EPIDEMIOLOGICAL STUDY ON BLACK POINT OF WHEAT

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ABSTARCT

The black point disease of wheat is characterized by the brown to black discolouration on the embryonic end of the seed. The multi-location field experiment was conducted during 2008-09 to 2014-15 to quantify the role of weather variables on black point incidence. Six wheat varieties viz., Lok 1, GW 496, GW 366, GW 322, GW 273 and GW 1139 were used. The data indicated significant differences for relative humidity with per cent black point incidence for most of the growth stages. Morning relative humidity (68.9 to 73.7 %) was significantly and positively correlated, while afternoon relative humidity (27.1 to 46.9 %) was significantly and negatively correlated with black point incidence. Bold seeded aestivum wheat varieties like GW 366, Lok 1 and GW 496 were more vulnerable, while durum wheat varieties like GW 1139 was nearly free from black point incidence.

KEY WORDS: Black point disease, correlation, epidemiology, weather parameters, wheat

INTRODUCTION

Black point disease of wheat was reported for the first time in India by Dastur (1932) from the Central provinces. The fungus *Alternaria tenuis* (*Alternaria alternata*) is predominantly associated with black point of wheat in India (Gaur, 1986; Agrawal *et al*., 1987; Cunfer, 1987). The black point disease of wheat is characterized by the brown black discolouration on the embryonic end of the seed with dark black coloured outer margin and lighter inner discolouration. Usually, kernels are infected by these fungi during the dough stage. This reduced the market price due to reduction in appearance of grains. The reduction in market price was reported 3.71 to 12.49 per cent in 5 to 50 per cent infected seed lot, respectively (Solanki *et al*., 2006). The post-harvest survey conducted every year in Gujarat state revealed that 15.3 - 34.8 per cent samples were black point infected (Patel and Solanki, 2012). It reflected that the disease is occurring every year. The information on role of weather variables in development of black point in different varieties under natural conditions is meagre. Hence, a field experiment was conducted to quantify the relationship of weather parameters with black point incidence over different location.

MATERIALS AND METHODS

A field experiment to quantify the role of weather variables on black point disease of wheat was conducted during 2008-09 to 2014-15 at five

different locations *viz.*, Vijapur (District: Mehsana); Dehgam (District: Gandhinagar); Talod (District: Sabarkantha); Sardarkrushinagar (District: Banaskantha); Mundra and Kothara (District: Kachchh). The locations were purposively selected to represent the entire North Gujarat having different climatic conditions and soil types. Six varieties *viz.*, Lok 1, GW 496, GW 366, GW 322, GW 273 and GW 1139 commonly cultivated in the state were grown separetely in a plot of 2.76 m x 10.0 m (12 rows) at each location. A common spacing of 22.5 cm between rows, seed rate of 125 kg/ha with a fertilizer dose of 125-60-0 NPK kg/ha was followed. All required agronomic practices were followed uniformly for each variety. The varieties were sown under timely sown conditions (15-25 November) at each location. Location-wise data of different weather variables were collectedfrom the automatic weather station installed at respective location and were utilized for calculating correlation co-coefficient values. The location-wise and variety wise uniform seed samples were collected and per cent black point incidence was calculated by randomly examining 1000 seeds. The seed diameter of different varieties was also measured using Single Kernel Characterization System (Perten Instruments, Sweden).

RESULTS AND DISCUSSION

Year-wise black point incidence

The data presented in Table 1 indicated that per cent black point incidence vary widely during different years. The highest mean black point incidence of 12.84 was observed during the year 2008-09 at Sardarkrushinagar followed by 7.42 per cent during 2010-11. At Vijapur, highest mean black point incidence was recorded 2.98 per cent during 2014-15 followed by 2.36 per cent during 2009-10 and 2.14 per cent during 2008-09. Similarly, at Dehgam, mean black point incidence was 5.38 per cent during 2008-09 followed by 3.46 per cent during 2014-15. The black point incidence was comparatively less at Talod, Kothara and Mundra.

