# EVALUATION OF DIFFERENT CONCENTRATIONS OF PLANT EXTRACTS AGAINST DAMPING OFF DISEASE ON MAIZE (*Zea mays*) IN THE GREENHOUSE

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**ABSTRACT**

Damping-off disease, caused by soil-borne pathogens, is a major challenge in maize production, leading to significant seedling losses. Synthetic fungicides are commonly used for control, but concerns over environmental impact and resistance development necessitate alternative approaches. This study evaluates the efficacy of plant extracts (henna, neem, onion, garlic, and ginger) in controlling damping-off disease in maize. A greenhouse experiments was conducted using different concentrations (10%, 5%, 3.3%, 2.5%, and 2%) of plant extracts in the year 2023 rainy season greenhouse, Federal College of Education (Technical) Bichi Kano State, in the Sudan Savanna agro-ecological Zone of Nigeria. The extracts were applied as seed treatments and tested against damping-off pathogens. Disease incidence, seedling emergence, and vigor were assessed. Data were analyzed using statistical methods to determine the treatment effects. The findings revealed that plant extracts significantly reduced damping-off disease incidence compared to the untreated control treatment. Neem, henna and garlic extracts were the most effective, particularly at higher concentrations (10%, 5% and 3.3%) reducing disease severity while enhancing seedling vigor. However, excessive concentrations caused phytotoxic effects in some treatments. The study demonstrates the potential of plant-based treatments as eco-friendly alternatives for managing damping-off disease in maize. Further research through field trials and formulation optimization is recommended to enhance effectiveness and farmer adoption. Its recommended that farmers in Kano State, Nigeria, should consider using neem, henna and garlic extracts at proper concentrations as biofungicides for seed treatment to reduce damping-off disease in maize.

Keywords: Damping-Off, Plant Extracts, Concentrations.

## 1.0 INTRODUCTION

### 1.1 BACKGROUND TO THE STUDY

**Maize (*Zea mays* L.)** is one of the most widely cultivated cereal crops in Nigeria, contributing to food security, livestock feed, and agro-industrial development. In Kano State, maize production is essential for the livelihoods of small-scale farmers and commercial growers. However, maize cultivation faces several challenges, among which damping-off disease is a major constraint to seedling establishment and overall yield. Maize is an annual grass in the family Poaceae and is a staple food crop grown all over the world. The maize plant possesses a simple stem of nodes and internodes. A pair of large leaves that extend off each internode and the leaves total 8–21 per plant. The leaves are linear or lanceolate (lance-like) with an obvious midrib (primary vein) and can grow from 30 to 100 cm (11.8–39.4 in) in length. The male and female inflorescences (flower bearing region of the plant) are positioned separately on the plant. The male inflorescence is known as the 'tassel' while the female inflorescence is the 'ear'. The ear of the maize is a modified spike and there may be 1–3 per plant. The maize grains, or 'kernels', are encased in husks and total 30–1000 per ear. The kernels can be white, yellow, red, purple or black. Maize is also a major source of starch, which can be processed into oils and high fructose corn syrup. Maize is also commonly grown as feed for livestock, (CABI Crop Protection Compendium, 2012). Maize belong to the family *Poaceae*, maize are group of grass crops that produces edible grain seeds that are made up of endosperm composed of carbohydrate molecules, germ (embryo) that contains the genetic contents and bran (seed coat) that contains the proteins and other essential vitamins. Thus, maize and cereal-based foods are rich sources of energy, protein, vitamins, and minerals for both humans and animals [Cereals; http://en.wikipedia.org/wiki/Cereal (2014)]. Maize, rice and sorghum originated from Central America, Asia and Africa respectively. Maize and rice were cultivated since 4,500 BC (Before Christ) while sorghum cultivation was as far back as 4,000 BC (History of Agriculture;http://en.wikipedia.org/wiki/History_of_agriculture).

Maize is the most widely-grown staple food crop in sub-Saharan Africa (SSA) occupying more than 33 million ha each year (FAOSTAT, 2015). The crop covers nearly 17% of the estimated 200 million ha cultivated land in SSA, and is produced in diverse production environments and consumed by people with varying food preferences and socio-economic backgrounds. More than 300 million people in SSA depend on maize as source of food and livelihood (http://dtma.cimmyt.org/index.php/background). The top 20 countries, namely South Africa, Nigeria, Ethiopia, Tanzania, Malawi, Kenya, Zambia, Uganda, Ghana, Mozambique,

Cameroon, Mali, Burkina Faso, Benin, DRC, Angola, Zimbabwe, Togo, and Cote d'Ivoire, account for 96% of the total maize production in SSA. (FAOSTAT, 2015).

