Pak J Sci Ind Res 1999 42 (2) 93-97

Relationship of Seed-borne Fungi to Field Diseases of Sunflower

A Rauf Bhutta* [a], M H Rahber Bhatti [b] and Iftikhar Ahmed [c]

[a]*Federal Seed Certification & Registration Department, G-9/4, Islamabad, Pakistan*

[b]*Department of Plant Pathology, Sindh Agriculture University, Tando Jam, Pakistan*

[c]*Crop Diseases Research Institute, NARC, PARC, Islamabad, Pakistan*

(Received 25 July 1996; accepted 14 May 1998)

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 Phomospsis 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; Ghafoor 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.

*Author for correspondence

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

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 21seed-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. longirostra, Fusarium culmorum, F. oxysporum, Myrothecim roridum, M. verrucaria, Phoma oleracea, Phomopsis helianthi, Stemphylim helianthi* and *Verticillium dehliae*, 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 %
Alternaria alternata	0.5-98.5	*A.alternata*	7.5-25.0	*Alternaria* leaf spot	1.0-80.0
A. helianthi	0.5-1.0	–	–	–	–
A. zinniae	0.5-1.0	–	–	–	–
Curvularia lunata	0.5	–	–	–	–
Drechslera hawaiiensis	0.5-2.0	*D.longirostrata*	2.0	–	–
D. longirostrata	0.0-1.0	–	–	–	–
D. tetramera	0.5-3.0	*D. tetramera*	1.56	–	–
Emericellopsis terricola	0.5-10.0	*E. terricola*	1.56	–	–
Fusarium culmorum	1.0	–	–	–	–
F. moniliforme	0.5-3.5	*F.moniliforme*	1.56-2.77	–	–
F. oxysporum	0.5-1.0	–	–	–	–
F. semitectum	0.5-11.0	*F. semitectum*	1.31-2.77	–	–
F. solani	0.5-2.5	*F. solani*	1.38-2.50	–	–
Macrophomina phaseolina	0.5-5.0	*M.phaseolina*	3.75	Charcoal rot	1.0-90.0
Myrothesium roridum	0.5-2.0	–	–	–	–
M. vernucaria	0.5	–	–	–	–
Phoma oleracea	0.5-2.0	*P.oleracea*	2.0	Phoma leaf spot/black stem rot	1.0-3.0
Phomopsis helianthi	1.0	–	–	Phomopsis leaf spot	1.0-30.0
Verticillium dahliae	0.5-1.0	*V.dahliae*	1.56	–	2.0-95.0
Rhizopus spp.	**	*Rhizopus sp.*	**	Head rot	2.0-95.0
Stemphylium helianthi	0.5-6.5	*S.helianthi*	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	*A.alternata*	55.5	78.0	16.0	6.0	
SF-100	*A.alternata*	16.0	85.0	10.0	5.0	
	F.semitectum	0.5	-	-	-	
	F.solani	1.0	-	-	-	
	Stemphylium	-	-	-	-	
	helianthi	0.5	-	-	-	
SF-100	*A.alternata*	40.50	85.0	12.0	3.0	
HO-1	Nil		88.0	7.0	5.0	Control
HO-1	*A.alternata*	59.5	75.0	19.0	6.0	
	Emericellopsis terricola	10.5	-	-	-	
	F.semitectum	2.0	-	-	-	
	F.solani	2.5	-	-	-	
	S.helianthi	1.0	-	-	-	
HO-1	*A.alternata*	70.0	74.0	18.0	8.0	
	E.terricola	1.5	-	-	-	
	F.moniliforme	0.5	-	-	-	
	F.semitectum	1.0	-	-	-	
HO-1	*A.alternata*	44.5	80.0	16.0	4.0	
	E.terricola	3.5	-	-	-	
	Verticillium dahliae	0.5	-	-	-	
NK-212	Nil		95.0	3.0	2.0	Control
NK-212	*A.alternata*	75.5	68.0	19.0	13.0	
	E. terricola	2.5	-	-	-	
	D.tetramera	1.0	-	-	-	
	F. moniliforme	2.5	-	-	-	
	F. semitectum	1.5	-	-	-	
NK-212	*A.alternata*	57.0	70.0	20.0	10.0	
	D.tetramera	1.0	-	-	-	
	M.phaseolina	5.0	-	-	-	
	Phoma oleracea	2.0	-	-	-	
Suncome-90	Nil		95.0	3.0	20.0	Control
Suncome-90	*A.alternata*	57.0	74.0	18.0	8.0	
	D.tetramera	1.0	-	-	-	
	F.moniliforme	3.0	-	-	-	
	F. solani	2.0	-	-	-	
	F.semitectum	5.0	-	-	-	
	S.helianthi	6.5	-	-	-	
Suncome-90	*A. alternata*	96.5	75.0	20.0	5.0	
	E. terricola	1.5	-	-	-	
Suncome-90	*A.alternata*	29.0	86.0	20.0	4.0	
	D.longirostrata	3.0	-	-	-	
	D.tetramera	1.0	-	-	-	
	F.semitectum	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 percent 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 secondry 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 (Balasubrahamanyam 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
Sclerotinia 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
Alternaria leaf spot	0.0-80.0	1.0-12.0	0.0-25.0
Septoria leaf spot	0.0-1.0	0	0.0-1.0
Phomopsis leaf spot	0.0-20.0	0	0
Phoma 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.

