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Original Research Article

Influence of Weather on Severity of Late Leaf Spot on Selected Groundnut Genotypes

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A B S T R A C T

A field experiment was conducted at Agricultural college farm, Bapatla during late *kharif* 2016-17 on sandy soils to study the progress of late leaf spot disease with respect to weather factors on selected groundnut genotypes. Fourteen genotypes (including check) were sown. The results indicated that late leaf spot PDI of K-6 showed significant positive correlation with sunshine hour (r = 0.592*) and negative correlation with minimum temperature (r = -0.819*), rainfall (r = -0.568*) and all other tested genotypes showed significant negative correlation with mean minimum temperature. RSB-87, Kisan, Vemana, GG-2, K-9, AVT-1638, Abhaya, Anantha, JCG-88, AVT-1666, ALR-1 and ALR-3 were moderately resistant and other two genotypes (K-6 and Narayani) were susceptible to late leaf spot. The genotype AVT-1666 showing moderate resistance reaction against late leaf spot recorded lowest AUDPC value (1480.67), K-6 which was categorized as susceptible genotype has recorded the highest AUDPC value (2812.95).

Keywords

Groundnut, Late leaf spot, Weather parameter, Resistance

Introduction

Groundnut [*Arachis hypogaea*. L.], also known as Peanut, is an important leguminous oilseed crop belongs to the family Fabaceae (Mali and Bodhankar, 2009). It is very important cash crop for small scale farmers. Groundnut kernel has high protein (25-28 %) and oil content (43-55%) (Naeem *et al.*, 2009). The low productivity of the crop is ascribed mainly due to foliar disease late leaf spot caused by *Phaeoisariopsis personata* (Berk and Curtis) Deighton (teleomorph *Mycosphaerella berkeleyi* Jenk.) is the major destructive disease of groundnut worldwide (Jackson and Bell, 1969; Backman and Crawford, 1984; Smith *et al*., 1992).

Problems related to late leaf spot disease cause nearly complete defoliation and yield losses up to 50 % or more. The late leaf spot disease epidemics are affected by weather patterns such as hot and wet conditions (Shew *et al*., 1988). It reduces the photosynthetic area and cause abscission of leaflets (Subramanyam and Ravindranath, 1988). This experiment was conducted to study the progress of late leaf spot disease with respect to weather factors on selected groundnut genotypes.

Materials and Methods

A trial was conducted to determine the influence of weather conditions on the

severity of late leaf spot on selected groundnut genotypes. The experiment was laid out in randomised block design (RBD) with two replications to evaluate 13 entries during late *kharif* 2016-17. Each genotype was sown in three rows of three metre length with a susceptible check variety of K-6 (standard check) sown as infector row. Recommended dose of nitrogen, phosphorus and potassium at 30: 40: 50 kg ha^{-1} was applied in the form of urea, single super phosphate and muriate of potash, respectively. The entire quantity of phosphorus was applied as basal dose. Nitrogen and potassium were applied at the time of sowing and at flowering stage in equal splits. 500 kg ha^{-1} gypsum was applied at flowering stage.

Collection of experimental data

Meteorological data of mean maximum temperature, minimum temperature, relative humidity at morning and evening hours, wind velocity, rainfall and sunshine hours was collected from the Meteorological Station located at Agricultural College Farm, Bapatla. Per cent Disease Index (PDI) was calculated, correlation and regression analyses were conducted following the standard procedures (Gomez and Gomez, 1984) to determine the influence of weather conditions on the severity of late leaf spot on groundnut genotypes. The reaction of the entries to late leaf spot was assessed by recording the severities at weekly interval from 15 DAS up to seven days before harvesting, using disease rating scale developed by Subrahmanyam *et al*., (1995). For categorization of genotypes, data on severity at 14 days before harvesting was used.

