

Evaluating the Effect of Different Planting Dates on Pests and Diseases Infecting Cowpea (*Vigna unguiculata* (L.) Walp in Buea, Cameroon

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ABSTRACT

Cowpea (*Vigna unguiculata*, (L) Walp) is an important staple in Sub-Saharan Africa including Cameroon. Productivity is low due to pests and diseases. Timing of planting is a sustainable cultural practice that mitigates pest and diseases. This study was aimed at growing cowpea on different dates in order to determine the most appropriate in terms of incidence and severity of pests and diseases. Research was carried out from March to June and September to December, 2022. It was a Randomized Complete Block Design with four replications using a variety 'Fekem' planted in first and second seasons. 200 seeds were sown per experimental unit and data collected for pests included identification, abundance, incidence and prevalence while for diseases were symptoms, incidence, severity, fungal identification and prevalence. Data was subjected to descriptive analysis, analysis of variance and Duncan test. Pests identified were, aphids, thrips, snails and birds. There was significance difference ($P>0.05$) in aphid abundance in second season plantings (13.7) compared to the first (6.61). This was similar to that of thrips (21.3 against (10.2) and birds (6.8 against 4.1). For snails, it was the reverse (7.1 against 4.8). Incidence of aphids was significant ($P>0.05$) in the second season compared to the first. Thrips were most prevalent (36.9 %) while birds were least (12.9 %) in first season. Disease symptoms included leaf spot and mosaic. There was significant difference ($P>0.05$) in number of leaf spots on cowpea during the first season (6.5) than the second (3.5) and likewise for severity. Mosaic incidence and severity were significantly higher in second season than the first. *Fusarium oxysporum*, *Colletotrichum gleosporioides* and *Fusarium verticilloides* were identified with *F. oxysporum* most abundant. Cowpea should be planted in the second season to reduce pest and disease occurrence thus enhancing grain quality and yield.

Keywords: Planting dates, pest, diseases, cowpea, abundance, severity

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp) belongs to the Fabaceae and grown in the sub-tropical and tropical regions of the world with origin from Sub-Saharan Africa [1]. The crop is one of the most important food and forage legumes in the semi-arid tropics including Asia, Southern Europe, Southern United States, Central and South America and Africa including Cameroon [2]. It is multifunctional, providing food for humans and livestock and serving as a valuable and dependable revenue-generating commodity for farmers and grain traders [3]. It is nutritious, rich in protein (24%), dietary fiber (11 %) and potassium (1112 mg/100 g) while low in lipids (<2%) and sodium (16 mg/100 g) (U.S. Department of Agriculture [4], 2021).

The uses of cowpea are enormous: seeds are prepared as porridge and also as a traditional steamed cake (khoki) wrapped in plantain leaves. Cowpea is also used as fodder for livestock. In spite of the importance of this crop, production is quite low due mainly to pests and diseases. In addition, farmers have minimal knowledge on the optimum planting date (s) that can mitigate these pests and diseases thereby increase yield of this crop.

Cowpea is a short-day plant and floral bud initiation and development is sensitive to photoperiod in many accessions. Also, it is drought-tolerant and prefers warm weather that has a unique ability to fix atmospheric nitrogen and grows well even in poor soils with more than 85% sand [5]. Cameroon is ranked 6th in world's cowpea production with 185,832 metric tons [6]. Yield per hectare is quite low when compared to the contribution of other countries like Nigeria [6]. Low yield in Cameroon is attributed to drought, low or erratic rainfall, soil nutrient deficiency, biological constraints and minimal adoption of improved varieties but the most important biological constraints are diseases and pests. Cowpea flower bud thrips has been reported as the most damaging pest followed by the flower beetles, aphids and the pod-sucking bugs [7].

Several measures have been employed to reduce pests/diseases in farmlands such as the use of insecticides, fungicides but their limitations are far reaching because of unsustainability. Abudulai *et al.* [8] noted that appropriate timing of planting date for crops is important since it mitigates incidence and severity of pests and diseases. Unfortunately, only scanty information is available on the effects of time of planting to crop yield and quality within the Southwest region of Cameroon. The objectives of this study were to: To identify the pests and diseases affecting cowpea production [2] To determine the incidence, severity and prevalence of these pests and diseases planted at different planting dates and [3] To determine the appropriate planting date for cowpea where pests/disease incidence will be lowest in fields.

