

REAL TIME WEED DETECTION IN PRECISION AGRICULTURE



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[Bdiv – 3474]

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AGENDA

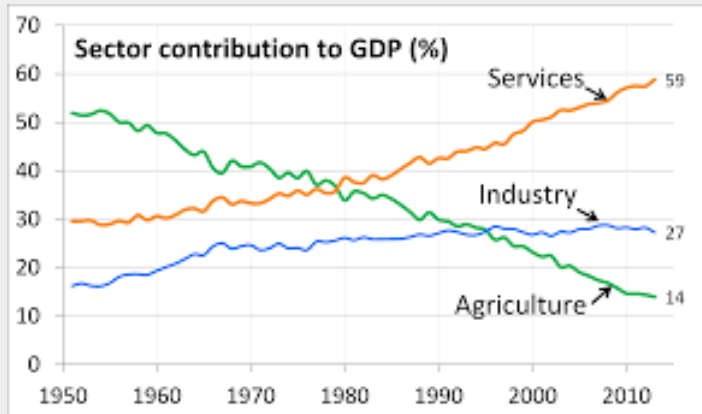
- IMPORTANCE OF AGRICULTURE?
- CHALLENGES FACED BY AGRICULTURE.
- WHAT ARE WEEDS?
- WHY WEED MANAGEMENT IN AGRICULTURE IS IMPORTANT?
- WHY WEED MANAGEMENT IS DIFFICULT?
- PRECISION AGRICULTURE
- PRECISION AGRICULTURE IN WEED MANAGEMENT
- RESOURCES



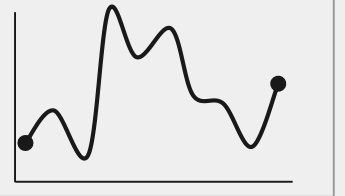
WHY AGRICULTURE IS IMPORTANT?

Agriculture plays a critical role in the entire life.

Agriculture is the backbone of the economic system of a given country.



It accounts for more than 15% of the gross domestic product.
It ensures food security for the country and produces several raw materials for industries.



Agriculture is the main stay of India's economy.

Agricultural development is therefore, a precondition of our national prosperity.

