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Effects of Seed Treatments on Growth and Yield of Two Wheat Varieties

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ABSTRACT. The five fungicides Bavistin, Benlate, Cozib 62, Daconil W-75 and Dithane were tested for their efficacy against *Alternaria alternata* and *Fusarium roseum* which were isolated from two varieties of wheat in the laboratory. Cozib, Dithane and Benlate, proved to be efficient seed fungicides; Daconil was less efficient.

Alternaria alternata was present as a seed saprophyte on almost all seeds of the LYP-73 wheat variety brought from Pakistan and germinated in petri dishes. Both *A. alternata* and the *F. roseum* were present on the Maxipack variety from the Al-Hassa area. Cozib and Dithane were the only two chemicals which controlled both *Alternaria alternata* and the *F. roseum*. Benlate controlled only the *F. roseum*.

Implications of these results for the chemical treatment of these crops are discussed.

Seed-borne pathogens can reduce seed quality and serve as a source of primary inoculum for development and spread of certain plant diseases (Leach 1979). The benefits of controlling seed-borne pathogens go beyond increasing yield, the parameter most frequently used to justify seed treatments and fungicide sprays. The literature on control of seedborne fungi has been reviewed through 1975 by Neergaard (1977), and history of seed pathology and seed-health testing has been published by Noble (1979).

Both chemical and non-chemical methods of seed treatment have been practiced by agriculturists for centuries (Neergaard 1977). Chemical seed treatments are applied to control externally-or internally-borne pathogens intimately associated with seeds or soilborne pathogens of seeds and seedlings. Externally- or

internally-borne microorganisms usually become associated with the seeds prior to harvest. Therefore, efforts to reduce the amount of inoculum available for seed infection or infestation before harvest will result in healthier, better quality seeds. In a study in the United States on the effect of fungicide sprays on scab (*Fusarium graminearum* Schwale) of winter wheat, Jacobson (1977) used an amended agar assay to detect the percentage of seedborne *F. graminearum* in seeds from plants unsprayed or sprayed with benomyl, Methylbenzimidazole carbamate (MBC) or benomyl + mancozeb. He found that *F. graminearum-infected seeds/grains were reduced from 24% in unsprayed plants to 12% in plants treated with benomyl + mancozeb and to 4-8% in plants treated with benomyl or MCB alone.*

The results from spraying different crops (including wheat) for internally seed-borne species of Cercospora, Cladosporium, Colletotrichum, Fusarium, Lasiodiplodia, Phomopsis, Rhizoctonia and *Septoria* were reviewed by Sinclair (1983). Mussa and Makki (1985) reported that Cozib, Daconil and Dithane were very effective on *F. roseum* and *A. alternata,* when tested in the laboratory while Benlate (benomyl) controlled only the *Fusarium* sp. Russell and Mussa (1977) confirmed the inhibition of *Fusarium solani* f. sp. *Phaseoli* by the systemic fungicides benomyl and thiabendazole. Hoffmann *et al.* (1983) tested 22 formulations with known or suspected systemic fungicidal activity as seed treatments for the control of dwarf bunt of wheat caused by *Tilletia controversa* and found that thiabendazole (Mertect LSP) exhibited the best control with the least adverse effects.

New materials with suspected systemic activity against seed-borne fungi have become available in recent years. The purpose of this study was to examine the potential of these compounds in an effort to find a more consistently effective and economical seed treatment for controlling *Fusarium* sp. and *Alternaria* sp.

Material and Methods

The fungicides used were Bavistin (Carbendazim), Benlate (benomyl), Cozib 62, Daconil 2787W-75, and Dithane M-45 (mancozeb).

Two previously isolated fungi, *Fusarium roseum* and *Alternaria Alternata,* were used in this study.

