SUPPRESSIVE SOIL: A LEGITIMATE WAY TO CHECK OR RESTRAINT SOIL BORNE DISEASES

Vivek Kumar Srivastava[1], Dr.Abhatripathi[2]

Abstract:-Practically about 60 years ago, principally suppressive soils for soil-borne pathogens were diagnosed and mostly assigned to antagonistic or suppressive microorganisms. Soil disease suppression is the reduction in the prevalence of soil-borne diseases even when a host crop and inoculums are present in the soil. Suppressive soil diseases provide plants with effective protection against infection by soil-borne pathogens consisting of bacteria, fungi, oomycetes and nematodes. Rather than testing ,identifying and applying potential bio control agents in an inundative fashion, exploration into suppressive soils has tried to comprehend how indigenous microbiomes can alleviate disease, even in the existence of the pathogen , favourable environment and susceptible host. Soils are a valuable source of microbes that are assumed to help plants suppress pathogens by optimizing the plant health ,hyperparasitizethe pathogen or compete against pathogens , induce natural plant defence, generate antibiotics. General types of two suppression has been elucidated:- General and Specific suppression along with their theories. Suppressive soil is an attractive technique of bio control , because it has the capacity to be viable over numerous seasons under favourable conditions. To date, numerous microbial genera have been proposed as key players in soil disease suppression , but the complication of the microbial interactions as well as the primary mechanisms and microbial traits remain elusive for most suppressive soil. Disease suppressive soils are the best examples of microbiome-mediated protection of plants against root infections by soil-borne pathogens. Thus, this review dissertation critically investigates disease-suppressive attributes in soils , biotic and abiotic determinants affecting DSS , mechanisms involved, concise history and also reviewing their case studies.

Keywords :-Suppressive soil , Soil-borne pathogens, Disease , Pathogens ,Plants, Microbial etc.

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Introduction:- Many different types of organic and inorganic materials, including a significant proportion of stock that is currently unknown, are present in soil, according to the great majority of research that were included in the study. A portion of the species cause significant agricultural losses as pests, while others carry out or carry out "environmental services" such nutrient and water cycling, drainage, aeration, and biological pest management. In addition to serving as the physical underpinning for human activities, soil is a dynamic and very potent living resource that is essential to successful agriculture. Over a century has passed since the discovery of disease-suppressive soils, and research on the processes behind disease suppression has lasted over 40 years.The level of suppression is related to soil physical

REDUCED = disease suppressive.
I. OXIDIZED = disease inducing.

Concept:-The concept of disease-suppressive soil has been described in terms of general suppression and specific suppression.

- **General Suppression**:-The overall suppression of a pathogen is directly related to the total amount of microbial activity in the soil or plant at a critical time in the pathogen's life cycle. The general suppression is non-specific, effective against most if not all pathogens, and involves the activities of many resident soil organisms.
- **Specific Suppression:-**Specific suppression works only against certain types of pathogens. Specific suppressive ability has been demonstrated for Fusarium wilt, Gaeumannom ycesgraminis var. tritici, Phytopthora spp., Pythium spp., Rhizoctonia soloni and Thielaviops is basicola. In all cases, a pathogen causes significantly less disease in repressive soils than in other soils (promoting soils); The effect is lost when the soil is treated with biocides, indicating the involvement of microorganisms.
- **Long-standing type of disease suppression**:-Often occurs in soils with specific disease suppression, where disease suppression is naturally associated with the soil without the existence of plants, although their origins are unknown ***(Weller et al.2002).*** The Fusarium wilt-suppressive soils from the Chateaurenardvicinity of France are one such example of long-lasting disease suppression ***(Alabouvette 1986).***
- **Induced type of specific disease suppression**:-It has been linked with maintaining disease suppression by plant monoculture or inoculation of the soil with pathogens or by growing susceptible plants ***(Weller 2002)***. A prominent example of induced specific suppression is the decrease in take-all disease by wheat monoculture ***(Weller 2002).***

The phenomena of disease-suppressive soils have been documented for numerous plant pathogen systems around the world, and some of these are listed in Table 1. Among the plant/fungal patho-systems, wilt soils that suppress Fusarium caused by F. oxysporum or take-all of wheat caused by G. Gramin is var. tritici have been studied most extensively and represent classic example of the patho-system of plant fungi in suppressive soil.

Fig. 1 shows the Types of suppressiveness occurred in soils under different agro ecosystems.

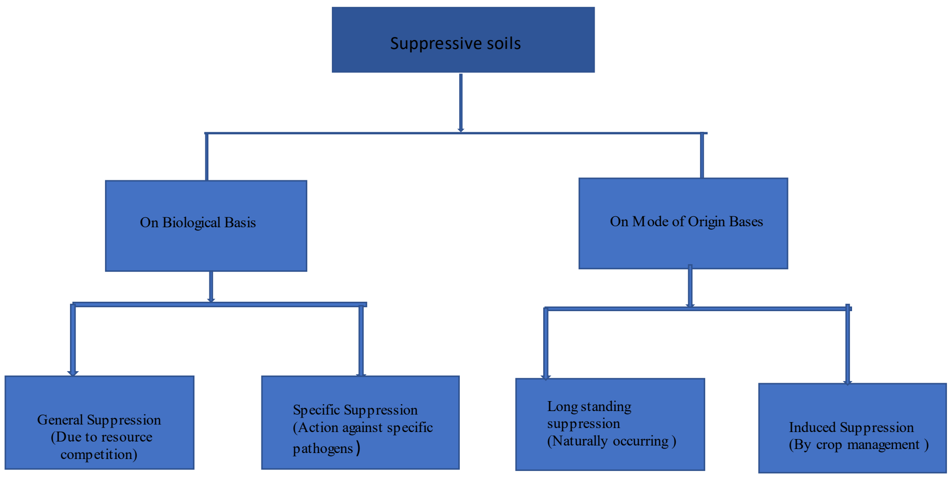

Fig. 1. Types of suppressiveness occurred in soils under different agro ecosystems.
Souce:-R.s. Yadav et al.,2015

