

Pre-Harvest Diseases Associated With Cowpea (*Vigna Unguiculata*) Production in FijiLaurence Shiva Sundar¹, Mohammed Ifraaz², & Asneel Lal²¹ College of Agriculture, Fisheries and Forestry, Fiji National University, Koronivia campus Nausori, Fiji² Biosecurity Authority of Fiji (BAF), Level 3, Provident Plaza I, Ellery Street, Suva, Fiji² College of Agriculture, Fisheries and Forestry, Fiji National University, Koronivia campus Nausori, Fiji**Correspondence:** College of Agriculture, Fisheries and Forestry, Fiji National University, Koronivia Campus Nausori, Fiji. Tel: 679-935-6121. E-mail: laurence.sundar@fnu.ac.fj**ABSTRACT**

Cowpea locally known as bora, is one of the most famous leguminous crops in Fiji due to its taste and acceptance by the locals. This famous leguminous crop is now experiencing problems related to pre-harvest diseases. Many farmers in Fiji are uneducated about such problems which in turn is affecting their production on a yearly basis. This particular research is conducted to provide fair ideas to farmers in Fiji about these diseases and its control measures. This research was divided into three parts which includes field visits, construction of research plots and distribution of questionnaires to farmers. These three methods were used in conducting and compiling of this research. Most of the answers about these pre-harvest diseases were revealed through farm visit where a random part of the field was selected and carefully observed. Other useful material was derived from the research plots and questionnaires forwarded to farmers. Upon completion of this research, pre-harvest diseases of cowpea such as angular leaf spot, bacterial blight, anthracnose, brown blotch, cercospora leaf spot, bean rust, bean yellow mosaic disease, common mosaic, Powdery mildew, Web blight, Sclerotinia rot disease, Cottony leak and stem rot diseases of cowpea were discovered.

Keywords: Cowpea, Pre-Harvest, Fiji Islands, Bora, Ornamentals.**1. Introduction****1.1. Climatic condition of Fiji**

Fiji has a warm tropical atmosphere. Most extreme temperatures occasionally move out of the 31 °C (88 °F) to 26 °C (79 °F) territory throughout the entire year. Southeast exchange winds from March to November bring dry climate and the stormy season keeps running from December to April. Fiji has a wet season, which is described by overwhelming, brief nearby gives and contributes a large portion of the nation's yearly precipitation. The wet season is regularly from November to April and results from the southerly developments of the South Pacific Convergence Zone. Commonly the littler islands in Fiji get less precipitation than the primary Island with different sums as indicated by their area and size. Fiji often gets affected by Cyclones, which is a major threat to crops.

1.2. What are plant diseases?

All plants, including weeds, crop plants, trees and ornamentals, are attacked by diseases at some stage during their life. In many instances, the plant can tolerate diseases with few adverse effects. However, when conditions favor disease, the effects can be severe and very damaging. As Horsfall and Dimond have summarized, “when something is functioning

poorly” in the body we come to decision that we are sick, hence “disease is a malfunctioning process that is caused by continuous irritation. This process results in suffering. Therefore disease can be defined as a pathological process.

1.3. Importance of plant disease

Plant diseases are important because of the loss they cause. The loss can occur in the field or in the store and at any time between sowing and consumption of the harvest. A pathogen is constantly associated with a disease. The word “pathogen” in strict sense means anything that causes the plant to suffer. In 2014 it was studied that round spots, radish brown or purple in colour and cercospora leaf spot were the only diseases of the cowpea that was intercepted in Fiji but aligning the objective of this research, we are to discover those diseases that are yet to be identified. It is noted that when weather favors these diseases, they continue to affect the plant which in turn affected the market supply. Therefore better management practices or control methods are in depth need to overcome these problems which in turn will increase the production; meet the local market demand and enabling exporters to explore new markets.

1.4. Research objective and hypothesis

The prime objective of this research is to identify new diseases of cowpea that are yet to be identified and find its control measures. The core hypothesis of this research is that there are several other diseases of cowpea that are yet to be discovered. Theoretically, reference books, farm management manuals, pamphlets and questionnaires were used to study the problem. Practically, research plots and field visits were conducted in the three major divisions (central, western and northern) of Fiji.

