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Climate smart practices followed by acid lime growers

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Abstract

Climate change poses significant threats to fruit crops worldwide, affecting growth, development, and productivity. Warmer temperatures disrupt flowering patterns, reduce fruit set, and increase pollination failures, leading to lower yields and decreased fruit quality. Climate smart practices is a strategy aimed at lowering greenhouse gas emission, strengthen climate change resilience and improving crop productivity. Climate change significantly impacts acid lime production, necessitating the adoption of climate-smart practices to ensure sustainability and resilience. These practices include selecting climate-ready varieties, employing water-efficient irrigation methods, optimizing nutrient management, and mitigating the effects of extreme weather events like heatwaves and droughts. By adopting these climate-smart practices, acid lime growers can enhance the resilience of their orchards, improve productivity, and contribute to sustainable agricultural development in the face of climate change.

Keywords: Acid lime growers, greenhouse gas emissions, climate smart practices

Introduction

Climate change and Agriculture

The agricultural sector is the sector most Climate change vulnerability. The climate is the primary element influencing agricultural productivity. The environment has changed during the previous many decades due to human activities, increasing the danger of climate-dependent crop production. The most urgent of the climatic changes is the increase in temperature brought about by an increase in the amounts of atmospheric greenhouse gases (IPCC 2007). It has manifested as a recurring pattern of events such as sea level rise, glacier melt, droughts, floods, and storms. The Rainfall distribution and amount have become incredibly unpredictable. The nation's food security is seriously threatened by these advancements, which are already starting to take shape (Pathak *et al.* 2012). By 2050, the world's population will have increased by a third compared to its current size.

The FAO estimates that agricultural production will need to increase by 60 per cent to fulfil projected food and feed demands by 2050. This is assuming that present income and consumption growth trends continue. Therefore, agriculture must change if it is to feed a growing global population and serve as the foundation for economic progress and the eradication of poverty.

Climate change and India

Agriculture is the backbone of Indian economy. It plays the most crucial role in the socio-economic area of the farmers. In India, over 60 per cent of total land is under agriculture and nearly 21.71 per cent covered by forests and about 70 per cent of its rural households still depend primarily on agriculture for their livelihood. Numerous studies have demonstrated that the country's overall crop yield has decreased in recent years as a result of rising temperatures. It is anticipated that India would encounter difficulties in the near future, such as unwelcome pressure from the expanding population and shifting global agricultural trade conditions. Due to the unpredictability of weather, farmers cultivate resistant kinds of crops and are ready for ongoing changes in farming methods (UNFCCC, 1992). A strategy for changing agricultural systems is required to promote global food security and the fight against poverty since climate change affects agricultural production and food systems. Farmers and policymakers face increased risk and uncertainty as a result of climate change.

Climate change and acid lime

The productivity and growth of plants are affected by climate change especially drought and high temperatures collectively. An increase in temperature and water stress

after pollination inhibits ovule fertilization, which in return reduces tree fruit set, increases June fruit drop, and reduces tree yield (García-Tejero I 2009). Fruit growth phases from button size to mature fruit are more sensitive to heat stress and deficit irrigation. Citrus under water deficit conditions faces reduced fruit growth and ripening, which is associated with a decrease in fruit size, an increase in fruit acidity (Pérez-Pérez JG 2009), and low tree yield. An increase in optimum temperature at fruit ripening causes pre-harvest fruit drop and reduced yield. High temperatures affect citrus plants, increasing transpiration and photosynthesis, destabilising their cell membranes, and incrementing oxidative damage. The optimal temperature range for citrus cultivation is estimated to be 22-34 °C. Temperatures above this range lead to fruit abscission and smaller fruit size.

