

RELATIONSHIP OF SEED-BORNE FUNGI TO FIELD DISEASES OF SUNFLOWER

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Twenty one seed-borne fungi were recorded from 196 seed samples collected from seeds used for sowing of sun-flower crop and a total of ten field diseases were recorded during survey of sunflower crop in 1991-92. All the field diseases observed in this survey are known to be seed transmitted. The causal organisms of five field diseases namely *Alternaria* leaf spot, charcoal rot, head rot, *Phoma* leaf spot/black stem rot and *Phomopsis* leaf spot were found to be associated with seeds. In germination test, it was found that role of seed-borne fungi in causation of various abnormalities in germination depended on the frequency of their occurrence in the seeds.

Key words : Sunflower, Seed-borne fungi, Field diseases.

Introduction

In Pakistan, sunflower as an oilseed crop was introduced in early 1960's but large scale production was started during 1980. Efforts are under way to increase both its area and yield to bridge the edible oil gap in the country which is increasing at the rate of 11.0% per annum (Beg 1983). With an increase in the acreage of sunflower, however, the pathological problems have increased. Uptil now, more than sixteen diseases including charcoal rot (*Macrophomina phaseolina*), head rot (*Rhizopus* sp. and *Sclerotinia rolfsii*), stalk rot (*Sclerotinia sclerotiorum*), collar rot (*Sclerotinia rolfsii*), black stem rot (*Phoma oleracea*), bacterial rot (*Erwinia carotovora*), leaf spot (*Alternaria helianthi*) and powdery mildew (*Erysiphe cichoracearum*) have been reported (Khan and Kamal 1968; Akhtar and Khan 1972; Ghaffor and Khan 1976; Ahmad 1988; Bunney *et al* 1988; Mirza and Aslam 1988; Bhutta *et al* 1993). Most of the fungi associated sunflower seeds are reported to be seed-borne in nature (Richardson 1990).

Sunflower diseases survey (Mirza and Beg 1983; Masirevic *et al* 1987; Ahmad *et al* 1988) and study on seed-borne fungi associated with sunflower seeds (Khan and Kamal 1968; Khan *et al* 1974; Mobibullah 1980; Dawar and Ghaffar 1991) were carried-out earlier, but the studies so far made do not indicate the relationship of seed-borne fungi with the incidence of field diseases of sunflower. A study in this regard was conducted to find out the correlation between seed-borne fungi and occurrence of sunflower diseases under field conditions.

It may help with better understanding of sun-flower diseases control strategy in Pakistan.

Materials and Methods

Survey of sunflower diseases. To study the prevalence and incidence of various sun-flower diseases, a survey of 45 localities covering 1400 acres, was conducted during May, 1991 in the main sunflower growing areas of Pakistan. In each field, 1000 plants at five spots were examined visually or by hand lens, using diagonal path procedure as described by Acimovic (1966). Number of plants showing symptoms of a particular disease and supplementing with microscopic examination if necessary, were counted and results were expressed in term of percentages.

Detection of seed-borne mycoflora. A total of 196 sunflower seed samples were collected from seed stock of indigenous and exotic cultivars to be used for sowing during 1991-92. These samples were representing 12 localities and 85 sunflower varieties/hybrids. Seed samples were drawn by the procedure as laid down in ISTA rules (Anon 1985). Four hundred seeds for each sample were tested by plating twenty seeds per plate using standard blotter paper method (Bhutta *et al* 1993). Fungal species were identified with the help of authoritative literature and based on diagnostic characters (Barnet 1960; Ellis 1971; Nelson *et al* 1983).

Germination test and detection of fungi. Fifteen seed samples were tested by keeping seeds between the anchor paper to know the effect of seed-borne fungi on germination. Four hundred seeds of each sample were placed separately

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on such paper. After eight days, the paper rolls were opened and seedlings were examined individually (Anon 1985). To know the quantitative role of seed-borne fungi during germination, abnormal seedlings and un-germinated seeds were again tested using blotter paper method of ISTA (Anon 1985).

Results and Discussion

To know the identity of seed-borne mycoflora of sunflower, 196 seed samples were collected from seed stock used for sowing of the crop surveyed. A total of 21 seed-borne fungi were detected using blotter paper method (Table 1). Present

study revealed the presence of the seed-borne fungi of sunflower reported earlier (Khan and Kamal 1968; Khan *et al* 1974; Ghafoor and Khan 1976; Bhatti and Muhammad 1984) and in addition eleven fungi are new reports on sunflower seed in Pakistan. These are *Alternaria helianthi*, *Drechslera hawaiiensis*, *D. longirostrata*, *Fusarium culmorum*, *F. oxysporum*, *Myrothecium roridum*, *M. verrucaria*, *Phoma oleracea*, *Phomopsis helianthi*, *Stemphylium helianthi* and *Verticillium dahliae*, are known to cause field diseases in Pakistan (Mirza and Beg 1983; Mirza and Aslam 1988), but were not reported earlier from sunflower seeds in Pakistan.

