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Evaluation of Varying Rates of Mancozeb fungicide and Some Plant Leaf Powders as Seed Treatment and their cost-benefit for the Management of Early Leaf Spot (*Cercospora arachidicola Hori*) Disease of Groundnut in Makurdi, Nigeria

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Abstract **Original Research Article**

Field experiment were carried out during the first and second cropping seasons (2013//2014) at the Teaching and Research Farm of the Federal University of Agriculture Makurdi, Benue State of Nigeria, the effect of seed treatments with varying rates of Mancozeb fungicide, Pawpaw and Moringa leaf powders on early leaf spot incidence and ground nut yield was studied; and the cost benefit ratios calculated**.** The seed treatments were: Mancozeb, Moringa leaf powder and Pawpaw leaf powder while the seed treatments rates were 0.0 (control), 2.0, 2.5 and 3.0gm. Groundnut variety Benue AGR seeds were treated with the seed treatment rates replicated 3 times and arranged in a randomized complete block design (RCBD). Results of the first season and second seasons showed that seed treatment with Mancozeb significantly gave the highest plant establishment followed by moringa leaf powder and pawpaw leaf powder respectively. In the first year, 3.0g seed treatment significantly gave the highest plant establishment while the untreated control recorded the lowest plant establishment, but was not significantly difference ($P \leq 0.05$) amongst the treatment rates in the second year. In the two cropping seasons, plants grown from seed treated with mancozeb recorded the lowest incidence of early leaf spot disease followed by moringa leaf powder at 40, 47 and 54 DAS respectively. Seed treatment rate of 3.0gm gave the lowest disease incidence from 40 to 54 DAS. At 90 DAS of the first season, seed treatment with Mancozeb significantly lowered the leaf defoliation followed by Moringa leaf powder compared to Pawpaw leaf powder. Similarly, during the second season, seed treatment with Mancozeb also reduced the leaf defoliation compared to the plant powders at 70, 80 and 90 DAS respectively. Mancozeb and Moringa leaf powder gave higher grain yield compared to Pawpaw leaf powder in the first season. Increase in seed treatment rate resulted to higher percentage increment in grain and haulm yields over the untreated control in the two cropping seasons respectively. Similarly, Mancozeb gave the highest net profit while Pawpaw leaf and Moringa leaf powders gave higher cost- benefit ratio and profit margin. Mancozeb fungicide is expensive and can have ill health effects, giving to these reasons, moringa leaf and pawpaw leaf powders could be another option in the management of early leaf spot disease of groundnut in this zone because of their accessibility, environmental friendliness, low cost of production and higher income return.

Keywords: Disease incidence, Groundnut, Early leaf spot, Leaf defoliation, Seed treatments, Plant leaf powders, cost benefit, Mancozeb.

INTRODUCTION

Groundnut *(Arachis hypogaea L.)* is highly valuable economic crop cultivated widely in the developing and developed countries. It is one of the most important and multipurpose oil seed crops of the World [1]. It is also the 4th important oil seed crop and the 13th most important food crop of the World [2]. Groundnut is a very good source of income and valuable fodder for farm animals in Nigeria. Groundnut seeds contain 40 to 50% digestible protein and 10 to 20% carbohydrate [3].

In Nigeria, the groundnut production output is lower below 2.8 million tons per hectare despite the increased in area devoted for groundnut production [4]. Africa productivity of 929kg/ha remain poor compared to the United State of America with 3,673kg/ha [5]. The low groundnut production is a big setback which could

be as results of several factors particularly when the crops are not properly managed. Among the groundnut fungal diseases, early leaf spot (*Cercospora arachidicola Hori)* and Late leaf spot *(Phaeoisariepsis personata)* (Berk and Curt) Deighton) are devastating and responsible for highest yield loss worldwide [1]. [6] reported the early leaf spot pathogen usually over winter in the soil and infect almost every plant part, it undergoes several reproduction cycles under favourable environmental conditions during the crop growing periods in a single season. The primary initial inocula are responsible for the onset of disease epidemic and seasonal perpetuation.

Also, [7] reported that in severely infected field, the leaves may drop prematurely resulting to reduced haulm quality and pod yield. Yield loss of up to 50 to 70% in West Africa has been reported [8]. The management of disease requires various control strategies and methods as an alternative to suit the farmers other than conventional synthetic pesticides [9]. Studies on the use of plant extracts for the control of diseases have shown the important of natural chemicals as possible source of non-phytotoxic and easily biodegradably alternative fungicides [10]. Seed dressing is mostly employed to protect the seed against seed and soil-borne pathogens even in resistant varieties. Gerken *et al*., [11] reported that chemical control has been practiced by farmers for higher yield but the diseases and insect pests can easily become resistant to these synthetic pesticides. Besides, the synthetic pesticides are not affordable to majority of peasant farmers [12-14] apart from the myriad of problems that have been reported from the misuse of these synthetic pesticides Obeng-Ofori *et al*., [15], some of these synthetic broad-spectrum pesticides are persistence, carcinogenic and poses health hazard. Against this back drop it has necessitated the shift in search and use of botanical pesticides as alternative safety disease control measure. [16] suggested several techniques that can be employed to increase the useful life span of a resistant variety as part of an integrated pest management. According to him any management strategy such as sanitation, seed treatment or fungicide application that reduces the exposure of the variety to large pathogen populations is likely to increase its useful life span. [17] reported that Neem (*Azadirachta indica*) can be used effectively as insecticide, repellent, fungicide, nematicide and anti-feeding growth inhibitor, while [18] also reported that seed treatment with *Tulbaghia violacea* water extract reduced the incidence of sorghum loose and covered smut diseases significantly. The botanical pesticides are easier to formulate, locally renewable, user-friendly and environmentally safe [19]. Pathologically, disease assessment is an important tool which provides useful clues on when and how to mitigate the disease menace. On this note, [20] reported that the assessment of disease at more than one growth stage provides account of disease pattern and variation on its development at different disease assessment levels. Hence, the objective of this study was to evaluate varying rates of mancozeb fungicide and some plant leaf powders as seed treatments and their cost-benefit for the management of early leaf spot disease of groundnut in Makurdi, Nigeria**.**

MATERIALS AND METHODS

Field trial was carried out to evaluation of varying rates of mancozeb fungicide and some plant leaf powders as seed treatment and their cost-benefit for the management of early leaf spot (*cercospora* sp) disease of groundnut at the Teaching and Research Farm of the Federal University of Agriculture Makurdi, Benue State of Nigeria in the 2013 and 2014 Cropping Seasons. The Experimental field was manually cleared using cutlass and ridged using native hand-hoes. The experimental field measured 12m x 15.5m = (186.0m^2) and each plot measuring 3m x 1m with four ridges. The seed treatments used were *Moringa* leaf powder, Pawpaw leaf powder and Mancozeb fungicide, whereas the groundnut variety used was Benue-AGR which was obtained from Benue State Agricultural and Rural Development Authority (BNARDA). The 3 x 4 treatments were arranged in a randomized complete block design (RCBD). The groundnut was treated with Moringa leaf powder, Pawpaw leaf powder and Mancozeb (80%) fungicide at the rates of 0.0 (control check), 2.0, 2.5 and 3.0g / 200gm seeds accordingly. The seeds were sown on top of the ridges within 24 hours of treatment. Two seeds were sown per hole with 10 cm and 75cm as an intra- and inter-row spacing respectively. The field was weeded three times using native hoe to keep the experimental field weed-free.