MATERIALS AND METHODS

Experimental Site

This study was conducted from March to June and September to December (2022), at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, University of Buea. Buea is located at the foot of mount Cameroon, Southwest Region Cameroon, situated between latitudes 4°10" North of the equator and longitudes 9°20" East and 900m above sea

level. It has a mono-modal rainfall regime with a less pronounced dry season and 80% to 85 % relative humidity, sunshine between 900 to 12000 hours per annum. The rainy season starts from March to mid-November and dry season from mid-November to March with mean annual rainfall ranging from 1500mm to 2800mm [9]. The mean monthly air temperature is from 19°C–30°C. Soil temperature at 10cm depth decreases from 25°C to 15°C with increasing elevation from 200m to 2200m respectively. The soil is derived from weathered volcanic rocks dominated by silt, clay and sand [10].

Site Preparation and Experimental Design

A surface area of 210 m² with grasses and maize stalks were cleared. The experiment was laid out in a Randomized Complete Block design with four treatments comprising of different planting dates per season in March-April, 2022 (15th Mar, 22nd Mar, 5th April and 12th April) and 7th, 14th, 21st and 28th of September, 2022 and each replicated four times making a total of 16 experimental units in the experimental area. Each experimental unit (bed) was measured (3 m x 3 m) using a meter tape and raised during ploughing to a height of 30 cm. The planting distance for the cowpea was 30 cm x 30 cm in March, 2022 and same in the next planting season (September, 2022).

Agronomic Practices

The Fekem cowpea variety seeds were obtained from Institute of Agricultural Research and Development (IRAD) and sown three/mound and later thinned to two, seven days after planting thereby, having two seeds per stand, 10 stands per row, making a total of 100 stands/bed and 1600 stands on the whole plot (3200 plants). Weeding was done as necessary while nets were suspended above the beds to prevent birds damaging the cowpea pods.



Plate1: Nets suspended on cowpea canopy.

Data Collection

Identification of Pests and Diseases Infecting Cowpea:

Pests and diseases were identified based on their morphological characteristics, colour, shapes and signs and symptoms they express on the plant [11]

Pest Abundance:

Five plants were randomly selected in the middle rows of each bed and tagged for visual count of aphids on the whole plants at weekly intervals from 21 to 49 days after planting (DAP). Data collection was done between 8am-10am when most adult aphids usually bask on the leaves and stems.

Thrips infestation was assessed at weekly intervals from flower bud initiation to 50% podding stage. At each sampling occasion, 10 flower buds were randomly collected from each bed and kept in a Petri dish containing 50% detergent (soap water) and dissected with a blade on a wooden board at weekly intervals for visual counts of thrips population per flower (Plate 2). Data collection started from when the cowpea started producing flowers (46-53 and 42-47) in first and second seasons.

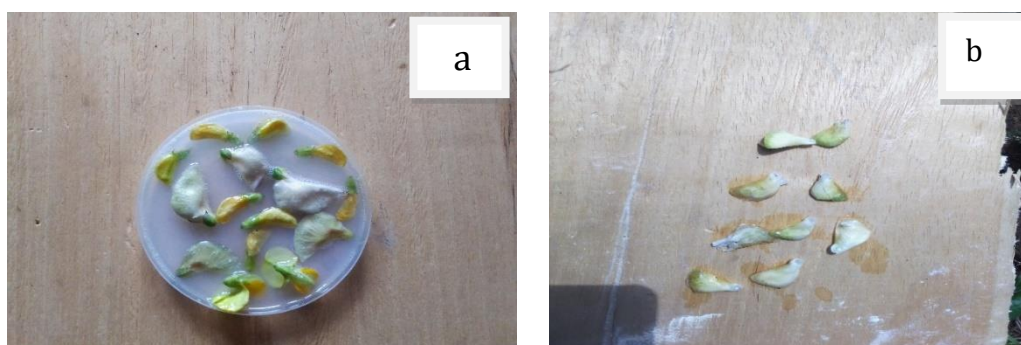


Plate 2: Isolated flower buds in petri (a) and on wood board (b) prior to thrips count the number of snails was counted on each bed at weekly intervals from 21-49 DAP.