Pathogen involved	Diseases	References
Cystnematode Heterodera sp.	Molya disease	***Kerry 1988; Westphal & Becker,1999***
Pythium sp.	Damping off	***Hancock,1977***
Rhizoctonia solani	Root rot	***Henis et al., 1978,1979***
Plasmodiophorabrassicae	Clu root rot	***Murakami et al., 2000***
Phytopthora cinnamomic	Root rot	***Broadbent & Baker , 1974***
Fusarium oxysporum	Wilt	***Stotzky& Martin ,1963; Scher& Baker , 1980***
Streptomyces scabies	Scab	***Menzies , 1959***

Table no.1 :- Plant pathogen concealed by disease suppressive soils.

In the table no.1 Plant pathogen concealed by disease suppressive soils was represented.

Mechanisms of Action :- The mechanism by which antagonistic microorganisms affect pathogenpopulationsisnotalwaysclear,buttheyaregenerallyattributedtooneoffoureffects:

- Direct parasitis morlys is and death of the pathogen,
- Competition with the pathogen for food,
- Direct toxic effects on the pathogens by antibiotic substances released by the antagonist

In Figure 2 Factors involved in the induction of disease suppressiveness was represented..

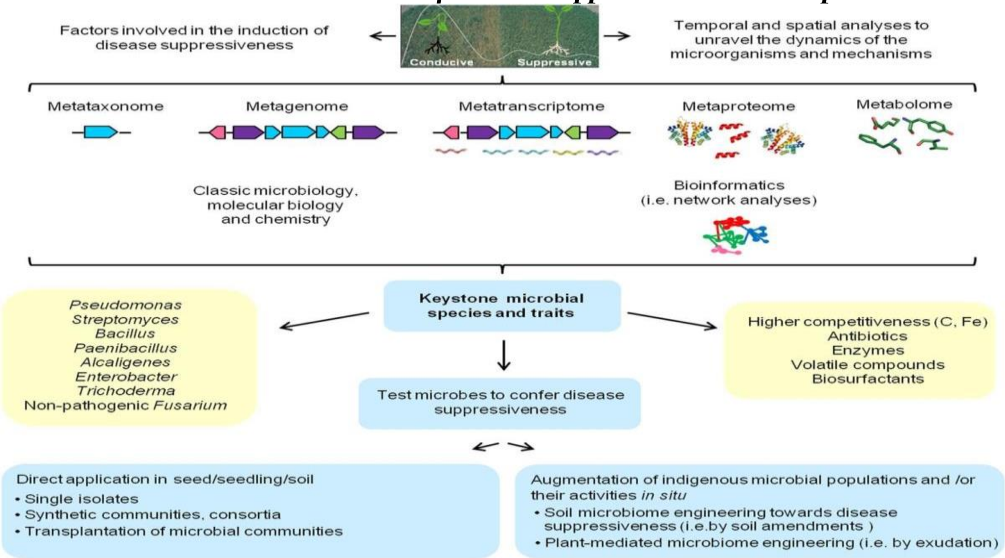

Figure 2:Factors involved in the induction of disease suppressiveness.
Source:-Ruth GomezExpositoetal.,2017

Development of suppressive oils including both biotic and abiotic determinants:-

▪ **Biotic determinants**

Biotic determinants play a crucial function in the evolution of soil suppression, even though the require procedure elaborate are naught completely appreciate. Crop rotation can be manipulated effectually to accomplish soil suppression. There are numerous for-instance that propose that the provision of monocultures over a long-term duration can persuade soil suppression of an individual crop disease***(Mazzola,2002).***How be it, this ought not evaluable or an effectual tool in mercantile production systems since the duration of a crop monoculture necessitated to generate the desired implication would be years. Nevertheless, it is feasible to thrive soil-suppressive impact opposed to specifics oil-borne pathogen in the skive of crop monocultures. Crop rotations that en compass cover crops such as rape, oil seed or legumes can considerably reduce the prevalence of root disease in cereals because these crops do not port fungi that germ cereal root disease. Canola has further beneficial influence as it secrete out some chemicals into the soil that kill or prevent the fungi that cause root diseases in crops ***(Chandrashekara et al., 2012). Table no.1 shows the Plant pathogen concealed by disease suppressive soils.***

▪ **A biotic determinants**

Many different biotic determinants, comprising clay content and organic matter, texture and pH, may play a role in disease suppression in soils. However, their role may not be direct, but rather a result of their influence on the composition and activity of soil saprophytic micro biota ***(Mazzola, 2002).*** Soil physicochemical properties can be correctly managed to formulate soil a less hospitable habitat for pathogens. Changes in soil structure and texture can affect multiple soil parameters such as B. The ability to store water, nutrients and gas exchange. Therefore, poor soil aeration can encourage the growth of Pythiums pp .Generates tooth decayincarrots. However, agricultural practices that favour aeration of soils and avoid water retention encourage the burgeoning of repressive soils for this pathogen ***(Agrios,1997).*** Fig.3 representing a biotic and biotic factors and their strategies for enhancement soil suppressiveness