2. Methods

2.4. Field visit

To be accurate with the research, a field visit throughout the three major divisions of Fiji was made in order to determine the availability of these diseases. A random portion of the field was selected and it was carefully observed for the availability of these diseases. Further to this, loss percentage due to presence of these diseases was also noted in order to get a fair idea of the population of these diseases in a particular division of Fiji.

2.5. Research plots

To fairly conduct this research, 114 research plots were prepared in which 109 plots had an assigned individual to do necessary intercultural operations while 5 plots were left as a control. The size of the plot was 8m x 1m with the drain size of 30cm x 30cm in between the plots. In each plot, pink eye variety of cowpea was sown at a recommended spacing of 75cm x 75 cm. Weeding, mulching, watering and nutrient management was done in the plots except for pest and disease control in order to determine the availability of different diseases of cowpea. No intercultural operations were done in the control plots. Any changes in the normal structure and functions of the cowpea plant or plant parts were immediately reported by the individual in order for successful identification of diseases if available.

2.6. Questionnaires

A set of questionnaire was made composing of 21 questions, which was later forwarded to farmers in several different localities. This questionnaire was formed in order to get farmers views on issues related to cowpea production in their

locality. The questions were printed in simple English to allow farmers to easily understand the questions and answer it appropriately. All the questionnaires were hand delivered or posted since no farmers in any locality had an access to emails or faxes.

3. Results

3.1. Observations made during field visits

During the field visit, six other diseases of cowpea was identified including the ones observed in the research plots as well. These six diseases include bean yellow mosaic disease, common mosaic, Powdery mildew, Web blight, Cottony leak and stem rot disease and Sclerotinia rot disease. It was estimated that western farmers experienced the greater number of losses, followed by northern and central division farmers (see figure 1). Many farmers in Fiji are still struggling in identifying these diseases due to lack of knowledge and availability of the resources.

