



**BIO-CONTROL OF CHILLI PLANT BY *Aspergillus parasiticus* DERIVED  
ELICITORS**

**SELIYA A AND SHRIVASTAV A\***

Department of Microbiology, Parul University, Vadodara, Gujarat 391760

\*Corresponding Author: E Mail: [anupama.shrivastav82045@paruluniversity.ac.in](mailto:anupama.shrivastav82045@paruluniversity.ac.in)

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**ABSTRACT**

Host defence mechanisms can be elicited by using different elicitors produced from the pathogen/host. In this study, an effort has been made to study the effect of two fungal elicitors derived from *Aspergillus* spp. and *A. parasiticus* on induction of various defence related enzymes in Chilli. Foliar application was done on 20-days-old Chilli plant with 10% *A. parasiticus* fungal culture filtrate (APFCF) as elicitors to trigger systemic acquired resistance (SAR). As a response of SAR, an increase in activities of phenylalanine ammonia lyase (PAL), Total protein content, Total phenol content, Germination in form of vigor index were found highest on 4th day after treatment (DAT) in comparison with the control plants. The treated plants showed enhanced growth and development as well as increase in yield. About 100% survival rate was found in Chilli seeds treated with *Aspergillus* spp. and APFCF than control. The enhanced activities of defence enzymes and elevated protein, phenol, chlorophyll content in treated Chilli plants suggest the induction of SAR against *Aspergillus* spp and *A. parasiticus* by using the same fungal elicitors.

**Keywords:** *Aspergillus parasiticus*, *Capsicum frutescens* (Chilli), *Aspergillus parasiticus* fungal culture filtrate (APFCF), Phenylalanine ammonia lyase (PAL), Enzymes

**INTRODUCTION**

The chili pepper is the fruit of plants from the genus *Capsicum* which are members of the nightshade family, Solanaceae. Chili peppers are widely used in many cuisines

as a spice to add heat to dishes. The substances that give chili peppers their intensity when ingested or applied topically are capsaicin and related compounds

known as capsaicinoids. Chilies are reported to have cultivated in Peru since pre-historic times. Nevertheless, India has now become the largest producer as well as the exporter of chilies in the world. Indian chilies are known for their pungency and color particularly grown Guntur district of Andhra Pradesh state. It is estimated that around 25-30% of the chili crop is used for powder preparation [5].

The large sized and mild form varieties are called bell peppers or paprika or capsicum in different countries and are used primarily as vegetables. Chili peppers originated in Mexico. After the Columbian Exchange, many cultivars of chili pepper spread across the world, used for both food and traditional medicine. *Capsicum* fruits have been a part of human diets since about 7,500 BC, and are one of the oldest cultivated crops in the Americas as origins of cultivating chili peppers are traced to northeastern Mexico some 6,000 years ago. They were one of the first self-pollinating crops cultivated in Mexico, Central America, and parts of South America [1].

Peru is considered the country with the highest cultivated *Capsicum* diversity because it is a Center of diversification where varieties of all five domesticate were introduced, grown, and consumed in pre-Columbian times. Bolivia is considered to be the

country where the largest diversity of wild *Capsicum* peppers is consumed [12].

Chili is one of the most important and the largest produced spice in India and India its pale of pride in chili production as well as exports. Chili is reported to have originated from South America and was believed to be introduced to the rest of the world by Columbus. Chili is also referred as hot pepper, red pepper, cayenne pepper, capsicum, etc. Most of the cultivated varieties in India belong to the species *Capsicum annum* [3].

The chili pepper features heavily in the cuisine of the Goan region of India, which was the site of a Portuguese colony. Chili peppers journeyed from India, through Central Asia and Turkey, to Hungary, where they became the national spice in the form of paprika. Worldwide in 2016, 34.5 million tones of green chili peppers and 3.9 million tones of dried chili peppers were produced. China was the world's largest producer of green chilies, providing half of the global total. Global production of dried chili peppers was about one ninth of fresh production, led by India with 36% of the world total [12].

Birds do not have the same sensitivity to capsaicin, because it targets a specific pain receptor in mammals. Chili peppers are eaten by birds living in the chili peppers' natural range, possibly contributing to seed dispersal and evolution of the protective

capsaicin in chili peppers. Red chillies contain large amounts of vitamin C, other species contain significant amounts of pro vitamin A beta-carotene. In addition, peppers are a rich source of vitamin B6 [12].

Chillies need moisture for growth. It has been found that black soil which retains moisture is ideal in case they are grown as rainfed crops. Under irrigated conditions, the crop needs well drained sandy loam with rich organic content. They can also be grown in deltaic soil under irrigated conditions. Chilli is grown in both tropical and sub-tropical climate as it comes up well in warm humid climate with an optimum temperature of 20 to 25°C. It is grown as a rainfed crop at an annual rainfall of 25-30 cm. However, excessive rainfall is harmful to the crop causing defoliation [9].

