African Journal of General Agriculture
Vol. 5, No. 2, June 30, 2009
Printed in Nigeria

1595-6984/2009 $12.00 + 0.00

http://www.asopah.org

AJGA 2009044/5207

Incidence and severity of common viral and fungal diseases of dry season okra crop in the derived savannah of Nigeria

O. S. Balogun and K. A. Dada

Department of Crop Protection, Faculty of Agriculture, University of Ilorin, Nigeria

(Received April 28, 2009)

ABSTRACT: A field experiment was carried out on the Teaching and Research Farm of the Faculty of Agriculture, University of Ilorin between the months of January and April 2005 to survey the incidence and severity of some common fungal and viral diseases of dry season okra crop. Okra cv Clemson was planted under furrow irrigation. During the first 4 weeks after germination (i.e. seedlings/ vegetative stage) the highest incidence of single infection was fungal at 21.1% recorded by the end of the second week. At the second week, single viral infection was 5.9% while mixed infection was 3.2%. The trend with time however, was that of steady decrease in single fungal infection and correspondent increase in both single viral and mixed fungal and viral infections. By the flowering and fruiting stages at 6 weeks after germination, the percentage incidence of mixed infection was ca. 30% while fungal and viral alone stood at 16% and 13% respectively indicating aggravated infection of viral infection on already fungal infected plants. Considering, total incidence regardless of causal agents, stage I had total incidence of diseases at 30.2%, Stage 2 had 40.2%, while stage 3 had 58.8%. Over all, there was significant retardation in the growth attributes of diseased plants compared to the healthy ones with the mixed infected plants having the highest retardation.

Key words: Viral infection, fungal infection, dry season, okra, savannah

Introduction

Okra, *Abelmoschus esculentus* (L.) Moench. is an annual, herbaceous, hairy, erect, broad-leafed plant of the Mallow family –Malvaceae. It is native to the tropics of the Eastern hemisphere and is widely cultivated or naturalized in the tropics and subtropics of the Western hemisphere for its edible fruit. Okra is a warm season crop, growing best where the minimum and maximum mean temperatures are 18^{o}C (65^{o}F) and 35^{o}C (95^{o}F) respectively. It grows on all types of soils but best crops are grown on a moist, pliable, well-manured soil with pH between 6-0 and 6-8 [6].

To whom correspondence should be addressed: E-mail: samcleo1@yahoo.com

The economic importance of okra is numerous both industrially and nutritional–wise. However, production especially in the tropics is limited by pests and diseases attack Among the primary diseases of okra are powdery mildew caused by *Erysiphe cichoracearum*, sooty leaf spot, caused by *Alternaria* spp and *Cercospora abelmoschus* (Fungi imperfecti); yellow vein mosaic, caused by okra mosaic virus; *Fusarium* wilt, caused by *Fusarium oxysporum* (f.sp *vas infectum*); Southern blight caused by *Sclerotium rolfsii* and root knot caused by root knot nematode *Meloidogyne* spp [7]. All these pathogens especially the fungi and viruses can be a serious problem on okra as they contribute to the drastic reduction in the yield of the crop. Reduction of up to 50% as a result of fruit rot and abortion caused by *Choanephora cucurbitarum* Berk and Rav, had been reported in Okra [1].

The post-rainy season okra, as with other vegetables, such as tomato, has recently become popular in the Central part of Nigeria where Ilorin is located. The itinerant farmers who migrate from the Northern part in large numbers to farm around the fertile plains of streams and large rivers that dote the study area, started the era but the local (native) farmers are gradually imbibing the idea as they see the practice as capable of bringing higher yields and more returns to the grower. Over all, it is a significant contribution to the much needed food security which, is one of the agenda of the Federal government.

In recent times, probably as a result of the practice of cultivating the same areas year after year, many categories of diseases have become particularly problematic in the zone where this study was carried out. However, there is as yet inadequate information in the literature on these diseases associated with dry season cultivation of okra in the area. The present study, therefore, sought to bridge the gap by surveying the incidence and severity of the major viral and fungal diseases associated with dry season cultivation of okra and the growth stage with the highest incidence of diseases in this derived savannah agro-ecology of Nigeria.