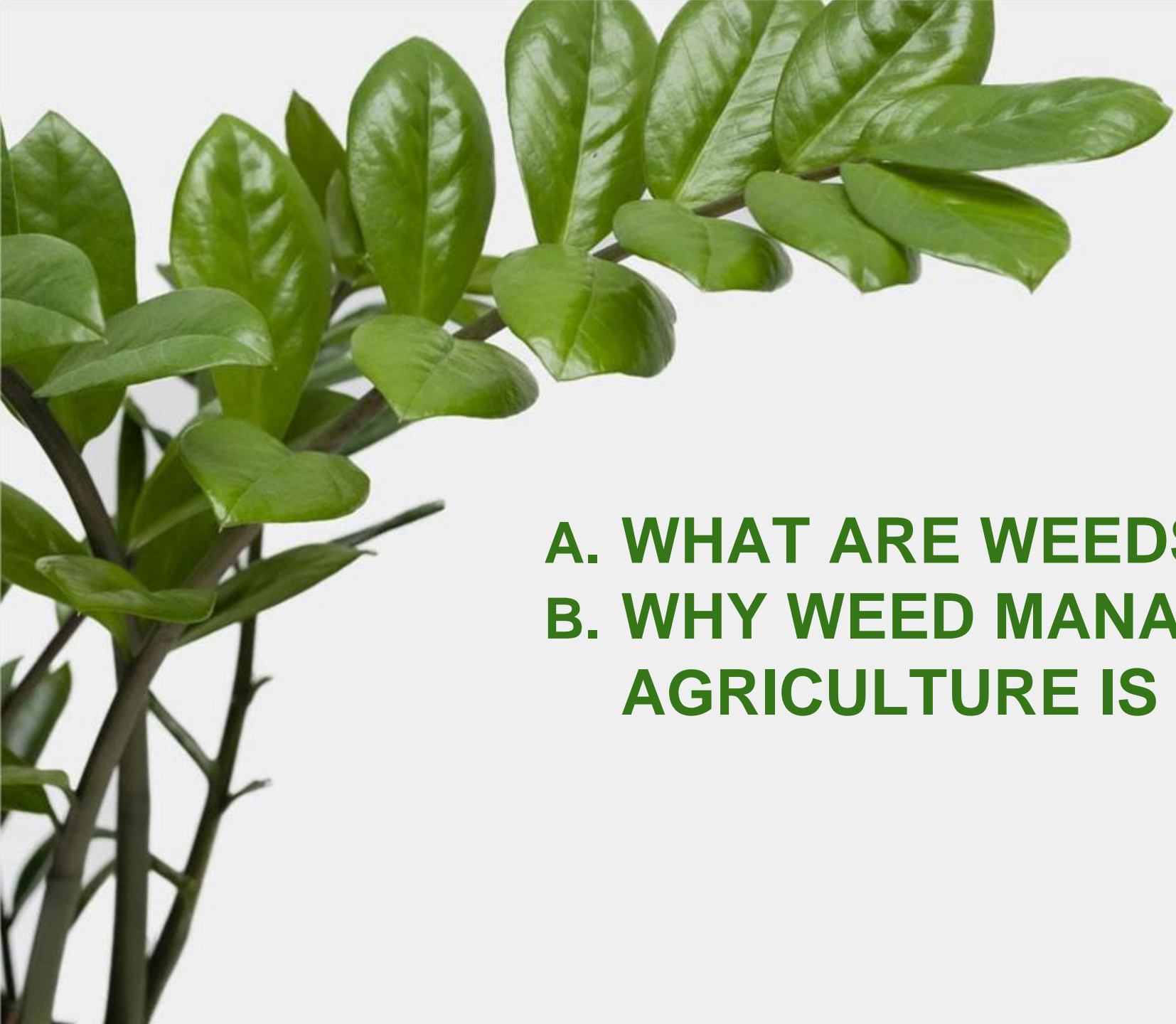


CHALLENGES FACED BY AGRICULTURE

- Lack of proper land reform measures
- Lack of credit facilities.
- Lack of fertilizers.
- Lack of proper agriculture research.
- Small and uneconomic holdings.
- Inadequate irrigation facilities.
- Defective marketing facilities.
- Soil erosion.
- Pests and plant diseases.
- Soil erosion.
- Very high dependency on monsoons.



There is a strong link between weed competition and crop yield loss!



- A. WHAT ARE WEEDS ?**
- B. WHY WEED MANAGEMENT IN AGRICULTURE IS IMPORTANT?**

WEEDS



Plant grown out of place and not intentionally sown



plant growing where it is not wanted



plant whose virtues have not yet been discovered

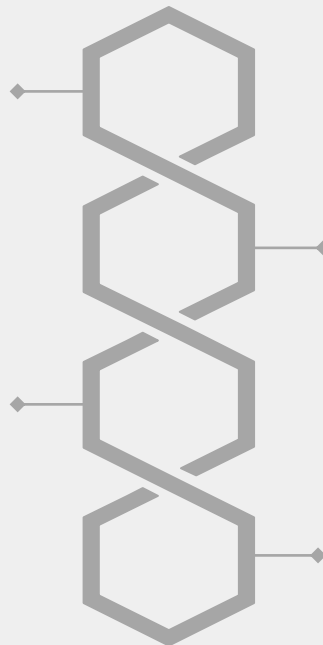


plants that interfere negatively with human activity

Why is it important to control weed?

Weeds fight with crops in the domain of space soil moisture, nutrients, and solar radiation.

Weeds are the most challenging difficulty of farmers as these threaten their ability to produce good quality food cost-effectively.



Weeds should be removed at every step of the growth of any crop particularly at the initial stages to diminish overall production loss.

Weeds harm crops drop in the commercial value of cultivated areas.



WHY WEED MANAGEMENT IN AGRICULTURE IS DIFFICULT?



Manual Weeding

Hard and labour costing that's why making it infeasible!



Mechanical Weeding

Could not remove intra-row weed and could damage the main crop due to human error!



Herbicide Usage

Causes waste of herbicide and environmental pollution!