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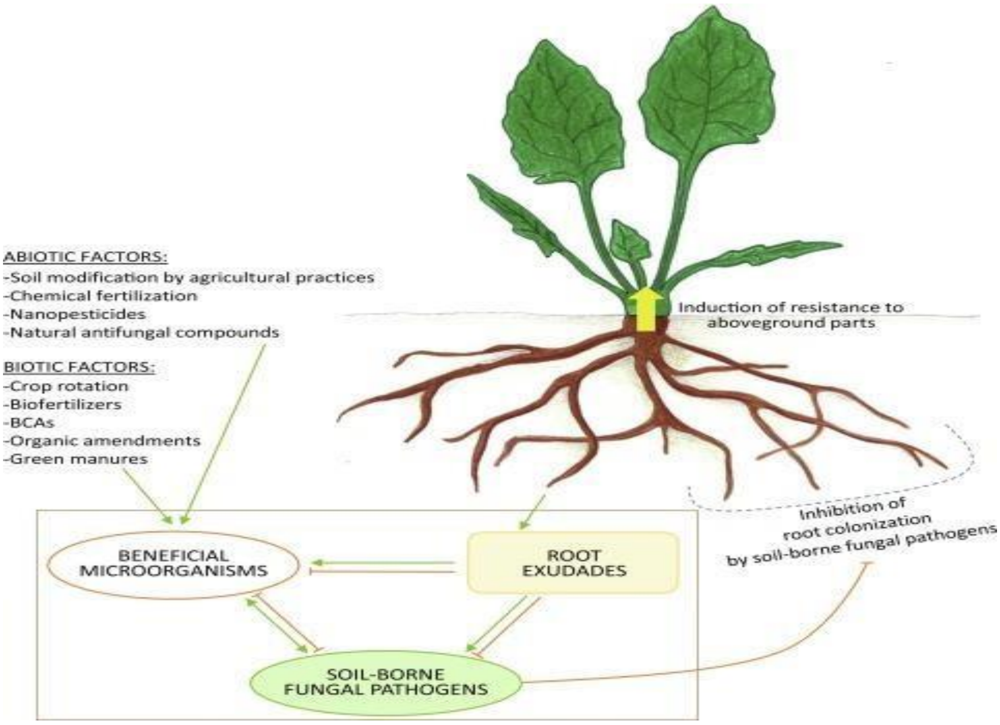


Fig.3 representing a biotic and biotic factors and their strategies for enhancement soil suppressiveness.

Suppressive oils introduced by natural antagonists:-

I. Several soil-borne pathogens such as Fusarium, Pythium, Phytopthora, etc. Thrive and cause serious disease in some soils known as conducive soil or non-suppressive soil. With this type of soil disease, disease easily occurs.

II. In some other soils, the pathogens develop much fewer and milder diseases called suppressive soils.

III. This failure to establish itself in oppressive soils has been attributed to the presence of several microorganisms that antagonize the pathogens in these soils.

IV. Antagonists prevent the pathogen from reaching populations high enough to cause serious disease by using antibiotics, lytic Produce enzymes, food competition or direct parasitism of pathogens.

ADVANTAGES AND DISADVANTAGES: - Suppressives oil reduces legal, environmental, and public problems, and indirectly reduces the residual impact of hazardous chemicals by reducing the use of pesticides. In addition, suppressive soil can be easily incorporate into plant disease management and planning, and disease control is not achieved immediately.

Several soil-borne pathogens such as Fusarium oxysporum (vascular wilt), Gaueum an nomyces gram in is (take all of wheat), Phytophth or a cinnamon (root rot of many fruitandforesttrees),Pythiumspp.(damping-off)andHeteroderaavenae(oatcystnematode) cause heavy losses when present in eligible soils. However, they cannot thrive in oppressive soil and cause significantly less damage. The mechanisms by which soils suppress various pathogens are not always clear, but may involve biotic and/or a biotic factors and may vary by pathogen. In most cases, however, they appear to act primarily through the presence of one or more microorganisms in such soils that counteract the pathogen. Such antagonists, by competing or parasitizing the pathogen, production of antibiotics and/or lyticen zymes,prevent the pathogen, production of antibiotics and/or lytic enzymes, from reaching populations high enough to cause serious disease has been found that numerous species of antagonistic microorganisms increase in oppressive soils; most common though disease suppression has been shown to be carried out by fungi such as Trichoderma, Penicillium and Sporidesmiumor by bacteria of the genera Pseudomonas, Bacillus and Streptomyces. Suppressive soil added to conducive soil can reduce disease levels by introducing microorganisms that counteract the pathogen.

For a period of time does a soil become suppressive?

For how long does it take? Over the years, the idea has changed. A common theory holds that Suppression intensifies with time. depending on the circumstances and the organic residues' recycling. Moreover, pathogen-suppressive soils may be divided into two categories: naturally occurring and artificially produced disease suppression. Call for a soil to go into depression? Generally unaffected by crop history, natural suppression is linked to the physical characteristics of the soil. Agricultural methods have a direct impact on the suppression of the opposing viewpoint. The intriguing possibility of suppressing plant illnesses and infections by introducing these antagonists to formerly permissive soils or substances is made possible by the identification, isolation, and sophistication of the antagonistic microbes responsible for suppression in soils.

