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VARIETAL RESPONSE OF MAIZE TO DOWNY MILDEW DISEASE (*PERONOSPORA MAYDIS*) IN MINNA

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Abstract
Maize (Zea mays L.) is ranked among the four principal cereal crops in the world. It has high adaptability qualities of growing all over the world under a range of climatic conditions. However, there have been many diseases responsible for the economic losses of maize. Peronospora maydis is one of the most serious diseases affecting maize production in Nigeria. This study is aimed at screening maize varieties for their resistance to Peronospora maydis. The experiment was laid out in a randomized complete block design with three replicates. Five varieties were used for the experiment. The result of the research showed that OBA 98 had the highest resistance to downy mildew followed by AMANA 1 while OBA SUPER 6, OFA 1 and SAMMAZ 52 were the most susceptible to downy mildew respectively. OBA 98 is recommended for the optimum yield in endemic areas of downy mildew.

Keywords: Maize, Downy mildew, *Peronospora maydi*s, Resistance.

Sub-Theme 3: Harnessing the Potentials of Plant Breeding towards Sustainable Development Goals in the Country.

Introduction
Maize (*Zea mays*) is a cereal that was first inhabited by the native indigenes of Southern Mexico many years ago about 10,000 years (Pruitt, 2016). *Peronospora maydis* which has been the most notorious diseases in Nigeria and was first discovered in 1969 in Zaria, Kaduna state. It's also a major disease of maize in Uganda (Kumi *et al*., 2018). The infected plants shows two types of symptoms on the plant, that is the local and the systemic symptoms. The systemic symptoms occurs as the invading pathogen reaches its growing stage (at the top of the stalk tissue of the plant). The affected leaves becomes dwarf, chlorotic and develops patches in parallel in with the leaf bone as it grows. The local symptoms, there is presence of chlorotic lines, powdery surface layer of velvet consisting of conidiophores and conidia of the fungus on leaves which causes poor production of maize (Alemu, 2018).

Downy mildew, being one of the most notorious cereal diseases can be rendered harmless by planting a resistant variety of maize. The panacea and development of downy mildew resistant varieties commenced by IITA since early 1980s, and since then various resistant varieties have been developed and released. The development of maize downy mildew

will help to increase maize yield, alleviate poverty, provide food security and provide food security and yield potential for industrial use and generate income to farmers (Akinbode, 2014). Tolerant variety like hybrid DMRSR varieties are efficient varieties against downy mildew and maize streak virus through the effort of Research institutions in Nigeria. It has helped in the production of maize more than 3tonnes/ha under severe pressure of downy mildew of which susceptible varieties gives a very low yield of about 1tonnes/ha (Tsedeke, 2017). Development of new resistance has been of productive in terms of yield which has led to success of agriculture to feed the fast growing world population (Hai, 2016). New varieties have reduced the stress on the agricultural field against diseases, weed, edaphic and climatic conditions. Resistance varieties have helped to have a produce with less cost input and expenditures. Resistance varieties have the reduced the gap between the constraints and the yielded results during and after the agricultural season for disease management (McGrath, 2022).

The aim of this paper was to identify resistant varieties to downy mildew. The objectives were to; identify downy mildew progression rate on different varieties of maize and mitigate loss of yield in maize due to downy mildew.

Materials and Methods

Minna is the capital city of Niger state, which is found in the Southern guinea savanna of Nigeria's ecological zone. The experimental site has coordinates that lies between latitude 9.35°N and longitude 6.29°E (Global Positioning System Navigator). It has altitude and elevation of 256m (841ft) above the sea level, annual relative humidity of 48.9% and 73% in July and August and annual rainfall of 1,207mm. The research was carried out in 2021 at the research farm Gidan-Kwano campus, Federal University of Technology, Minna.

There were five varieties of maize considered which include OBA 98, OBA super-6, Sammaz-52, Amana-1 and OFA-1. OBA 98, OBA SUPER 6 and SAMMAZ 52 was gotten from Premier Seed Company, Kaduna state, while OFA-1 was gotten from Star seed company, Otta, Ogun state and Amana-1 from Gold-Agric seed Company, Kaduna state.

