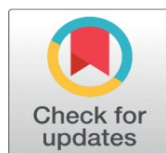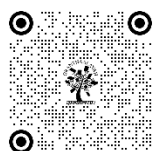# A REVIEW ON ROLE OF METAHEURISTIC AND MACHINE LEARNING IN WHEAT DISEASE DETECTION

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ABSTRACT

Wheat is one of the highest cultivated and important crops to mankind but diseases are known to reduce grain yield potential and quality and have historically caused major crop losses. Diseases detection is very important for increasing the livelihood of crops. The early detection of diseases can be very helpful in curing the disease completely. Many techniques have been developed to detect the diseases in wheat crop at an early stage. In this paper we have surveyed the meta heuristic and machine learning techniques used for the detection of wheat diseases. Both the techniques have shown the better results in increasing the efficiency and accuracy of the algorithms used for the detection the wheat crop disease.

**Keywords:** Metaheuristic, Machine Learning, Leaf Rust

1. INTRODUCTION

Wheat is one of the main grown crops in the whole world. It provides a substantial source of food. After rice, wheat is the second most important grain in India. It is an essential food especially for the Northern India. It is estimated that almost 40% of worldwide crops are lost to various diseases [1]. Wheat diseases are not only degrading its quality but also responsible for the severe decrease in its production. Early detection of disease is very important. Farmers use manually inspection method for the disease detection but this process is very time consuming for the large farms. Automated methods not only save time but also provide good results in detection of disease. Several researchers have expressed their enthusiasm in automated detection of wheat diseases. This paper mainly surveys the use of metaheuristic and machine learning methods in the field of diseases detection in wheat crop. Main diseases of that currently contribute to its loss are rust, blotches and head blight [13]. Other wheat diseases like stripe rust, leaf rust, powdery mildew, tan spot, Karnal Bunt also have severe effect on the production of the crop. Rust and non rust on average causes 10-28% yield losses globally [14]. There is a high need of automated methods for the early detection of these diseases. Meta heuristic and machine learning methods are highly adapted methods nowadays. These techniques provide better and efficient results in detection of diseases. Techniques like PSO, ACO, ABC, GA and classifiers like SVM, NN proved to be a boon in detection of diseases. Many researchers had used these techniques in their respective fields

and got amazing results. In this review study we have provided an overview of severe effect of these diseases on yield loss and the use of metaheuristic and machine learning in detection of the wheat diseases.

2. WHEAT DISEASE DETECTION PROCESS

The process of detection of disease in wheat crop includes various steps which are shown below
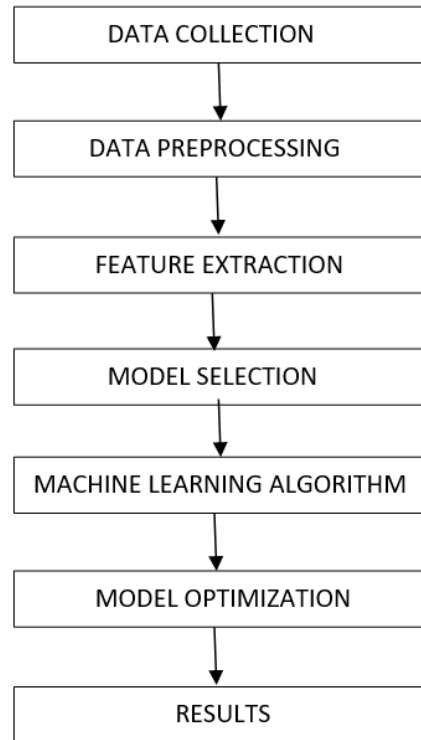
Figure Wheat Disease Detection Process

3. LITERATURE REVIEW

Some of the diseases of the wheat crop and their adverse effect on decreasing yield of wheat crop in agriculture economy is shown in below given table [13][14].

Table 1 The estimated wheat yield losses due to diseases

Disease	Yield Loss (US)	Yield Loss (India)
Rust (Stem, Stripe, Leaf)	$ 4.3 to 5.0 billion	10 to 70%
Leaf Rust	$ 350 million	50-70%
Powdery Mildew	$ 44.6 million	20-40%
Stripe Rust	$ 1 billion	10-70%
Stem Rust	$6.2 million	100%
Fusarium Head Blight (FHB)	$ 3 billion	UPTO 80%

These diseases have severe effect on production and quality of crop so a quick solution to these diseases is required. Metaheuristic and machine learning techniques can be useful in this detection process. Many researchers have done research in this field using different techniques. Some used meta heuristic and machine learning techniques for detection of disease and achieved better results. The research of some researchers is presented in the survey table below.

Reference	Purpose of Research	Technqiue Used	Result/Outcome
S.M.Naveen Raja et.al (2024)[3]	Wheat leaf disease detection	MFO and RBFNN algorithms	99.32% accuracy was achieved
Musa Dogan et.al 2023 [4]	To determine the types of wheat	HHO and PSO were used with ELM algorithm	99.32% in binary classification and 95.95% in multi-class classification.
El-Sayed M. El-Kenawy et.al(2022)[5]	Weed detection	GWO algorithm and SVM,KNN,NN classifiers	accuracy of 97.70% was achieved
Tagel Aboneh et.al 2021[6]	Wheat disease detection	Deep learning models were used	accuracy 99.38%was achieved
Ali Moghimi et.al[7] 2019	Detection of Fusarium head blight disease	Spectral bands and Machine learning classifiers	99% accuracy
Xin Zhang et.al2019[8]	Detection of yellow rust disease	deep convolutional neural network (DCNN), using very high spatial resolution hyperspectral images captured with UAVs.	combining both spectral and spatial information could significantly improve the accuracy
Varsha P. Gaikwad et.al 2017[9]	Detection of wheat leaf disease	Neural network and SVM classifier and Image processing technqiues	SVM achieved more accuracy(89.23%) than neural network
Jiang Lu et.al 2017[10]	Proposed novel wheat disease diagnosis system	VGG-FCN-VD16,VGG-FCN-5 used	97.95% and 95.12% accuracies achieved
Christoph Romer et.al 2011 [11]	Wheat Leaf rust disease detection	polynomial fitting of fluorescence signatures with Support Vector Machines	93% accuracy was achieved.
Thorsten Mewe et.al 2011 [12]	Detection of wheat disease	HyMap bands,spectral angle mapper (SAM) and support vector machines (SVM) classifiers were used	SVM provided better results.

4. KEY CHALLENEGES

Apart from the benefits that machine learning offers in detection of disease it faces some challenges. First challenge is the changeability in environmental factors. Environmental conditions like rain, humidity and temperature can affect the intensity of disease transmission cycle. Environmental factors can change the dynamics of diseases. It can even lead to the outbreak of new disease. Second challenge is real time monitoring. Real time monitoring leads to quicker identification of disease [15]. Disease detection at an early stage can be really helpful in detection process. Real time monitoring helps the researcher in gaining abundance of data to check the progress of disease over time. So real time monitoring should be done carefully. Another challenge is dataset. More the data is much better the results will be. Getting quality of data is a one of the challenging task. By getting labeled data researchers can train their model to identify the disease patterns. So, these are some of the challenges which machine learning and metahueristic techniques face while detecting the disease. Despite the challenges both techniques have shown their strength and capability in detecting the disease.

5. CONCLUSION

Metaheuristic and machine learning techniques have given good results and accuracy. Combinations of these will surely give much better results. The combination of these techniques in detection of diseases either on crops, fruits or vegetables will give good results. More future research can be done using the combination of these two techniques.

CONFLICT OF INTERESTS

None.

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