Preparation of Plant leaf powders / Mancozeb 80% WP Seed treatment

Fresh healthy pawpaw (*Carica papaya*) and moringa (*Moringa oleifera)* leave were harvested, washed and sundried for two weeks, powdered with electric blender and sieved separately. 10g of gun arabic was dissolved in 50ml sterile distilled water. The groundnut variety Benue-Agric seeds were separately dressed with respective seed treatment rates inside polyethylene bags. 2ml of gum arabic solution was added to each plant powder inside the polyethylene bag respectively to act as adhensive similar to coalin in synthetic fungicides. Active ingredient-mancozeb 80% WP Ethylen Bisdithiocarbamate (EBDC) is a synthetic preventive, contact broad spectrum fungicide sold under the trade name ‘Z-Force’. The polyethylene bags containing the seeds dressed with respective mancozeb and plant powders were closed and shaken thoroughly for 5 minutes for proper adhesiveness (Plate 1) while the control was left dressed.

Plate 1: Seed dressed with Pawpaw leaf powder (1), Mancozeb (2), Moringa leaf powder (3) and untreated seeds (4)

Data Collection

Pant Establishment count (%): At 2 weeks after sowing (WAS) plant establishment was obtained by expressing the total number of plants that have germinated as percentage of expected plant stands in the net plot.

Disease development (%): Disease incidences was assessed at 40, 47 and 54 days after sowing (DAS) by counting infected plants and expressing as a percentage of total plants in the net plot using the disease incidence formula by Turaki *et al*, [21].

$$Z = \frac{K}{Y} \times 100$$

Where:
Z = Disease incidence, K = Number of infected plants in the net plot and Y = total number of plants in the net plot.

Defoliation (%): This was assessed on five randomly selected tagged plants in each net plot at 70, 80 and 90 DAS using a scale by [22]. Where: 1= No leaf fall, 2 = less than 10% leaf fall, 3 = 10 – 25% leaf fall, 4 = 25 – 50% leaf fall, 5 = More than 50% leaf fall and formulae below were used to calculate percent defoliation for the plot.

$$\text{Defoliation (\%)} = \frac{\sum n \times 100}{N \times 5}$$

Where: $\sum n$ = summation of individual plants assessments
N = Total number of plants assessed
5 = Highest score of the defoliation scale.

Grain and haulm: After the harvest the groundnut leaves in each net-plot was gathered separately, sundry for 2 weeks, weighed using a weighing balance scale and the values were converted into kilogram per hectare. Similarly, the groundnut pods from each net plot were separately, sundry for 2 weeks, shelled and the seeds were weighed in gram using a sensitive electronic weighing scale model (Sartorius 6 MBH Gottingen), and values were converted into kilogram per hectare.

Data Analysis

The data collected were subjected to two Way analysis of variance (ANOVA) using [23] and means were separated using Duncan's New Multiple Range Test (DNMRT) at 5% level of probability [24]. Yield increases as well as Cost-benefit analysis on the treatments were calculated using the formulae:

$$\text{Yield increase over the untreated check} = \frac{\text{Treated} - \text{Untreated}}{\text{Treated}} \text{ X } 100$$

$$\text{Selling price} = \text{mean yield X cost of grain in the market at that time}$$

$$\text{Profit} = \text{Selling price} - \text{Cost of production}$$

$$\text{Cost} - \text{benefit ratio} = \frac{\text{Profit}}{\text{Total cost of production}}$$

RESULTS

Effect of Seed Treatment with *Pawpaw* Leaf Powder, *Moringa* Leaf Powder and Mancozeb on Plant Establishment at 2 Two Weeks After Sowing (WAS) in the First and Second Cropping Seasons.

Results on effect of seed treatments with mancozeb, pawpaw leaf and moringa leaf powders; rate and interaction on plant establishment count in the first and second cropping seasons are presented in Table 1.There was significant difference (P≤ 0.05) in plant establishment count among the seed treatments in the two cropping seasons. Plant grown from seeds treated with mancozeb recorded significantly the highest plant establishment followed by moringa in the two years. The effect of seed treatments rate, and the interaction between seed treatments and rates were significant in first cropping season only. The effect of seed treatment rates significantly increases with increasing seed treatment rate in both years.

Similarly, in the first cropping season, those groundnut plants grown from seeds dressed with 3.0g treatment rate recorded the highest plant establishment count of 84.44% followed by those grown from seeds treatment rate of 2.5g and 2.0g which had establishment count of 80.0% and 78.33% respectively which did not significantly vary from each other. The lowest plant establishment of 75.56% was recorded from those groundnut plants grown from the untreated control plots. Results of the interaction between the seed treatments and treatment rates showed that higher establishment count of 91.67 % and 88.33 % were recorded from those seed treated with 3.0 and 2.5g of mancozeb fungicide respectively but did not vary from each other.

In the second cropping season, plants grown from seeds dressed with mancozeb recorded significantly the highest establishment count of 84.17%, followed by moringa leaf powder whereas those grown from seeds treated with Pawpaw leaf powder recorded the lowest plant establishment.

Table 1: Plant Establishment of Seeds treated with Mancozeb, Pawpaw Leaf and Moringa Leaf Powders in the First and Second Cropping Seasons

Seed Treatments/Rate/Interactions	Plant Establishment (%)	
	First Year	Second Year
Treatments(A)		
Mancozeb fungicide	87.08±1.99^{a}	84.17±2.20^{a}
Moringa Leaf powder	77.50±1.79^{b}	79.58±1.68^{ab}
Pawpaw Leaf powder	74.17±1.35^{b}	76.67±1.28^{b}
P-Value	≤0.05	≤0.05
CV (%)	7.50	7.60
Rates (B)		
2.0g	78.33±3.23^{ab}	80.56±2.27
2.5g	80.00±2.76^{ab}	81.67±2.50
3.0g	84.44±2.42^{a}	76.11±2.00
0.0g (Control)	75.56±1.55^{b}	82.22±1.88
P-Value	0.1	0.20^{ns}
CV (%)	9.70	8.20
Interactions (A X B)		
Undressed Seeds X 0.0g X 0.0g	75.00^{bc}	78.30
Pawpaw leaf powder X 2.0g	70.00^{c}	76.70
Pawpaw leaf powder X 2.5g	73.33^{bc}	78.30
Pawpaw leaf powder X 3.0g	78.33^{b}	73.30
Moringa Leaf powder X 2.0g	75.00^{bc}	80.00
Moringa Leaf powder X 2.5g	78.83^{b}	83.33
Moringa Leaf powder X 3.0g	83.33^{b}	73.30
Mancozeb fungicide X 2.0g	80.00^{b}	85.00
Mancozeb fungicide X 2.5g	88.33^{ab}	83.33
Mancozeb fungicide X 3.0g	91.67^{a}	81.70
P-Value	0.02	0.96^{ns}
CV (%)	6.20	7.90