Suppressive Soil Management

- Addition of organisms that colonise the roots: Plants can become "stronger" through the phytostimulatory and biofertilizing activities that these microorganisms can promote. Numerous rhizosphere bacteria have the ability to cause a plant's systemic reaction, which activates the plant's defence systems.
- Improved agricultural techniques: It has been proposed to modify traditional methods to lower the possibility of soil contamination or boost the levels of disease prevention. The control of diseases has been attained by means of tillage methods, organic supplements, cover crops, biofumigation, cultivation, and residue elimination, either independently or in combination.

For many plant-pathogenic systems worldwide, the phenomena of disease-suppressive soils has been reported. Plant pathologists have long sought to use these soils' potential as an effective tool for managing disease in agro ecosystems. It has been proven to cure soil-borne plant illnesses through the modification of microbial populations to create a disease-suppressive soil environment has been extensively shown and documented.

Table2:-Some of the case study findings are demonstrated in Table.

Compost material	Disease suppression	Observed effect	References
Compost municipal waste	*Phytophthoranicotiansei ncitrus seedling*	Disease decreased increasing proportions of one CMW(20%v/v)	***Widmeretal.,1998***
Grape marc compost (GMC),Cork compost(CC)	*Fusariumoxyaporum lap. Lycopersici (Fusarium wilt of tomato)*	GMC was the most suppressive, CC was intermediate and peat and vermiculite were conducive media . heated GMC was Still moderately	***Borreroetal.,2004***
		suppressive , importance of pH, ß-glucosidase activity and microbial populations.	

Mature bio solid compost (sewage sludge and yard waste)	*Scierotinarol fall in bean plant*	Prolonged compost curing negates suppressiveness. Combination of microbial populations and the chemical environment were responsible for pathogen suppression.	***Danonetal., 2007***
Cork compost and light peat	*Verticilliumwiltoftomato*	Cork compost was suppressive in comparison with peat . this compost had highermicrobial activityandbiomass.	***Borreroetal.,2002***
Grape macro + extracted olive press calco (GM+EPC), Olive tree leaves + olives mill waste water (OL + OMW) and spent mushroom compost (SMC)	*Fusariumoxysporium f.sp. radiceslycopersiciin tomato plants.*	The three composts were extremely suppressive and suppression is related to the presence of specific Microorganism	***Ntougias et al., 2008;kavroulaidset al.,2010***

Micronutrient Suppressive Effects: A plant's natural defaces are triggered when it is attacked by a fungus, and both at the infection site of and in parts of the plant, there is an increase in the production of antifungal phenolic compounds and flavonoids. The plant's nutrition has a major role in regulating the synthesis and movement of these molecules. In terms of micronutrients, zinc and boron are crucial for preserving the structural integrity and regulating the permeability of cell membranes. Significant compromise results in leakage and instability of the diaphragm. Antioxidant vitamins B and zinc also serve as defaces against the harmful effects of very toxic free radicals. The release of a variety of chemical substances from the cells of the root and the leaf is likely increased in Zn and B shortage. Table2 shows the Some of the case study findings are demonstrated.

Tableno.3:Role of micro nutrient deficiency on soil-borne diseases.

SL.No.	Micro nutrient deficiency	Disease	Causalorganism
1.	Boron(Bo)	Tomato Wilt	*Verticilliumalbo-atrum*
		Beans Root root	*Fusariumsolani*
2.	Zinc(Zn)	Take all of wheat	*G.graminis var. tritici*
		Rhizoctonia Rootrot	*Rhizoctoniasolani*
3.	Manganese(Mn)	Take all of wheat	*G. graminisvar. tritici*
4.	Calcium(Ca)	Tomato and potato soft rot	*Erwinia*
5.	Copper(Cu)	Take all of wheat	*G.graminis var. tritici*
		Powdery mildew of wheat	*Erysihpe*
		Take all of wheat	*G.graminis var. tritici*
		Sunflower	*Alternaria*

Source:Kausadikaretal., 2006

The Disease Triangle Model: Complex yet Intriguing:-The disease triangle model: intricate yet intriguing because soil microbes and pathogens share a common space in therhizosphere,theirpre-seedingandpost-seedinginteractionshaveasubstantialinfluenceon plant productivity ***(Penton et al. 2014).***

Tableno.3 shows the Role of micro nutrient deficiency on soil-borne diseases.

