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A Review on Preharvesting Soybean Crop Pests and Detecting Techniques

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Abstract: Plants are of fundamental importance to life on Earth. Diseases in plants cause major production and economic losses in agricultural industry worldwide. A good understanding of plants is necessary to improve agricultural productivity and sustainability. With the aim of increasing and diversifying income sources for farmers and providing alternative options to shifting cultivation, the Indian government is actively promoting the production of cash crops, most recently of which is soybeans. The present review explores various diseases on soybean crops and recognizes the need for developing a rapid, cost-effective, and reliable system for detecting diseases that would upgrade the agricultural sector. It describes the currently used technologies for assist in monitoring health and diseases in plants under field conditions. These technologies include spectroscopic and imaging-based, and volatile profiling-based plant, artificial neural network, machine vision ,using metadata and remote sensing and geospatial technology Site-specific crop management for agriculture field.

Keywords: Soybean Crop, Soybean Diseases, Image Processing, Artificial Neural Network.

I. INTRODUCTION

Farming is no longer a subsidiary occupation. The agricultural sector plays important role in the Indian Economy. Now with the recent advances in science and technology, evaluation of crops has become highly scientific. Plants are the most important source of food for man. Plant diseases reduce both quantity and quality of plant products. The prime objective of plant pathology is to prevent epidemic which are widespread outbreak of destructive diseases. Knowledge of different disease causing pathogen and their control is very essential in order to prevent the epidemics of the disease. With a growing human population and a changing climate, there is an increasing threat to many ecosystems an expert on one species or family may be unfamiliar with another. This has lead to an increasing interest in automating the process of species identification and related tasks.

Soybean is known as the “GOLDEN BEAN” of the 20th century. Originated from China soybean crop find place in the cropping pattern of farmers in USA. Japan, China, Indonesia Brazil, Argentina, Philippines and India. It was only during the mid-eighties that farmers started cultivating this high value oilseed crop mainly due to high element of profit involved in its cultivation.*[1]* Soybean possesses a very high nutritional value. It can supply the much needed protein to human diets, because it contains above 40 per cent protein of superior quality and all the essential amino acids particularly glycine, tryptophan and lysine, similar to cow’s milk and animal proteins. Soybean also contains about 20 per cent oil with an important fatty acid, lecithin and Vitamin A and D. The 4 percent mineral salts of Soybeans are fairly rich in phosphorous and calcium.

There has been growing demand of soybean not only in domestic but also in international market due to perceptible change in consumption habits of urban population. It is now the second largest oilseed in India after groundnut as per information in Table 1.Commercial production of soybean is a potential source of income to farmers, traders and Government. Stakeholders, market factors and communication structures are some of the major determinants to successful promotion of soybean as a cash crop in India. However, being a new cash crop, soybean production faces many challenges.

Table I: India Oilseeds Production

	2009/10	2010/11	2011/12	2012/13	Nov 2013/14
Production					
Oilseed, Cottonseed	10,402	11,548	12,312	12,100	12,300
Oilseed, Peanut	4,900	5,850	5,500	5,000	5,500
Oilseed, Rapeseed	6,400	7,100	6,200	6,800	7,000
Oilseed, Soybean	9,700	9,800	11,000	11,500	11,800
Oilseed, Sunflowerseed	820	655	620	700	730
Other	749	749	749	749	749
Total	32,971	35,702	36,381	36,849	38,079

Source: United States Department of Agriculture

II. SOYABIN DISEASES

A plant disease is any abnormal condition that alters the appearance or functions of a plant and may reduce the quality and/or quantity of the harvested product. A susceptible host plant, a pathogen and a favorable environment are the three factors composing the plant disease triangle. For the pre harvest losses, generally animal pests (insects, mites, rodents, snails and birds), plant pathogens (bacteria, fungi, virus and nematodes) and weeds are collectively called as pests.

Soybean is the main oil seed crop in India. About 35 diseases have been identified on soybean in India; 14 of these are important based on the magnitude of yield loss. The most yield losses were caused by viruses, Sclerotium blight, anthracnose, rust, charcoal rot, and Rhizoctonia aerial blight (Table 2) *[2]*.

