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Influence of secondary metabolites against biotic stress in Chilli

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Abstract
In today's world the soil and environment are contaminated with various toxicants which cause pollution and are very harmful for the population. The micro-organisms are used for the detoxification of these chemicals from the soil and environment as well. Chilli is one of the most important vegetable crops having many uses. The temperature and humidity play important role in the cultivation of chilli as moisture is the main factor for chilli development. The stress condition causes hinderance in the growth and development of plant. Different type of stress conditions like biotic and abiotic stress are responsible for the proper development of chilli plants. In plants, secondary metabolites are present which are the by-product of primary metabolic processes and does not have any direct effect on plant growth and development but acts as a defence mechanism in plants and they are considered as secondary compounds. Secondary metabolites act as a plant defence system, along with this it is also a collector for many phytohormones which protect the plant against any stress. there are various environmental stresses such as drought, salinity, heat, temperature and heavy metal stress SMs have antioxidant properties which act against oxidative damage. Secondary metabolites are very important for the good growth and better development of chilli.

Keywords: Secondary metabolites, microorganisms, chilli, antioxidant

Introduction
Chilli also known as Capsicum annum L. belongs to the family Solanaceae and along which there are also 30 species are present and out of which 6 species are cultivated widely like *Capsicum annum, Capsicum baccatum, Capsicum chinense, Capsicum pubescens* etc. basically, it has a very pungent smell, and it is the most demanding feature of chilli and for this smell capsaicinoidsares responsible. If we talk about its use, it is basically for cuisines as it has unique flavour due to which it is used as a taste enhancer and make the food spicier. according to the previous data it has been observed that India is in top number in the cultivation of chilli and after that China, Peru, Mexico and so on. as we have discussed earlier in India the chillies are famous for their spicy taste and the chilli which wase grown in Andhra Pradesh has strong pungency and colour. The shape and size can be varied like some chillies are big and known as bell peppers and also used as vegetables (Soesanto *et al*., 2020) [17]. In India there are local names for chillies i.e. Lankaa, Mirchii, etc. for chilli cultivation requires warm environment and dry weather too and at the time of growth stage it is very important the climate should be humid because it will be suitable for the maturity of fruit, if we talk about temperature so up to 20 to 25° c the temperature would be appropriate because if the temperature is higher than the development of chilli can be affected, along with temperature, rainfall also plays a very important role like if there is heavy rain at the time of fruit maturation then the fruit will start rotting and eventually die, also if there is low moisture content then the development of fruit will not be proper or both the flower and fruit may get dropped from the plant (Saurabh *et al*., 2015) [13]. As it is concluded from the upper discussion that both temperature and humidity play important role in the cultivation of chilli as moisture is the main factor for chilli development. For chilli cultivation black soil is very ideal but only if it retains moisture and grown as rainfed crop, but in rainfed condition the crop needs to be well drained, and soil should be sandy loam with rich in organic matter. In state like Uttarakhand soil is combination of both gravel and coarse sand and the main advantage of chilli is it can be grown both as rabi and kharif too. Chilli can be grown in the month from May to June as kharif crop and for rabi it can be grown from September to October (Ramakrishna & Ravishankar, 2011) [10].

January and February month would be appropriate if it is grown as the summer crop. Chillies are the crop have the tolerant capacity towards lots of water like heavy rainfall or stagnant water but not much or otherwise the fruit will start rotting. therefore, the irrigation should be appropriate and only if necessary if we provide frequent irrigation to chilli then the flowers would start to get shed. there is also a way to find out the level of irrigation in chilli like if in daytime the leaves started drooping then it requires irrigation. some farmers irrigate the whole field at once when the soil moisture dropped to 25% and after that they leave the field as it is to prevent heavy irrigation (Waterman & Peter, 1992) [19].

Chilli are propagated through the seeds and it is must to choose seeds which are disease free and resistant too, seeds should be of good quality and also there are many researchers that developed high yielding seeds and resistant varieties too. but if anyone wants to cultivate chilli as organic farming then then they should take care of all things like the farms should be certified as organic and seeds should be organic (Mera *et al*., 2019) [8]. for chilli the land should be prepared appropriately like it should be ploughed from 2 to 3 times and brought to very fine tilth. any unwanted material is present will be removed, it is very important that the soil must be clear without ant disease so that the plant would not get affected as any environmental condition can easily affect the chilli cultivation therefore, for chilli production greenhouse is preferred, mainly at the time of early spring because that time the climate vary (Li *et al*., 2020) [7]. There are many problems faced by crops like biotic and abiotic stress like pest and various diseases or rainfall, temperature or intensity of light can affect easily and decrease the quality and quantity of crop (Butt *et al*., 2016) [1].