The Per cent Disease Index was computed from the above scale by using the following formula (Wheeler, 1969).

$$PDI = \frac{\text{Sum of all the numerical ratings}}{\text{Number of observations} \times \text{maximum disease grade}} \times 100$$

Area Under Disease Progress Curve (AUPDC) values for representative genotypes per each category was calculated (Wilcoxson *et al.*, 1975).

$$\mathbf{AUDPC} = \sum_{i=1}^{k} \frac{1}{2}(S_i + S_{i-1}) \times d$$

Where,

Si = Disease incidence at i^{th} day of evaluation

k =Number of successive evaluations of the disease

d = Interval between i and i-1evaluation of disease

Results and Discussion

Late leaf spot disease on groundnut first appeared on 6^{th} October when the corresponding mean maximum temperature and minimum temperature, R.H. (8.30 A.M.), R.H. (5.30 P.M.), rainfall, sunshine hours and wind speed were 33.37 ^{0}C, 25.04 ^{0}C, 86.14 %, 73 %, 19 mm, 2.85 hours and 1.72 kmph, respectively. The disease severity increased gradually and reached in the range of 42 % (AVT-1666) to 77.21 % (K-6) on 8^{th} December when the mean maximum temperature was 31.72 ^{0}C, minimum temperature was 20.8 ^{0}C, R.H. was 85.14 % at morning hours, R.H. was 65.57 % at evening hours, with 4.7 mm rainfall, 4.5 sunshine hours and 1.98 kmph wind speed (Table 2 and 3).

The favourable temperature for germination of *C. personatum* conidia was 16-30 ^{0}C and sharply inhibited at higher temperatures (Sommartya and Beute, 1986) which are in accordance with this present investigation.

Shew *et al*., (1988) observed that the infection of peanut by *C. personatum* was favoured by 20 or 24 ^{0}C temperature and high relative humidity (> 93 %) for at least 12 h/day. Alderman and Nutter (1994) noticed that the cumulative conidia per leaflet increased with increasing hours of daily periods of RH> 95 %, when high relative humidity periods exceeded 12 h per day and at temperature 20 ^{0}C the greatest number of conidia was produced.

The genotype K-6 showed significant positive correlation with sunshine hours and significant negative correlation with minimum temperature and rainfall. This study was in accordance with the reports of Mahapatra (2016) that bright sunshine hours (0.399) positively significantly influenced the leaf spot disease progression. The results revealed that late leaf spot severity in all the genotypes showed significant negative correlation with mean minimum temperature, similar report was made by Kanade *et al*., 2015 who reported a significant negative correlation between late leaf spot severity and minimum temperature (-0.55) during *kharif* season (Table 4).

Regression analysis was performed by late leaf spot severity as dependent variable and mean maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, rainfall, sunshine hours and wind speed as independent variables for best fit for multiple regression models by the coefficients of determination (R^2).

Stepwise multiple regression analysis was performed using the following equation:

$y = bo + b1x1 + b2x2 + b3x3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots + bnxn$

where y = per cent disease index, *bo* = intercept, *b1*, *b2*…….*bn* = regression coefficient, and x1, x2, ……..xn = independent variables. Multiple regression analysis yielded seven distinct equations with R^2 value. However, the best fit equation was obtained with maximum temperature and minimum temperature as independent variables for all the genotypes (Table 5).

Table.1 Reaction of groundnut genotypes to late leaf spot severity

S.No	Genotype	Disease Score	Reaction
1	RSB-87	5.35	MR
2	Kisan	5.32	MR
3	Vemana	5.11	MR
4	JCG-88	3.88	MR
5	GG-2	5.27	MR
6	AVT-1666	3.67	MR
7	ALR-3	5.74	MR
8	K-9	4.74	MR
9	AVT-1638	4.67	MR
10	Abhaya	5.36	MR
11	Narayani	6.25	S
12	ALR -1	5.44	MR
13	Anantha	5.45	MR
14	K-6 (check)	6.89	S

Table.2 Weather data during crop growth period in late *kharif* 2016-17 from Meteorological Observatory, Agricultural College, Bapatla

