Response of Four Varieties of Courgettes (*Cucurbita pepo*) to Powdery Mildew (*Sphaerotheca fuliginiea*) Disease

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Abstract

Courgettes are known to be good source of Potassium, an important intra-cellular electrolyte that helps in reducing blood pressure problems. Powdery mildew disease has become a stumbling block to yield, quality and production of Courgettes in both greenhouse and field production. A study was conducted to screen different varieties of Courgettes; Hybrid Squash STAR 8021, Hybrid Squash Ambassador, Dark Green Zucchini, Squash Black Beauty against powdery mildew inoculum. This was carried out at the School of Agriculture and Biotechnology – University of Eldoret, greenhouse and laboratory where four varieties of were planted in a Completely Randomized Design (CRD) with 3 replicates each. Fresh Diseased plant materials were then collected from CHEPFRESH and isolated to obtain inoculums by scraping the conidia of a virulent isolate into sterilized distilled water. Courgettes in the greenhouse were then transferred to the laboratory at stage of 16th day after germination for inoculation. Inoculation was done by spraying using a hand sprayer until run-off. There was no use of chemicals in the management of the disease. Data was collected on height of plant at intervals of 1 week, number of fruits per plant, days to flowering and disease severity rated at 0-5 rating scale 8 days after inoculation. The quantitative data collected was subjected to Analysis of Variance (ANOVA) using Genstat Version 14.1 and means separated using Duncan's Multiple Range Test. From the results there was a difference between the four varieties on their response to disease where Hybrid Squash STAR 8021 (highly susceptible), Hybrid Squash Ambassador (susceptible), Dark Green Zucchini (resistant), Squash Black Beauty (moderately susceptible). On number of fruits, Hybrid Squash STAR 8021 had the highest mean (8.250) and Dark Green Zucchini with the lowest mean (3.750).

Key Words: Powdery Mildew, *Sphaerotheca fuliginiea*, Response, *Cucurbita pepo*

Introduction

Courgette is a horticultural crop in the family of Cucurbitaceae that originated in Central America. It is considered as a vegetable whose synonyms are; summer squashes, vegetable marrow and zucchini Courgette fruits are small, firm and fleshy that can be steamed, boiled, fried or roasted depending on the taste of the consumer. It is grown in tropics from lowlands up to 2500 m above sea level. They are warm season crops adapted to monthly mean temperatures of 18-27°C and respond well to medium to heavy application of compost or well decomposed manure. They can be cultivated on almost any fertile, well drained soils that are neutral or slightly acidic (pH 5.5-7). The crop currently has become a valuable export crop in Kenya especially to Spain where it is sold at 72 cents to the thin Courgette fruits and 70 cents to the thick ones (agronoticias.es, publication on 21st September 2015). Courgettes are known to be good sources of potassium that is an important intra-cellular electrolyte and helps in reduction of blood pressure, its peels also have dietary fibre that helps in reducing constipation when consumed. Its fresh roots are rich in Vitamin A and contain moderate levels of vitamins like Thiamin and minerals like Iron, Manganese, Phosphorous and Zinc also its one of the very low calorie vegetable; provides only 17 calories per 100g. It contains no saturated fats or cholesterol. Production of this crop becomes thus important but there are factors that lower its productivity in-terms of yields and marketability. Some of the production constraints include: pests like Aphids and diseases like powdery mildew, downy mildew, cucumber mosaic virus disease and Zucchini yellow virus disease. Powdery mildew is the main fungal disease that kills its hosts but utilizes their nutrients, reduces photosynthesis, increases respiration and transpiration, impairs growth and reduces yields sometimes by as much as 20-40% (Agrios, 1997). This is due to decrease in size or number of fruits and decrease in the length of the harvest period and premature senescence of the infected leaves resulting to reduction in market quality because the fruit become sunburnt and some ripen prematurely. Such fruits show poor storability, poor flavor and poor color. The infection also predisposes the plants to other diseases like Gummy Stem Blight. It has not been known how fungus causing the disease survive between seasons therefore crop rotation and cultural practices have shown very little effect on the incidence of powdery mildew making it difficult to manage the disease. Powdery mildew is caused by *Sphaerotheca fuliginea* or *Erysiphe cichoracearum.* The disease affects the yield and quality of a wide range of edible and non-edible horticultural crops both in the field and protected productions.

