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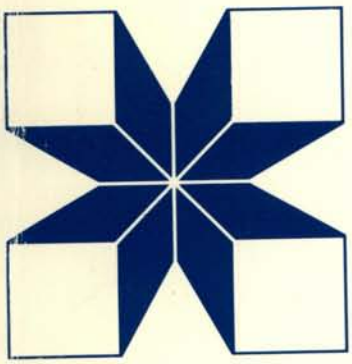

CANADA

OIL CROPS:
PROCEEDINGS OF THE THREE MEETINGS HELD AT PANTNAGAR AND HYDERABAD, INDIA, 4 – 17 JANUARY 1989

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1. The Brassica Subnetwork-II
2. The Other Oil Crops Subnetwork-I
3. The Oil Crops Network Steering Committee-I

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DISEASE PROBLEMS IN BRASSICAS AND RESEARCH ACTIVITIES AT PANTNAGAR

S.J. Kolte, R.P. Awasthi and Vishwanath

Abstract

Research activities on management of seedling blights, Alternaria blight (AB), white rust (WR) and downy mildew (DM) diseases of rapeseed-mustard are highlighted. Tolerance to AB in *Brassica carinata*, *B. napus*, *B. alba* and in some cultures of cultivated *B. juncea*, has been established to be characterized by reduced infection rate suggesting its race-nonspecific nature against different races of most predominant causal fungus, *Alternaria brassicae*. However, resistance to WR in the above crop species appears to be race-specific as some of these (*B. juncea* exotic series) are immune or highly resistant to *Albugo candida* as against the highly susceptible reaction of some others as cultivated *B. juncea* cultures. This suggests the occurrence of races in *A. candida* also.

Until a break-through in breeding high yielding agronomically acceptable disease resistant cultivars is made, the diseased control strategy depends on the integrated use of early maturing and disease escaping or tolerant cultivars and on chemical control. Superiority of Iprodione to Dithiocarbamates in controlling AB is established, whereas the effectiveness of the use of mixture of Metalaxyl + Mancozeb in the control of WR and DM is confirmed.

Pathological research in respect of rapeseed-mustard crops is being carried out at Pantnagar with an overall objective of finding out disease resistant or tolerant cultivars or germplasm among the indigenously available materials or from the exotic *Brassica* species. In addition to this, assessment of yield losses due to diseases under different agricultural situations, variability in pathogens, and uses of cultural and chemical measures, also form part of the research activities for providing some basic information in devising integrated control strategy for management of the diseases of economic importance.

Seedling blights, Alternaria blight (AB), white rust (WR), downy mildew (DM), sclerotinia rot, powdery mildew, bacterial rot and phyllody are the important disease problems in India (1). Part of the information generated through research activities at Pantnagar has been presented in (2). Additional information obtained during the last two years period, i.e., 1986-1988, is given below:

A. Seedling Blights

Toria and mustard crops have been found to be affected by seedling diseases in the range of 1-3% under field conditions. The disease incidence may go beyond 15% when these crops are grown in rotation with sugarcane. Affected seedlings show distinct symptoms of collar rot, wilting, root and stem rots. Isolations from the disease seedlings may yield the growth of *Sclerotium rolfsii*, *Rhizoctonia solani* and *Fusarium oxysporum*. Though resistant to other important diseases, *Brassica alba*, has been found to be susceptible to *S. rolfsii* as compared to *B. campestris*, *B. carinata*, *B. juncea*, *B. napus* and *B. nigra* under natural conditions, Table 1.

Seed treatment with Mancozeb, Thiram, Captafol (each @ 0.2%) has been found to protect the plants against infection from *S. rolfsii* and *F. oxysporum*, whereas seed treatment with Thiophanate methyl (0.2%) or Carbendazim (0.2%) has been observed to be more effective for the control of seedling infection caused by *R. solani*.

Table 1. Natural occurrence of collar rot of rapeseed-mustarc caused by *sclerotium rolfsii*

Crop species	Incidence of collar rot (%)*
Brassica alba	10.53
B. campestris var Toria cv. PT 303	2.80
B. campestris var yellow sarson cv. 151	1.30
B. carinata	1.10
B. juncea cv. varuna	1.80
B. napus	0.90
B. nigra	1.90

*Average of two years observations at Pantnagar in field previously grown with soybeans.

