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EFFECT OF SEED-BORNE FUNGI ON OIL CONTENT AND FATTY ACID PROFILE IN SUNFLOWER

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SUMMARY

Eleven naturally infected and four uninfected sunflower seed samples were used to study their oil content and fatty acid profile. It was observed that oil content showed decreasing trend due to a number of various types of seed mycoflora. The study of fatty acids profile showed that saturated fatty acid (palmitic and stearic acid) concentration increased and unsaturated decreased due to high infection level and number of seed mycoflora in all sunflower cultivars in relation to the control (healthy seed).

Key words: Seed-borne fungi, oil content, fatty acid profile, Pakistan.

INTRODUCTION

Most disease-causing microorganisms in sunflowers are reported to be seed-borne in nature (Richardson, 1990). More than twenty seed-borne fungi, pathogenic and saprophytic in nature, have been found to be associated with sunflower in Pakistan (Dawar and Ghaffar, 1991; Ahmad *et al.*, 1992). Seed is basically a living tissue which is affected directly by seed moisture content and temperature for maintenance of viability of seed in storage (Delouche, 1973a). Seed-borne fungi are not only important for their effect on germination and subsequently in causing field diseases but also for their effect on sunflower oil quantity and quality (Prasad and Singh, 1983). *Alternaria* leaf spot has been reported to reduce the seed and oil yield by 27 to 80 percent and 17 to 33 percent, respectively (Reddy and Gupta, 1977 and Balasubrahmanyam and Kolte, 1980). *Macrophomina phaseolina* increased the free fatty acids and oil content and caused discoloration of the oil (Ataga and Akueshi, 1986). Differences in oil content have been recorded in various localities in Pakistan (Khan *et al.*, 1993). However, effect of sunflower seed-borne pathogens on oil quantity and quality is not reported. The ultimate efforts to produce healthy

crop is to increase oil quantity and quality. Therefore, a study was conducted in this regard and results are presented in this paper.

MATERIALS AND METHODS

Effect of seed-borne fungi on oil content

Eleven naturally infected and four uninfected sunflower seed samples comprising four varieties/hybrids were used to study oil content. These seed samples were collected in nine sunflower growing areas, Sukkur, Tandojam, Islamabad, D.I. Khan, Lahore, Multan, Khairpur, Faisalabad and Peshawar (Table 1). All seed samples were stored at 4°C and no disinfectant was used as pre-treatment. A Nuclear Magnetic Resonance (NMR) Analyzer was used to measure the percent oil content in sunflower seeds. The uninfected sample of each variety/hybrid served as control. A 100g portion of each sample was separately placed in oven at 50°C for several hours, then brought at room temperature in NMR room and readings were recorded on the NMR Analyzer (Robertson and Morrison, 1979 and Robertson and Windham, 1981).

Fatty acid profile determination

The same sunflower seed samples were used to study fatty acid profile in relation to seed mycoflora using gas chromatography which determines the fatty acid composition of esterified constituents of seed oil by methylating fatty acid acylesters into oil. Oil from sunflower was extracted with Raney oil seed crusher. One ml of methylating solution was dispensed into test tubes in which 0.5 ml pertroleum ether was added. A loop full of oil extracted from sample was added to each test tube. Oil loop was swirled in solution to disperse for methylation. One µl of the upper layer of these samples was injected into gas chromatographer (Raney, 1987 and Hougen and Bodo, 1973). Results were recorded by G.C. data recorder/analyzer and concentration of each fatty acid in percentage was measured by corrected area normalization method.

RESULTS AND DISCUSSION

Total oil content in control samples of the different cultivars ranged from 38.21 in Ho-1 to 49.65 percent in C-206. Oil content showed decreasing trend in samples having high percentage of seed-borne fungi in all the cultivars especially when a combination of more than one pathogen was present (Table 2). Although the objective of the study was to learn the quantative effect of seed mycoflora on oil content in various cultivars from different localities but due to unavailability of sunflower seed samples of same cultivars from each locality, direct and firm correlations could not be established between mycoflora and oil content in relation to specific

Table 1: Mycoflora of seed samples used for determination of oil content and fatty acid profile

Variety/ hybrid	Locality	Fungus	Percentage	Remark
C-206	Sukkur	Nil	0.0	Control
C-206	Sukkur	*Alternaria alternata*	46.0	
Ho-1	Islamabad	Nil	0.0	Control
Ho-1	D.I.Khan	*A. alternata*	70.0	
		Emericellopsis terricola	1.5	
		Fusarium moniliforme	0.5	
		F. semitectum	1.0	
Ho-1	Tandojam	*A. alternata*	45.5	
		E. terricola	3.5	
		F. semitectum	1.00	
		Verticillium dehliae	0.5	
SF-100	Lahore	Nil	0.0	Control
SF-100	Multan	*A. alternata*	55.5	
SF-100	Islamabad	*A. alternata*	49.5	
SF-100	Peshawar	*A. alternata*	77.0	
Suncome-90	Khanpur	Nil	0.0	Control
Suncome-90	Faisalbad	*A. alternata*	57.0	
		Drechslera tetramera	1.0	
		F. moniliforme	3.0	
		F. solani	2.0	
		F. semitectum	5.0	
		Stemphylium helianthi	6.5	
Suncome-90	Faisalabad	*A. alternata*	61.5	
		D. tetrnata	0.5	
		F. semitectum	2.0	
Suncome-90	Faisalabad	*A. alternata*	96.5	
		E. terricola	1.5	
Suncome-90	Khanpur	*A. alternata*	62.0	
		F. semitectum	1.5	
		F. oxysporum	0.5	
Suncome-90	Faisalabad	*A. alternata*	29.0	
		D. longirostrata	3.0	
		D. tetramera	1.0	
		F. semitectum	2.0	