The counting of birds that visited cowpea beds planted at different dates was done once/ week to ascertain the planting date with more abundance of birds. Point count method was used to count birds. The number of pods damaged by birds were counted on each bed in the different planting dates at weekly intervals from pods initiation at 46-53 DAP in the first and second seasons.

Pest Incidence and Prevalence:

Pest incidence was recorded by counting the number of plants affected by pest in relation to the total number of plants per bed expressed as a percentage at weekly intervals from 21 to 49 DAP while pest prevalence was the proportion of each pest in relation to total number of pests expressed as a percentage. The formulae in page 7 were used:

Disease Symptoms on Cowpea

Disease Incidence:

Disease incidence was calculated by counting the number of plants showing leaf spot and mosaic disease symptoms. Incidence was calculated as below:

$$\frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100\% \quad [12]$$

Disease Severity:

Number of plants were counted per severity score in each experimental bed from 21 to 49 DAP on a scale of 1-5 according to the table/formula below.

$$\bar{X} \text{ ISSAP} = (\sum_{s=1}^5 (SX_s)) / (\sum_{s=1}^5 (X_s)) \quad [13; 14].$$

Where;

$\bar{X}$ ISSAP= Mean index of severity considering all plant units

S = Severity class (1-5)

Xs = Number of plant units scored in severity class (1-5)

AP = Consider all plants units

Table 1: Severity scores for leaf spot and mosaic on cowpea

Leaf spots symptoms	Mosaic symptoms
1= No visible symptoms	No visible symptoms
2 = 1-5% visible spots on leaves	0.1-20% plant infection, very mild mosaic on few leaves/plants
3 = 6-20% visible spots on leaves	20.1-40% plant infection, moderate mosaic (mosaic on many leaves/plants)
4 = 21-40% visible spots on leaves	40.1-60% plant infection, severe mosaic (severe mosaic and mild mottling)
5 = 41-60% visible spots on leaves	60.1-80% plant infection, severe mosaic (severe mosaic and severe mottling)

Source: [15] Source: [14]

Fungal Isolation and Identification

Sterilization of Laboratory Materials and Preparation of Growth Media:

Detergents were used to wash glassware for the experiment. Inoculation needles, cork borers and scalpels were dipped into 70% ethanol and flamed to red hot using a Bunsen flame to effect sterilization. Glassware like beakers, pipettes agar plates were sterilized by heating at 120°C for an hour in hot air oven while the laminar flow Hood was cleaned with cotton wool soaked in 70% ethanol. The UV-light of the lamina flow hood was put on for at least 2 hours and put off before plating of the various samples in semi-solidified agar. Media including Potato dextrose agar, nutrient agar, bacto-agar, carnation leaf agar were suspended individually in one litre conical flask containing distilled water in a water bath and heated for 20 minutes at 50°C and later autoclaved at 121°C for 20 minutes to effect sterilization before they were cooled and stored at 4°C in a refrigerator until when needed.

Isolation and Identification of Fusarium:

Equipment used was sterilized and growth media prepared as described earlier. Leaf tissue from some randomly selected tolerant and susceptible progenies were examined with light microscope. *Fusarium* isolates were identified by streaking sample portions on Peptone-pentachloronitrobenzene (PPA) a selective medium for isolation of *Fusarium* sp. and the others fungi, sub-cultured in potato dextrose agar (PDA). Single spores were plated and incubated on water agar for a day; in complete medium for seven days and on carnation leaf agar for 2 weeks. Pure fungal cultures raised were identified based on colony morphology and microscopic examination of their spores [16]. All microscopic examination of fungal isolates was done by teasing a small portion of the material with a sterilized needle on a slide using lactophenol and covering with a cover slip before mounting on a microscope. Sub-culturing was done by cutting a 2mm² portion of growing mycelium using a sterile needle and placing it centrally on a fresh plate containing PDA. All magnifications were done on X100 and or X400 depending on clarity of the micrographs. Colony morphology, growth rates and presence of pigments was identified on PDA alongside microconidia (shape, size, number of septa, shape of basal and apical cells, presence of chlamydiospores, conodiogenous cells (monophylides and polyphylides) and spore type. Description of microconidia was done aided by the use of the mycological dictionary of [17], while Rayners morphological chart [18] and [19] terminologies were used in describing colony colours and nature of their edges, zonation and texture of aerial mycelium.

