International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

PREVENTION TO BLISTERBLIGHT IN CAMELLIA SINENSIS USING IOT AND FIELD OBSERVATION METHOD

Priyamvadha.S.Menon Suphiksha GDepartment Of Biochemistry Department Of Biochemistry Dr N G P Arts and Science college Dr N G P Arts and Science College (An Autonomous Institution) (An Autonomous Institution) Affiliated by Bharathiyar University Affiliatedby Bharathiyar University Coimbatore Tamil Nadu-641048Coimbatore Tamil Nadu-641048

Lincya Immaculate H
Department Of Biochemistry
Dr N G P Arts and Science College
(An Autonomous Institution)
Affiliated by Bharathiyar UniversityCoimbatore Tamil Nadu-641048

Karthika Nandhini S Department Of Biochemistry

Dr N G P Arts and Science College
(An Autonomous Institution)
Affiliated by Bharathiyar University
Coimbatore Tamil Nadu-641048

PREVENTION TO BLISTER BLIGHT IN CAMELLIA SINENSIS USING IOT AND FIELD OBSERVATION METHOD

Priyamvadha s menon[1], Suphiksha G[1], Karthika Nandhini S[1] and Lincya Immaculate[1]

Dr.T.Indhumathi*[2], Dr.D.Pradeepa*[2], Dr.N.Kannikaparameswari*[2] [1]UG Student, PG and Research Department of Biochemistry

[2]Professor, PG and Research Department of Biochemistry

[1, *2]Dr. N. G. P. Arts and Science College, Coimbatore, Tamilnadu-641048, India

Abstract

Tea is one of the main agricultural industries in worldwide, and is available in various forms of consumer beverages. Green tea is richer in antioxidants compared to other forms of tea. Tea is composed of polyphenols, caffeine, minerals, and trace amounts of vitamins, amino acids, and carbohydrates. The problem that often attacks green tea plant is *Exobasidium vexans* which causes a disease called blister blight. The detection of disease can be identified manually but it needs huge processing time and accuracy of plant disease is need. Hence, there are various ways have developed to predict diseases in tea plant which is more efficient and accuracy in recent technology advances, and one of the way is to apply in this study are machine learning. The crop field environmental data is captured by developing an IoT-based hardware prototype. The environmental conditions like temperature, humidity, and rainfall are used to determine the probability of the occurrence of a blister blight disease attack on tea plants. This review discusses a summary on tea plant diseases by machine learning which are used for identifying blister blight disease.

Keywords: Polyphenols, Caffeine, Exobasidium vexans, Carbohydrates.

INTRODUCTION:

Green tea is obtained from the tea plant Camellia sinensis belongs to the family Theaceae. Tea is the most consumed drink in the world after water. Green tea is a 'non fermented' tea and contains more catechins than black tea or oolong tea. Catechins are in vitro and in vivo strong antioxidants. Presently, it is cultivated in at least 30 countries around the world. Tea beverage is an infusion of the dried leaves of Camellia sinensis. It is a widely used medicinal plant by trials throughout India, China and popular in various indigenous system of medicine like Ayurveda, Unani and Homoeopathy Green tea has been consumed throughout the ages in India, China, Japan and Thailand.

ISSN 2581-7795

Fig 1: Green tea Scientific Classification:

Kingdom : Plantae

Order : Ericales

Family :Theaceae

Genus :Camellia

Species` : C.sinensis

Binomial name: Camellia sin

Description:

Camellia sinensis an evergre small tree that is usually below two metres (six cultivated for its leaves. It I taproot. The Flowers are yellow-white, 2.5-4 cm in diameter, with 7 to 8 petals. The seeds of Camellia sinensis and Camellia Oleifera can be pressed to yield tea oil, a sweetish seasoning and cooking oil that should not be confused with tea tree oil, an essential oil that is used for medical and cosmetic purposes and originates from the leaves of a different plant. The leaves are 4-15 cm long and 2-5 cm broad. The young, light green leaves are preferably harvested for tea production. They have short white hairs on the underside. Older leaves are deeper green. Different Leaf ages produce differing tea qualities, since their chemical compositions are different. [1]

Phytochemicals: These are phenolic compounds That are neither vitamins nor minerals. These Include:

Flavonoids: These are phenolic compounds that give vegetables fruits, grains, seeds leaves, flowers and bark their colours.

Catechins: The most active antioxidants in green and black tea and sesamol.

Carotenoids: Fat soluble colour in fruits and vegetables.

Beta Carotene: Which is rich in carrot and converted to Vitamin A when the body lacks enough of the vitamin.