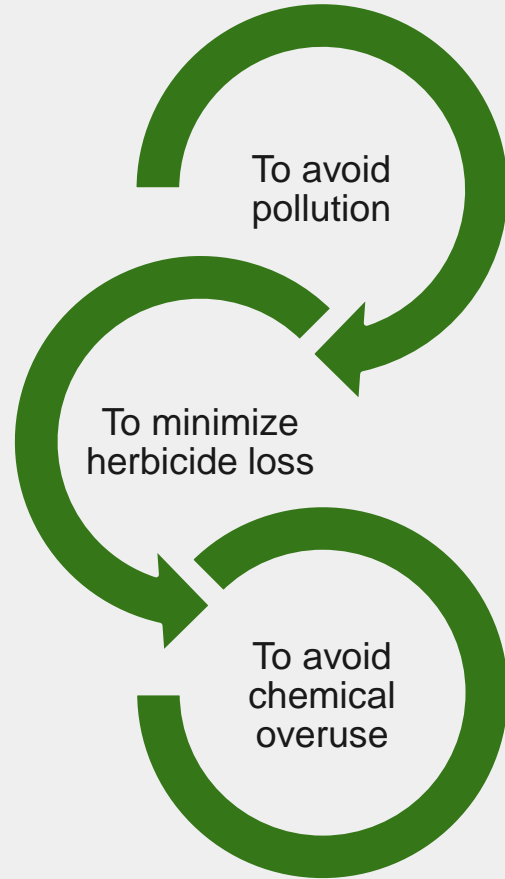


Chemical Weeding

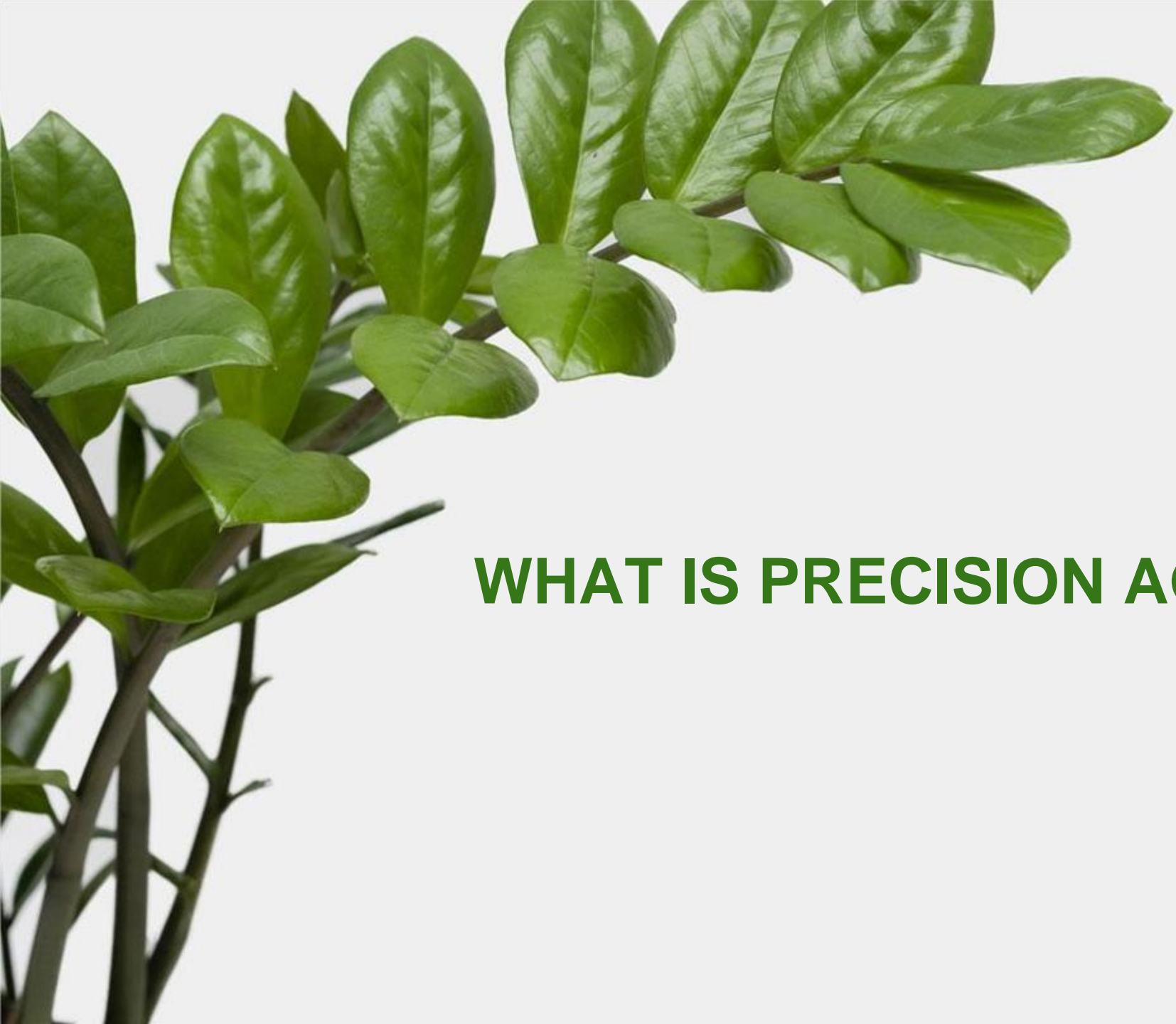
Have detrimental effects on farmer health and undesired environmental pollution!



SOLUTION



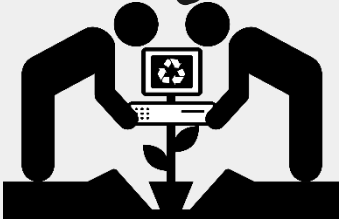
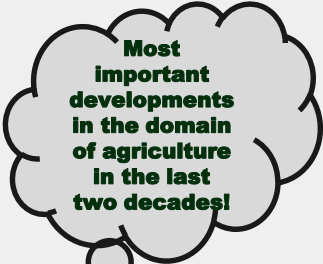
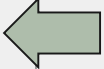
Modern technology should be used to autonomously detect weeds and remove it...



