Original Research Article

Problems encountered byCoconut growers by adopting TNAU Coconut tonic and their perceived benefits

ABSTRACT

Aim: The study aims to analyse the problems encountered byCoconut growers by adopting the TNAU Coconut tonic and their perceived benefits

Study design: Ex post facto research design.

Place and Duration of Study: The study was conducted in theCoimbatore district which represents a major coconut-growing tract of theWestern zone of Tamil Nadu.

Methodology: From the Coimbatore district of Tamil Nadu, 120 Coconut growersfrom three different blocks namely Pollachi (North), Pollachi (South) and Anaimalai block were purposively selected for conducting the study. Data were collected from coconut growers who are all adopting TNAU Coconut tonic. The well-structured pre-tested interview schedule was used to collect data from farmers. Garrett ranking and weighted average method were computed to analyse the constraints and perceived benefits of coconut growers who are all adopting the TNAU Coconut tonic as their nutrient management practices.

Results: The major constraints werereported by the growers viz.,availability of tonic at TNAU (8.75%), Unskilled labour (8.57%), difficulty to identify the root (8.04%), theabsorption rate of tonic is low (7.92%), non-availability of labour (7.31%), high cost of labour (7.13%), High cost of crop boosters (6.81%), poor knowledge onthe availability of tonic at TNAU Agri cart, Coconut Research Station, Aliyar & Courier services (6.45%) as major constraints. The obtained key benefits include increased chlorophyll content and greenness of leaves (16.93%), improved photosynthetic efficiency of leaves (11.73%), decreases button shedding (30.53%), increased number and size of nut (22.27%), increased nut yield up to 20 per cent (18.20%), increased longevity and vigour of the palm (19.40%) and resistance to pests, diseases and environmental stresses (24.20%) shows that maximum number of coconut growers benefited by adopting TNAU Coconut tonic.

Conclusion:
To overcome these constraints, concerted efforts from researchers with government and institutional support set forth the easy adoption of TNAU Coconut tonic. The adoption of TNAU Coconut tonic technology brings forth a multitude of perceived benefits to the coconut growers, along with their conventional, recommended nutrient management practices and the livelihood of coconut growers will be improved.

Keywords:*Coimbatore; TNAU Coconut tonic; technological and labour constraints; perceived benefits; institutional support.*

1. INTRODUCTION

The coconut (*Cocos nucifera L*.) serves as a monocot classified into the Arecaceae, subfamily Arecoideae and isthe only species in the genus Cocos (Gurbuz and Manaros 2019).Coconutis predominantly grown in humid tropics and is located within 23 degrees north and 23 degrees south of the equator to an altitude of 600 meters from above mean sea level for coconut production (Kumar and Aggarwal 2013). Temperature ranges from 20° to 32° Celsius with mean annual temperature of 27° Celsius for better yield. Rainfall is distributed equally throughout the year; a total of 1000 mm is adequate.In thewestern zone of Tamil Nadudue to more suitable climate(Hebbar, Abhin et al.

2022),the maximum productivity under coconut cultivation was majorly in theCoimbatore district with an area of 88467.00 hectares, annual production of 13,237.00 million nuts and productivity of 14,963 nuts/hectares (Department of Agriculture & Co-operation, Ministry of Agriculture & Farmers Welfare (Horticulture division), Govt. of India, 2021). In despite of the state, it is impractical to expand the productionarea-wise due to pests and disease attacks, environmental distress, water deficit, utilization of land for other purposes and unavailability of labour. Because of urban development and other socioeconomic factors, the usable land for coconut cultivation would rapidly diminish(Hebbar, Abhin et al. 2022).As a result,productivity should be increased within the existing area by using site-specific technologies (Srinivasan, Kumar *et al*. 2021).One of the harmful effects of chemical fertilizers were depleting our environment and ecosystem, as pointed out by (Sudha, John et al. 2021). Inpalm production the enhanced tree growth characteristics and yield attributes i.e., improved button nut productivity and nut setting and hence increasing yield while adopting the improved technologies (Jayakumar, Janapriya *et al*. 2017). Although the coconut palm yields fronds and nuts areyear-round, it requires a steady supply of necessary nutrients from the soil. In a coconut system, nutrient replacement demands increase faster than uptake and loss, and because root surface for absorption is limited, it is critical to keep nutrient supply at a level of modest extravagant consumption (Hameed Khan. H. 1993).The interaction effect of potassium and boron application on improving nut productivity encompassed that improved yield (15642 nuts/ha/year) (Babu S. *et al*. 2022). Thus, the coconut was commercially cultivated, the coconut growers lack the potential yield is due to unaware of scientist-generated innovations and technologies and are not persuaded to accept the latest technology in their fields (Archana *et al*. 2022).

