SHORT COMMUNICATION

Cercospora duddiae Welles. (1923) alters the Nutritional Content of Garlic Leaves after Inducing Leaf Spot Disease

Mayur A. Dongre*

DOI: 10.18811/ijpen.v9i04.13

Abstract

As a vegetable, garlic leaves can be used in cooking. They are used in various recipes, primarily in India; Maharashtrian people frequently use garlic leaves. The foods taste better because of the powerful flavor and aroma. In addition, it can enhance the flavor of the foods rather than using no garlic leaves. It can be steamed, fried, or added to the soup. The study report is based on data collected over five years from five distinct Maharashtra zones. Garlic is one of the onion family plants on which the fungus *Cercospora duddiae* grows. Pathogens causing infection then produce leaf spot disease. Pathogen *C. duddiae* consumes basic nutrients from leaves during infection, changing the contents from a healthy one. The current study establishes the pathogenicity of *C. duddiae* on garlic plant leaves. It quantifies the nutrients in fully developed disease spots before contrasting them with healthy ones. According to the, the following values have changed: water content decreased by 38.333%, total carbohydrate by 36.764%, reducing the sugar by 5.263%, fibre by 22.580%, protein increased by 47.619%, amino acids increased by 25%, dry matter increases by 29.677%. Lipids contents, vitamin C contents and total chlorophyll contents are absent in diseased samples.

Keywords: Garlic, *Cercospora*, Nutrient, Fungi, Leaf Spot and Maharashtra.

International Journal of Plant and Environment (2023); **ISSN:** 2454-1117 (Print), 2455-202X (Online)

Introduction

Garlic belongs to the members of the *Allium* (onion) family plants. It has been farmed for 500 years; symbols of agriculture may be seen throughout history, including Mesopotamian literature from 3000 BC and Egyptian art from 2700 BC (Block, 2014). Some plants other than garlic are leeks, shallots, and onions. A clove is a portion of a garlic bulb. Due to its powerful aroma and mouthwatering flavor, garlic is a common component in cooking. However, due to garlic's health and medical benefits, people have used it extensively. Many significant civilizations, including the Egyptians, Greeks, Romans, Chinese, and Indians, have used it. (Healthline Editorial Team, 2020)

In the production of Garlic in India, Madhya Pradesh ranked first with a total of 62.85%, While Maharashtra ranked tenth with 0.71% of total country garlic production (India's production of garlic. (2021-22), National Horticulture Board. (2021)

Generally, we all use bulbs and cloves of garlic, but one more component used in rural areas is garlic leaves. Garlic leaves can be used in cooking as a vegetable. They are generally utilized in Indian cuisine; Maharashtrians typically employ garlic leaves. The strong flavor and perfume make the food taste better. Moreover, it can improve the flavor of the cuisine as opposed to not utilizing any garlic leaves. It can be cooked, steamed, or included in the soup. The leaf juice extract was mixed with flour and made pancake or bhakar, a type of thick bread.

Many pathogens are attacking plants and causing various diseases, including *Cercospora duddiae*, a fungus responsible for leaf spot disease. It was the first time reported by Welles in 1923 from the Philippines. Udit Narain and Sakshena,1971 reported this disease from India for the first time. Pathogen *C. duddiae* belongs to Ascomycota, order Capnodiales and the family Mycosphaerellaceae.

Shri. Shivaji Vidhya Prasarak Sansthas, Late Karmveer Dr. P. R. Ghogrey Science College, Deopur, Dhule, M.S., India

***Corresponding author:** Mayur A. Dongre, Shri. Shivaji Vidhya Prasarak Sansthas, Late Karmveer Dr. P. R. Ghogrey Science College, Deopur, Dhule, M.S., India, Email: mayurdon82@gmail.com

How to cite this article: Dongre, M. A. (2023). *Cercospora duddiae* Welles. (1923) alters the Nutritional Content of Garlic Leaves after Inducing Leaf Spot Disease. International Journal of Plant and Environment. 9(4), 382-384.

Submitted: 22/09/2023 **Accepted:** 24/11/2023 **Published:** 28/12/2023

Material and Methods

The material and method for this study have been divided into the following categories: sample collection, disease characteristics, pathogenicity test, and isolation of nutrients from the sample. (Dongre, 2021,2022; Dongre and Borse, 2019,2021).