WHAT IS PRECISION AGRICULTURE?

Measurement, analysis and appropriate action—both spatial and temporal variability of soil and crop parameters.

objective of optimizing profitability, sustainability and protection of the environment.

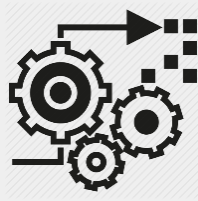


**OPTIMIZATION
&
DETERMINATION**
**To reduce production costs
and improve the quality of
crops.**





HOW IS PRECISION AGRICULTURE USED IN WEED MANAGEMENT?



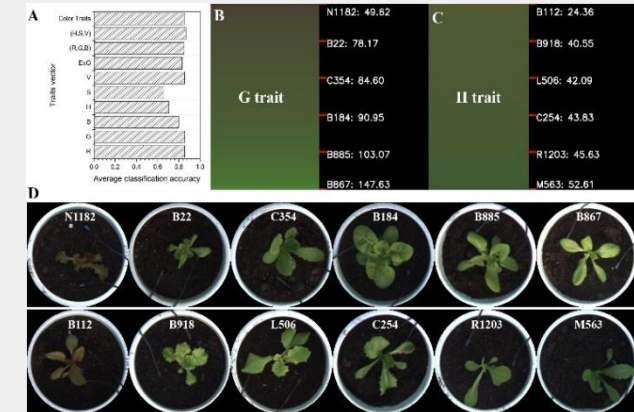
Colour Based classification

Threshold-based classification

Learning-based classification

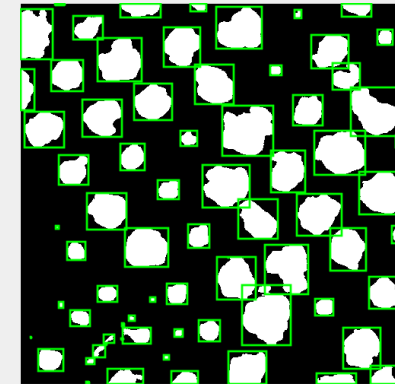
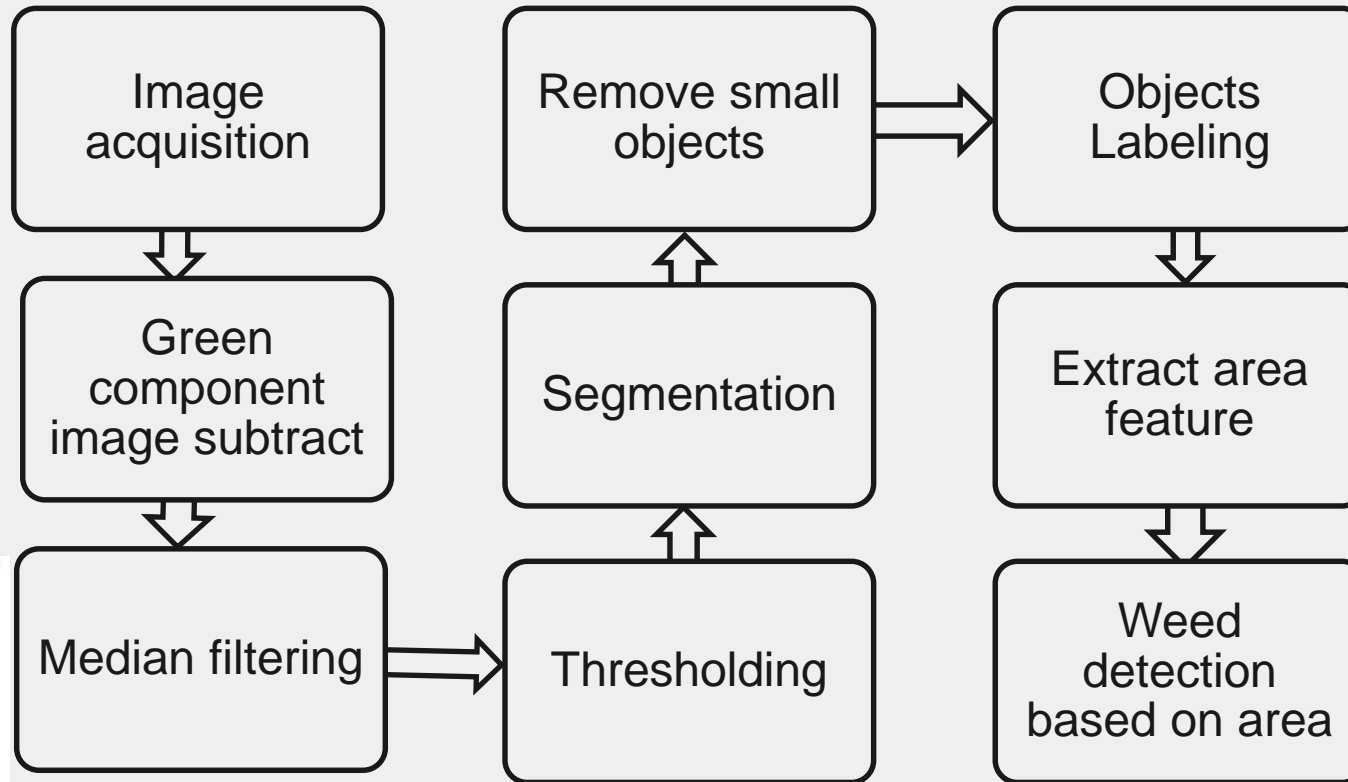
***Support vector
machine***

