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Effect of *Alternaria sesami* on Germination and Seedling Growth of Sesame

P. Lakshmi Pravallika[1], S.L. Bhattiprolu[1], K. Radhika[1], M. Raghavendra[1]

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ABSTRACT

Background: Sesame is an important oil seed crop affected by toxigenic fungal pathogens *viz*., *Alternaria*, *Fusarium* and *Aspergillus*. Among these, *Alternaria sesami* is seed borne and most destructive pathogen causing yield loss to an extent of 28.9 per cent. Hence the effect of artificial infection with *A. sesami* on seed quality of various samples of sesame was investigated during 2017-2018.

Methods: A total of 28 samples were collected from different sesame growing areas of Andhra Pradesh and Telangana and inoculated with *A. sesami*. The inoculated and uninoculated seeds were tested for germination and seedling growth by rolled paper towel method.

Result: Significant differences in seed germination, seedling length and seedling vigour index were observed among the uninoculated as well as inoculated sesame seed samples. The results indicated that *Alternaria sesami* caused 15.13% to 49.68%, 12.77% to 46.14% and 28.28% to 72.87% reduction in seed germination, seedling length and vigour index, respectively, of inoculated seed over uninoculated seeds. The per cent reduction was highest in the seed samples of YLM-17 collected from farmers' saved seed samples of Prakasam district.

Key words: *Alternaria sesami*, Germination, Seedling length, Sesame, Vigour index.

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an ancient oil yielding crop in the world and known as "Queen of Oilseeds" due to high cooking quality and medicinal value (Tiwari *et al*., 2011). Presence of potent antioxidants (sesamolin and sesamol) makes sesame oil to be one of the most stable oils in the world. It is cultivated mainly for its high quality edible oil as the seed contains more than 50% oil with a balanced composition of oleic and linoleic acid and it is also used as a flavoring agent. Besides food, sesame is used as an active ingredient in antiseptics, bactericides, viricides, disinfectants, moth repellants and antitubercular agents (Bedigian *et al*., 1985).

Seed borne microflora are carried over by infected seed and cause seed deterioration, reduce germination, vigour and weaken the initial seedling growth resulting in the reduction of plant population in the field. Sesame plants are highly susceptible to fungal infections, including toxin-producing fungi. Among the several toxigenic fungi, the predominant fungi are *Alternaria*, *Fusarium* and *Aspergillus*. Post-harvest conditions favour infection during storage which may lead to production of different mycotoxins. These toxigenic fungal pathogens are important constraints to the production of the crop, affecting the seed quality parameters like germination, seedling vigour and also biochemical properties during storage. So, there is a need to study the effect of seed-borne fungal pathogens on seed quality parameters of sesame.

MATERIALS AND METHODS

The present investigation was carried out in the Laboratory of Plant Pathology, Regional Agricultural Research Station, Lam and the Department of Seed Science and Technology, Advanced Post Graduate Centre, Lam, Guntur, Andhra Pradesh during 2017-2018. A total of 28 samples were collected from different sesame growing areas *viz.,* five samples from Agricultural Research Station (ARS), Yellamanchili; four samples from Regional Agricultural Research Station (RARS), Lam, Guntur; 16 farmers' saved samples from villages of Darsi and Marturu mandals of Prakasam district of Andhra Pradesh and three samples from RARS, Jagtial, Telangana.

Preparation of culture filtrate

A small disc of 5 mm diameter was cut from the margin of actively growing 3-day old fungal colony with the help of a sterile cork borer and the fungal disc was transferred aseptically into a 100 ml flask containing 20 ml of sterile broth. The flasks were incubated at 28±1°C for 15 days. At the end of incubation, when the growth was full, the fungal

[1]Regional Agricultural Research Station, Acharya N.G. Ranga Agricultural University, Lam, Guntur-522 034, Andhra Pradesh, India.

Corresponding Author: P. Lakshmi Pravallika, Regional Agricultural Research Station, Acharya N.G. Ranga Agricultural University, Lam, Guntur-522 034, Andhra Pradesh, India.
Email: lakshmipravallika019@gmail.com

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mats were filtered repeatedly through a double layer of Whatman No. 41 filter papers. From the filtrate obtained, the conidia were adjusted to required concentration (10^6 conidia/ml) by using a haemocytometer and the density of original suspension in number of cells/ml was calculated by multiplying with dilution factor as given by Karuna Vishunavat and Kolte (2005).