Monthly Weather Conditions of The First and Second Seasons

The data for monthly weather conditions (precipitation, humidity, minimum and maximum temperatures) were obtained using the historical-meteo.net of Buea for 2022 (appendix).

Data Analyses

All data collected was subjected to descriptive analysis, analysis of Variance (ANOVA), and then analyzed using the SPSS statistical package (version 23). Treatment means were separated using Duncan test at 5% probability level and graphs plotted using Microsoft Excel for Windows (version 2013).

RESULT**Identification of Pests Infecting Cowpea****Aphids (*Aphis craccivora*) Identification:**

Cowpea aphids were black and formed dense colonies on individual cowpea plants with infestations starting on the terminal buds and spreading down the stems. These colonies were often visited by black ants on the plants to feed on honeydew secreted by the aphids; the damage is characterized by leaf bunching and stem twisting (Figure 1).

Identification of Thrips (*Megalurothrips sjostedi*):

The cowpea flower thrips were identified by their shiny, black and small-winged that fed on flower buds and flowers. When the flower buds were attacked, they became brown and eventually fall-off and damaged flowers distorted, then they changed colour and fall-off early with the result that pods were not formed (Figure 2).

Description of Snail Damage:

The first symptom due to snails was that, they made irregular holes on cowpea leaves with their rasping mouthparts and they fed on the leaves at any level on the plant. Secondly, sometimes the snails left their slime trails which was observed as a silvery deposit on leaves and stems and the slime trails facilitate the snail movement (Figure 3).

Description of Black-Headed Oriole Bird (*Oriolus larvatus*):

Orioles always produced sweet whistling sound echoing from trees which were pleasant to hear. They had a bright yellow body, contrasting black head and flesh-coloured beak. They fed on a vast invertebrates, seeds and fruits. During cowpea growth, they were observed by feeding on cowpea fresh pods (Figure 4).

Images of Pests Infecting Cowpea



Figure 1: Black Cowpea aphids on cowpea



Figure 2: Thrips (*Megalurothrips sjostedi*)



Plate 3: A Snail feed on cowpea plant



Plate 4: Black-headed Oriole (*Oriolus larvatus*)

Pests Abundance and Prevalence on Cowpea

Results of pest abundance and prevalence on cowpea planted at first and second seasons 2022 are shown in Table 2. Aphid population was significantly higher ($P<0.05$) on cowpea in the second season with mean value of 13.7 compared to those of the first season with 6.6 (Table 2). Thrip population was significantly higher in the second season (29.3) compared to first season with the mean value of 10.2 (Table 2). The highest mean population of snails that damaged cowpea leaves was recorded in the first season (March) with mean population of 7.1 compared to their population in the second (September) of 4.8. Bird population in the second season had a significant higher number of 6.8 and 4.1 in the second season. Out of the four pests were identified thrips were the most prevalent (36.9 %) (205 out of 556.4) and least were birds (12.9 %) (71.8 out of 556.35) (Table 2)

During the second season, the most prevalence pest was the Thrips (56.1 %) and the lowest pest prevalence were birds (8.6 %). The results in both seasons showed that pests were more prevalent in the second season compared to the first season.

Table 2: Mean Standard Deviation of Abundance and Prevalence of Pests on Cowpea Planted at first and second growing seasons of 2022.

Seasons	Pests	Abundance	Prevalence (%)
First	Aphids	6.6±2.2 ^b	23.6
	Thrips	10.2±4.2 ^b	36.9
	Snails	7.1±2.2 ^a	26.6
	Birds	4.1±1.5 ^b	12.9
Second	Aphids	13.7±3.5 ^a	26.2
	Thrips	29.3±7.4 ^a	56.1
	Snails	4.8±1.1 ^b	9.1
	Birds	6.8±1.2 ^a	8.6

Values in the same column with different letters are significantly different between seasons according to Duncan test ($P < 0.05$).