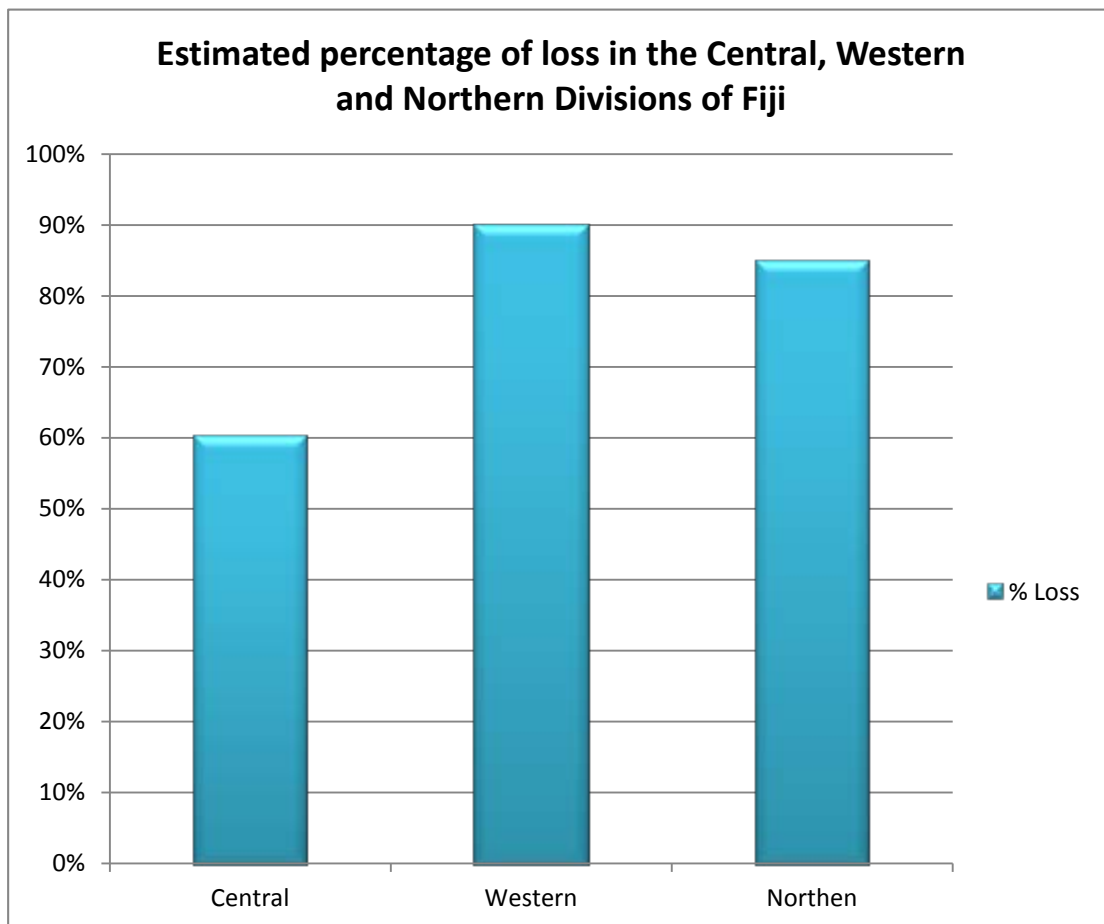


Figure1: Estimated percentage loss incurred by diseases in the three major divisions of Fiji

3.2. Results gathered from research plots

After careful observation of the plots, we were able to identify the most common diseases of cowpea that are initially present in Fiji. This includes angular leaf spot (picture 1), bacterial blight disease (picture 2), anthracnose (picture 3),

brown blotch (picture 4), cercospora leaf spot (picture 5) and bean rust (picture 6). These diseases were identified on the basis of the symptoms seen on the plant and plant parts.



Picture 1: Angular leaf spot disease



Picture 2: Bacterial blight disease



Picture 3: Anthracnose disease



Picture 4: Brown blotch disease



Picture 5: Cercospora leaf spot disease



Picture 6: Bean rust disease

3.3. Compilation of questionnaires

After compiling the questionnaires, it can be said that most of the cowpea farmers are not happy with the production they achieve. This is because most of their fields are infected with these diseases which in turn cause production loss. Most of these farmers are uneducated and this becomes a hindrance in order for them to successfully identify and control these diseases. As seen, most of the farmers use orthene in controlling pest or diseases of cowpea which is becoming a regular habit. Therefore, most of these diseases are becoming resistance to the above mentioned control.

4. Discussion

Many farmers in Fiji are experiencing this problem of diseases of cowpea due to unavailability of knowledge and lack of resources in controlling these diseases. Knowledge about these diseases and its control measures should be provided to farmer through different extension programmes. In Fiji it was noted that from 2009 to 2013 the quantity of cowpea exported from Fiji was fluctuating where disease was a major contributor amongst the other factors. In 2013, the export quantity suddenly increased due to favorable weather conditions as well a low pest and disease infestations. It was also noted that from the year 2013 till the year 2015 the exported quantity was gradually decreasing due to problem of diseases as the main contributor (see figure 2).

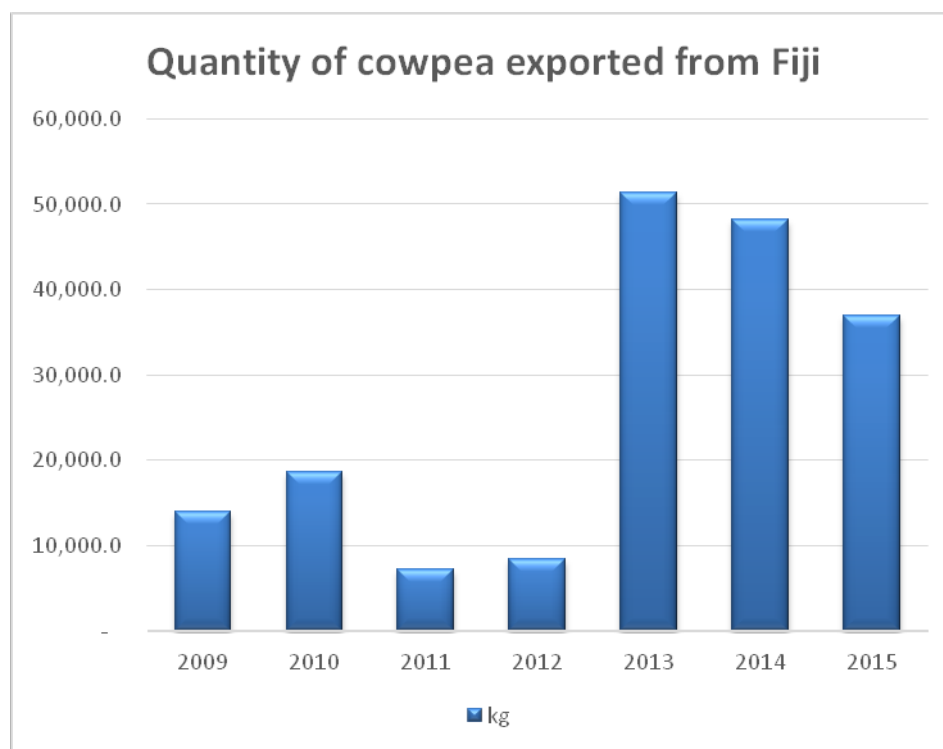


Figure 2: Quantity of cowpea exported from Fiji from the year 2009-2015.