Mean values within each column with the same letter (s) are not significantly different (P≤ 0.05) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, ns = Not significant, DAS = Das after sowing

Effect of Seed Treatment with Mancozeb, Pawpaw Leaf Powder and Moringa Leaf Powder on Incidence of Leaf Spot Disease of Groundnut at 40, 47 and 54 DAS in the First and Second Cropping Seasons

Results on effect of seed treatments with mancozeb, pawpaw leaf and moringa leaf powders; rate and interaction on disease incidence at 40, 47 and 54 DAS in the first and second cropping seasons are presented in Table 2. There was significant difference (P≤ 05) on disease among the treatments with mancozeb recording the lowest disease incidence of 32.31, 39.92 and 46.41% in the first season and 54.18, 55.69 and 78.82% at 40, 47 and 54 DAS in the second season respectively compared to the plant powders. There were significant differences among the seed treatment rates in both seasons. Seed treatment rate of 3.0g gave the lowest disease incidence, followed by 2.5gm seed treatment rate in the first and second seasons respectively. The plants grown from undressed seeds (0.0g) recorded significantly the highest disease incidence of 51.68, 57.18 and 75.88% in the first season and 74.39, 83.3 and 89.32% at 40, 47 and 56 DAS in the second season respectively.

The interactive effect between seed treatments and rates on disease incidence was significantly difference from each other at 40, 47 and 54 DAS in the first and second years. Results indicated that from 40 to 54 DAS, plants grown the control plot recorded significantly the highest disease incidence compared to those plants which were grown from other seed treatment rates in the two cropping seasons Seed treatment of 3.0g lowered the disease incidence compared to other seed treatment rates and the control at 40, 47 and 54 DAS in both years.

Table 2: Effect of Seeds treated with Mancozeb, Pawpaw Leaf Powder and Moringa Leaf Powder on Incidence of Early Leaf spot Disease of Groudnut at 40, 47 and 54 DAS in the First and Second Cropping Seasons

Seed Treatmentcts/Rate/Interactions	First Cropping Season			Second Cropping Season		
	40 DAS	47 DAS	54 DAS	40 DAS	47 DAS	54 DAS
Treatments (A)						
Mancozeb Fungicide	32.31±5.91^{b}	39.92±2.89^{b}	46.41±8.53^{b}	54.18±5.30^{b}	55.69±5.00^{b}	78.82±3.57^{b}
Moringa Leaf powder	38.72±2.62^{ab}	45.43±4.37^{ab}	54.47±4.33^{a}	65.92±3.11^{ab}	70.32±4.39^{a}	88.01±3.24^{a}
Pawpaw Leaf powder	41.77±1.54^{a}	52.09±4.43^{a}	55.83±2.69^{a}	69.51±3.90^{a}	75.49±2.85^{a}	84.70±2.88^{ab}
P-Value	0.03	0.01	0.02	0.01	0.02	0.03
CV (%)	35.30	38.10	22.40	30.10	22.60	13.40
Rates (B)						
2.0g	38.79±4.09^{b}	46.64±4.96^{ab}	53.22±5.40^{b}	63.05±4.71^{a}	70.88±6.04^{ab}	86.01±2.83^{ab}
2.5g	30.46±2.97^{b}	42.33±4.80^{b}	40.54±3.94^{bc}	67.81±4.44^{a}	59.30±3.84^{bc}	83.84±4.76^{ab}
3.0g	29.47±2.79^{b}	37.18±4.54^{b}	39.31±3.28^{c}	49.56±5.24^{b}	53.34±4.08^{c}	76.20±4.62^{b}
0.0g (Control)	51.68±3.98^{a}	57.10±2.36^{a}	75.88±5.13^{a}	74.39±1.22^{a}	83.13±3.16^{a}	89.32±1.16^{a}
P-Value	0.03	0.02	0.01	0.02	0.01	0.04
CV (%)	28.00	26.00	19.90	27.80	19.80	13.10
Interactions (AXB)						
Undressed Seeds X 0.0g	64.41^{a}	95.00^{a}	81.40^{a}	59.00^{a}	78.00^{a}	93.60^{a}
Pawpaw Leaf powder X 2.0g	45.22^{b}	62.10^{b}	83.30^{a}	48.60^{a}	67.80^{a}	83.80^{ab}
Pawpaw Leaf powder X 2.5g	38.99^{bc}	52.80^{bc}	70.80^{b}	48.30^{a}	74.20^{a}	92.10^{a}
Pawpaw Leaf powder X 3.0g	37.64^{bc}	46.80^{c}	66.00^{b}	52.40^{a}	58.00^{b}	76.50^{ab}
Moringa Leaf powder X 2.0g	47.06^{b}	64.20^{b}	81.20^{a}	50.00^{a}	60.00^{ab}	86.30^{ab}
Moringa Leaf powder X 2.5g	31.70^{bc}	40.60^{c}	59.90^{bc}	36.80^{b}	69.40^{a}	82.20^{ab}
Moringa Leaf powder X 3.0g	30.69^{b}	42.00^{c}	54.00^{bc}	32.60^{b}	59.90^{b}	84.50^{ab}
Mancozeb Fungicide X 2.0g	24.07^{bc}	33.30^{cd}	48.10^{bc}	41.30^{a}	61.30^{ab}	80.60^{ab}
Mancozeb Fungicide X 2.5g	20.70^{c}	28.20^{d}	47.20^{bc}	41.90^{a}	59.80^{b}	77.20^{ab}
Mancozeb Fungicide X 3.0g	20.07^{c}	29.10^{d}	40.00^{c}	26.50^{b}	30.80^{c}	67.50^{b}
P-Value	<0.01	<0.01	0.04	0.04	0.04	0.02
CV (%)	15.80	11.70	11.40	26.30	17.50	12.80

Mean values within each column with the same letter (s) are not significantly different (P≤ 0.05) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, ns = Not signify at 95% CL (P < 0.05). CV = coefficient of variation, ns = not significant, DAS = Das after sowing

Effect of Seed Treatment with Mancozeb, Pawpaw Leaf Powder and Moringa Leaf Powder and on Leaf Defoliation at 70, 80 and 90 DAS in the first Cropping Seasons

The results on the effect of seed treatments with Mancozeb, pawpaw leaf powder, Moringa leaf powder and, seed treatment rates and their interaction on leaf defoliation at 70, 80 and 90 DAS in the first are presented in Table 3.