**Damping-off disease** is caused by soil-borne fungal pathogens such as *Pythium spp., Rhizoctonia solani, and Fusarium spp*., which attack seeds and young seedlings, leading to poor germination, seed rot, and seedling death. The disease is particularly severe in warm, humid conditions, exacerbating yield losses for maize farmers. If left unmanaged, damping-off can cause up to 60–80% seedling mortality, leading to reduced plant populations and poor crop performance. To control damping-off disease, farmers often rely on synthetic fungicides, which, although effective, pose significant challenges, including: High costs that make them inaccessible to resource-poor farmers, environmental concerns, as excessive use leads to soil and water contamination; health risks due to chemical residues in food and water; pathogen resistance, which reduces long-term effectiveness etc. Given these concerns, plant-based disease management strategies are gaining attention as environmentally friendly alternatives. Several plants contain bioactive compounds with antimicrobial properties that can inhibit fungal pathogens. Among them, extracts from henna *(Lawsonia inermis)*, neem *(Azadirachta indica)*, onion *(Allium cepa)*, garlic *(Allium sativum), and* ginger *(Zingiber officinale)* have shown promise in controlling plant diseases due to their antifungal, antibacterial, and growth-promoting properties. However, despite the reported antimicrobial effects of these plants, there is limited research on their effectiveness against damping-off disease in maize, particularly under the agroecological conditions of Kano State, Nigeria. Furthermore, the optimal concentration required for disease suppression without causing phytotoxic effects on maize seedlings remains unknown. Damping-off is a destructive seedlings disease caused by several soil-borne fungi including *Rhizoctonia solani*, *Pythium spp.*, *Phytophthora* spp., *Sclerotinia* spp. and *Fusarium* Spp (Stephens and Powell, 1981). The injury from damping-off is of two types: Pre-emergence damping off causing decay of the germinating seed or death of the seedling before it can push through the soil. This injury is a common cause of poor stands, which are often attributed to inferior quality of the seed or the untreated seeds. *Pythium spp.* and *Phytophthora spp.* cause seed decay. Pre-emergence damping off occurs when a seed is infected and killed before it can open up the soil surface as an emerged seedling Post-emergence damping-off which occurs after the seedlings have emerged from the soil but while still small and tender. The roots may be killed, and affected plants show water soaking and shriveling of the stems at the ground level; they soon fall over and die. In post-emergence damping off, the seedling emerged but is girdled at the soil surface leading to collapse and eventual death (Omokhua, *et al*. 2009b). Post-emergence damping-off is mostly caused by *Rhizoctonia spp*. In particular, pre- and post-emergence damping-off caused by *Pythium* spp. in cereal crops is economically very important worldwide (Whipps and Lumsden, 1991). *Pythium* spp. are fungal-like organisms (*Oomycetes*), commonly referred to as water molds, which naturally exist in soil and water as saprophytes, feeding on organic matter. Some *Pythium* spp. can cause serious diseases on cereal crops resulting in significant crop losses. Infections by *Pythium* lead to damping-off in seedlings and crown and root rot of mature plants. Damping-off diseases of seedlings are found worldwide and can be caused by several species of fungi under various weather conditions. The damping-off is usually refers to the disintegration of stem and root tissues at and below the soil line. The plant tissues become water soaked and mushy, and the seedling wilts and falls over. Removal and disposal of diseased plants, crop rotation, improved soil drainage and air circulation, reduced nitrogen fertilization and soil solarisation are essential for successful management of damping off disease (Agrios, 2005). Because of the potential negative impacts of chemical pesticides on the environment and consumers, several Biological Control Agents (BCAs) of fungi and bacteria have been recently identified and integrated in disease management programmes and their effectiveness in controlling soil borne diseases is well documented (Meszka and Bielenin, 2010, Matarese, *et al*, 2012,Widnyana and Javandira, 2016). The concept of disease management with eco-friendly materials has gained momentum as mankind became more and more environment conscious. Use of botanicals instead of chemical fungicides is one of the recent approaches to plant disease control, as fungicides may cause health hazard and may directly increase environmental pollution. Many researches have reported the successful management of a wide range of seed borne pathogens with botanicals (Howlader, 2003, Hossain, *et al.*, 2005, Chowdhury, 2005, Islam, *et al.*, 2006.) However, not much research have been carried out to determine the efficacy of botanicals against soil borne pathogens under field condition (Monaim, *et al.*, 2011).

