SEED-BORNE FUNGI OF SOYBEANS IN KANSAS

by

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INTRODUCTION

Soybeans (Glycine max (L.) Merrill) as a crop is one of the oldest known to man (Hill 1952). De Candolle, in his L' origine des plantes cultivee's, listed the soybean as one of the old world species cultivated for over 4000 years. Soybeans were in cultivation in China many years before their first written records in 2838 B.C. The plant is a native of southeastern Asia. The leading producer of soybeans is Manchuria.

The uses of soybeans varies throughout the localities where grown (Hill 1952). In the Far East, soybeans constitutes part of the regular daily diet, eaten as a supplement to rice. Soybeans are fermented and eaten as "tempe" in Indonesia. Soybean flour, which has a low carbohydrate and high protein content, is used as food for diabetics. Soybean milk, an extract from the seeds, is used in cooking. In the United States soybeans are produced for seed, hay, silage and green manure. While the agricultural properties are well known, by far the most important use of soybeans is the commercial use of soybean oil. Soybean oil is a drying or semi-drying oil which is extremely valuable. Its uses include salad and cooking oil, food products such as margarine and shortenings, and a vast list of industrial uses.

While the role of soybeans in Kansas agriculture is less varied than found throughout the world, it is none the less important to our economy. In the year 1959, Kansas produced 443,000 acres of the 23,579,000 acres of soybeans produced in the United States (Statistical Reporting Service 1961). Of the 31 states reporting soybean production, Kansas ranked eleventh.

The idea that seed-borne fungi are important, was recognized quite early, and is now considered a relatively old concept (Orton 1931, Noble 1958). In its relation to plant pathology, it is most important. Seeds are responsible for transmitting and spreading many important diseases in the United States. The soybean crop is no exception, with many of their pathogenic fungi being seed-borne. Examples of these include: Cercospora kikuchii (purple seed stain), Cercospora sojina (frog eye leaf spot), Peronospora manshurica (downy mildew), and Septoria glycines (brown spot) (Kreitlew et al. 1961). With this in mind, it was the purpose of this study to determine the fungus flora of soybean seeds in Kansas.

MATERIALS AND METHODS

The soybean seeds used in this investigation were secured from the Seed Laboratory, Kansas State Board of Agriculture, Topeka. The samples were obtained in the order they were received by the seed laboratory, starting with the date January 1 and continuing through January and February of the years 1961 and 1962. It was considered there would be no special correlation in the dates farmers sent their samples to the seed laboratory. Seeds were selected in consecutive order with the exception that samples listed as coming from experimental farms or seed companies were not taken. The seeds were further randomized by selecting samples according to the counties in which they were grown. Since soybeans are grown primarily in the eastern section of the state, only 36 counties were represented in this investigation, therefore some duplication of counties had to be made in order to select enough samples for testing (Table 1).

Table 1. Number of samples used per variety and county.

County	1961 Soybean Crop				1962 Soybean Crop			
	Clark	Kent	Shelby	Scott	Clark	Kent	Shelby	Scott
Allen	1	1			1		1	
Anderson	2	1			1	1	1	
Atchison					1	1		
Bourbon	1							
Brown					1	1		
Butler	1				1			
Cherokee	2	1		2	1	1		2
Clay	1							
Coffey	2	1			1	1		
Cowley					1			
Crawford	2	1		2		1		2
Dickinson	1				1		1	
Douglas	1		1		1		1	
Franklin					1	1	1	
Greenwood					1			
Harvey						1		
Jefferson	2				1	1		
Labette	1	3			1	1		1
Leavenworth			1		1			
Linn	1				1	1		
Lyon	2				1	1		1
Marion					1			
McPherson	1							
Miami					1	1		
Mitchell					1			
Montgomery			1					
Neosho	1				1	1		
Osage	1		1		1	1	1	1
Pawnee			1					
Pottawatomie	2					1		
Sedgwick	1				1			
Shawnee	1				1	1	1	
Sumner		1			1			
Washington	1				1			
Wilson		1			1	1		
Woodson	1	2			1		1	
Total	29	12	5	4	28	18	8	7

