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# Effect of cement dust on colony interaction between *Alternaria brassicae* and test fungi

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The colony interaction were studied by inoculating the selected phylloplane fungi individually with the pathogen, *A. brassicae,* 3.00cm apart from each other on Potato Dextrose Agar medium under influence of two doses of the pollutant. Less per cent inhibition in colony growth of *Alternaria brassicae* (cf. control) was recorded at all the concentrations of cement dust in case of interactions with *Alternaria alternata, Aureobasidium, Fusarium oxysporum.* However, *A. candidus, Epicoccum purpurascens* and *Penicillium rugulosum* caused more per cent inhibition of growth of the pathogen at 5.0 x $10^6$ μg/1 concentration. More per cent growth inhibition of the pathogen (cf. control) was recorded due to interaction with *A. candidus, Epicoccum purpurascens, Penicillium citrinum, P. rugulosum* at all the concentrations of cement dust used whereas relatively less per cent inhibition was recorded due to *A. niger, Fusarium oxysporum* at (5.0 x $10^6$ μg/1) and *A. niger, Penicillium citrinum* at 1.0 x $10^7$ μg/1. Less per cent growth inhibition of the test species was recorded by the pathogen at each concentration in the cases of interactions with *Alternaria alternata, Aureobasidium, Epicoccum purpurascens,* and *Penicillium citrinum.* Relatively more per cent inhibition (cf. control) was noted for *Aspergillus candidus, A. niger,* and *Fusarium oxysporum.*The grading of colony interaction was altered from A to $B_2$ *(A. alternata);* C to D *(E. purpurascens);* $B_2$ to D *(A. niger);* D to $B_1$ *(Aspergillus candidus);* A to C *(Aureobasidium* and *Fusarium oxysporum* and $B_1$ to C *(Penicillium citrinum).* However, the grading of colony interaction in case of *Cladosporium cladosporioides* remain unchanged (D to D).

## Introduction

Deposition of cement kiln dust on leaves of sugar beet increased the incidence of leaf spot disease caused by *Cercospora beticola*. It was postulated by [1] that lime dust altered the physiological balance and increased the plant susceptibility to infection. [2] It also noted increased susceptibility of sassafrass and wild grape plants to infection by *Guignardia bidwelli* and *Gloeosporium sp.* on exposing plants to emissions of lime stone dust. [3] noted increased populations of bacteria and fungi but decreased population of actinomycetes on the phylloplane of potato in a cement dust polluated locality. *Penicilluim javanicum* was constantly isolated from the polluted locality while *Mortierella subtilissima, Trichoderma koninqii, T. viride, Aspergillus sulphureus, Helminthosporium sp.* were absent in polluted locality. However, *Aspergillus niger, A. flavus, A. luchuensis, Cladosporium cladosporioides, Curvularia lunata* and *Alternaria alternata* were frequently isolated from the polluted locality. [4-6] reviewed the work on microbial life under hypersaline environment and showed *Alternaria tenuis, Cladosporium herbarum* and *Stemophylium lanuginosum* etc. occurred widely in high saline conditions. [7] reported that incidence at root *rot* of citrus caused by *Phytophthora parasitica,* increased with increasing soil salinity.

Some workers [8a, 8b] have observed suppression in growth of *Pythium splendens* causing damping off of cucumber by calcium which is an important constituent of cement. [9] observed that calcium increased the resistance of a barley mutant to powdery mildew. [2] observed reduced numbers of bacteria and fungi on phylloplane of grape heavily incrusted with dust. [10] observed the least incidence and severity of leaf spot disease of rice caused by *Helminthosporium oryzae* in polluted locality in comparison to Control. They also observed qualitative and quantitative variations in distribution of phylloclade microorganisms.

Some mechanisms which are potentially involved in changing the physiology and biochemistry of leaves and modifying host-parasite relationship.

Direct chemical effects of polluted rain on the pathogen.

Direct chemical effects of polluted rain on leaf epidermal tissue.

Combined physical/chemical degradation of protective waxes on leaf surface by polluted rain.

Indirect effect on leaf surface microflora resulting from shifts in pH or nutrient leaching and causing shifts in competitive microflora.

Pollutant induced changes in response of the plant to other pollutants resulting in alteration of plant tissue susceptibility to infection.

Pathogen induced changes in resistance or sensitivity to pollutant injury (Fig. 1). [3] frequently isolated *Cladosporium cladosporioides*, C. *herbarum*, *Mortierella subtilissima*, *Alternaria solani*, *Curvularia lunata* and *Rhizopus nigricans* on phylloplane of potato from $SO_2$ polluted locality whereas *Cephalosporium roseogriseum*, *Aspergillus sydowi*, *Bipolaris tetramera*, *Torula herbarum* and *T. graminis* were absent in this locality.

