

# Maize Crop Disease Dataset

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## Abstract

Maize is a very important multipurpose crop and is grown most widely across the globe. It is affected by multiple diseases which reduce its yield. A disease detection early warning system may prove quite helpful for increasing its yield. Numerous researchers have tried to develop it but success was seldom mainly due to lack of annotated datasets. Some pre-existing datasets are discussed in the paper but all of them suffers from severe limitations. Therefore a new dataset of Maize crop leaf images is presented in this paper viz Maize Crop Disease Dataset (MCDD). It consists of six different classes of maize crop images: healthy leaves, pest attacked leaves, leaves infected by bacterial stalk rot, northern leaf blight, maydis leaf blight, and downy mildew. It contains 350 images of each class and 2175 images in total.

**Keywords:** maize, dataset, disease detection.

## 1. Introduction

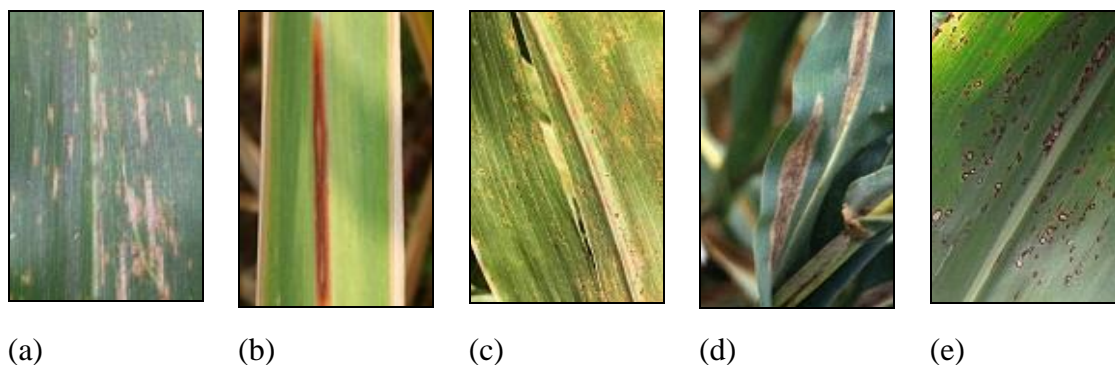
Global food security is declining day by day coupled with increasing malnutrition have engulfed 25% of the world population (IFAD, UNICEF, WFP, WHO, & FAO, 2018). Comparatively, Indian condition is even worse due to population explosion (expected to reach 1.7 billion by 2050) and occupation shift from agriculture to more urban ones (General Assembly, 2009). So, for a sustainable and healthy future, the human race needs to increase its food production stressing mainly on crops that are versatile and provides more nutrients than others. For this, maize may prove to be very effective.

Maize (corn) is economically a very important crop for its verity of uses. It is the most important fodder crop, suggesting the dependence of the livestock industry on its production. It is also used to produce many food products like cornmeal, sweeteners, corn oil, and starch; and non-food products, such as ethanol, which is used as a cleaner-burning alternative to gasoline in many countries.

The production of maize suffers from many challenges that need to be addressed. Parasitic and disease attacks reduce crop yield by approximately 20% (Zadoks., 2009). Further yield is dwindled by extreme weather conditions and water logging. This yield degradation directly affects the households dependent on its production. The stresses on maize are discussed in the following section.

## 2. Stresses on Maize

Maize crop suffers from many diseases that need to be taken care of. The most deadly and infectious diseases of Maize are Gray Leaf Spot, Red Rot, Common Rust, Northern (Turcicum) Corn Leaf Blight (NCLB) and Anthracnose Leaf Blight as shown in figure 1 below and details illustrated in table 1.



**Fig 1:** Diseases of Maize (Kharif) Crop infecting leaves (a) Gray Leaf Spot, (b) Red Rot, (c) Common Rust, (d) Northern (Turcicum) Corn Leaf Blight (NCLB) and (e) Anthracnose Leaf Blight