A nutritional crop booster is a complex mixture of all the essential nutrients that the crop requires for proper vegetative development and growth. It mostly contains nutrients that are unavailable in thesoil for each crop. Each plant will require a different crop booster based on its growth and development requirements. Considering the problems faced by coconut growers around the coconut belts of Tamil Nadu, the Department of Crop Physiology, the crop booster's division, Tamil Nadu Agricultural University released the "TNAU Coconut tonic" (A technique of feeding nutrients to trees through the root) during the year 2003 for the welfare of coconut growers. The technology provides the application of nutrients and growth regulators in the form of liquid directly to theroot of the plant. Hence, the study will examine the constraints encountered by coconut growers to adopt the TNAU Coconut tonic technology and the key advantages attained by farmers after using the root feeding of TNAU Coconut tonic over the years.

2. MATERIALS AND METHODS

2.1 Research location

The deliberate selection of the Coimbatore district was made in part because of the importance of coconut farming. This district was selected, since it has the maximum area covered in coconuts of any district in the state, as well as the highest productivity. The major perennial crop raised in the district was coconut (49% of thenet sown area) and 28.2 per cent of thetotal area in the plantation crop, it could be seen that coconut is the predominant crop of the district with an area of 83887 ha (According to TNRTP- Coimbatore DDR, 2019). For this, theCoimbatore district was purposively chosen and three blocks (Pollachi (North), Pollachi (South) and Anaimalai block) were selected purposively.

2.2 Data collection

A well-structuredpre-tested interview schedule was prepared forthe collection of constraints and perceived benefits obtained by coconut growers while adopting TNAU Coconut tonic. After contacting the respondents, the gathered data were coded and tabulated for statistical tests to get meaningful results.

2.3 Research design

An ex-post-facto research design was used for the present study to be consistent with the research objective. The sampling unit was coconut growers adopting TNAU Coconut tonic. From each block,

40 coconut growers were selected randomly withasample size of 120 respondents from the Pollachi taluk of Coimbatore district.

a

2.4 Statistical tools employed

Garret ranking

Garrett's ranking encompasses the score for constraints and advantages. The major benefit of this technique over simple frequency distribution is that the constraints are decided based on their seriousness from the point of view of respondents Garrett's formula for converting ranks into percent is:

Percent Position Value= 100* (Rij-0.5)/ Nj

Were,

Rij = rank given for ith constraint bythejth individual;

Nj = thenumber of constraints ranked by jth individual.

The per cent position of each rank will be modified into scores withthe help of the table given by Garrett and Woodworth (1969). For each constraint, the scores of individual respondents will be added together and divided by the total number ofrespondents. These mean scores for all the constraints will be arranged in descending order; the constraints will be accordingly ranked.

Weighted average

A weighted average is a calculation that takes into account the varying degrees of importance of the numbers in a data set. In calculating a weighted average, each number in the data set is multiplied by a predetermined weight before the final calculation is made. A weighted average can be more accurate than a simple average in which all numbers in a data set are assigned an identical weight.

$$W = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i}$$

Where,

W = Weighted average

n = number of terms to be averaged

w_i = Weights apply to X values

X_i = Data values to be averaged

$\sum_{i=1}^{n} w_i X_i$ = Sum of numbers with theweighting factor

$\sum_{i=1}^{n} w_i$ = Sum of all the weights

3. RESULTS AND DISCUSSION

3.1 Problems Encountered byCoconut Growers by Adopting TNAU Coconut Tonic

The coconut growers facevarious constraints while adopting the TNAU Coconut tonic in different categories viz., technological constraints, labour constraints, economic constraints and accessibility constraints as listed in Table 1.