Climate Smart Agriculture

In order to effectively support development and guarantee food security in a changing climate, agricultural systems must be transformed and reoriented. The CSA method helps

to steer these measures. Climate-smart agriculture has demonstrated its efficacy in delivering tangible benefits to farmers. According to studies, the adoption of climate-smart practices can increase farmers' incomes by up to 30 per cent and enhance crop yields by 20-30 per cent (Musafiri *et al.*, 2021). CSA offers the tools to assist local, national, and international stakeholders in determining agricultural practices that are appropriate for their particular circumstances. The concept of Climate-smart agriculture was first launched by FAO in 2010 in a background paper prepared for the Hague Conference on Agriculture, Food Security and Climate Change, in the context of national food security and development goals, to tackle three main objectives:

- Sustainably increase in food security by increasing agricultural productivity and incomes
- Build resilience and adapt to climate change
- Reduce and/or remove greenhouse gas emissions wherever possible.

Climate smart practices followed by acid lime growers

CSP components	Acid lime practices followed	Frequency	Percentage
Soil type			
	Medium black soil (CS)	351	97.5
	Lateritic soil	9	2.5
Intercultural operations			
Mulching	Grass mulching:- Two layer of rice straw, wheat straw 3 ton/ha, Up to 5 to 10 cm around tree trunk (CS)	67	18.61
	Plastic mulching:- Black polythene sheet of 100 micron (CS)	13	3.61
Weed management	Spray Glyphosate 100-120 ml + 100-120 gm Urea in 10 lit water	214	59.44
	Mechanical mulching (CS)	287	79.72
Intercropping	can be grown in between the interspaces of the plants up to 5 years (CS)	123	34.17
	Acid lime + marigold	35	9.72
	Acid lime + Gram	15	4.17
	Acid lime + wheat	71	19.72
	Acid lime + maize	44	12.22
	Acid lime + Cabbage/Onion/tomato/Methi	72	20
Bahar treatment	Spraying of GA3 (50ppm) in June (Mrig bahar)	342	95
	Cycocel (1000ppm) in September (Hasta bahar) & Potassium Nitrate 1% in October	342	95
Water management			
Micro irrigation	Drip irrigation (CS)	215	59.72
	sprinkler irrigation (CS)	65	18.06
Ring basin method	Ring 2 m away from trunk.	65	18.06
Drainage	Trenching size: 30cm depth, 45 cm top width and 30 cm bottom width after each 2 rows of plants. (CS)	15	4.17
Nutrient management			
FYM	For 1 year plant:- 10 kg FYM, 1 kg Neem seed cake For 2 year old - 15 kg FYM, 2 kg Neem seed cake (in June), For 3 year old - 15 kg FYM, 2 kg Neem seed cake For 4 year old- 15 kg FYM, 15 kg Neem seed cake (June) (CS)	360	100
Fertilizers	600:300:600 NPK, 40 per cent N, 100 per cent Phosphorus, 100 per cent Potassium in June and remaining 60 per cent Nitrogen in September and January (CS)	351	97.5
Green manuring	For green manuring sow seeds of dhaincha or sunhemp @ 40 kg per hectare. (CS)	9	2.5
Pest and Disease management			
Citrus canker	•Spray of copper oxychloride 25-30 gm in 10 litre water before onset of monsoon (CS)	345	95.83
	2 spraying of Neem Extract 50 ml in 10 litre water (CS)	5	1.39
Leaf eating caterpillar	Quinalphos 25 EC 20 ml in 10 litre Water (CS)	252	70
Fruit sucking moth	Fruit sucking moth - Spray neem oil @ 10 ml/litre water and destroy all the fallen fruits by burying in the pit. (CS)	15	4.17