B. *alternaria Blight*

The quantitative loss in yield due to AB has been estimated to be 35-46% (4). Pods harvested from affected plants show shrivelled, shrunken and discolored seeds. Four species of *Alternaria* i.e., *A. brassicae*, A. brassicicola, A. raphani and *A. alternata* have been found to be associated with the disease under field conditions, though leaf and pod infection due to *A. brassicae* is most common. When two or more species occur together on the same leaf, it may, in practice, be difficult to distinguish them by macroscopic symptoms. Thus, correct identification of the pathogen depends on the isolation and microscopic studies.

1. Variability in *A. brassicae*

i. Natural occurrence of different strains: The most predominant *Alternaria* species i.e., *A. brassicae* has been found to exist as three distinct isolates; A, C, and D which have been proved, for the first time, to be three distinct strains or races of *A. brassicae* under Indian conditions. It is observed that *A. brassicae* isolate C is more prevalent (65%) than A (47.3%) and D (42.9%) isolates. *A. raphani* infects more readily *B. alba* and *B. juncea* cv. Exotic to the extent of 65-70%. The prevalence of *A. alternata* is noted only to the extent of 2-17% but when it interacts with *A. brassicae* and *A. raphani* it increases the susceptibility of *Brassica* species to the disease.

ii. Variability in growth characters: The three isolates of *A. brassicae* show distinct variability with respect to their growth and colony characters on media, size and shape of conidia, sporulation and chlamydospore formation. The best sporulating is isolate C. Asparagine, as a source of nitrogen, does not support the growth of any of the isolates of *A. brassicae* which otherwise supports good growth of *A. raphani* and *A. alternata*. *A. brassicae* isolate A could usually germinate from the middle cell and isolate C from the upper most cell in comparison with the germination of spore by formation of elongation of the spore beak itself in respect of isolate D. Isolate C has been observed to produce secondary conidia as against the absence of such conidia in the case of isolates A and D.

It has been distinctly observed that isolate D shows brownish-grey colony on Sabourd's agar (SA) medium which is quite distinct from white cottony growth of isolates A and C. Thus the SA medium can be used to identify the strains of *A. brassicae*. The formation of chlamydospores has been observed in the case of *A. raphani* and *A. brassicae*

isolate A as against the absence of the chlamydospores in the case of isolates C & D.

iii. Variability in degree of virulence: Based on degree of defoliation effect through artificial infection, *A. brassicae* isolate C is more virulent on indigenously cultivated *B. juncea* and *B. campestris* cultivars, whereas isolate D is more virulent on *B. napus* cv.2, Table 2. On *B. carinata*, the three isolates of *A. brassicae* produce three kinds of distinct spots thus enabling the use of *B. carinata* as indicatr host for identification of races of *A. brassicae*. Similarly B. alba, B. juncea cv. exotic, and *B. napus* cv. EA are found to be indicator hosts for identification of *A. raphani*.

Table 2. Degree of Virulence* of *A. brassicae* isolates, *A. raphani* and *A. alternata* on different *Brassica* species

Brassica	*A. brassicae* isolates			*A. raphani*	*A. alternata*
	A	C	D	E	B
B. alba	-	-	-	+	-
B. carinata cv GS	-	+	-	-	-
B. carinata cv RS	+				
B. napus cv EA	-	-	-	+	-
B. napus cv Regent	-	+	-	-	-
B. napus cv 1	+	-	-	-	-
B. napus cv 2	-	-	+	-	-
B. juncea cv Varuna	-	+	-	-	-
B. juncea cv Exotic	+	-	-	+	-
B. campestris cv YST 15	+	+	-	-	-

*+indicates highest degree of virulence of respective isolate or species.
-indicates low to moderate virulence.

