

The Incidence of Field Diseases and Vertebrate Pests on Popcorn (*Zea mays everta*) Varieties Cultivated in Forest Agro-Ecologies of Nigeria

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Abstract: Eleven popcorn varieties cultivated in the humid forest zone of south-western Nigeria were subjected to natural infections with disease causing agents and vertebrate pest infestation. Data were taken on the incidence and severity of maize field diseases, birds and on rodents attacks. Result of the experiments revealed that all the 11 popcorn varieties were found susceptible to leaf spot diseases with varying degrees of incidence. Five out of 11 Popcorn varieties namely Mercy, Ashland, Pearl shaped, P618 and DMRSR were found having maize rust infection. The incidence of occurrence of streak was found in New A2, Pearl shaped and Grace, while the remaining popcorn varieties had no streak infection. The popcorn variety with the least leaf blight incidence of 12.4 was New A2 followed with Prayer with the incidence of 14.6%. There was no incidence of smut and downy mildews recorded on the popcorn varieties. The vertebrate pests found associated with popcorn include bird species such as *Ploceus cucullatus* (Weaverbirds), *Streptopelia semitorquata* (Dove) and *Francolinus bicalcaratus* (Bush fowl), while the rodents include species such as *Xerus erythropus* (Red legged Ground Squirrel), *Rattus rattus* (Black grey Rat), *Mastomys natalensis* (Multimammate Rat) and *Thryonomys swinderianus* (Grass cutters/Cane rats). The activities of these vertebrate pests were more significant in P618, followed by Mercy, Yellow composite and Mixed grain.

Key words: Popcorn varieties % Vertebrate pests and diseases insurgence % humid forest agro-ecologies

INTRODUCTION

Popcorn, (*Zea mays everta*) is a special kind of flint corn with popping characteristics originally selected by Indians in early western civilizations [1]. It is now a common refreshment mostly found in many homes, offices and motor parks in Nigeria [2]. Nutritionally, it is one of the best all-around snack foods, providing 67% as much protein, 110% as much iron and as much calcium as an equal amount of beef. An average 1.5 ounce serving of popcorn supplies the same energy as two eggs and a cup of unbuttered popcorn contains less calories than half a medium grapefruit [2]. Popcorn is sold either as a plain or flavor-added popped product, or as an un-popped product in moisture-proof containers ranging from plastic bags and sealed jars ready-to-use containers both for conventional and microwave popping. Popcorn flavor is enhanced to individual tastes with the addition of salt, butter and honey.

Popcorn, which was imported to Nigeria in early fifties, became very lucrative in the early eighties and its

importation was banned by the Govt. in an effort to improve its production in Nigeria in the nineties. As a result of the ban, Institute of Agricultural Research and Training (IAR and T) with the national mandate for cereal improvement in Nigeria embarked upon extensive germplasm collection from all-over the world. These germplasms were then evaluated for popping value and adaptation to the Nigerian ecology [2].

Popcorn like other cereal crops is faced with many production constraints such as low yield, susceptibility to diseases, insects and vertebrate pests [3 - 5]. Both the researchers and farmers now face serious threat from the menace of pathogens and pests affecting this crop on the field. Corn leaf diseases can cause greater yield losses if infection occurs early in the growth stages of the plant. While the activities of some vertebrate pests on cornfields have resulted in zero yield (Personal communication). The aim of the present study was to investigate the incidence of field diseases and vertebrate pests on popcorn varieties cultivated in the humid forest of south-western Nigeria.

MATERIALS AND METHODS

Eleven (11) popcorn varieties were selected from the breeding Programme of the Institute of Agricultural Research and Training, Moor Plantation, Ibadan between 1996 and 2000. These progenies were screened under natural inoculation during 2001 and 2003 maize planting season. Each variety was planted to four row plots at a spacing of 75 cm x 25 cm per plot and replicated four times in each locality where the trials were conducted, cultural operations in the trial sites were carried out e.g. herbicide application, fertilizer application, supplementary weeding etc., data were taken on incidence and severity of maize diseases, birds and the rodents attacks. The assessment of the disease incidence and severity was made of 30 randomly selected popcorn plants in a diagonal cutting across the field. Symptoms of severity were determined by individually screening each of the 30 plants and by giving an overall note for the symptom severity of each disease. For fungal and viral diseases, a 1-5-disease severity scale was used to assess the amount of disease in each particular field. Identification of the diseases were based on visual symptoms as described in the CIMMYT field disease identification Guide [6] and confirmed through laboratory analysis of the diseased samples.