Table II. Estimated reduction of soybean yields
(Thousand metric tons) due to diseases in the top eight soybean-producing countries

Disease	Argentina	Bolivia	Brazil	Canada	China	India	Paraguay	USA	Total
Anthracnose	45.3	Tr[w]	220	0	1663.5	117.6	0.3	492.9	2,539.6
Bacterial diseases	22.6	Tr	130	Tr	570.3	19.6	0	101.5	844.0
Brown spot	1176.5	Tr	340	0.8	2186.3	19.6	0.1	536.6	4,259.9
Brown stem rot	22.6	0	40	3.3	998.1	0	0	497.5	1,561.5
Charcoal rot	905.0	500.0	360	1.6	0	39.2	1.6	697.6	2,505.0
Downy mildew	0	Tr	50	1.6	1996.2	0	0	147.4	2,195.2
Frogeye leaf spot	22.6	Tr	40	0.3	0	19.6	0	345.1	427.6
Fusarium root rot	0	Tr	40	19.6	1615.9	19.6	0	169.1	1,864.2
Phomopsis seed decay	45.3	0	130	16.3	95.1	0	0	122.0	408.7
Phytophthora root and stem rot	67.9	0	Tr	26.1	760.5	0	0	1464.2	2,318.7
Pod and stem blight	181.0	0	0	11.4	95.1	19.6	0.1	208.3	515.5
Powdery mildew	0	Tr	0	0	0	0	0	0	0
Purple seed stain & Cercospora leaf blight	1086.0	Tr	720	0.3	0	19.6	0.7	85.2	1,911.8
Rhizoctonia aerial blight	0	0	300	0	1188.2	39.2	0	12.5	1,539.9
Root-knot and other nematodes	22.6	Tr	260	7.1	2186.3	0	0.4	215.5	2,691.9
Sclerotinia stem rot	135.7	Tr	200	4.9	1520.9	0	0	362.0	2,223.5
Sclerotium blight	0	0	58	0	0	156.9	0	5.2	220.1
Seed diseases	45.3	0	70	16.3	1188.2	0	0.1	18.5	1,338.4
Seedling diseases	45.3	Tr	82	89.7	2043.8	19.6	0	1085.3	3,365.7
Soybean cyst nematode	22.6	0	520	97.8	3184.4	0	0	3368.1	7,192.9
Soybean rust	45.3	2000	4720	0	6368.9	78.4	1.9	24.5	13,239.0
Stem canker	0	Tr	0	11.4	0	0	0	211.7	223.1
Sudden death syndrome	769.3	0	320	16.3	0	0	0	743.4	1,849.0
Virus diseases	45.3	Tr	100	9.8	1568.5	196.1	0	202.7	2,122.4
Other diseases	45.3	500.0	0	26.1	1948.7	58.8	0	0	2,578.9
Total									59,936.5

A. Soybean rust

Soybean rust was first discovered in the continental United States in November 2004. This foliar disease is caused by the fungus Phakopsora pachyrhizi. Soybean rust is capable of destroying a soybean crop if it becomes established in a field early and weather conditions favour the spread of infection. The fungus is an obligate parasite, which means it can grow and reproduce only in living plant tissue. The fungus uses nutrients manufactured in soybean leaves to support its growth and reproduction. As a result, this drain on soybean plants can substantially reduce yields. Early soybean rust symptoms are best viewed on backlit leaves. Note the small, brown specks with no surrounding chlorate (yellow) tissue on this infected leaf in figure 1. *[3]*

Figure 1. Soybean rust

B. Anthracnose

Symptoms are look for darkened gray-black lesions on leaves, stems, and pods. This disease is favoured by humid weather and comes usually from infected crop debris. Veins may appear reddened, and petioles or stems may have dark blotches resembling pod and stem blight. Microscopic evaluation may reveal characteristic acervuli (fruiting bodies).Impacts are losses are usually minor and associated with damaged seed, as the disease is present at later growth stages. Seedlings may also be affected by the fungus, leading to seedling blight stand losses.

