

Advances in Research on Tea Species Adaptive to Climatic Changes

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Introduction

- Tea is one of tree crops, and a beverage made from the leaves of tropical shrub of *the camellia family*.
- According Fuller [2008], “it is aromatic beverage commonly prepared by pouring hot or boiling water over cured leaves of tea plant, *camellia sinensis*”. The botanical name is *camellia sinensis*.
- Tea drinking likely began during the **Shang dynasty** in china, when it was used for medicinal purposes.

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- It is believed, soon after “for the first time, people began to boil tea leaves for consumption into a concentrated liquid without the addition of other leaves or herbs, thereby using tea as a bitter yet stimulating drink, rather than as a medicinal concoction” [Heiss and Heiss, 2011].
- Tea is native plant of East and south Asia and probably originated around the meeting of Burma and South West China.
- The areas of origin include the part of northern part of Burma and Yunnan and Sichuan provinces of China [Yamatoo et al, 1997].

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- Its cultivation is believed to have started in sixnth century in the Yangtze valley in china.
- Later its cultivation spread to Japan and to the other parts of the world.
- Tea plant was introduced in East Africa in 1900 when it was planted in Entebbe in Uganda.
- In Kenya it was introduced in Limuru in 1903 by the British settlers and at Amani in Tanzania [Kibuuka et al, 2004].

Introduction

- The requirements for tea plant cultivation are classified into two as physical factors [climatic conditions] for growing tea and human factors [prerequisites] which favour tea growing and other processes.

- Physical include the following:

Altitude- altitude is the point above sea-level.

- In Kenya, tea is successfully grown on highlands at altitudes of between 1500 and 2200m.
- Above 2200 m the plants are affected by frost and below 1500 m rainfall is inadequate;

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Soil- is loosely, the earth or ground, but specifically, the loose material of the earth's surface in which terrestrial plants grow, usually formed from weathered rock, [Clark, 1998], therefore, tea grows deep, well-drained, acidic soils but with good water-retaining capacity. The Kenyan highland soils are volcanic acidic with slightly a pH of between 4 and 6, with little calcium;

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Temperature-as a climatic element is the degree of sensible heat or cold in the atmosphere [Clark,1998], therefore, tea grows well in areas where temperature ranges between 15 and 30 degrees centgrade. The crop thus does well in warm but not excessively hot climates;

Rainfall- is the quantity of rain falling in a certain time within a given area, usually expressed in mm or in, therefore, the mean annual rainfall should be between 400 and 1750 mm. In Kisii highlands it does well because evapo-transpiration is very low and rainfall should be distributed thro' the year;

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windbreaks-for protection of tea bushes against strong damaging winds. Rows of tea at the edges of plots are left unpruned and the stems of tea bushes can grow to a height of 9 to 12 m depending on the variety.

Humidity-refers to the state of the atmosphere with respect to its content of water vapour, warm or being able to hold more water vapour than cold air. Therefore, high humidity which produces morning mist or dew enables the young leaves to grow luxuriantly [Saka et al, 2008].

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- **Human requirements include:**

Labour-intensive labour supply for field preparation, weeding, pruning and plucking throughout the year;

capital-is needed to pay the labour which is required for land preparation, weeding and regular plucking;

roads-good passable feeder roads between the farms and factories are essential-for tea to reach the factory before withering;

tea factories-since tea leaves are perishable, nearness to the processing factories is important to ensure quick processing and maintaining quality standards.

The statement of the study

- Research done by small scale farmers through simple random sampling in Nyagesenda village, Sensi location, Kisii County, indicated five species of tea plants apart from Assam and china planted in mixed mode in their farms.
- The research was on experimental basis on the behavior, characteristic or features and appearance of tea harvested on production stage.
- The farmers experienced changes in tea behavior and characteristic in wet and dry seasons, as some ripen quickly after plucking during rainy season and others dry quickly during drought season.

The statement of the study

- During the time of hailstones, also some species ripen quickly and others slowly. It is against this changing behavior, the current research focused the study.

Objective of the research

- The farmers needed to identify a variety drought resistant, qualitative and quantitative production throughout the year.