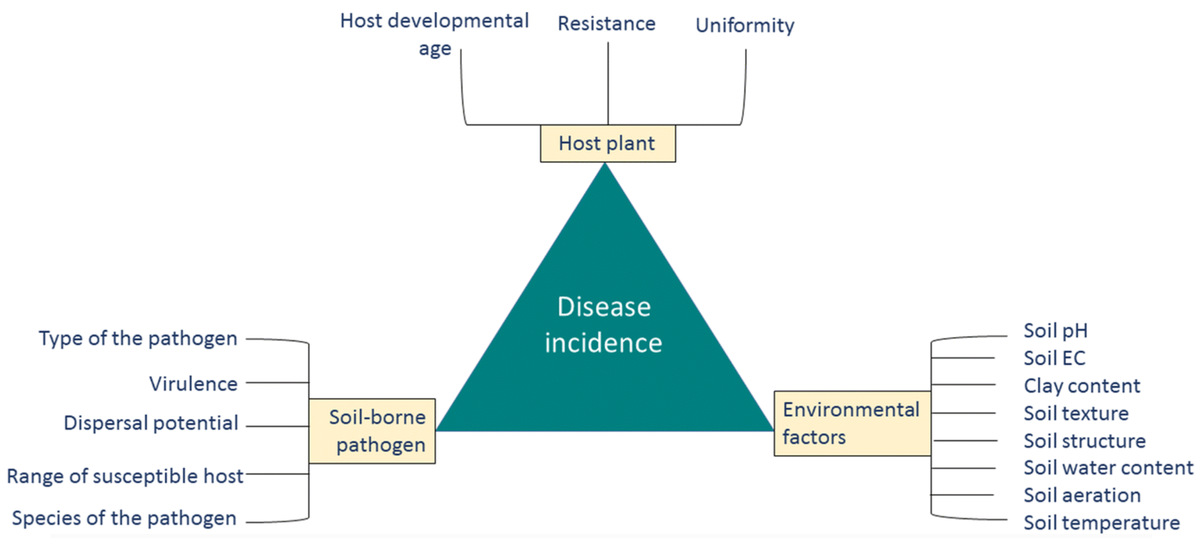


Fig. 4Concept of soil disease triangle with main components and their respective factors.

It also reported that the degree of suppression is related to soil physical conditions, fertility level, biodiversity and populations of soil organisms, and soil management practices. For example, the use of Manu relaters physical, chemical, and biological parameters of the soil that directly affect crop infection and pathogen survival. It also reduced the number of plant parasitic nematodes for a period of 3 years after a single application. A significant reductioninredstelestrawberryrootdiseasewasalsoobservedinfieldstreatedwithox/poultry and dairy manure compost compared to the control ***(Millner et al.2004). Fig. 4 shows the Concept of soil disease triangle with main components and their respective factors.***

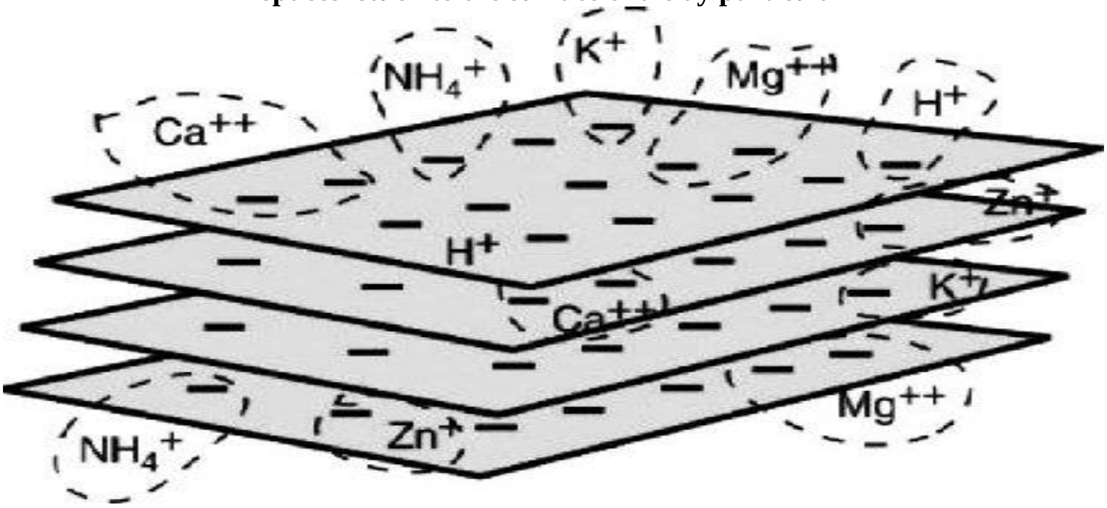
Old and New Approaches to Study Disease Suppressive Soils :-Succeeding display of the microbial under pinning disease suppressiveness of soil's by heat treatment, biocides and/or soil transplantations, the propel forward step taken in past and numerous presentstudiesusuallycomprisesill-targeted,macroscaleisolationofmicrobesfrombulksoil, rhizosphere or endosphere of plants grown in disease suppressive soils, followed by testing their activities against the target pathogen both *in vitro*(i.e., plate assays) and *in vivo*(i.e., introduction into conducive soils). Following this line of research, numerous microbial genera have been proposed for their role in specific disease suppressiveness.

Conclusion:-. The global drawback is crop losses owing to diseases and pests. Soil-borne disease govern is highly successful and cost-effective when all the necessary data about the plant, the disease impacting it, its history in new years, the host's resistance level and the prevalent environmental conditions are available. A blend of disease-suppressive soil management practices can have additive or synergistic effects, and such technique is very appealing in the case of soil borne diseases that are epidemiologically distinct. All management practices are suitably adapted to minimize soil borne pathogens. The phenomenon of disease- suppressive soils has been documented for many plant-pathogenic systems around the world. Harnessing the capability of these soils as a practicable means of controlling disease in agro ecosystems has long been an aim of plant pathologists.

Effect of Organic Matter on storage of nutrients in soil

Nutrients are released either when chemical fertilizers dissolve , or when organic matter decomposes. If the soil cannot store the nutrients , they will be washed away by water before the roots can absorb them . the soil stores nutrients in two places: stuck to the surface of clay particles and stuck to surface of humus (decomposed organic matter). Clay particles and humus store nutrients viz., Ca^{++}, NH_4^{+}, Zn^{+}, Mg^{++}) etc. can be "parked" (Fig .3). Farmers cannot add more clay to their soil . But,they can add more organic matter and thus, improves the capability of the soil to store nutrients.