In the first season, there was significant (P ≤ 0.05) difference among the seed treatments and treatment rates on leaf defoliation at 90 DAS but not at 70 and 80DAS. Plants grown from seed dressed with mancozeb recorded lower leaf defoliation, followed by those plants grown from seeds dressed with moringa leaf powder. Similarly, at 90 DAS plants grown from the control plots recorded significantly the highest leaf defoliation of 84.45% compared with those grown from

seeds dressed with 3.0, 2.5 and 2.0gm of the seed treatments.

The effect of interaction between seed treatments and treatment rates on leaf defoliation was significantly different ($P \leq 0.05$) from 70 to 90 DAS. Those plants grown from the control plots recorded significantly the highest leaf defoliation of 48.0, 55.40 and 88.15% at 70, 80 and 90 DAS compared to those plants grown from seeds dressed with 2.0, 2.5 and 3.0 gm of the seed treatments respectively.

Table 3: Effect of Seeds Treated with Mancozeb, Pawpaw Leaf Powder and *Moringa* Leaf Powder on Leaf Defoliation at 70, 80 and 90 DAS in the First Cropping Season

Seed Treatmens/Rate/Interactions	Leaf Defoliation (%)		
	70 DAS	80 DAS	90 DAS
Treatments(A)			
Mancozeb Fungicide	44.09±1.76	54.40±2.79	72.72±2.38^{b}
Moringa Leaf powder	38.59±2.52	48.90±1.73	75.41±1.63^{b}
Pawpaw Leaf powder	43.01±1.32	52.44±1.07	85.41±0.82^{a}
P-Value	0.14^{ns}	0.15^{ns}	<0.01
CV	16.00	13.30	7.70
Rates(B)			
2.0g	36.67±3.18	50.92±1.92	76.41±2.38^{b}
2.5g	41.33±1.63	50.47±0.88	74.55±3.20^{b}
3.0g	41.33±1.76	50.89±0.98	72.99±2.49^{b}
0.0g (Control)	45.26±2.31	55.36±4.14	84.45±1.35^{a}
P-Value	0.39^{ns}	0.39^{ns}	<0.01
CV	16.50	13.70	9.40
Interactions (AXB)			
Control plot X 0.0g	48.00^{a}	55.40^{a}	88.15^{a}
Pawpaw Leaf Powder X 2.0g	41.30^{ab}	50.70^{b}	83.22^{ab}
Pawpaw Leaf Powder X 2.5g	44.00^{ab}	53.10^{ab}	86.36^{ab}
Pawpaw Leaf Powder X 3.0g	38.70^{ab}	50.50^{b}	83.93^{ab}
Moringa Leaf Powder X 2.0g	33.70^{b}	48.50^{b}	74.44^{b}
Moringa Leaf Powder X 2.5g	38.70^{ab}	49.10^{b}	71.85^{b}
Moringa Leaf Powder X 3.0g	41.30^{ab}	51.20^{b}	75.42^{b}
Mancozeb Fungicide X 2.0g	44.00^{ab}	53.60^{ab}	71.57^{b}
Mancozeb Fungicide X 2.5g	41.30^{ab}	49.20^{b}	65.43^{c}
Mancozeb Fungicide X 3.0g	44.00^{ab}	51.00^{b}	68.62^{ab}
P-Value	0.79	0.38	0.01
CV	16.70	13.20	4.90

Mean values within each column with the same letter (s) are not significantly different ($P \leq 0.05$) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, ns = Not significant, DAS = Das after sowing

Effect of Seed Treatment with Mancozeb, Pawpaw Leaf Powder and Moringa Leaf Powder on Leaf Defoliation at 70, 80 and 90 DAS in the second Cropping Seasons

The results on the effect of seed treatment with mancozeb, pawpaw leaf powder and moringa leaf powder, seed treatment rates and their interaction on leaf defoliation at 70, 80 and 90 DAS in the second season are presented in Table 4.

There was significant difference ($P \leq 0.05$) among the seed treatments on leaf defoliation at 70, 80 and 90 DAS, whereas the seed treatment rates influenced leaf defoliation only at 80 DAS. The lowest leaf defoliation was recorded on plants grown from seeds dressed with mancozeb compared to plant powders from 70, 80 and 90DAS, followed by moringa powder from 80 to 90 DAS respectively. Seed treatment rate of 3.0gm gave the lowest leaf defoliation while the control plot (0.0gm) recorded significantly the highest leaf defoliation of 50.16% at 80 DAS. moringa leaf powder and 2.0 to 2.5g of mancozeb compared to higher leaf defoliation recorded on those plants grown from treated seeds (0.0g) and other seed treatment rates. There were significant differences on leaf defoliation as a result the interaction between treatment and seed treatment rates at 80 and 90 DAS in which those plants grown from the control plots recorded significantly the highest leaf defoliation of 52.43^{a} and 61.60^{a} compared to those grown from other rates of the seed treatment from 80 to 90 DAS.

Table 4: Effect of Seeds Treated with Mancozeb, Pawpaw Leaf Powder and Moringa Leaf Powder on Leaf Defoliation at 70, 80 and 90 DAS in The Second Cropping Seasons.

Seed Treatments/Rate/Interactions	Leaf Defoliation (%)		
	70 DAS	80 DAS	90 DAS
Treatments(A)			
Mancozeb Fungicide	35.75±1.33^{b}	47.69±0.82^{b}	55.75±0.93^{b}
Moringa Leaf Powder	39.52±0.63^{a}	47.87±0.68^{ab}	55.67±0.96^{b}
Pawpaw Leaf Powder	37.32±0.75^{ab}	49.86±0.62^{a}	59.66±0.55^{a}
P-Value	0.04	0.04	<0.01
CV	8.80	5.10	5.20
Rates(B)			
2.0g	38.82±1.46	47.83±1.22^{ab}	57.06±1.38
2.5g	37.46±1.09	48.66±0.55^{ab}	57.36±1.04
3.0g	36.87±0.87	47.25±0.65^{b}	56.09±1.11
0.0g (Control)	36.94±1.35	50.16±0.69^{a}	57.62±118
P-Value	0.65^{ns}	0.04	0.74^{ns}
CV	9.70	5.10	6.20
Interactions (AXB)			
Control plot X 0.0g	35.37	52.43^{a}	61.60^{a}
Pawpaw Leaf Powder X 2.0g	38.83	48.74^{ab}	59.49^{ab}
Pawpaw Leaf Powder X 2.5g	37.70	49.73^{ab}	59.18^{ab}
Pawpaw Leaf Powder X 3.0g	37.41	48.56^{ab}	58.38^{ab}
Moringa Leaf Powder X 2.0g	41.11	47.89^{b}	55.41^{b}
Moringa Leaf Powder X 2.5g	39.07	48.67^{ab}	57.19^{ab}
Moringa Leaf Powder X 3.0g	38.15	45.58^{ab}	53.19^{b}
Mancozeb Fungicide X 2.0g	36.52	46.87^{ab}	56.28^{b}
Mancozeb Fungicide X 2.5g	35.70	47.60^{b}	55.70^{ab}
Mancozeb Fungicide X 3.0g	35.07	48.70^{ab}	56.69^{ab}
P-Value	0.98^{ns}	0.86	0.60
CV	9.80	5.10	5.50