**1.2 STATEMENT OF THE PROBLEM**

Damping-off disease is a major constraint in maize production, especially at the seedling stage, where it causes significant mortality of young plants. The disease, primarily caused by soil-borne pathogens such as *Pythium spp., Fusarium spp., and Rhizoctonia solani,* leads to poor crop establishment and considerable yield reduction. In regions like Kano State, Nigeria, where maize is a staple food and an important source of income, the impacts of damping-off can be devastating. Studies have shown that damping-off can result in up to 60% loss in seedling emergence, translating into substantial economic losses and reduced food security. Traditionally, synthetic fungicides have been used to manage damping-off. While these chemicals can be effective, their application is increasingly problematic due to several factors. Firstly, the high cost of synthetic fungicides limits their accessibility to smallholder farmers, who form the majority of maize producers in sub-Saharan Africa. Secondly, indiscriminate use of fungicides has led to the development of resistant pathogen strains, reducing the long-term effectiveness of these chemicals. Thirdly, synthetic fungicides pose environmental and health risks, including contamination of soil and water, and exposure-related health issues for farmers and consumers. These challenges underscore the urgent need for alternative, affordable, and eco-friendly strategies to manage damping-off disease in maize. Botanical extracts, such as neem, henna, ginger, garlic, and onion, have shown promising antifungal properties and could serve as viable substitutes for synthetic fungicides. However, there is limited research on their effectiveness, optimal concentrations, and practical application in field conditions, particularly in local contexts like Kano State. Addressing this gap is critical to developing sustainable disease management practices that protect both crop yields and the environment. This study, therefore, seeks to evaluate the efficacy of these plant extracts at different concentrations for the control of damping-off disease in maize. The findings will provide valuable insights into sustainable disease management strategies that can benefit farmers by reducing reliance on synthetic chemicals while improving maize production.

## 1.3 SIGNIFICANCE OF THE STUDY

This study is significant particularly for sustainable maize production in Kano State, Nigeria, and beyond, in the following ways:

Agricultural Impact: Damping-off disease leads to poor seed germination and high seedling mortality, reducing maize yield. This research provides an alternative control method that can improve seedling survival and crop establishment.

Eco-Friendly Disease Management: The study explores the use of henna, neem, onion, garlic, and ginger extracts, which are natural and biodegradable, as alternatives to synthetic fungicides. This promotes environmentally sustainable farming practices by reducing chemical residues in the soil and water.

Farmer Benefits and Cost-Effectiveness: Many small-scale farmers cannot afford expensive fungicides. Using locally available plant extracts offers a low-cost, accessible solution for disease management, potentially improving farmers' income and food security.

Scientific Contribution: The study adds to existing knowledge on plant-based disease control strategies particularly for the management of soil borne pathogens in Kano state.

Public Health and Environmental Safety: Reducing the use of synthetic fungicides minimizes health risks associated with chemical exposure for farmers and consumers. It also contributes to biodiversity conservation by reducing pesticide contamination in the ecosystems.

Future Research and Policy Development: The findings will serve as a foundation for future field trials, formulation improvements, and policy recommendations on the use of plant extracts in disease management. This can encourage further research and possible integration of biofungicides into national agricultural policies. By addressing these key areas, this research contributes to the development of a sustainable, cost-effective, and environmentally friendly approach to managing damping-off disease in maize.

## 1.4 OBJECTIVES OF THE STUDY

The objectives of the study are as follows:

i. To evaluate the efficacy of different concentrations of some plant extracts as seed treatment against damping-off pathogens on maize.

ii. To determine the effect of plant extracts on the growth and yield of maize.

iii. To recommend the most effective plant extract (s) and concentration for sustainable damping-off disease management in maize.

## 3.0 METHODOLOGY

## 3.1 RESEARCH LOCATION

The experiments were carried out at Greenhouse, Federal College of Education Technical Bichi, Kano State (12$^{\circ}$ 14' N, 8$^{\circ}$ 28' E) situated in the Sudan Savanna Ecological Zone of Nigeria, during 2023 rainy seasons.

