Survey of Wheat Crop Diseases using Meta-heuristic and Machine Learning Techniques

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ABSTRACT

All human being accomplishments are sustained by playing a vital role in the field of agriculture. Survival of this whole living world depending upon Agriculture that is an essential item. Some of the factors like conventional outlook, increase in population, changes in climate and irrigation related problems create diseases in agriculture crops. Crop production reduced due to crop-related diseases. Several mechanisms and techniques were developed to handle and reduce the increasing problems occurring in crops. Precision agriculture working and smart farming is the best-advanced tools for the reduction of diseases. Mainly meta-heuristic mechanisms with machine learning techniques are the key items for controlling and reduction of agriculture crop diseases especially in wheat crop. Due to the availability of data related to wheat agriculture crop and research methodology related to these diseases detect the occurrence and remove it by using machine learning. Diversity of wheat crops liveliness can be easily detected by using the meta-heuristic methodology and show favourable outputs with the help of some agricultural related websites. In this research paper, a systematic survey was done by the deep study related to machine learning and meta-heuristic processes for the detection of wheat-related agriculture crop.

Keywords:

Wheat crop diseases**;** Plant diseases; Leaf diseases; Soft computing; Meta-heuristic; Machine learning; Deep learning; Data analytics.

1. INTRODUCTION

Crops play a vital role in the living of human beings and also develop a sustainable atmosphere for living organs especially in the field of agriculture. Energy consumption is today's priority in the field of agriculture to provide sufficient food with the increase of population [1]. Now the wheat crop is a big demand due to the growth of the global population. From all the agriculture crops, the wheat crop is worldwide called the *king of cereals* and due to that, the main objective of agriculture research is to improve the management and productivity of wheat agriculture crops. Wheat crop is a winter-based food crop and mostly productivity occurs in South-West part of Asia. Wheat crop is the main agricultural source of plant protein creation for living organs and human beings. Moist and cool weather is the main requirement for better grain formation of wheat crop. Wheat crop is cultivated in Punjab, Haryana, Uttar Pradesh states as leading states. It is helpful for mankind for providing a better diet than other foods. It is having carbohydrates, vitamins, protein, nutrients fibres and many natural dietary minerals for the disease protections. However whether it is one of the high level cultivated crop but faces a number of sufferings or hindrance or diseases having some of the major problems as black chaff, leaf rust, crown rot, root rusing and tan spot and many more which affect the growth and production of wheat. To avoid such a type of problem there be a need to diagnosis the disease at the right time and to care for and prevent it from further extension in plants. To find the solution of crop disease and timely management to handle the disease is to diagnosis first and according vaccinate it. No doubt manually diagnosis is a very difficult process but using some meta-heuristic mechanisms, it is very easy to overcome and control.

So, automation of the disease detection process becomes beneficial for handling and monitoring wheat crop-related problems. Automation of wheat crop-related disease identify and prevent in such a way

that it becomes fruitful for the farmers and is the best aid for detection, prevention and cure. It is a very less costly and also timely manageable system for crop diseases [2]. Several automated mechanisms was developed for crop diseases detection as meta-heuristic, machine learning, image processing, deep learning, fuzzy system, Support Vector Machines (SVM) and so on. Researchers work on these techniques for the detection and prevention of wheat crop diseases that becomes beneficial to the farmer society. As there are multifaceted problems arising in the good production of agricultural wheat crop, there be need to use computerized smart farming approaches.

Major job of data analytics is to provide ecological sustainability and guarantee good food safety and a positive food security future. Some of the troublesome statistics data and communication approaches like big data analytics, machine learning, blockchain and cloud computing can speak about number of problems occurring in yield improvement, better productivity, a good plant health, water conservation and providing better environment [3]. Number of scientists have applied various data mining and soft computing methods like Genetic Algorithm, Particle Swarm Optimization, Ant Colony Optimization and Artificial Bee Colony techniques for different diseases protection in human beings which are further helpful in the agricultural field [4]. Also soft computing, fog computing and internet of things like techniques becomes useful in remote monitoring of covid patient that becomes useful in crop diseases also [5]. Here a survey was done based on various techniques to detect wheat crop-related diseases so that further research can be done to improve the production of wheat crop.

