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RESEARCH ARTICLE

BIODERIORATION OF SEED DUE TO SEED-BORNE *ALTERNARIA SPECIES*

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ABSTRACT

The primary cause of seed biodeterioration has been identified as the ability of seed molds to generate many kinds of hydrolytic enzymes. The effects of six Alternaria species—A. alternata, A. citri, A. crassa, A. macrospora, A. dianthicola, and A. tenuissima on nutritional supplies such as ash content, carbohydrates, nitrogen, protein, and fat were investigated in relation to seed biodeterioration. The immediate effect on productivity and seed quality. These seeds are regarded as being of low quality both for the seed industry and for human consumption. Mycotoxin from fungi ruins the contents of the seeds. Taking into account that efforts were undertaken to investigate the effects of nutritional sources because of Alternaria species. For six months, the effects of Alternaria species were observed bimonthly on the following parameters: moisture, total fat, crude protein, nitrogen free extract, and ash levels. During the storage period, the seeds underwent deteriorative alterations due to the presence of Alternaria species.

INTRODUCTION

The most fundamental and important ingredient in crop production is seed. Approximately 90% of the food crops grown worldwide are grown from seeds. It has also been discovered that seeds are the source of disease transmission. It is known that seeds can spread more than 3000 illnesses. This transmission occurs under storage conditions or in the field. It is acknowledged that global disease-related losses can range from 10% to 25% every year. In India, we are losing an average of 30 metric tons of food grains, 4 metric tons of oilseed, 36 metric tons of cane, and 23 metric tons of fruit and vegetables—even with conservative estimates of losses of about 15%.

The primary determinant of seed-borne pathogen incidence is the physical or meteorological environment in which seed crops are planted. Similar to this, storage conditions also contribute to the development of different kinds of seed damage because of related seed-borne infections, which cause seeds to lose a significant amount of their chemical content. Neergaard (1977) documented a number of these anomalies, the most common of which are seed rots, sunken seeds, abortions in the seed, and reductions in size. Seeds with sclerotisation, necrosis, and decreased germinability; seeds with discolorations; and other physiological abnormalities.

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MATERIAL AND METHODS

Collection of sample seeds

The procedure outlined by Neergaard (1973) has been used to obtain seed samples. As a result, random samples of various seed kinds were gathered from farms, markets, warehouses, and seed corporations. Each variety's individual samples were combined to create a composite sample, which was then kept in cotton bags at room temperature in the laboratory throughout the duration of the investigation.

Detection of seed mycoflora The seed mycoflora was isolated by using standard moist blotter method (SBM) and Agar plate methods (APM) as recommended by International Seed Testing Association (ISTA 1966); De Tempe (1970), Neergaard (1973) and Agarwal (1976).

Biodeterioration of crop seeds Freshly picked, mature, and seemingly healthy seeds were gathered from the fields for this purpose. They were cleaned and submerged in sterile distilled water for four hours after being surface sterilized with a 0.1% mercuric chloride solution. The seeds' excess water was drained off. Three flasks containing one hundred grams of seeds each were filled, and each flask was individually inoculated with two milliliters of the test fungus' spore suspension. After being cultured at room temperature for a range of 10, 20, and 30 days, the flasks were collected so that the physical and chemical changes in the seeds could be examined. Freshly picked, mature, and seemingly healthy seeds were gathered from the fields for this purpose. They underwent surface sterilization using a 0.1% mercuric chloride solution, followed by a sterile distilled water wash and soak. When the seeds were harvested, they were carefully cleaned under running water to get rid of all of the mycelia growth. The seeds were then ground into a fine powder and dried at 60°C for 48 hours in order to estimate various compounds. The control was provided by seeds that were incubated similarly but without the addition of fungus spore suspensions.

RESULT AND DISCUSSION

Plant diseases are mostly spread by seeds. The interaction between pathogens and seeds, whether in the field or in storage, is what causes the seeds to bio deteriorate both qualitatively and quantitatively. The biodeterioration of three widely grown crop seeds from the Marathwada region—wheat, black gram, and safflower—against six prevalent species of *Alternaria* is thoroughly examined. The reduction of seed content was thoroughly investigated. Plant diseases are mostly spread by seeds. The interaction between pathogens and seeds, whether in the field or in storage, is what causes the seeds to biodeteriorate both qualitatively and quantitatively. Three widely grown agricultural seeds from the Marathwada region—wheat, black gram, and safflower—are thoroughly examined for biodeterioration against six *Alternaria* species.

1. Change in dry weight of seed caused by *Alternaria* sp.

Table No. 1 summarizes the findings. Six species of *Alternaria* were chosen to artificially infect seeds of three different crops, which were then cultured for 15 days at room temperature. A dry weight loss was computed by comparing the infected seeds to the non-infected ones. The data makes it abundantly evident that each of the six species had a loss in dry weight, albeit to varying degrees. It has been noted that *A. tenuissima* significantly decreased the weight in the case of wheat and *A. citri* in black gram.