Mean values within each column with the same letter (s) are not significantly different (P≤ 0.05) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, ns = Not significant, DAS = Das after sowing

Effect of Seed Treatment with Mancozeb, Pawpaw Leaf Powder and Moringa Leaf Powder on Grain Yield and Haulm Weight (kg/ha) in The First and Second Cropping Seasons

The results on the effect of seed treatment with mancozeb pawpaw leaf powder, moringa leaf powder and, seed treatment rates and their interaction on grain yield and haulm weight (kg/ha) in are presented Table 5.

The results of the first season showed that among the seed treatments groundnut plants grown from seeds dressed with mancozeb recorded significantly the highest grain yield of 222.o kg/ha followed by those grown from seeds dressed with Pawpaw leaf powder which had grain yield of 208.40 kg/ha. The lowest grain yield of 155.80kg/ha was recorded from those plants grown from seeds dressed with moringa leaf powder. Results also showed that seed treatment rates of 3. 0, 2.0, and 2.5 significantly resulted in higher grain yield of 317.20, 316. 60 and 314.50 kg/ha respectively compared to untreated control plots with grain yield of 242.92 kg/ha. Similarly, higher haulm yield of 1047.20, 1040.10 and 1004.90 kg/ha which were statistically similar were obtained from those plants grown from seeds that received 2.5, 2.0 and 3.0g of the seed treatments respectively. Those plants grown from the untreated control plots (0.0g) recorded the lowest haulm weight of 819.40 kg/ha in the same season.

The interaction between seed treatments and treatment rates on grain and haulms yields were significantly different in the second. Seed treatment with 3.0g mancozeb and the two plant powders both resulted in higher grain and haulms yield compared to other seed treatment rates.

Table 5: Effect of Seed Dressing with Mancozeb, Pawpaw Leaf powder, Moringa Leaf Powder and on Grain and Haulm Yield (kg/ha) in the First and Second Cropping Seasons

Seed Treatments/Rate/Interactions	First Cropping Season		Second Cropping Season	
	Grain Yield Weight (kg/ha)	Haulm Weight (kg/ha)	Grain Yield Weight (kg/ha)	Haulm Weight (kg/ha)
Treatments(A)				
Mancozeb Fungicide	222.00±30.30^{a}	1035.90±64.80	316.70±18.00	1041.00±36.00
Moringa Leaf Powder	155.80±11.20^{b}	923.60±57.60	281.90±14.40	922.20±28.80
Pawpaw Leaf Powder	208.40±18.40^{ab}	974.20±44.40	294.90±14.80	821.30±79.60
P-Value	0.04	0.37^{ns}	0.30^{ns}	0.25^{ns}
CV	38.00	19.90	18.40	34.40
Rates(B)				
2.0g	197.10±21.60	1040.10±69.30^{a}	316.60±14.20^{a}	982.10±55.60
2.5g	201.90±28.70	1047.20±56.30^{a}	314.50±20.00^{a}	982.40±56.70
3.0g	221.50±35.60	1004.90±61.90^{a}	317.20±18.60^{a}	967.00±77.00
0.0g (Control)	161.0±11.80	819.40±49.80^{b}	242.92±5.97^{b}	782.10±97.60
P-Value	0.43^{ns}	≤0.05	≤0.05	0.49^{ns}
CV	39.90	18.20	15.70	35.10
Interactions(AXB)				
Control Plots X 0.0g	166.00	792.00	243.20^{b}	588.00^{c}
Pawpaw Leaf Powder X 2.0g	237.00	1112.00	299.10^{ab}	1053.00^{b}
Pawpaw Leaf powder X 2.5g	203.00	1125.00	312.10^{ab}	1012.00^{b}
Pawpaw Leaf Powder X 3.0g	228.00	1114.00	325.10^{ab}	1513.00^{a}
Moringa Leaf Powder X 2.0g	154.00	956.00	305.60^{ab}	584.00^{c}
Moringa Leaf Powder X 2.5g	177.00	989.00	290.80^{ab}	933.00^{bc}
Moringa Leaf Powder X 3.0g	154.00	965.00	299.20^{ab}	1045.00^{b}
Mancozeb Fungicide X 2.0g	200.00	9052.00	327.20^{ab}	533.00^{c}
Mancozeb Fungicide X 2.5g	226.00	1028.00	340.60^{ab}	890.00^{bc}
Mancozeb Fungicide X 3.0g	283.00	936.00	345.50^{a}	960.00^{bc}
P-Value	0.91^{ns}	0.93^{ns}	0.04	0.01
CV	40.80	19.60	16.90	28.40

Mean values within each column with the same letter (s) are not significantly different (P ≤ 0.05) from each other according to Duncan's New Multiple Rang Test (DNMRT). CV = coefficient of variation, ns = Not, DAS = Das after sowing

Percentage Yield Increase of the Treated over the Untreated Control in the First and Second Cropping Seasons

The effects of seed treatment rates on grain and haulm yields increase (%) of the treated over the untreated control in the first and second cropping seasons are presented in (Table 6).

In the two cropping seasons, there was percentage increase in grain and haulm yields on the treated plants as a result of increment in seed treatment rate over the untreated check. In the first year, there were percentage increase of 18.32, 20.26 and 27.31 in grain yield and percentage increase of 21.22, 21.75 and 18.46 in haulm yield as a result of 2.0, 2.5 and 3.0gm increment of the seed treatment rate over the untreated check respectively. Similarly, in the second year there were percentage increase of 23.27, 22.76 and 23.42 in grain yield and percentage increase of 20.36, 20.39 and 19.12 in haulm yield as a result of increment of 2.0, 2.5 and 3.0gm of the seed treatment over the untreated check respectively.