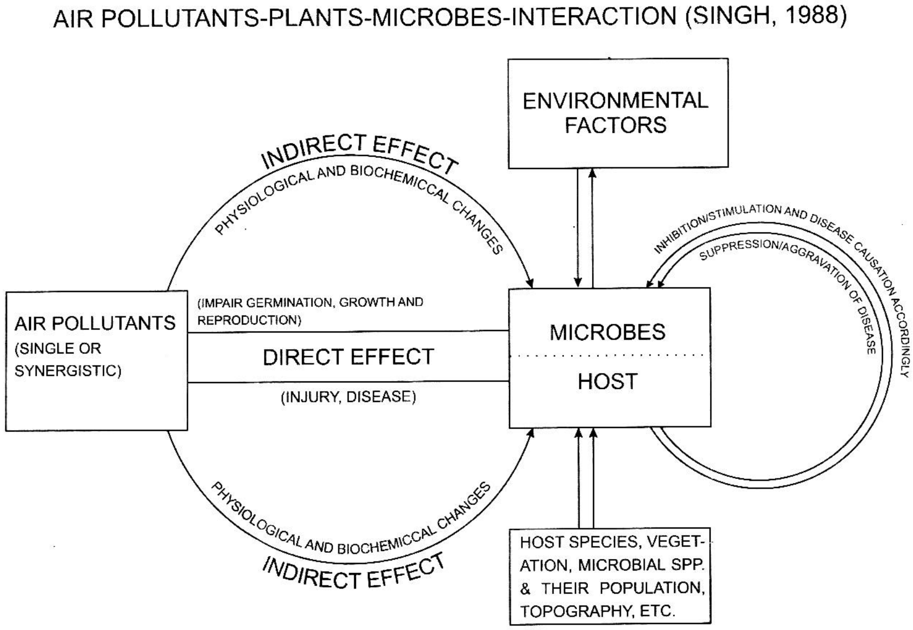


**Fig. 1.** Air pollutants-plants-microbes-interaction`

**Table 1.** Influence of cement dust on microbial interaction of some selected dominant phylloplane fungi and *Alternaria brassicae* on leaf surfce of mustard in relation to leaf spot disease

| Fungal species | Total doses of air pollutant (s) | |
|---|---|---|
| | cement dust (Cumulative doses) | |
| | I ($5X10^6$ $\mu g/m^2$) | II ($1X10^7$ $\mu g/m^2$) |
| *Alternaria alternata* | -9.37 | -4.27 |
| *Aspergillus candidus* | -53.23 | -52.27 |
| *A. niger* | -22.87 | -21.45 |
| *Aureobasidium species* | -13.34 | -12.56 |
| *Cladosporium cladosporioides* | -11.85 | -9.65 |
| *Epicoccum purpurascens* | -18.37 | -17.85 |
| *Fusarium oxyporum* | -12.90 | -11.67 |
| *Penicillium citrinum* | -17.67 | -15.23 |
| *P. rugulosum* | -21.53 | -20.67 |
| *Composite microflora* | -83.89 | -78.45 |

CD (p=0.05)

| | Lower dose | Higher dose |
|---|---|---|
| Species | 140.48 | 52.24 |
| Pollutants | 81.68 | 30.02 |

Values represent % inhibition (-) in lesion size, (cf. control)

 

## Material and method

The colony interaction were studied by inoculating the previously selected leaf surface fungi individually with the pathogen *Alternaria brassicae,* 3 cm apart from each other on PDA medium (pH 5.6) in Petri dishes in triplicates. These inoculated Petri dishes were treated with different cumulative doses of cement dust. Untreated Petri dishes served as controls. After the treatment the Petri dishes were incubated at 25±$^0$C. The positions of the colony margins on the back of the dishes were recorded daily. Assessments were made when the fungi had achieved an equilibrium after which there was no further alteration in the growth pattern. The assessment of the interaction was made according to [11, 12, 13].

Parameters used for the measurements of inhibition were the width of zone of inhibition and the percentage inhibition of radial growth i.e. 100 x ($r_1$ - $r_2/r_1$) where $r_1$ denotes diam of fungus towards opposite side and $r_2$ denotes diam of fungus towards other fungus [14].