## 3.2 SOIL ANALYSIS

Composite soil sampling technique was used for soil analysis in this research. Soil samples were obtained from experimental plot at a depth of 0–15 cm before planting. Five sub-samples were randomly taken from each plot using a soil auger and then mixed thoroughly to obtain a representative composite sample per plot. The composite samples were air-dried, sieved through a 2 mm mesh, and analyzed for physico-chemical properties such as pH, organic matter, nitrogen, phosphorus, and potassium. This method ensures accurate representation of the soil condition in each treatment plot. Physical and chemical properties of the soil samples were determined below:

1. Physical Properties: Soil Texture (Sand, Silt, Clay) the Soil samples were dispersed in water with a dispersing agent. A hydrometer were used to measure particle settling rates as loam, sandy loam.

2. Chemical Properties: Soil samples was mixed with distilled water, allow to settle, and measured the soil pH by pH meter (1:2.5 soil to water ratio).

Organic Matter Content: Walkley-Black method were used to indicate fertility and microbial activity of the soil.

Nitrogen: Kjeldahl method were used to quantify the nitrogen.

Phosphorus: Olsen method were used and read with spectrophotometer to measure the Phosphorus.

Exchangeable Cations (Ca, Mg, K, and Na): Ammonium acetate extraction followed by AAS and flame photometry method were used.

Cation Exchange Capacity (CEC): Ammonium acetate saturation were used to indicate soil's ability to hold nutrients.

Electrical Conductivity (EC): EC meter (1:2.5 soil to water extract) were used to indicate salinity.

## 3.3 TREATMENTS AND EXPERIMENTAL DESIGNS

Screen house experiment were conducted using a maize variety (*SAMMAZ 27*). The treatment consisted of twenty six (26) pots of which 25 pots sown with treated seeds with different concentrations of plant extracts (10%, 5%, 3.3% 2.5% and 2%) and 1 pot sown with untreated (0%) seeds which serve as control treatment, all the treatments were set in a completely randomized design (CRD).

## 3.4 PLANT EXTRACTS PROCEDURES

The plant parts (leaves of neem and henna, onion bulb, ginger rhizome and garlic clove) were weighted on an electronic scale (WH-B20) and then washed with clean water. To get the extract of neem and henna leaves, onion bulb, ginger rhizome and garlic clove, the weighted plant parts were separately crushed in a mortar and pestle as described by using the method of Ashrafuzzaman and Hossain (1992). The 10g of each crushed plant part were amalgamated with 100, 200, 300, 400 and 500 ml of distilled water were squeezed through 3 folds of fine cotton cloth. To get the percentage of 10g:100ml , 10g:200ml, 10g:300ml, 10g:400ml, and 10g:500ml weight/volume (w/v) ratio it was respectively calculated as follows:

10g: 100ml=10/100x100=10%

10g: 200ml=10/200x100=5%

10g: 300ml=10/300x100=3.3%

10g: 400ml=10.400x100=2.5%

10g: 500ml=10/500=2%

**3.5 EXPERIMENTAL TREATMENTS**

T1= Seed treatment with Neem leaf extract (10%, 5%, 3.3%, 2.5%, 2%),

T2= Seed treatment with henna leaf extract (10%, 5%, 3.3%, 2.5%, 2%),

T3= Seed treatment with ginger rhizome extract (10%, 5%, 3.3%, 2.5%, 2%),

T4= Seed treatment with onion bulb extract (10%, 5%, 3.3%, 2.5%, 2%),

T5= Seed treatment with garlic clove extract (10%, 5%, 3.3%, 2.5%, 2%),

T6=Control treatment (0%)**.**

## 3.6 PLANT AND THEIR PARTS USED FOR THE EXPERIMENT

| Common Name | Scientific Name | Plant Parts |
|---|---|---|
| 1. Neem | *Azadirachta indica* | Leaf |
| 2. Garlic | *Allium sativum* | Clove |
| 3. Onion | *Allium cepa* | Bulb |
| 4. Ginger | *Zingiber officinale* | Rhizome |
| 5. Henna | *Lawsonia innermis* | Leaf |

