Protomyces macrosporus Unger のコエンドロへの感染に関する条件

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Environment in Relationto Infection of Coriander by *Protomyces macrosporus* Unger

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Abstract

Susceptibility of coriander (*Coriandrum sativum* L.) to stem gall disease incited by *Protomyces macrosporus* Unger is mainly influenced by the inoculum potential, microclimate comprising of soil and air around the host plant, and susceptible host period amongst other factors. Occurrence of concurrent influence of all the environmental factors for a severe disease outbreak is probably thwarted by the shortfall of some factor(s) for an early maturing crop escaping the pathogenic infection.

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Introduction

Interaction of environmental conditions and host susceptibility relative to age of the plant directly influence severity and destructiveness of a disease. Field observations indicated that progress of stem gall of coriander (*Coriandrum sativum* L.) was closely circumscribed by environmental conditions and plant age. Cultivation of coriander at Varanasi, Uttar Pradesh normally starts in mid-October to November and the crop is irrigated 4 to 6 times during the growing period. Early planting of the crop in late September to early October usually escapes infection. Comparative freedom from disease of the early-sown crop and severity of stem gall in the late-sown crop (until December) are probably associated with prevalent environment and susceptible plant age. The ralation between the date of planting of coriander and infection by the pathogen *Protomyces macrosporus* Unger under field conditions is not yet known precisely. Knowledge of factors affecting incidence of disease including predisposition has potential value in disease control. The present experiment was laid out to determine the influnece of these factors on the disease incidence in coriander.

Materials and methods

Coriander (*Coriandrum sativum* L.) seed of local variety susceptible to stem gall disease was planted in pots at 10 days intervals from October 15, 1963 to March 30, 1964. More than 10 seedlings/pot in 3 pots from each planting were inoculated a month after emergence at similar intervals, since a month old plants were observed suscetible to infection during the field studies. Inoculation was done by sprayng equal amounts of spore suspension of uniform density in sterile dist. water from 7 days old colonies of *P. macrosporus* (Mukhopadhyay and Pavgi[2]). Inoculated seedlings were retained in moist chambers for 48hr and exposed outside in isolation.

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In another set, similar plantings were made from September 30, 1963 to January 28, 1964 and likewise inoculated late in February by spraying the culture spore suspension. Control blanks were run in each set by spraying the plants with sterile dist. water alone. The inoculations were repeated in the following seasons. Disease intensity in both the seedling lots was assessed by an average count of galls/plant on the stem a month after inoculation.

Observations

Inoculum potential The pathogen *P. macrosporus* hibernates and oversummers through the development of thickwalled chlamydospores in the host tissues. Primary inoculum of the disease is carried to the field with the seed drawn from an infected crop, crop debris and/or uncleaned seed mixed with fruit galls. Earlier experiments demonstrated that the pathogen was capable of perpetuating through blastospores multiplying in the soil during the crop season and later rendered heat resistant through desiccation in intensively cultivated fields (unpublished data). The chlamydospores hibernating in the crop debris and/or hypertrophied fruit galls are released after the monsoon period (July-September) in the former case and in the richly irrigated fields with heavy soil in the latter. The chlamydospores from fruit galls are induced to germinate on the soil surface late in January. Ability of the pathogen to build up chlamydospores *in vitro* in the soil further adds to the inoculum potential. Concentration of the inoculum thus remains at a high level. Infection of the seedlings takes place through the endospores and subsequent blastospores during January-February.

Environment The period of infection of coriander (*Coriandrum sativum* L.) by *P. macrosporus* ranged from early December to a little over mid-March, the highest infection being in February. It is favorably induced from December onward showing a gradual increase. The infection adjudged by the number of galls/plant sharply decreases in early March and ceases to occur after middle of the month (Table 1). Failure in infection is obviously due to rise in temperature and fall in moisture both in the soil and atmosphere. Maturation of the infection galls and the chlamydospores within prolonged until March to April in case of early infections as well.

Comparative field observations indicated that light to moderate infection occurred in fields with light soil, which retained irrigation water only for a few days. In richly irrigated, low-lying, shady areas with heavy soil retaining the water over a longer period, the disease was of general occurrence and more severe in intensity. The chlamydospres germinated in richly irrigated soil with the onset of low temperature during December increasing the concentartion of primary inoculum and the period of host infection ranged from December through February and occasionally extended over to early March. The atmospheric temperature during December-

Table 1. Relative intensity of gall development on coriander stem inoculated at progressive time periods

Inoculated on		Avg. no. galls/Plant
November	30	0
December	9, 19, 30	8, 11, 11
January	8, 19, 29	13, 15, 18
February	7, 18, 26	38, 41, 45
March	7, 20, 28	14, 8, 0
April	8	0

January ranged between 5-20°C (5-10°C during December, 10-15°C in early January, 15-20°C in late January and 20-25°C during February), which was suboptimal for chlamydospore germination, multiplication of the culture cells/blastospores and development of the pathogen within the host. Consequently, the infection was much less during this inoculation period in the potted plants. A temperature range between 20-25°C prevalent in February appeared favorable. Prevalence of low temperature (10-20°C) in the late night and early morning hours and moderately high temperature (20-25°C) during the daytime associated with an optimum humidity (75-90% R.H.) were conducive for chlamydospore germination, infection and subsequent devolopment within the host. Relatively rapid rise in temperature, fall in humidity and high light intensity resulted in low disease incidence in March in the field.