Collection of Sample

Maharashtra was divided into six administrative divisions suggested by (Wikimedia, 2021). Disease samples from five divisions of these six divisions, and at least two samples were processed for further analysis from each division. The details of places of collections are tabulated in Table 1.

Symptoms of the Disease

The symptom of the disease started as an elongated or circular spot with brown color and a yellowish margin initially occurring on the leaf surface. Small spot later elongates and sometimes occupy the entire leaf surface. The area of the spot gets dried, and black-coloured or dark-coloured hyphal mass, especially conidiophore seen on the grey-coloured dried leaf surface. (Fig. 1A, B and C)

As this disease occurs and occupies an area on a leaf, it reduces the photosynthetic rate and production of food. High temperature with moisture favors the growth of the disease; this disease occurs in the early summer in Maharashtra, from February to April.

Morphology of Pathogen

Conidiophores grow in groups on the surface of leaves. They are in a group of 5-18, with the blackness of the conidiophore increasing from top to bottom. The bottom of the conidiophore was dark, while the tip was hyaline. Knee bending is visible; the conidiophore may sometimes be straight or bent. Conidiophores range from 5 to 6.7 µm in diameter to 84 to 195 µm in length. Conidia are needle-like, hyaline structures that are straight or slightly bent. The base of the conidia was broad, and the tip was sharp and septate. Conidia have diameters ranging from 3.5 to 5 µm and lengths ranging from 60 to 210 µm. (Fig. 1: D, E, F and G)

Pathogenicity Confirmation

The healthy leaves of the cultivated plant were inoculated with the pathogen isolated from the diseased spot. After a week, the same symptoms appeared on healthy leaves cultivated in controlled conditions. As the pathogen induces the same disease, it confirms the pathogenicity ability of it.

Biochemical Analysis

The plant sample collected at the site was stored in cool conditions to check deterioration. The sample was quickly analyzed for listed biochemical contents using standard protocols suggested by authors and writers; sometimes, some modifications are employed to achieve better results.

Hedge, J. E. and Hofreiter, B. T.'s 1962 anthrone method was used to measure total carbohydrates. Systronics 2202 double beam UV Visible spectrophotometer was used to measure the absorbance of reference glucose and samples from the sick and healthy heads at 630 nm. The major components of crude fibre are cellulose, lignin, and a few minerals. The degradation of cellulose and lignin was caused by acid and alkali treatment. The sample's crude fiber content can be determined from the starting and final weights after igniting at 600^0C. Reducing sugar was calculated by employing the Nelson-Somogyi (1944) and Somogyi, M. (1952) method and the arsinomolybdate reagent. On a Systronics 2202 double-beam UV-visible spectrophotometer, absorbance was measured at 520 nm. The Lawry *et al.* (1951) method was used to calculate the protein content of healthy and diseased leaves.

Using a double-beam Systronics 2202 UV-vis spectrophotometer, absorbance was measured. As per the instructions provided by Sadasivam S. and Manickam (2005), the lipid from leaves was extracted using the Soxhlet apparatus with petroleum ether as the solvent. The ninhydrin technique was used to estimate the free amino acid content. On a Systronics 2202 double-beam UV-vis spectrophotometer, the absorbance was measured at 570 nm. Water content, as well as dry matter content, were examined using the Ruck (1969) method. Leslie J. Harris and Mamie Olliver (1942) and Sadasiwam and Manickem (2005) gave the method used to estimate ascorbic acid contents.

Observations

The disease symptoms and morphology confirm that the pathogen is *Cercospora duddiae* Welles, (1923). Identifying pathogenic fungi after references to Barnett and Hunter (1998), Dix and Webster (1995), Kirk *et al.* Dictionary of Fungi (2011), Ellis (1971), Koike *et al. (*2007). The amount of healthy leaf and the diseased part of the leaf is summarised as Carbohydrates, Fibres, Lipids, Proteins, Amino acids, Ascorbic acids, Chlorophyll, Dry matter, and Water contents in Table 2.

Table 1: Sample collection sites for *C. duddiae*-infected garlic leaves.

