

A STUDY OF *ALTERNARIA* BLIGHT OF *BRASSICA OLERACEA* VAR. *CAPITATA* L. UNDER DIFFERENT AGROCLIMATIC CONDITIONS OF KUMAUN HIMALAYA

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Alternaria alternata, *A. brassicae*, *A. brassicicola*, *A. raphani*, *A. longissima* and *A. tenuissima* were isolated from seed samples of *Brassica oleracea* Var. *capitata* grown in Kumaun Himalaya. *Alternaria alternata* and *A. brassicicola* were associated with the seeds of most of the samples while *A. brassicae*, *A. longissima*, *A. raphani* and *A. tenuissima* were recorded from 4, 1, 3 and 2, respectively. *A. alternata*, *A. brassicae*, *A. brassicicola*, *A. raphani* and *A. tenuissima* reduced the seed germination by seed rot, root rot and damping-off. Three fungicides viz., thiram, captan and dithane M-45 were effective against *Alternaria* blight. The available literature reveals that *A. alternata*, *A. longissima*, *A. raphani* and *A. tenuissima* are being reported from the seeds of cabbage of India first time.

Key words : *Alternaria* association, blight, Pathogenicity, seed plant transmission, control.

Cabbage (*Brassica oleracea* var. *capitata* L.) is cultivated under different agroclimatic conditions of Kumaun region of India. Production of cabbage is one of the important sources of revenue to the farmers of this region. Many investigators including Suryanarayana & Bhombe (1961), Porwal & Kothari (1970), Gangopadhyay & Kapoor (1975), Mali & Joi (1985) and Duhan & Suhag (1989 & 1990) have worked in tropical parts of India on *Alternaria* blight and its pathogenic effects on cabbage and other crucifers. Dhyani *et al.* (1989) studied *Alternaria* blight of *Capsicum annum* under different agroclimatic conditions of Kumaun Himalaya.

The present study deals with the *Alternaria* blight of cabbage under different agroclimatic conditions of Kumaun Himalaya.

MATERIALS AND METHODS.

Isolation of fungal species : Samples of stored seeds of cabbage were collected in fresh polythene bags from different agroclimatic conditions of Kumaun Himalaya (Table 1). Different *Alternaria* spp. associated with the seeds were isolated by standard blotter and agar (PDA) Plate methods following the rules recommended by International Seed Testing Association (ISTA, 1966).

Infected leaves and pods were also collected from different sites, treated by NaOCl solution (1% available chlorine) for 10 minutes, then washed with sterilized water, dried and inoculated on sterile agar plates. These

plates were incubated for 7 days at 20±2°C for the growth of fungal species.

Pathogenicity tests : Pathogenicity tests of *Alternaria alternata*, *A. brassicae*, *A. brassicicola*, *A. raphani* and *A. tenuissima* were made under glass-house conditions. For this, healthy and surface sterilized seeds of cabbage were rolled over actively sporulating cultures and sown in sterilized (by autoclave) pot soil. The average temperature and soil moisture of all the pot soils were 18.0°C and 60% respectively. One hundred seeds (5 replicates of 20 seeds/pot of 24 cm. dia) were sown in sterilized soil for each pathogen and 100 seeds sown without inoculum served as control. Regular observations were made to study the effects of these pathogens.

Disease control experiments : To control seed borne infection of *A. alternata*, *A. brassicae*; *A. brassicicola* and *A. raphani* in cabbage, laboratory evaluation of some fungicides was carried out. For this, healthy seeds of cabbage were surface sterilized with 2% NaOCl solution, washed with sterilized water and dried. These seeds were rolled over actively sporulating cultures of the tested pathogens and kept under moist conditions at 20°C for 48 hours for the establishment of pathogens in seeds. These seeds were washed, dried and dressed with different fungicides at 0.3 conc. of seed weight. The dressed seeds were directly placed on moist blotter plates (10 replicates of 10 seeds each) and incubated for 14 days. One hundred seeds plated directly without fungicidal dressing served as control.

Table 1: Percentage occurrence of *Alternaria* species with seeds *Brassica* Var. *capitata* in different agroclimate conditions of Kumaun hills, U.P. India.

Areas	Agroclimatic conditions (Average during 1987-1989)		<i>A. alternata</i>		<i>A. brassicae</i>		<i>A. brassicicola</i>		<i>A. longissima</i>		<i>A. raphani</i>		<i>A. tenuissima</i>	
	Tempe- rature (°C)	Rain- fall mm	NT	T	NT	T	NT	T	NT	T	NT	T	NT	T
Mona	19	116	18	6	-	-	12	5	-	-	-	-	-	-
Janoli	16.5	135	22	5	8	5	13	8	-	-	5	3	2	1
Aroli	21	110	16	4	3	-	8	2	-	-	-	-	-	-
Pilkholi	20	118	18	5	-	-	9	4	-	-	-	-	-	-
Tarikhet	16	134	20	8	3	1	5	3	5	2	-	-	-	-
Ranikhet	16	135	21	9	-	-	16	8	-	-	2	1	-	-
Nainital	14	240	24	12	5	3	22	13	-	-	3	2	2	2
Bamathi	12	110	15	6	-	-	10	3	-	-	-	-	-	-

NT = Non Treated seeds; T = Treated Seeds by NaOCl solution (1% available chlorine); - = Absent.