The 12 major diseases of cowpea that were identified during the research together with its symptoms and its control methods are as listed below:

4.1. Bean yellow mosaic

Bean yellow mosaic disease of cowpea is caused by Bean yellow mosaic virus. When the plants are attacked by this disease, the leaves develop a mosaic pattern of contrasting dark and yellowish-green areas, often accompanied by bright

yellow spots and also severe strains may cause rough, wrinkled, malformed leaves. To overcome this disease, disease-free seeds, e.g. certified or approved cowpea seeds and plant resistant varieties of cowpeas is recommended.

4.2. Common mosaic

Common mosaic disease of cowpea is caused by bean common mosaic virus. The virus causes cupping and twisting of leaves with a light-green and dark-green mosaic pattern. The dark-green tissue is often bubbled and/ or in bands next to the veins. Affected plants produce smaller, curled pods with a greasy appearance, and yields are reduced. To overcome this disease, disease-free seeds, e.g. certified or approved cowpea seeds and plant resistant varieties of cowpeas is recommended.

4.3. Cercospora leaf spot

Cercospora leaf spot disease of cowpea is caused by fungus *cercospora canescens*. The infected leaves, particularly those that are more matured, develop circular or slightly angular, greyish spots, sometimes with reddish margins. Spots may dry and portions may fall out, giving the leaf ragged appearance. To control this disease, crop rotation and general field sanitation should be done. Also clean seeds should be used for sowing. For chemical control, benomyl at 11grams per 16liter of water or mancozeb at 53grams per 16liter of water can be used.

4.4. Powdery mildew

Powdery mildew disease is caused by *Erysiphe polygonic* DC. Formation of white floury patches on both sides of the leaf as well as on the tendrils, pods, stems, etc. indicates that the disease is present. To control this disease, field sanitation should be strictly done. Also sulphur dust (200mesh) at the rate of 25-30kg per hectare is also effective.

4.5. Angular leaf spot

Angular leaf spot disease is caused by fungus *phaeoisariopsis griseola*. Symptoms of this disease can occur on all aerial parts of the plant. Circular spots, up to 10mm in diameter, develop on primary leaves and often have a zonate of target appearance. Spots on the trifoliolate leaves are smaller, up to 3mm wide, and angular. Small black clusters of bristles (synnemata) which bear the fungal spores are generally visible on the spots on the undersides of the leaves. Dark, sunken patches of varying size occur on pods and often have diffuse margins. To control this disease, plant resistance cultivars are recommended for planting. Plough in diseased crops immediately after harvest. Also recommended fungicides are to be applied.

4.6. Bean rust

Bean rust disease of cowpea is caused by fungus *uromyces appendiculatus*. The common symptom of bean rust is scattering of reddish-brown, circular pustules on the leaves or pods. Pustules, at first light-green in colour, rupture the epidermis to produce abundant, powdery, reddish-brown spores (urediniospores). The pustules vary in size from pinpoint to 1 to 2mm in diameter. Large pustules are often surrounded by a halo of yellow host tissue. During cold weather, spores masses may be black rather than red. To control this disease, recommended fungicides are to be sprayed. Plough in crops immediately after harvest. Also resistant varieties are recommended.

4.7. Anthracnose

Anthracnose disease of cowpea is caused by fungus *collectotrichum lindemuthianum*. As seen on plants, dark streaks develop along the veins on the undersides of leaves. Infections of pods causes dark-brown sunken spots, the centers of

which becomes covered with pink, waxy spores during moist weather. To control this disease, disease free seeds are recommended, e.g. certified or approved cowpea seeds.