Deep learning



Weed Detection by Computational Vision!

Vision System Flow Chart



Neighborhood Processing (filtering)

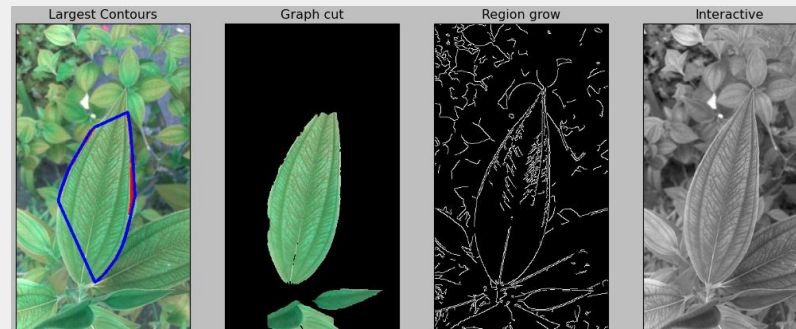
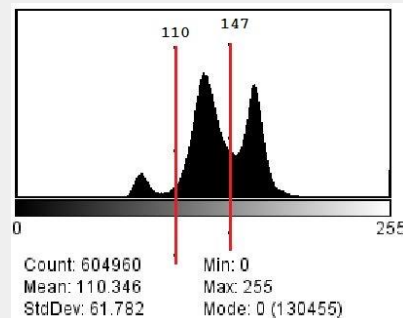
Median filters

- Is a median filter a kind of convolution?
No, median filter is an example of non-linear filtering

$$\text{Median}(f_1(x) + f_2(x)) \neq \text{Median}(f_1(x)) + \text{Median}(f_2(x))$$

$$1 = \text{Median}\left(\begin{bmatrix} 1 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 1 \end{bmatrix}\right) = \text{Median}\left(\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} + \begin{bmatrix} 0 & 1 & 0 \\ 1 & 2 & 1 \\ 0 & 1 & 0 \end{bmatrix}\right) \neq$$

$$\text{Median}\left(\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}\right) + \text{Median}\left(\begin{bmatrix} 0 & 1 & 0 \\ 1 & 2 & 1 \\ 0 & 1 & 0 \end{bmatrix}\right) = 1 + 1 = 2$$





Green plant detection algorithm

- Ways of separating separation from the soil
- Different sunlight and background conditions

- I. Source image is converted to grayscale intensity whereby the hue and saturation information is eliminated while retaining the luminance
- II. All components in XY space corresponding to green value on image are subtracted from the corresponding element in grayscale array



Image subtracted

$$I_{\text{plant}}(x_{\text{pixel}}, y_{\text{pixel}}) = I_{\text{green_source}}(x_{\text{pixel}}, y_{\text{pixel}}, G) - I_{\text{gray}}(x_{\text{pixel}}, y_{\text{pixel}})$$



Feature Extraction

- segment the image in order to locate plants
- assigning a label to each pixel
- highlighting the similarity of the features used for detection of plants
- color and area serves as descriptors for a threshold classifier

Segmentation is accomplished by

$$I_{\text{bin}}(x, y) = \begin{cases} 0, & I_{\text{Median}}(x, y) < t \\ 1, & I_{\text{Median}}(x, y) \geq t \end{cases}$$