The two varieties of wheat used in this work were Maxipack and LYP-73. Maxipack already had been grown at the King Faisal University Research Station, Al-Hassa, Saudi Arabia. LYP-73 was supplied by Dr. Bajwa, Wheat Department, Punjab Agriculture Research Station, Faisalabad, Pakistan.

Fifty grains of each of the two varieties were surface sterilized with 0.1% $HgCl_2$ for three minutes and rinsed twice in sterilized distilled water prior to inoculation with a suspension of either *Alternaria* or *Fusarium.* Grains were then treated with the fungicides and placed in PDA plates. Non-treated grains served as control. Each plate was sown with ten grains at a fixed distance from each other and replicated five times. All plates were kept under normal daylight photoperiod in the laboratory at a temperature of 22°C ± 2°. After one week, the fungi growing from the grains were microscopically identified. For a further check, the isolated fungi were subcultured in PDA plates for identification by their microscopic colony characteristics.

Single spore isolation techniques were applied for isolation and purification of cultures of both fungi. Identification of the seed-borne pathogens were accomplished following the standard descriptions of the original taxonomic references (Dickson 1956 and Neergaard 1977).

The effectiveness of the test fungicides on *in-vivo* growth *Alternaria alternata* and *Fusarium ruseum* was assessed by applying the chemicals as seed treatments prior to planting in the field.

The area chosen for planting on the University Research Station at Al-Hassa, was divided into eighteen blocks for each of the two varieties, each block being 2 × 2 m.

Grains of the wheat varieties Maxipack and LYP-73 were thoroughly mixed with each of the fungicides in polyethylene plastic bags at the rate of 3g/kg of grain. Each block was planted with three rows 40 cm apart, each row containing 50 g of seeds and irrigated regularly. There were three replicates for each of the six treatments; treatments were Bavistin, Benlate, Cozib 62, Daconil 2787W-75, Dithane M-45 and the untreated control.

During the growing period, the blocks were weeded regularly. Forty gramme of Urea (46% N) were added as fertilizer to each block twice, once after emergence of the plants and again before the flowering stage.

Randomized shoot height in cm, root length in cm, number of tillers, number of leaves, fresh and dry weights in g and leaf area in cm^2, were scored three months after the sowing date. Similarly, head length in cm, spikes/plant, spikelets/plant, kernels/spike, kernels/spikelet, weight of 1000 seeds in grammes and total yield in grammes were recorded for each treatment.

Results

The results of the fungicides tests in the laboratory are shown in Table 1 and indicate that Cozib 62, Daconil 2787W-75 and Dithane M-45 were active in controlling both *Alternaria alternata* and *Fusarium roseum;* the systemic fungicides

Table 1. Effects of five fungicides on the wheat varieties Maxipack* and LYP-73 when infected with *Alternaria* or *Fusarium* and incubated in petri plates at 22°C

Treatment	Maxipack		LYP-73	
	Alternaria	*Fusarium*	*Alternaria*	*Fusarium*
Control	18	20	35	11
Bavistin	15	18	30	10
Benlate	19	01	26	01
Cozib	01	04	02	01
Daconil	05	01	05	03
Dithane	03	01	03	02
S.E.	± 4.65	± 5.20	± 8.71	± 1.16

* 50 seeds/treatment

Benlate effectively controlled only *Fusarium roseum* ($P < 0.05$). Bavistin was clearly inferior to the other fungicides tested, whereas Cozib 62 and Dithane were superior to the other three compounds in controlling both fungi. No significant differences were noticed among the effects of Cozib 62, Dithane and Daconil on both pathogens, or among the effects of these fungicides and Benlate on *F. roseum.*

After 7 days, the mycelial growth of both *F. roseum* and *A. alternata* had completely colonized untreated control gains. There was no evidence of infection on any of the fungicide-treated seeds except those treated with Bavistin, and in the Benlate treatments where the inoculum was *A. alternata.*

In the field experiment, the protectant effects of the five fungicides on the two varieties of wheat are shown in Tables 2 and 3.