Materials and Methods

A survey of okra plants grown on the field was carried out between the months of January and April 2005 and repeated at the same time in 2006 at the Teaching and Research farm of the University of Ilorin on the incidence and severity of common fungal and viral diseases associated with furrow irrigated, dry season okra crops. The beds were made manually with the hoe after ploughing and harrowing with a tractor - driven equipment. The land was then partitioned into 100 beds each measuring 2m x 2m. Seeds were sown directly on the field and thinned down to three plants per hill. The plants were watered, by furrow irrigation, twice a week throughout the survey period. The cultivar planted was Clemson, a short duration variety. NPK (15:15:15) fertilizer was applied by spot placement at the rate of 5 g/stand two weeks after planting. Manual weeding was done as at when necessary.

The treatments were obtained by partitioning the growing period of the plant into 3 stages. Stage1 covered the first 3 weeks after germination, stage 2 was the period from the 4^{th} week through the 6^{th} week, i.e., main vegetative and early flowering stage, while stage 3 was from the 7th to the 9^{th} week, i.e., main fruiting stage. The fungal and viral diseases were also grouped into 3 categories viz: viral only, fungal only, and mixed fungal and viral infection, which were also treatments examined under the various stages of growth. All treatments were replicated in the 100 plots.

Survey and collection of data on disease incidence were carried out weekly. Numbers of leaves of healthy and diseased plants were counted directly while height was measured with the use of a tape rule. Characteristic symptoms were used to identify the category of pathogenic diseases and the actual number of plants infected per bed were recorded as either viral alone, fungal alone, or fungal + viral infected plants. Simple descriptive statistic was used for the counting and percentage. The percentage infected plants was determined using the formula:

$$\frac{\text{Number of infected plants/bed} \times 100}{\text{Population of plants/bed} \quad 1}$$

All data were subjected to analysis of variance using appropriate experimental design for analysis. Comparison for all pairs of treatment means were carried out using the New Duncan's multiple range tests at 5% level of significance.

Results

Okra plants that were identified to exhibit unambiguous foliar symptoms, characteristic of fungal or viral infections, in the experimental units were tagged for data collection over a 9-week study period on the field. Plants infested with the okra mosaic virus manifested characteristic symptoms of green-yellow mottling of leaves. Those plants that were infected with the leaf curl virus exhibited symptoms of severe curling of leaves in an adaxial direction. Such leaves became thickened and generally deformed. The petiole, the main stem and lateral branches also became greatly twisted. Chlorotic spots, followed by desiccations of the leaves, starting at the margin were the most noticeable symptoms on plants infected with foliage fungal agents as seen in Plate 1.

Quite a number of deaths resulting from soil- borne fungal agents such as *Rhizoctonia* and *Fusarium* and oomycetous agents such as *Pythium* spp were also observed. Such plants generally wilted and died before the expiration of the study. Plate 1 shows plants manifesting different symptoms as a result of infection with different pathogens.

Plate 1: Some symptoms manifested by dry season okra under infection with different fungal and viral pathogens

Upper row from left: Okra plants manifesting okra yellow mosaic symptoms as seen at the fruiting stage. Right: Severe stunting in mixed viral and fungal infection

Lower row from left: Apparently healthy plant with good fruiting attributes. Right: Mild leaf blight (fungal)

Incidence of Diseases
Cumulative incidence of the individual disease category

As shown in Fig 1, the general trend of infection of plants during the study period was the prevalence of more fungal incidence (21%) in the early stages following germination than viral incidence (3.2%). Over time however, more plants manifested viral infections while considerable proportion of those hitherto infected with fungal agents alone became super infected by viruses. As at the flowering stage, therefore, mixed viral and fungal infections accounted for 30%, single infections with fungi was 16% and virus alone was 13%.