Number of conidia in the diluted suspension/ml =

Number of conidia counted × 2,50,000 × dilution factor

Seed inoculation

Apparently healthy seed of sesame cultivars were surface sterilized. The sterilized seeds were soaked in conidial suspension of *A. sesami* for 30 min and dried at room temperature overnight. The seeds of control treatments were similarly treated except that they were soaked in sterile distilled water.

Evaluation of seed quality

The inoculated seeds and control (uninoculated) seeds were kept for germination between moistened paper towels using rolled paper method. Four replications of 100 seed from each seed sample were placed on the germination paper at uniform spacing. The paper towels were rolled, lined with blotter paper and placed in plastic tray in an upright position at ambient conditions for six days.

Observations recorded

Observations on various seed quality parameters *viz.,* germination (%) and seedling length (cm) were recorded as detailed below

Germination (%)

On the day of final count (6th day), all the normal seedlings were counted. Based on the number of normal seedlings, the germination percentage from each sample in each replication was computed using the formula:

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seed sown}} \times 100$$

Seedling length (cm)

Ten normal seedlings, at random, were taken from each replication of samples on the 6th day and the seedling length was measured from the tip of the primary leaf to the tip of the primary root with the help of the scale and mean seedling length was expressed in centimetres.

Seedling vigour index

Seedling vigour index was computed using the following formula given by Abdul Baki and Anderson (1973).

Seedling vigour index =

Germination (%) × Mean seedling length (cm)

Statistical analysis

The data recorded as percentage was subjected to angular (arc sin) transformation before statistical analysis. The standard method of analysis of variance technique appropriate to the completely randomized design (CRD) as described by Panse and Sukhatma (1985) was used. The data were analyzed by employing 'paired t test' at five per cent level of significance on the basis of null hypothesis using SPSS software. The appropriate standard error of mean (S. Em. ±) were calculated in each case and the Standard Deviation (S.D.) at five per cent level of probability were worked out to compare the two treatment means, where the treatment effects were found significant under 'paired t' test.

RESULTS AND DISCUSSION

The inhibitory effect of major seed-borne fungus, *Alternaria sesami* was observed on seed germination, seedling length and seedling vigour index of sesame seed samples collected from different locations (Table 1).

Germination (%)

Significant variation in germination was observed between the inoculated and uninoculated sesame seed samples collected from different areas of Andhra Pradesh and Telangana (Table 1). The uninoculated seed samples exhibited 92.00% to 98.25% germination, while the inoculated seed samples showed germination ranging from 49.06% to 83.38% irrespective of locations and sources. The germination was inhibited by *Alternaria sesami* in all the seed samples.

Maximum reduction (49.68%) in germination of inoculated seed over uninoculated sample was observed in the farmers' saved seed sample no. 14 followed by farmers' sample no. 15 (47.12%) of YLM-17, whereas the least reduction (15.13%) was observed in foundation seed sample of YLM-66 collected from ARS, Yellamanchili (Fig 1). Sesame seed samples collected from different locations showed that maximum per cent reduction in germination of inoculated seed over uninoculated seed was observed with samples collected from farmers' of Darsi and Maruturu mandals of Prakasam district with the range of 30.31% to 49.68% followed by seed samples from RARS, Lam, Guntur (15.90% to 23.81%). The samples collected from ARS, Yellamanchili showed the least per cent reduction of germination ranging from 15.13% to 21.40%, while samples from RARS, Jagitial recorded 17.51% to 21.53% reduction in germination.

Seedling length (cm)

Seedling length was found to vary significantly between the inoculated and uninoculated sesame seed samples collected from different locations of Andhra Pradesh and Telangana (Table 1). The seedling length varied from 9.12 cm to 14.96 cm in uninoculated and 5.30 cm to 11.70 cm in inoculated seed samples across different locations and sources of sample collection.