**Table 1:** Maize diseases and their symptoms

Disease	Caused by	Infected part	Symptoms (Early stage)	Symptoms (Late stage)
Gray Leaf Spot (Wise, 2010)	Fungus ( <i>Cercospora zea-maydis</i> )	Leaf	In early-stage, small oval to elongated lesions appears on lower leaves of the plant. The disease slowly populates to the upper leaves of the plant	The lesions gradually increase to about an inch long with reddish-brown or yellow-orange borders and tanned center. Lesions combine to and the entire leaf becomes blighted.
Red Rot (Schoeman & Greyling, 2014)	Fungus ( <i>Fusarium graminearum</i> )	Leaf, Root, Grain, Stalk	Red rotten tissue shows up on the midrib of the leaf.	Cavities may form within the pith. Midrib lesions become long and sometimes are observed along its full length.
Common Rust (Schoeman & Greyling, 2014)	Fungus( <i>Puccinia sorghi</i> )	Leaf	Leaf develops multiple small red speckles which	The elongated spots turn into powdery, golden-

			gradually evolve into small, tan, slightly raised spots.	brown pustules loosely dispersed in patches on upper and lower sides of the leaf.
Northern (Turcicum) Corn Leaf Blight (NCLB) (Diseases of corn Northern corn leaf blight, 2011)	Fungus (Exserohilum turcicum)	Leaf	Small oval-shaped water-soaked spots appear on the lower leaves	The lesions become pale grey to tan and grow to the size of 1 to 6 inches.
Anthracnose Leaf Blight (Bergstrom. Gary, n.d.)	Fungus (Colletotrichum graminicola)	Leaf	Minute oval-shaped water-soaked lesions appear on the leaves which gradually develops translucent spots with purplish margins and tan centers.	These lesions combine to blight the whole leaf. Sometimes, dark raised spots appear on the dead tissues.

Detecting the diseases at an early stage will be very effective for keeping these diseases in check. Recently computer vision and machine learning are being utilized for the same. For building an effective machine learning technique, it's training with sample images is needed. This requires an effective dataset with the following qualities:

**Sufficient size:** A small dataset may not represent all symptoms of the diseases of the crop. So, the dataset should be of sufficient size to be able to simulate all crop conditions classes effectively.

**Annotations:** All images of the dataset should be properly labeled. This task of image labeling is quite a time consuming and requires experts.

**Realistic:** Data must be collected from actual fields of the crop, under natural light conditions.

**Ease of Understanding:** The dataset should be self-explanatory and should be in a format widely used.

Existing labelled datasets of the Maize crop are discussed in the following section.

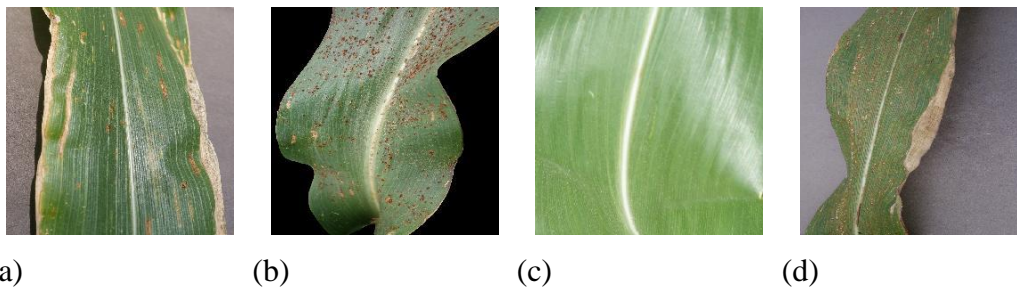
### 3. Existing datasets

Maize crop disease datasets are found in the literature are discussed further.

**D. P. Hughes et al.** (Hughes, Salathé, & Salathe, 2015) released crop leaf image dataset containing 54,309 expertly curated images of both healthy and infected leaves through

PlantVillage ([www.plantvillage.org](http://www.plantvillage.org)) platform. It consisted of images of fourteen crop species namely Apple, Bell Pepper, Blueberry, Cherry, Soybean, Strawberry, Maize (Corn), Grape, Squash, Orange, Peach, Potato, Raspberry, and Tomato. It covers twenty-two crop diseases containing seventeen fungal, four bacterial and a mite disease. It consisted of four classes of maize crop leaf images having 1,162 images of healthy, 513 infected by Grey Leaf Spot, 1,192 by Common Rust and 985 by Northern Leaf Blight sample of each of the four maize class leaf is shown in figure 2. Limitations of the dataset are:

