Vol. XVI (1-2), 1979

FUNGI OCCURRING ON SAFFLOWER SEED IN PAKISTAN

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The external and internal infestation varied from 45—93 and 34—71 per cent respectively in all the 13 samples. The fungi isolated were the species of *Aspergillus, Rhizopus, Absidia, Helminthosporium, Curvularia, Fusarium, Sclerotium* and *Alternaria.* Infested seed sown in infested soil gave significantly less germination as compared to the seed sown in disinfested soil. All the five cultivars tested were equally susceptible. Fungi in combination rather than alone reduced the germination to a greater extent. However, *Fusarium* sp. proved to be most pathogenic in this respect.

INTRODUCTION

In Pakistan, safflower has recently occupied a considerable acreage and with the expansion of the area under the crop, rust and leaf spot diseases have assumed a serious problem (Khan, 1972). Thomas (1952) reported that leaf spot diseases may be seed-borne. No work has so far been reported on the nature of safflower seed fungi in Pakistan which could help in a comprehensive understanding of the safflower leaf spot diseases.

Very little information is available from the literature on the nature of fungi from safflower. However, according to Singh, *et al.* (1973) several fungi were associated with safflower seed. Petrie (1974) stated that *Alternaria carthami* occurred on 95 per cent of untreated seed. Irwin (1976) reported that *A. carthami* which caused leaf blight of safflower was found to be seed borne and it could be isolated from visually discoloured and non-discoloured seeds. *A. carthami* isolated from seed, produced typical leaf blight symptoms in glass house inoculations. The present paper reports the occurrence of fungi on safflower seed.

MATERIALS AND METHODS

Thirteen samples of safflower seed comprising of different strains were obtained from the Director Oil Seeds, Ayyub Agricultural Research Institute,

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Faisalabad. One hundred random seeds from each sample were plated on potato dextrose agar as such to have fungi externally borne on the seed. Another one hundred seeds were taken at random, disinfested with 0.1 per cent mercuric chloride solution to remove the external infestation and plated on PDA. Hyphae of fungi coming out from each seed were transfered to PDA and Czapeck's agar for further growth and identification. The fungi in both the cases were identified upto specific level.

These fungi were then tested for their pathogenicity on five different strains of safflower in pots. The seed was disinfested with 0.1 per cent mercuric chloride solution, washed thoroughly with sterilized water and then infested with the isolated fungi individually and in mixture, and divided into two batches. One set was sown in the pots filled with sterilized soil while the second set was planted in the pots filled with steam sterilized but infested afterwards with the individual fungi singly as well as in mixture. Disinfested seed sown in sterilized soil served as check. Twenty seeds were sown in each pot and 36 pots were sown for each strain of safflower. Observations on germination were recorded after 4—10 days of sowing.

RESULTS AND DISCUSSION

In all 2600 safflower seeds were examined for the presence of fungi. The fungi isolated were *Absidia hesseltinii*, *Alternaria tenuis* (Fr.) Nees., *Aspergillus flavus* Link., *Aspergillus niger* Van. Tieg., *Curvularia lunata* (Wakker) Boaed., *Fusarium nivale* Ces., *Fusarium solani* (Mart.) Syn. and Hans., *Hilmenthrosporium nodulosum* (Berk. and Curt) Sacc, *Helminthosporium tetramera* Mackinney, *Rhizopus arrhizus* Fisher. and *Sclerotium bataticola* Tubenhaws. The external infestation varied from 45—93 per cent with an average of 72.54 per cent for all the 13 samples (Table 1). Five samples comprising of UTE, Zimmerman, L.H.P.I., H.K. Jordon, US-10 and P-6 were heavily infested externally ranging from 90 to 93 per cent. Strains of P 4–2, P 5, P 5-A, leed 2-6 and P 123, 90, 43 were found to be externally infested with the fungi above 60 per cent and the rest three ranged from 45 to 54 per cent. The internal infestation ranged from 34 — 71 per cent with an average of 52.46 per cent. The strains UTE, H.K. Jordon, and P-6 were heavily infested internally with the fungi ranging from 63 to 71 per cent, whereas S 65—158, R 47 Gila and SA 120 carried less than 40 per cent internal infestation. The remaining ranged in between.

The fungi infesting externally comprised in order of prevalence, the species of *Aspergillus, Rhizopus, Fusarium, Sclerotium, Curvularia, Helminthosporium, Alternaria, Absidia* and mixtures of *Helminthosporium* with *Aspergillus* and *Curvularia* (Table 2). Almost the same fungi were isolated from the surface disinfested seed as in the external infestation. But they differed in their order of prevalence. The fungi isolated comprised of the species of *Aspergillus, Sclerotium, Helminthosporium, Fusarium, Curvularia, Alternaria, Rhizopus, Absidia,* mixture of *Helminthosporium* with *Aspergillus* and with *Curvularia* in the descending order (Table 2).