The seedling length decreased after artificial inoculation in all the seed samples. Among the 28 samples, maximum reduction in seedling length (46.14%) was observed in the farmers' sample no. 14 of YLM-17, whereas the least reduction (12.77%) was observed in foundation seed sample of Swetha

Table 1: Effect of major seed borne fungus, *Alternaria sesami* on germination, seedling length and seedling vigour of sesame.

Place	Sample	Sample no.	Seed germination (%)		Seedling length (cm)		Seedling vigour index		Remarks
			Uninoculated	Inoculated	Uninoculated	Inoculated	Uninoculated	Inoculated	
ARS,	YLM-11	1	96.00	75.69	13.68	11.48	1313	869	Foundation
Yellamanchili	YLM-17	2	97.25	78.31	14.58	11.70	1418	916	seed
	YLM-66	3	98.25	83.38	13.89	11.56	1365	964	
	Gouri	4	93.75	73.69	13.46	11.54	1262	851	
	Madhavi	5	97.25	78.50	14.96	11.43	1456	897	
RARS,	YLM-11	6	96.75	80.19	10.68	7.82	1033	627	Seed harvested
Lam,	YLM-17	7	92.75	78.00	11.69	9.55	1084	745	from experimental
Guntur	YLM-66	8	96.25	74.94	10.78	8.35	1037	626	plot
	Gouri	9	94.25	71.81	10.51	7.40	990	532	
Maruturu,		10	93.50	60.19	10.73	6.51	1003	392	
Prakasam		11	93.00	49.44	9.59	6.45	891	319	
district	YLM-17	12	93.25	61.75	11.78	7.07	1098	437	
		13	96.25	58.25	10.39	6.87	1000	400	
		14	97.50	49.06	9.84	5.30	959	260	
		15	95.50	50.50	10.73	6.41	1024	323	
		16	94.00	58.19	10.79	6.36	1014	370	Farmers'
		17	96.50	52.88	10.92	7.10	1054	375	saved seed
		18	96.00	60.94	10.40	5.74	998	350	
Darsi,		19	92.00	59.63	9.12	6.97	839	415	
Prakasam	Local	20	92.00	59.50	10.41	7.19	958	428	
district	variety	21	95.25	66.38	9.97	7.80	950	517	
		22	94.75	52.38	10.64	7.67	1009	402	
		23	94.50	53.69	10.26	6.85	969	368	
		24	95.50	58.00	9.63	5.77	919	335	
		25	93.00	58.31	10.86	7.17	1010	418	
RARS,	Hima	26	95.50	74.94	12.66	10.35	1209	776	Foundation seed
Jagitial	Swetha	27	94.50	77.75	11.98	10.45	1133	813	
	Rajeswari	28	96.00	79.19	12.14	10.39	1165	823	Breeder seed
Mean			95.04	65.55	10.50	7.56	9.98	5.04	
SEm ±			0.32	2.10	0.25	0.23	25.24	29.24	
SD			1.71	11.09	1.31	1.20	133.58	154.36	
t–caluculated value	Uninoculated-inoculated		14.61		19.90		32.90		
P-value 0.000 at 5% LOS – Significant									

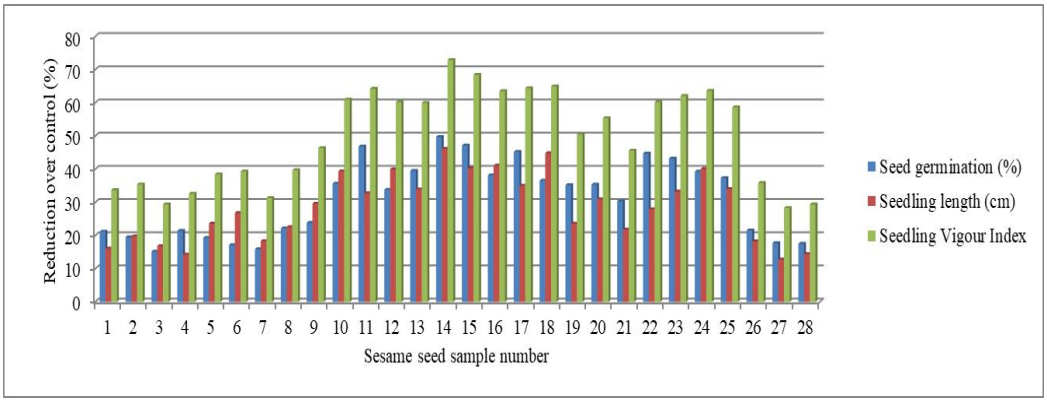

Fig 1: Effect of *Alternaria sesami* on germination, seedling length and vigour index in sesame.