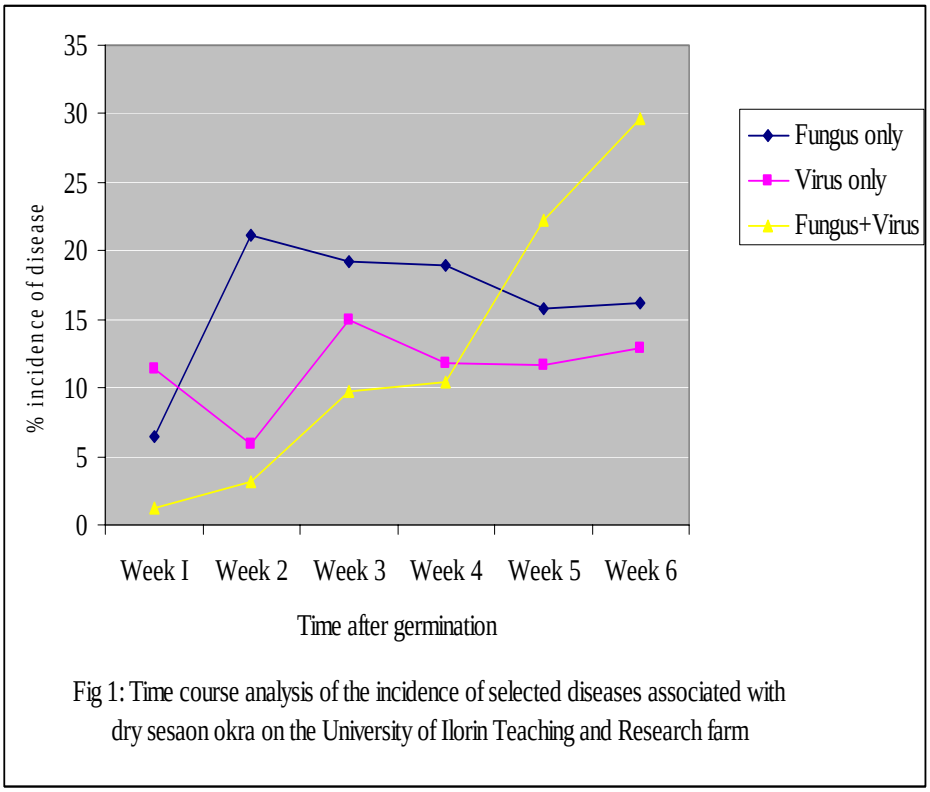

Fig 1: Time course analysis of the incidence of selected diseases associated with dry sesaon okra on the University of Ilorin Teaching and Research farm

Marginal incidence at different stages of growth

Figure 2 illustrates the mean marginal incidence of the various pathogenic diseases at different stages of growth of okra. At the end of stage 1 of growth (i.e. seedlings stage), plants infected with fungus only was the highest (21.1%) while mixed fungal + viral infection was lowest. The trend, however, was different in stage 2 (i.e. pre-flowering stage). The percentage new incidence of fungus had reduced by 2.1% , while plants with mixed infection symptoms increased (7.2%). At stage 3 of growth, the new incidence of fungus + virus disease rose significantly (19.4%).