Four varieties of soybeans were tested during the course of this investigation. The soybeans used were the varieties Clark, Kent, Shelby and Scott. These four varieties were selected because they formed the bulk of the seeds found at the seed laboratory, constituting 91.5% of the 1961 seeds and 95.4% of the 1962 seeds sent in at the time the samples were selected. Of the 1961 seeds selected, Clark constituted 54.3% of the total, with Kent, Shelby and Scott comprising 24.2%, 6.1% and 7.0% respectively. Of the 1962 seeds selected, Clark constituted 54.1% of the total, with Kent, Shelby and Scott comprising 24.3%, 5.0% and 9.0% respectively. It was on this basis that the largest numbers of samples selected belonged to the variety Clark, with Kent, Shelby and Scott varieties comprising lesser roles in the investigation. Fifty samples of seed were used from the 1961 soybean crop, with 29, 12, 5 and 4 samples being respectively chosen from the varieties Clark, Kent, Shelby and Scott. Sixty-one samples of seed were used from the 1962 soybean crop with 28, 18, 8 and 7 samples being respectively chosen from the varieties Clark, Kent, Shelby and Scott. This constitutes a total of 111 samples used in this investigation.

The methods used during the two year investigations were similar although the number of samples varied with most emphasis being placed on the fungi associated with the seeds secured from the 1962 soybean crop. Of the 50 samples used from the 1961 soybean crop, only 40 seeds of each sample were plated (throughout the investigation 10 seeds were placed in each petri dish), giving a total of 2000 seeds observed. Of the 61 samples from the 1962 soybean crop, 200 seeds of each sample were plated, giving a total of 12,200 seeds observed. This constitutes a total of

14,200 soybeans being observed of detection of seed-borne fungi.

The treatments used were uniform for both years. During the first years investigation, 20 seeds of each sample were surface sterilized and plated in petri dishes, and 20 seeds of each sample were washed with tap water and plated. During the second year of the investigation, 100 seeds of each sample were surface sterilized and plated, and 100 seeds of each sample were washed with tap water and plated.

The soybeans were plated in petri dishes on potato dextrose agar (Difco Laboratories 1953) which had been acidified with 85% lactic acid to a pH of 5. The soybeans which were surface sterilized were placed in strainers and immersed for 1 minute in a 70% solution of ethyl alcohol and then immersed for 1 minute in a 1% solution of sodium hypochlorite. The alcohol acts as a wetting agent to eliminate the liquid-gas interface existing of the seed, thereby allowing complete seed coverage by the sodium hypochlorite. According to Riker and Riker (1936), sodium hypochlorite is a more desirable surface disinfectant than the commonly used mercuric chloride, because there is less residual effect with the sodium hypochlorite. The seeds that were washed were placed in sterilized strainers and held for 2 minutes under running tap water to remove excess dirt particles from the seed sample. All plating and isolating was done under sterile conditions within an isolating chamber. The interior of the chamber was thoroughly washed down with a 1:1000 solution of mercuric chloride. The chamber was then filled with live steam. The spores and other impurities within the chamber would adhere to the mist particles and upon condensation and settling to the chamber surface, would be killed by the mercuric chloride, thus leaving a relatively sterile chamber.

After the seeds were plated on the agar media, they were left at room temperature for 7 to 9 days and were then observed for results. The percent germination was recorded for the soybean seeds and an accurate record was kept of the fungi observed. The fungi were subcultured on potato dextrose agar slants for identification. Records were kept of the percentages of fungi found on the surface sterilized seeds as opposed to the fungi found on the non-sterilized seeds.

Special media and techniques were employed for the isolates which would not sporulate on potato dextrose agar. Water agar (17 g agar per liter of water), straw agar (infusion from 75 g of grass clippings per liter of water agar), and soybean seed agar were used to induce sporulation. The soybean seed agar was prepared using the same weights and methods as the potato dextrose agar with the exception chopped soybeans were substituted for the potatoes. All isolates which did not belong to the nine main genera, which did not sporulate or which were not identified were listed as other fungi. Under especial circumstances water agar plates containing soybeans sterilized with propylene oxide (Hansen and Snyder 1947) and autoclaved soybeans were used to induce sporulation.