Figure 2. Anthracnose

C. Alternaria leaf spot

Causal organism is Alternaria tenuissima (Kunze ex Pers.). Damages are Seed become small and shrivelled. Dark, irregular, spreading sunken areas occur on the seed. Appearance of brown, necrotic spots with concentric rings on foliage, which coalesce and form large narcotic areas. Survival & Favourable Conditions are the pathogen survives in crop residues. Disease is favoured by high humidity and high temperature, more severe in high rainfall areas.

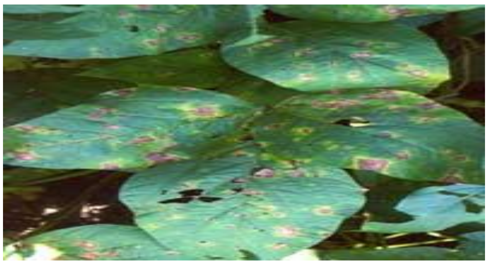

Figure 3. Alternaria leaf spot

D. Pod and Stem Blight

Caused by organism Diaporthe phaseolorum. Symptoms are look for small black specks on the main stem, lower branches, and pods. The specks are often aligned in rows up and down the stem. Heavily infected seeds at maturity will be shriveled, cracked, and frequently covered with a white fungal growth. Warm, wet weather at flowering and pod-fill favor the disease. Control actions rotate crops, plow soybean fields, and harvest seed on time.

Figure 4. Pod and Stem Blight

E. Bacterial Blight

Bacterial blight is a very common foliar disease of soybean throughout the North Central region, but it seldom causes serious yield loss. Together with Septoria brown spot, it is usually the first foliar disease to occur on soybeans in most growing seasons. Diseased plants are usually widespread within a field. Lesions or dead spots are most obvious on leaves in the mid- to upper canopy but can also occur on stems, petioles and pods. Lesions are small, angular and reddish-brown with water-soaked margins surrounded by a yellow halo. As disease progresses, lesions often grow together to produce large, irregularly shaped dead areas. Centers of older lesions frequently fall out, causing leaves to appear tattered. On stems and petioles, lesions are large and black. Figure 5 shows Bacterial blight infections in soybean.

Figure 5: Bacterial blight

F. Charcoal Rot

Caused by Pathogen Fungus Macrophomina phaseolina Symptoms are loss of vigor in mature plants. Leaves turn yellow and wilt but remain attached. Light gray or silver discoloration in taproot and lower stem after flowering. Small black fungal structures (microsclerotia) present in taproot and stem tissues. Conditions are High soil temperatures, dry weather. Plants that are under stress from adverse environmental or cultural conditions are more susceptible.

Figure 6. Charocal Rot

G. Rhizoctonia aerial blight

Rhizoctonia root rot is one of the most common soil borne diseases of soybeans. Diseased plants usually occur singly or in patches in the field. Disease is typically more common on the slopes of fields. Symptoms are Rhizoctonia infects young seedlings, causing pre- and post-emergence damping off. Infected seedlings have reddish-brown lesions on the hypocotyls at the soil line. These lesions are sunken, remain firm and dry and are limited to the outer layer of tissue. If seedlings survive the damping off phase, infections may expand to the root system, causing a root rot. The root rot phase may persist into late vegetative to early reproductive growth stages. Older infected plants may be stunted, yellow and have poor root systems.

Figure 7: Healthy root (left); Rhizoctonia-infected roots (right)

H. Sclerotinia Stem Rot

The disease is prevalent in cooler growing regions and can cause significant yield losses, especially during cool, wet seasons. Symptoms and Signs are White mold is often recognized by fluffy, white growth on soybean stems. Initial symptoms generally develop from R3 to R6 as gray to white lesions at the nodes. Lesions rapidly progress above and below the nodes, sometimes girdling the whole stem. White, fluffy mycelial growth so covers the infected area, especially during periods of high relative humidity. Characteristic black sclerotia eventually are visible and embedded within mycelium on stem lesions, and inside the stem as the plant approaches death. Initial foliar symptoms include tissues between major veins turning a gray-green cast, while vein tissues remain green. This can be mistaken for other diseases like brown stem rot, sudden death syndrome or stem canker. Eventually, leaves die and turn completely brown while remaining attached to the stem. *[3]*