2. Management

i. Host Resistance in Commonly Cultivated *Brassica* species: Several varieties and germplasm lines of cultivated forms of *B. campestris* (Toria or sarson) and *B. juncea* (mustard) have been screened both under naturally and artificially infected conditions. These show differences in the degree of their susceptibility; some being tolerant, but the possibility of the existence of major gene sources of resistance is lacking. The level of resistance/ tolerance is not sufficient enough to be used as transferable sources for incorporation of resistance/ tolerance in the more desirable, agronomically acceptable but susceptible cultivars. Some types such as yellow sarson "Type 6" and mustard "PHR 1" have the potential to be used as such,

following selection procedure. It has been observed that young plants of less than 30 days are less susceptible to the disease and the susceptibility increases as the plant age increases.

ii. Host Resistance in Exotic *Brassica* Species: Among the exotic *Brassica* species, *B. alba* and *B. napus* cv EA show resistance to the most prevalent *A. brassicae* isolates. But the problem of using their resistance

becomes complicated as these are susceptible to *A. raphani* as discussed above. The possibility of using these species in hybridization program poses a danger of increasing susceptibility of the cross-bred material to *A. raphani*.

Based on the components of resistance, like relatively small size of spots, less defoliation, longer incubation, latent periods and reduced sporulation /lesion, it is consistently observed in the present studies that *B. carinata* is more resistant to *A. brassicae*, *A. raphani* and *A. alternata* as compared to other species, Table 3 and the nature of resistance appears to be non-specific i.e, horizontal type characterized by reduced infection rate. The apparent infection rate in the case of *B. carinata* has been observed to be 0.154-0.267 as against very high infection rate of 0.763 in the case of *B. juncea* cv. Varuna and *B. campestris* var yellow sarson cv T 151. On the basis of the yield data, *B. carinata* has a potential of yielding to the extent of 24 q/ha as against 7-9 q/ha in the case of *B. juncea* and *B. campestris* cultivars under Alternaria-affected conditions. *B. carinata* has never been found to be affected by WR, DMand PM diseases when cultivars of commonly cultivated *B. juncea* and *B. campestris* show very high degrees of severity of these diseases under similar conditions.

Table 3. Incubation (I) and latent (L) periods in days in respect of *A. brassicae* isolates (A,C,D), *A. raphani* (E) and *A. alternata* (B) on surfaces of leaves of some oleiferous *Brassica* species.

Crop species	*A. brassicae* isolates						*A. raphani*		*A. alternata*	
	A		C		D		E		B	
	I	L	I	L	I	L	I	L	I	L
B. alba	14	22	12	17	12	18	7	11	15	22
B. carinata cv BS	12	16	11	16	11	16	12	16	13	23
B. napus cv 1	14	21	13	16	13	16	9	12	13	20
B. napus cv EA	13	17	13	19	13	17	13	16	13	24
B. napus cv Regent	9	13	13	17	12	15	13	16	14	24
B. juncea cv Varuna	6	9	7	9	6	8	9	13	9	14
B. juncea cv PHR	11	14	14	13	8	10	8	10	9	13
B. campestris cv YST 151	5	7	6	9	7	11	10	13	11	15

Note : Data were obtained through artificial infection keeping the inoculated leaves in moist chambers.

iii. Control Through Disease Escape: Early maturing cultivars, if planted during the last week of September and the first week of October, have been found to be escaping the severe development of AB, WR and DM diseases. Fortunately, in the important crop species, some early varieties have been identified. These are Toria types: M-27, TS-29, PT-83, Bhavani and RAU-1; mustard types: PR-36, PR-1D, RLM 51; yellow sarson types: YSB-9, RAUS-3 and PYS-6. It is suggested that the efforts should be made to identify such varieties for cultivation.

iv. Chemical Control: Alternaria blight can be controlled by spraying some fungicides like Mancozeb, Captafol or Ziram @ 0.2%, (Table 4). The results of the field trials conducted over the last three crop seasons (1985-1988) at Pantnagar revealed that Iprodione is superior to Mancozeb, Ziram and Captafol and can result in 86% increase in yield as compared to unsprayed plants. But Iprodione is not effective against WR+ DM. Spray of mixture of Metalaxyl + Mancozeb (Ridomil MZ) @ 0.2% is found to be effective in the control of WR, DM and AB diseases provided the sprays are made to control the staghead phase at 3.9-4.0 stages of the crop growth.