Table 2: Pathogenicity tests of virulent *Alternaria* sp. in *Brassica oleracea* Var. *capitata* L.

Fungal species	No. of seeds sown	Normal Healthy Seedlings	Infected Seedling		Percentage of seedling infection	% seed germinated	Pre-emergence loss.
			Slightly infected seedlings	Severely infected seedlings			
<i>Alternaria alternata</i>	100	58	7	3	14.70	68	32
<i>A. brassicae</i>	100	71	6	6	14.45	83	17
<i>A. brassicicola</i>	100	68	2	10	17.07	82	18
<i>A. raphani</i>	100	49	4	2	10.01	55	45
<i>A. tenuissima</i>	100	67	-	3	4.28	70	30

OBSERVATIONS

Direct Inspection of seeds : During the Inspection of seeds with naked eye and under stereo binocular microscope, it was noted that *Alternaria alternata* showed blakish green spots, while *A. brassicae*, *A. brassicicola*, *A. raphani* and *A. tenuissima* caused blackish spots on the seeds. *A. raphani* and *A. longissima* were colonized on seed coats only while *A. alternata*, *A. brassicae*, and *A. brassicicola* collected from diseased pods showed deepseated infection.

Incidence of *Alternaria* species in seeds : 5 species of *Alternaria* were associated with the seeds of cabbage (Table 1). of them, *A. alternata* and *A. brassicicola* were found in all the samples while *A. brassicae* was recorded from Janoli, Aroli, Tarikhet and Nainital, *A. longissima* from Tarikhet, *A. raphani* from Janoli, Ranikhet and Nainital, and *A. tenuissima* from Pilkholi and Nainital with different percentage occurrence. All these species caused seed rotting and seedling infection.

Leaf and pod spots observations : The important species isolated from infected leaves and pods were *A. alternata*, *A. brassicae*, *A. brassicicola*, *A. raphani* and *A. tenuissima*.

***Alternaria alternata* (Fr.) Keissler;** This species caused severe losses due to seed rot and infection of young seedlings. In fruits, a few black rounded sunken spots with black mycelium were developed. Most of the pods were reduced in size containing shrivelled and discoloured seeds. Young and old leaves showed small, spherical, irregular, black necrotic spots, which reduced photosynthetic area and caused premature leaf defoliation.

***A. brassicae* (Berk) Sacc. -** In leaves this pathogen caused small to large circular lesions in concentric rings and covered entire surface of the leaves.

In the seedling it caused yellowing and blackening of the cotyledonary leaves. In pods, black, rounded sunken spots with grey mycelium were found near the tip.

Table 3: Efficacy of different fungicide against *Alternaria* species in cabbage seeds (0.3% concentration of seed weight).

Chemical used		<i>A. alternata</i>		<i>A. brassicae</i>		<i>A. brassicicola</i>		<i>A. raphani</i>	
		(M)	(%I)	(M)	(%I)	(M)	(%I)	(M)	(%I)
1	2	3	4	5	6	7	8	9	10
Control	Infection	19	95	19.8	98	19.8	98	19	93
	Seed Germination	7.2	36	12.8	64	8.16	48	8	19
	Seed Rot	5	25	4	20	9	48	5	24
	Seedling blight	7	36	5	25	8	37	4	22
Bavistin 50% WDP	Infection	15.6	78	8	40	14	68	12	60
	Seed Germination	10	50	16.8	84	8	42	14	71
	Seed Rot	4	20	2.4	12	3	13	3	15
	Seedling blight	6	30	3.0	15	2	8	4	19
Brassicol	Infection	11.6	58	9.0	45	9	45	6	29
	Seed Germination	8.8	44	18	80	3	54	16	80
	Seed Rot	3	15	3.4	17	2	10	1	5
	Seedling blight	2.8	14	4	18	4	20	2	11
Captafol	Infection	3	15	1	5	0.6	3	1	5
	Seed Germination	14.4	72	18	90	17	85	18	90
	Seed Rot	0.2	1	0.2	1	0.2	1	0.4	2
	Seedling blight	0.8	4	0.2	1	0.4	2	0.6	3
Dithane M-45	Infection	1.8	9	1.4	7	0.6	3	1	6
	Seed Germination	13.5	69	17	85	16	81	17	85
	Seed Rot	1	5	0.2	1	0.2	1	0.4	2
	Seedling blight	0.4	2	-	-	0.4	2	0.8	4
Thiram 75% WDP	Infection	0.6	3	0.2	1	-	-	0.8	4
	Seed Germination	13.8	69	18.4	92	18	90	0.2	1
	Seed Rot	-	-	-	-	-	-	18	90
	Seedling blight	-	-	-	-	-	-	0.2	1
	Infection	1.8	54	3	15	4	24	1	7
	Seed Germination	13.6	68	14.2	71	13	64	18	89
	Seed Rot	0.6	3	0.4	2	0.8	4	0.6	3
	Seedling blight	0.6	3	-	-	0.4	2	0.2	1

M = Mean Infection; % I = Percentage infection; - = nil.