Lycopene: High in tomatoes

Zeaxantin: High in spinach and other dark greens.[2]

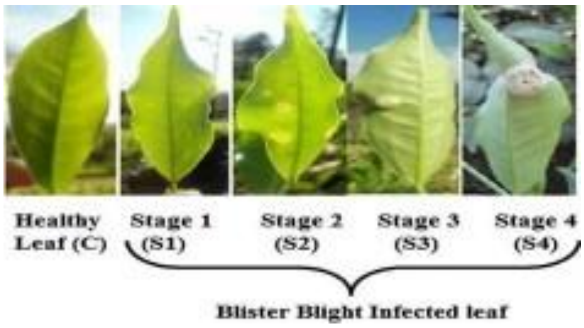
Tea leaf's disease:

Leaf disease is an impairment to the normal state of the plant that modifies or interrupts its vital functions such as Photosynthesis, transpiration, pollination, fertilisation, Germination etc. The change in the leaf colour is the important aspect for the notification. When the physical condition of the tea plant is at a good stage then the colour of the leaf is different but as soon as the leaf is affected by some harming pathogens, the colour changes automatically. The emergence of plant disease has become more common nowadays as factors such as climate and environmental conditions are more unsettled than ever [3]. Tea plant diseases are usually caused by fungi, bacteria, alga and viruses and also there are other diseases which are caused by adverse environmental conditions [4].

Early prediction of disease attacks is very important to take proactive, efficient, and effective control against the disease [5] and to support sustainable development. Tea is grown in hot and humid regions as a cash crop that is used to make the world's most used beverage [6]. Fungal diseases of tea plants cause severe losses to the tea production and quality of the produce [7]. Blister blight (*Exobasidium vexans*) is the most common and destructive disease of the tea plant that seriously affects tea production across the world. Blister blight (*Exobasidium vexans*) can reduce the yield of Tea by up to 40% [6]. Disease attack on crops is a serious hazard to sustainable developments and productivity in agriculture [8]. Early prediction and detection of disease attacks are very important to preserve crop yield.[9]

Fig2: Blister Blight Disease Fig3: Leaf infected by Blister Blight

Tea (*Camellia sinensis*) production is affected by different pests and disease attacks. Fungal diseases seriously affect the yield and quality of the tea. Blister blight (*Exobasidium vexans)* is the major fungal disease of the tea that affects the leaves, shoots, and buds. Blister blight not only affects the production of the tea but also damages the plants to such an extent that survival of the tea plant become impossible [6], [7].Blister blight is caused by Exobasidium vexans pathogen. This disease is present in



almost every tea-growing area except in America and Africa. Tea is the sole host for the E. vexans pathogen. Moderate temperature, from 15 to 25◦C, and high humidity above 80% are the favourable environmental condition for the development of blister blight by *Exobasidium vexans* [10], [11]. Wet and cool weather favours the development of blister blight disease on tea plants [10], [6] The E. vexans affect the tea plant at every stage and almost every part of the plant. Lemon colour spots at leaves are the first symptoms of the disease in the tea plant. Blister blight (*E. vexans*) can affect 20-50% of the yield of tea. Apart from crop production, blister blight also affects the quality of tea in terms of caffeine production [6]. The latest trends of research in agriculture are toward the use of gene technology to develop disease resistant variants of the plant, and to increase food quality and productivity of the plant with reduced expenditure [12].

MATERIALS AND METHODS:

In this section, the method of environmental data collection and flow chart for crop disease prediction, the environmental data, and the machine learning model is described.

PROTOTYPE FOR ENVIRONMENTAL DATA SENSING:

The crop field environmental data is captured by developing an IoT-based hardware prototype. The Arduino platform is used with DHT-22 (Digital Temperature and Humidity) and a rain sensor to directly sense the temperature, humidity, and rainfall from the crop field. The hardware prototype with the DHT-22 sensor. The environmental data is sent to the server for further processing according to the proposed solution.

FLOW CHART OF THE PROPOSEDDISEASE PREDICTION

International Research Journal of Educati
Peer Reviewed Journal
ISSN 2581-7795

The proposed solution determines the probability of blister blight disease of tea plants from prevailing temperature, humidity, and rainfall conditions. Daily temperature and humidity are used to determine the average monthly temperature and average monthly humidity. The maximum rainfall of any day in the month is taken as the maximum rainfall of the month. The average monthly temperature, humidity, and maximum monthly rainfall are used to determine the probability of the occurrence of a blister blight disease attack on tea plants. The predictions made by the model are validated by field observations. If the field observations show the disease attack more than 15% of the plants, that is the Economic Threshold Level (ETL) of blister blight on tea plants. The predictions are compared against the field observations and validated. The validations of the predictions are provided as feedback to the machine learning model to improve the performance over time. The complete flow of information is shown by a flow chart.