Biotic Stress in Plants

Various living organisms are living in the soil such as fungi, bacteria, insects and pests and they eventually harm the plants by feeding on them and destroy them as shown in (figure 1). Among all the biotic organisms' fungi are the most problematic organisms and most of the problems occur by them, if we talk about its total population it is around 8100 and act as pathogen for plants and along with fungi, viruses also are the most dangerous organisms and if the plants are attacked by them they show some kind of symptoms like spot on leaves, rust, rotting of roots, wilting and seed damage (Lakshmi Sahitya *et al*., 2018) [6]. They also damage the plant physically by damaging its stem, bark, flower and fruits too and even these fungi and pathogen can transfer from infected plant to uninfected plant and transfer from one place to another. another biotic stress can cause by the weeds which are the unwanted plant grows in unwanted place. Weeds grow very fast in few days they have the ability to adapt any climate condition very easily and dominate the main crop by competing for food and shelter (Ichwan *et al*., 2017) [2].

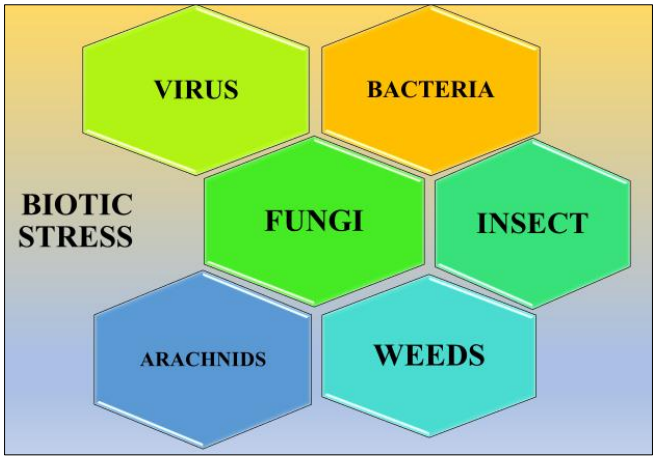

Fig 1: Organisms which cause biotic stress

Some of the plant bacteria are saprophytic in nature thus, it does not damage the plant itself but other than this other bacterium damages the plant vigorously. in the region like sub-tropical and tropical these bacterial diseases dominate the crops but mostly rod-shaped bacteria are responsible for huge losses of crops (R. Singh & Rathore, 2018) [16]. in pathogens, there is some special factor known as pathogenicity which enables them to spread diseases and there are also 5 major factors proteins, cell wall degradation enzymes present in them, exopolysaccharides, phytohormones, and toxins (Mishra & Dayal, 2018) [9]. In plants, the formation of the tumour by agrobacterium species through alteration in auxin level same like this some of the bacteria block the xylem vessel by generating exopolysaccharide and leads to death of the plant. many viral infections that are caused by biotic stress are the major problem in the decreasing yield, there are two groups of plant viruses i.e., Reoviridae and Geminiviridae. These are the virus-containing genomes that infect the plants by invading fields and mostly by the infected seeds, these viruses spread through the damaged and injured plants or by infected plants and seeds too. To reduce the viral infections, we need to control the viral vectors, using controlled plant material during crop trapping, using transgenic crops and increasing agriculture practices (Thakur *et al*., 2018) [18].

Influence of secondary metabolites towards biotic stress

In plants there are some secondary metabolites are present which are the by-product of primary metabolic processes and does not have any direct effect on plant growth and development but have acted as a defence mechanism in plants and due which they are considered as secondary compounds. The main and primary function of secondary metabolites is that they support the plant for growth and survival and help them to adapt to any harsh climate condition. during the communication of pollination, legume root nodule and antagonistic interaction during mutualistic relationship

secondary metabolites play an important role (Khan *et al*., 2018) [5].