S. No.	Dates	Standard Dates of 2016	Maximum temperature (^{0}C)	Minimum temperature (^{0}C)	Morning relative humidity (%)	Evening relative humidity (%)	Rainfall (mm)	Sunshine (hrs)	Wind speed (Kmph)
1	15-Sep	09-15 Sep	32.00	24.24	84.85	81.42	134.80	1.00	0.00
2	22-Sep	16-22 Sep	31.91	25.02	83.71	75.71	132.20	2.71	1.48
3	29-Sep	23-29 Sep	31.75	25.48	82.57	78.42	19.20	1.14	1.73
4	6-Oct	30 Sep-06 Oct	33.37	25.04	86.14	73.00	19.00	2.85	1.72
5	13-Oct	07-13 Oct	33.57	24.77	83.00	71.00	6.60	5.92	1.94
6	20-Oct	14-20 Oct	34.47	21.74	71.00	50.00	0.00	6.85	1.71
7	27-Oct	21-27 Oct	34.45	20.32	69.71	53.57	0.00	7.35	1.85
8	3-Nov	28 Oct-03 Nov	32.97	23.67	82.85	69.85	0.50	6.85	1.88
9	10-Nov	04-10 Nov	33.72	21.21	73.14	52.85	0.00	7.21	1.92
10	17-Nov	11-17 Nov	32.02	22.24	83.14	69.42	0.00	4.28	1.62
11	24-Nov	18-24 Nov	31.25	19.47	86.57	63.85	0.00	6.92	1.65
12	01-Dec	25 Nov-01 Dec	32.72	18.02	84.71	57.71	0.00	7.14	1.78
13	08-Dec	02-08 Dec	31.72	20.80	85.14	65.57	4.70	4.50	1.98

Table.3 Late leaf spot PDI in groundnut genotypes at standard week during late *kharif* 2016-17

S. No	Genotype	15th sep	22ndst sep	29th sep	6th oct	13th oct	20th oct	27th oct	3rd nov	10th nov	17th nov	24th nov	1st dec	8th dec
1	RSB-87	11.11	11.11	11.11	11.11	11.11	15.10	20.65	39.97	49.57	57.37	59.00	59.25	61.00
2	Kisan	11.11	11.11	11.11	11.11	11.11	19.20	21.95	39.58	47.70	54.40	58.80	59.20	63.43
3	Vemana	11.11	11.11	11.11	11.11	11.11	18.45	20.70	33.28	43.28	53.66	55.15	56.84	58.96
4	JCG-88	11.11	11.11	11.11	11.11	11.11	14.35	15.50	18.47	20.35	35.82	41.05	43.21	45.00
5	GG-2	11.11	11.11	11.11	11.11	11.11	16.95	18.08	24.38	52.55	54.02	56.25	58.64	59.23
6	AVT- 1666	11.11	11.11	11.11	11.11	11.11	11.80	14.76	16.98	19.21	38.85	39.55	40.85	42.00
7	ALR-3	11.11	11.11	11.11	11.11	11.11	19.95	23.60	50.68	58.48	61.45	64.68	67.25	68.74
8	K-9	11.11	11.11	11.11	11.11	11.11	17.30	18.10	33.66	46.23	52.15	53.66	54.28	56.76
9	AVT-1638	11.11	11.11	11.11	11.11	11.11	18.10	18.46	20.70	27.68	51.07	51.06	52.13	53.07
10	Abhaya	11.11	11.11	11.11	11.11	11.11	19.50	20.30	44.02	57.77	58.47	58.84	59.65	61.23
11	Narayani	11.11	11.11	11.11	11.11	11.11	21.00	23.60	50.25	58.10	58.85	63.6	69.45	72.15
12	ALR-1	11.11	11.11	11.11	11.11	11.11	18.45	20.30	34.75	42.93	50.32	55.10	60.52	67.63
13	Anantha	11.11	11.11	11.11	11.11	11.11	19.55	19.90	46.58	50.67	52.93	59.21	60.54	63.25
14	K-6 (Check)	11.11	11.11	11.11	14.40	22.90	28.80	31.78	49.97	51.05	62.93	74.00	76.58	77.21

Table.4 Correlation of late leaf spot severity with weather variables on groundnut genotypes during late *kharif* 2016-17