Downy mildew inoculum was gotten from different landraces of maize plant in different locations; from Gidan-Mangoro, Gidan-Kwano, Gidan-paity, and Garatu. Conidia lesions were collected and deduced from infected leaves. It was air-dried in cool-dry place and then pulverized to form powder. It was then cleaned with 78% of glucose solution to increase the pressure of downy mildew conidia on the leaves then further suspended in distilled water for 2-4 days (Atak, 2017). The suspension was then sprayed on the leaves of the plants under cold temperature early in the morning because *Peronospora species* thrive well and penetrate in to the host under cool weather condition (Atak, 2017).

Visual disease evaluation scale of 0, 1, 3, 5, 7, and 9 was used to determine the degree of infection on each variety, this was done at every two weeks after inoculation (WAI). The infection severity were judged on the entire leaf area of the plants. Scoring was done at two weeks interval to determine the responses of each varieties to the inoculum.

Randomized Complete Block design (RCBD) was used on the farm. The land size was 17.5m by 15.5m with total land area of 271.25m². Each plot was 4.5m by 2.3m. It had 5 plots per replicate. There were three replicates for each varieties. Visual disease evaluation scale of 0, 1, 3, 5, 7, and 9, was used to determine the degree of infection on each variety, this was done at two weeks interval after inoculation (Azmat *et al*., 2012). Disease incidence was determined based on the number of maize leaves infected. Number and sizes of lesions on leaves was used to calculate disease progression; Using Logistic growth model as postulated by Vanderplank (1963),

$$p = \frac{1}{t2-t1} \ln \left(\frac{mx2\ (1-x1)}{x1\ (1-x2)}\right)$$

Where *r* is the rate of disease progression,
m= being the host mass $= \frac{y2(present\ number\ of\ leaves)}{y1(previous\ number\ of\ leaves)}$,

t2= present time taken (days),
t1= is the previous time taken (days),
x2= present number of leaves infected,
x1= previous number of leaves infected (Coutinho *et al*., 2020).

Average number of total grains per cob were counted and recorded. Fresh weight were recorded using MANSI Casting mechanical weighing scale, PAS 9815 model. Dry weight of plant after sun-drying were measured and recorded. Total grain weight were measured using MANSI Casting mechanical weighing scale, PAS 9815 model. All data were collected and subjected to Analysis of Variance (ANOVA) with the aid of Statistical Analysis System (SAS). Different means that are significantly similar were subjected to Duncan Multiple Range Test (DMRT) at 5% level of probability.

Results and Discussion

The result on table 1 shows the effect of downy mildew on fresh weight and dry weight. The effect was not significantly different in fresh weight ($p>0.05$). OBA98 (164.21) has the highest fresh grain weight and OBA SUPER6 (101.11) had the lowest fresh grain weight.

Effect of downy mildew on dry grain weight was significantly different ($p<0.05$). AMANA1 (54.24) and SAMMAZ52 (57.56) was not significantly different from OBA 98 which had the highest weight. OFA1 (70.85) which was the lowest, was not significantly different ($p>0.05$) from OBA SUPER6 (30.26).

Table 1. Effect of downy mildew *Peronospora maydis* **on selected maize varieties on weight.**

	Weight (Kg⁻ha)	
Treatment	**Fresh Weight (kg⁻ha)**	**Dry Weight (kg⁻ha)**
OBA98	164.21[a]	70.85[a]
AMANA1	82.66[a]	54.24[ab]
SAMMAZ52	113.65[a]	57.56[ab]
OFA1	122.14[a]	29.15[b]
OBA SUPER 6	101.11[a]	30.26[b]
SE±	0.71	0.27

___Means with the same letters within the same column are not significantly different at (P≤0.05) using Duncan Multiple Range Test.

The result on table 2 shows that at 2, 4, 6 and 10 Weeks after Inoculating (WAI), the disease scoring was not significantly different ($p>0.05$). At 8WAI, the maize varieties was significantly different from each other ($p<0.05$), AMANA1, SAMMAZ52 and OBA SUPER6 was not significantly different. OFA1 consistently had the highest disease infection throughout evaluation period.

Table 2. Effect of downy mildew *Peronospora maydis* on selected maize varieties on disease scoring.