The severity evaluations were made according to the following scoring system:

Maize Streak: (1) no symptom; (2) mild chlorotic patterns and slight; (3) streak pattern on over 70% of the leaves; (4) Streak pattern on all the leaves, leaf distortion and (5) stunting of the whole plant.

Downy mildew: (1) Very slight infection; usually [0 on lower leaves. Hypersensitive type lesion; (2) Light infections; moderate of number of lesion on lower leave; (3) Moderate infection; an abundant lesion on lower leaves a few on middle leaves; (4) Heavy infection; lesion abundant on lower and middle leave extending to upper leaves and (5) Very heavy infection; lesion abundant on all leaves. Sometimes plant may be prematurely killed.

Rust: (1) No visible symptoms on the plant; (2) Visible chlorosis but no uredia are present; (3) 50 percent severity with a moderate number of pustules; (4) # 60% severity with a abundant pustules and (5) Abundant pustules; almost all leaves are dried and killed.

Blights: (1) Very slight infection; usually on lower leaves. Hypersensitive type lesion; (2) Light infections; moderate number of lesion on lower leave; (3) Moderate infection; abundant lesion on lower and middle leaves a few on middle leaves; (4) Heavy infection; lesion abundant on lower and middle leave extending to upper leaves and (5) Very heavy infection; lesion abundant on all leaves. Sometime plant may be prematurely killed.

Vertebrate pests: The incidences of vertebrate pests on the 11 popcorn varieties were also recorded, by determining the percentages of stands affected by the vertebrate pests (birds and rodents) right from the planting stage to the harvesting stages. While the types of vertebrate pests found associated with the maize farm were also recorded.

RESULTS

All the 11 popcorn varieties were found susceptible to leaf spot diseases with varying degrees of incidence. Popcorn variety P618, Pear shaped and Mercy were found to have over 50% incidence of *Curvularia* infection. The least % incidence of 25.6 and 26.4 was recorded for popcorn variety, mixed grains and DMRSR, respectively (Table 1). The popcorn variety with the least leaf blight incidence of 12.4 was New A2 followed with Prayer with the incidence of 14.6%. While the highest incidence of leaf blight of 36% was recorded for variety Yellow composite. The incidence of rust on the popcorn varieties ranges from 0% in New A2, Prayer and Mix grain to 4.9% in DMSR (Table 1).

The highest incidence of occurrence of streak (4.9%) was found in New A2, followed with 3.8% in Pearl shaped and Grace while the remaining popcorn varieties had no incidence of streak. There was no incidence of smut and downy mildews recorded on the popcorn varieties.

The severity of leaf spot disease recorded on the popcorn varieties ranges from 2.6 in Mix grain to 3.8 in P618. (Table 2). All the popcorn varieties used in the present study were also found susceptible to maize leaf blight diseases with varying degrees. With regards to streak only varieties Pear shaped, P618, Grace and New A2 were found with streak having severity score ranging between 2.9 and 3.4. Popcorn varieties Mercy, Ashland, Pearl shaped, P618 and DMRSR were found having maize rust severity score of between 2.6 to 3.4, while other varieties had no symptoms of rust infection (Table 2).