Fig. 5 shows the above figures illustrate the fact that Temporary storage of nutrients in "parking spaces' stuck to the surface of a clay particular



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Souce:-chandrashekra ,C., et al.,2012

Effect of organic matter on soil acidity (pH)

Here we discuss the theoretical basis of the effect of soil pH on plant disease infection and development, directly through influences on soil-borne pathogens and colonies of microorganisms, and indirectly through the accessibility of soil nutrients to the plant host. If pH is extremely high or too low, nutrients can become trapped in the soil and become unavailable to plants (Fig. 4). For example, if the pH is extremely high, the iron in the soil will not be accessible to the roots. Soil pH can also impact on plant growth through its influence on the activity of advantageous microorganisms. Beneficial fungi tolerate marginally acidic soils, but bacteria that break down soil organic matter are hampered in highly acidic soils. This prevents organic matter from degrading, which outcomes in nutrients (particularly nitrogen) becoming trapped in undecomposed organic matter. Highly acidic soil also generates the fast loss of soil nutrients. Because clay particles and humus store positively charged nutrients on adversely or negatively charged parking spaces. However, if the soil water is highly acidic (too much H+), then the H+ clogs numerous parking spaces. When this happens, some of the nutrients that would usually be stored on the surface of the clay particles are lost (washed away to a lower level in the soil profile).

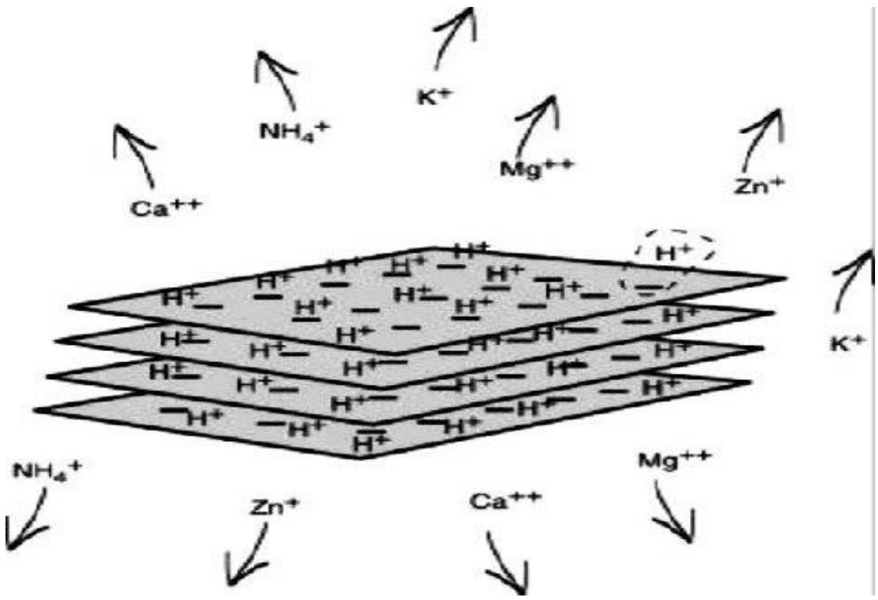

Fig.6 : Figure shows schematically the process of Excess acid (hydrogen ions) pushes nutrients out of the "parking spaces" on the surface of a clay particle.
Souce:-chandrashekra ,C., et al.,2012

According to the literature, this effect could be explained by some case study of suppressive soil borne pathogen by using different types of compost. The scenarios described here cover a wide range of possibilities. These are the possible cases here that need to be considered by the several scientists and researchers. Fig.6 shows schematically the process of Excess acid (hydrogen ions) pushes nutrients out of the "parking spaces" on the surface of a clay particle.

Table 4:-Some of the case study endings are demonstrated in Table.

Compost material	**Disease suppression**	**Observed effect**	**References**
Compost municipal waste	*Phytophthora nicotianse in citrus seedling*	Diseasedecreased inscreasing proportions of one CMW (20% v/v)	***Widmer et al., 1998***
Grape marccompost (GMC), Cork compost (CC)	*Fusarium oxyaporumlap. Lycopersici (Fusarium wilt of tomato)*	GMC was the most suppressive , CC was intermediate and peat and vermiculite were conducive media . heated GMC was still moderately suppressive , importance of pH, ß-glucosidase activity andmicrobial populations.	***Borrero et al., 2004***
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Cork compost and light peat	*Verticillium wilt of tomato*	Cork compost was suppressive in comparision with peat . this compost had higher microbial activity and biomass.	***Borrero et al., 2002***
Grape macro + extracted olive press calco (GM+EPC), Olive tree leaves + olives mill waste water (OL + OMW) and spent mushroom compost (SMC)	*Fusarium oxysporiumf.sp. radices lycopersici in tomato plants.*	The three composts were extremely suppressive and suppression is related to the presence of specific microorganism	***Ntougias et al., 2008; kavroulaids et al.,2010***

The Table 4 demonstrates Some of the case study endings**.**

Micronutrient Suppressive Effects: When a plant is attacked by a fungus, its natural shieldare activated and there is increased generation of antifungal phenolic compounds and flavonoids both at the site of infection and in other sections of the plant. The production and transport of these compounds is controlled in large part by the diet of the plant. Therefore, a dearth of key nutrients (K, Mn, Cu, Zn, and B) in the soil and then in the plants reduces the quantity of the plants' natural antifungal agents at the site of infection. Many of the micronutrients are involved in phenol metabolism from the control of carbohydrate movement in synthetic pathways (boron) to the final polymerization of lignin (Fe and Mn). Among the micronutrients, Zn and B play an important role in maintaining the structural integrity and controlling the permeability of cell membranes. Diaphragms are profoundly compromised, generating diaphragms to leak and become unstable. Zinc and B also have protective functions against the detrimental attack of highly toxic free oxygen radicals. Under Zn and B deficiency, the release of numerous organic compounds from both root and leaf cells is presumably enhanced. Several examples are accessible in the literature showing that the susceptibility of plants to multiple diseases such as Rhizoctonia solani,Phytophthora and Fusarium is heightened by ZN and B deficiency.