Table 6: Percentage Yield Increased of the Treated over the untreated control

	First Cropping Season		Second Cropping Season	
Treatment Rates	Grain yield kg/ha	Haulm yield kg/ha	Grain yield kg/ha	Haulm yield kg/ha
0.0gm	-	-	-	-
2.0gm	18,32%	21-22%	23.27%	20.30%
2.5gm	20.26%	21-75%	22.76%	20.39%
3.0gm	27.31%	18.46%	23.42%	19.12%s

The Activities and Cost of Production

Production activities and cost of production groundnut are presented in Table 7. The result showed that the production activities and cost of using mancozeb fungicide seed treatment for groundnut production was higher (#8,000.25k) compared to the use of moringa leaf powder (# 6300.25k) and pawpaw leaf powder (#6200.25k) respectively.

The cost benefits of production using mancozeb fungicide, moringa leaf powder and pawpaw leaf powder

in the first and second cropping seasons are presented in Table 8. In the first year, the cost benefit ratio of production using mancozeb fungicide for seed treatment gave the highest net profit of (#103,055.25k) with cost benefit ratio of 1:12:9 against the production cost of (#8,000.25k), followed by pawpaw leaf powder which gave the net profit of (#98,051.85k) but with the highest cost benefit ratio of 1:15:8; while moringa leaf powder gave the lowest net profit (#71,638.7k) and cost benefit ratio of and 1:11:4 respectively against their cost of production (#6,200.0k). In the second year, seed treatment with mancozeb fungicide gave the highest net profit of (#150,428.925k) against the production cost of (#8,000.25k) and with cost benefit ratio 1:18:8. But in the second year seed treatment with pawpaw leaf powder and moringa leaf powder gave the highest cost benefit ratio of 1:22:8 and 1:21:4 with net profit of (#141,323.475k) and (#134,720.225k) against their production cost of (#6,200.25k) and (#6,300.25k) respectively.

Table 7: Farm activities and cost of production

Production activities (#)	**Pawpaw leaf powder**	**Moringa leaf powder**	**Mancozeb fungicide**
Land clearing/ridging	1500	1500	1500
Cost of mancozeb (500gm)	-	-	2500
Cost of plant leaves	200	300	-
Cost of preparing plant leaf powder/ seed treatment	500	500	500
Cost of sowing	800	800	800
Cost of seeds (average)	500.25	500.25	500.25
Weeding Cost of harvesting and bagging of groundnut pods	1200 1000	1200 1000	1200 1000
Transportation	500	500	500
Total cost of production =	#6200.25k	#6300.25k	#8000.25k

(#) = Naira, K = Kobo

Table 8: Cost-benefit Ratio of Grain Yield Production in the First and Second Cropping Seasons

Income	**First cropping Season**			**Second Cropping Season**		
	Pawpaw leaf powder	**Moringa leaf powder**	**Mancozeb fungicide**	**Pawpaw leaf powder**	**Moringa leaf powder**	**Mancozeb Fungicide**
Marketable gain yield (kg/ha)	208.40	155.80	222.0	294.90	281.90	316.70
Cost of production (#)	6200.25	6300.25	8000.25	6200.25	6300.25	8000.25
Selling price (#)	104,252.1	77,938.95	111,055.5	147,523.7.25	141,020.475	158,429.175
Profit (#)	98,051.85	71,638.7	103,055.25	141,323.475	134,720.225	150,428.925
Cost benefit ratio	1:15:8	1:11:4	1:12:9	1:22:8	1:21:4	1:18:8

Cost-benefit ratio was basically determined on #500.0k and #500.50k which were the prevailing cost of groundnut grain per medium mudu measure at the North Bank Market of Benue State in the first and second cropping seasons respectively.

DISCUSSIONS

Groundnut production is limited by pyramid of biotic and abiotic production constraints. Early leaf spot disease pathogen (*Cercospora arachidicola Hori*) is said to over winter in plant debris, seeds and soil causing severe disease epidemic in the subsequent season due to inoculum build-up [25]. The disease dose not only infect the crops, but also reduce plant establishment, annihilate the crops in most cases resulting to poor or no yield attainment and increase in cost of protection. [26], reported that seed infection can severely affect seed viability seedling, growth poor seedling vigor and ultimately leading to poor performance and reduced productivity.

Treatment of seeds against soil-and seed-borne pathogens before seed sowing can be a panacea in protection of the plants and reduction of disease incidence. Seed treatment with Mancozeb fungicide, Pawpaw and *Moringa* leaf powders significantly influenced plant establishment in two cropping seasons. The highest plant establishments were observed as a result of seed treatment with Mancozeb compared with the botanical powders. Although plants grown from seeds treated with *Moringa* and Pawpaw leaf powders also had higher plant establishment which were statistically similar at 2 weeks after sowing in both seasons. From the result, it was observed that the seed treatments protected the seeds by inhibiting the seed and soil-borne pathogens resulting to better plant establishment which corroborate with [27] that some plants exudates are effective against seed and soil-borne pathogens. Similarly, lowest plant establishment was observed from those plants grown from the untreated seeds (0.0g) which could be as a result of the effect of seed-and soil-borne pathogens. According to [28] most pathogenic seed-borne fungal hyphae progressively ramify through the protoplast cells as the cell membranes are disrupted. Thus, fungus-infected seed often exhibit a reduction in germination and emergence leading to poor

plant stands as was observed in this study. Seed treatment with 3.0g significantly gave the highest plant establishment at 2WAS in the first season. Akueshi *et al.,* [29] emphasized that there is a strong need to source for plant extracts as alternative to synthetic chemical in plant disease control that are biodegradable, readily available and environmentally friendly. In view of this, [30] reported that Neem, Thyme and Lemongrass successfully controlled several important seed-borne pathogenic fungi.

