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EFFECT OF *Alternaria* BLIGHT (*Alternaria helianthi*; *Alternaria alternata*) ON YIELD OF SUNFLOWER (*Helianthus annuus* L .) IN INDIA

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SUMMARY

Epidemics of *Alternaria* blight (*Alternaria helianthi* (Hansf.) Tubaki and Nishihara; *A. alternata* (Fr.) Keissler) simulated at different plant growth stages showed yield losses as high as 57 and 48 percent in "Morden" and "APSH11" varieties of sunflower respectively. Other yield attributes like test weight of seed and number of seeds per head were also significantly reduced. Regression equations developed on percent disease severity and yield losses gave a coefficient of determination between 0.88 and 0.96.

Key words: Sunflower, blight, *Alternaria helianthi*, *Alternaria alternata*, yield.

INTRODUCTION

Sunflower is an important oil seed crops grown all over the world. In India the area under sunflower cultivation increased from meager 500 ha in 1972-73 to 2.7 million ha in 1993-94 (Virupakshappa *et al.*, 1995).

Alternaria blight, one of the major limiting factors for the production of sunflower resulted in losses upto 80 per cent (Agrawat *et al.*, 1979; Balasubrahmanyam and Kolte, 1980). This paper reports the effect of *Alternaria* blight on yield and yield attributes of sunflower.

MATERIALS AND METHODS

Field experiments were conducted to study the yield losses of sunflower due to blight disease during the rainy seasons of 1991 and 1992 at College of Agriculture, Hyderabad, A.P., India. Experiment was conducted with two genotypes viz., an open pollinated variety (Morden) and a hybrid (APSH11) in a randomized block design replicated four times. The plot size was 4.2 x 3.0 m, with a spacing of 45 cm between rows for Morden, 60 cm for APSH11 and 30 cm between plants for both (Virupakshappa *et al.*, 1995). Inoculation with blight-causing pathogens (*Alternaria alternata; A. helianthi*) was done at four growth stages (Table 1) of the crop with a concentration of 1x105 conidia / ml for *A. alternata* and 1x104 conidia / ml for *A. helianthi* (Agrawat *et al.*, 1979). The control plots were maintained by giving three sprays with mancozeb 75 WP@ 3.0 g per litre of water at 25, 45 and 60 days after sowing of the crop.

Table 1: Plant growth stages of sunflower at inoculations time

Growth stage		Days after sowing	
		Morden	APSH 11
Vegetative stage	1 (VS1)	8-10	10-12
	2 (VS2)	25-38	29-30
Reproductive stage	1 (RS1)	35-40	40-45
	2 (RS2)	55-58	55-60

Disease severity was recorded in plots on ten plants at random at 10-day interval using the rating scale proposed by Allen *et al.* (1983). Yield and other yield attributes were recorded at the time of harvesting and analysed statistically. Regression equations were developed between disease progression and yield to predict models for yield losses due to *Alternaria* blight in sunflower. The rate of spread of the disease was calculated by following the formulae developed by Van der Plank (1963).

$$r = 2.3/t. \log x / x_o$$

where:

r = rate of spread

t = time interval between two observations

x = final amount of disease

x_o = initial amount of disease

RESULTS AND DISCUSSION

Effect of *Alternaria* blight on yield

All treatments differed significantly from protected control plots in both seasons. There were no significant differences between the varieties tested. During both seasons, VS2 stage of inoculation had more effect on yield leading to high yield losses, i.e., 62 percent in Morden, 46 percent in APSH 11 during rainy season 1991 and 52 percent in Morden and 50 percent in APSH 11 during rainy season 1992 compared with protected control (Table 2).