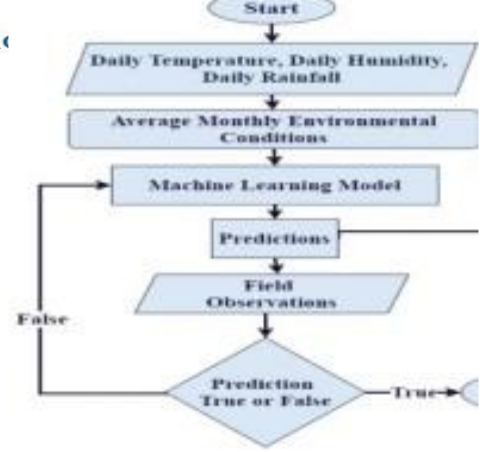


Fig4: Flow chart of disease prediction

ENVIRONMENTAL CONDITIONS

This section presents the environmental conditions that are important for the development of blister blight disease attacks on tea plants. The blister blight disease attack on tea plants is affected by temperature coupled with humidity.

1) TEMPERATURE

Temperature is highly related to the growth of diseases. The average monthly Temperature (T*avg*) is obtained from the daily maximum temperature (T*xi*) by Equation 1.

$$Tavg = \sum^{n} i=1^{Txi}/n$$

where ''*Tavg*'' is the average monthly temperature and ''*Txi*'' is the daily maximum temperature, and 'n' is the number of days in a month. The temperature in the selected area is observed from May to September for selected years. The average monthly temperature (*Tavg*) and daily maximum temperature (*Txi*) for selected months from the year 2015 to 2019 are shown. The temperature in the selected area is mostly around 30◦C during the tea plants season, which is favorable for the development of the disease.

2) HUMIDITY

Humidity is the percentage of moisture in the air. The daily maximum humidity (H*xi*) and average monthly humidity *(Havg*) for the years 2015 to 2019 are shown in Fig. 10. The humidity in July, August, and September are high as compared to other selected months, which makes these more favorable for the development of blister blight attacks on tea plants. The humidity from July to September is 40 to 70% in the selected area. The average monthly humidity is determined by Equation 2.

$$Havg = \sum^{n} i=1^{Hxi}/n$$

where ''*Havg*'' is the average monthly humidity, and ''*Hxi*'' is the daily maximum humidity. 3) RAINFALL

The maximum monthly rainfall is themaximum rainfall on any day for a particular month and is given by

Equation 3. $R_{max} = Max_{Rxi}$

where ‘‘R*max*’’ is the maximum monthly rainfall, ‘‘Rxi’’ is the maximum daily rainfall. The daily rainfall for the selected month.

MACHINE LEARNING MODEL

Due to the existence of a linear relationship, the multiple regression machine learning model is applied. The Multiple Linear Regression (MLR) model determines the dependent variable from one or more independent variables. In case of a problem on hand, the probability of occurrence of a tea (*Camellia sinensis*) disease attack is determined by the prevailing temperature, humidity, and rainfall. For the ’n’ number of the dataset, the relationship between the dependent variable ’y’ and the regressor vector is expressed by Equation 4.

$$y_i = \beta_0 + \beta_{i1} + ... + \beta_p x_{ip} + \varepsilon_i$$

where i = 1,…., n. The Sciket Learn python library is used for implementationpurposes. The dataset is partitioned into 80:20 for training and testing of the Machine Learning (ML) model. IV.

EVALUATIONS

Evaluations are performed based on.

1. Performance of the machine learningmodel

2. Exact of the predictions by field observations.

A. MACHINE LEARNING MODEL PERFORMANCE

In this section, different statistics are given to implement the machine learning model. In Table 1, the correlation between environmental conditions and blister blight disease development is given. The development of blister blight disease is more positively correlated with temperature and humidity while negatively correlated with rainfall. Due

ISSN 2581-7795

to the existence of a correlation between the predictor and response variable, the regression line model is used for implementation purposes. Fig. 13 shows the distribution of ‘‘Yes’’ and ‘‘No’’ probabilities in the data set. The probabilities of prediction of ‘‘Yes’’ and ‘‘No’’ over the ETL are evenly distributed in the dataset. ‘‘Yes’’ is mapped with ’1’ that is distributed to 50%, and ‘‘No’’ is mapped with ‘‘0’’ that is also distributed to 50% in the dataset.