Table 4. Effect of some fungicides on yield of toria at Pantnagar, 1985-88.

Fungicide	Yield (q/ha) 85-86	86-87	87-88	Yield increase Over check (%)
Iprodione @ 0.2	15.73	15.62	23.74	86.78
Mancozeb @ 0.2	13.33	12.30	21.01	57.92
Captafol @ 0.2	12.26	11.92	19.75	50.81
Ziram @ 0.2	13.39	11.00	-	23.88
Metalaxyl + Mancozeb (Ridomil MZ)*	13.39	10.99	17.75	42.68
Thiophanate Methyl @ 0.05	9.19	9.85	-	-3.25
Boric acid powder @ 0.53	11.53	12.97	17.15	40.75
Check: No spray	8.39	8.83	12.30	-
CD at 5%	2.44	2.16	3.94	-

*Concentration used in 1986-86 and 1985-87 was 0.2% and in 1987-88 it was 0.5%.

C. White Rust and Downy Mildew

Based on the staghead phase severity, the losses in yield due to WR + DM infection have been estimated to be in the range of 17-37% (2). Both diseases, unlike AB, are more dependent on the favourable weather conditions as described earlier (2). Reduced period of sunlight (2-6 h/day) and rainfall upto 161 mm during the flowering period favour the severe occurrence of the stagheads in the winter rabi crop season (3).

Results of the work done during the past two years period are briefly given below.

1. Variability in *Albugo candida*

There are indications that there are races of *A. candida*. This is evident because of the differences in the pustule size and shape and immune reaction of some exotic *Brassica* species (BEC series) as against susceptible reactions of commonly cultivated *B. juncea* cultivars like Varuna etc., (Table 5). However, detailed studies on characterization of races through differential host reaction need to be carried out. There are problems and practical difficulties in the development of artificial infection and easy use of the screening techniques.

2. Management

i. Host resistance/tolerance: Among the cultivated *Brassica* species, *B. juncea* cv "YRT 3" and *B. campestris* cv "PYS 6" have been observed to show resistance/ tolerance reaction to WR + DM under field conditions. Some of the *Brassica* species like *B. alba*, *B. carinata*, *B. napus* and *B. juncea* cv Exotic have never been found to be affected with these diseases. The nature of resistance

appears to be race-specific which needs further study for their effective utilization in the breeding program.

ii. Control through disease escape: Use of early maturing cultivars as discussed under AB can be of practical importance to minimize the losses caused by WR + DM diseases.

Table 5. Reaction of some exotic *B. juncea* cultures to *Alternaria* blight (AB) and white rust (WR)*

Culture	AB index on leaf (%)	AB index on pods (%)	WR index on leaf (%)
BEC 107	50-60	17-28	0-10
BEC 109	60-75	22-23	0-0
BEC 111	40-75	9-40	0-0
BEC 112	48-60	25-45	0-10
BEC 115	30-58	12-28	0-0
BEC 127	30-68	16-32	0-0
BEC 138	30-52	9-24	0-0
BEC 152	30-50	9-11	0-0
BEC 142	58-65	9-22	0-0
BEC 164	58-64	9-17	0-0
K 41729	36-58	9-22	0-3
Varuna	60-84	36-40	60-78
Yellow sarson "T 151"	80-90	50-60	20-40

*Data based on average of two crop seasons (1986-87 & 1987-88) at Pantanager.

iii. Chemical control: As in the previous years, seed treatment with Apron 35 SD @ 0.2% concentration is found to be effective in checking cotyledonary infection of downy mildew in both Toria and mustard. But seed treatment alone is not effective to control the staghead phase of WR + DM. Hence, spray of mixture of Metalaxyl + Mancozeb is required to control the staghead phase, (Table 4).

D. Other Diseases

Research on disease control measures in respect of bacterial rot, and *Sclerotinia* rot, and phyllody needs to be initiated as their occurrence is seen to be increasing under the changing cropping pattern.

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