Table 1 Change in Dry weight of seeds due to seed-borne *Alternaria species*

Different species of Alternaria	% Protein content crop seeds of		
	Wheat	Black gram	Safflower
Alternaria alternata	23.437	23.027	19.158
Alternaria crassa	21.695	18.115	19.567
Alternaria citri	22.902	17.416	16.555
Alternaria dian-thicola	23.206	23.705	20.296
Alternaria macro-spora	21.852	22.461	19.108
Alternaria tenuis-sima	19.432	23.346	21.990
Control	25.00	25.00	25.00
Mean	22.50	21.86	20.32
S.D	1.615	2.69	2.42
S.E.	0.61	1.01	0.91
C.D	1.49	2.49	2.24

2. Change in Ash content

Table No. 2 presents the findings of a study conducted on six species of Alternaria in relation to the percentage of ash present in three crop seeds. The results show that A. dianthicola is mostly to blame for the decrease in ash content in all three crops, although A. crassa is also equally to blame for the decrease in ash content in safflower and black gram.

Table 2 Change in Ash content of seeds due to seed-borne *Alternaria species*

Different species of Alternaria	% Ash content crop seeds of		
	Wheat	Black gram	Safflower
Alternaria alternata	2.48	2.34	2.30
Alternaria crassa	2.36	2.06	2.14
Alternaria citri	2.24	2.03	2.33
Alternaria dianthicola	2.29	1.91	2.24
Alternaria macrospora	2.54	2.49	2.49
Alternaria tenuissima	2.58	2.61	2.28
Control	2.64	2.82	2.50

Value are expressed as % of dry matter

3. Change in protein content

One of the essential contents of legumes is protein, which was measured using the Microkjeldahl technique. The results are shown in Table No. 3. The data show that *A.dianthicola* is a dominant pathogen that decreased the amount of protein in safflower, black gram, and wheat. *A. citri,* however, for wheat Equal blame goes to *A. macrospore* for black gram, *A. crassa*, and *A. macrospora* for safflower.

Table 3 Change in Protein content of seeds due to seed-borne *Alternaria species*

Different species of *Alternaria*	% Protein content crop seeds of		
	Wheat	Black gram	Safflower
Alternaria alternata	25.92	30.60	22.26
Alternaria crassa	21.00	24.96	21.96
Alternaria citri	19.08	25.98	24.72
Alternaria dian-thicola	13.92	22.98	22.50
Alternaria macro-spora	13.50	22.50	17.16
Alternaria tenuis-sima	22.38	24.72	16.50
Control	34.20	39.00	30.00

Value are expressed as % of dry matter

4. Change in Nitrogen content

Change in nitrogen contents in three crops against six species of *Alternaria* is studied and results are summarized in table no. 4. It is observed from the results that nitrogen percent in wheat seeds are changed due to *A. dianthicola* and *A. citri,* whereas nitrogen percent of black gram seed is reduced due to *A. dianthicola* and *A. macrospora* and it is of safflower is takes place due to *A.dianthicola, A. macrospora* and *A. crassa.*

Table 4 Change in Nitrogen percent of seeds due to seed-borne *Alternaria species*

Different species of Alternaria	Nitrogen % in crop seeds of		
	Wheat	Black gram	Safflower
Alternaria alternata	4.32	5.10	3.71
Alternaria crassa	3.50	4.16	3.66
Alternaria citri	3.18	4.33	4.12
Alternaria dian-thicola	2.32	3.83	3.72
Alternaria macro-spora	2.25	3.75	2.86
Alternaria tenuis-sima	3.73	4.12	2.75
Control	5.70	6.50	5.00

Value are expressed as % of dry matter

5. Change in total carbohydrates

The seed was incubated with six species of *Alternaria* for 15 days in order to estimate the total amount of carbohydrates. The findings are shown in Table 5.The results show that *Alternaria alternata and A. tenuissima* are mostly in charge of reducing the amount of carbohydrates found in wheat and black gram, while *Alternaria alternata* and *A. citri* are in charge of altering the amount of carbohydrates found in safflower seeds.

Table 5 Change in total carbohydrates percent of seeds due to seed-borne *Alternaria species*

Different species of Alternaria	Nitrogen % in crop seeds of		
	Wheat	Black gram	Safflower
Alternaria alternata	62.7	59.36	68.54
Alternaria crassa	67.34	63.38	68.20
Alternaria citri	70.78	64.19	64.85
Alternaria dian-thicola	74.09	65.41	67.46
Alternaria macro-spora	72.46	65.31	74.06
Alternaria tenuis-sima	65.24	62.97	72.62
Control	85.08	68.48	60.90

Value are expressed as % of dry matter

6. Change in crude fat

Chloroform (CHCl3) and methanol are the solvents used to extract the fat from plant material (CH3OH). This is carried out in a soxhlet extraction assembly, and the amount of extracted fat is measured once the solvent has completely evaporated. The data presented in Table 6 make it abundantly evident that *A. alternata* is mostly to blame for the variations in fat content observed in all crop seeds. Similar to how *A. citri*-infected black gram and wheat seed decreased the fat content, *A. macrospore, A. crassa,* and *A. dianthicola* also decreased the fat content of safflower seed.