Table 2: Oil content and fatty acid profile of sunflower seeds

Variety/ hybird	Locality	Total infection % age	Oil content % age	Fatty acid profile (Percentage)								Remark
				Palmitic acid	Stearic acid	Oleic acid	linoleic acid	Linolenic acid	Arachidic acid	Gadolic acid	Erucic acid	
				(18:0)	(18:0)	(18:1)	(18:2)	(18:3)	(22:0)	(20:1)	(22:1)	
C-206	Sukkur	0.0	49.65	4.90	3.47	36.73	53.75	0.33	0.64	0.24	0.28	Control
C-206	Sukkur	46.0	36.98	6.68	4.99	16.65	68.71	0.78	0.64	-	0.53	
Ho-1	Islamabad	0.0	38.21	5.05	4.27	19.45	70.79	0.39	-	-	-	Control
Ho-1	D.I.Khan	73.0	29.92	6.53	5.54	17.61	70.21	-	-	-	-	
Ho-1	ARI Tanojam	50.5	35.81	7.17	4.87	15.91	70.90	0.81	0.75	-	0.59	
SF-100	Lahore	0.0	40.16	5.38	2.88	26.45	61.65	0.63	0.64	-	0.37	Control
SF-100	Multan	55.5	31.74	5.70	2.44	43.62	47.02	0.44	0.75	-	-	
SF-100	Islamabad	49.5	40.10	5.61	2.48	38.57	51.11	0.72	0.43	0.71	0.67	
SF-100	Peshawar	77.0	38.70	7.35	3.27	40.85	46.31	0.50	0.40	0.66	0.50	
Suncome-90	Khanpur	0.0	41.04	4.54	2.23	20.21	72.67	0.35	-	-	-	Control
Suncome-90	Faisalabad	74.5	34.46	4.97	4.61	15.73	72.34	0.80	0.37	0.47	0.67	
Suncome-90	Faisalabad	64.5	37.09	6.52	4.04	14.28	72.74	0.92	-	0.55	0.53	
Suncome-90	Faisalabad	98.0	34.31	4.57	3.77	12.37	76.75	0.73	0.55	0.43	0.78	
Suncome-90	Khanpur	64.0	35.51	6.37	4.30	15.53	72.50	0.47	-	0.50	0.35	
Suncome-90	Faisalabad	35.0	37.18	5.19	5.02	16.65	74.19	0.58	0.22	0.45	0.60	

cultivars and localities. However, in present study, decreasing trend in oil content was found correlated with the level of fungal infection in individual samples of various cultivars from different localities. Increasing level of a single pathogen also showed decreasing trend in oil content. This is evident from the difference in oil quantity of healthy and diseased seed samples of sunflower infected with *A. alternata* from Sukkur and Khanpur.

A total of eight fatty acids, palmitic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, arachidic acid, gadolic acid and erucic acid, were determined in fifteen sunflower seed samples. The concentation of saturated fatty acids (palmitic acid and stearic acid) showed increasing trend in all sunflower seed samples, having high level of infection with different seed mycofloras whereas low levels of these acids were found in healthy seed samples. In a biodeterioration study on seed mycoflora, increases in free fatty acid content were also reported by Ataga and Akueshi (1986). In the present study, the concentration of unsaturated fatty acids showed a decrease as compared with healthy sunflower seed samples. This effect of seedborne fungi on fatty acids is considered unfavourable for human health (Veldstra and Klere, 1990).

In the presence of unsaturated fats, oxidation increases during hydrogenation process that make the oil easily digestible. Unsaturated fatty acids have lower melting point than saturated fatty acids. Among unsaturated fatty acids, oleic and linoleic acid are the nutritionally essential fatty acids for human beings (Swern, 1979).

CONCLUSIONS

It is concluded from the present study that decreasing or increasing trends in the concentration of fatty acids and percentage of oil content are due to infection level and type of seed borne fungi associated with sunflower seed.

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EFECTO DE LOS HONGOS DE LA SEMILLA EN EL CONTENIDO EN ACEITE Y PERFILES DE ÁCIDOS GRASOS EN EL GIRASOL

RESUMEN

En la investigación presente, fue observado que el contenido de aceite disminuyó debido al alto nivel de micoflora de la semilla independientemente de la localidad y tipo de cultivo del girasol. El estudio de perfiles de ácidos grasos en relación a la micoflora de la semilla, mostraron que la concentración de ácidos grasos saturados (palmitico y esteárico) se incrementó debido al alto nivel de infección y número de la micoflora de la semilla en todos los cultivares de girasol sobre el control (semilla sana).

EFFET DES CHAMPIGNONS TELLURIQUES DE LA GRAINE SUR LA TENEUR EN HUILE ET LA COMPOSITION EN ACIDES GRAS CHEZ LE TOURNESOL

RÉSUMÉ

Dans ces recherches, il a été observé que la teneur en huile diminuait par suite des niveaux élevés de mycoflore sur les graines, indépendamment du lieu ou de la culture de tournesol. L'étude de la composition en acides gras en relation avec la mycoflore de la graine montre que la concentration en acides gras saturés (acides palmitique et stéarique) augmente avec le niveau d'infection et le nombre de champignons présents dans la graine chez tous les cultivars, par rapport aux témoins (graines saines).