Research has been done to find the solutions to powdery mildew like; use of cow's milk against Zucchini powdery mildew under greenhouse conditions (Bettiol, 1999) and in 2002 and 2008 milk proved to work effectively on Cucurbitaceae family crops as some conventional fungicides and better than Benomyl and Fenanimol at higher concentration (Crisp *et al.,* 2002 and Bettiol *et al.,* 2008), foliar application of potassium silicate to reduce severity of powdery mildew in Zucchini and use of Bacillus subtilis for the control of Powdery mildew in Zucchini.Among the many research done there is no any that concentrates on screening how courgette varieties responds to powdery mildew under greenhouse condition. There are research

gaps that still existing such as developing a chemical that can completely manage powdery mildew regardless of strains diversity.

With all these challenges of decreased production the research on response of different varieties of courgettes to powdery mildew disease will help in increasing productivity of courgettes.

Methodology

The study was carried out in the University School of Agriculture greenhouse and Laboratory. Two hybrid varieties and two local varieties of Courgettes (Hybrid Squash STAR 8021, Hybrid Squash Ambassador, Dark Green Zucchini, Squash Black Beauty) were obtained from seed shops and screened basing on their tolerance, resistance and susceptibility to powdery mildew.

Soils collected from the university farm were mixed with planting mavuno fertilizer and each variety replicated 3 times and CRD design used. Diseased plant materials were obtained from CHEPFRESH and taken to laboratory. In the laboratory, conidia of a virulent isolates were scraped from the fresh leaves into a Sterile Distilled Water.

Courgettes were transferred to the laboratory at stage of 16^{th} day after germination for inoculation. Inoculation was done by spraying using a hand sprayer until run-off. There was no use of chemicals in the management the disease.

Data Collection

Data was collected before inoculation, at inoculation and after inoculatio on performance of the varieties. The parameters considered were; heights and diameter of plants at intervals of 1 week (cm)- this was measured using a ruler, plant height at inoculation, days to flowering, number of fruits per plant to show whether there is any influence of the crops to pathogen presence. The severity of disease was then scored on 0-5 rating scale according to Jan (1999) but with slight modifications, where 0= no spore colonies was highly resistant, 1= few spores scattered was resistant, 2= numerous spores scattered on the leaves was moderately resistant, 3= 10%-50% of the leaf area covered by colonies was moderately susceptible, 4= 50% of the leaf area covered by spores was susceptible and 75%-100% of the leaf area covered by the spores was highly susceptible. What were the modifications made to Jan's protocol?

Data Analysis

Quantitative data was subjected to Analysis of variance on GENSTAT version 14.0 and means separated using Least Significant Difference at 5% level of significance

Results

Days to Flowering

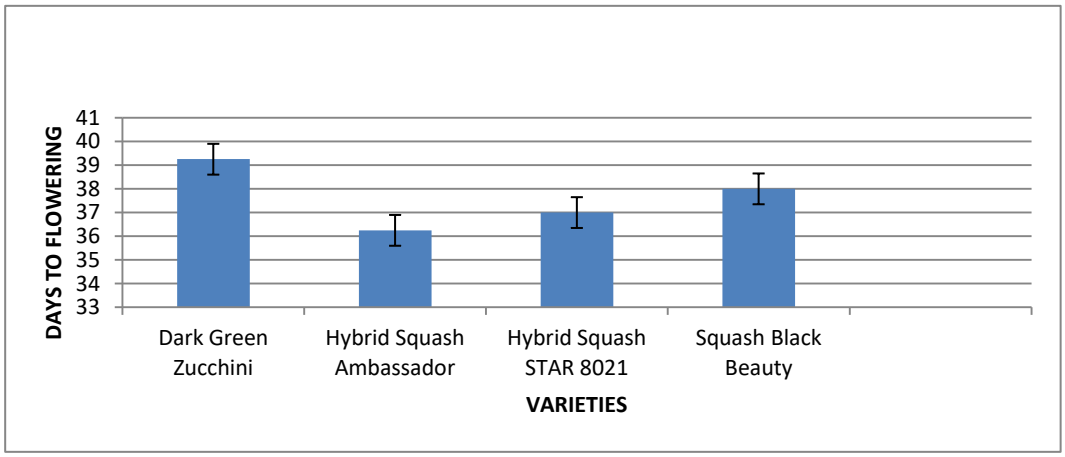

Figure 1. Days to flowering of four varieties of Courgettes (*Cucurbita pepo*)