Microclimate or ecological situation immediately in the vicinity around the tender herbaceous host plant significantly influenced both the host and the pathogen. This primarily included in the present case the amount of soil moisture and temperature (of soil and atmosphere), condensation from the atmosphere during late night and early morning hours, low light intensity, low oxygen and higher CO_2 conc. and crowding in the host stand directly predisposed the host and favored the pathogen in infection and its development within. Exposure to low temperature increases susceptibility to disease. The range of low temperature in Varanasi may not necessarily touch the level of frost injury as it occasionally does during January. However, no evidence was observed modifying host susceptibility due to low temperature injury. Similarly high soil moisture and reduced light intensity contributed to increasing host susceptibility. High level of field fertility and variation in pH of the soil due to chemical fertilization, thereby enhancing host vigor profoundly affected disease proneness and intensity of disease development. Free moisture, essential for the pathogen both at the spore germination and infection stages over prolonged periods increased succulence of the host due to higher water content in the tissues.

Age of host plant Possible correlation between maturation due to aging and disease susceptibility in the host was determined. Infection of coriander by *P. macrosporus* appeared directly

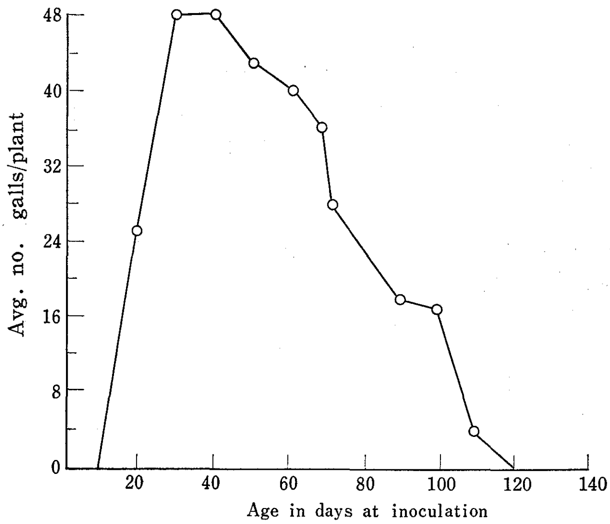

Fig. 1. Relation of age of seedlings to development of stem gall of coriander incited by *Protomyces macrosporus*.

conditioned by age of the host plant. The seedlings became susceptible to infection 10-11 days after emergence and remained so with an increasing degree for over 6 weeks due to succulence of stem (Fig. 1). Younger seedlings escaped infection due to a waxy coating on the newly formed shoots and possible presence of an inhibitor in the tender shoots above the mesocotyl. It remained at a fairly high level until the preblossoming stage of the plant (10 weeks) and receded gradually with advancing age acquiring resistance with thickening of cell walls and firmness in tissues and physiological maturation of the plants. The susceptibility declined sharply during the fruiting stage.

Discussion

Inoculum potential is the product of the quantity of inoculum present (the intensity factor) and the capacity of the environment to produce disease in a susceptible host (Dimond and Horsfall[1]). Interaction of the factors like the inoculum potential in the soil, environment and age of the host plant directly condition the infection of coriander by *P. macrosporus* and development of the stem gall disease. The oversummering resting chlamydospores and desiccated blastospores in the soil become effective only after the onset of favorable environment. The quantum of inoculum at a threshold level is not known for epiphytotic occurrence of the disease cumulatively intensified with other prevalent factors in the field. This would partially explain escape of early-planted crop from the infection.

Severity of disease incidence was conspicuous in late-planted fields with heavy, richly irrigated soil. Presence of low temperature coincident with abundant moisture deposit during early morning and night hours and a slightly high temperature during the day time in February appeared to predispose the succulent plants to stem gall incidence. Decrease in humidity and rise in temperature adversely affected disease incidence retarding development of the pathogen within the host. However, the period of maximal infection might vary with the location and seasonal variation. The severity of infection and the magnitude of damage to the crop proportionally increase in fields with heavy, poorly drained soil in low-lying shady areas and the period over which moisture is retained in the soil.

The coriander plants remain susceptible over a longer period of their age under optimum environment. In ontogenetic predisposition, coriander in relation to stem gall infection comes under the fourth category having youth and age resistance with susceptibility in the middle life span (Yarwood[3]). Susceptibility to a facultative saprophyte such as *P. macrosporus* increases with age of the host tissue for a certain period. Decrease in susceptibility with advancing age beyond this peak of susceptibility permits escape from infection in an early planted crop. High disease incidence occurs in a normal and late crop planted during December, since the plants attain the most susceptible age during February, when the environment at Varanasi is at optimum level. Preventive control may, therefore, be directed to disease escape measures by planting (not later than October 10) early maturing varieties besides dirert measures to minimize the primary pathogenic inoculum in the soil. The basis of genetical and physiological susceptibility in this host is yet unknown.

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和文摘要

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Protomyces macrosporus Unger による茎瘤病に対するコエンドロ（*Coriandrum sativum* L.）の感受性は，主として感染源の力，寄主をとりまく土の中および空気の微気象と，そのほかの多くの条件のうちとくに寄主植物の生育期に影響される。