Table 1: The incidence of fungal diseases on popcorn varieties in the humid forest of western Nigeria

Popcorn varieties	Rust	Blight	Streak	Smut	Leaf spot
Yellow composite	3.8	35.4	0.0	045.5	48.6
Mercy	2.9	23.5	0.0	0.0	54.4
Ashland	3.0	24.5	0.0	0.0	46.5
Golden pup	0.0	26.5	0.0	0.0	48.9
Pear shaped	4.8	18.9	3.8	0.0	55.8
P618	1.2	25.5	4.2	0.0	57.8
Grace	0.0	18.6	3.8	0.0	42.6
New A2	0.0	12.8	4.9	0.0	38.8
Prayer	0.0	14.6	0.0	0.0	35.2
Mix grain	0.0	19.8	0.0	0.0	26.2
DMRSR	4.9	19.8	0.0	0.0	25.6

Table 2: The severity of popcorn diseases in Ibadan, Nigeria

Popcorn varieties	Rust	Blight	Streak	Smut	Leaf spot
Yellow composite	3.2	3.5	0.0	0.0	3.0
Mercy	2.9	3.4	0.0	0.0	3.4
Ashland	3.0	3.6	0.0	0.0	3.1
Golden pup	0.0	3.3	0.0	0.0	3.2
Pear shaped	3.4	3.1	3.1	0.0	2.8
P618	2.6	2.5	3.0	0.0	3.8
Grace	0.0	2.6	2.5	0.0	2.9
New A2	0.0	2.9	2.9	0.0	3.6
Prayer	0.0	3.2	0.0	0.0	2.8
Mix grain	0.0	3.1	0.0	0.0	2.6
DMRSR	2.1	3.0	0.0	0.0	2.6

Table 3: The incidence of vertebrate pests infestation on popcorn varieties in the humid forest of south-western Nigeria

Popcorn varieties	Bird	Rodent
Yellow composite	25.5	16.0
Mercy	30.4	25.0
Ashland	15.4	18.0
Golden pup	15.8	14.5
Pear shaped	15.6	13.5
P618	42.2	38.8
Grace	20.1	19.2
New A2	15.4	12.3
Prayer	10.6	25.2
Mix grain	20.6	23.2
DMRSR	25.2	18.3

The vertebrate pests found associated with popcorn include bird species such as *Ploceus cucullatus* (Weaver birds), *Streptopelia semitorquata* (Dove) and *Francolinus bicalcaratus* (Bush fowl), while the rodents include species such as *Xerus erythropus* (Red legged Ground Squirrel), *Rattus rattus* (Black grey Rat), *Mastomys natalensis* (Multimammate Rat) and *Thryonomys swinderianus* (Grass cutters/Cane rats) (Fig. 3). The popcorn seeds/seedlings were often found dugged up and removed from their holes, these were found associated with Bush fowls and ground squirrel. While seedling and young plants with twisted, bent, cut, chopped to pieces and chewed were found associated with small rodent and ground squirrel. However at the

later stage of growth, the activities of cane rat/grass cutter were found to be more pronounced. The maize cubs found with the husk torn to shreds very profusely usually from tip to base were found associated with Ground Squirrel. The activities of birds such as Weaverbirds is often pronounced on maize cubs that are about maturing ie., (succulent) as the cub matures and the grain dries up the activities of these birds diminished.

The activities of these vertebrate pests were more significant with P618, followed by Mercy and Yellow composite and Mixed grain. While the least activities of the vertebrate pests were found with Prayer. However, the activities of birds were more pronounced on the popcorn varieties than that of the rodent pests (Table 3.).

DISCUSSION

The result of the experiment revealed that all the popcorn varieties were found susceptible to leaf spot diseases with varying degrees. Curvularia leaf spot disease of maize has been described as one of the major diseases affecting maize plants in the humid tropics [7]. According to Ladipo *et al.* [3], humid weather encourage the abundant production of conidia which are usually dispersed by wind and rain splash unto susceptible hosts. The low incidence of leaf spot in Mixed grains and DMRSR is an indication that inherent resistance to leaf spot in popcorn is visible. The maize leaf spot was also found to be least severe in Mixed grains, while Popcorn varieties P618, Pearl shaped and Mercy that had highest leaf spot incidence and were also severely susceptible.