Table 1. Ranking of constraints faced by coconut growers while adopting root feeding technology of TNAU Coconut tonicn= 120

S. No.	Constraints	Sum	Average score	Percentage	Garrett rank
A.	**Technological constraints**				
1.	Difficult to identify the root	7248	60.40	8.04	3
2.	Low absorption rate of tonic	7139	59.49	7.92	4
3.	Loss of tonic due to packet damage	4921	41.01	5.47	12
4.	Lack of awareness on mixing and quantity of application	4924	41.03	5.46	11
5.	Lack of adequate training and demonstration	5428	45.23	6.02	10
6.	Poor post care maintenance	3901	32.51	4.33	15
7.	Involvement of private players	6214	51.78	6.9	7
8.	No difference in yield and income	4857	40.48	5.39	14
B.	**Labour constraints**				
9.	Non-availability of labour	6584	54.87	7.31	5
10.	High cost of labour	6427	53.56	7.13	6
11.	Unskilled labour	7719	64.33	8.57	2
C.	**Economic constraints**				
12.	High cost of crop boosters	6137	51.14	6.81	8
13.	Additional costs incurred for thecost of cultivation	4916	40.97	5.45	13
D.	**Accessibility constraints**				
14.	The tonic is only available at TNAU	7890	65.75	8.75	1
15.	Poor knowledge oftheavailability of tonic at TNAU Agri cart, Coconut Research Station, Aliyar & Courier services	5815	48.46	6.45	9
	Total	90120		100	

A. Technological constraints

Difficult to identify the root (8.04%) was one of the predominant technological constraints as expressed bythe majority of coconut growers and rank 3 is due to thenon-availability of skilled labour. This finding is in line withthe findings of (Kalarani, Raja *et al*. 2009). The absorption rate of tonic is low was reported by coconut growers (7.92%) with rank 4 due to excess moisture retained in the soil while root feeding of the tonic. Thus, the absorption rate of tonic by the roots was low in water-logged soil when compared to non-water-logged soil. The time taken for absorption of the tonic was 6-8 days.

This finding was in close contact withthe findings of (Kalarani, Raja *et al.* 2009). Loss of tonic due to packet damage (5.47%) with rank 12 was reported by meagre of coconut growers by cause of birds, domestic animals and less thinness or gauge of polythene bags after the use of tonic. Similar findings were reported by (Kalarani, Raja *et al.* 2009).

Lack of awareness on mixing and quantity of application (5.47%) with rank 11might be due to poor awareness of the application of TNAU Coconut tonic. (Archana *et al*. 2022) revealed that lack of awareness of the latest technologies in coconut cultivationis a personal constraint. Lack of adequate training and demonstration (6.02%) with rank 10 reported by coconut growers was due to inadequate capacity-building programmes and demonstrations concerningnew technologies and innovations. Poor post-care maintenance (4.33%) with rank 15 was noticed very less among the coconut growers. Involvement of private players (6.90%) with rank 7 expressed by coconut growers because of easy availability in local extent by input dealers or commission agents or mandis on a contractual basis. No difference in yield and income (5.39%) with rank 14 was due to theapplication of coconut tonic for thefirst time in their field thus reported by themajority of coconut farmers.

B. Labour constraints

Labour constraints include the non-availability of labour (7.31%) with rank 5 expressed by most of the respondents. This might be due to laboursmigrating towards high-wage employment in other sectors as guaranteed jobs, so labour scarcity occurs. Farm labourers are currently transferring tothe industry due to the higher income they receive. This manpower migration to industry has resulted in a labour shortage in agriculture. Because of this, producers are forced to pay high wages to agricultural labourers. This finding aligns with that of (Archana *et al*. 2022). The high cost of labour (7.13%) with rank 6 was the significant labour constraint because of theunavailability of labour there is more demand in that particular region, andthe existing labour hike their wages. Unskilled labour wasa major constraint faced by coconut growers (8.57%) with rank 2. This might be due to the root feeding technology requiring the skill and experience to adopt, in the study area there was labour but they are not trained and skilled in the specific technology. The labour constraints arein line withthe findings of (Kalarani, Raja *et al*. 2009).