## 3.7 TEST CROP DESCRIPTION

- Common Name: Maize
- Scientific Name: *Zea mays* L.
- Family: Poaceae
- Variety Used: SAMMAZ 27
- Seed Source: International Institute of Tropical Agriculture (IITA) Kano Substation, Nigeria. Growth Habit: Annual cereal crop with an erect growth habit, producing a single main stem (culm) and several broad, green leaves.
- Test Plant Population: 20 plants per pot in the greenhouse
- Sowing Date: June 23, 2023
- Growth Duration: 90-100 days (early maturing)

## 3.8 EVALUATION OF THE PLANT EXTRACTS

Screen house experiment were performed to study the effect of plant extracts on damping-off disease as follows:

### 3.8.1 Green House Experiments (Pot Experiments)

**3.8.1 Seeds Treatment:** Twenty (20) viable seeds of maize for each treatments were soaked in different concentrations (10%, 5%, 3.3%, 2.5%, and 2%) of the plant extracts (Botanical Priming) for 6 hours. The untreated seeds were also soaked in water only (Hydropriming) for the same period as in the treated seeds to serve as control treatment. The soaked seeds were air dried for 2 hours.

**3.8.1 Sowing:** The treated seeds was sown by broadcasting technique in the pots with the naturally infested soil with pathogenic fungi (such as *Pythium spp., Rhizoctonia solani, and Fusarium spp*.). The pot sown with non-treated seeds served as control treatments.

**3.8.1 Seed rate:** The 20 treated seeds of maize was sown by broadcasting technique to each pot.

**3.8.1 Weed control**: Hand weeding once at two weeks after sowing (WAS).

**3.8.1 Fertilizer applications:** NPK 20:10:10 fertilizer was applied at the rate of 7.5g/pot to all treatments at two weeks after sowing (WAS).

### 3.9 DATA COLLECTION

The following parameters were recorded

**3.9.2 Incidence of Damping off:** The pre-emergence seed rot was recorded at seven (7) days after sowing (DAS) and post-emergence seedling mortality was also recorded at 14 days after sowing (DAS) in the screen house. Percent pre-emergence seed rot and percent post-emergence seedling mortality were calculated by the formula developed by Kataria and Grover (1967).

$$\%PESM = \frac{\text{Number of seeds rot per pot}}{\text{Total number of seeds sown per pot}} \times 100$$

$$\%POESM = \frac{\text{Number of seedlings affected per pot}}{\text{Total number of seeds sown per pot}} \times 100$$

PESM is pre emergence seedling mortality and POESM is post emergence seedling mortality.

**3.10 DATA ANALYSIS:** All the data collected were subjected to statistical analysis and compared according to the Least Significant Difference (LSD) to test for significant difference between treatments at $p \leq 0.05$ (Gomez & Gomez, 1984).

## 4.0 RESULT DICUSSION

### 4.1 Pre-Emergence Damping-Off in the greenhouse at Bichi during 2023 Rainy Season

Table 1 below shows the efficacy of plant extracts on pre-emergence damping-off disease at seven (7) days after sowing at Bichi screen house. Result also indicated that lower average mortality rates was recorded on seedlings treated with neem leaf, ginger, onion and garlic extracts at Bichi compared to seedlings treated with henna leaf extract (5.00%) and the control (17.00%). It also revealed that there is no significant differences on all the treatments. It also shows that percent of pre-emergence damping off was decreased with increase in concentrations of the plant extracts tested. This shows that the use of plant extracts can reduce pre emergence damping off disease and increase seed germination in maize. It also indicate that there is no significance interactions between plant extracts and concentration. The greatest damage usually occurs when infection occurs early, prior to or immediately after emergence (Agrios, 2005). Infection of seeds can result in failure of germination, where seeds become rotten, soft and mushy, and disintegrate, causing pre-emergence damping-off (Agrios, 2005; Hendrix and Campbell, 1973).

**Table 1: Efficacy of plant extracts on pre-emergence damping-off at seven (7) days after sowing at Bichi in the Screen house during 2023 rainy Season**

| Treatment | Concentrations | | | | | | |
|---|---|---|---|---|---|---|---|
| **Plant Extract** | **10%** | **5%** | **3.3%** | **2.5%** | **2%** | **AM (%)** | **Difference From Control** |
| Neem | 0.00 | 0.00 | 0.00 | 5.00 | 5.00 | 2.00 | -15.0 |
| Henna | 0.00 | 5.00 | 10.0 | 10.0 | 10.0 | 7.00 | -10.0 |
| Ginger | 0.00 | 0.00 | 5.00 | 5.00 | 10.0 | 4.00 | -13.0 |
| Onion | 0.00 | 0.00 | 0.00 | 0.00 | 15.0 | 3.00 | -14.0 |
| Garlic | 0.00 | 0.00 | 0.00 | 5.00 | 5.00 | 2.00 | -15.0 |
| Control | 15.0 | 20.0 | 15.0 | 15.0 | 20.0 | 17.0 | |
| LSD (5%) | | | 2.08 | | | | |
| Interaction PxC | NS | NS | NS | NS | NS | | |