The popcorn variety with the least leaf blight incidence was New A2 (12.4%) followed by Prayer (14.6), while others have higher incidences and are found susceptible to the disease. The maize leaf blight observed on the field is incited by the fungus *Exserohilum turcicum* (Pass) K.J. Leonard and E.G. Suggs). The disease has been reported as a major constrains to maize production in the humid agro-ecologies [8, 9]. In south-western Nigeria, the resurgence of this disease on conventional maize plants have been observed [10], since maize is being cropped continuously due to population pressure on the land. The pathogen has a high sexual recombination capacity [11], which implies that development of new races of the pathogen is easy. It is now imperative that efforts should be made to continuously evaluate the existing germplasms for resistance to the disease and incorporate resistant genes into the high yielding but susceptible popcorn varieties in the forest agro-ecology of western Nigeria.

Popcorn varieties Pearl shaped, P618, Grace and New A2 were found with streak having incidence and severity score ranging between 3.8 and 4.9 and 2.9 and 3.4, respectively. Amusa *et al.* [10] had earlier reported that the mean incidence of maize streak now ranges between 8 and 17% in both the rainforest and the derived savanna agro-ecologies of south-western Nigeria. Maize streak virus disease is caused by maize streak gemini-virus persistently transmitted by leafhoppers of the genus *Cicadulina* [12]. This disease had been reported to critically limit maize production [13]. Plant infected less than one week after germination produce no yield [14] and those infected 3-8 weeks after germination experience loss of <50%. Kim *et al.* [4] reported that yield losses of up to 70% might occur under controlled infestation. It is a known fact that the humid environment prevalent in the forest agro ecology provides conducive atmosphere for the development and spread of the virus vector *Cicadulina* spp, the breeding and evaluation for resistance to streak especially with regards to popcorn varieties adapted to the agro-ecologies should commence and be done as routine process.

Downy mildew was reported as the most devastating economic disease of maize in the south-western Nigeria especially in the 1980s and mid 1990s [15]. The absence of downy mildew on the popcorn is a testimony to the fact that the disease has almost been eradicated in the humid agro-ecologies of south-western Nigeria, or that the popcorn materials probably had inherent resistance to *Perenosclerospora sorghi* the causative pathogens of downy mildew disease.

Four out of 11 Popcorn varieties namely Mercy, Ashland, Pearl shaped, P618 and DMRSR were found having maize rust infection. Maize rust is known over the years to cause significant yield reduction on cornfield. Infection usually occurs primarily during conditions of high humidity, with over 6 h of moisture on the leaves and favorable atmospheric temperatures that prevails in the humid tropics. Young leaves are more readily infected than older mature leaves. According to some reports, 10% total leaf area infected can result in yield reductions of 3 to 8%. There is therefore a need to incorporate rust resistance gene into the popcorn varieties meant for cultivation in the humid forest.

The attacks of birds and rodents on popcorns were more prominent on P618, followed by Mercy, Yellow composite and Mixed grain. P618 has characteristically small seeds, which are highly floury in grain texture; birds and other pests probably found it easier to consumed or swallowed compared with other popcorn varieties. It also

has high popping expansion with other nutritive qualities that makes more even preferred by man. Funmilayo [16] and Fayenuwo, [17] had earlier reported the activities of bird species such as *Ploceus cucullatus* (Weaverbirds), *Streptopelia semitorquata* (Dove) and *Francolinus bicalcaratus* (Bush fowl) and the rodents include species such as *Xerus erythropus* (Red legged Ground Squirrel), *Rattus rattus* (Black grey Rat), *Mastomys natalensis* (Multimammate Rat) and *Thryonomys swinderianus* (Grass cutters/Cane rats) on maize in south-western Nigeria. Vertebrate pests (Birds and Rodents) have been reported to cause total crop failure in cases where the planted seeds were all dugged from ground if not properly buried [17]. While damages resulting from birds and rodents in some maize farm in the humid forest of south-western Nigeria has been reported to be between 20-59%. Beside the yield loss caused by vertebrate pest attack on maize the pests also caused reduction in the quality of maize grains resulting from damages inflicted on the grains.

Although, a lot of study has been done on vertebrate pest control on maize, these pests especially birds such as bush fowls, get used to the control devices. Rodent pests that have been previously identified such as Cane rat, Giant rat, Multimammate rat Black rat in some areas are being replaced by new ones such as ground squirrels. Vertebrate pest damage to developing maize cobs often lead to opening up of the cob to pathogen entry for further damage.

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