Nature of Pod Damage by Birds

The birds fed on the fresh pods by picking all the pods to the extent that they picked every pod and the cowpea stems were podless.



Figure 5: Nature of cowpea pods damaged by birds in the field Pod damaged due to birds

Result of number of pods damaged by birds on cowpea planted at different dates are shown in Table 3. Pods initiation started at 49 and 46 DAP for cowpea of (15th and 22nd March) and (5th and 12th April), respectively in the first season. During the early stage of podding, birds appeared in the plots and fed on pods. Cowpea planted on 15th March had the highest number of pods damaged (27.2) by birds in the first season while the lowest pods damaged (4.9) recorded was on cowpea sown on 5th April. Number of pods damaged by birds on planting date (12th April) was low (21.1) but significantly higher than those planted on 22nd March (7.1). During the second season, pod initiation started earlier as from 46 DAP compared to first season and cowpea that was planted on later planting dates had fewer pods damaged. From the

results in both seasons, pod damaged by birds was significantly higher ($P<0.05$) in the second season compared to the pod damaged number in the first season (Table 3).

Table 3: Mean Standard Deviation of Number of Pods Damaged by Birds on Cowpea Planted at Different Dates of First and Second Seasons of 2022.

Seasons	Planting dates	Pods damaged
First	15 March	27.2±10.9 ^b
	22 March	7.1±2.9 ^b
	5 April	4.9±2.0 ^b
	12 April	21.1±12.2 ^b
Second	7 September	132.3±45.4 ^a
	14 September	30.7±13.8 ^a
	21 September	24.9±9.4 ^a
	28 September	29.0±4.7 ^a

Values in the same column with different letters are significantly different between seasons according to Duncan test ($P < 0.05$).

Disease Symptoms on Cowpea

Leaf Spot:

The symptoms of this disease observed on leaves were small, grey circular lesions on petioles. It first appeared in older leaves followed by younger leaves and as the disease progressed, leaves roll, wilt and fall-off from the plants. (Plate 6).

Cowpea Mosaic:

The symptoms of cowpea mosaic disease were bright yellow to green mosaic or mottle appearance of infected leaves which became most apparent on leaves as they aged. The leaves also became wrinkled and curled (Plate 7).

Disease Incidence and Severity on Cowpea

Leaf spot and mosaic disease incidence and severity are shown on Table 4. The mean incidence of leaf spot in the first season (6.5) was significantly higher ($P<0.05$) on cowpea compared to those of the second season (3.5). The high incidence of leaf spot on cowpea leaves resulted to moderate symptoms of the disease (3.5) in the first season and mild symptoms on cowpea planted in the second season. High incidence of mosaic disease was recorded on cowpea of the second season and lower incidence in the first season. These high incidence of this in the second season resulted to mild symptoms on cowpea while no symptoms were recorded on cowpea of the first season.

Table 4: Mean Standard Deviation of Leaf Spot and Mosaic Incidence and Severity on Cowpea Planted at First and Second Season of 2022.

Seasons	Diseases	Incidence	Severity
First	Leaf spot	6.5±1.4 ^a	3.5±0.4 ^a
	Mosaic	2.1±0.9 ^b	1.9±0.3 ^b
Second	Leaf spot	3.5±0.9 ^b	2.1±0.3 ^b
	Mosaic	6.0±2.2 ^a	2.0±0.3 ^a

Values in the same column with different letters are significantly different between seasons according to Duncan test ($P < 0.05$).

Isolation and identification of *Fusarium*

From the colony characteristics on Potato dextrose agar, fusarium isolate exhibited fast growth producing abundant uniform mycelia and pale brown pigment. On CLA, it had abundant macroconidia that were medium in length, falcate, thin with characteristic 3 septa. The apical cell was hook-shaped. Chlamydospores were abundant on the hyphae and also microconidia were non-septate, oval in shape and formed on monophialides (Plate 1).