Cement dust was mixed in PDA in 5x10$^6$ µg/1 and 1x10$^7$ µg/1 concentrations, and then poured in Petri dishes. Blocks from the colonies of *Alternaria brassicae* and the phylloplane fungi were inoculated on the medium opposing each other and the growth was recorded after 6 days. (Table 1)

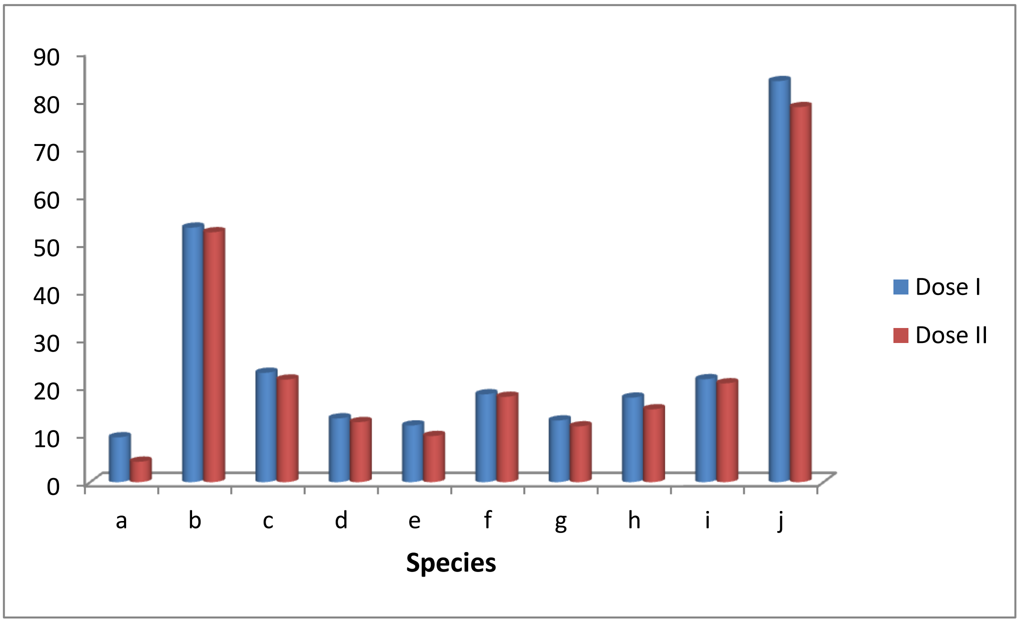


**Fig. 2.** Influence of cement dust on microbial interaction of some selected dominant phylloplane fungi and *Alternaria brassicae* on leaf surfce of mustard in relation to leaf spot disease

| | | | | |
|---|---|---|---|---|
| *a- A. alternata* | *b- A. candidus* | *c- A. niger* | *d- Aureobasidium species* | *e- C. cladosporioides* |
| *f- E. purpurascens* | *g- F. oxyporum* | *h- P. citrinum* | *i- P. rugulosum* | *j- Composite microflora* |

## Result and discussion

Less per cent inhibition in colony growth of *Alternaria brassicae* (cf. control) was recorded at all the concentrations of cement dust in case of interactions with *Alternaria alternata*, *Aureobasidium, Fusarium oxysporum.* However, *A. candidus, Epicoccum purpurascens* and *Penicillium rugulosum* caused more per cent inhibition of growth of the pathogen at 5.0 x 10$^6$ µg/1 concentration. More per cent growth inhibition of the pathogen (cf. control) was recorded due to interaction with *A. candidus, Epicoccum purpurascens, Penicillium citrinum, P. rugulosum* at all the concentrations of cement dust used whereas relatively less per cent inhibition was recorded due to *A. niger, Fusarium oxysporum* at (5.0 x 10$^6$ µg/1) and *A. niger, Penicillium citrinum* at 1.0 x 10$^7$ µg/1. Less per cent growth inhibition of the test species was recorded by the pathogen at each concentration in the cases of interactions with *Alternaria alternata, Aureobasidium, Epicoccum purpurascens,* and *Penicillium citrinum.* Relatively more per cent inhibition (cf. control) was noted for *Aspergillus candidus, A. niger,* and *Fusarium oxysporum* (Fig. 2).