*=significant at 5% level, $^{NS}$ =not significant, AM= Average Mortality

### 4.2 Post-emergence damping-off at fourteen (14) DAS at Bichi in the greenhouse during 2023 rainy season

Table 2 below shows the efficacy of plant extracts on post-emergence damping-off at fourteen (14) DAS Bichi location. Results showed that lowest average seedlings mortality rate was recorded on seeds treated with garlic extract (3.00%) at Bichi, henna leaf and onion extracts both 5.00% as well as the control treatment with an average mortality rate of maize seedlings 16.00% at Bichi with significant differences ($p \leq 0.05$). It also reveals that percent of post-emergence seedling mortality was decreased with increase in concentrations of the plant extracts tested. It also indicate that there is significance interactions between plant extracts and concentration at all concentrations levels (10%-2%). In post-emergence damping-off, seedlings are infected in the roots or the stems at the soil line, and the invaded tissues become water-soaked, discolored, and soon collapse (Agrios, 2005; Hendrix and Campbell, 1973). Damping-off often results in poor stands, which can be mistaken for poor seed quality or seed maggot damage rather than damping-off (Hendrix and Campbell, 1973; Laemmlen, 2001).

**Table 2: Efficacy of plant extracts on post-emergence damping-off at fourteen (14) DAS at Bichi in the screen house during 2023 rainy season**

| **Treatment** | | | **Concentrations** | | | | |
|---|---|---|---|---|---|---|---|
| **Plant extract** | **10%** | **5%** | **3.3%** | **2.5%** | **2%** | **AM (%)** | **Difference From Control** |
| Neem | 5.00 | 10.0 | 10.0 | 15.0 | 15.0 | 11.0 | -5.00 |
| Henna | 0.00 | 0.00 | 5.00 | 5.00 | 15.0 | 5.00 | -11.0 |
| Ginger | 5.00 | 5.00 | 10.0 | 10.0 | 10.0 | 8.00 | -8.00 |
| Onion | 0.00 | 5.00 | 5.00 | 5.00 | 10.0 | 5.00 | -11.0 |
| Garlic | 0.00 | 0.00 | 5.00 | 5.00 | 5.00 | 3.00 | -13.0 |
| Control | 10.0 | 15.0 | 15.00 | 20.0 | 20.0 | 16.0 | |
| LSD (5%) | | | -9.20 | | | | |
| Interaction PxC | * | * | * | * | * | | |

*=significant at 5% level, **NS** =not significant, AM= Average Mortality

## 5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

### 5.1 SUMMARY

Damping-off disease is a major challenge in maize production, particularly in Kano State, Nigeria, where it causes significant seedling losses and poor crop establishment. Farmers often rely on synthetic fungicides to manage the disease, but concerns over environmental pollution, pathogen resistance, and high costs necessitate alternative control strategies.

The study was conducted through greenhouse experiment, where maize seeds were treated with plant extracts before sowing in the screen house. Disease incidence and seedling emergence were assessed to determine the effectiveness of each extract. Results revealed that plant extracts significantly reduced disease incidence compared to untreated controls, with neem, henna and garlic extracts showing the highest efficacy. However, excessive concentrations led to phytotoxic effects on seedlings. The findings suggest that plant-based treatments can serve as eco-friendly and cost-effective alternatives to chemical fungicides for managing damping-off disease.

## 5.2 CONCLUSION

The study evaluated the efficacy of different concentrations (10%, 5%, 3.3%, 2.5%, and 2%) of plant extracts in controlling damping-off disease in maize. The results showed that certain extracts (e.g., neem, henna and garlic) were more effective in reducing disease incidence compared to the control. Higher concentrations (10%, 5% and 3.3%) generally exhibited better disease suppression, though some extracts showed phytotoxic effects at higher levels. Seed priming with plant extracts improved maize seedling vigor and survival rates, suggesting additional benefits beyond disease control.