4.8. Bacterial blight

Bacterial blight of cowpea is caused by the bacterium *Xanthomonas campestris* pv. *Phaseoli*. Leaf symptoms initially appear as small, angular, water-soaked spots which gradually enlarge to form large, brown, dead area on the leaves. These areas are often surrounded by a bright-yellow zone. Spots develop on the margin and in interveinal areas of the leaf. As spots enlarge and coalesce, the plants appear to be burned. Dark-green, water-soaked streaks may develop on stems, later becoming tan. Pod symptoms consist of small, water-soaked spots later becoming sunken and reddish-brown. Under humid conditions, pod lesions are often covered with yellowish bacterial ooze. The symptoms on the pod may be difficult to distinguish from those of halo blight. To control this disease, disease free seed, e.g. certified or approved cowpea seeds are recommended. Also avoid movements of workers and machinery between diseased and disease free areas of the crop, particularly when wet. Copper sprays are recommended as it slows diseases development. Plough the diseased crops immediately after harvesting. Rotate crops with at least two years between bean crops. Estimate weeds, legumes, volunteer beans and other crop hosts from production areas.

4.9. Cottony leak and stem rot

Cottony leak and stem rot disease of cowpea is caused by the fungus *Pythium aphanidermatum*. As seen, soft, water-soaked areas develop on leaves and stems which may be covered by a fine, white, cottony growth in wet weather. The fungus may also cause dumping-off of seedlings and root rot of mature plants. Watery, soft rot can develop on pods in transit or storage, or abundant, white, cottony growth mats pods together into 'nets' which later become a soft, leaking mass known as 'cottony leak'. For stem rot control in the field, avoid close planting and deep sowing of seeds, cultivate carefully to avoid plant injury, do not plant in poorly drained areas and prepare land thoroughly to allow residues to decompose. To control cottony leak disease, discard disease pods and pack only dry pods and also to store pods in well-ventilated areas at a temperature of 12 to 15°C.

4.10. Sclerotinia rot

Sclerotinia rot disease of cowpea is caused by the fungi *Sclerotinia sclerotiorum*. Typical symptoms of this disease are water-soaked rotting of leaves, stems or fruits, with a white, fluffy fungal mycelium covering affected areas. Large, compact resting bodies or sclerotia of the fungus soon develop. The sclerotia are white at first, but later become black and hard. Sclerotia of *S. sclerotiorum* are 2 to 10 mm long. To control this disease, rotate susceptible crops with resistant once. Plough in diseased crops immediately after harvest. Apply the recommended fungicides. Correct timing and good penetration of foliage are essential for effective control.

4.11. Brown blotch

Brown blotch is caused by fungus *Colletotrichum capsici* and *C. truncatum*. Its symptoms include: purplish brown discoloration of petioles, leaf veins, stems, peduncles and, especially pods. Discoloration may be accompanied by cracking of stems. Pod infection leads to distortion and maldevelopment of pods which bear black fruiting bodies of the causal fungi. Symptoms first appear either at the stem base before flowering, or on pedicels (floral cushion) following flowering, the latter being characteristic. *C. lindemuthianum* also occurs on cowpea pods but the brown blotch fungi differ

in that their conidia are boat-shaped. To control this disease, seed Treatments with mancozeb followed by 2 foliar sprays of mancozeb.

4.12. Web blight

Web blight disease of cowpea is caused by fungus *Corticium solani*. Its symptoms include: initial symptoms on the leaves are small, circular reddish-brown spots which enlarge, becoming Surrounded by irregular shaped water-soaked areas. Under humid conditions, the lesions develop rapidly and coalesce, and mycelium of *C. solani* can be clearly observed on the under surface of leaves and on young stems. The initial discrete leaf lesions may be confused with those induced by *Cercospora cunescens*, but the subsequent spreading lesions are characteristic of web blight. To control this disease, the use of clean seed and cultural methods (avoidance of dense plantings, and sowing timed to avoid peak rainfall periods) offer the best means of control. Low levels of resistance occur but are insufficient alone to control the disease. Chemical control is feasible but uneconomic.

5. Conclusion

After compiling this research, it can be said that cowpea is becoming a major leguminous crop consumed by locals. Lack of knowledge and improper controlling methods is a major problem faced by farmers in Fiji. It was noted that these diseases not only tend to affect cowpea production but also farmers in terms of income earned for their livelihood. Anthracnose disease of cowpea as seen, not only affects the plant but pods as well. This disease is a major reason why losses in farm produce was experienced by farmers in Fiji.

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