The analysis of variance for days to flowering showed that there were significant differences (P≤0.001) on treatment means of the four varieties. Dark Green Zucchini(39.25d) took the longest time to flower and had a significant difference between Squash Black Beauty(38.00c), Hybrid Squash STAR 8021(37.00b) and Hybrid Squash Ambassador(36.25a). The results indicated that as the varieties were responding to the pathogen effect, they influenced their days to flowering.

Plant Diameter

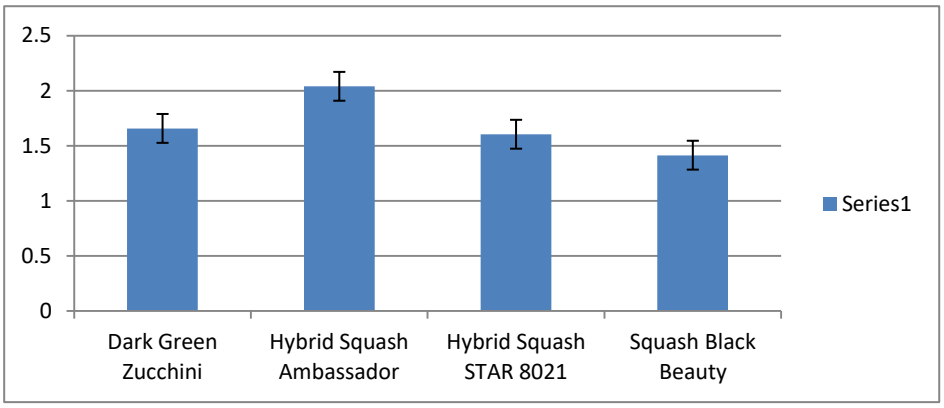

Figure 2. Plant diameter of four varieties of Courgettes (*Cucurbita pepo*)

The analysis of variance for the plant diameter showed that there were significant differences (P≤0.012) on treatment means of the four varieties. Hybrid Squash Ambassador (2.039b) being the highest and have a significant difference between Squash Black Beauty (1.414a), Hybrid Squash STAR 8021(1.604a) and Dark Green Zucchini(1.657a) which have no significant difference between them.

Number of Fruits

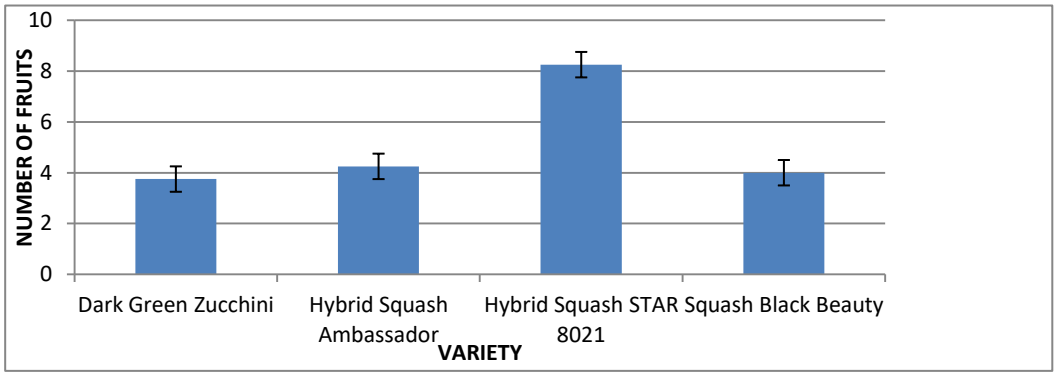

Figure 3. The number of fruits of four varieties of Courgettes (*Cucurbita pepo*)

The analysis of variance for the number of fruits showed that there were significant differences (P≤0.001) on treatment means of the four varieties. Hybrid Squash STAR 8021 (8.250b) with the highest number of fruits, Hybrid Squash Ambassador (4.250a), Squash Black Beauty (4.000a), Dark Green Zucchini (3.750a).