	Poison baiting with 10 ml malathion mixed with 100 g jaggery in 900 ml water (two portion bottles per 25 trees). (CS)	67	18.61
	Create smoke in orchard with grass (wet), cow dung cakes and neem leaves in the late evening hours i.e. 7.00 to 8.00 pm during this month to repel the fruit sucking moth (CS)	278	77.22
Citrus psylla	Psylla - Spraying dimethoate 2 ml or acephate 2 g or imidacloprid 0.5 ml per litre water at bud burst stage. Second spray should be carried after 10 days interval. (CS)	85	23.61
Management of climatic extremes			
Heavy rainfall	Heavy rainfall -1.5g 2, 4 D or gibberellic acid + 100g Carbendazim + 1 kg urea in 100 litres water at the earliest. Interval spray may reduce to 15 days if an excessive fruit drop continues. (CS)	197	54.72
High temperature	Spray 2,4 D/1.5gm and potassium nitrate 1 kg in 100 litre water if there is sudden rise in temperature between 35 to 40 °C (CS)	6	1.67
	Heavy summer pruning for reducing canopy transpiration above 15 years old tree. Cut green branches up to 45 cm from the tip Foliar spray of 1g Carbendazim in 1 litre water after pruning. Apply 50 kg FYM + 7.5 kg Neem seed cake (CS)	354	98.33
Dry spell	If there is wide gap of more than a week between two spells of rains spray potassium nitrate at the rate of 1.5 kg + 2, 4, D 1.5 gms per 100 litres of water. (CS)	85	23.61

It was observed that 97.5 per cent of acid lime growers prefer black medium soil which is climate smart practice and only 2.5 per cent of growers used lateritic soil for acid lime cultivation. In intercultural operations, 18.61 per cent growers used grass mulching and only 3.61 per cent of respondents used plastic mulching. Maximum i.e. 79.72 per cent of acid lime growers used mechanical mulching for weed management, while 59.44 per cent of growers used glyphosate for weed management. Most of the growers (34.17%) of the growers takes marigold as intercrop with acid lime, 20 per cent respondents takes vegetables like methi/onion/cabbage/tomato crop as intercrop, 19.72 per cent, 12.22 per cent, 9.72 per cent and 4.17 per cent acid lime growers takes maize, cowpea, gram and wheat as intercrop, respectively. Almost all i.e.95 per cent of growers takes mrig bahar and hasta bahar in acid lime.

In water management practices, 59.72 per cent of acid lime growers used drip irrigation, while 18.06 per cent, 18.06 per cent and 4.17 per cent of the growers used sprinkler irrigation, ring basin method and drainage, respectively. In nutrient management, all respondents (100%) used FYM for acid lime crop, 97.5 per cent of growers used fertilizer as a source of nutrients and only 2.5 per cent of growers used

green manuring for nutrient management. Citrus canker is major disease in acid lime caused significant economic impacts on acid lime production. Almost all growers (95.83%) spray copper oxychloride for control of citrus canker. Only 1.39 per cent of growers used neem extract for control due to high cost. 70 per cent respondents used quinalphos to control leaf eating caterpillar. 77.22 per cent of acid lime growers create smoke in orchard to control fruit sucking moth, 18.61 per cent and 4.17 per cent respondents used poison bating and neem oil spraying, respectively. 23.61per cent respondents used spraying of dimethoate to control citrus psylla.

In management of climatic extremes, 54.72 per cent of growers used spraying of 2,4 D or gibberellic acid + carbendazim + urea to control fruit drop due to heavy rainfall. During high temperature 1.67 per cent of growers take spraying of 2,4 D and potassium nitrate and almost all i.e. 98.33 per cent of acid lime growers used heavy summer pruning for reducing canopy transpiration. 23.61per cent of growers take spray of potassium nitrate if there is wide gap of more than week between two spells of rain.