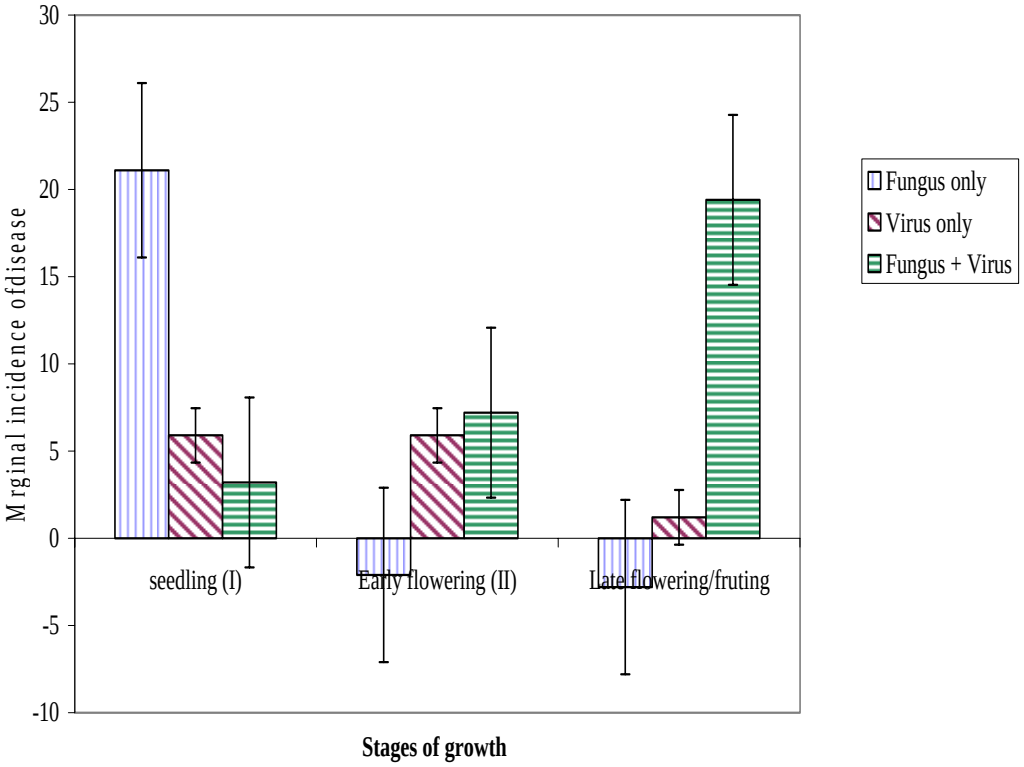

Fig 2: Mean marginal incidence of diseases at 3 different stages of growth of okra planted during the dry season.
Error bars are standard errors of the data

Total incidence regardless of pathogenic cause

As shown in Fig 3, on absolute basis i.e. regardless of the causal pathogen, stage 1 had total incidence of diseases at 30.2% of all plants in the experimental area. Stage 2 had 40.2% incidence, while stage 3 had 58.8%. This shows the cumulative nature of disease incidence under the prevailing condition of the experiment.

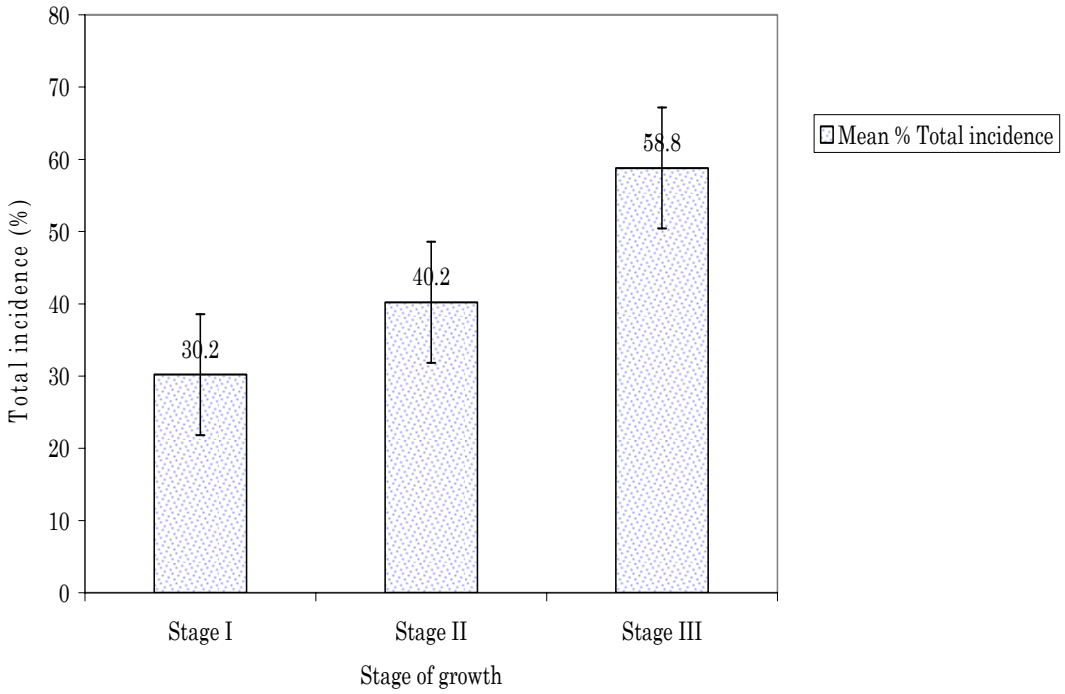

Fig 3: Mean % total incidence of all diseases regardless of the pathogenic cause at different stages of growth of okra. Error bars are standard errors of the individual data. Data represent an aggregate for two years.

Growth attributes

Table 1 shows that there were significant differences between plant height and mean number of leaves of healthy and diseased plants, measured at first harvest (i.e. at the 3rd stage of growth). The diseased plants had an average mean height of 52 cm while the healthy ones were an average of 74 cm, indicating significantly taller healthy plants. The mean number of leaves per healthy plant was 11.2 while that of the diseased ones was 8.4.