Treatment	2WAI	4WAI	6WAI	8WAI	10WAI
OBA98	3.00[a]	6.33[a]	6.66[a]	6.33[b]	8.00[a]
AMANA1	2.66[a]	6.33[a]	6.66[a]	7.66[ab]	8.00[a]
SAMMAZ52	3.00[a]	7.00[a]	7.33[a]	7.66[ab]	8.00[a]
OFA1	4.33[a]	7.66[a]	7.66[a]	8.00[a]	8.33[a]
OBA SUPER 6	4.00[a]	7.00[a]	7.33[a]	7.66[ab]	8.33[a]
SE±	0.52	0.52	0.46	0.43	0.25

Means with the same letters within the same column are not significantly different at (P≤0.05) using Duncan Multiple Range Test.

The result on Fig.1 shows the progression rate of different varieties of maize. At 4WAI, AMANA1 was the most resistance follow by OBA 98 and SAMMAZ52 had the highest susceptibility to downy mildew progression. While At 6WAI, OBA 98 was the most resistance to Downy Mildew (DM) followed by AMANA1 while OFA1 was the most susceptible. At 8WAI, SAMMAZ 52 was the most resistance to DM, there was no significant difference between OBA98 and AMANA1. However, OFA1 was the most susceptible.

At 10WAI, OBA 98 and OBA SUPER 6 were the most resistance to DM which were not significantly different, SAMMAZ 52 was highly susceptible to DM. OFA1 consistently shows decrease in resistance throughout the entire research period.

Chart Showing Downy Mildew Progression Rate on Maize Varieties at 2 Weeks Interval after Inoculation.

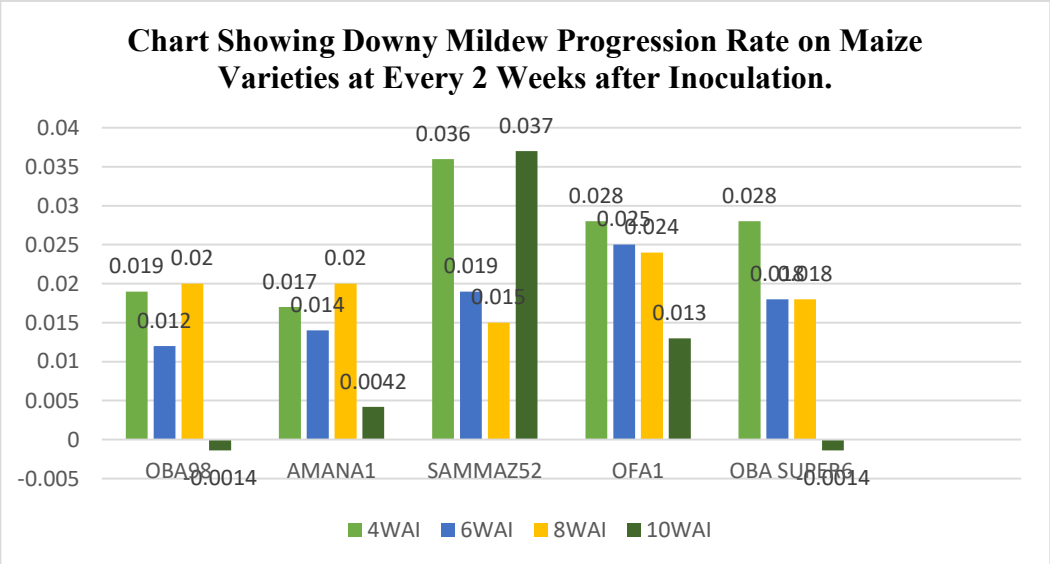

Fig 1

KEYS
4WAI: 4 Weeks after Inoculation
6WAI: 6 Weeks after Inoculation
8WAI: 8 Weeks after Inoculation
10WAI: 10 Weeks after Inoculation

Conclusion

Based on the result obtained from this research on screening of downy mildew on maize varieties, it is concluded that OBA98 has more resistance to downy mildew of maize *(Peronospora maydis)* than other varieties.

Recommendations

OBA98 is recommended as the best variety in endemic downy mildew environment to obtain high yield. It is also recommended that OBA98 can be used in further research in comparison with other resistance varieties.

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