The production of secondary metabolites occurs in plant by PKSs i.e., polyketide synthases as basically SMs have very low molecular weight thus, along with PKSs there is also other compound contribute in synthesis of SMs is NRPSs i.e. non-ribosomal peptide synthetases or enzyme prenyl transferases and also dimethyl tryptophan synthases. according to species and various environmental condition the production and accumulation of secondary metabolites vary (Rm *et al*., 2018) [12]. At the growth stage of plants there are various processes are going on in plants physiology, genotype these are the factors that determines which type of secondary metabolites are produced and also their concentrations. Basically, when the plants are exposed to various stress conditions then the SMs biosynthesis started. As we know plants are exposed to various stress like biotic and abiotic stresses, the morphology and other phenolic pigments, activity of antioxidant levels, flavonoids, phenol content altered by various stress conditions. in the cellular system which induces oxidative stress due to which the level of ROS is enhanced by the action of any biotic and abiotic stress lead to peroxidation of lipid, enzyme inactivation and damage of DNA. To conquer pressure limitations plants, take on numerous elective systems that include an amalgamation of the wide scope of secondary products, which fills in as opposed to resistance instruments. An antioxidative safeguard framework and different metabolites assist the plant with making do under antagonistic conditions. The ideal acknowledgement of the pressure by the plant is critical for a quick and viable reaction. Natural basal guard instrument is activated in plants because of stress acknowledgement which thus starts complex flagging falls of protection fluctuating starting with one pressure then onto the next. The cooperation and joined openness to different stress conditions are likewise conceivable. In light of consolidated burdens, different flagging falls shared many intermediates mixtures and results. The opportune acknowledgement of the pressure by the plant is pivotal. This could be invaluable for making a flagging organization that serves to improve protection from abiotic stress under different biotic pressure. Henceforth absence of SMs and cell reinforcement compounds amalgamation prompts long haul upset outcomes in plants. Present survey centres around the biosynthetic relative of SMs, SMs modification made inside plants in the levels presented to different abiotic and biotic burdens existing in current natural circumstances (Ramzan *et al*., 2021) [11].

Plants are under the danger of stress and risk from numerous organisms, like microbes, parasites, and herbivore bugs. Plants have laid out an assortment of obstruction components for insurance, a few of which are produced because of microbe assault. The microbial assault is detected by the extracellular receptors of plants, which are found on the layer, and they perceive microorganism connected examples and reasons for contamination in the plant body before the hurtful organisms spread in the general body of the plant. Nonetheless, sickness making organic entities have fostered the instrument hinder microbe related sub-atomic example (PAMP)- set off invulnerability by delivering explicit proteins into the cytosol of the plant cell that change motioning for plant opposition, articulation of protection reactions. When microbes fostered the capacity to quell the fundamental protections, plants laid out a more positive component to detect microorganisms, named as effector set off insusceptibility (ETI). In the ETI condition, obstruction qualities (R) articulation, for the most part, receptors recognize the effector particles communicated, brought by the microorganism that attacks the host cell. The contact of the effector and receptors got change plants, which might cause obstruction (K, M *et al*., 2016) [3]. Opposition coming about because of R quality articulation accompanies an oxidative burst as free oxygen extremists, which is fundamental for the following technique for the assurance, a sort of apoptosis expected to prevent the expansion of microorganisms from water and supplements. Biotic anxieties in plants are brought about by different living organic entities that incorporate nematodes, microorganisms, infections, and parasites. Plants can't change their position to stay away from the unpleasant climate (Khaitov *et al*., 2019) [4]. Nonetheless, plants display an extraordinary level of resilience to microbe assaults fundamentally through the creation of SMs. Phytoalexins are such SMs that intercede plant guard reaction to microorganism assault because of their antimicrobial exercises. Plants under microbe assault show upgraded biosynthesis of SMs. Plants going through parasitic diseases by strains of Lupinus Angustifolius show critical variety in the endogenous degrees of phenolics. An intrinsic invulnerable framework is created in plants because of microorganism assault (A. P. Singh *et al*., 2021) [15]. The natural resistant arrangement of plants is interceded by effector-set off invulnerability and basal insusceptibility. In basal resistance framework, secondary cells recognize microorganisms through organism related sub-atomic examples that are seen by design acknowledgment receptors present on have cells. Furthermore, have cells additionally perceive microbe assault by means of effector-set off insusceptibility because of effectors or harms because of poisons of microorganisms. Plants see signals from such effectors and invigorate various metabolic pathways to deliver SMs. The centralization of SMs is altogether diminished during pressure recuperation (Sharma & Kumar, 2017).

Conclusion

In plants there are some secondary metabolites are present which are the by-product of primary metabolic processes and does not have any direct effect on plant growth and development but have acted as a defence mechanism in plants and due which they are considered as secondary compounds. It is clear from the above discussion that secondary metabolites are very important for plants as they do not directly contribute to the growth and development of plants but act as a plant defence system, along with this it is also a collector for many phytohormones which protect the plant against any stress. there are various environmental stresses such as drought, salinity, heat, temperature and heavy metal stress SMs have antioxidant properties which act against oxidative damage. When there is excessive production of ROS i.e., reactive oxygen species then it leads to oxidative damage and thus, membrane integrity is damaged by the ROS cellular level. When the plant is exposed to any biotic or abiotic stress then it triggers the production of secondary metabolites. Thus, from the discussion, it was concluded that along with primary metabolites, secondary metabolites are also very important and prevent the plants from any type of damage.

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