The early leaf spot disease incidences were significantly lowered by the seed treatments and treatment rates two cropping seasons. In both seasons, seed treatment with Mancozeb gave the lowest disease incidences compared to the botanical powders at 40, 47 and 54 DAS respectively. It was also observed that those plants grown from seeds treated with *Moringa* leaf powder had lower disease incidence compared to pawpaw leaf powder in both seasons. From 40 to 54 DAS of the two cropping seasons, incidence of early leaf spot disease differs significantly with respect to seed treatment rates. The highest disease incidence was observed among those plants grown from the untreated seeds (0.0gm). Likewise, in two cropping seasons, 3.0g seed treatment gave the lowest disease incidence at 40, 47 and 54 DAS. This finding agreed with [31] who reported that seed dressing before sowing reduced the initial disease inoculum and thereafter lowered disease incidence and severity. The seed treatment using Mancozeb was effective in lowering the disease incidence which also corroborate with [32, 33] who also reported that the use of fungicide decreases disease development and increase yield. On the same trend, *Moringa* leaf and Pawpaw leaf powders exhibited some level of fungicidal protection and reduced the disease incidence which could be due to the presence of their fungicidal properties. *Moringa oleifera* contains fungicidal active properties called *Morigin*, flavonoids and saponins. As reported by [34] moringa leaf extract inhibited the growth of *mucur spp* and *Rhizopus spp, Alternaria alternate, Colletrichum spp Diplodia spp* and *Pestalotia spp*. Pawpaw contains fungicidal property called parpain. The leaves exhibited fungicidal activities against *Fusariun oxysporium* [35, 36]. Similar report revealed that leaf mould, leaf spot, early blight, frog eye, leaf, fruit and stem rot have been controlled by *Carica papaya*. This suggests that the seed treatments must have interfere with the biology of the pathogens in the root rhyzosphere and perhaps conferred some degree of systemic protection to the crop. This finding corroborates with the results of several researchers [37, 38, 39] who reported that various plant extracts inhibit germination and growth pathogenic fungi. These nonnutritive compounds could have served as barrier to hinder conidia germination and pathogenic activities. The seed treatments and rates significantly lowered the leaf defoliation in the first and second cropping seasons. Leaf defoliation of groundnut was lowered on those crops grown from Mancozeb and *Moringa* leaf seed treatments compared with those received treatment of pawpaw leaf powder. Based on the seed treatment rates, plants grown from the untreated control (0.0g) had the highest leaf defoliation than those from other seed treatment rates. The low leaf defoliation on the treated plants could be as a result of the reduction in effect of disease infection in the presence of seed treatments. The result agreed with [40] who reported that the crude extract of *Occimum gratissimum* effectively exhibited antifungal actively of *Cercospora arachidicola*, the causal organism of early leaf spot disease of groundnut. The use of plant extracts with antifungal activity offers economic, safe and easily available alternative methods for the management of leaf spot disease of groundnut [1], and this can adequately meet the shortage of pesticides in the country [41]. Mancozeb fungicide gave the highest grain in kg/ha compared with Pawpaw leaf powder compared to *Moringa* leaf powder in first season. Seed treatment from 2.0 to 3.0g gave significantly higher but statistical similar haulm and grain yield in kg/ha compared to the untreated control in the two cropping season respectively. Richard *et al.*, [42] reported grain yield increase of 64%, 9.04%, 43%, 51.3% and 22.4% among sorghum varieties such as ICSV 111, BES, Ex-Mali and Wareware-Bashi treated with Metalaxyl (Apron Star 42 WS) above their untreated counterparts respectively. In this study, it was observed that that Mancozeb fungicide had higher cost of production and equally gave greater monetary net profit more the botanical extracts in two cropping seasons. The work also revealed that for every naira invested using these plant leaf powders for groundnut production there are higher income returns over the untreated and which make them good alternative considering their low cost of production and availability.

CONCLUSION

In this study, seed treatment with Mancozeb, botanical plant powders and seed treatment rate of 2.0 to 3.0g/ 200g resulted to higher plant establishment. In this study, 3.0g Mancozeb fungicide significantly lowered the incidence of early leaf spot disease with corresponding reduction in leaf defoliation and equally enhanced higher grain yield compared to the botanical plant powders in two seasons. But considering the expensive nature and hazardous impacts of the synthetic chemicals to man, animals and the environment at a long run, hence there is a need for shifting to other safe disease management approach. Mancozeb fungicide gave the highest net profit whereas the botanicals powders also gave a satisfactory profit returns with lower cost of production. Therefore, the use of pawpaw leaf and *Moringa* leaf powders as seed treatment before sowing could be another alternative option to synthetic fungicide. There is a need for the standardization of these plant products in readymade forms accessible to farmers for the management diseases since they are environmentally safe, biodegradable and economically cheap and also has high attainable economic returns.