Table 2: Effect of *Alternaria* blight epidemics initiated at different plant growth stages on yield and yield parameters of sunflower

Variety	Growth stage of inoculation	Rainy season 1991					Rainy season 1992				
		Yield (kg/ha)	Yield loss (%)	Test seed weight (g)	Average number of seeds per head	Head diameter (cm)	Yield (kg/ha)	Yield loss (%)	Test seed weight (g)	Average number of seeds per head	Head diameter (cm)
Morden	vs1	508.19	55	3.95	304.36	8.29	553.27	49	3.85	330.26	8.16
	VS2	434.43	62	3.67	255.14	7.12	524.59	52	3.23	271.75	7.49
	RSI	922.13	19	4.56	372.77	9.03	903.68	17	4.59	366.50	8.98
	RS2	1004.09	12	4.96	459.58	9.77	1026.64	6	4.89	476.06	10.32
	Control	1141.39	0	5.06	544.86	12.79	1086.07	0	5.32	529.10	12.81
APSH 11	vs1	815.57	38	4.24	331.75	8.43	737.70	46	4.09	302.91	8.52
	VS2	715.57	46	3.85	237.70	7.83	688.52	50	3.68	224.24	7.94
	RSI	893.44	32	4.85	406.64	10.49	926.23	32	4.56	368.64	10.68
	RS2	1151.64	13	5.16	487.31	11.46	1141.39	17	4.57	441.67	10.00
	Control	1317.62	0	5.18	524.32	12.51	1368.85	0	5.26	567.73	13.08
		SEm ± CD (P=0.05)		SEm ± CD (P=0.05)	SEm ± CD (P=0.05)	SEm ± CD (P=0.05)	SEm ± CD (P=0.05)		SEm ± CD (P=0.05)	SEm ± CD (P=0.05)	SEm ± CD (P=0.05)
Varieties		14.6 42.5		0.1 0.2	9.7 28.2	0.2 0.6	11.8 51.9		0.1 0.3	10.3 31.8	0.2 0.7
Treatments		23.1 67.2		0.1 0.4	15.4 44.6	0.3 0.9	28.3 82.1		0.1 0.4	17.3 50.2	0.4 1.1
Varieties x Treatments		32.8 94.9		0.2 0.6	21.7 63.0	0.5 1.4	40.0 116.1		0.2 0.6	24.5 71.1	0.5 1.5

SEm: Standard Error Mean; CD: Critical Difference

However, during rainy season 1992, VS1 and VS2 stages of inoculation were at par and they were not significantly different (Table 2). Gemawat *et al.* (1989) also reported great reduction in seed yield (95.8%) and oil yield (96.3%).

Effect of *Alternaria* blight on yield attributes

Test weight of the seed: The two varieties differed significantly in the test weight of the seed. APSH 11 had significantly higher test seed weight than Morden. All the treatments caused significantly less test seed weight in both the varieties during both seasons than it was with the controls. During both seasons, VS2 stage of inoculation resulted is less test seed weight than the other treatments (Table 2).

Head diameter: The two varieties differed significantly in head diameter during rainy season 1991 but were on par during rainy season 1992. During both seasons, VS2 stage of inoculation had smaller head diameter than the other treatments. However, it was on par with VS1 which indicates that *Alternaria* blight severity had no effect on head diameter.

Number of seeds per head: No significant difference was observed between the two varieties in both seasons tested. VS2 stage of inoculation had a significantly lower number of seeds per head than the other treatments. However, compared with protected control all the treatments had significantly fewer seeds per head.

Relationship between *Alternaria* blight severity and yield

Correlations obtained between disease progress rates at different stages of inoculation indicated a significant negative correlation between disease progress rates and yield (Table 3). The correlation coefficients between *Alternaria* blight and yield were higher which indicate that the regression equations developed were better fit for predicting yield losses. However the success of prediction of sunflower yield losses due to *Alternaria* blight depended upon the plant growth stages at which the disease severity was assessed, host genotype and year which the epidemics were studied.