S. No.	Correlation co-efficients (r)							
	Genotypes	Maximum Temperature (^{0}C)	Minimum Temperature (^{0}C)	Morning Relative Humidity (%)	Evening Relative Humidity (%)	Rainfall (mm)	Sunshine (hrs)	Wind speed (Kmph)
1	RSB-87	-0.330	-0.754*	0.179	-0.381	-0.491	0.490	0.326
2	Kisan	-0.311	-0.779*	0.156	-0.415	-0.504	0.509	0.338
3	Vemana	-0.327	-0.785*	0.169	-0.406	-0.495	0.486	0.323
4	JCG-88	-0.435	-0.776*	0.310	-0.305	-0.420	0.371	0.262
5	GG-2	-0.315	-0.783*	0.139	-0.426	-0.465	0.458	0.305
6	AVT-1666	-0.468	-0.739*	0.339	-0.253	-0.402	0.327	0.238
7	ALR-3	-0.277	-0.760*	0.131	-0.422	-0.513	0.535	0.349
8	K-9	-0.325	-0.764*	0.166	-0.401	-0.490	0.484	0.324
9	AVT-1638	-0.398	-0.781*	0.245	-0.344	-0.448	0.394	0.266
10	Abhaya	-0.271	-0.746*	0.112	-0.428	-0.508	0.525	0.342
11	Narayani	-0.271	-0.770*	0.131	-0.431	-0.511	0.535	0.355
12	ALR-1	-0.334	-0.782*	0.192	-0.395	-0.481	0.469	0.332
13	Anantha	-0.296	-0.755*	0.159	-0.408	-0.507	0.528	0.346
14	K-6 (Check)	-0.242	-0.819*	0.142	-0.464	-0.568*	0.592*	0.390

N= 13; *Significant at 5%; ‘r’ tab value= 0.553

Table.5 Regression statistics on severity of LLS with certain weather variables on groundnut genotypes during late *kharif* 2016-17

S.No	Genotype	Equation	R^2	Standard error	F Value
1	RSB-87	$Y=455.859-8.006X_1$*$-7.187X_2$*	0.719	12.88	12.84
2	Vemana	$Y=422.550-7.287X_1$*$-6.826X_2$*	0.767	10.723	16.485
3	JCG-88	$Y=330.935-6.272X_1$*$-4.592X_2$	0.848	5.835	27.914
4	AVT-1666	$Y=330.300-6.489X_1$*$-4.282X_2$*	0.822	6.138	23.233
5	AVT-1638	$Y=415.624-7.695X_1$*$-6.088X_2$*	0.820	8.396	22.830
6	GG-2	$Y=438.894-7.514X_1$*$-7.224X_2$	0.755	11.683	15.425
7	Kisan	$Y=441.021-7.496X_1$*$-7.261X_2$*	0.744	12.058	14.597
8	ALR-3	$Y=480.107-7.899X_1-8.240X_2$*	0.690	15.493	11.144
9	K-9	$Y=407.125-7.064X_1$*$-6.492X_2$*	0.731	11.266	13.598
10	Abhaya	$Y=425.577-6.968X_1-7.291X_2$*	0.664	14.528	9.913
11	Narayani	$Y=482.218-7.839X_1-8.414X_2$*	0.702	15.297	11.831
12	ALR-1	$Y=451.661-7.878X_1$*$-7.226X_2$*	0.767	11.379	16.524
13	Anantha	$Y=435.889-7.346X_1-7.223X_2$*	0.696	13.502	11.468
14	K-6	$Y=488.515-7.425X_1-9.126X_2$*	0.764	13.970	16.189