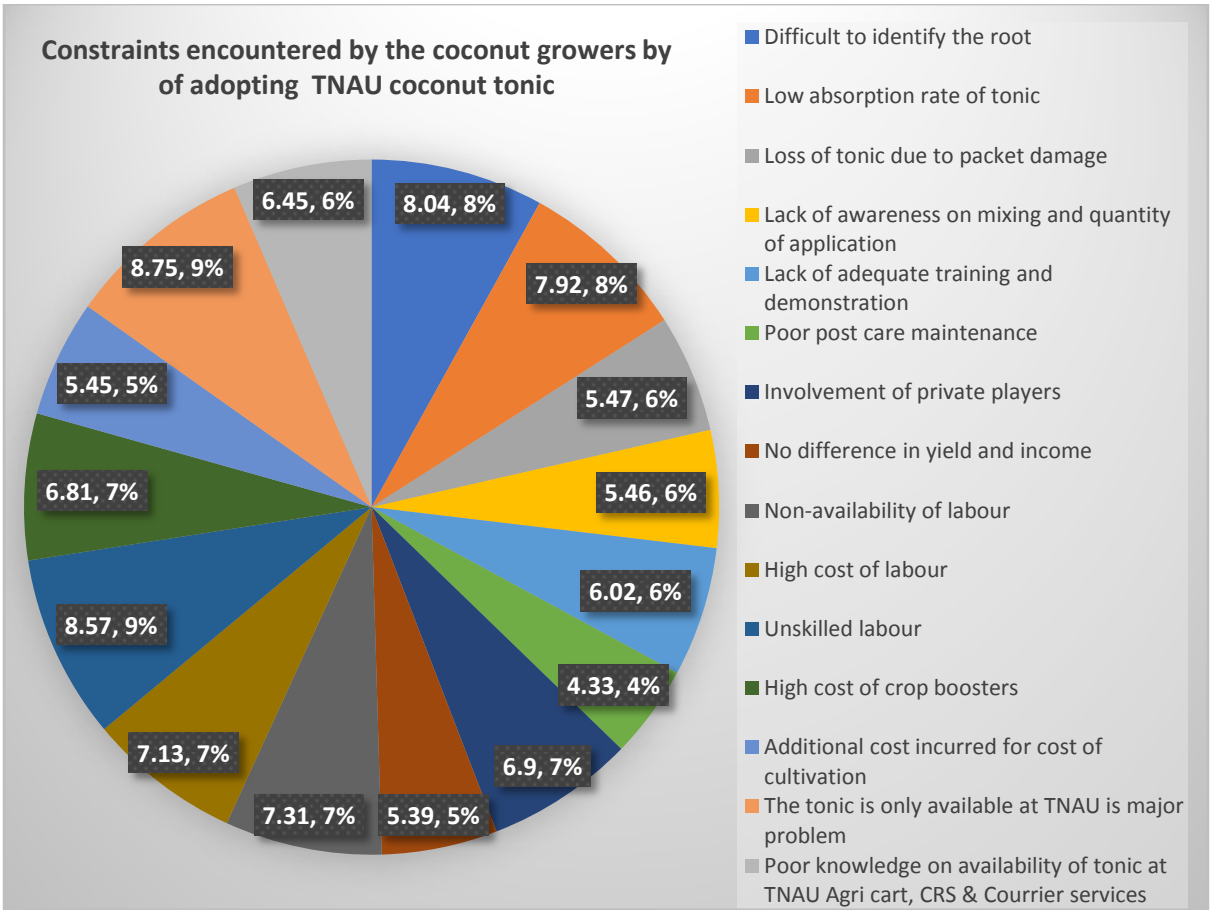
C. Economic constraints

The high cost of crop boosters was experienced by coconut farmers (6.81%) with rank 8, followed by additional cost incurred for thecost of cultivation (5.45%) with rank 13 due to usage of TNAU Coconut tonic and labour charges. This finding is in line with thefindings of (Kalarani, Raja *et al*. 2009). Coconut farmers facing high cultivation costs in their production, as pointed out by (Sathuragiri and Muthumani 2022).Therefore, governments, agricultural universities, and development agencies can play a critical role in providing financial assistance, training programmes, and demonstration for coconut growers to overcome these economic barriers. Collaboration between the public and private sectors can also aid in the adoption of TNAU Coconut tonic and the reduction of nutritional disorders and environmental stress.

D. Accessibility constraints

The tonic is only available at TNAU (8.75%) with rank 1 encountered by themajority of coconut growers due to the production unit beingonly available at TNAU, Coimbatore only. So, government takethe necessary steps to takeadditional sales centres to overcome these constraints.Similar findings were reported by (Kalarani, Raja *et al*. 2009). Poor knowledge of theavailability of tonic at TNAU Agri cart, Coconut Research Station, Aliyar & Courier services (6.45%) with rank 9 was faced by coconut growers due to lack of mass media exposure and illiteracy among coconut growers.