Table 3: Relations between *Alternaria* blight disease progress rates and yield

	APSH 11				Morden			
	Rainy season 1991		Rainy season 1992		Rainy season 1991		Rainy season 1992	
	Rate of plot	spread yield (kg/ha)	Rate of plot	spread yield (kg/ha)	Rate of plot	spread yield (kg/ha)	Rate of plot	spread yield (kg/ha)
VS_1	0.689	508	0.810	553	0.612	815	0.722	738
VS_2	1.001	432	1.150	524	1.053	715	1.183	689
RS_1	0.460	922	0.578	904	0.647	893	0.544	926
RS_2	0.246	1004	0.467	1027	0.420	1152	0.379	1141
Control	0.149	1141	0.256	1086	0.103	1318	0.254	1369
Intercept	1245.143		1290.259		1361.789		1401.997	
Slope	-865.160		-722.897		-675.819		-696.824	
Correlation	-0.9629		-0.9371		-0.93938		-0.8876	

Selected regression equations to predict yield losses in sunflower due to *Alternaria* blight based on disease severity are as follows:

Rainy season 1991 :

For "Morden"	$y = 1245.1 - 865.2x$	$r^2 = 0.96$
For "APSH11"	$y = 1361.8 - 675.8x$	$r^2 = 0.94$

Rainy season 1992 :

For "Morden"	$y = 1290.3 - 722.8x$	$r^2 = 0.94$
For "APSH11"	$y = 1401.9 - 896.8x$	$r^2 = 0.89$

The study also showed that late vegetative stage to flower bud stage was the most susceptible period and if the disease occurs at this stage the resulting yield losses will be greatest. Many research workers also reported heavy losses in yield, up to 80 percent, due to *Alternaria* blight epidemics (Reddy and Gupta, 1977; Agrawat *et al.*, 1979; Balasubrahmanyam and Kolte, 1980). Allen *et al.* (1981) reported that control of epidemic at anthesis stage increased seed yield by 26 percent and oil yield by 27 percent. Hence, sunflower sowing should be taken up in such a way that late vegetative stage to flower bud stage of the crop should not coincide with unfavorable weather conditions. Moreover, this is the critical stage in which one should follow integrated disease management strategies to keep disease pressure at lower levels. It is also clear that the late vegetative to flower bud stage is the appropriate stage for inoculation during screening the available germplasm accessions of sunflower.

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EFECTO DE LA MANCHA DE ALTERNARIA (*Alternaria alternata, Alternaria helianthi*) EN EL RENDIMIENTO DE GIRASOL (*Helianthus annuus* L.)

RESUMEN

La epidemia de mancha de alternaria (*Alternaria alternata*, (Fr) Keissler; *Alternaria helianthi* (Hansf) Tubaki y Nishihara) simuladas en diferentes estados de crecimiento mostró perdidas de rendimiento tan altas como 57 y 48% en las propiedades de girasol Morden y APSH11. Otros componentes del rendimiento como peso de 100 semillas, número de semillas por capítulo fueron tambien reducidos significativamente. Las ecuaciones de regresión desarrolladas en porcentaje de severidad y perdidas de rendimiento dieron un coeficiente de determinación entre 0.88 y 0.96.

L'EFFET DE L'ALTERNARIA (*Alternaria alternata; Alternaria helianthi*) SUR LE RENDEMENT DU TOURNESOL (*Helianthus annuus* L.)

RÉSUMÉ

Des infections d'alternaria (*Alternaria alternata* (Fr) Kiessler; *Alternaria helianthi* (Hansf.) Tubaki et Nishihara) observées à différents stades végétatifs conduisent à des pertes de rendement de 57 et 48%, respectivement dans les variétés de tournesol Morden et APSH11. Les autres composantes du rendement comme le poids de 1000 grains, le nombre de grains par capitule sont aussi significativement réduites. Les équations de régression établies entre le pourcentage d'attaque et les pertes de rendement ont un coefficient de détermination compris entre 0.88 et 0.96.