A. brassicicola (Schw) Wiltshire - was detected from most of leaves, causing sunken spots covered with powdery spore mass. It caused small dark brownish, black, circular, spots on leaves and linear spots on petioles. Pods infection was very rare. Infection on leaves appeared from June to August when condition was humid and cool. These spots coalesced to form bigger patches and reduced photosynthetic area of leaves.

A. raphani Groves & Skolko. Infected leaves showed small, irregularly scattered, zonate, brown to black necrotic spots in concentric rings. It was isolated from mixed infection with *A. brassicae* and *Fusarium oxysporum*. On young seedlings it produced black,

powdery spore mass that caused damping-off and blighting of radicle and plumule.

A. tenuissima (Kunze & Pers). Wiltshire, were detected only from few pods causing small, sunken spots covered with powdery spore mass. This pathogen was mixed with *A. alternata*.

Pathogenicity tests : In the pathogenicity *A. alternata*, *A. brassicae*, *A. brassicicola*, *A. raphani* and *A. tenuissima* were studied under glass house conditions. All five species caused reduced seed germination, seed rot, seedling blight, damping-off wilting and stunting of seedlings. *A. alternata* caused 14.70% *A. brassicae* 14.45%, *A. brassicicola*, 17.07%, *A. raphani* 10.9% and *A. tenuissima* 4.2% seed infection respec-

tively. Rotted seeds were found heavily colonized by these fungi. However, in control good seed germination and seedling growth was observed. (Table 2).

Disease control experiments : In control, out of 6 fungicides, thiram and captafol gave best results. Thiram eliminated infection of *A. brassicae* and *A. brassicicola* completely, while *A. alternata* and *A. raphani* showed 3% and 4% infection, respectively. Captafol, dithane M-45, and vitavax were also found effective against all the four tested *Alternaria* spp. with better seed germination. Bavistin and brassicol did not show good results against *A. alternata*, *A. brassicae*, *A. brassicicola* and *A. raphani*. (Table 3). In control (Uninfested seed), *A. alternata*, *A. brassicae*, *A. brassicicola* and *A. raphani* caused 95%, 98%, 98% and 93% infection respectively.

DISCUSSION

Alternaria species have showed pathogenic association with seed, seedlings, leaves and pods of cabbage under various agroclimatic conditions of Kumaun Himalaya. These caused heavy losses in crop yield besides quality deterioration. Among, *Alternaria* spp. isolated, *A. alternata* was most virulent pathogen which reduced seed germination and infected many seedlings. It was followed by *A. brassicae*, *A. brassicicola*, *A. raphani*. However, *A. longissima* and *A. tenuissima* was less common in seeds. Four species namely, *A. alternata*, *A. brassicae*, *A. brassicicola* and *A. raphani* have been previously reported by many investigators (Groves & Skolko, 1944, Neergaard, 1945, Richardson, 1970, Babadoost & Gabrielson, 1979, Michail *et al.*, 1979, Humpherson-Jones, 1983, Maude *et al.*, 1984 and Singh *et al.*, 1989 from Cruciferous plants.

A review of literature reveals that *A. alternata*, *A. longissima*, *A. raphani*, *A. tenuissima* are new records on cabbage seed, seedlings and pods in India. Various investigators including Survanarayana & Bhombe (1961) and Gangopadhyay and Kapoor (1975) found regular infection of *A. alternata*, *A. brassicicola* and *A. brassicicola* in seed, seedlings caused large amount of the losses in vegetables and cereals crop.

In pathogenicity tests of *A. alternata*, *A. brassicae*, *A. brassicicola*, *A. raphani* and *A. tenuissima*, different symptoms e.g. seed rotting, damping-off, leaf blight and wilting of seedlings were recorded. These observations revealed the transmission of *Alternaria* spp. from

seed to seedlings and also responsible for heavy losses. Survanarayana & Bhombe (1961), Changsri & Weber (1963) Taber *et al.* (1968), Richardson (1970), Keyworth (1972), Shirahama (1977), Petri (1979), Babadoost & Gabrielson 1979; Michail *et al.*, 1979; Maude *et al.* (1984) have also reported similar results in cabbage crop by *A. alternata*, *A. brassicae*, *A. brassicicola* and *A. raphani*.

The results of fungicides seed treatment indicated that contact fungicide thiram is the most effective fungicide for seed dressing with no inhibitory effects on seedling growth of cabbage; It was followed by captafol, dithane M-45 and vitavax. Such results against other fungal pathogens were also found by Mali and Joi, 1985, Lahoti & Potdukhe (1990), who observed that thiram, captafol and captan were highly effective in chillies crops. Kaushik *et al.* (1985), Singh & Prasad (1989) and Singh *et al.* (1990) observed that difolation, dithane M-45 and captafol were very effective in controlling seed-borne *Alternaria* spp.

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