Figure 1. Pie chart forthe constraints of adopting TNAU Coconut tonic technology



3.2 Perceived benefits obtained by coconut growers while adopting TNAU Coconut tonic technology

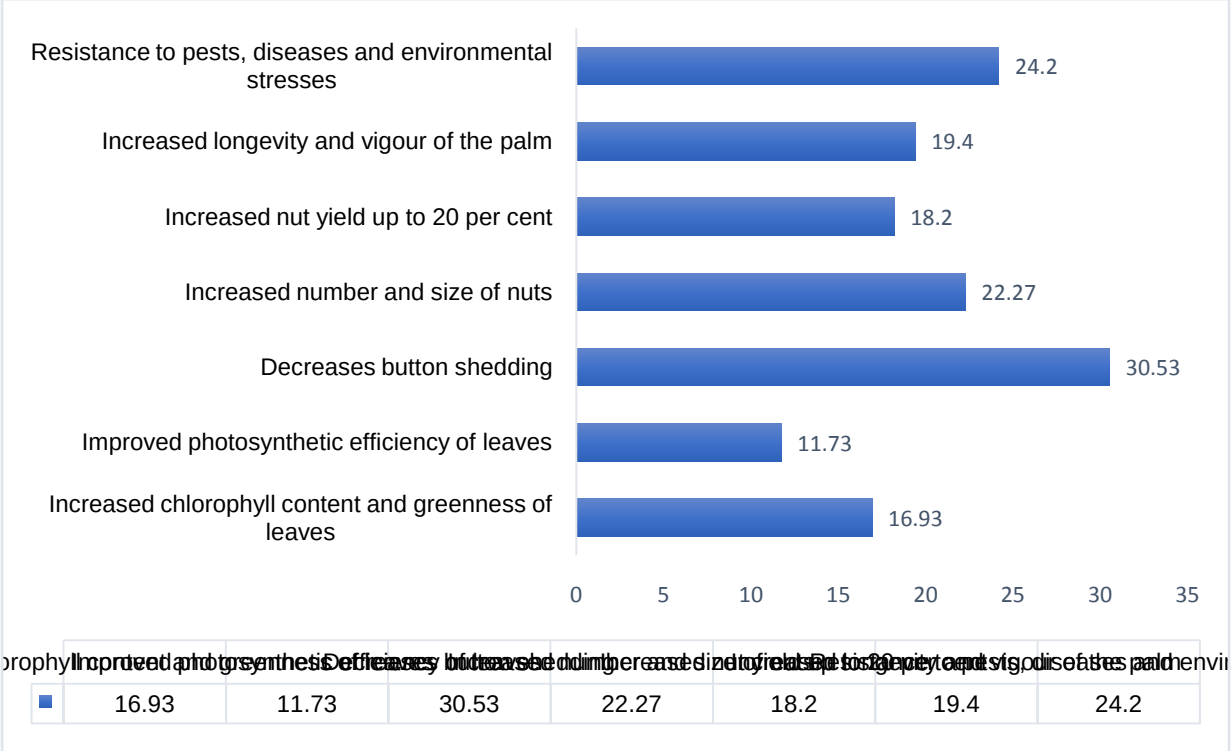
The key advantages benefited by coconut growers in Table 2.While adopting the root feeding of TNAU Coconut tonic technology was decreases button shedding (30.53%), followed byresistance to pests, diseases and environmental stresses (24.20%), increased number and size of nuts (22.27%), increased longevity and vigour of the palm (19.40%), increased nut yield up to 20 per cent (18.20%), increased chlorophyll content and greenness of leaves (16.93%) and improved photosynthetic efficiency of leaves (11.73%). Coconut growers can experience numerous perceived benefits when adopting TNAU Coconut tonic in their cultivation practices. The major problems in coconut cultivation such as pests and diseases, nutritional deficiencies and hormonal disorders, small size and less number of nuts, nut cracking and poor pericarp formation, button shedding, drying of buttons and spath, pencil point disorder, improper nutrient supply, yellowing and scorching of leaves were drastically reduced. This finding was also similar in connection with (Kalarani, Raja *et al.* 2009). These benefits can positively impact various aspects of coconut farming and improve the overall well-being of farmers.

Table 2. Item-wise perceived benefits attained by coconut growers n=120

S. No	List of key advantages	Weighted average
1.	Increased chlorophyll content and greenness of leaves	16.93
2.	Improved photosynthetic efficiency of leaves	11.73
3.	Decreases button shedding	30.53
4.	Increased number and size of nuts	22.27
5.	Increased nut yield byup to 20 per cent	18.20
6.	Increased longevity and vigour of the palm	19.40

7.	Resistance to pests, diseases and environmental stresses	24.20

Figure 2. Percentage of key benefits of adopting TNAU Coconut tonic technology



4. CONCLUSION

4.1 Constraints of adopting TNAU Coconut tonic

The adoption of TNAU Coconut tonic in coconut cultivation offers the potential for improved productivity, efficiency and sustainability. However, several constraints hinder the widespread integration of these technologieswithin the coconut farming sector. Technological constraints, labour constraints, economic constraints and accessibility constraints can deter farmers from investing in modern practices.