Sr. No	*Division*	*Location*
	Nagpur Division	21°26′48.6″N 80°03′09.2″E
	Nagpur Division	21°27′35.5″N 80°11′53.4″E
	Amravati Division	20°24′12.7″N 78°08′02.4″E
	Amravati Division	21°03′19.7″N 76°06′11.7″E
	Aurangabad Division	20°15′36.3″N 75°08′04.9″E
	Aurangabad Division	18°27′43.1″N 75°39′27.8″E
	Nashik Division	20°00′50.3″N 73°47′39.7″E
	Nashik Division	20°55′44.0″N 74°46′35.6″E
	Pune division	19°06′29.5″N 74°46′52.4″E
	Pune division	18°42′43.2″N 73°50′37.9″E

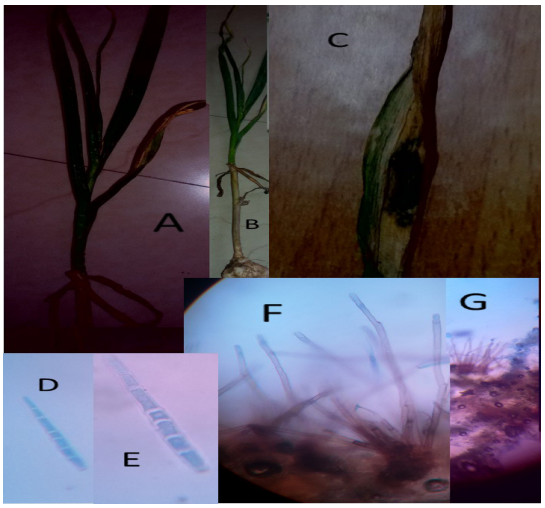

Fig. 1: Garlic plant with infection of *Cercospora duddiae* (A and B), Part of leaf showing infection (C), Conidium (D and E) and Section through infection (F- Conidiophores and G- low power view).

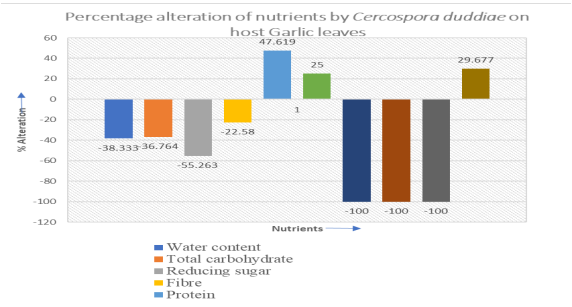

Fig. 2: Percentage alteration of nutrients by *Cercospora duddiae* on host Garlic leaves

Table 2: Nutrient content in Healthy and Diseased vegetables and % alteration of content by *Cercospora duddiae* on Garlic leaves

Sr. no.	*Nutrients*	*Content in 100gramfresh material*	*Content in 100gram diseased vegetable*	*% alteration due to disease*
	Water content	69 Grams	59.8 Grams	-38.333
	Total carbohydrate	6.8 Grams	4.3 Grams	-36.764
	Reducing sugar	3.8 Grams	1.7 Grams	-55.263
	Fibre	3.1 Grams	2.4 Grams	-22.580
	Protein	1.4 Grams	3.1 Grams	47.619
	Amino acids	2.8 Grams	3.5 Grams	25
	Lipids	0.2 Grams	00 Grams	-100
	Vitamin C	62 mg	00mg	-100
	Chlorophyll content (total)	13.4 mg	00mg	-100
	Dry matter	31 Grams	40.2 Grams	29.677

Result

As per the morphological and diseased symptoms, the pathogen is *C. duddiae*; the pathogenicity test confirms the potential of isolated fungi to create disease in the healthy part of the plant.

According to the observation values protein content increased by 47.619%, amino acids by 25%, and dry matter by 29.677% in diseased material than healthy ones. Water content decreased by 38.333%, total carbohydrate decreased by 36.764%, reducing sugar decreased by 5.263%, and fibre decreased by 22.580% in the diseased sample. Lipids, vitamin C and total chlorophyll content are absent in the diseased sample and from its healthy control plant sample, tabulated in Table 2 and shown in Fig. 2.