For the Maxipack variety, Cozib 62 and Dithane showed significant increases in all seven measured characteristics ($P < 0.05$), Table 2. Daconil and Benlate showed significant increases in all categories except root length. Bavistin showed

significant increases in all categories except root length and number of tillers ($P < 0.05$). Strong increases in four or more categories occurred with Cozib and Dithane. Daconil and Bavistin were the least effective of the five fungicides.

Table 2. Effects of five fungicides on the different characteristics of the wheat variety Maxipack

Treatment	Plant characteristic						
	Leaf area (cm^2)	Shoot height (cm)	Root length (cm)	No. of tillers	No. of leaves	Fresh weight (g)	Dry weight (g)
Control	28.10	48.3	8.4	0	5.3	3.6	1.03
Bavistin	38.90	59.9	8.5	1	5.9	5.3	1.60
Benlate	45.4	62.5	8.8	2.3	6.1	6.5	1.90
Cozib	50.72	71.9	9.2	4.3	6.5	7.1	2.50
Daconil	39.30	58.5	8.9	2.3	5.9	6.0	1.80
Dithane	49.36	61.0	11.5	3.3	6.4	7.2	2.20
S.E.	± 6.78	± 6.95	± 1.00	± 1.46	± 0.42	± 1.08	± 0.40

Table 3. Effects of five fungicides on the different characteristics of wheat variety LYP-73

Treatment	Plant characteristic						
	Shoot height (cm)	Root length (cm)	No. of tillers	No. of leaves	Leaf area (cm^2)	Fresh weight (g)	Dry weight (g)
Control	40.0	7.0	0.0	6.3	4.41	2.9	1.06
Bavistin	49.9	8.4	0.3	6.7	5.4	3.8	1.10
Benlate	48.07	9.9	3.7	9.3	7.5	5.9	2.00
Cozib 62	51.6	9.4	3.3	10.6	7.5	6.2	2.20
Daconil	50.3	8.6	0.3	7.1	4.6	3.7	1.20
Dithane	51.2	10.1	3.7	9.4	7.5	6.5	2.13
S.E.	± 4.08	± 0.89	± 1.43	± 1.19	± 1.16	± 1.13	± 10.39

For the LYP-73 variety, Benlate, Dithane and Cozib 62 showed significant increases in all measured characteristics ($P < 0.05$), Table 3. Daconil showed significant increases in three categories; Bavistin showed significant increases in

only two categories. Strong increases in four or more categories occurred with Benlate, Cozib 62 and Dithane. Bavistin and Daconil again were the least effective fungicides.

Table 4 shows the effects of five fungicides on seven categories of measurement concerned with yield for the Maxipack variety ($P < 0.05$). Significant increases occurred in all seven categories when Cozib 62 or Dithane was applied. Significant increases in six of the seven categories occurred where Benlate or Daconil was used. Significant increases occurred in only two categories where Bavistin was used. Strong increases in four or more categories occurred with Cozib 62 and Dithane. Bavistin produced poor results.

Table 4. Effects of five fungicides on yield and yield components of the wheat variety Maxipack

Treatment	Measurement						
	Head length (cm)	Spikes/ plant	Spikelets/ plant	Kernels/ spike	Kernels/ spike lets	Weight of 1000 seeds (g)	Yield (g)
Control	1.41	0.31	3.1	7.1	3.7	38.1	182.3
Bavistin	1.91	0.32	3.3	7.3	3.9	39.2	199.2
Benlate	2.13	0.44	3.2	7.9	4.8	40.3	210.5
Cozib	2.39	0.47	4.5	8.2	5.8	45.2	246.5
Daconil	1.92	0.30	3.8	7.9	4.4	41.0	209.3
Dithane	2.28	0.48	4.7	8.3	5.9	45.3	245.9
S.E.	± 0.20	± 0.05	± 0.39	± 0.28	± 0.54	± 1.76	± 14.87

Table 5 shows the effects of five fungicides on six categories of measurement concerned with yield for the LYP-73 variety ($P < 0.05$). Significant increases occurred in all six categories when Benlate, Cozib 62 or Dithane was applied. Significant increases in five of the six categories occurred where Daconil was used. Significant increases occurred in only three categories where Bavistin was used. Strong increases in four or more categories occurred with Cozib 62 and Dithane. Bavistin again produced inferior results.