Plate 7: Cultural and morphological characteristics of *Fusarium oxysporum*



Plate 8: Cultural and morphological characteristics of *Colletotrichum gloeosporioides*

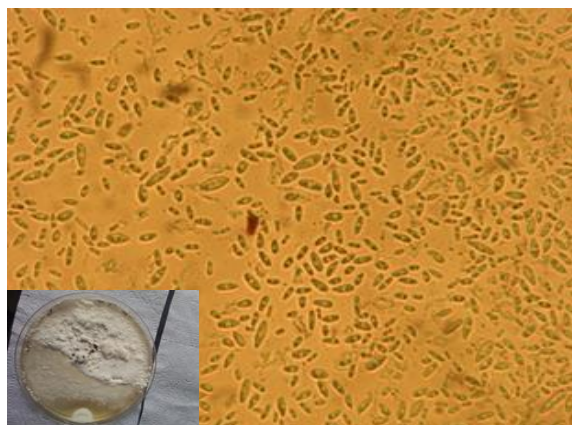


Plate 9: Cultural and morphological characteristics of *Fusarium verticilloides*

Prevalence of Diseases on Cowpea

Fusarium oxysporum was the most prevalence fungal disease infecting cowpea

DISCUSSION

Effect of Planting Dates on Pests of Cowpea of the First and Second Seasons

Aphid Abundance:

In first cropping season (March), sowing time significantly affected aphid infestation on cowpea leading to their lower population compared to the second season (September). This might be due to frequent rainfall (33-115 mm) in the first season which washed away aphid adults giving low infestation of cowpea. Similarly, [20] reported that small-bodied pests like aphids, mites, jassids, and whiteflies can be washed away during heavy rainfall and variable rainfall can have a major impact on insect populations. Cowpea infestation by aphids was influenced by time of planting because aphid population was reduced as the time of planting was delayed and this is consistent with [21] who reported that aphid infestation in lentil varied significantly depending on sowing time, and during this planting period, there was frequent and abundance rainfall which tend to wash off the aphids from the plants since rainfall is a high natural mortality factor in aphid populations.

There was high aphid population on cowpea in the second season which could be attributed to high temperatures (27-33°C) during that growth period which favored the pest since aphids are more active in warmer conditions than in lower temperatures and this support [22] who reported that higher temperatures in some cases may be beneficial for aphids which is especially visible in species from warmer climates.

Thrips Abundance:

Thrips population in the flowers differed significantly between the seasons with the lowest population observed in the first season (March) planting time. During this growth period, the frequency of rainfall was high (33-115 mm) that washed away the pest given their smaller sizes and this is in agreement with Angus and Jeff, 2012 who reported that another factor that can influence thrips on plants is rainfall and a heavy rain, even for a short period of time can kill a lot of thrips.

Thrips generally reproduce and survive more during dry conditions and during the second season, the frequency of rainfall was low (74-22 mm) and this favoured the survival of thrips since they were not frequently washed off from the plants given their small sizes. It has been reported that with the increase in temperature from 25 to 35°C it brought a decrease in the duration of development, total life cycle and percent survival of Thrips [23] and this is not similar to these results obtained which from historical metoe.net of Buea in second season (September), the maximum temperatures ranged from 27-33°C which favored the growth and development of thrips giving their high population during this cropping season.

Snail Abundance:

Sowing dates influences number of snails. The highest number of snails was observed during the first season compared to second season. This might be due to more frequent and higher rainfall (33-115 mm) in the first (March) season which favored population increased of snails causing high leaves damaged. Snails require moist and wet environments and they do most of their work at night or during periods of high humidity or rainfall [24]. In second cropping season, the highest mean snail population was observed on cowpea of early September due to favorable environmental conditions for the snails since they prevail more during cold and moist conditions but generally snail population was lower in the second season due to high temperatures (27-33°C) and low rainfalls (74-22 mm). During the heat of the day, snails hide in damp places under rocks, crevices and in thick ground covers to survive [24] and this is why they only become active when it rains.