To overcome these constraints, concerted efforts from researchers with government and institutional support and coconut research stations set forth the easy adoption of TNAU Coconut tonic are essential. Adapting root feeding of TNAU Coconut tonic technology to specific regional conditions and encouraging knowledge sharing will enable farmers to make informed choices about technology adoption. Collaboration between the public and private sectors can help speed up the adoption of TNAU Coconut tonic technology, ensure sustainable coconut cultivation practices, and ultimately benefit farmers, consumers, and the environment. By overcoming such challenges, the coconut farming sector could achieve its full potential and contribute to boost the income of coconut growers and overcoming environmental distress such as drought, pest and disease attack.

4.2Perceived benefits of TNAU Coconut tonic technology

The adoption of TNAU Coconut tonic technology brings forth a multitude of perceived benefits for coconut growers, along with their conventional,recommended nutrient management practices, root feeding of TNAU Coconut tonic was added to their cultivation practices and improved their livelihoods. The integration of TNAU Coconut tonic offers the potential for increased productivity and improved quality, which translates into higher income and market access for farmers. Furthermore, TNAU Coconut tonic technologies contribute to the resilience of coconut cultivation by mitigating risks associated with pest and disease and environmental challenges.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Gurbuz, I. B. and M. Manaros. Impact of coconut production on the environment and the problems faced by coconut producers in Lanao del Norte Province, Philippines.Scientific Paper Series Management, Economic Engineering in Agriculture and Rural Development. 2019;19(3): 247-258.

Jayakumar, M., S. Janapriya and U. Surendran.Effect of drip fertigation and polythene mulching on growth and productivity of coconut (Cocos nucifera L.), water, nutrient use efficiency and economic benefits.Agricultural Water Management. 2017;182: 87-93.

Sathi Babu, N., P. S. Medda, Himadri Bhattacharjee, A. Kumar Sinha and Ghosh, A. Impact of Potassium-Boron Content of Leaf on Nut Yield of Coconut (Cocos nucifera L.) in terai Region of West Bengal. Int.J.Curr.Microbiol.App.Sci. 2022;11(07): 282-294

Hameed Khan. H.Fertilizer management in Coconut, In: Tandon,H.L.S. (Ed). Fertilizer Management in Commercial Crops. Fertilizer Development and Consultation Organisation, New Delhi. 1993

Srinivasan, R., K. A. Kumar, M. Chandrakala, K. Niranjana, N. Maddileti and R. Hegde. Characterization and classification of major coconut growing soils in South Eastern Ghats of Tamil Nadu, India.Journal of Plantation Crops 2021;49(2): 94-103.

A. S. Archana, V. Sakthivel, and K. Kanagasabapathi. An Analysis of Constraints Encountered by Coconut Growers in Coconut Cultivation of Kanyakumari District . Bull. Env.Pharmacol. Life Sci., Vol 11 [11] October 2022 : 05-08

Kalarani, M., D. Raja and P. Janaki. Popularization of TNAU Coconut Tonic and its impact.Agriculture Update 2009;4(1/2): 36-40.

https://rabicrop.com/crop-booster-and-different-type-of-fertilizers/

http://www.agritech.tnau.ac.in/expert_system/coconut/coconut/coconut_planting_seasons.html

Kumar, S. N. and P. K. Aggarwal (2013). Climate change and coconut plantations in India: Impacts and potential adaptation gains. Agricultural Systems 2013;117: 45-54.

Hebbar, K. B., P. S. Abhin, V. Sanjo Jose, P. Neethu, A. Santhosh, S. Shil and P. V. Prasad. Predicting the potential suitable climate for coconut (Cocos nucifera l.) cultivation in India under climate change scenarios using the MaxEnt model. Plants 2022;11(6): 731.

Sudha, B., J. John, A. Meera, A. Sajeena, D. Jacob and J. Bindhu. Coconut based integrated farming: a climate-smart model for food security and economic prosperity. J. Plantation Crops 2021;49(2): 104-110.

Sathuragiri, V. and K. Muthumani. A Study Of Production Problems Faced By Coconut Farmers In Theni District Confront. Elementary Education Online 2022;19(4): 7283-7283.