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The Extent to Decrease the Seed Quality Due to Seed-borne *Macrophomina phaseolina* in Blackgram

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Abstract

Macrophomina phaseolina is a causal organism of charcoal rot disease of blackgram being a seed-borne fungus. To know the actual detrimental effect of this fungus on seed quality of blackgram, an experiment was undertaken by comparing inoculated and non-inoculated seeds. Artificially inoculated seeds of two blackgram varieties with *M. phaseolina* showed three folds lower normal seedlings in comparison to non-inoculated seeds. The mean shoot length, root length, and dry weight of seedlings, which implies the seedling vigor, were also found significantly reduced in the both inoculated blackgram varieties. Accelerated aging test (AA-test) showed almost half normal seedlings in inoculated seeds compared to control treatment that indicates that *M. phaseolina* can decline the storability of blackgram seeds greatly. In AA-test, the proportion of dead and rotten seeds in the inoculated treatments appeared to be doubled than that of control treatment. Nevertheless, no significant change was noticed in hard seeds in both varieties.

Introduction

Blackgram (*Vigna mungo*) is one of the major pulse crops containing high protein and carbohydrate. It has also the very high ability to fix atmospheric nitrogen in soil, which enriches the soil quality. However, the successful production of this crop is restricted by various growth-limiting factors. Many plant pathogenic fungi affect adversely on seed germination and seedling vigor (Neergaard, 1979). In Thailand, blackgram encounters high incidence of *Macrophomina phaseolina* and causes charcoal rot disease (Putasamai and Surin, 1988). This fungus causes reduction in seed viability and seedling vigor (Sharada and Shetty, 1987). No any work has been carried out regarding the effect of this fungus *M. phaseolina* on seed quality of blackgram.

Therefore, the present investigation was designed to evaluate the extent of damage caused to seed viability, vigor and storability of blackgram due to invasion by *M. phaseolina*.

Materials and Methods

The two blackgram varieties Phitsanulok 2 and Uthong 2 were grown in Chiang Mai University Experimental Farm and newly harvested seed samples were used in the series of experiments. The *M. phaseolina* fungus was isolated from blackgram infected seed (carrying 24.0% *M. phaseolina*) which was obtained from Chai Nat Field Crops Research Center. The fungus was artificially cultured at the laboratory and the newly harvested seeds were artificially inoculated by the isolated inoculum.

Viability Test: Viability test was employed by Paper Towel Method (ISTA, 1976). Fifty seeds were placed on the two layered moist germinating papers, covered with another moist germinating paper, and then rolled. Each rolls considered as one replication and four replications were maintained. All the rolls were kept in germinating chamber at 30°C temperature and 85% relative humidity. After 6 days, the data were taken on normal seedlings, abnormal seedlings, rotten and dead seeds and hard seeds.

Vigor Test: The vigor of seedlings were estimated by the mean shoot length, root length and dry weight of 7 days old seedlings from inoculated and non-inoculated seeds. The seedlings were raised in a germinator following Paper Towel Method (ISTA, 1976). The average shoot length and root length of seedlings was estimated from 50 seedlings per replication. Dry weight of 7 days old seedlings were taken after drying the seedlings in air-dry oven at 60°C for 3 days. In every case, 4 replications were maintained.

Storability test: It was estimated by Accelerated Aging Test (AA-test). After accelerated aging for 96 hours, the seeds were tested by Paper Towel Method (ISTA, 1976). After 7 days, data were taken on normal seedlings, abnormal seedlings, dead seeds and hard seeds.

Results

Viability: From the results of viability test it was observed that *M. phaseolina* reduced the production of normal seedlings and increased the abnormal seedlings including dead and rotten seeds remarkably (Table 1). Most of the abnormal seedlings contained typical symptom of charcoal rot disease. Infections started from cotyledonary leaves and spread later to the stem and downwards, which ultimately caused the death of the plant. The incidence of hard seed was not affected by *M. phaseolina* in any varieties.

Vigor: Vigor test was done by the mean shoot length, root length, and dry weight of seedlings. The mean shoot and root length was decreased considerably due to *M. phaseolina* infection. Significant decline in dry weight of seedlings was also observed.