2. LITERATURE SURVEY

It is intrinsic and necessary for better utilization of energy resources, best optimization and good forecasting regarding the agricultural crop to study all the techniques for detection and prevention of crop diseases. So, in this literature survey all the techniques using meta-heuristic and machine learning are elaborated for the detection and prevention of diseases in crops specially for wheat crop. Number of approaches have been discussed for identification of crop diseases by the researchers with various techniques as follows.

Bravo et. al. (2003) [6] classified a database normalisation model for reflection and to adjust the illumination in data. This reduced the 12% to 4% confusion error rate that was an encouraging approach for measuring the cost and its effect on recognising diseases like yellow rust etc. Tangour et. al. (2007) [7] minimize the makespan, distribution cost, finding out of date products and optimize the data in production of agro-food. Olden et. al. (2008) [8] used machine learning for prediction and handling the complex problems having number of interacting elements in ecological systems. Pant et. al. (2010) [9] studied an optimization technique based on linear programming for measuring crop plan in an optimal way related with a project in the Kerala state of India. Prasad et. al. (2010) [10] used machine learning concept with Artificial Bee Colony algorithm and a rule based mechanism by investigating web based chilly plant diseases and their treatment and find the best-optimized outcomes. Thorsten et. al. (2011) [11] studied and analyzed a single airborne hyperspectral HyMap dataset for finding infection and stress in wheat crops by using SVM and Spectral Angle Mapper (SAM) to experiment and classification of data covering. It reduced the Kappa coefficient factor from 0.59 to 0.57 and so best optimized. Sharma et. al. (2013) [12] revealed the effect of genetic algorithm on some complex research area like task scheduling, query optimization, phrase chunking, speech tagging, inventory management and control and data mining, image segmentation etc. Revathi et. al. (2014) [13] has elaborated a new feature extraction technique with an enhance PSO with fuzzy and some of the skew divergence methods that enhanced the 94% accuracy.

Further Jagadeesh et. al. (2014) [14] discussed fungal disease symptom identification and behaviour of its classifiers by taking the data of vegetable crops by using Neuro-KNN for training and K-nearest neighbour (KNN) for testing that improves the average accuracy from 84.11% to 91.54%. Liangxiu et.al. (2015) [15] designed a unique computer vision for crop disease detection by extracting disease-related symptom with controlled segmentation by analyzing gabor, tectural and gradient-based features. It detects septoria and yellow rust in wheat crop and compared ANN with SVM disease detection. ANN have poor results as compared to SVM and so SVM becomes better. Sharma et. al. (2015) [16]

optimized a query base decision support system using exhaustive enumeration, Genetic Algorithm, Dynamic Programming and Entropy based Genetic Algorithm. Sharada P. Mohanty et. al. (2016) [17] considered deep learning approach for plant diseases diagnosis by taking the images by smart phones and achieved 99.35% accuracy. Srdjan Sladojevic et. al. (2016) [18] explained about leaf image classification using CNN classifier to recognaize crop diseases (to compare non healthy with healthy leaves) with deep neural networks and achieved 96.3% accuracy. Prabira et. al. (2016) [19] conveyed a new methodology to detect leaf related diseases by using multi SVM, k-means clustering and PSO by achieving 97.91% accuracy. Pranjali et. al. (2016) [20] classified and detected plant leaf related disease method with SVM classifier and segment it by K-Mean clustring and extracted texture and color of leaves. 88.89% accuracy achieved with this technique.