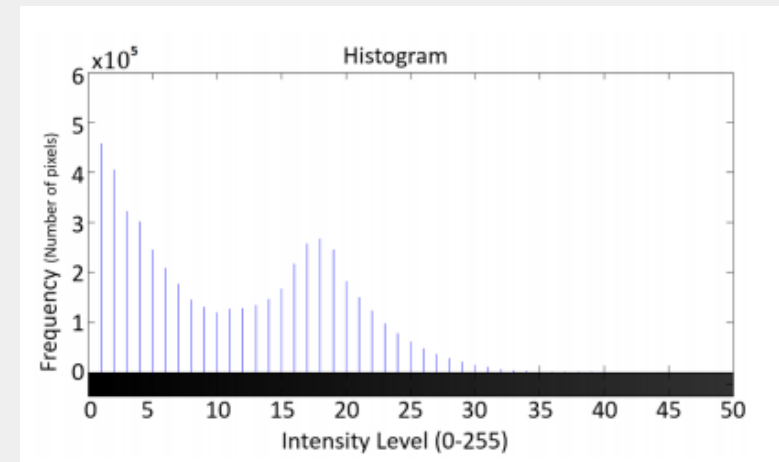


Image Histogram

➤ Otsu method

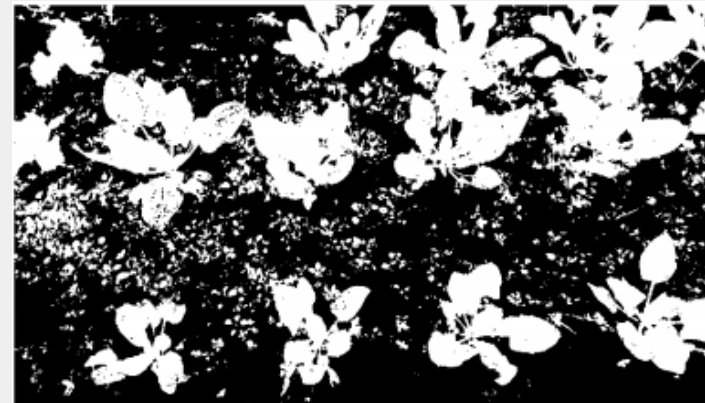
Estimates optimal threshold to segment through an exhaustive search of maximum variance between classes in gray levels



Fill image holes

- Morphological reconstruction
- This method uses 4 or 8 connected neighborhood pixels to evaluate the resulting image

$$F_{\text{mark}}(x, y) = \begin{cases} 1 - I_{\text{source}}(x, y), & (x, y \text{ is on the border of } I_{\text{source}}) \\ 0, & \text{otherwise} \end{cases}$$