Table 1: Selected growth and yield attributes of healthy and diseased dry season okra plants at first harvest (2005 and 2006).

Treatments	Mean Height of plants at harvest (cm)	Mean number of leaves at harvest	Mean number of Pods/plant	Total weight of Pods/plant (g)	Mean weight of a pod (g)
Healthy	74.5a	11.2a	5.5a	90.7a	16.6a
Diseased	52.2b	8.4b	3.2b	44.9b	14.2b
S.E.	2.219	0.341	0.334	5.223	0.484

Means followed by different letters are significantly different at $P<0.05$ using Anova.
Data is an aggregate for two years.

Yield attributes

There were significant differences between healthy and diseased plants with regard to the mean number of edible pods produced per plants and the total weight of edible fruits per plant as at first harvest. The number was a mean of 3 pods per plant for the diseased plants and 5 pods per plant for the healthy ones. The total weight of pods per plant was 44 g for the diseased plants and 90 g for the apparently healthy ones (Table 1). The mean weight of a pod from healthy plants was significantly higher (16.5 g) than that for diseased plants (14.15 g).

Discussion

Consideration of the results showed that dry season okra was attacked by both fungal and viral agents causing diseases at the various stages of growth. Stage 1, which is the early seedling stage from day of germination to the 14th day, was shown to have the highest percentage rate of single fungal disease incidence. Most of the early infection was soil-based and this could be a result of the resident fungal population, seed infestation and the irrigation method adopted (Furrow irrigation). Hill and Waller [4] suggested crop sanitation, which includes all control measures designed to prevent dispersal of pathogens through infested seed, plant propagating material, and crop residues, or by means of infective propagules carried by wind, rain-splash, moving water or animals. In cases of root diseases caused by fungi, Holliday [5] suggested the use of sprinkler irrigation system rather than the furrow system where practicable.

The percentage single viral infection in the first stage of growth was lower compared with single fungal infection. Many viral diseases on crops are usually as a result of the presence of vectors such as aphids or leafhoppers that are carriers of viral pathogens. Therefore, the lower incidence of viral disease indicates a relatively low vector population at the initial stages of growth in mid January. Seed transmission was also very low. However, the observable increase in insect vector population with time apparently led to significant increase in new viral incidence and mixed infection of already fungal-infected plants. Plants with these double infections were the most retarded in growth and had lower yield attributes as at harvest. Mixed infection of okra with *Meloidogyne incognita* and *Phythium aphanidermatum* has been reported as causing a more severe disease syndrome than single infections with individual pathogens [3]. In some tomato cultivars, some mixed viral infections are known to cause severe growth retardations and low yield attributes [2].

The results of this present study has highlighted the need to sensitize growers in this area to the practice of fungicidal seed treatment before sowing, to curtail the initial high fungal incidence, and seedling treatment with appropriate insecticides to forestall widespread vector transmission of viral diseases during the vegetative stages of dry season okra in the derived Savannah, otherwise known as the Southern Guinea savannah ecology of Nigeria.

References

1. Balogun, O.S and J.O Babatola 1999. Effect of plant age and injury on the pathogenicity of *Choanephora cucurbitarum* on okra *Abelmoschus esculentus* Moench *Agrosearch* 5: 62-69.
2. Balogun, O.S. 2003. Patterns of disease manifestation in tomato seedlings, singly or doubly infected with *Potato X potexvirus* and *tobacco mosaic tobamovirus*. *Biokemistri*. 14: 59 – 68.
3. Balogun, O.S. and R.K. Odutola, 2003. The influence of infection sequence and plant age on the development of the root knot and root rot disease complex in okra. *Journal of Tropical Biosciences* 3: 68-73.
4. Hill, D.S and J.M. Waller, 1990. Pests and diseases of tropical crops. Field handbook. Longman Group U.K Ltd. vol. 2.
5. Holliday, P. 1980. Fungus Diseases of Tropical crops. Cambridge University press.
6. Kochhar, S.L., 1986. Tropical crops: a textbook of economic botany. Pp 263-264.
7. Lyon, H.H and W.T. Johnson, 1994. Identifying diseases of vegetable (AGRS – 21), the Pennsylvania State University, Publication distribution center, pp 20-30.