

Toxin Production by Seed-borne Fungi

BY

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ABSTRACT

The seed-borne fungi of castor reduced the germinability of the seeds. The root and shoot elongation was also markedly affected. The fungi produced toxins in culture which inhibited the seed germinability and seedling vigour. Czapek-Dox medium was observed to be suitable for the production of toxins by the seed-borne fungi.

INTRODUCTION

Seeds are invaded by multitude of fungi during storage (Cherewick, 1954). These fungi cause germination failures and reduce the seedling vigour. The reduction in germinability and seedling vigour due to seed-borne fungi has been reported in paddy (Vidhyasekaran and Govindaswamy, 1968), in vegetables (Chidambaram, 1968), in groundnut (Lalitha Kumari *et al.*, 1972) and in gingelly (Vidhyasekharan *et al.*, 1972). The present paper attempts to explain, how the seed-borne fungi reduce the seed germinability and seedling vigour.

MATERIALS AND METHODS

Castor (*Ricinus communis* L.) seeds were used to study the effect of seed-borne fungi on the seed viability. Five frequently isolated seed-borne fungi, *Aspergillus flavus* Link., *Alternaria brassicicola* (Schw.) Wiltshire, *Curvularia*

pallescens Boedijn, *Helminthosporium tetramera* McKinney and *Mucor hiemalis* Wehmer, were employed in the present investigation. Healthy seeds of castor seeds were surface sterilized with 0.1 per cent mercuric chloride, treated with the spore suspensions of the test fungi and stored at 75 per cent humidity. Suitable control was maintained. After 6 months of storage the seed germinability and shoot and root elongation of 15-day old seedlings were assessed by sowing the seeds in sterilized soil.

To study the production of toxins by the different seed-borne fungi, they were grown in Richard's and Czapek-Dox liquid media. After an incubation period of 15 days, the cultures were filtered through fritted glass filters. The effect of the culture filtrates on the castor seed germination and seedling vigour was assessed. Healthy surface sterilized castor seeds were soaked for

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24 hours in 10 ml of the culture filtrate and then spread on a filter paper placed inside a sterile Petridish. Ten ml of the culture filtrate was added to the filter paper. Germination percentage was taken after 5 days of incubation. Seeds soaked in uninoculated medium served as control.

To assess the effect of the cultures on the root and shoot elongation, the seeds were just germinated in water. Ten seeds measuring 5 mm root length or shoot length were placed on a filter paper moistened with 10 ml of the culture filtrate kept inside a Petridish. Filter papers moistened with the inoculated medium were kept as control. After 5 days the root elongation or shoot elongation over the initial 5 mm length was assessed (Vidhyasekaran *et al.*, 1970).

RESULTS AND DISCUSSION

The effect of seed-borne fungi on the castor seed germination and seedling vigour was assessed and the results are presented in Table 1.

All the test fungi reduced the seed germination and the reduction was more pronounced in *A. flavus* and *M. hiemalis*-treated seeds. Root and shoot elongations were also inhibited due to the action of the seed-borne fungi and *A. flavus* reduced the root and shoot elongation to the maximum extent. The effect of the culture filtrate on the seed germination and seedling vigour was assessed and the data are presented in Table 2.

In general, Czapek-Dox medium induced more toxins than Richard's

TABLE 1. Effect of seed-borne fungi on the castor seed germination and seedling vigour

Fungi	Germination percentage	Per cent reduction over control	Root length (cm)	Per cent reduction over control	Shoot length (cm)	Per cent reduction over control
<i>A. flavus</i>	12.0	83.3	4.4	79.0	6.4	76.2
<i>A. brassicicola</i>	38.0	47.2	15.4	26.7	12.5	53.5
<i>C. pallescens</i>	37.0	48.6	10.8	48.6	12.0	55.4
<i>H. tetramera</i>	42.0	41.7	16.5	21.4	14.2	47.2
<i>M. hiemalis</i>	22.0	72.2	8.6	59.0	12.8	52.4
Control	72.0	...	21.0	...	26.9	...

TABLE 2. Effect of toxins on the castor seed germination and seedling vigour

Fungi	Richard's medium						Czapek-Dox medium					
	1	2	3	4	5	6	7	8	9	10	11	12
<i>A. flavus</i>	33.3	66.7	3.6	74.6	4.3	55.0	28.7	71.3	2.8	81.2	2.7	79.4
<i>A. brassicicola</i>	99.3	0.7	8.5	40.6	5.0	48.5	70.0	30.0	4.6	70.7	3.2	75.2
<i>C. pallescens</i>	90.0	10.0	7.0	51.1	5.0	48.5	60.0	40.0	3.4	78.3	2.3	82.4
<i>H. tetramera</i>	60.0	40.0	9.0	37.1	5.5	43.0	50.0	50.0	6.9	56.1	4.0	69.0
<i>M. hiemalis</i>	80.0	20.0	7.2	49.7	3.5	63.6	69.0	31.0	4.3	72.6	1.9	85.0
Uninoculated medium (Control)	100.0	—	14.3	—	9.7	—	100.0	—	15.7	—	12.9	—

1. Germination percentage 2. Per cent reduction over control 3. Root length in cm
 4. Per cent reduction over control 5. Shoot length in cm 6. Per cent reduction over control
 7. Germination percentage 8. Per cent reduction over control 9. Root length in cm
 10. Per cent reduction over control 11. Shoot length in cm
 12. Per cent reduction over control.

medium. The culture filtrates of all the fungi reduced the seed germination and root and shoot elongation. The toxin of *A. flavus* caused the maximum damage on seed germination and root elongation while that of *M. hiemalis* reduced the shoot elongation to the maximum extent.

The reduction in seed germination and seedling vigour due to the attack of seed-borne fungi seems to be a common phenomenon (Vidhyasekaran and Govindaswamy, 1968). The culture filtrates of the seed-borne fungi also inhibited the seed germination and the seedling vigour. The seed-borne fungal culture filtrates have

been reported to reduce the seed germination and seedling vigour of paddy (Vidhyasekaran *et al.*, 1970) and of groundnut (Lalitha Kumari *et al.*, 1970). Toxins have been defined as products of microorganisms which act directly on the living protoplasts to influence either the course of disease development or symptom expression (Ludwig, 1959). Hence the substance in the culture filtrates of the seed-borne fungi may be called as toxins as they influence the disease development.

Czapek-Dox medium seems to be the best medium for toxin production by the seed-borne fungi. Czapek-Dox medium was found to be suitable for

the production of toxins by *Penicillium expansum*, *Verticillium albo-atrum* and *Gloeosporium fructigenum* (Barnum, 1944; Green, 1954; Radha Menon, 1961). However, Richard's medium has been reported to be suitable for the production of toxin by *Fusarium moniliforme* (Vidhyasekaran *et al.*, 1970), *F. vasinfectum* (Kalyanasundaram, 1954) and *Helminthosporium victoriae* (Meehan and Murphy, 1947). Vidhyasekaran *et al.* (1966) suggested that the seed-borne fungi produced hydrolytic enzymes to facilitate the entry of the fungi into the seed through the seed coat. After reaching the endosperm, the seed-borne fungi may produce toxins by utilizing the nutrients in the endosperm. The toxins produced by the seed-borne fungi may kill the embryo resulting in seed germination failures and reduction in seedling vigour.

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