Methodology

- True experimental research was deliberately manipulated for ten years through observation method, on the alternating climatic changes of the area, in relation to occurrence of hail stones and drought.
- True experiment is a practical approach to the study of the problem or phenomena and all results were recorded through observation as the behaviors/ characteristic kept on changing in relation to changing climatic conditions throughout the year.

Cultivation of tea and varieties

- There are three varieties of tea grown in Kenya classified on the basis of its behavior on the characteristic features of leaves and stems. According to Mondal [2007], Leaf size is the chief criterion for classification of tea plants, within three primary classifications being
 1. “**Assam type**”, characterized by largest leaves;
 2. **China type**, characterized by the smallest leaves;
 3. **Cambodian**, characterized by intermediate size.
- The major varieties of tea grown in Kenya are Assam and China and minor hybrid.

Cultivation of tea and varieties

- The Assam variety has large, wide and long green leaves which usually point downwards.
- If left unpruned, the plants grows as a single trunk up to a height of 9m and produces flower and eventually seeds.
- China variety is shorter, has short, narrow and dark-green leaves which are usually pointed downwards.
- This variety produces very many flowers and stems if left unpruned, the stems can grow to a height of 4.5m.
- The third variety is hybrid produced cross-breeding of the two varieties of Assam and China

Cultivation of tea and varieties

- This has the qualities and characteristic of both varieties.
- Clones are produced from rare plants which have high yielding abilities and good qualities [Kibuuka et al, 2004].
- A clone refers to creation of a plant in a laboratory that is an exact copy of another using plant's DNA [Macmillan Dictionary].
- According to oxford Dictionary, a lone is a plant that is produced naturally or artificially from cells of another and is therefore exactly the same as it.

Cultivation of tea and varieties

- According to the current research by observation method, found uniquely, that the maturity of tea plant, tea leaves grow and becomes mature and naturally indicates the number in the tea leaves which becomes the species number or variety.
- The way “number” or “alphabet” is indicated in the leaves is not properly known.
- There are theories propagated to explain, one, caterpillar/artificial theory-explaining that as it moves leave marks in the leaves in the face of the leaf.

Cultivation of tea and varieties

- Another, mature leaf/ natural theory-explains that it's the nature of tea leaves when matures to indicate the number or alphabet.

The key findings

- The experiment was done on harvesting stage, where tea bush is prepared for picking by the development of a plucking table and the growth of shoots must be controlled, by “tipping” the shoots.
- The plucking table refers to the level of the height of tea bushes in the whole farm and seen from a distance “one cannot see any tree above after plucking”.
- **Tipping** means or refers to removing two or three leaves and of one bud from each shoot.
- **Plucking** or **picking** is the harvesting of the tips of the shoots as they appear above the plucking table.

The key findings

- Also a distinction is made between fine plucking and coarse plucking.
- *Coarse* plucking means that more than two leaves and a bud are removed. If too many leaves and buds are taken from a shoot, the growth of new ones will be affected.
- The common practice is *fine* plucking where only two leaves and one bud are taken. This method produces a better quality tea.
- This is common among the small scale farmers in Sensi location, where the experiment was done.

The key findings

- There is also a difference between hard plucking and light plucking.
- **Hard** plucking means that the tips of the shoots are removed at exactly the height of the plucking table.
- This affects the propagation capacity as the plucking table becomes short of the necessary growing points.
- Therefore the plucking table is raised by **light** plucking two or three times a year to prevent this happening.
- There are no firm rules about frequency of picking
[Deters 1997]

The key findings

- The frequency of picking depends on the season and the plucking method involved.
- The research was on experimental basis on the behavior, characteristic or features and appearance of tea harvested on production/harvesting stage.
- The farmers through purposive random sampling gave the key findings of the varieties or species were as follows:
- **First sample species,** Tea leaves have the following characteristic features in two climatic season of rainy and dry and in relation to hailstones:

The key findings

- [i] The tea leaves slow to ripen rainy season.
- [ii] The tea leaves are dark green, slender & small
- [iii] The tea leaves are soft plucking, and
- [iv] The tea leaves are drought resistant.
- [v] The tea leaves plucked have low weights in the K.T.D.A. buying centres
- [vi] The tea leaves are slow to ripen after hail stones.
- [vii] After pruning, it is slow to shoot buds & spreads sideways.
- [viii] The mature tea leaves indicate alphabet “u” or 8.