Figure 8: Sclerotinia Stem Rot

III. REVIEW OF VARIOUS TECHNIQUES

Spectroscopic techniques using lots of spectral channels could be applied in image processing especially in the field of precision agriculture. Combining hyper-spectral remote sensing data and predictive models most plant diseases can be detected and discriminated. The spectral library, which contains reference spectra, will be built using spectral module of Environment for Visualizing Images image processing software. Back propagation neural network model is a full-connected neural network including input layer, hidden layer, and output layer to build a predictive model for disease and training and testing with the MATLAB software. *[5]*

A portable narrowband Spectroradiometer was used to detect sclerotinia stem rot infection, caused by the fungus Sclerotinia sclerotiorum in soybeans. Various vegetation indexes can serve as indicators of plant health and chlorophyll pigment loss. It involves the measurement of canopy reflectance of damaged plants in comparison with variations in wavelength reflectance between damaged and healthy plants measured at optimum sampling dates during the soybean growing season. *[6]*

Knowlege based expert system for soyaben covering 25 different diseases implemented in this paper. The inference engine of system has been developed as ObjectOriented inference model using O-O programing .The EDSS software was develped on 3 tire architecture design using ASP.NET and integrated Text to Speech.Disease management case study uses 566 disease rules for 25 disease attack. Disease management subsystem can be implemented using image processing techniques. This system can be integrated with suitable disease forcast model.*[7]*

Savita Kolhe, Raj Kamal, Harvinder S. Saini and G.K. Gupta*[8]* described the development of a web-based intelligent disease diagnosis system (WIDDS) using the fuzzy logic approach. It is a disease diagnostic system for particularly oilseeds like soybean, groundnut rapeseeds etc. The knowledge base of Pulse Expert contains up-to-date Knowledge about 19 major diseases of pulses appearing right from seedling to maturity. The system provides user-friendly interface to farmers and asks the textual as well as pictorial questions. The order of questions to be asked is decided dynamically depending upon the answers of the farmer. On the basis of answers, Pulse Expert diagnosis the pulse crop diseases along with its confidence factor and suggests most appropriate control measures which are composed of cultural practices as well as chemical controls. Pulse Expert handles uncertainty associated with the disease diagnosis and treatment knowledge base by using fuzzy logic approach. *[9]*

The image processing Technique used to detect plant diseases by various ways like detect diseased leaf, stem, fruit, quantify affected area by disease, find shape of affected area, determine colour of affected are determine size & shape of fruits.

A feasible method for detecting soybean rust and quantifying severity is explored. The images of soybean leave with different rust severity were collected by using both multispectral CCD camera and portable spectrometer. Three Parameters i.e. ratio of infected area, lesion colour index and rust severity index were extracted from the multispectral images and used to detect leaf infection and severity of infection. *[10]*

The aim of this research was to create an integrated environment with routines in C language for image analysis of foliar diseases of soybean and extracting metadata that describe aspects of the image and also to verify that the sheet is ill or not. With this information, it is expected to provide a decision-making in combat and/or control of soybean rust. The metadata available, describe, locate and assist in the understanding of the data, transforming them in knowledge. *[11]*

For the implementation of site-specific fungicide applications, the spatiotemporal dynamics of crop diseases must be well known. High-resolution multi-spectral remote sensing data hold the potential for multi-temporal monitoring of fungal wheat diseases powdery mildew and leaf rust, though they are only moderately suitable for early detection, due to the high misclassification rate. Three high-resolution remote sensing images were used to execute a spatio-temporal analysis of the infection dynamics. A decision tree, using mixture tuned matched filtering (MTMF) results and the Normalized Difference Vegetation Index (NDVI), was applied to classify the data into areas showing different levels of disease severity. *[12]*

The objective of this study was to develop a back propagation artificial neural network (ANN) model that could distinguish young corn plants from weeds. ANN indicates the potential for fast image recognition and classification useful in the control of real-world, site-specific herbicide application. *[13]*

Neural network classifiers have been successfully implemented for various quality inspections and grading tasks of different agricultural products. Neural networks are very good pattern classifiers because of their ability to learn patterns that are not linearly separable and concepts dealing with uncertainty, noise and random situations. As compared to statistical classifiers, multi-layer neural network (MLNN) Classifier advantages like adaptively, massive parallel processing and fault tolerance *[14]*.