Although it can be growth on all types of soils, it is best suited for sandy loams and clay loams with proper drainage. Chillies are grown throughout the year at one or the other parts of the country for vegetable purpose. Chill is grown both in kharif and rabi seasons. The crop planting starts from July-August and extends till October [9].

Crop takes around 180-200 days for maturity. Green chillies are harvested at regular intervals for vegetable purpose. Fully ripe chillies are harvested at the maturity for the production of dry red chillies [14].

Chillies are crops that cannot withstand a lot of water. Heavy rainfall and stagnated water would result in rotting of the plants. In case of irrigated crops, watering should be only when it is necessary. A frequent watering would result in shedding of flowers and a spurt of vegetative growth [13].

The amount of water to be irrigated, the number of irrigations and its frequency highly depends on the climatic conditions and the soil type. If the leaves start drooping during day time it is an indication of water requirement. Similarly, if the flowers seem weak or exhibit not enough vigor, irrigating the crop would help. Some farmers irrigate the field once the soil moisture content drops below 25% [8].

### ASPERGILLUS AND ITS IMPORTANCE

*Aspergillus* is a fungus whose spores are present in the air we breathe, but does not normally cause illness. In those people with a weakened immune system, damaged lungs or with allergies, *Aspergillus* can cause disease. Common Aspergillus infections include invasive aspergillosis, ABPA CPA and aspergilloma. Aspergillosis is a group of diseases which can result from *aspergillus* infection and includes invasive aspergillosis, ABPA CPA and aspergilloma. Asthma is also complicated and exacerbated by aspergillus infection (SAFS). [9]

*Aspergillus* spp. has been increasingly identified in endophthalmitis. *Aspergillus* is a ubiquitous mold with many species, the most common of which are *A. flavus* and *A. parasiticus*. *Aspergillus* grows well in soil, decaying vegetation, hay, dung, compost piles, hospital airconditioner filters, and potted plants, and may be isolated from the air. *A. parasiticus* major importance in agricultural field. It is the most common species of *Aspergillus* Genera [15].

#### *Aspergillus parasiticus*

*Aspergillus parasiticus* is a fungus belonging to the genus *Aspergillus*. This species is an unspecialized saprophytic mold, mostly found outdoors in areas of rich soil with decaying plant material as well as in dry grain storage facilities. Often confused with the closely related species, *A. flavus*, *A. parasiticus* has defined morphological and molecular differences. *Aspergillus parasiticus* is one of three fungi able to produce the mycotoxin, aflatoxin, one of the most carcinogenic naturally occurring substances [13].

Environmental stress can upregulate aflatoxin production by the fungus, which can occur when the fungus is growing on plants that become are damaged due to exposure to poor weather conditions, during drought, by insects, or by birds [2]. In humans, exposures to *A. parasiticus* toxins have potential to cause delayed development in children and produce

serious liver diseases and/or hepatic carcinoma in adults. The fungus is also able to cause the infection known as aspergillosis in humans and other animals [4].

*A. parasiticus* is of agricultural importance due to its ability to cause disease in corn, peanut, and cottonseed. *A. parasiticus* is an unspecialized saprophyte, living off dead and decaying matter. It can invade crops either in the field or post-harvest during drying, handling, and storage [5].

*A. parasiticus* is disseminated via wind-borne spores but also has been shown to be transmitted through moist soil when in contact with damaged pecan shells, peanut pods, and kernels. Even though fruits and nuts may be invaded by the fungus to some degree, production of aflatoxins rarely occurs unless fruits have been damaged by insects, drought stress, high temperatures, early frost, windstorms, hail, Birds, mites, or generally unfavorable weather. Although sexual reproduction has been observed, *Aspergillus parasiticus* normally reproduces in the asexual state [6].

A wide range of morphological diversity has been shown. Spores are produced on crops, crop residue on the soil surface, and stored grains. Fungal spores travel to other hosts through the air and can overwinter on plant residue or as sclerotia (i.e., survival structures) in the soil. In the asexual state, conidial heads are dark green and

predominately unbranched. Conidia (i.e., spores) are distinctly roughened, globose to subglobose and are borne on stalks, which are commonly covered in small spines [10].

### **ECONOMIC IMPORTANCE OF CHILLI PLANT**

Chilli accounts for 20-30% of total Indian spices exports valuing approx Rs. 400-500 crores. Oleoresin is important product being exported to European countries. When chillies taken with food stimulates our taste buds and thereby increase the flow of saliva which contains the enzyme amylase which inturn helps in the digestion of starchy or cereal foods etc., into the easily assimilable sugar namely glucose [7].