(sample no. 27) collected from RARS, Jagitial (Fig 1). Maximum per cent reduction was observed with samples collected from farmers' of Darsi and Maruturu mandals of Prakasam district with a range of 21.77% to 46.14% followed by seed samples from RARS, Lam, Guntur (18.31% to 29.59%). The samples collected from RARS, Jagitial and ARS, Yellamanchili exhibited reduction in seedling length to the tune of 12.77% to 19.75%.

Seedling vigour index

Inoculated and uninoculated sesame seed samples collected from different areas of Andhra Pradesh and Telangana showed significant variation in seedling vigour index. The range of seedling vigour index of uninoculated and inoculated seed samples of sesame was 839 to 1456 and 323 to 964, respectively (Table 1).

Reduction in seedling vigour index, after inoculation with *Alternaria sesami*, was observed in all the seed samples of sesame. Maximum reduction in seedling vigour index of inoculated sample over uninoculated sample (72.87%) was observed in the farmers' sample no. 14 followed by farmers' sample no. 15 (68.42%) of YLM-17, whereas the least reduction (28.28%) was observed in foundation seed sample of Swetha (sample no. 27) collected from RARS, Jagitial (Fig.1). In sesame seed samples, maximum per cent reduction was observed with samples collected from farmers' of Darsi and Maruturu mandals of Prakasam district with the range of 45.57% to 72.87% followed by seed samples from RARS, Lam, Guntur (31.30% to 46.33%). The samples collected from RARS, Jagitial showed the least per cent reduction of seedling vigour index ranging from 28.28% to 35.83%, while samples from ARS, Yellamanchili recorded 29.38% to 38.41% reduction in seedling vigour index of uninoculated sample over inoculated sample.

Decreased germination, seedling length and seedling vigour index were observed in seed samples of Prakasam district with an increased total number of fungal colonies. Sesame seed samples with the highest fungal flora also recorded less germination, seedling length and seedling vigour. The reduction in germination may be due to the usage of energy rich compounds by these fungi that are otherwise required for proper germination (Irshad *et al.,* 2017). This effect may be due to seed-borne fungi like *Alternaria*, which is known to produce some toxins that are detrimental to seed germination (Ramegowda and Naik, 2008). *Alternaria* species produce non-host specific toxins [*e.g.*, tenuazonic acid (TeA), alternariol (AOH), alternariol monomethyl ether (AME), brefeldin A, tentoxin and zinniol] (Saha *et al*., 2012) as well as host-specific toxins (Thomma, 2003) which contaminate the seed. Rao and Vijayalakshmi (2000) reported tenuazonic acid (TA) toxin production by *Alternaria sesami* in sesame resulting in reduced germination and seedling vigour.

Similar variation in reduction of germination (%), seedling length (cm) and seedling vigour index of uninoculated seed over inoculated seed was earlier reported by Bavaji *et al.* (2000); Naik *et al*. (2017) and Nayyar *et al*. (2017) in sesame. Ahammed *et al*. (2006) in soybean, Anand *et al*. (2008) in groundnut, Kumar (2010) in finger millet, Bhajbhuje (2015) in wheat and Chaudhari *et al*. (2017) in redgram reported that seed borne fungi reduced the germination, seedling vigour and other seed quality parameters.

Hence, from the results it is concluded that seed borne fungus, *Alternaria sesami* inhibits the seed germination, seedling length and vigour of sesame seedlings to a great extent. Hence, farmers' are advised to take preventive measures including selection of sesame seed from healthy fields followed by treating the seeds with recommended fungicides to achieve good germination, initial vigour and optimum plant population in the field for realizing higher yields.

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