Plant Height

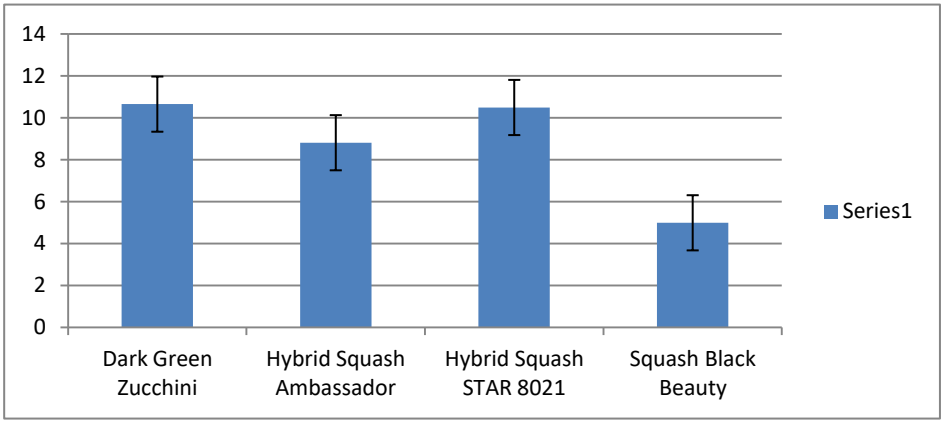

Figure 4. The plant height of four varieties of Courgettes (*Cucurbita pepo*)

The analysis of variance for plant height showed that there were significant differences (P≤0.001) on treatment means of the four varieties. Dark Green Zucchini (10.650c), Hybrid Squash STAR 8021 (10.489bc), Hybrid Squash Ambassador (8.811b), Squash Black Beauty (4.988a). This exhibited that there was a negative effect on the height of the plant due to disease response.

What was to be achieved by collecting data on the following in relation to the main focus of the papers?: days to germination, days to flowering even the plant height, diameter etc

Disease Severity

Hybrid Squash Ambassador Ambassador and its Control


At inoculation


14 days after inoculation


21 days after inoculation

Dark Green Zucchini


At inoculation


14 days after inoculation


21 days after inoculation

Squash Black Beauty and its control

At inoculation 14 days after inoculation 21 days after inoculation

Hybrid Squash STAR 821

At inoculation 14 days after inoculation 21 days after inoculation

- Squash Black Beauty = had 10%-50% of the leaf area covered by spores thus moderately susceptible.
- Hybrid Squash STAR 8021= had 75%-100% of the leaf area covered by colonies of spores thus highly susceptible
- Dark Green Zucchini= had few spores scattered on the leaves resistant
- Hybrid Squash Ambassador= had 50% of the leaf area covered by spores thus susceptible
- How many times was data on disease severity collected? Were the results consolidates?

Discussion

There was a significant difference between the four varieties in their response to powdery mildew inoculums. This was due to the difference in their genetic make-up as they respond to the

attack by the pathogen. The Dark Green Zucchini which is the resistant variety had fewer fruits therefore this variety had greater capacity to limit the growth and development of powdery mildew pathogen while Hybrid Squash STAR 8021 which was the highly susceptible variety had the highest fruit number due to their yielding capacity. The disease causes a reduction in size and texture of fruits, reduced harvesting period due to pre-mature senescence of infected leaves. Due to this disease effect both plant height and stem diameter is influenced together with days to flowering.

This research topic aimed at reducing growers' reliance on conventional fungicides available for powdery mildew control.

Conclusion

Resistant squash varieties will continue to be an important tool for managing powdery mildew since there is reduced environmental hazards as compared to control of powdery mildew using pesticides. The genetic make-up of Dark Green Zucchini was able to resist the effects of the pathogen as compared to Squash Black Beauty, Hybrid Squash STAR 8021 and Hybrid Squash Ambassador. This demonstrates that genetic resistance is important in management of powdery mildew disease.

Recommendation

Farmers to use Dark Green Zucchini since it is the most resistant variety compared to the four varieties used in the research. Researchers and breeders to continue with research since the variety with the lowest fruits were resistant to the inoculums.

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