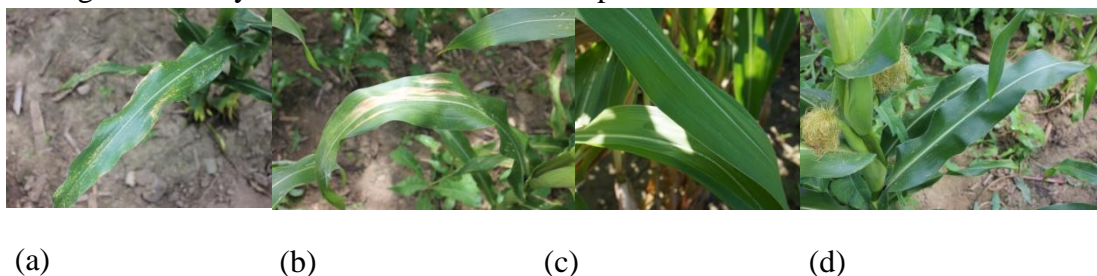
- Datasets were captured in solely laboratory conditions.
- Only three diseases and a class of healthy images is covered, thus lacks a variety of diseases that exists in the real-world scenario.



**Fig 2:** Sample images of maize crop leaf from plant village dataset of (a) gray leaf spot, (b) common rust, (c) northern leaf blight and (d) healthy leaves

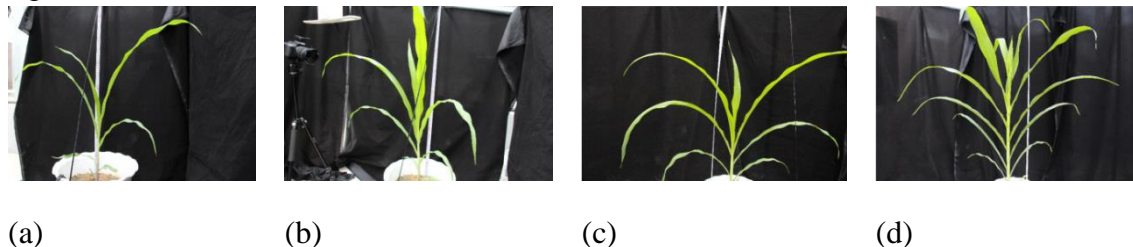
**C. DeChant et al.** (DeChant et al., 2017) built a dataset of Maize crop leaf images infected by Northern Leaf Blight (NLB) disease. The dataset consists of 1,796 images captured using Canon EOS Rebel or Sony a6000 camera (resolution of 6000 X 4000 pixels) over the period of 28-78 days after sowing. It consisted of 1,028 images infected with northern leaf blight and 768 images of non-infected leaves. The dataset is hosted at CyVerse BisQue platform. A couple of sample images of infected and healthy leaves are shown in figure 3. Limitations of this dataset are:

- Lack of stresses covered: This dataset focussed on only NLB disease, thus ignoring all other diseases.
- Lack of annotated images: This dataset comprised of only 1,796 images. Such a small image count may not be able to mimic multiple real field conditions.



**Fig 3:** Sample images of maize crop leaf from C. DeChant et al.'s dataset of (a,b) northern leaf blight and (c,d) non-infected leaves

**B. Jiang et al.** (Jiang et al., 2018) introduced three datasets consisting of 1,297 images of maize crop captured using Canon Eos 700D camera with 18 million pixels resolution (5184 X 3456 pixels) in studio conditions with a black background. Four sample images are shown in figure 4.



**Fig 4:** Sample images of Maize Leaf dataset as presented by B. Jiang et al.

These datasets are extensively used for maize crop leaf disease detection. Still, the techniques developed using these fail in real-cultivation conditions due to some deficiencies in these image datasets as examined further. Limitations of this dataset are:

- Artificial conditions: Dataset was captured in laboratory conditions. This makes it less effective for use in real-cultivation conditions.
- Lack of stresses covered: It focuses only on drought stress.
- Lack of annotated images: It consists of just 1,297 images. Such a small image count may not be able to mimic multiple real field conditions.

**Ty Wiesner-Hanks et al.** (Wiesner-Hanks et al., 2018) developed a dataset of maize (*Zea mays* L.) leaf images. The images were taken in three ways: by a hand held camera, boom mounted camera and with a drone. Northern Leaf Blight (NLB) lesions were annotated on the leaves, In total, dataset consisted of 18,222 images annotated with 1,05,705 NLB lesions as described in table 2. These images were captured from the fields of Cornell University's Musgrave Research Farm in Aurora, NY.