Table 1
Relationship of seed-borne fungi to seed germination and the incidence of field diseases of sunflower

Seed mycoflora	Seed recovery* %	Fungi associated with seedlings	Fungal infection %	Field disease	Disease incidence %
<i>Alternaria alternata</i>	0.5-98.5	<i>A.alternata</i>	7.5-25.0	<i>Alternaria</i> leaf spot	1.0-80.0
<i>A. helianthi</i>	0.5-1.0	—	—	—	—
<i>A. zinniae</i>	0.5-1.0	—	—	—	—
<i>Curvularia lunata</i>	0.5	—	—	—	—
<i>Drechslera hawaiiensis</i>	0.5-2.0	<i>D.longirostrata</i>	2.0	—	—
<i>D. longirostrata</i>	0.0-1.0	—	—	—	—
<i>D. tetramera</i>	0.5-3.0	<i>D. tetramera</i>	1.56	—	—
<i>Emericellopsis terricola</i>	0.5-10.0	<i>E. terricola</i>	1.56	—	—
<i>Fusarium culmorum</i>	1.0	—	—	—	—
<i>F. moniliforme</i>	0.5-3.5	<i>F.moniliforme</i>	1.56-2.77	—	—
<i>F. oxysporum</i>	0.5-1.0	—	—	—	—
<i>F. semitectum</i>	0.5-11.0	<i>F. semitectum</i>	1.31-2.77	—	—
<i>F. solani</i>	0.5-2.5	<i>F. solani</i>	1.38-2.50	—	—
<i>Macrophomina phaseolina</i>	0.5-5.0	<i>M.phaseolina</i>	3.75	Charcoal rot	1.0-90.0
<i>Myrothesium roridum</i>	0.5-2.0	—	—	—	—
<i>M. verrucaria</i>	0.5	—	—	—	—
<i>Phoma oleracea</i>	0.5-2.0	<i>P.oleracea</i>	2.0	Phoma leaf spot/black stem rot	1.0-3.0
<i>Phomopsis helianthi</i>	1.0	—	—	Phomopsis leaf spot	1.0-30.0
<i>Verticillium dahliae</i>	0.5-1.0	<i>V.dahliae</i>	1.56	—	2.0-95.0
<i>Rhizopus spp.</i>	**	<i>Rhizopus sp.</i>	**	Head rot	2.0-95.0
<i>Stemphylium helianthi</i>	0.5-6.5	<i>S.helianthi</i>	1.32-2.77	—	—

* Percentage of fungi recovered from seed.

** Noted abundantly but not counted.

Table 2
Effect of seed-borne fungi on germinating sunflower seeds

Variety	Seed-borne fungi of sunflower	% age of seed-borne fungi	Normal seedlings(%)	Abnormal seedlings(%)	Dead seed(%)	Remarks
SF-100	Nil		89.0	8.0	3.0	Control
SF-100	<i>A.alternata</i>	55.5	78.0	16.0	6.0	
SF-100	<i>A.alternata</i>	16.0	85.0	10.0	5.0	
	<i>F.semitectum</i>	0.5	-	-	-	
	<i>F.solani</i>	1.0	-	-	-	
	<i>Stemphylium helianthi</i>	-	-	-	-	
SF-100	<i>A.alternata</i>	40.50	85.0	12.0	3.0	
HO-1	Nil		88.0	7.0	5.0	Control
HO-1	<i>A.alternata</i>	59.5	75.0	19.0	6.0	
	<i>Emericellopsis terricola</i>	10.5	-	-	-	
	<i>F.semitectum</i>	2.0	-	-	-	
	<i>F.solani</i>	2.5	-	-	-	
	<i>S.helianthi</i>	1.0	-	-	-	
HO-1	<i>A.alternata</i>	70.0	74.0	18.0	8.0	
	<i>E.terricola</i>	1.5	-	-	-	
	<i>F.moniliforme</i>	0.5	-	-	-	
	<i>F.semitectum</i>	1.0	-	-	-	
HO-1	<i>A.alternata</i>	44.5	80.0	16.0	4.0	
	<i>E.terricola</i>	3.5	-	-	-	
	<i>Verticillium dahliae</i>	0.5	-	-	-	
NK-212	Nil		95.0	3.0	2.0	Control
NK-212	<i>A.alternata</i>	75.5	68.0	19.0	13.0	
	<i>E.terricola</i>	2.5	-	-	-	
	<i>D.tetramera</i>	1.0	-	-	-	
	<i>F.moniliforme</i>	2.5	-	-	-	
	<i>F.semitectum</i>	1.5	-	-	-	
NK-212	<i>A.alternata</i>	57.0	70.0	20.0	10.0	
	<i>D.tetramera</i>	1.0	-	-	-	
	<i>M.phaseolina</i>	5.0	-	-	-	
	<i>Phoma oleracea</i>	2.0	-	-	-	
Suncome-90	Nil		95.0	3.0	20.0	Control
Suncome-90	<i>A.alternata</i>	57.0	74.0	18.0	8.0	
	<i>D.tetramera</i>	1.0	-	-	-	
	<i>F.moniliforme</i>	3.0	-	-	-	
	<i>F.solani</i>	2.0	-	-	-	
	<i>F.semitectum</i>	5.0	-	-	-	
	<i>S.helianthi</i>	6.5	-	-	-	
Suncome-90	<i>A.alternata</i>	96.5	75.0	20.0	5.0	
	<i>E.terricola</i>	1.5	-	-	-	
Suncome-90	<i>A.alternata</i>	29.0	86.0	20.0	4.0	
	<i>D.longirostrata</i>	3.0	-	-	-	
	<i>D.tetramera</i>	1.0	-	-	-	
	<i>F.semitectum</i>	2.0	-	-	-	