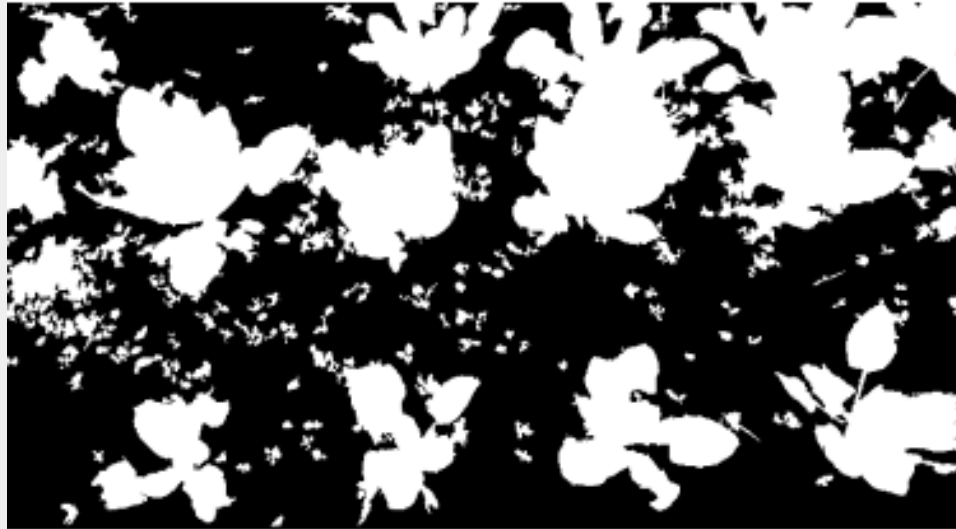


Threshold segmentation

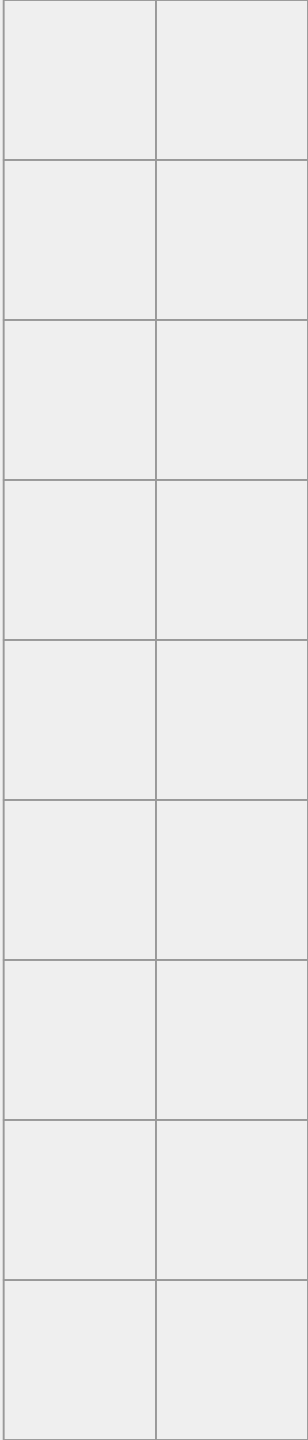


Fill image holes

- Iterates until it reaches all image positions,
$$H_k = (H_{k-1} \otimes B) \cap G$$
where B is a 3×3 matrix of ones,
 $H_0 = F_{\text{mark}}$
 G image to fill in the holes.
- Then, H_k , is a binary image with holes filled in.



Images with holes filled





Labelling

- Identifying objects in the scene, requires to label each element as a plant, getting a region description in order to extract features in the next step.
- Therefore, an algorithm based on connected components is used.
- The region labeling stage evaluates each pixel with a 4 neighbor-connectivity.





Classification based on area

- Extract area features from each element to discriminate weed and crop
- The algorithm presented, defines an area counting the number of pixels in the object region then, the value is stored for all items.



Weeds detected



ANALYSIS

➤ The classes assigned to define the specificity and sensitivity are shown as follows:

- True positive (TP): Number of plants detected as weed correctly.
- True negative (TN): Number of plants detected as crop correctly.
- False positive (FP): Number of crop plants detected as weed.
- False negative (FN): Number of weed plants detected as crop.

➤ Each image is accompanied with a table that indicates sensitivity and specificity to group information about correct weed detection. Additionally, positive and negative values are calculated to highlight the percentage of true positive and true negative detections with respect to all classifications.

The indices are calculated as follows:

- Sensitivity = $TP / (TP + FN)$
- Specificity = $TN / (FP + TN)$
- Positive predictive value (PPV) = $TP / (TP + FP)$
- Negative predictive value (NPV) = $TN / (FN + TN)$



Weeds plant detected

| | Weed Plants (Confirmed manually) | | |
|-------------------------|----------------------------------|---------------------|-------|
| | Condition Positive | Condition Negative | |
| Plants detected as Weed | True Positive (TP) | False Positive (FP) | PPV |
| | 80 | 1 | 0.98 |
| Plants detected as crop | False Negative (FN) | True Negative (TN) | NPV |
| | 5 | 6 | 0.545 |
| Sensitivity | | Specificity | |
| 0.94 | | 0.857 | |

Results : [Algorithm of Weed Detection in Crops by Computational Vision](#)



Conclusion and Future Work

1. High performance and accuracy validated with sensitivity and specificity indices above 90%
 2. Most of plants detected as weed are true positive
 3. Reduce the cost per hour of work required for inspecting weeds in crops
- Use crop rows to estimate a grid, in which weed detection includes plants position
 - Due to random behavior of weeds and include shape features to complement classification stage



Weeds plant detected

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2. S. Babu, "A software model for precision agriculture for small and marginal farmers," 2013 IEEE Global Humanitarian Technology Conference: South Asia Satellite (GHTC-SAS), 2013, pp. 352-355, doi: 10.1109/GHTC-SAS.2013.6629944.
3. A. J. Irías Tejeda and R. Castro Castro, "Algorithm of Weed Detection in Crops by Computational Vision," 2019 International Conference on Electronics, Communications and Computers (CONIELECOMP), 2019, pp. 124-128, doi: 10.1109/CONIELECOMP.2019.8673182. Crop Weed Identification System Based on Neural Network.
4. S. I. Moazzam, U. S. Khan, M. I. Tiwana, J. Iqbal, W. S. Qureshi and S. I. Shah, "A Review of Application of Deep Learning for Weeds and Crops Classification in Agriculture," 2019 International Conference on Robotics and Automation in Industry (ICRAI), 2019, pp. 1-6, doi: 10.1109/ICRAI47710.2019.8967350.
5. F. Miao, S. Zheng and B. Tao, "Crop Weed Identification System Based on Convolutional Neural Network," 2019 IEEE 2nd International Conference on Electronic Information and Communication Technology (ICEICT), 2019, pp. 595-598, doi: 10.1109/ICEICT.2019.8846268.