Use of high performance computing (HPC) agriculture application is limited. The research work *[15]* suggests HPC is possible to be implemented in all steps in image processing starting from preprocessing to classification process. HPC reduces the computational time and consequently the results are produced efficiently and decision making can be made much faster.

In this work, an automated system has been developed to classify the leaf brown spot and the leaf blast diseases of rice plant based on the morphological changes of the plants caused by the diseases *[16]*. Radial distribution of the hue from the centre to the boundary of the spot images has been used as features to classify the diseases by Bayes' and SVM Classifier[*17]*.Histogram of oriented gradients and distance features obtained based on line moving algorithm are significant features identifying diseased coconut leaves*[18]*.This paper provides faster and more accurate solution by identifying the infected object(s) based upon K-means clustering procedure, extracting the features set of the infected objects using color co-occurrence methodology for texture analysis and detecting and classifying plant leaves and stems images type of disease using ANNs*[19]* .Colour Transform Based Approach for Disease Spot Detection on Plant Leaf is studied with comparison for YCbCr, HSI and CIELAB colour models *[20]*. Soybean rust is one of the most destructive foliar diseases of soybean two disease diagnostic parameters, ratio of infected area (RIA) and rust colour index (RCI), were extracted and used as symptom indicators for quantifying rust severity. To achieve automatic rust detection, an alternative method of analysing the centroid of leaf colour distribution in the polar coordinate system was investigated. *[21]*

IV. Discussion and Conclusion

Commercial production of soybean is a potential source of income to farmers, traders and government. Reliable detection of plant diseases in early stages is essential for economic, production and agricultural benefits. In order to curb pre-harvest losses, there is need to provide proper guidance to the farmers on pests and disease control measures. The major diseases reported to be affecting soybean crop production are Leaf spot, Pod blight, Bacterial blight and Soybean mosaic virus. This paper has outlined computational techniques for crop disease detection. Imaging techniques with different spectrum such as Infrared, hyper spectral imaging, X-ray were useful in determining the vegetation indices, canopy measurement, with greater accuracies. Histogram equalization, Contrast stretch, Wavelet and PCA based Image processing techniques are used recent papers. Soft computing methods like Fuzzy logic, artificial neural networks &back propagation feed forward neural network, Genetic algorithms Bayesian inference, Decision tree, Support Vector Machine (SVMs) solve problems and have attracting greater interest recently in agricultural engineering. Automatically estimating the severity of the detected disease and modeling future prediction of diseases are area interest for research.

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References

1. Post Harvest Profile of Soybean agmarknet.nic.in/soybean-profile.pdf
2. Wrather, A., Shannon, G., Balardin, R., Carregal, L., Escobar, R., Gupta, G. K., Ma, Z., Morel, W., Ploper, D., and Tenuta, A. 2010. Effect of diseases on soybean yield in the top eight producing countries in 2006.
3. Gurudatta M.H, Raghavendra, A.K..Mesta "Integrated Management of Soybean Rust" Research Article International Journal of Life Science and Pharma Research Vol 2, Issue 1, 2012 ISSN 2250-0480.
4. D. H. Scott, G. E. Shaner, and T. S. Abney, "Sclerotinia stem rot (white mold) of soybeans," Dept. Botany Plant Pathology, Purdue Univ., West Lafayette, IN, Tech. Bul. BP-43.
5. Salwani Mohd Daud, Hossein Jafari Jozani, and Farnaz Arab, "A Review on Predicting Outbreak of Tungro Disease in Rice Fields Based on Epidemiological and Biophysical Factors", International Journal of Innovation, Management and Technology, Vol. 4, No. 4, August 2013.
6. Bernard J. Vigier, Elizabeth Pattey, and Ian B. Strachan, "Narrowband Vegetation Indexes and Detection of Disease Damage in Soybeans", IEEE Geosciences and Remote Sensing Letters, vol. 1, No. 4, October 2004.