The grading of colony interaction was altered from A to $B_2$ (A. alternata); C to D (E. purpurascens); $B_2$ to D (A. niger); D to $B_1$ (Aspergillus candidus); A to C (Aureobasidium and Fusarium oxysporum) and $B_1$ to C (Penicillium citrinum). However, the grading of colony interaction in case of Cladosporium cladosporioides remain unchanged (D to D) (Table 2).
The results obtained show that different types of interactions occur between paired fungi on agar media which have been observed earlier by several workers [15, 12, 14, 13] . These interaction are altered by the kind and concentration of the air pollutants. The alteration in interactions particularly growth inhibition of the pathogen as well as test saprophytic fungi occur due to direct favourable or adverse effect of the air pollutants

on growth of the pathogen and other test fungi. Radial growth inhibition on agar plates is commonly ascribed to production of antibiotics by the antagonists, competition for nutrients, mechanical obstruction and hyperparasite reaction [17, 18, 14, 14]. These activities seem to be altered under influence of air pollutants and might be responsible for the changes in per cent growth inihibition of pathogenic and saprophytic species. Change in pH of the nutrient medium due to antagonistic fungi and its inihibitory effect on the growth *Septoria nodorum* has been recorded by [13].

**Table 2.** Colony interaction between *Alternaria brassicae* and selected dominant phylloplane fungi in relation to cement dust

| Test fungi | Concentration | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Control | | | | | I (5X10$^6$ μg/m$^2$) | | | | | II (1X10$^7$ μg/m$^2$) | | | | |
| | % Colony inhibition of test pathogen | % Colony inhibition of test fungi | Inhibit-ion Zone (mm) | Interming iled Zone (mm) | Type of interact-ion | % Colony inhibition of test pathogen | % Colony inhibition of test fungi | Inhibit-ion Zone (mm) | Interming iled Zone (mm) | Type of interact-ion | % Colony inhibition of test pathogen | % Colony inhibition of test fungi | Inhibit-ion Zone (mm) | Interming iled Zone (mm) | Type of interact-ion |
| *Alternaria alternata* | 5.18 | 28.07 | - | - | A | 5.66 | 22.36 | - | 2.00 | $B_2$ | 10.52 | 24.00 | - | 3.00 | $B_2$ |
| *Aspergillus candidus* | 10.68 | 1.36 | 2.26 | - | D | 20.63 | 5.45 | - | 6.00 | $B_1$ | 15.90 | 3.07 | - | 4.00 | $B_1$ |
| *A. niger* | 27.05 | 7.93 | - | 1.00 | $B_2$ | 23.21 | 21.72 | 2.00 | - | C | 24.11 | 5.48 | 13.00 | - | D |
| *Aureobasidium species* | 6.89 | 42.57 | - | - | A | 4.87 | 31.94 | 2.00 | - | C | 9.09 | 23.07 | 1.33 | - | C |
| *Cladosporium cladosporioides* | 21.05 | 13.48 | 2.60 | - | D | 21.08 | 22.56 | 2.60 | - | D | 21.96 | 18.18 | 2.86 | - | D |
| *Epicoccum purpurascens* | 5.66 | 35.93 | 1.66 | - | C | 21.12 | 13.51 | 4.66 | - | D | 22.68 | 12.47 | 4.66 | - | D |
| *Fusarium oxyporum* | 6.89 | 32.57 | - | - | A | 4.87 | 36.94 | 2.00 | - | C | 9.09 | 23.07 | 1.33 | - | C |
| *Penicillium citrinum* | 18.25 | 33.04 | - | 3.00 | $B_1$ | 21.31 | 29.34 | 1.00 | - | C | 12.08 | 30.89 | 2.00 | - | C |
| *P. rugulosum* | 4.78 | 13.88 | 2.25 | - | D | 14.51 | 10.88 | 2.16 | - | D | 10.78 | 14.51 | 2.00 | - | D |

CD (p=0.05)

| | Pathogen | Saprophytes |
|---|---|---|
| Dose | 8.72 | 5.60 |

Intermingled growth (grade A) of interacting fungi is possible only when both the fungal colonies show equal growth rate and equal competitive and resistance capacity. Overgrowth (grade $B_1$, $B_2$) is possible when one of the interacting species has a higher growth rate and/or produces antibiotic substances and has tolerance against any such substance produced by the other. Diffusion of active staling growth substances in nutrient agar by the antibiotic producing fungal species may be inhibitory/lethal to the test fungi (grade C or D).

The alteration of grade A to C in the case of *Aureobasidium,* and *Fusarium oxysporum* under influence of both doses of cement dust: B. *to* C *(Penicillium citrinum)* and B2 to D in case of *A. niger* under influence of cement dust; A to $B_2$ *(A. alternata)* and C to D in case of *Epicoccum purpurascens,* under cement dust treatment(s) seems to be due to some effect of the respective doses of the cement dust on growth of interacting fungal species. If D grade is altered to anyone of the remaining grades eg. *A.candidus* it may be attributed to favourable effect of the pollutants on the interacting species. Thus it is evident from the present study that the air pollutants greatly influence the fungal colony interactions.