Storability: After accelerated aging, the mycelia and microsclerotia of *M. phaseolina* were grown profusely on the inoculated seeds. In the towel test, it was observed that the production of normal seedlings was reduced drastically in the inoculated seeds. On the contrary, the abnormal seedling production was increased greatly in the inoculated seeds in both the blackgram varieties. The dead or rotten seeds were found to be

Table 1: Effect of *Macrophomina phaseolina* on different variables of seed viability in blackgram seeds (mean of four replications).

Variables	Blackgram varieties							
	Uthong 2				Phitsanulok 2			
	Healthy or Control	Inoculated	(%) Change over control \pm LSD ^{0.05}	Significant at p value	Healthy or Control	Inoculated	(%) Change over control \pm LSD ^{0.05}	Significant at p value
Normal seedlings (%)	85.85	37.5	-48.0 \pm 5.81	0.000	91.5	30.0	-61.5 \pm 3.05	0.000
Abnormal seedlings (%)	3.0	42.5	+39.5 \pm 1.59	0.000	2.5	56.0	+53.5 \pm 1.59	0.000
Dead, rotten seed (%)	0.0	8.0	+8.0 \pm 2.59	0.002	0.0	9.0	+9.0 \pm 1.84	0.000
Hard seed (%)	11.5	12.0	+0.5 \pm 4.00	0.727	6.0	5.0	-1.0 \pm 4.11	0.495

Table 2: Effect of *Macrophomina phaseolina* on different variables of vigor estimation in blackgram seeds (mean of four replications).

Variables	Blackgram varieties							
	Uthong 2				Phitsanulok 2			
	Healthy or Control \pm LSD ^{0.05}	Inoculated \pm LSD ^{0.05}	Decrease over control (%)	Significant at p value	Healthy or Control \pm LSD ^{0.05}	Inoculated \pm LSD ^{0.05}	Decrease over control (%)	Significant at p value
Shoot length (cm)	16.36 \pm 0.70	10.01 \pm 0.70	38.81	0.000	16.08 \pm 0.21	10.16 \pm 0.21	36.82	0.000
Root length (cm)	10.43 \pm 0.37	8.4 \pm 0.37	19.46	0.000	10.25 \pm 0.57	8.32 \pm 0.57	18.83	0.001
Dry weight (g/100 seedlings)	4.08 \pm 0.05	3.52 \pm 0.05	13.73	0.000	4.14 \pm 0.022	3.46 \pm 0.022	16.42	0.000

Table 3: Effect of *Macrophomina phaseolina* on different variables of storability in blackgram seeds (mean of four replications).

Variables	Blackgram varieties							
	Uthong 2				Phitsanulok 2			
	Healthy or Control	Inoculated	(%) Change over control \pm LSD ^{0.05}	Significant at p value	Healthy or Control	Inoculated	(%) Change over control \pm LSD ^{0.05}	Significant at p value
Normal seedlings (%)	67.5	37.0	-30.5 \pm 4.77	0.000	67.5	38.5	-29.0 \pm 5.51	0.000
Abnormal seedlings (%)	16.5	50.0	+33.5 \pm 5.43	0.000	22.0	48.0	+26.0 \pm 3.67	0.000
Dead, rotten seed (%)	4.0	9.0	+5.0 \pm 2.25	0.005	5.0	8.0	+3.0 \pm 1.83	0.014
Hard seed (%)	9.5	9.0	+0.5 \pm 3.05	0.638	5.5	4.75	-0.75 \pm 2.37	0.391

significantly higher in *M. phaseolina* infested seeds. No significant difference was noticed regarding hard seeds between inoculated and non-inoculated seeds of either variety.

Discussion

From the result it is evident that *M. phaseolina* can reduce the seed quality of blackgram seeds in terms of viability, vigor and storability. After accelerated aging the production of profuse mycelia and microsclerotia on the inoculated seeds indicates that high temperature and humidity is suitable for this fungus. The germination reduction and seedling rot due to *M. phaseolina* in blackgram was reported earlier by Nayak and Behera (1994). Decline in seedling vigor was observed by 82.8 percent because of *Aspergillus nidulans* in cowpea seeds (Maheshwari et al., 1984).

Conclusion

Blackgram seed quality can be reduced as a result of *M. phaseolina* infection by decreasing viability, vigor and storability. The *M. phaseolina* infested seed might spread disease in the field. Therefore, to keep the proper quality of blackgram seed, appropriate, practical and overall effective control measures like seed treatment should be employed.

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