This increase in number of seed mycoflora may be due to the use of uncertified seeds for cultivation. Though, mostly treated sun-flower seeds are being cultivated but in the present investigation, treated seeds also yielded seed-borne fungi.

A study was conducted to determine the effect of seed-borne mycoflora on germination of sunflower seeds. Germination of infected sunflower seeds significantly lowered the germination as compared with the certified samples. Seed-borne fungi caused 25 percent disease symptoms. The seed samples having *A. alternata* as seed-borne fungi alone reduced the germination to some extent when its occurrence was low but in combination of other seed-borne fungi especially with *Fusarium* spp. and *M. phaseolina*, it further reduced the percentage of germination (Table 2).

Nine fungal and one bacterial diseases were observed during field survey in the provinces of Punjab, Sindh and NWFP during 1991. These included charcoal rot, head rot, *Sclerotinia* rot, collar rot, *Alternaria* leaf spot, *Phomopsis* leaf spot, *Phoma* leaf spot/stem black, powdery mildew and bacterial blight. Prevalence of these diseases was low in Sindh and NWFP as compared with Punjab (Table 3). No new disease was observed during the current survey but the percentage incidence of diseases showed an upward trend (Mirza 1984; Masirevic *et al* 1987). It may be ascribed to the lack of knowledge about sunflower diseases or on the disease management technology.

The causal organisms of all the ten sunflower diseases reported in this present study are known to be seed-borne in nature (Richardson 1990). Of these, the causal organisms of the five diseases were found on the seeds and the diseases appearing in the field were *Alternaria* leaf spot, charcoal rot, head rot, *Phoma* leaf spot and *Phomopsis* leaf spot (Table 1). In seeds, *A. alternata* infection was upto 98.5 percent and in the field, the disease incidence was upto 80 percent. Similarly, head rot incidence in the field was recorded upto 95 percent. High incidence of these field diseases in relation to their presence on seeds is indicative of high rate of transmission of causal organisms to plants under field conditions. *A. alternata* is usually reported as a secondary of weak pathogen but it has been reported in Greece as potential pathogen having 50-80 percent incidence under field conditions (Thanassolopoulos and Kolokousi 1988). The loss in germination varied from 23 to 33 percent in India (Balasubrahmanyam and Kolte 1980) which shows its importance as a pathogen. The present study highlights the pathogenic potential of *A. alternata* in Pakistan.

The causal organisms of charcoal rot, *Phoma* leaf spot/black stem rot and *Phomopsis* leaf spot were detected on seeds were found to be 0.5-5.0, 0.5-2.0 and 1.0 percent, respectively,

Table 3
Prevalence of various sunflower diseases observed during field survey in 1991

Field diseases	Percentage incidence		
	Punjab	Sindh	N.W.F.P.
Charcoal rot	0.0-90.0	0.0-15.0	0.0-60.0
Head rot	0.0-95.0	0.0-20.0	0.0-2.0
<i>Sclerotinia</i> rot	0.0-10.0	0.0-2.0	0
Collar rot	0.0-5.0	0.0-2.0	0.0-1.0
Bacterial rot/blight	0.0-10.0	0	0
<i>Alternaria</i> leaf spot	0.0-80.0	1.0-12.0	0.0-25.0
<i>Septoria</i> leaf spot	0.0-1.0	0	0.0-1.0
<i>Phomopsis</i> leaf spot	0.0-20.0	0	0
<i>Phoma</i> leaf spot/ black stem rot	0.0-3.0	0	0
Powdery mildew	0.0-30.0	0.0-2.0	0.0-3.0

whereas their field incidence was upto 90,30 and 30 percent respectively. Higher field incidence of these diseases indicate that soil-borne inocula have a major role in field infection and seed inocula are not much important; however, seed infection is very important in the imported seed materials to check the introduction of virulent strains of these pathogens.

To assess the role and correlation of seed mycoflora in causation of diseases during seed germination, the seedlings were incubated. The prevalence of *A. alternata* was on a much higher side than *M. phaseolina* in diseased parts of the seedlings.

Conclusion

It is concluded that the role of the seed-borne fungi in causation of diseases depends on frequency of their occurrence on seeds. It is, therefore, suggested that seeds free from seed-borne fungi should be sown to minimize the incidence of the field diseases.

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