EXPERIMENTAL RESULTS AND CONCLUSIONS

One term which will be used frequently by the writer may need some explanation. While a distinct difference may be found in the definitions of infested and infected, the writer will use the term infected exclusively when dealing with the fungi associated with the seeds to facilitate ease of discussion. This term will satisfactorily suffice since practically all the fungi noted were found on both the seeds which were surface sterilized

and those which were washed in tap water.

The fungi found in this investigation were placed into one of ten categories. Preliminary observation of results showed that the most frequently found fungi belonged in the following nine genera: Alternaria, Aspergillus, Cercospora, Chaetomium, Fusarium, Mucor, Penicillium, Pleurostromella and Rhizopus. The other genera found were listed in the tenth category, other fungi. All percentage data were based on these ten categories.

As could be expected, there was a vast difference in the prevalence of the fungi depending on the type of seed treatment used. It was found in the 1961 soybean crop that an average of 13.4% of the seeds were infected which were surface sterilized before plating, whereas in the 1962 soybean crop it was found that an average of 32.1% of the seeds were infected. There was less variation in fungi incidence found with the seeds which were water treated. It was found in the 1961 soybean crop that an average of 68.6% of the seeds were infected, whereas in the 1962 soybean crop it was found that an average of 75.6% of the seeds were infected.

Seed germination was also recorded for the soybeans. As noted in Table 2, there was hardly any appreciable variation in the infection percentages between the types of surface treatments among the four varieties. The highest non-germinating percentage for the two years crops were 6.2% for the surface sterilized seeds and 7.2% for the water treated seeds.

The fungi were categorized by their prevalence in the three eastern Kansas agricultural sections (Table 3). Of the 36 counties represented, 26 counties were found in the NE, EC, or SE agricultural sections. Because of the close proximity of the other 10 counties to these 3 agricultural

Table 2. Germination percentages by variety, year, seed treatment and fungi infection on soybeans.

Variety	Crop year	Seed treatment	Infected seeds G[1]	Infected seeds NG[2]	Non-infected G	Non-infected NG
Clark	1961	S. S.[3]	9.0	0.8	89.8	1.2
		Water	62.3	0.2	36.3	1.2
	1962	S. S.	25.4	4.5	63.9	6.1
		Water	76.9	4.1	17.1	1.9
Kent	1961	S. S.	15.2	0.0	83.0	1.7
		Water	70.2	0.0	28.9	0.8
	1962	S. S.	29.3	2.6	61.3	6.2
		Water	57.3	3.4	35.7	3.5
Shelby	1961	S. S.	6.0	0.0	89.0	5.0
		Water	93.0	1.0	6.0	0.0
	1962	S. S.	27.5	2.5	65.9	4.2
		Water	48.5	4.0	42.6	4.9
Scott	1961	S. S.	17.5	0.0	80.0	2.5
		Water	85.0	0.0	15.0	0.0
	1962	S. S.	35.7	5.3	55.7	3.2
		Water	65.9	7.2	21.1	5.7

[1]Germinated seeds

[2]Non-germinated seeds

[3]Surface sterilized seeds

sections, they were also included in the following sections: NE: Clay, Mitchell and Washington; EC: Dickinson, Marion, McPherson and Pawnee; SE: Harvey, Sedgwick and Sumner. In the 1961 crop it was found that 47.8% of the fungi were from the SE section, while the EC and NE sections had 38.6% and 13.4% respectively. In the 1962 crop it was found that 43.1% of the fungi were from the EC section while the SE and NE sections had 39.4% and 16.4% respectively. While these two crop years varied somewhat in sectional fungi prevalence, it can be noted that the least amount of

Table 3. Percentages of fungi on infected soybean seeds by year and agricultural section.