Capsaicin has significant physiological action which is used in many pharmaceutical preparations and ointments for cold, sore throat, chest congestion etc.,. It is also used in cosmetics like prickly heat powders and skin ointments. Used as spice on account of its pungency and pleasant flavour [9].

### **Chilli Cultivation**

Chillies need moisture for growth. It has been found that black soil which retains moisture is ideal in case they are grown as rainfed crops. Under irrigated conditions, the crop needs well drained sandy loam with rich organic content. They can also be grown in deltaic soil under irrigated conditions. In hilly areas like Uttarakhand,

soil is mixed with gravel and coarse sand before undertaking chilli cultivation [10].

### **BIOCONTROL OF CROP DISEASE**

Fungal phytopathogens are cause of many plant diseases and much loss of crop yields, especially in tropical and subtropical regions. Chemical fungicides are extensively used in agriculture. However, these products may cause problems such as environmental pollution and affect human health. Microorganisms as biocontrol agents have high potential to control plant pathogens and no effect on the environment. In the present study antagonistic activity of some soil fungi were studied in in vitro [13].

All the *Aspergillus spp.* showed the ability to inhibit the pathogen some of the species showed variability in the percentage of inhibition was discussed. Microorganisms as biological control agents have high potential to control plant pathogens and no effect on the environment (or) other non-target organisms. In the present scenario numerous reports are available on the potential use of biocontrol agents as replacements of agrochemicals.

However their usage is not extensive, therefore constant need is required for more effective chemical treatments. Chilli is an important vegetable crops of India. It grows tropical and sub-tropical Climates [16].

There are many families like Solanaceae (Night shade) of plant Capsicum. There are

some other families also like climbers. The Solanaceae family contains 90 genera & 3000 species chili, this family suffers from many diseases which are caused by fungi, bacteria, viruses, nematodes and also biotic stress. . Chilli (*Capsicum annuum* L) is an important spices crop grown all over the world [17].

Pythium species are essentially soil borne pathogenic fungi, which causes seed rot and damping off of many crops including chilli. Biological control refers to the management of pest population below damaging levels through employing their own natural enemies [19].

Improvement in agricultural output is attributed to increasing use of synthetic chemicals. These chemicals include nematicides, weedicides, fungicides etc., and many of these chemicals are not biodegradable hence become toxic to the living organisms. Controlling this pathogen using biocontrol agents will help in enhancing the yield of the crop [12].

*Aspergillus* sp. possesses innate resistance to most agricultural chemicals, including fungicides, although individual strains differ in their resistance. Sometimes have been selected (or) modified to be resistant to specific agricultural chemicals [15].

Most manufactures of *Aspergillus* strains for biological control have extensive lists of susceptibilities or resistance to a range of 22 pesticides. *Aspergillus* spp., and

*Aspergillus parasiticus* which are well known antagonistic fungi useful in controlling soil borne diseases [14].

They have been used against disease caused by *Aspergillus* spp [9]. Mutants of *Aspergillus* spp. that do not produce aflatoxin are reduced in their ability to control Pythium damping off [20].

#### SUMMARY

The higher PAL activity, Total protein, phenol concentration and Chlorophyll content showed induction of resistance and enhance. The Height of the plant and leads to better growth in treated Chilli plant than control Chilli plant there were first *Aspergillus* spp. were isolated and used as elicitor in different time interval. After seeds treated with elicitor there observed that 7th day and AAPFCF gives the highest enzyme activity. For further study there were APFCF used which applied on 20 day Chilli plant and observed the growth in regular day interval. Which shows that at day 3 and day 4 gives the highest enzyme activity as well plant growth. The study shows great significance in evaluation and interpretation of effect of a biocontrol agent (elicitor) on resistance developed in chilli plant against invading pathogens and ultimately healthy plants with higher crop yield.

#### CONCLUSION

The elevated activities of various enzymes, total protein, PAL and chlorophyll content

observed in Chilli plants in response to treatment with FCF of *A. parasiticus* and APFCF indicate the induction of biochemical defence mechanism, whereby the plants may develop broad spectrum resistance against fungal diseases.

The elicitor treatments also help in growth and development of the maize plants as well as higher survival rate in fungal-infested soil. From the above research findings, it was concluded that the treatment of FCF (elicitors) induced plant defence mechanisms in the maize plants in field condition. Hence, the FCF of *A. flavus* and *A. parasiticus* may be used as elicitors to induce systemic acquired resistance against ear rot disease and broad spectrum of pathogens.

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