Table 6 Change in crude fat percent of seeds due to seed-borne *Alternaria species*

Different species of *Alternaria*	Nitrogen % in crop seeds of		
	Wheat	Black gram	Safflower
Alternaria alternata	8.9	7.7	6.9
Alternaria crassa	9.3	9.6	7.7
Alternaria citri	7.9	7.8	8.1
Alternaria dianthicola	9.7	9.7	7.8
Alternaria macrospora	9.7	9.7	6.5
Alternaria tenuissima	9.8	9.7	8.6
Control	10.1	9.7	9.4

Value are expressed as % of dry matter

7. Change in crude fiber

One of the most significant ingredients in seeds is fiber. After artificially inoculating the seeds with six different *Alternaria* species and letting them sit for 15 days, a shift in the amount of fiber was seen. The results displayed in Table no. 7 make it abundantly evident that every *Alternaria* species is to blame for variations in seed content. The primary cause of variations in the fiber content of seeds, however, is *A. alternata* for wheat seeds, *A. citri and A. dianthicola* for black gram seeds, and *A. citri and A. tenuissima* for safflower seeds.

Table 7 Change in crude fiber percent of seeds due to seed-borne *Alternaria species*

Different species of Alternaria	Nitrogen % in crop seeds of		
	Wheat	Black gram	Safflower
Alternaria alternata	9.8	12.5	12.2
Alternaria crassa	10.5	11.1	13.4
Alternaria citri	10.1	9.8	10.1
Alternaria dian-thicola	11.4	10.5	12.6
Alternaria macro-spora	13.2	11.6	14.2
Alternaria tenuis-sima	15.1	15.1	11.4
Control	19.1	18.0	17.5

Value are expressed as % of dry matter

DISCUSSION

When grains are stored improperly, they become susceptible to fungus that decrease the grains' quality and quantity. Many biochemical alterations in seeds are caused by fungi. They altered the stored grains' levels of protein, starch, and insoluble nitrogen. Fungi are one type of microbe that is closely linked to seeds. They grow quickly and have the strongest interaction with seeds of different crops, both in the field and in storage. An estimated 4% of the world's grain production is lost as a result of seed biodeterioration (Clarke, 1966). The study examines the effects of *Alternaria* species on the dry weight content of crop seeds. The findings indicate that *Alternaria tenussima and A. citri* are primarily accountable for the seed's weight loss. This strongly implied that the two *Alternaria* species are better at using the contents of their seeds, which may have contributed to the seed weight drop. These seeds have decreased viability and cause physiological issues. Sawney and Aulakh (1980) found similar types of observations about leguminous seeds. The findings about the shift in ash content were examined. The decrease in the percentage of ash content is discovered to be caused by *A. dianthicola* and *A. crassa*. According to Bhikane (1979), the highest reduction in ash content of black gram seeds was observed in *Alternaria alternata*.

Leguminous seeds are high in protein and provide necessary amino acids. Changes in crude protein were thoroughly examined. It is discovered to be quite fascinating that *Alternaria* sp. uses seed protein in various crops. Since *A. dianthicola, A. citri, A. macrospore*, and *A. crassa* are known to use more protein from the seeds, they are able to persist as dominant species on a variety of seed types. This demonstrates unequivocally that the degree of use varies across these four species. Significant protein content loss was reported by Bilgrami et al. (1979) as a result of mold connected to black and green grams. *Alternaria alternata* caused a significant biochemical shift in mug seeds, according to Charya and Reddy (1981), while Prasad (1980) reported a loss in protein.

The decline in the carbohydrate content of wheat and black gram is primarily due to *A. alternata* and *A. tenuissima*, according to estimates of total carbohydrate. Vidhya Shekharan and Govind Swami (1968) reported similar kinds of observations. On the other hand, Sonwane (2002) found that *A. alternata* in pea causes a change in sugar reduction of more than 50%. Results of a study on the degradation of crude fat and crude fiber levels caused by six species of *Alternaria* are quite intriguing. Only *A. alternata*, out of the six *Alternaria* species, was found to be highly efficient in breaking down and using the carbohydrate, protein, and fat contents of seeds. This was demonstrated by *A. alternata's* ability to degrade the crude lipid content and fiber content of wheat, black gram, and safflower seeds. The reduction in crude fiber in all of the seeds caused by *A. alternata* made it abundantly evident that the fungi were secreting cellulose and other enzymes that broke down cell walls, or that the amount of crude fiber suggested that components of the cell wall, such as hemicellulose, lignin, and pectinase, were breaking down. Similar findings were reported by Bhikane (1988) in the cases of green and black grams, Sonwane (2002) in the case of pea (*Pisum sativum)* varieties, and Kanaujia and Singh (1975) in the case of jowar.

Authors Contribution-

All author contributed to the study conception and design. Material preparation, data collection and analysis were performed by Sulochana Rathod. The first draft of the manuscript was written by Reena Jadhav. All authors read and approved by the final manuscript.

Competing Interest-

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Ethics Approval and Consent to participate –

This is an observational study, no ethical approval is required. Research not involved any human subject.

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