Genus	1961				1962				Ave.
	SE	EC	NE	Total	SE	EC	NE	Total	
Alternaria	2.0	1.6	0.8	4.4	11.7	14.3	5.8	31.8	28.9
Aspergillus	29.8	32.7	10.4	72.9	9.1	10.1	4.1	23.3	28.4
Cercospora	0.4	0.0	0.0	0.4	0.2	0.9	0.2	2.4	2.1
Chaetomium	0.5	0.1	0.0	0.6	1.5	1.4	0.5	3.4	3.1
Fusarium	1.6	0.1	0.0	1.7	1.1	2.1	0.3	3.5	3.4
Mucor	1.0	0.3	0.3	1.6	0.7	0.2	0.3	1.2	1.2
Penicillium	8.0	1.0	0.5	9.5	2.7	3.4	1.8	7.9	8.1
Pleurostromella	0.0	0.1	0.0	0.1	5.2	3.9	0.9	10.0	9.0
Rhizopus	0.0	0.0	0.0	0.0	0.6	0.8	0.2	1.6	1.4
Other Fungi	4.5	2.7	1.4	8.6	6.6	6.0	2.3	14.9	14.2

fungi was observed within the NE section with the EC and SE sections containing the most fungi.

Soybean Varieties

Clark. This soybean variety constituted the largest sample of seeds used in this investigation. It was found in the 1961 crop that all genera were represented except the genus Rhizopus (Table 4). It was observed that the genus Pleurostromella was only found on seeds which were water treated and the genera Cercospora and Chaetomium were found only on the surface sterilized seeds. It was observed in the 1962 crop that all genera were represented in the isolates. The only difference existing between the

Table 4. Percentages of fungi on infected Clark soybean seeds by year and seed treatment.

Genus	Surface sterilized		Water treated	
	1961	1962	1961	1962
Alternaria	15.8	18.4	3.5	34.6
Aspergillus	35.1	9.7	86.3	30.3
Cercospora	1.7	0.1	0.0	1.7
Chaetomium	1.7	14.3	0.0	0.4
Fusarium	5.2	7.4	0.3	1.8
Mucor	12.2	0.0	0.3	1.1
Penicillium	1.7	1.1	4.8	11.9
Pleurostromella	0.0	21.4	0.3	2.8
Rhizopus	0.0	0.2	0.0	2.4
Other Fungi	26.3	26.6	4.3	12.5

surface sterilized seeds and the water treated seeds was that the genus Mucor was found only on the water treated seeds.

Kent. This soybean variety represented the second largest sample of seeds used in this investigation. It was found in the 1961 crop that only the genera Alternaria, Aspergillus, Chaetomium and Penicillium were represented (Table 5). The only variation existing between the surface sterilized seeds and water treated seeds was that the genus Chaetomium was found only on the surface sterilized seeds. It was observed in the 1962 seeds that all genera were represented. The only variation existing between the surface sterilized seeds and water treated seeds was that the genus Mucor was found only on the water treated seeds.

Table 5. Percentages of fungi on infected Kent soybean seeds by year and seed treatment.

Genus	Surface sterilized		Water treated	
	1961	1962	1961	1962
Alternaria	5.0	38.2	3.5	36.3
Aspergillus	65.0	22.5	68.0	30.2
Cercospora	0.0	2.8	0.0	1.1
Chaetomium	10.0	6.2	0.0	0.7
Fusarium	0.0	3.1	0.0	2.1
Mucor	0.0	0.0	0.0	2.6
Penicillium	2.5	2.9	22.1	12.2
Pleurostromella	0.0	11.5	0.0	3.8
Rhizopus	0.0	0.4	0.0	2.8
Other Fungi	17.5	11.9	6.4	8.3

Shelby. Seeds from this variety represented one of the smaller samples used in this investigation. In the 1961 crop only the genera Alternaria, Aspergillus, Fusarium and Mucor were represented (Table 6). Fusarium was the only genus found on the surface sterilized seeds, while the genera Alternaria, Aspergillus and Mucor were found only on the water treated seeds. In the 1962 crop all genera were represented. The only variation existing between the surface sterilized seeds and the water treated seeds was that the genus Cercospora was found only from seeds which were water treated and the genera Fusarium and Mucor were found only from the seeds which were surface sterilized.