Table no. 5:Role of micronutrient deficiency on soil-borne diseases.

SL.No.	Micronutrient deficiency	Disease	Causal organism
1.	Boron (Bo)	Tomato Wilt	*Verticillium albo-atrum*
		Beans Root rot	*Fusarium solani*
2.	Zinc (Zn)	Take all of wheat	*G. graminis var. tritici*
		Rhizoctonia Root rot	*Rhizoctonia solani*
3.	Manganese (Mn)	Take all of wheat	*G. graminis var. tritici*
4.	Calcium (Ca)	Tomato and potato soft rot	*Erwinia*
5**.**	Copper (Cu)	Take all of wheat	*G. graminis var. tritici*
		Powdery mildew of wheat	*Erysihpe*
		Take all of wheat	*G. graminis var. tritici*
		Sunflower	*Alternaria*

Source : Kausadikaret al., 2006

The Disease Triangle Model: Complex yet Intriguing :-The disease triangle model: intricate yet intriguing because soil microbes and pathogens share a common space in the rhizosphere, their pre-seeding and post-seeding interactions have a substantial influence on plant productivity ***(Penton et al. 2014).*** The overall notion of disease suppression can be pictured using a disease triangle concept consisting of three main determinants: environmental factors, host plant and soil-borne pathogens, (Fig. 5) ***(Scholthof2007).*** Since plants are the main suppliers of soil carbon and energy sources, plant diversity affects the composition and structure of microbial communities ***(Scholthof2007).*** Soil physical and chemical properties such as pH, electrical conductivity, soil nutrients and soil organic carbon (SOC) also ascertain microbial activities as soil provides the optimal habitat for the growth and evolution of soil microbes ***(Hadar and Papadopoulou2012)*** . In addition, farming practices such as weeding,tillage, fertilization and irrigation manipulate the soil environment and affect soil microbiota populations (Fig. 6). It is nearly impossible to study the function of these factors independently in disease suppression, and researchers must address them simultaneously (Yin et al. 2013). Understanding the disease triangle model (i.e. a model based on the interactions between the host plant, the pathogen and the environment conducive to disease development) is one of the key steps in studying the complex system of DSS ***(Scholthof2007).*** Diseases develop when all components of this model have favourable conditions for the pathogen. The environmental component needs to be manipulated and specially tailored to develop DSS or reduce the conduciveness to disease development, even in the presence of both the pathogen and the host ***(Hadar and Papadopoulou2012).***Whether soil properties are fully altered or pathogens are metamorphose, the perseverance of disease suppression is outrightlanky even after recurrent entry of the pathogen into the soil ***(Cook et al.1995). The*** **Table no. 5 shows the Role of micronutrient deficiency on soil-borne diseases.**

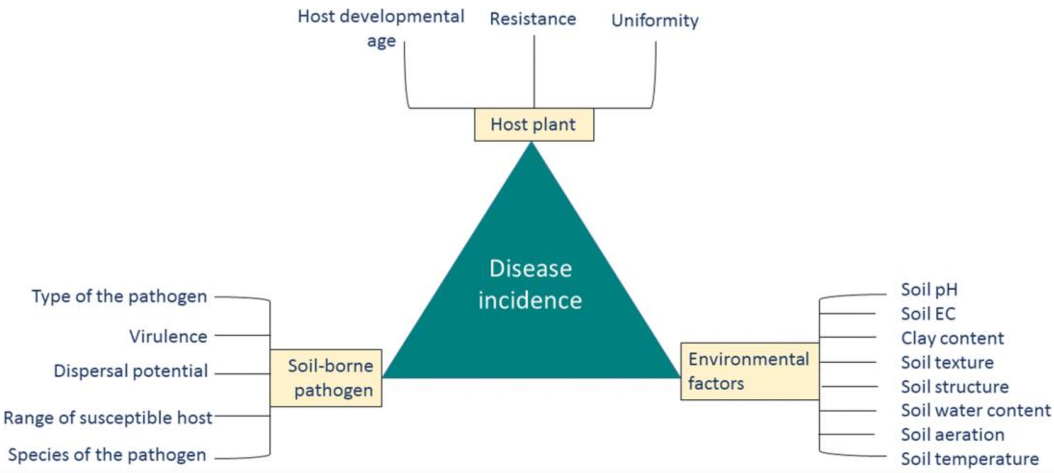
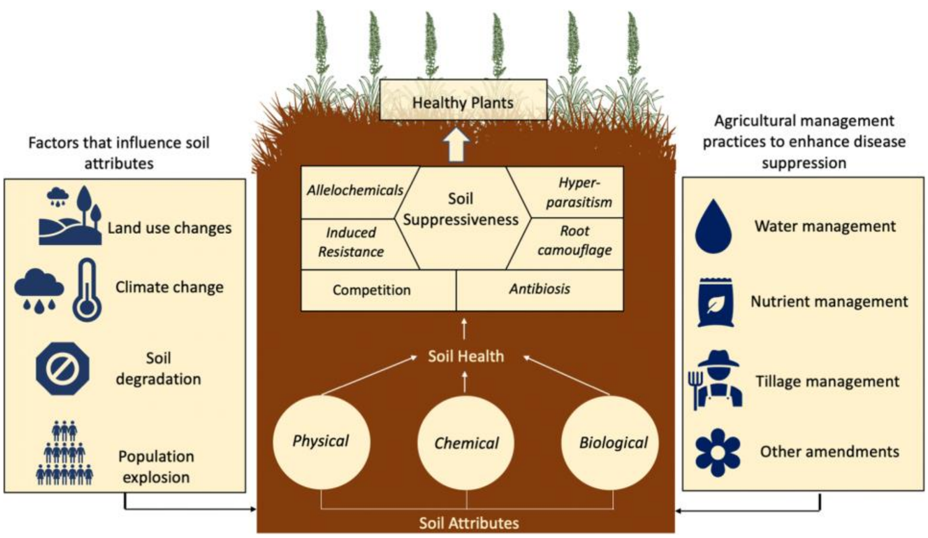