	Temperature	Humidity	Rainfall
Disease Intensity	0.89	0.81	-0.50

Fig 5: Correlation Between Environmental Conditions and Disease Intensity

CULTURAL PRACTICES:

Young succulent harvestable leaves that are typically plucked for commercial tea production are the main targets of E.vexans infection. Tea estates have used the cultural practices of forceful plucking, also known as fish leaf plucking, and early pruning to lesson the severity of Blister Blight infection. According to Eden(1947), the tea plants are not significantly harmed by the practice of hard plucking every two to three months throughout the year. Long term however it might reduce crop output because the bushes weaken and become more vulnerable to mite assault. Additionally, the growth of new foliage is delayed and uneven in tea plantations following severe plucking, giving the plants a worn out appearance. Tea plants that are severely afflicted must be immediately pruned to stop blister blight illness. To guarantee that foliage grew during the time when the illness posed no threat, pruning was done during hot, dry weather. But as a result, the stems suffered sunscald damage that led to cankers. According to cultural customs, shade tress are pruned to allow sunlight to reach tea bushes because prolonged sunlight has been shown to prevent the basidiospores of E.vexans from germinating. According to reports blister blight disease is naturally controlled by a solar radiation component called UV-B. According to the study, the removal of the component from sunlight hitting tea bushes led to a increase in the number of blisters while reducing the number of sporulating and blisters after 62 hours of inoculation was complete sunlight. This demonstrates that many generations cannot be completed within the same cropping season when the sunshine exposure is prolonged.

CHEMICAL CONTROLS: Since the illness occurrence was first noted in southern India in 1960, scientists have recognized the significance of chemical management of blister blight disease and the development of commercially viable chemical therapies. As foliar sprays, preventative, eradicating and systematic fungicides are employed to combat blister blight. Bordeaux mixture and copper oxychloride are the two most commonly used protective fungicide formulations. The acceptance level of the use of copper in tea leaves to control blister blight was set at 150ppm (lamb,1950) as copper-based fungicides also possess collateral damage of phytotoxicity and release of copper residues to environment causes human health hazard, effect soil microflora, and marine population. With a usage rate of 0.21kg metallic copper per hectare, the formulations of copper oxychloride proved successful in controlling the blister blight disease. Copper oxychloride formulations (59-61%) employed a copper content of 50% wettable powder. By inhibiting sporulant action the eradicant fungicide nickel chloride hexahydrate was found to be useful in managing blister blight. After three weeks of treatment the infection was reduced by 84% to 24% and by five weeks, it had dropped to up to 13%. The use of nickel chloride as a therapy, however was rejected since it was discovered to be extremely phytotoxic organic fungicides were introduced in Sri Lanka, Indonesia and Southern India due to the phytotoxicity and secondary health risk posed by chemical fungicides. In contrast to the copper based fungicides, the disease resistance effectiveness was less effective. Additionally the expensive processing of organic fungicides rendered it useless for controlling blister blight

{25,60,62,63}. Daconil and Difolatan are two popular brand names for organic fungicides used to combat blister blight.

BIOLOGICAL CONTROL:

In addition to establishing that blister blight disease can be effectively controlled by chemical therapies, the associate phytotoxicity and health risk havespurred the development of biological control agents against blister blight disease include Trichoderma harzianum, Serratia marcescens, Gliocladium virens,Bacillus subtilis and pseudomonasfluorescens Pseudomonas and Bacillus tocontrol the blister blight disease was investigated. The blister blightdisease was significantly reducedby foliar application ofpseudomonas fluorescens Pf1 bioformulation at 0.5%concentration once a week, thelowest mean disease indexcomparable to the chemical fungicide (14.57%). For twoseasons, disease incidence was reduced and the tea plants treatedwith the defensive enzymes peroxidase, polyphenol oxidase,b-1,3-glucanase,chitinase, phenylalanine ammonia lyase andphenolics were shown to have accumulated. As a result , blisterblight infestation to PGPR mediatedinduction of systematic resistance.