Scott. Seeds from the variety Scott represented the smallest sample

Table 6. Percentages of fungi on infected Shelby soybean seeds by year and seed treatment.

Genus	Surface sterilized		Water treated	
	1961	1962	1961	1962
Alternaria	0.0	27.6	1.9	25.7
Aspergillus	0.0	5.0	93.2	29.5
Cercospora	0.0	14.2	0.0	0.0
Chaetomium	0.0	3.7	0.0	2.6
Fusarium	50.0	0.0	0.0	1.2
Mucor	0.0	0.0	2.8	0.7
Penicillium	0.0	1.7	0.0	12.1
Pleurostromella	0.0	32.9	0.0	10.5
Rhizopus	0.0	0.4	0.0	5.0
Other Fungi	50.0	14.2	1.9	12.5

used in this investigation. In the 1961 crop the genera Chaetomium, Mucor, Pleurostromella and Rhizopus were not found (Table 7). The genus Penicillium was found only on the water treated seeds and the genera Alternaria, Cercospora and Fusarium were found only on surface sterilized seeds. In the 1962 crop all genera were represented. The only variation existing between the surface sterilized seeds and the water treated seeds was that the genera Aspergillus, Penicillium and Rhizopus were found only on the water treated seeds.

Table 7. Percentages of fungi on infected Scott soybean seeds by year and seed treatment.

Genus	Surface sterilized		Water treated	
	1961	1962	1961	1962
Alternaria	7.1	22.1	0.0	34.9
Aspergillus	50.0	0.0	74.6	14.8
Cercospora	14.3	13.1	0.0	0.2
Chaetomium	0.0	1.0	0.0	2.6
Fusarium	7.1	4.4	0.0	10.9
Mucor	0.0	0.7	0.0	0.2
Penicillium	0.0	0.0	16.9	2.1
Pleurostromella	0.0	38.6	0.0	9.3
Rhizopus	0.0	0.0	0.0	1.1
Other Fungi	21.4	19.9	8.5	24.0

Genera of Fungi

Identification of the fungi was accomplished primarily through the use of the keys found in Barnett (1960) and Gilman (1957) with the aid of the descriptions of Alexopoulos (1962) and Bessey (1950). Other references used for identification purposes will be cited with the various genera listed.

Alternaria Nees ex Wallr. As noted in Table 3, Alternaria was the most prominently found genus in this investigation, comprising 28.9% of the total number of isolates from the infected seeds. This fungus was found on both surface sterilized and water treated seeds. The fungus was more frequently observed on water treated seeds (Table 8). From the

Table 8. Percentages of fungi found infecting surface sterilized and water treated seeds.

Genus	1961 crop: Total % of fungi	1961 crop: % on S. S. seeds	1961 crop: % on water treated seeds	1962 crop: Total % of fungi	1962 crop: % on S. S. seeds	1962 crop: % on water treated seeds
Alternaria	4.4	36.4	63.6	31.8	24.8	75.2
Aspergillus	72.9	8.2	91.8	23.3	15.1	84.9
Cercospora	0.4	100.0	0.0	2.4	62.7	37.3
Chaetomium	0.6	100.0	0.0	3.4	79.9	20.1
Fusarium	1.7	87.5	12.5	3.5	41.5	58.5
Mucor	1.6	63.6	36.4	1.2	2.8	97.2
Penicillium	9.5	9.3	90.7	7.9	5.9	94.1
Pleurostromella	0.1	0.0	100.0	10.0	68.2	31.8
Rhizopus	0.0	0.0	0.0	1.6	5.0	95.0
Other Fungi	8.6	44.5	55.5	14.9	39.7	60.3

1961 crop 63.6% of the isolates were from the water treated seeds whereas from the 1962 crop 75.2% of the isolates came from the water treated seeds.