*Significant at 5%, X_1- Maximum temperature, X_2- Minimum temperature

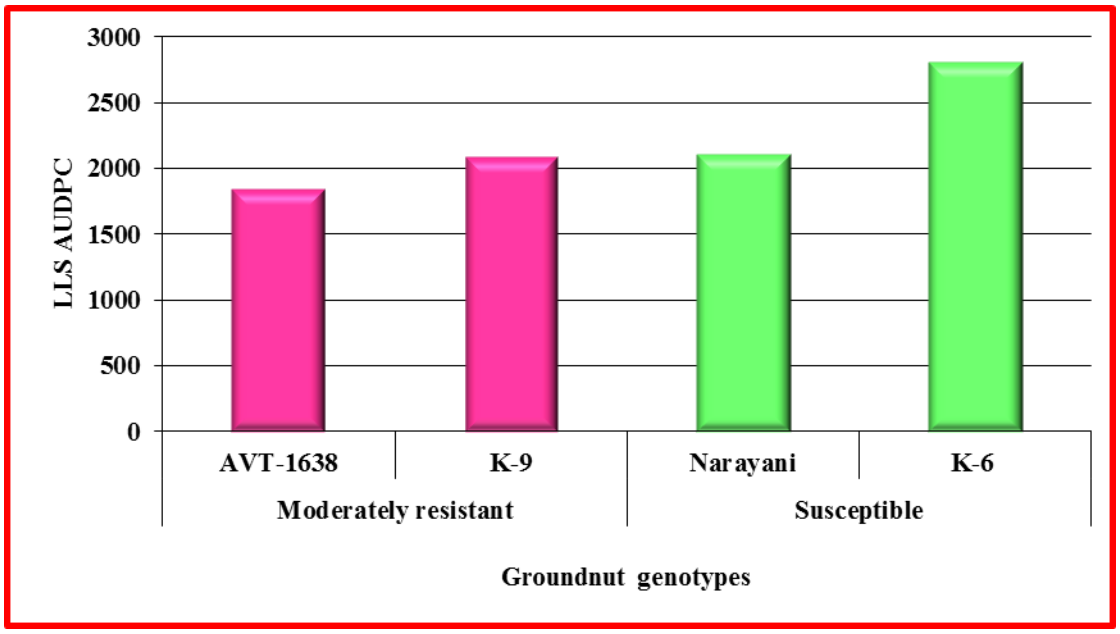
Table.6 Categorization of groundnut genotypes against late leaf spot severity

Disease score	Reaction	Genotypes
Below 3	Resistant (R)	-
3-5	Moderately Resistant (MR)	RSB-87, Kisan, Vemana, JCG 88,GG-2,AVT-1666,K-9,AVT-1638,Abhaya,Anantha, ALR-3, ALR-1
6-9	Susceptible (S)	Narayani, K-6

Table.7 AUDPC values of late leaf spot in different groundnut genotypes

S.No	GENOTYPES	AUDPC Values of Late Leaf Spot
1	RSB-87	2248.43
2	Kisan	2248.19
3	Vemana	2120.23
4	JCG-88	1519.52
5	GG-2	2110.36
6	AVT-1666	1480.67
7	ALR-3	2536.90
8	K-9	2087.33
9	AVT-1638	1841.45
10	Abhaya	2370.51
11	Narayani	2111.13
12	ALR-1	2114.35
13	Anantha	2303.35
14	K-6 (Check)	2812.95

Fig.1 AUDPC of late leaf spot on genotypes showing differential reaction during late *kharif* 2016-17



Categorization of groundnut genotypes against late leaf spot

Out of thirteen genotypes including check evaluated for their resistance to late leaf spot, at 92 DAS (last observation) none of the genotypes was resistant whereas the genotypes RSB-87, Kisan, Vemana, GG-2, K-9, AVT-1638, Abhaya, Anantha, JCG-88, AVT-1666, ALR-1 and ALR-3 were moderately resistant and two genotypes *viz*., K-6 and Narayani were susceptible (Table 1 and 6).

Chiteka *et al*., (1988) reported that out of 116 genotypes, the most resistant genotypes against late leaf spot were UF81206-1, UF81206-2, 72x32B-3-2-2-2-2-1-b3-B, US 29-b3-B. These resistant genotypes had smaller lesions, longer latent periods and reduced sporulation.

Hossain *et al*., (2007) who reported that out of 25 groundnut genotypes evaluated, genotypes 259/88 and 262/88 were found moderately resistant to both leaf spot and rust diseases. It was noted that genotype 269/89 was moderately resistant against leaf spot disease only and M-5 and 255/88 were moderately resistant to rust only. It also revealed that both leaf spot and rust moderately resistant groundnut genotypes had lower percentage defoliation due to failure of fungi to successfully invade the host tissues in all infection sites, resulting low infection frequency. This low percentage of leaf damage resulted low percentage defoliation.

AUDPC (Area Under Disease Progress Curve) of late leaf spot

AUDPC is considered as a useful parameter for assessment of disease resistance for discriminating the susceptible and resistant genotypes of peanut effectively (Wilcoxson *et al.*, 1975). In this study AUDPC values were calculated for late leaf spot disease severity recorded at seven days interval for each variety and the results are furnished in the Table 7.

The genotype AVT-1666 which showed moderate resistant reaction against LLS has recorded lowest AUDPC value (1480.67). K-6 which reacted as susceptible genotype has recorded the highest AUDPC value (2812.95) (Fig. 1).