In further survey, Dhiman et. al. (2016) [21] detected rust leaf diseases in wheat crops with fuzzy approach, rough set method and image processing by experimenting on non-diseased and diseased wheat leaf images by achieving 94% accuracy and found best method. Jingwei et. al. (2016) [22] applied Ant Colony method that becomes more helpful by detecting and solving the fuzziness for infected crops with analysing multi-spectral image of these infected plants. This achieved 97% accuracy in detection. Varsha et. al. (2017) [23] designed computer program solution that classify based on neural network approach and detect plant diseases automatically in four step methodology. Sarangdhar et. al. (2017) [24] elaborated a model for controlling and detection of cotton leaf related diseases by monitoring the soil quality using Support Vector Machine (SVM). It classify and identify cotton crop related diseases in five pattrens by developing a regression system for plant detection with 83.26% accuracy. Monzurul et. al. (2017) [25] integrated image processing with machine learning mechanism by analysing images of plant leaves and detect the diseases in a better way that achieved 95% accuracy by using segmentation and Support Vector Machine (SVM).

Priyanka et. al. (2018) [26] recognized some of the parasitic maladies by considering the oat trims of rice, wheat and maize by using multiple perceptron, LibSVM classifier and Naïve classifiers. It was found that Naïve base classifiers have 90.97% accuracy as compared to other approaches. Serawork et. al. (2018) [27] discussed the CNN technique to detect soybean plant-related diseases and overall 99.32% accuracy achieved. Sandeep et. al. (2018) [28] explained exponential optimization naming spider monkey that employed for fixing some of the important features using the SPAM mechanism. Also, the support vector machine used for plant classification for the detection of plants diseases enhances the reliability in the classification of plant diseases. Diana et. al. (2019) [29] considered a feature selection approach (SVM) for the classification and identification of diseases by using ant bee colony methods on grape crops. By comparing the proposed method with previous techniques, it was found that the proposed method has better efficiency and accuracy by considering some of the performance metrics like classification accuracy, precision and recall approaches. Pooja et. al. (2019) [30] detected a disease using HSV classification, k-means clustering and image segmentation methodology by analysing infected parts of the plant leaves with GLCM feature extraction mechanism that produced 98% accuracy as compared to older approaches.

Zhang et. al. (2019) [31] developed a deep learning mechanism for yellow leaf rust disease detection with hyperspectral high-resolution UAVs images and overall achieved 85% accuracy. Sharma et. al. (2019) [32] narrated a review on a query optimizer that was cost-based and designing done by considering some of the popular techniques and approaches like cost-effectiveness, a hybrid mechanism to handle a set of various datsets from different experiments, using database strategies, stochastic approach, deterministic methodology, energy efficient and accuracy based methods. Jahan et. al. (2020) [33] detected and distinguished the wheat crop related diseases by using machine learning technique with image processing and improved the results. Zhu et. al. (2021) [34] designated a low relative yield shock and also did analysis of wheat yield shocks substaintial around Europe in previous four decades. In proposed system discrepancies removed by observation and simulating the yield data calling for crop model improvement. Sharma et. al. (2021) [35] reviewed in a systematic manner to analyize the stress prevalence and its diagnosis way with supervised learning and soft computing mechanisms. Haider et. al. (2021) [36] proposed a novel generic technique for classification and identification of wheat crop diseases with Decision Trees method and using various deep learning mechanisms. Below is a survey

table that elaborates the research with techniques and its accuracy factor related with crop diseases detection and prevention. This will beneficial for further research and study.