Other references used for the identification of this genus includes Beardmore (1955), Groves and Skolko (1944) and Swarup (1955).

Aspergillus Mich. ex Fr. The genus Aspergillus was the second most observed fungus, comprising 28.4% of the total number of isolates from the infected seeds. This fungus was found on both surface sterilized and water treated seeds. The fungus comprised 93.2% of the total number of isolates found on the infected seeds from the water treated, Shelby variety, 1961 crop. This was the highest percentage noted for any variety

or seed treatment. As can be noted in Tables 3, 4, 5, and 6, the fungus was most frequently isolated from seeds which were water treated and not surface sterilized. In the 1961 and 1962 crops, Aspergillus isolates from water treated seeds constituted 91.8% and 84.9% respectively.

Thom and Raper's, Manual of the Aspergilli (1945) was also used as an aid to identification.

Pleurostromella Petrak. The genus Pleurostromella was the third most frequent fungus isolated constituting 9.0% of the total number of isolates from the infected seeds. This fungus was found only on water treated seeds in the 1961 crop but in the 1962 crop it was found on both surface sterilized and water treated seeds. The isolates from the surface sterilized seeds constituted 68.2% of the total.

It was observed in several cases that this fungus was found associated with non-germinated seeds more frequently than with germinated seeds (Table 9). The fungus was rarely found from the 1961 soybean seeds, but was prominently found from the 1962 soybean seeds. The fungi percentages used in Table 9 are taken from Tables 4, 5, 6, and 7.

Penicillium Link ex Fr. The genus Penicillium was the fourth most frequently observed fungus, constituting 8.1% of the total number of isolates from the infected seeds. The fungus was found on both seeds which had been surface sterilized and water treated, but over 90.0% of the isolates of both years crops were taken from water treated seeds (Table 8).

Raper and Thom's Manual of the Penicillia (1949) was used as a reference aid.

Table 9. Percentages of soybean seeds infected with Pleurostromella by year, seed treatment, germination and variety.

Variety	Surface sterilized				Water treated			
	1961		1962		1961		1962	
	G	NG	G	NG	G	NG	G	NG
Clark	0.0	0.0	10.6	10.8	0.3	0.0	1.2	1.6
Kent	0.0	0.0	4.5	7.0	0.0	0.0	1.4	2.4
Shelby	0.0	0.0	29.2	3.7	0.0	0.0	9.3	1.2
Scott	0.0	0.0	30.7	7.9	0.0	0.0	3.9	5.4

Fusarium Link ex Fr. The genus Fusarium constituted 3.4% of the total number of isolates from the infected seeds. This fungus was found primarily on surface sterilized seeds in the 1961 seed sample, constituting a total of 87.5% of the isolates; whereas the fungus was more prominently found on water treated seeds in the 1962 seed sample, constituting a total of 58.5% of the isolates.

Snyder and Hansen (1945) was used as a reference aid.

Chaetomium Kunze ex Fr. The genus Chaetomium constituted 3.1% of the total number of isolates from the infected seeds. The fungus in both years was found primarily on seeds which had been surface sterilized. In the 1961 and 1962 crops, Chaetomium isolates from surface sterilized seeds constituted 100.0% and 79.9% respectively.

Ouye (1957) and Skolko and Groves (1953) were references used in the identification of this genus.

Cercospora Fres. The genus Cercospora constituted 2.1% of the total number of isolates from the infected seeds. This fungus was found on both

surface sterilized and water treated seeds, with most isolates coming from surface sterilized seeds. From the 1961 crop, 100.0% of the isolates were from surface sterilized seeds and from the 1962 crop, 62.7% of the isolates were from the surface sterilized seeds.

Chupp (1954), Deutschmann (1953) and Murakishi (1951) were references used for the identification of this genus.

Rhizopus Ehrenb. ex Corda. The genus Rhizopus constituted 1.4% of the total number of isolates from the infected seeds. This fungus was found only in the 1962 seed crop. The fungus was found on both surface sterilized and water treated seeds, however the Rhizopus isolates from the surface sterilized seeds constituted only 5.0% of the total number.