Discussion

The results of the *in-vitro* chemical control study showed that Cozib 62, Dithane and Daconil 2787W-75 were effective in controlling *Alternaria alternata*

Table 5. Effects of five fungicides on yield and yield components of the wheat variety LYP-73

Treatment	Measurement					
	Head length (cm)	Spikes/ plant	Spikelets/ plant	Kernels/ spikelet	Weight of 1000 seeds (g)	Yield (g)
Control	1.51	0.33	3.4	7.2	38.6	184.3
Bavistin	1.89	0.39	3.9	7.1	38.4	198.1
Benlate	1.97	0.41	4.2	7.7	41.2	211.2
Cozib	2.39	0.48	4.8	8.3	45.4	247.1
Daconil	1.93	0.40	4.1	7.9	40.1	203.4
Dithane	2.28	0.47	4.9	8.2	45.7	244.6
S.E.	± 0.18	± 0.03	± 0.33	± 0.29	± 1.88	± 14.79

and *Fusarium roseum* while the system fungicide benomyl (Benlate) was effective only in preventing the fungal growth of *Fusarium roseum*. However, benomyl is known to a wide range of Fungi Imperfecti and Ascomycetes such as species of *Ascochyta, Colletotrichum, Fusarium, Phoma, Septoria* and *Sclerotinia* (Neergaard 1977). Accordingly, Vidhyasekaran (1980) included benomyl in his tests on *Drechslera* and found that it did not eradicate that fungus. This agrees with our *in-vitro* work.

The results of the field trials showed that Cozib and Dithane, and to a lesser extent Benlate, significantly increased the different characteristics and yield components of the two varieties. Bavistin and Daconil were not as effective as the other three chemicals.

Thus, one can conclude that the use of such fungicides has a strong influence on growth and yield of the two wheat varieties tested, and their application as seed treatments for these varieties is strongly recommended. Since better seed quality can bring higher prices, seed quality should be included with yield increases in cost/return analyses of the use of fungicides for plant diseases control of field crops.

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تأثير بعض معاملات الحبوب على نمو وإنتاجية القمح

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اختبرت قدرة خمسة مبيدات فطرية هى كوزيب ٦٢، دايثين م ـ ٤٥، داكونيل، بافستين وبنليت لمكافحة فطرى الترناريا وفيوزيريوم تم عزلهما من نوعين من القمح في المعمل.

كان تأثير كوزيب ودايثين وداكونيل جيد جداً على الحبوب المعالجة، تبعهم كل من بنليت وبافستين على التوالي.

وجد الترناريا الترناتا كفطر مترمم على كل الحبوب في العينة ل ى ب ـ ٧٣ المستوردة من الباكستان، والتي نمت على الأطباق في المعمل على العكس من العينة ماكس باك المأخوذة من منطقة الأحساء بالمملكة العربية السعودية، والتي ظهر عليها وجود طفيف من الترناريا الترناتا وفيوزيريوم.

أثرت كل المبيدات الفطرية التي ذكرت سلفاً ـ ما عدا بافستين ـ تأثيراً فعالاً على الفيوزيريوم، أما كوزيب ودايثين وداكونيل فقد أثروا تأثيراً جيداً على كل من الترناريا الترناتا وفيوزيريوم؛ كما لوحظ أن بنليت قد أثر فقط على فطر الفيوزيريوم.

وقد سجلت هذه النتائج ونوقشت في ضوء هذه الملاحظات.