Climate smart practices component Index

Table 1: Climate smart practices component index

Sr. no.	CSP components	CSP	Max Indicator Value	Min Indicator Value	Indicator Index value	CSP component Index
A	Soil type					0.5
1		Medium black	1	0	0.975	
2		Lateritic soil	1	0	0.025	
B	Intercultural operation					0.71
3		Mulching	1	0	0.03	
4		Weed management	1	0	0.93	
5		Intercropping	1	0	0.95	
6		Bahar treatment	1	0	0.95	
C	Water management					0.36
7		Micro irrigation	1	1	1	
8		Ring basin	1	0	0.01	
9		Drainage	1	0	0.08	
D	Nutrient management					0.38
10		FYM	1	1	1	
11		Chemical	1	0	0.01	
12		Green manuring	1	0	0.14	

E	Pest and disease management					0.49
13		Citrus Canker	1	0	0.95	
14		Leaf eating caterpillar	1	0	0.14	
15		Fruit sucking moth	1	0	0.86	
16		Citrus Pyslla	1	0	0.02	
F	Management of Climatic extremes					0.72
17		Heavy rainfall	1	0	0.96	
18		Increase in temp	1	0	0.98	
19		Dry spell	1	0	0.24	

It was observed that in soil type components medium black soil has 0.97 index indicator value and lateritic soil having 0.025 index indicator values with 1 and 0 maximum and minimum indicator value, respectively for both soil types. Climate smart practices index for soil type was 0.5. In intercultural operations, Mulching, weed management, intercropping and bahar treatment has maximum and minimum values are 1 and 0, respectively with indicator index value 0.03, 0.93, 0.95 and 0.95. 0.71 was the climate smart practice index for intercultural operations.

For water management component, Micro irrigation has maximum and minimum value is 1 with 1 indicator index value. While ring basin and drainage has 1 and 0 maximum and minimum value, respectively with indicator index value of 0.01 and 0.08. Climate smart practice component index was 0.36 for water management. In nutrient management, FYM has maximum and minimum value was 1 with 1 indicator index value. For chemical and green manuring 1 and 0 are maximum and minimum values, respectively with 0.01 and 0.14 indicator index value. 0.38 was the climate smart practice component index for nutrient management. In pest and disease management, for citrus canker, leaf eating caterpillar, fruit sucking moth and citrus pyslla maximum and minimum values are 1 and 0, respectively with 0.95, 0.14, 0.86 and 0.02 indicator index values. 0.49 was the climate smart practice component index value.

In management of climatic extremes, heavy rainfall, increase in temperature, and dry spell has maximum and minimum values are 1 and 0, respectively with 0.96, 0.98 and 0.24 indicator index value. 0.72 was the climate smart practice component index value. This component has highest index value among all components.

Overall distribution of respondents according to climate smart practices followed by acid lime growers

Table 2: Overall distribution of respondents according to climate smart practices followed by acid lime growers

Indicators	Index value
Soil type	0.50
Intercultural operations	0.71
Water Management	0.36
Nutrient Management	0.38
Disease& Pest Management	0.49
Management of Climatic extremes	0.72
Overall index	0.52

Information in table 2 revealed that the overall climate smart practice index of study area was 0.52. The study area having more climate smart practices followed in management of extremes component and least climate smart practices followed was water management component.

Distribution of Acid lime growers according to level of climate smart practices followed

On the basis of the index values the acid lime growers are classified into very low, low, medium, high and very high climate smart practices followed. The results are presented in the table 3.

Table 3: Distribution of Acid lime growers according to level of climate smart practices followed

Sr. no.	Climate smart practices followed level	Criteria	Frequency	Percentage
1	Very low	<0.20	0	0
2	Low	0.21 - 0.40	25	11.68
3	Medium	0.41 - 0.60	293	81.38
4	High	0.61 - 0.80	42	6.94
5	Very high	> 0.80	0	0
	Total		360	100

Table revealed that 3 per cent of acid lime growers have medium climate smart practices followed level, 11.68 per cent of acid lime growers have low level of climate smart practices followed and 6.94 per cent of acid lime growers have high level of climate smart practices followed.

Conclusion

Acid lime orchard is greatly impacted by climate change, which changes many facets of their development and growth. Among these include altered flowering patterns, decreased fruit set, more pollination errors, poor colour development, and more physiological diseases.

Citrus growers may increase orchard resilience, boost productivity, and support sustainable agricultural development in the face of climate change by using these climate-smart strategies.

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