**Table 2:** Tyr Wiesner-Hanks dataset description.

Capture technique	No. of images	No. of NLB lesions annotations
Handheld	1,787	7,669
Boom	8,766	55,919
Drone	7,669	42,117

Limitations of the dataset are as follows:

- Only one disease (Northern Leaf Blight) is considered for classification.

To overcome these drawbacks, a real-time dataset consisting of 2175 annotated images of maize leaves is prepared from the farms of S.A.S. Nagar, Punjab under actual cultivation conditions. Details of the dataset are discussed in the following section.

#### 4. Maize crop disease dataset (MCDD)

The Maize Crop Disease Dataset (MCDD) is captured from fields of different villages (Manana, Sihanpur, Daun and Fatehullapur) of S.A.S. Nagar, Punjab and consists of 2175 selected images. Fields of were chosen based on the availability of the crop over the time of two months i.e. July and August 2019. Images were captured using the Redmi Note 4 smart-phone with 13MP camera with an aperture of f/2.0. The procedure of development of the dataset included:

- i. Maize crop disease photos capturing from fields.
- ii. Selecting the good photos and discarding the poor ones. Poor ones includes the photos which were under exposed and over exposed, blurry and mis-captures.
- iii. Cropping of unwanted image area i.e. area with excessive background clutter (author's hand, shoes, etc).
- iv. Resizing and cropping of images from 2340 X 4160 native camera resolution to 512 X 512 pixels.
- v. Manual classification of the photos.

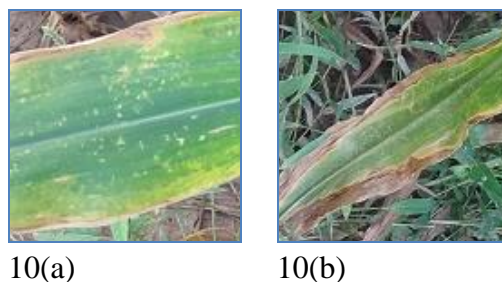
Step five above resulted in 11 classes of images: Healthy, Gray Leaf Spot, Red Rot, Pest and Gray Leaf Spot, Common Rust, Northern (Turcicum) Corn Leaf Blight (NCLB), Magnesium Deficiency, Nitrogen Deficiency, Anthracnose Leaf Blight and Potassium Deficiency. Bifurcation of the dataset is illustrated in table 3. Further, two samples from each phenotype of the developed dataset are given in figure 5

**Table 3:** Illustration of the dataset

Class Id	Category	Crop part under attack	Disease common name	Caused by	Image count
0	Healthy	-	-	-	500
1	Diseased	Leaf	Gray Leaf Spot	Fungus ( <i>Cercospora zeae-maydis</i> )	500
2	Diseased	Leaf	Red Rot	Fungus ( <i>Fusarium graminearum</i> )	500
3	Pest attack	Leaf	-	Pests	250
4	Pest attack and diseased	Leaf	Pest and Gray Leaf Spot	Fungus ( <i>Cercospora zeae-maydis</i> ) and Pests	125
5	Diseased	Leaf	Common Rust	Fungus( <i>Puccinia sorghi</i> )	125
6	Diseased	Leaf	Northern (Turcicum) Corn Leaf Blight (NCLB)	Fungus ( <i>Exserohilum turcicum</i> )	50
7	Deficiency	Whole	Magnesium Deficiency	Lack of Magnesium in soil	50
8	Deficiency	Whole	Nitrogen Deficiency	Lack of Nitrogen in soil	25

9	Deficiency	Whole	Anthrachnose Leaf Blight	Fungus (Colletotrichum graminicola)	25
10	Deficiency	Whole	Potassium Deficiency	Lack of Potassium in soil	25
<b>Total</b>					<b>2,175</b>





**Fig 5:** Two sample images of each class of the dataset MCDD (labelled as class Id(sample no.)).

## 5. Conclusion

A Maize Crop Disease Dataset viz. MCDD is presented in this paper. It consists of real field condition images of Maize Crop leaves (both diseased and healthy) and is fully labelled. This dataset will help the researchers in enhancing future research on the target crop. Training and testing on the dataset may be performed using Machine Learning techniques and an annotated version of it may be effective for Deep Learning models for disease detection on Maize.

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