These results revealed that the genotypes with low AUDPC value are resistant to diseases with less disease severity which are in accordance with Motagi *et al*. (2014) who reported genotypes D 39d, B 37c and ICGV 87165 were resistance for both leaf spot and rust by recording lower values for field disease score and AUDPC during two rainy seasons 2007 and 2008.

References

Alderman, S.C., and Nutter Jr, F.W. 1994. Effect of temperature and relative humidity on development of *Cercosporidium personatum* on peanut in Georgia. Plant Dis. 78: 690-694.

Backman, P.A., and Crawford, M.A. 1984. Relationships between yield loss and severity of early and late leaf spot disease of peanut. Phytopathol. 74: 1101-1103.

Chiteka, Z.A., D.W. Gorbet, F.M. Shokes, T.A. Kucharek, and Knauft, D.A. 1988. Components of resistance to late leaf spot in peanut. I. Levels and variability - implications for selection. Peanut Sci. 15: 25-30.

Gomez, K.A., and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. 2nd edition, John Wiley Sons, Singapore. 683.

Hossain, M.D., M.Z. Rahman, A. Khatun, and Rahman, M.M. 2007. Screening of groundnut genotypes for leaf spots and rust resistance. Int. J. Sustain. Crop Prod. 2(1): 07-10.

Jackson, C.R., and Bell, D.K. 1969. Diseases of Peanut (groundnut) caused by fungi. University of Georgia College Agricultural Station Research Bulletin. 56: 1-5.

Kanade, S.G., A.A. Shaikh, J.D. Jadhav, and Chavan, C.D. 2015. Influence of weather parameters on tikka (*Cercospora* spp.) and rust (*Puccinia arachidis*) of groundnut (*Arachis hypogaea* L.). Asian J. Environ. Sci. 10 (1): 39 - 49.

Mahapatra, S., 2016. Effect of fungicides and meteorological factors on severity of rust and tikka disease of groundnut in field. Int. J. Tropical Agri. 34 (1): 221-228.

Mali, G.V., and Bodhankar, M.G. 2009. Antifungal and phytohormone production potential of *Azotobacter chroococcum* isolates from groundnut (*Arachis hypogaea* L.) rhizosphere. Asian J. Exper. Sci. 23: 293-297.

Motagi, B.N., G. K. Naidu, C.C. Angadi, and Gowda, M.V.C. 2014. Potential genotypes for resistance to foliar diseases and productivity in groundnut (*Arachis hypogaea* L.). Karnataka. J. Agric. Sci. 27: 445-448.

Naeem-Ud-Din., A. Mahmood, G.S.S. Khattak, I. Saeed, and Hassan, M.F. 2009. High yielding groundnut (*Arachis hypogaea* L.) variety "Golden". *Pak. J. Bot.* 41: 2217-2222.

Shew, B.B., M.K. Beute, and Wynne, J.C. 1988. Effects of temperature and relative humidity on expression of resistance to *Cercosporidium personatum* in peanut, Phytopathol. 78: 493-498.

Smith, D.H., G.D.C. Pauer, and Shokes, F.M. 1992. Plant disease of international importance. Diseases of Vegetables and Oil Seed. 232.

Sommartya, T., and Beute, M.K. 1986. Temperature effects on germination and comparative morphology of conidia for Thai and USA isolates of *Cercosporidium personatum.* Peanut Sci. 13: 67-70.

Subrahmanyam, P., and Ravindranath, V. 1988. Fungal and nematode diseases in Groundnut (Reddy, P.S. ed.) ICAR Krishi Anusandhana Bhavan. New Delhi. 507-543.

Subrahmanyam, P., D. McDonald, F. Waliyar, L.J. Reddy,S.N. Nigam, R.W. Gibbons, V. Ramanatharao, A.K. Singh, S. Pande, P.M. Reddy, and SubbaRao. P.V. 1995. Screening methods and sources of resistance to rust and late leaf spot of Groundnut. Information Bulletin no. 4*:* 1-15.

Wheeler, B.E.J., 1969. An Introduction to Plant Diseases. John Wiley, London. 301.

Wilcoxson, R.D., B. Skovamand, and Atif, A.H. 1975. Evaluation of wheat cultivars for ability to retard development of stem rust. *Ann. Appl. Bio.* 80 : 275-281