## Notes and References


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1. **SchÖenbeck, H. 1960**. Beobachtung zur Frage des Einflusses von industriellen immissionne auf die Krank-bereitschaftder Pflantz Ber. Landesanstalt. Bodennut-zungsschutz., 1: 89-98.
2. **Manning, W. J. 1971**. Effects of Limestone dust on leaf condition, foliar disease incidence and leaf surface mircoflora of native plants. Environ. Pollut., 2 : 69-76.
3. **Rai, B. and Pathak, K. K. 1981**. Studies on phylloplane microflora of potato in relation to air pollutants. Environ. Pollut., 26 : 153-166.
4. **Singh, A.K. 198**8. Effect of air pollutants on phylloplane microflora of wheat. Ph. D. Thesis.
5. **Singh, A.K. and Siddique, S. 2009**. A comparative aeromycological study of unpolluted and polluted air localities. J. Basic, Appl. Mycol. 8(I&II): 109-112.
6. **Singh, V. P. and Garg, K. L. 1985**. Microbial life under hyper saline environments. Ecophysiological aspects. In "Frontiers in applied microbiology", (Eds. Mukerji, K. G., Pathak, N. C. and Singh, V. P., Print House, Lucknow, 315-326.
7. **Blaker, N. S. and Mac Donald, J. D. (1986)**. The role of salinity in the development of *Phytophthora* root rot of citrus. Phytopathology, 76 : 970-975.
8. **(a) Kao, C. W. and Ko, W. H. 1986a**. Suppression of *Pythium splendens* in a Hawaiian soil by calcium and microorganisms. Ecology and Epidemiology, 76 : 215-220. **(b) Kao, C. W. and Ko, W. H. 1986b**. The role of calcium and microorganisms in suppression of cucumber

damping off caused by *Pythium splendens* in Hawaiian soil. Ecology and Epidemiology, 76 : 221-225.

9. **Bayles, C. J. and Aist, J. R. 1987**. Apparent calcium mediation of resistance of an ml-o barley mutant to powdery mildew. Physiological and Molecular Plant Pathology, 30 : 337-346.

10. **Singh, A. K. Solanki, R. S. and Rai, B. 1987**. Effects of air pollutants on phylloplane microflora of *Oryza sativa* Linn. and development of leaf spot disease. In "Proc. Symp. Plant Micobe Interaction" Cited Singh, 1988.

11. **Porter, C. L. 1924**. Concerning the characters of certain fungi as exhibited by their growth in the presence of other fungi. Am. J. Bot., 11 : 168-188.

12. **Dickinson, C. H. and Boardman, F. 1970**. Physiogical studies of some fungi isolated from peat. Trans. Br. mycol. Soc., 55 : 293-305.

13. **Skidmore, A. M. 1976**. Interactions in relation to biological control of plant pathogens. In "Microbiology of Aerial Plant Surface (Eds. Dickinson, C. H. and Preece, T. F,), Academic Press, London, pp. 507-528.

14. **Fokkema, N. J. 1973**. The role of saprophytic fungi in antagonism against *Drechslera sorokiniana (Helminthospor-ium sativum)* on agar plates and on rye leaves with pollen. physiol. Pl. Path., 77 : 322-342.

15. **Van Den J. Heuvel. 1970**. Antagonistic effect of epiphytic microorganisms on infection of dwarf bean leaves by *Alternaria zinniae.* Thesis, Utrecht. Mededeling van het Phytopathologisch Laboratorium "Willie Commelin Scholten" No. 84 : 88.

16. **Skidmore, A. M. and Dickinson, C. H. 1976**. Colony interaction and hyphal interference between *Septoria nodorum* and phylloplane fungi. Trans Br, mycol, Soc., 66 : 57-64.

17. **Diem, H. G. 1969**. Microorganisms de la surface des feuilles II. Introductions entre quelques champignons parasites et divers saprophytes filamenteux de la phyllosphere de I'orge. III Effect de la competition nutritive sur la germination des spores d'une Souchede *Helminthosporium sativum*. Bull. Ecol. nat. Sup. Agron. 11 : 12-17; 18-25.

18. **Ikediugwu, F. E. O. and Webster, J. 1970**. Antagonism between *Coprinus heptemerus* and other coprophilous fungi. Trans. Br. mycol. Soc., 54 : 181-204.

19. **Fokkema, N. J. 1976**. Antagonism between fungal saprophytes and pathogens on aerial plant surfaces. In "Microbiology of Aerial Plant Surfaces" (Eds. Dickinson, C. H. and Preece, T. F.). Academic Press, London, pp. 487-506.