IMAGES

1. Bing Images
2. Google Images


Plagiarism report


100%


Completed: 100% Checked

0% Plagiarism

100% Unique

Sentence Wise Result

Document View

Matched Sources


| | |
|--------|--|
| Unique | Agriculture plays a critical role within the whole lifetime of a given economy. |
| Unique | Agriculture is that the backbone of the financial system of a given country. |
| Unique | Agriculture is that the most stay of India's economy. |
| Unique | It accounts for more than 15% of the gross domestic product. |
| Unique | It ensures food security for the country providing several raw materials for industries. |
| Unique | Agricultural development is important to our national prosperity. |
| Unique | It is estimated that the planet population will reach around 9 billion by 2050 and to satisfy the food de... |
| Unique | On the opposite hand, weeds alongside other problems and challenges are the most causes which ar... |
| Unique | 1. plant out of place and not intentionally sown |


100%


Completed: 100% Checked

0% Plagiarism

100% Unique

Sentence Wise Result

Document View

Matched Sources


| | |
|--------|--|
| Unique | Precision Agriculture has opened the doors so that technology can be incorporated into the farming p... |
| Unique | This new concept has led to developed countries being highly productive in agriculture, opting for the... |
| Unique | Precision Agriculture is one of the most important developments in the domain of agriculture in the la... |
| Unique | are unwanted by the farmer since they are causing several problems in the crop. |
| Unique | Among its negative effects is the contamination of production, the shelter of insects and diseases faci... |
| Unique | The monitoring of these weeds allows us to detect the presence and/or abundance of weeds, gather t... |
| Unique | of the sites on which long-term actions can be designed term, detect the entry of invasive species, no... |


100%


Completed: 100% Checked

13% Plagiarism

87% Unique

Sentence Wise Result

Document View

Matched Sources


| | |
|-------------|--|
| Unique | The methodology of the report is achieving a baseline method for developing a real-time weed detecti... |
| Unique | plants and then to use a feature extraction for discriminating weed. |
| Unique | • The Green plant detection algorithm is implemented to get rid of soil from the image such image inf... |
| Unique | • The algorithm focus only on vegetation, then, median filtering removes noise as "salt and pepper" wi... |
| Plagiarized | With the resulting values obtained, we set a threshold to differentiate weed from the crop, suc... Compare |
| Unique | • The previous output is converted to binary; at now, small objects are removed so as to avoid outliers. |
| Unique | • After the pixels connected around their neighborhood are labeled, thus, all objects within the image ... |
| Unique | • Finally, the world calculation for every object is completed. |


100%


Completed: 100% Checked

14% Plagiarism

86% Unique

Sentence Wise Result

Document View

Matched Sources


| | |
|-------------|---|
| Plagiarized | Primarily, they lessen crop yield by competing for water, light, soil nutrients, and space. Compare |
| Plagiarized | Other problems associated with weeds in agriculture include: Compare |
| Unique | • Weeds fight with crops in the domain of space soil moisture, nutrients, and solar radiation. |
| Unique | • Weeds should be removed at every step of the growth of any crop particularly at the initial stages to... |
| Unique | • Weeds harm crops which include sharing of water, light, nutrients, and space, increased reduction c... |
| Unique | drop in the commercial value of cultivated areas. |
| Unique | • Weeds are the most challenging difficulty of farmers as these threaten their ability to produce good ... |


100%


Completed: 100% Checked

0% Plagiarism

100% Unique

Sentence Wise Result

Document View

Matched Sources


| | |
|--------|---|
| Unique | Precision Agriculture has opened the doors so that technology can be incorporated into the farming p... |
| Unique | This new concept has led to developed countries highly productive in agriculture, opting for the use o... |
| Unique | Precision Agriculture is one of the most important developments in the domain of agriculture in the la... |
| Unique | Precision Agriculture primarily attempts to manage—by measurement, analysis and appropriate actio... |
| Unique | Consequently, greater benefits are obtained such as the optimization of the use of inputs, determinati... |
| Unique | on the land, reducing production costs and improving the quality of crops. |
| Unique | PA employs multiple traditional and emerging technologies such as |


100%


Completed: 100% Checked

17% Plagiarism

83% Unique

Sentence Wise Result

Document View

Matched Sources

| | |
|--------|--|
| Unique | 1. The weed detection system testing was done using photos taken perpendicularly to crop lines to a... |
| Unique | 2. Based on the random behavior of weed and the expertise of the crops manager the images were la... |
| Unique | 3. The classes assigned to define the specificity and sensitivity are shown as follows: |
| Unique | A)True positive (TP) is defined as the Number of plants detected as weed correctly. |
| Unique | B)True negative (TN) is defined as the Number of plants detected as crops correctly. |
| Unique | C)False positive (FP) is defined as the Number of crop plants detected as a weed. |
| Unique | D)False negative (FN) is defined as the Number of weed plants detected as a crop. |

THANK YOU