## 5.3 RECOMMENDATIONS

Farmers in Kano State, Nigeria, should consider using neem, henna and garlic extracts as biofungicides for seed treatment to reduce damping-off disease in maize.

Proper concentration levels (10%, 5% and 3.3%) should be applied to balance disease control and seedling safety.

Training programs should be organized to educate farmers on the preparation and application of plant-based treatments.

Field trials should be conducted to assess the long-term effectiveness of plant extracts under real farming conditions.

Additional studies should focus on the mechanisms by which these extracts suppress damping-off pathogens.

## REFERENCE


Agrios, G.N. (2005) Plant pathology, Elsevier Academic Press. 5th edition 79-103.

Ashrafuzzaman, H. and I. Hossain, (1992). **Antifungal activity of crude extracts of plants against *Rhizoctonia solani* and *Bipolaris sorokiniana***. Proc, BAU.Res. Prog.6: 188-192.

CABI Crop Protection Compendium. (2012). **Zea mays datasheet.** Available at: http://www.cabi.org/cpc/datasheet/57417. Espinoza, L. & Ross, J. (Eds.) Corn Production Handbook.

Cereals; http://en.wikipedia.org/wiki/Cereals [Accessed 20th December, 2014]

Chowdhury, S.D., (2005). Comparative effect of plant extracts, physical and chemical agents in Seed treatment. MS thesis, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Food and Agriculture Organization, International Fund for Agricultural Development, World Food Program. 2015. The State of Food Insecurity in the World 2015. Strengthening The enabling environment for food security and nutrition". FAO.

Gomez, K.A. and A.A. Gomez. (1984). **Statistical Procedures for Agricultural Research**. A. Lviley-Interscience Publication, New York, pp. 678.

Hendrix, F.F., and Campbell, W.A. 1973. *Pythium* as plant pathogens. Annu. Rev. Phytopath. 11:77-98.

Howlader, A.N., (2003). Effect of seed selection and seed treatment on the development of phomopsis blight and fruit rot of eggplant. MS thesis, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Hossain, M.M., K.M. Khalequzzaman, F.M. Aminuzzaman, M.R.A. Mollah and G.M.M. Rahman, (2005). *Effect of plant extract on the incidence of seed-borne fungi of wheat*. Journal of Agriculture and Rural Development, 3(1 & 2): 39-43.

Islam, M.A., F.M. Aminuzzaman, M.R. Islam and M.S. Zamal, (2006). *Seed treatment with plant* *extract and Vitavax-200 in controlling leaf spot (Bipolaris sorokiniana) witincreasing grain yield of wheat.* Intl Journal of Sustainable Agricultural Technology, 2(8): 15-20.

Kataria HR, Grover RK (1967). **Some factors affecting the control of *Rhizoctonia solani* by Systemic and non-systemic fungicides**. Ann. Appl. Biol. 82:267-278.

Laemmlen, F. (2001). Damping-off diseases. University of California Davis Agriculture and Natural Resources Publication No.8041. http://anrcatalog.ucdavis.edu (accessed January 2010).

Matarese F, Sarrocco S, Gruber S, Seidl-Seiboth V, V annacci G (2012) Biocontrol of fusarium head blight: Interactions between Trichoderma and mycotoxigenic Fusarium. Microbiology 158:98-106.

Meszka B, Bielenin A (2010) **Polyversum WP a new biological product against strawberry grey mould. Phytopathol** 58:13-19.

Monaim, A.M.F., K.A.M.A. Elyousr and K.M. Morsy, (2011). **Effectiveness of plant extracts on suppression of damping-off and wilt diseases oflupine (*Lupinus termis* Forsik)**. Crop Protection, 30: 185-195.

Omokhua, G.E., M.I. Godwin and V.C. Okereke (2009b) **Damping-off Disease of two Pulp and Paper Forest Species (Pinus caribaea Morelet and Pinus oocarpa Schiede) in the Nursery** (pp.275-282).

Stephens CT, Powell CC (1981). **Pythium species causing damping off of seedling bedding Plants in Ohio greenhouses.** Phytopathology 71:1225-1228.

Widnyana IK, Javandira C (2016). Activities Pseudomonas spp. And Bacillus spp. to stimulate germination and seedling growth of tomato plants. Agriculture and Agricultural.