Mucor Mich. ex Fr. The genus Mucor constituted 1.2% of the total number of isolates from the infected seeds. This fungus was found on both surface sterilized and water treated seeds. From the 1961 crop, 63.6% of the isolates were from surface sterilized seeds, whereas from the 1962 crop, only 2.8% of the isolates were from surface sterilized seeds.

Other Fungi. The last classification, other fungi, contained all fungi isolates not related to the other nine genera. This included other genera each of which constituted less than 1/10 of 1% of the infected soybeans, fungi which did not produce fruiting structures, and those fungi not identified. This category constituted 14.2% of the total number of isolates from the infected seeds.

SUMMARY

This investigation consisted of determining the seed-borne fungus flora on 14,200 soybeans from the varieties Clark, Kent, Shelby and Scott. Two seed treatments (surface sterilization with sodium hypochlorite and washing with tap water) were used before plating on potato dextrose agar. It was found that in the years 1961 and 1962 respectively, that 13.4% and 32.1% of the seeds were infected that were surface sterilized. In the same years, 68.6% and 75.6% of the seeds were infected that were washed in tap water. Germination results for the 1961 and 1962 seeds showed over 93.0% germination with both treatments on all four varieties. It was found that 85.8% of the fungi isolated could be attributed to nine genera: Alternaria, Aspergillus, Cercospora, Chaetomium, Fusarium, Mucor, Penicillium, Pleurostromella and Rhizopus. Other fungi which were identified were considered relatively minor in the overall picture of fungi incidence, so were placed into the category other fungi, along with the fungi which were not identified. Results showed that the SE and EC agricultural sections produced soybeans with the highest fungi populations. In the years 1961 and 1962 respectively, only 13.4% and 16.4% of the fungi were found in the NE section. The fungi Cercospora, Chaetomium, and Pleurostromella were primarily isolated from seeds which had been surface sterilized, whereas the fungi Alternaria, Aspergillus, Fusarium, Mucor, Penicillium and Rhizopus were primarily isolated from seeds which were only water treated. The findings of the author are borne out by several investigators who have worked with microflora of soybeans. Tervet (1945) found approximately the same major fungi populations as did this writer.

Of the nine major genera included in this writing, Tervet also found that his most prominently found fungi were: Alternaria, Aspergillus, Chaetomium, Fusarium, Penicillium, and Rhizopus. It is therefore the conclusion of the author that the nine main genera presented in this paper, comprise an accurate representation of the prominent seed-borne fungi found in Kansas.

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SEED-BORNE FUNGI OF SOYBEANS IN KANSAS

by

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AN ABSTRACT OF A MASTER'S THESIS

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This investigation consisted of identifying seed-borne fungi of 14,200 soybeans from the varieties Clark, Kent, Shelby and Scott from the years 1961 and 1962. Isolates were secured from seeds, one-half of which were surface sterilized and one-half of which were water treated, then plated on PDA and incubated. The fungi obtained were categorized into 10 classifications according to prevalence. These 10 categories in descending order of their prevalence include: Alternaria, Aspergillus, Pleurostromella, Penicillium, Fusarium, Chaetomium, Cercospora, Rhizopus, Mucor and other fungi. These 9 genera constituted 85.8% of the isolates obtained while the fungi relegated to the category, other fungi, constituted a minor role due to their limited incidence. The fungi were more prominently observed from the SE and EC sections of the state, with the NE section comprising only 15% of the total isolates observed. Seed germination was high averaging 93% or over with all varieties and seed treatments. The isolates were obtained more frequently from seeds which had been water treated and not surface sterilized. In the years 1961 and 1962 the surface sterilized seed infection was 13.4% and 32.1% respectively. In the same years, the water treated seed infection was 68.6% and 75.6% respectively. The fungi Alternaria, Aspergillus, Fusarium, Mucor, Penicillium and Rhizopus were primarily isolated from seeds which were water treated, whereas the fungi Cercospora, Chaetomium and Pleurostro mella were primarily isolated from seeds which were surface sterilized.