed situation, coconut growers are to be informed about the importance of adopting appropriate mitigating measures. Emphasis should be on conserving the soil moisture in coconut garden with suitable agro techniques. Further, in the water scarce localities, adoption of water saving techniques such as drip irrigation is highly recommended.

Table 2. Weather data of west coast high rain fall region as recorded at Kudlu, Kasaragod during current monsoon season (June 2016 to August 2016)

Month	Wind speed (km/hr)			No of rainy days			Rain fall (mm)			
	Average (1985 to 2015)	2016	Difference	Average (1985 to 2015)	2016	Difference	Average (1985 to 2015)	2016	Difference	% difference
June	3.69	2.2	-1.49	24	25	+1	997.3	976.6	-20.7	2.1
July	3.02	1.8	1.22	27	29	+2	897.2	724	-173.2	19.3
Aug	2.36	1.4	0.96	24	26	+2	630.1	470.8	-159.3	25.3

In case of non receipt of rain during January to March, at least one life saving irrigation has to be provided to the palms by March 15th to save the palms. If the lack of rain continues, probably one or more life saving irrigation has to be provided at any cost to save the palms. Apart from soil and water conservation measures, integrated nutrient management practices also should be adopted to maintain palm health to overcome the adverse situations of moisture and nutrient stress.

Further analysis of rain fall data for the current monsoon season revealed that there was a deficit of rain fall starting from June 2016 to August 2016 (Table 2) and the deficit ranges from 2.1% to 25.3 %. This will further aggravate the problems of the survival of coconut palm. Hence, it is necessary to adopt mitigation measures for the survival of the coconut palm.

ICAR-CPCRI has evolved various simple and cost effective soil and moisture conservation and water harvesting techniques for coconut. The effectiveness of such measures has been amply demonstrated by CPCRI, Kasaragod in farmers' coconut gardens in north Kerala under Farmers Participatory Research Programme (FPARP) sponsored by Ministry of Water Resources, Govt. of India and NAIP project on value chain sponsored by ICAR.

Soil and moisture conservation measures in coconut

Mulching coconut basins with leaves, coir pith etc.

In order to conserve soil moisture in the coconut plantation, mulching with various types of organic materials viz., coconut leaves, husk and coir pith can be practiced which helps to reduce soil temperature and evaporation from soil surface and create conditions for proper root growth and proliferation of soil flora and fauna (Fig 2). The best time for mulching is before the end of the monsoon and before the top soil dries up.

For mulching, cut coconut leaves into two or three pieces. To cover 1.8 m radius of coconut basin, 15 to 25 fallen coconut leaves are required and can be spread in two to three layers. Leaf mulch prevents the top soil from getting heated up and this reduces the evaporation from the basin area. Mulching with coir pith to 10 cm thickness (approximately 50 kg/palm) around coconut basin is also ideal method to conserve moisture. Due to its fibrous and loose nature, incorporation of coir pith considerably improves the physical properties and water holding capacity of soil and thereby increases the coconut productivity.

Coconut husks and coir pith can hold moisture to the tune of three to five times of its weight. Approximately 250 to 300 husks are required for one coconut basin. Mulching is usually done upto a radius of 2 m. Besides conserving soil moisture, coconut husk is an important



Fig - 3

organic material and a good source of plant nutrients. On dry weight basis, the average composition of material is 0.23% N, 0.04 % P₂O₅ 0.78% K₂O, 0.08 % Ca and 0.05% MgO. On an average, husk constitutes 45% of the weight of nut and on this basis, a nut weighing 1,000 g will have 450 g of husk with 20% moisture. Decomposition of the mulches after a period of time results in enrichment of soil organic matter pool.

Mulching of coconut basin could also be done with other organic wastes as completely dried weeded material etc.



Fig - 4

Coconut husk burial in the interspaces of coconut garden

Trenches of 50 cm width x 50 cm depth and convenient length would be made in between two rows of coconut palms. These trenches would then be filled with coconut husk. Coconut husks need to be filled in layers with the bottom layers facing up and top layer facing down.

Half-moon bund around coconut basin reinforced with pineapple

This measure is to be taken up where there is mild slope (15-20%). Here a flat basin with a slight inward slope towards upstream is made by excavating soil from the upstream side and filling the excavated soil at the downstream side (Fig. 3). After making the basin a bund of 30 cm height and >50 cm width is made at the downstream side of the coconut using the excavated soil. Two layers of pineapple plants would be planted with a spacing of 20 cm row to row and 20 cm plant to plant on the bund. The bund prevents runoff and water gets collected within the basin and percolates down. Pineapple would help to protect the bund and stabilize the same in addition to giving fruit yield.

Trench filled with coconut husk

This measure is to be taken up where the land slope is high. Trenches of 50 cm width x 50 cm depth and convenient length would be made in between two rows of coconut palms (Fig. 4). These trenches would then be filled with coconut husk. Coconut husks need to be filled in layers with the bottom layers facing up and top layer facing down. A bund stabilized with crops like pineapple can also be made at the downstream as mentioned in case of half moon bund.

Catch pits with pineapple border

Catch pits with a dimension of 1.5 m length x 0.5 m width x 0.5 m depth can be constructed at all slopes to conserve soil and water. A bund is to be made at the downstream using the excavated soil and pineapple



Fig - 5

plants planted on it. This pit also may or may not be filled with coconut husk.

Cover crops as green manure and to reduce soil erosion

Crops like calopogonium, pueraria, cowpea etc. can be grown as cover crops in coconut gardens where mild to steep slopes are prevalent. Growing of cover crops protect the soil from the beating effect of rain especially during high intensity of rainfall thus helping in the percolation of the rainwater. This also helps in preventing the soil as well as nutrient loss.

Conclusion

Survival of coconut palms under rain fed situation heavily depends on the receipt of normal monsoon along with receipt of summer showers especially during the months of March and April in the west coast region. Deficit of rainfall during monsoon seasons and lack of summer showers adversely affect coconut production. To mitigate the adverse impact of change in the rainfall pattern in the west coast region, especially in localities where coconut palms are maintained under rain fed situation, adoption of technologies for conserving soil and moisture is essential. Integrated nutrient management should also be a part of the strategies for mitigation of problems related to climate changes. ■