The key findings



The key findings

- **Second sample species**, tea leaves have the following characteristic features in two climatic season of rainy and dry and in relation to hailstones. The tea leaves:
 - [i] are quick to ripen rainy season.
 - [ii] are dark green, wide & large surface.
 - [iii] are softer plucking or picking.
 - [iv] dry quickly in drought season.
 - [v] after plucking weigh high in the buying centres
 - [vi] are quick to ripen after hail stones.

The key findings

[vii] after pruning, are quick to shoot buds & spreads upwards.

[viii] mature tea leaves indicates number six “6”.

The key findings



The key findings

Third sample species, had the following Xtic features

The tea leaves:

[i] are quick to ripen during rainy season,

[ii] are dark green, slender and small surface,

[iii] are softer plucking/picking,

[iv] dries in drought season.

[v] after plucking weighs low in the buying centres.

[vi] quick to ripen after hail stones.

[vii] After pruning, are quick to shoot buds & spread upwards.

[viii] The mature tea leaves indicate number “d” or “Q”

The key findings



The key findings

Fourth sample species, have the following xtics. The tea leaves:

- [i] are slow to ripen rainy season.
- [ii] are yellowish green, wide and large surface.
- [iii] are hard plucking/picking in the farm.
- [iv] are drought resistant.
- [v] after plucking weigh low in buying centres.
- [vi] are slow to ripen after hail stones.
- [vii] After pruning, are slow to shoot buds & spread upwards.
- [viii] The mature tea leaves indicate number zero “0”.

The key findings



The key findings

Fifth sample species, tea leaves have the following
xtic features. The tea leaves:

- [i] are quick to ripen during the rainy season.
- [ii] never dry up during the drought season.
- [iii] are yellowish green, average surface.
- [iv] are Softer to pluck in rainy & hard in dry season.
- [v] are adaptive to all seasons
- [vi] weigh high during rainy & low in dry season.
- [vii] Ripen quickly after hail stones.
- [viii] After pruning, are quick to shoot buds & spreads upwards.

The key findings

[xi]The mature tea leaves indicate alphabet “c”.

The key findings



Conclusion

- It is concluded that the fifth sample species is the best species followed by the second sample and first sample species and third sample species and lastly fourth sample species.
- It is concluded that after the maturity of tea plant, the leaves grow and becomes mature and naturally indicates the number in the tea leaves which becomes the species number or variety.
- The research found that the cutting from clones is widely used in Kisii, because plants from the clone are genetically identical.

Conclusion

- The yields from cutting method of cultivation, is very high and quality the tea is also high. Seedlings are not widely used in Kisii as they take up to three years in nursery before they can be planted in the farmland.
- In the seedling method of cultivation, there is great genetic variation among plants raised from seedlings as regards and quality, which is low and poor quality respectively. The research concludes that the consumption of tea has positive effects to human health.

Significance of tea in human health

- It is important to state the importance of tea in reference to health effects.
- The positive effects include the following: tea contains a large number of possibly bioactive chemicals including, *flavonoids*, *amino acids*, *vitamins*, *caffeine* and several *polysaccharides*, and a variety of health effects to have been proposed and investigated [Khan et al,2007].
- According to Khan et al [2007],It has been suggested that green and black tea may protect against cancer.

Significance of tea in human health

- The catechins found in green tea are thought to be more effective in preventing certain *obesity*-related cancers such as *liver* and *colorectal* cancer. Both green and black tea may protect against *cardioscular* disease[khan et al,2007].
- According to Khan et al[2007],numerous recent epidemiological studies conducted to investigate effects, suggest significant protective effects of green tea against oral, pharyngeal, oesophageal, prostate, digestive, urinarytract, pancreatic, bladder, skin, lung, colon, breast and liver cancers, and lower risk for cancer metastasis and recurrence

Significance of tea in human health

- According to Heinrich et al[2011], recent studies suggest that green tea may help reduce the risk of
 - [i]cardiovascular disease and some forms of cancer
 - [ii]promote oral health
 - [iii]reduce blood pressure,
 - [iv] help with weight control,
 - [v]improve antibacterial and
 - [vi] antivirasic activity,
 - [vii] protection from solar ultraviolet light and
 - [vii]increase bone mineral density.