Author and Year of Publication	**Purpose of research**	**Techniques applied in research**	**Outcomes with accuracy**
Haider et. al. (2021)	classification and identification of wheat crop diseases with Decision Trees and deep learning	Decision Trees method and deep learning methods	It has more accuracy for the detection of diseases (97.2%)
Zahu et. al. (2021)	Improvement in wheat crops yield	Machine learning	Improved accuracy in removing discrepancies (88%)
Sharma et. al. (2021)	Diagnosis of stress	Soft Computing with Supervised learning	Presented a comprehensive review on stress diagnosis.
Jahan et. al. (2020)	detected and distinguished the wheat crop-related diseases	machine-learning technique with image processing	Detection accuracy improved as in previous methods used. (97%)
Pooja et. al. (2019)	Future extraction and recognization of infected leaves parts	Feature extraction methods with GLCM, K-means clustering and HSV	GLCM and HSV are more effective to detect infected leaves (98%)
Diana et. al. (2019)	Detection and classification of diseases in grape leaves	Ant Bee colony and Support vector machine	The reliability of ABC is more than KNN (93.01%)
Xin et. al. (2019)	Detection of yellow rust disease using UAV images	deep convolutional neural network	Spatial methods gave better accuracy (85%)
Prabira et. al. (2019)	Detection of leaf related diseases	PSO, SVM and k-means clustering mechanisms	SVM and PSO best for leaf related disease detection (97.91%)
Priyanka et. al. (2018)	Wheat, Maize, Rice related diseases detection	Multilayer perceptron, LibSVM Classifier and Naive Base Classifiers,	Naive Base Classifiers is best (90.97%)
Serawork et. al. (2018)	Crops and plant-related diseases classification	Using CNN	CNN classify and extract better as compared to others (99.93%)
Selim et. al. (2018)	Detection and recognition of plant leaf related disease	By using SVM	Detection of leaf diseases by SVM is fast (93%)
Varsha et. al. (2017)	Classification and detection of crop diseases automatically with a software	Image processing, Neural Network (NN) and SVM	SVM has better accuracy as compared to NN (89.23%)
Sarangdhar et. al. (2017)	Detection and controlling of cotton crop-related diseases by monitoring the quality of the soil.	Using SVM with some hybrid methods.	SVM has more accuracy as compared to others (83.26%)
Kumar et. al. (2017)	Detection of plant leaf diseases	SVM with ESMO and KNN with SMO	SVM with ESMO gave accurate output (92.12%)

Islam et. al. (2017)	Diseases diagnosis system by viewing leaf images	Image Segmentation with SVM	Segmentation with SVM has more accuracy (95%)
Mohanty et. al. (2016)	Detection of plant diseases with the help of Image of plants	Deep learning technique	Deep learning has accuracy and a clear path for crop diseases detection with the smart-phone facility (99.35%)
Srdjan et. al. (2016)	Plant diseases recognization system development with deep convolutional networks	Using CNN technique	CNN has better outputs (96.3%)
Waghmare et. al. (2016)	Identify plant-related disease by analyizing of leaf pattern recognization and leaf texture effects	SVM with DSS and HUE Saturation Value methodology	The proposed technique has more accurate results (96.6%)
Jingwei et. al. (2016)	To detect grape vine leafroll disease (GLD)	ant colony clustering algorithm	multi-This detect diseases at advanced stages (75%)
Padol et. al. (2016)	Classification and detection of leaf plant-related diseases with SVM	SVM and k-means clustering with Image processing	This methodology is best as compared to the previous (88.89%)
Dhiman et. al. (2016)	Detection of rust in wheat crop-related leaf	Fuzzy system with Image processing	It gives more accuracy (95%)
Han et. al. (2015)	Detection of crops related diseases using a novel approach based on computer vision and SVM, ANN classifier	ANN classifier with SVM and computer vision approach	It detects the diseases with more accuracy (95%)
Revathi et. al. (2014)	Cotton crop diseases identification with their visual symptoms and RGB images	A fuzzy system with EPSO methodology	Proposed methodology gave better results (94%)
Pujari et. al. (2014)	To detect and identify fungal on vegetable crops diseases	ANN with KNN and local binary patterns	Neuro-kNN is better than ANN (91.54%)

3. CONCLUSION

It was concluded from the literature survey that machine learning and meta-heuristic mechanisms shows better accuracy in outcomes as compared to previous traditional methods in detecting and preventing the various crops diseases, especially in wheat crop diseases. It becomes beneficial for future discussion and research work as well as helpful for managing various crops related diseases and in their forecast for disease detection and prevention.

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