References

Acimovic M The occurrence of *Macrophomina phaseolina* on some agricultural crop and morphological and ecological properties of the parasites. *Review of Applied Mycology* **45** 250 (1966).

Ahmad I, 1988 Occurrence of sunflower rots in Pakistan. In: *PARC-Cargill Joint International Conference on Sunflower Diseases,* May 27, 1988, Lahore.

Ahmad I, Burney K, Aslam M 1988 Sclerotial population of *Macrophomina phaseolina*, cause of sunflower charcoal rot in Barani area soils of Punjab,Pakistan In. *Proceeding of the 12th International Sunflower Conference* Novisad,

Yugoslavia, 25-29 July 1988 p 142.

Ahmad I, Iftikhar S, Bhutta A R 1992 *Seed-borne Microorganisms in Pakistan, Check list.* PARC, Islamabad, Pakistan pp 32.

Akhtar K S, Khan B A, 1972 Head rot of sunflower appears in Punjab. *Agri Pakistan* **240** 7-8.

Anonymous 1985 *Proc. Int Seed Test Asso,* 40-3-49

Balasubrahamanyam N, Kolte S J 1980 Effect of *Alternaria* blight on yield component, oil content and seed quality of sunflower. *Indian J Agric Sci* **50**(9) 701.

Barnet H C 1960 *Illustrated Genera of Imperfect Fungi.* Burgess Publ Co Minn pp 241.

Beg A 1983 Exploring production potential in oilseed crops. *Progressive Farming* **3**(6) 14-19.

Bhatti M A R, Muhammad F 1984 Fungi occurring on sunflower seeds in Pakistan. *Pak J Agric Res* **22**(3) 251-252.

Bhutta A R , Bhatti M H R, Solangi G R, Ahmad I, Rehman M H 1993 Sunflower production and pathological problem in Pakistan. *Sci Tech and Dev* **2**(2) 51.

Burney K, Ahmad I, Aslam M 1988 Survey of spring sunflower diseases in the irrigated areas of Punjab, Pakistan, In: *Proceedings of the 12th Int Sunflower Conference,*Novisad, Yugoslavia. 25-29 July, 1988, pp 628-632.

Dawar S, Ghaffar A 1991 Detection of seed-borne mycoflora of sun-flower in Pakistan. *Pakistan J Botany* **23**(2) 173-178.

Ellis M B 1971 *Dematiceous Hypomycetes,* CMI, Kew, Surrey, England pp 608.

Ghafoor A, Khan S A J 1976 *List of Diseases of Economic Plants in Pakistan.* Department of Plant Protection, Ministry of Food, Agriculture and Under-developed Areas, Govt. of Pakistan, pp 85.

Khan S A, Kamal M 1986 The fungi of South West Pakistan. *Pak J Sci Ind Res* **11**(1) 61-80.

Khan S A J, Mathur S B, Neergaard P 1974 Survey on new seed-borne organisms of Pakistan. *Seed Sci & Technol* **2**(4) 477-479.

Masirevic S, Rana M S, Khan M A 1987 *Report on the Sunflower Crop in Pakistan.* Oilseed Programme, NARC, Islamabad.

Mirza M S, Beg A 1983 *Diseases of sunflower in Pakistan.* FAO B11 Hella **6** 55-56.

Mirza M S 1984 The occurrence of sunflower diseases in Pakistan during 1980-83. *Proceedings of the National Sunflower Workshop*, PARC, Islamabad.

Mirza M S, Aslam M 1988 Occurrence of *Verticillium* and *Alternaria* on sunflower in Pakistan. Paper presented at *Seminar on Sunflower Diseases*, 23rd May 1988, Lahore.

Mobibullah 1990 *Detection of Fusarium spp in Sunflower with Special Emphasis on the Seed to Plant Transmission of F .moniliforme.* No. 110, Summaries of Research Projects 1987-88. DGISP-DC, Denmark.

Nelson P E, Joussoun T A, Marasas W F O 1983 *Fusarium* sp. In: *Illustrated Manual of Identification.* The State Uni Press, Pennsylvania pp 203.

Richardson M J 1990 *An Annotated List of Seed-borne Diseases.* ISTA, Switzerland.

Thanassolopoulos C C, Kolokousi A T 1988 A new *Alternria* disease of sunflower in Greece In: *Proc of the 12th Int Sunflower Conference,* Novisad, Yugoslavia, 25-29 July 1988 pp 126-130.