Fig. 7 Concept of soil disease triangle with main components and their respective factors.

Commonly available additives such as vermin compost, rice straw, animal manure and green waste are potential additives that have disease-suppressing properties through their effect on soil microbial communities ***(Liu et al. 2007).*** Although the biologically controllable soils illustrate satisfactory properties under either workshop or controlled conditions, attaining the similar results under field conditions is a major challenge ***(Bonanomi et al. 2010; Termorshuizen et al. 2006).*** Such differential response is attributed to the complex and specific interactions between these components in the disease triangle model and the better mixing of the bio-in oculant-enriched compost with the soil under controlled conditions than in the fields. ***Sullivan (2001)*** also reported that the degree of suppression is related to soil physical conditions, fertility level, biodiversity and populations of soil organisms, and soil management practices. For example, the use of manure alters physical, chemical, and biological parameters of the soil that directly affect crop infection and pathogen survival. ***Scheuerell et al. (2005)*** found that Pythiumsp. The suppression was linked to volatilization of ammonia from manure additives. Similarly, ***Conn and Lazarovits (1999)*** reported that application of pig manure reduced the occurrence of wilt and common scab in potato fields. It also reduced the number of plant parasitic nematodes for a period of 3 years after a single application. A significant reduction in red stele strawberry root disease was also observed in fields treated with ox/poultry and dairy manure compost compared to the control ***(Millner et al.2004).*** **Fig. 7 shows the Concept of soil disease triangle with main components and their respective factors.**

Fig. 8 This shows a photographic interplay of the soil inherent factors and environmental changes in the development of disease-suppressive soils.



Old and New Approaches to Study Disease Suppressive Soils :-Succeeding display of the microbial underpinning disease suppressiveness of soil's by heat treatment, biocides and/or soil transplantations, the propel forward step taken in past and numerous present studies usually comprises ill-targeted, macro scale isolation of microbes from bulk soil, rhizosphere or endosphere of plants grown in disease suppressive soils, followed by testing their activities against the target pathogen both *in vitro* (i.e., plate assays) and *in vivo* (i.e., introduction into conducive soils). Following this line of research, numerous microbial genera have been proposed for their role in specific disease suppressiveness. These include *Streptomyces (Liu et al., 1996; Cha et al., 2016)*,(fluorescent) *Pseudomonas* (*Kloepper et al., 1980; Scher and Baker, 1980, 1982; Wong and Baker, 1984; Lemanceau and Alabouvette, 1991; Raaijmakers and Weller, 1998; De Souza et al., 2003; Perneel et al., 2007; Mazurier et al., 2009; Mendes et al., 2011; Michelsen and Stougaard, 2011), Bacillus (Sneh et al., 1984; Cazorla et al., 2007; Abdeljalil et al., 2016; Zhang et al., 2016), Pantoea (Schisler and Slininger,1994),Enterobacter (Schisler and Slininger, 1994; Abdeljalilet al., 2016), Alcaligenes (Yuen and Schroth, 1986),* non-pathogenic *F. oxysporum (Sneh et al., 1987; Couteaudier and Alabouvette, 1990; Larkin et al., 1996; Larkin and Fravel, 2002; Nel et al., 2006; Mazurier et al., 2009; Raaijmakers et al., 2009), Trichoderma (Harman et al., 1980; Liu and Baker, 1980; Chet and Baker, 1981; Hadar et al., 1984; Smith et al., 1990; Mghaluet al., 2007), Pochoniachlamydosporia (Yang et al., 2012), Penicillium janczewskii (Madi and Katan, 1998), V. biguttatum (Jager and Velvis, 1983; Velvis and Jager, 1983),* and *P. oligandrum (Martin and Hancock, 1986). Fig. 8 shows a photographic interplay of the soil inherent factors and environmental changes in the development of disease-suppressive soils.*

Conclusion:-.The global drawback is crop losses owing to diseases and pests. Soil-borne disease govern is highly successful and cost-effective when all the necessary data about the plant, the disease impacting it, its history in new years, the host's resistance level and the prevalent environmental conditions are available. A blend of disease-suppressive soil management practices can have additive or synergistic effects, and such technique is veryappealing in the case of soil-borne diseases that are epidemiologically distinct. All management practices are suitably adapted to minimize soil borne pathogens. The phenomenon of disease-suppressive soils has been documented for many plant-pathogenic systems around the world. Harnessing the capability of these soils as a practicable means of controlling disease in agroecosystems has long been an aim of plant pathologists.

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