Significance of tea in human health

Also green tea is said to have “anti-fibrotic properties and neuroprotective power [Cabrera et al,2006].

According Korte[2010],tea catechins have known anti-inflammatory and neuroprotective properties, help regulate food,intake,and have affinity of canniboid receptors, which may suppress pain and nausea and provide calming effects.

- Consumption of green tea is associated with a lower risk of diseases that cause functional disability, such as “stroke, cognitive impairment, and osteoporosis” in the elderly

Significance of tea in human health

- tea contains L-theanine, and amino acid whose consumption is mildly associated with calm but alert and focused, relatively productive[alpha wave-dominant]mental state in humans. This mental state is also common to meditative practice.
- Negative effects of tea drinking are centered on the consumption of sugar used to sweeten the tea. Those who consume very large quantities of brick tea may experience *fluorosis* [Khan et al].
- Changing the potency of the antioxidants, the steep's temperature and time greatly effects the taste with white and green teas.

Significance of tea in human health

- Antioxidant content, measured by the lag time for oxidation of cholesterol, is improved by the cold-water steeping of varieties of tea as follows;
 1. **black tea**- water for black tea is usually added near the bp of water, at around 99°C. Many of the active substances in black tea do not develop at temp. lower than 90 °C. The temp. will have a large effect on the final flavor as the type of tea used.
 2. **Green tea**-water for green tea according to the regions of the world that prefer mild tea, should be around 80 to 85 °C; higher quality of the leaves, the lower the temperature.

Significance of tea in human health

- Hotter water will produce a bitter taste. High quality green and white teas can have new water added as five or more times, depending on variety, at increasingly higher temperatures.
1. **White tea**-water temp is 65-70 °C & it can be steeped for one to two minutes and infused thrice.
 2. **Yellow tea**- water temperature is 70-75 °C and it can be steeped for 1-2 minutes and infused thrice
 3. **Oolong tea**-teas should be brewed around 80-100 °C & the brewing vessel should be warmed before pouring in the water. High quality oolong can be brewed multiple times from the same leaves.

Significance of tea in human health

- 4. Premium or delicate tea**-using a tea strainer separates the leaves from the water at the end of the brewing time if a tea bag is not being used. Elevation and time of harvest offer varying taste profiles; proper storage and water quantity also have a large impact on taste.
- 5. Pu-erh teas**-require boiling water for infusion. Some prefer to quickly rinse pu-erh for several seconds with boiling to remove tea dust which accumulates from the ageing process, then, infuse it at the boiling point [100 °C] and allow it to steep from 30 seconds to five minutes

Significance of tea in human health

- Tea naturally contains tannins which are brought out in higher quantities with the teas exposure to hot water for longer periods.
- In black teas, the tannins are part of the natural flavour, as they tend to be rich and bolder.
- However in white and green teas, which tend to be more delicate, the tannins frequently give the tea a bitter taste which is commonly thought of as unpleasant.

Recommendations

- [i].It is recommended all species identified are significant; therefore, the farmers should grow in sections in the farm not in a mixed species as it is done in tea farms for the purpose of quality assurance and maintaining standards of tea and quick processing and grading in tea industry.
- [ii].It is recommended that this was an experiment conducted or done in the farm, therefore, KTDA, should take a step of separating the above identified species and processing in the firm[factory] and know which one gives qualitative products[high grade] of tea.

Recommendations

- [iii].It is recommended that the way the leaves indicate “numbers” or “alphabet” should be investigated scientifically through additional research, so that to be explained in a scientific manner.
- [iv].Additional research is needed to fully understand the contribution of tea to human health and advise people its regular consumption in African, Asian, European, American and Australian diets.
- [v] It is recommended that consumption of green and black tea may protect against cancer and other diseases in the human body.

THANKS

FOR LISTENING