7. Savita Kolhe, Harvinder S. Saini, Raj Kamal, G. K Gupta, "Expert System for Diseases Diagnosis in Soybean: ESDDS", Journal of Indian Society of Agricultural Statistics 67(1) 2013
8. Savita Kolhe, Raj Kamal, Harvinder S. Saini and G. K. Gupta , "A web-based intelligent disease-diagnosis system using a new fuzzy-logic based approach for drawing the inferences in crops", Journal of Computers and Electronics in Agriculture, year 2011, volume 76, pp 16–27
9. Devraj ,Renu Jain, "Pulse Expert: An expert system for the diagnosis and control of diseases in pulse crops", Expert Systems with Applications 38 11463–11471,2011.
10. Di Cui, Oin Zhang, Minzan Li, Youfu Zhao and Glen L. Hartman, "Detection of soybean rust using a multispectral image sensor", Springer Link –Journal article,2009.
11. Thiago Evaristo Wenceslau Moreno1, Albino Szesz Junior, "Image Analysis of soyabean leaf diseases using Metadata", Iberoamerican Journal of Applied Computing ISSN 2237-4523.
12. Jonas Franke, Gunter Menz, "Multi-temporal wheat disease detection by multi-spectral remote sensing" Precision Agric , 8:161–172, Springer Science+Business Media, LLC 2007.
13. Sudhanshu Sekhar Panda ,Gerrit Hoogenboom , and Joel O. Paz "Remote Sensing and Geospatial Technological Applications for Site-specific Management of Fruit and Nut Crops: A Review" Remote Sensing ISSN 2072-4292.
14. D. S. Jayas, J. Paliwal, N. S. Visen, "Multi-layer Neural Networks for Image Analysis of Agricultural Products" J.agric. Engng Res., 2000, 77 (2), 119-128.
15. A Fakhri A Nasir, M Nordin A Rahman and A Rasid Mamat ,"A Study of Image Processing in Agriculture Application under High Performance Computing Environment", International Journal of Computer Science and Telecommunications ,Volume 3, Issue 8, August 2012.
16. S. Phadikar, J. Sil, and A. K. Das, "Classification of Rice Leaf Diseases Based on Morphological Changes", International Journal of Information and Electronics Engineering, Vol. 2, No. 3, May 2012.
17. S. Phadikar, J. Sil, and A. K. Das, "Classification of Rice Leaf Diseases Based on Morphological Changes", International Journal of Information and Electronics Engineering, Vol. 2, No. 3, May 2012.
18. P. Balamurugan, R. Rajesh' "Neural Network Based System for the Classification of Leaf Rot Disease in Cocos Nucifera Tree Leaves", European Journal of Scientific Research ISSN 1450-216X Vol. 88 No 1 October, 2012, pp.137-145.
19. H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik and Z. A L Rahamneh, "Fast and Accurate Detection and Classification of Plant Diseases",International Journal of Computer Applications (0975 – 8887) Volume 17– No.1, March 2011.
20. Piyush Chaudhary, Anand K. Chaudhari, Dr. A. N. Cheeran and Sharda Godara, "Color Transform Based Approach for Disease Spot Detection on Plant Leaf", International Journal of Computer Science and Telecommunications, Volume 3, Issue 6, June 2012.
21. Marcelo de C. Alves, Luiz G. de Carvalho, Edson A. Pozza,Luciana Sanches Alves," A Soft Computing Approach For Epidemiological Studies of Coffee And Soybean Rusts", IJDCTA Volume 4, Number 1, February 2010.
22. Di Cui, Qin Zhang , Minzan Li , Glen L. Hartman , Youfu Zhao ,"Image processing methods for quantitatively detecting soybean rust from multispectral images" Science Direct Biosystems journal 2011.
23. D. N. D.Harini,D.Lalitha Bhaskari , "Identification of Leaf Diseases in Tomato Plant Based on Wavelets and PCA", IEEE World Congress on Information and Communication Technologies2011.

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