Bird Abundance:

The number of birds that visited cowpea during the first and second cropping season showed the highest number of birds on early planted cowpeas, thereby amounting to highest population of birds in the second season compared to the first season. This high number of birds was attracted by the early pods on these plants which were the most available food for the birds at these periods. Cowpeas planted on later dates attracted fewer birds because at this period, the birds had diversified fields to visit for diversified food sources. Though the results in both seasons are similar in the manner in which the birds visited the cowpea fields, but since during the second season, the climatic conditions were favorable which facilitate the birds to fly from one area to the other in search of food, therefore, created the opportunity for majority of the birds to visit the cowpea and feed on the pods during this growth period.

Nature of Pods Damaged by Birds of the First and Second Season of 2022

Though the cowpea pods were protected with nets to prevent birds from pod damaged, these birds still found their ways under the nets to feed on the pods. In first season, cowpea of 15th March had significantly more damaged pods and this might be due to scarcity of food sources for the birds during that period since early planting of cowpea in 15th March was the only food source ready for birds' consumption and the degree of damaged reduced when other food sources became available for them. As similar to first cropping season, the highest pod damaged by birds was noticed on cowpea planted at first planting date (7th September) and the lowest damaged recorded for September 21st planting in the second season. Cowpea pods were greatly damaged by birds in function of the planting date with cowpea of first planting date suffering the highest pods damaged by birds. The early planted cowpeas also formed pods early which

served as the first available food for the birds but the pods destruction decreased on the cowpea of September 21st to 28th since other food sources were ready for the bird consumption.

Effect of Planting Dates on Diseases of Cowpea of the First and Second Seasons Leaf Spot Incidence

Leaf spot disease incidence was generally higher in the first cropping season compared to the second season across all the planting dates. This increase of cercospora leaf spot in the first planting season might be due to frequent and abundant rainfall (33-115 mm) during this planting period since leaf spot is caused by a fungus which thrives mostly in moist conditions and rainfall could also spread the disease through splashing from one plant to the other, therefore infections were bound to increase. Leaf spot incidence was low in second planting season due to high temperatures (27-33 °C) and low rainfall (74-22 mm) which restricts the growth of this disease since cercospora leaf spot is mostly favored by wet and humid seasons. These results in both cropping seasons were in line with [25] who reported that leaf spot diseases incidence was higher on *telfairia occidentalis* in first cropping season than in second cropping season due to climate variability which favoured the development and spread of the disease in the field in first cropping season in Dschang, Cameroon.

Leaf Spot Severity

Leaf spot disease severity was also higher in the first cropping season compared to the second season in all the planting dates. During the first planting season, temperatures were low due to frequent rainfall and because of that it increases the development and spread of this disease on the plants. Leaf spot is a disease caused by a fungus and it thrive most in cold and moist conditions. The development of this disease was very low in the second season due to increase in temperatures. Leaf spot severity was higher in first cropping season compared to second season which was in line with the report from [26], that leaf spot incidence and severity on *Telfairia occidentalis* (fluted pumkin) was higher in first season than in the second season due to climate variability which favoured the development and spread of disease in the field in first cropping season in Dschang, Cameroon.

Cowpea Mosaic Incidence

Cowpea mosaic incidence was higher in the second cropping season compared to the first season across all the planting dates. These results were attributed to the fact that mosaic disease is caused by cowpea mosaic virus which is transmitted by aphids.

During the second season, there was a favorable environmental condition for aphids which led to their high population and therefore led to increase transmission of the mosaic virus to the plants. At the first season, there were low temperatures due to frequent rainfall which created an unfavorable condition for aphids leading to low spread of this disease.

Cowpea Mosaic Severity

Cowpea mosaic severity was higher in the second season compared to the first cropping season. These results were attributed to the favorable climatic conditions in the second season which created favorable conditions for aphid population which promote the spread of the

disease. An increase of the aphid population possibly led to high transmission of the mosaic virus leading to high mosaic severity.

Microscopic Identification of Fungal Pathogens

Three fungal pathogens were associated with diseases of cowpea

CONCLUSIONS AND RECOMMENDATIONS

From finding of this study, it was concluded that cowpea from late September resulted in the lowest pest and disease damage and late sowing of cowpea in the second cropping season in Buea was more favorable period for planting the crop. Therefore, based on the results/conclusion of this study, it could be recommended that, to regulate pest infestation and disease incidence/severity, cowpea should be planted in the second season especially at 21st and 28th September planting dates.

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