REFERENCES

1. Surender K, Sheweta J, Abhilasha A L, Amit K, Ankur V. Influence of natural products and bio-fungicide against tikaa disease of groundnut caused by *Cercospora* spp. The Pharma Innovation Journal.2017; 6 (3): 213-216.
2. Kees S. Agrometereological and groundnut production Draft by P. Vijaya Kumar reviewed by P.V. Vara Prasad revision by Kees Strighter assisted by orival do brunini. 2011;
3. FAO. Production Year Books. 2004; Vol. 60. Rome. Italy. Pp. 112-118.
4. ICRISAT. International crops research institute for the semi-arid tropics. Science with human face. ICRISAT – Patancherus 502 324, 2012; Pp. 1 – 3 .
5. FAOSTAT. Food and Agricultural Organization of the United Nation. Last modified May 21. 2017; http//www.foa.org/faostat/.
6. Shokes FM, Culbreath AK. Early and late leaf spots. In: Compendium of Peanut Disease, Second Edition. N. Kokalis-Burelle, D. M. Porter, R. Rodriguez-Kabana, D.H. Smith and P. Subrahmanyam, eds. *American Phytopathology Society*.1997; St. Paul.USA
7. Kyle D. Leaf spot disease a major problem for Georgia peanut growers. CAES NEWS. 2016; p 1-2.
8. Waliyar F. Evaluation of Yield Losses Due to Groundnut Leaf Diseases in West Africa, Summary Proceedings of the second ICRISAT Regional Groundnut Meeting for West Africa. Niamey. 1990; 11 –14 September.
9. Richard BI, Degri MM, Dauda Z. Susceptibility o sorghum genotypes and effect of chemical seed treatment on Sooty stripe (*Ramulispora sorghi)* of Sorghum in Semi- Aride Region of Nigeria. Nigerian Journal of Experimental and Applied Boilogy.2011; 12, No:2, pp.189-198.
10. Amadioha AC. Fungicidal activity of some plant extracts against *RhizoctomaSolani* in Cowpea arch phytopath. Ptlanz, 1-9 in Nigerian Journal of Plant Protection. 2000; 20, pp. 101–108.
11. Gerken A, Suglo JV, Braun M. Crop Protection policy in Ghana. Pesticide Policy Project produced by Plant Protection and Regulatory Services Directorate of Ministry of Food and Agriculture, Accra. 2001.
12. Ogunwolu EO, Ameh SA. Control of Post Flowering Insect Pest of Cowpea (*Vigna unguiculata* (L.) Walp) with neem plant extracts. Book of Abstract 30th Annual Conference of ESN at Central Hotel Conference Hall, Bompai, Kano from 4th–7th October, 1999; p.14.
13. Shara H A, Ali EA.. Impact of Insecticide Spray Regimes on Insect Abundance in Cowpea (*Vigna unguiculata*) in North Eastern Nigeria. International Journal of Agriculture and Biology. 2008; 10:255–260.
14. Adedire CO. Safety and Policy Issues in Formulation and Use of Medicinal Plants. In Fprmulation of Medicinal Plants for Crop and Animal Production in Nigeria: Realities and Challenges. 2009; *Proceedings of the 5th Conference (Akure-Humboldt Kellog)*
15. Obeng-Ofor D, Owusu EO, Kaiwa ET. Variation in the level of caxboxyl esterase activity as an indicator of insecticidal resistance in populations of the diamond back moth, *Plutella xylostella* (L.) attacking cabbage in Ghana. J. Ghana. Sci. Assoc. 2002 4(2): 52-62.
16. Agrios GN. Plant Pathology.5th ed. Elsevier Academic Press, Burlington, MA. 2005
17. Babeker AE. Effect of neem extracts on the cotton, aphide, jasside, whitefly and their predator, the green lacewing. M.Sc. Thesis, U.of Gezira, the Sudan. 2014.
18. Nteso G, Pretorius JC. Tubaghia violacea L.: in vivo antifungal properties towaeds plant pathogens. Aust. J. Agric. Res. 2016; 37:85-91.
19. Ya'adua AA. Potentials of biopesticides from neem tree (Azadiracta indica A. Juss), in sustainable pest and disease management in Nigeria. In: Medicinal plants in Agriculture. Proc Akure-Hombolt Kellog 3nd *SAAT Annual Conference* 2007; Pp. 237-254
20. Sharma D, Soekarno B. Performance of foliar disease resistant ICRISAT Groundnut lines (ICGV) in East Java, Indonesia. IAN. 1990; Pp.17-18.
21. Turaki ZGS, Richard BI, Degri MM. Assessment of the effect of fungicide and seed rates on the incidence of leaf blast *(magnaphorth grisea)* on the growth of foxtail millet (*Setaria italic (L.) P. BEAUV*) in North-eastern Nigeria. Asian Journal of Agriculture and Rural Development. 2014; 4 (2): pp 142-148.
22. Schiller JM, Sampoapol R. Foliar Diseases and Their Control in Rain fed Groundnut Production in Thailand. Tropical Pest Management. 1981; 27 (1): 13-23
23. Statistical Analysis Software (SAS) Package Version 9.1, *SAS Institute Inc., Cary, NC, USA*, 2009.
24. Obi UI. Statistical methods of dictating differences between treatment means and research methodology issues in laboratory and field experiment, 2nd edition AP Express Publishers, Nsuka. 2002; P.227
25. Richard BI, Nwankiti AO, Ukwella MU. An Investigation on the Initial Source of Inoculum of *Cercospora* Leaf Spot Spot Pathogens of Groundnut (*Arachis hypogaea L*.) in Nigerian Southern Guinea Savannah Ecology, Asain Journal of Advances in Agricultural Research. 2017; 3 (4); pp1-11
26. Enyiukwu DN, Maranzub. Response to Cowpea seed in culture to different rates of seed-treatment with phytochemicals from piper gincense L. International Journal of Agriculture and Earth Science. 2017; *l3* Pp 19-24.
27. Azcher, M. (229). Seed mycoflora of Shisham (Dalbergia Sissoo Roxb.) and their integrated management. *Ph.D Thesis*, Plant Pathology Department of Plant Pathology, University of Agricuulture, Faisalabad, Pakistan.pp.71-72.

28. Mehrotra RS, Aggarwal A. Plant Pathology.Tata McGraw-Hill Publishing Company. New Delhi, India. 2nd Edition. 2005; P.225-288
29. Akueshi CO, Kadir CO, Akueshi EU, Agina SE, Ngurukwen C. Antimicrobial potential of Hyptis Sauveolen poit (Lamiaceae). Nigerian Journal of Botany. 2002; 15: 37-41.
30. Amadioha A C. Controlling rice blast in vitro and in vivo with extract of *Azadirachta indica. Crop Prot*. 2010; 19:287-270
31. Richard BI, Anaso AB, Bdliya BS. Effects of Seed Dressing and Cultivar on the Incidence and Severity of Covered and Long Smuts in the Nigerian Sudan Savanna. Nigerian *Journal of Experimental and Applied Biology*. 2008;9(20):Pp 65- 70
32. Hagan AK, Campbell HL, Bowen KL, Pegues M. Evaluation of Calender AU-Pnuts fungicide schedules for the control of Late leaf spot and rust on peanut Southern Alabama. Alabama Agric Exp. Stn Bull. 2006; 663, 15pp.
33. Culbreath AK, Stevenson KL, Brenneman TB. Management of leaf spot of peanut with benomyl and chlorothalonil: A. study in preserving fungicide utility. Plant Dis. 2002; 86: 349-355.
34. Fleischer. Xylopoa aaethiopica A' Rich: A Chemical biological perspective. Journal of Science and Technology. 2003; 23(2): 24-31
35. Enyiukwu DN, Awurum AN. Efeeects of Phytochemicals from Carica papaya roots and seeds of Piper guineensis seeds on germination of spores of *Colletotrichum destructivum*, Continental J. Biological Science. 2011; (492):55-59
36. Hintz T, Matthew KK, Di R. The use of Plant Antimicrobial Compounds for Food Preservation, BioMed Research International. 2015.
37. Fleischer. Xylopoa aaethiopica A' Rich: A Chemical biological perspective. Journal of Science and Technology. 2003; 23(2): 24-31
38. Yar'adua AA. Studies on *Alternaria porri* the causal organism of purple blotch disease of onion in Zaria Env. M.Sc. Thesis Ahmadu Bello University of Zaria. 1986; 131pp
39. Anaso LE, Lale NES, Aminukano A, Anaso A B. Use of pesticide plant extracts for pest control in millet based cropping system. In: *Pear Millet Agriculture Processing of the Preseason National Coordinated Research Programme in Pearl Millet*. 1998; Pp. 54 – 59.
40. Damagum S, Nwachukwu E. Assessing the potential of neem seed and moringa seed powder as bio-fungicides and seed treatment against millet seed- borne fungi. Research Journal of Science. 2003; *9 (1020): 1-4*.
41. Okoi AI, Afuo CO. Effect of leaf powders of three plant species on *Cercopora arachidicola Hori*, the causal fungus of leaf spot disease of groundnut (*Arachis hypogaea* L.) *Nig. Jour. Pit Protect.* 2009; 22 *(Special edition)* 132-139.
42. Jackai L E N, Oediran I. The Potential of Neem *(Azadirachta indica A. Juss*) for Controlling Post-Flowering Pest of Cowpea (*Vigna unguiculata Walp*), The Pod Borer, Maruca vitrata. Insect Science and its Application. 1991; 12: 103-109
43. Richard BI, Ojo G O, Maina T Y. Determination of Efficacy of Metalaxyl Seed Treatment on Incidence of Sorghum Diseases and Its Cost Benefit in Borno State of Nigeria. Asian Journal of Agricultural and Rural Development. 2014; 4(2): pp 169-176.