HOST RESISTANCE AGAINST BLISTER BLIGHT DISEASES:

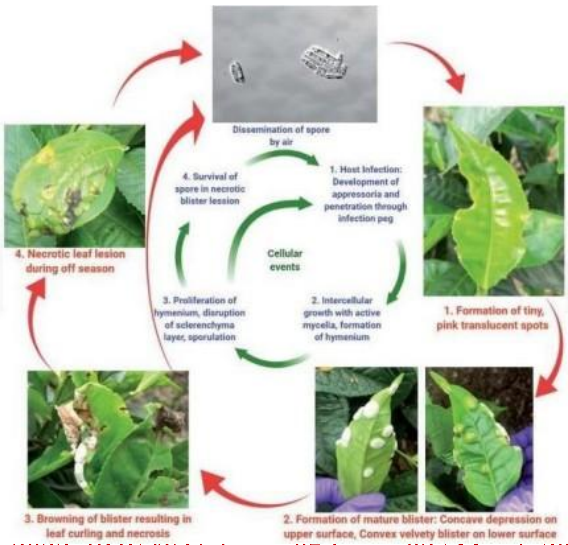
Numerous tea cultivators that have been discovered to be resistant to E.vexans infection have been reported in relation to blister blight disease. To further understand the nature and causes of resistance numerous investigations on the

[66-69]. However, itwas discovered that

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

morphological trait of these cultivators as well as analyses of the major blister blight defenses related enzymes and pathways have been conducted. A study was conducted using the susceptible clone TES-34 and the blister blight resistant clone SA-6. The anatomical differences between the two clones, including cuticle and epidermal thickness, stomatal length and width, palisade tissue and epicuticular wax quantification were examined. They claimed that when compared to other resistant clones, SA-6 displayed more epicuticular wax, a thicker cuticle and more stomatal frequency than TES-34 . PR proteins are said to causes systemic acquired resistance in plants after pathogen infection.

OVER ALL DISEASES CYCLE OF BLISTER BLIGHT



CONCLUSION:

A machine learning model for the blister blight (*Exobasidium vexans*) disease prediction of tea (*Camellia sinensis*) plants is proposed by directly sensing environmental conditions from crop fields. Temperature, humidity, and rainfall are directly captured from the crop field using Internet of Things (IoT) capabilities. The machine learning model shows high prediction accuracy when tested against the test data set. . It is observed that the prediction accuracy increased year by year. The proposed solution aims to support sustainable development in agriculture through judicious use of pesticides and effective control of the disease.

ACKNOWLEDGEMENT:

The authors wish to express their sincere thanks to the management ofDr.N.G.P. Arts and Science College (Autonomous), Coimbatore for rendering all the facilities and support.

REFERENCES:

1. Parmar Namita, Rawat Mukesh and Kumar J. Vijay; *"Camellia Sinensis (Green Tea): A Review"*, Global Journal of Pharmacology 6 (2): 52-59, 2012 ISSN 1992-0075.

2. Himani Vishnoi, Ramesh B. Bodla and Ravi Kant; *GREEN TEA (CAMELLIA SINENSIS) AND ITS ANTIOXIDANT PROPERTY*: A REVIEW, Vishnoi et al., IJPSR, 2018; Vol. 9(5): 1723-36. E-ISSN: 0975-8232; PISSN: 2320-5148 International Journal of Pharmaceutical Sciences and Research 1723 IJPSR (2018), Volume 9, Issue 5.

3.Camargo A., Smith J.S. (2009) Biosystems Engineering I02, 9-21.

4.Md. Saidur

Rahman Khan,

SUST, Disease

scenery of

Bangladesh in

tea

5. K. V. Raghavendra, D. S. B. Naik, S. Venkatramaphanikumar, S. D. Kumar, And S. V. Rama Krishna, ‘‘*Weather based prediction of pests in cotton,’’* in Proc. Int. Conf. Comput. Intell. Commun. Netw., Nov. 2014, pp. 570–574, Doi: 10.1109/CICN.2014.129.

6. C.Chaliha andE. Kalita,‘‘*Blister blight disease of tea:An enigma*,’’ In Diagnostics of Plant Diseases, Dec. 2020, doi: 10.5772/INTECHOPEN.95362.

7.S. Sen, M. Rai, D. Das, S. Chandra, and K. Acharya, ‘‘*Blister Blight a threatened problem in tea industry: A review,’’* J. King Saud Univ. Sci., vol. 32, no. 8, pp. 3265–3272, Dec. 2020, doi: 10.1016/ J.JKSUS.2020.09.008.

8. X. Yang, J. Zhang, D. Guo, X. Xiong, L. Chang, Q. Niu, and D. Huang, ‘‘*Measuring and evaluating anthocyanin in lettuce leaf based on color Information,’’* IFAC-Papers On Line, vol. 49, no. 16, pp. 96–99, 2016, doi: 10.1016/j.ifacol.2016.10.018.10.

9. C. Farber, M. Mahnke, L. Sanchez, and D. Kurouski, ‘‘*Advanced Spectroscopic techniques for plant disease diagnostics. A review,*’’ TrAC Trends Anal. Chem., vol. 118, pp. 43–49, Sep. 2019, doi: 10.1016/J.TRAC.2019.05.022.