Conclusion

Cercospora duddiae is a pathogen responsible for leaf spot disease. The reduction in the quality of leaves and the retardation of nutrients like carbohydrates, fibre, lipids, vitamin C, chlorophyll, and water contents.

Acknowledgment

The author is thankful to the institution and department for their support and researchers whose work here cited.

Author contribution

The study's conceptualization and design, data collection, analysis and result interpretation, as well as the creation of the paper, all bear the author's complete responsibility.

Conflict Of Interest

I wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

References

Barnett, H. L., & Hunter, B. B. (1998). Illustrated genera of imperfect fungi (4th ed.). APS Press.

Block, E. (2014). Garlic and other Allium: The lore and science [Webinar slides]. American Chemical Society. https://www.acs.org/content/dam/acsorg/events/culinary-chemistry/Slides/2014-09-11-alliums-final.

Dix, N. J., & Webster, J. (1995). Fungal ecology. Chapman & Hall.

Dongre, M. A. (2021). Colletotrichum capsici, pathogen alter nutritive value of greenchilli (Capsicum annum L.). International Research Journal of Management Science and Technology, 11(10), 96–101. https://doi.org/10.5281/zenodo.7700690

Dongre, M. A. (2022). Nutrient alteration study on coriander infected with Alternaria poonensis Raghunath. Journal of Mycology and Plant Pathology, 52(4), 409-413. https://doi.org/10.13140/RG.2.2.22635.11042

Dongre, M. A., & Borse, K. N. (2019). Nutrient alteration study on leafy onion (Allium cepa L.) infected with Alternaria porri from Maharashtra state, India. Journal of Emerging Technologies and Innovative Research, 6, 182-187. https://doi.org/10.5281/zenodo.7671715

Dongre, M.A., & Borse, K.N. (2021). Change in nutritive value of cabbage after infection of Colletotrichum dematium (Pers.) Grove. International Journal of Scientific Research in Science and Technology, 9(6), 885–889. https://doi.org/10.5281/zenodo.7685692

Ellis, M. B. (1971). Dematiaceous hyphomycetes. Commonwealth Mycological Institute.

Harris, L. J., & Olliver, M. (1942). The reliability of the method for estimating vitamin C by titration against 2:6-dichlorophenolindophenol. Biochemical Journal, 36, 155-182.

Healthline Editorial Team. (2020, November 6). 11 proven health benefits of garlic. Healthline. https://www.healthline.com/nutrition/11-proven-health-benefits-of-garlic

Hedge, J. E., & Hofreiter, B. T. (1962). Determination of reducing sugar and carbohydrates: Anthrone colorimetric method. In R. L. Whistler & J. N. B. Miller (Eds.), Methods in carbohydrate chemistry (Vol. 17, pp. 380-394). Academic Press.

India's production of garlic. (2021-22). Agricultural and Processed Food Products Export Development Authority. https://agriexchange.apeda.gov.in/India%20Production/India_Productions.aspx?hscode=1100

Kirk, P. M., Cannon, P. F., Minter, D. W., & Stalpers, J. A. (2011). Dictionary of the fungi (10th ed.). CABI.

Lowry, O. H., Rosebrough, N. J., Farr, A. L., & Randall, R. J. (1951). Protein measurement with the Folin phenol reagent. Journal of Biological Chemistry, 193, 265-275.

Narayan Udit, and Saksena, H. K. (1971). New record of Cercospora from India,Sydowia 25:134-136.

National Horticulture Board (NHB). (2021-22). Indian Production of Garlic. India production of garlic. https://agriexchange.apeda.gov.in/India%20Production/India_Productions.aspx?hscode=1100

Nelson, N., (1944). A photometric adaptation of Somogyi Method for the determination of Glucose. J. Biol. Chem. 153, 375-380.

Ruck, J. A. (1969). Chemical methods for analysis of fruit and vegetable products. Canada Department of Agriculture.

Sadasivam, S., & Manickam, A. (2005). Biochemical methods (2nd ed.). New Age International.

Somogyi, M. (1952). Notes on sugar determination. Journal of Biological Chemistry, 195, 19-23.

Wellees, C.B. (1923). A new leaf spot of Onion and Garlic. Phytopathology 13, 362-365.

Wikimedia Foundation. (2021, September). List of districts of Maharashtra. Wikipedia