F values for treatments (Set I and II) were highly significant (Table 3). Germination of infested seed sown in infested soil was significantly less as compared to the infested seed sown in disinfested soil. F values in respect of five strains were non-significant, meaning thereby that there was no difference of pathogenicity with respect to different strains of safflower or that they were equally susceptible.

Table 1. *Number of seeds infested with the fungi in thirteen samples of safflower seeds.*

Name of sample	Percentage of seeds infested externally	Percentage of seeds internally infested
Leed 2–6	67	50
US–10	83	58
P 4–2	79	52
P–6	81	63
P 5–A	74	49
P–5	78	48
UTE	93	71
H.K. Jordon	86	67
SA 120 Cultivar	54	38
R 47 Gila	45	35
P 123, 90, 43	62	59
S.65–158	52	34
Zimmerman L.H. P–1	89	58
Average	72.54	52.46

Table 2. *Infestation of safflower seed samples plated on PDA.*

Species of	*External infestation*			*Internal infestation*		
	No. of samples	Range	Average	No. of samples	Range	Average
Sclerotium	11	7.0—18.8	10.4	13	8.6—18.4	14.0
Helminthosporium	13	6.0—18.2	11.4	13	8.3—18.8	13.7
Curvularia	12	6.4—26.7	10.6	12	8.2—20.7	11.4
Alternaria	11	7.3—20.0	9.2	12	5.7—14.5	9.8
Fusarium	11	4.9—19.4	11.3	13	8.8—19.4	13.4
Aspergillus	13	19.4—30.8	27.1	13	14.7—24.1	20.3
Rhizopus	12	6.0—21.2	13.1	10	5.9—14.6	7.1
Absidia	6	3.0— 7.4	2.4	5	5.2— 8.8	2.8
Aspergillus + *Helminthosporium*	6	1.7— 9.8	3.0	7	3.4— 9.5	3.1
Curvularia + *Helminthosporium*	6	2.7— 6.1	1.7	8	2.1— 6.8	2.7

F values in respect of fungi were highly significant. The uninfested seed sown in uninfested soil gave significantly more germination over infested seed sown in disinfested soil and infested soil. Significant less germination was recorded in the pots which received the fungi in mixture over the other fungi except *Fusarium* sp. A little increased germination over the mixture was obtained in case of pots infested with sp. of *Fusarium*. Species of *Sclerotium*, *Helminthosporium* and *Curvularia* significantly differed from one another in lowering the germination of safflower seed in order of their merits (Table 3).

F values in respect of interaction between treatments and fungi and strains and fungi were significant. Similarly the interaction among treatments strains and fungi were also significant. There seemed to be no interaction between treatments and strains.

Curvularia sp. were more pathogenic on P–5 and proved to be less pathogenic on US–10 and Zimmerman L.H.P.–I in case of Set–I. *Fusarium* sp. showed differential behaviour on the five strains of safflower. US–10 and leed 2–6 were less affected. *Helminthosporium* sp. came out to be more pathogenic on UTE as compared to P–5. *Curvularia* sp. was more pathogenic on P–5 and less on Zimmerman L.H.P.I in Set II.

Singh *et al.* (1973) described that the several fungi associated with safflower attributed some changes in oil protein and carbohydrate contents. Hence the present investigations are not comparable.

Petrie (1974) isolated *A. carthami* while in the present studies a different sp. of *Alternaria* could be isolated. The studies conducted by Irwin (1976) are comparable to the present investigation to some extent and the results obtained are quite close to each other. No rust causing fungi could be isolated hence the present studies are not comparable to those done by Thomas (1952).

Table 3. *F values for germination of five strains of safflower infested with five different fungi.*

S.O.V.	*Anova*		
	D.F.	S.S.	F. Ratio
Treatments	1	367.80	16.52**
Strains	4	127.98	1.44 N.S.
Fungi	5	20797.56	186.78**
T×S	4	115.90	1.30 N.S.
T×F	5	646.10	5.80**
S×F	20	946.13	2.12**
T×S×F	20	947.24	2.13**
Error	120	2672.87	

S.E. for Treatments = 0.5
I = 47.281
II = 44.421
S.E. for fungi = 0.86

Check	*Curvularia*	*Helminthosporium*	*Sclerotium*	*Fusarium*	Mixture
65.83	50.94	47.91	40.13	35.95	34.31

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