Variety-wise / Location-wise black point incidence

Out of six locations, samples were not available from Kothara during 2008-09 and 2013-14, from Mundra centre during 2011-12 and 2012-13. Hence, for uniform analyses, the data of Vijapur, Sardarkrushinagar, Dehgam and Talod were utilized (Table 2). The data clearly indicated the significant difference in the mean black point incidence in different varieties as well as locations. Among different varieties, significantly high black point incidence of 3.97 per cent was recorded in GW 366 over different locations followed by Lok 1 (2.87 %). The black point incidence was 1.77 per cent in the most preferred variety GW 496. The negligible black point incidence of nearly 0.50 per cent was recorded in GW 322 and GW 273. The *durum* variety GW 1139 was consistently free from black point incidence at all the locations except at Sardarkrushinagar. The data further indicated that among different locations, the mean black point incidence irrespective of the varieties was recorded significantly higher at Sardarkrushinagar (3.08 %). The next in order were Dehgam (1.56 %), Vijapur (1.13 %) and Talod (0.68 %).

Relationship of meteorological variables with black point disease

Different weather parameters *viz.*, minimum temperature, maximum temperature, mean temperature, morning relative humidity (RH I), afternoon relative humidity (RH II) and mean relative humidity were

subjected for working out correlation co-efficient values for their association in the development of black point. The weather data of different growth stages *viz*., 10 days after Early Dough Stage (EDS), 15 days after Hard Dough Stage (HDS), Flowering to EDS, Flowering to maturity, EDS to maturity and Flowering to HDS were utilized for correlation study and presented in Table 3 to 6. Among different locations, the data of Talod, Kothara and Mundra and of the years 2011-12, 2012-13 and 2013-14 were not utilized for the purpose of correlation co-efficient analyses due to less black point incidence. The data indicated significant differences for relative humidity for most of the growth stages at all the locations except Sardarkrushinagar (Table 4). Significantly positive correlation for RH I, RH II and Mean RH was observed at Vijapur (Table 3), while at Dehgam (Table 5) also, same trend was observed except for flowering to EDS stage. In the mean correlation co-efficient values irrespective of the locations, morning relative humidity (RH I) showed significant positive correlation for all the growth stages except 15 days after HDS, whereas afternoon relative humidity (RH II) was negatively correlated at different growth stages except 10 days after EDS and flowering to EDS. Overall analyses of correlation study also suggested significant positive correlation of morning relative humidity and negative correlation of afternoon relative humidity. Among the other meteorological variables, significant positive correlation of minimum temperature was observed at Dehgam, while maximum temperature was negatively correlated. The mean and overall correlation co-efficient values for maximum as well as minimum temperatures were non-significant. Moist condition during grain development increased symptoms of black point (Rees *et al.*, 1984). The greater black point severity was due to cool, wet weather and frosts during seed development that delayed ripening (Fernandez *et al.*, 2000). A higher level of black point was reported by applying overhead water misting to increase the humidity during grain fill (Sulman *et al.*, 2001).

Relationship of grain diameter with black point disease development

The black point incidence was recorded high in bold seeded varieties, hence, the role of seed diameter with black point incidence was also subjected for correlation co-efficient analyses and the data are presented in Table 7. For this purpose, the data of different locations, varieties and years for which correlation studies of weather variables was carried out were used for analyses. A significant positive correlation of seed diameter with black point incidence over the locations as well as varieties was observed. The seed diameter (mm) was ranged from 2.72 to 3.26 at Vijapur, 2.76 to 3.27 at Sardarkrushinagar and 2.73 to 3.14 at Dehgam. The correlation co-efficient values for all the varieties as well as all the location were observed significant, which indicated that seed diameter also played important role in the development of black point. Gaur (1986) reported that larger grains in the spike were infected more, while small and shrunken ones remained free from infection. Positive correlation of 1000 grain weight with black point incidence exhibited that bolder grains in spike were most vulnerable to black point development (Solanki *et al.*, 2006).

CONCLUSION

It can be inferred from the foregoing discussion that bold seeded

aestivum wheat varieties like GW 366, Lok 1 and GW 496 were more vulnerable to black point incidence, while *durum* wheat variety like GW 1139 was nearly free from black point incidence. It was further concluded that morning relative humidity (68.9 to 73.7 %) was significantly and positively correlated, while afternoon relative humidity (27.1 to 46.9 %) was significantly and negatively correlated with black point incidence.

REFERENCES

Agrawal, K.; Sharma, J.; Singh, J. and Singh, D. (1987). Black point disease of wheat in Rajasthan, causal fungi and their pathogenicity. *Annls. Biol.*, **3**: 7-16.

Cunfer, B. M. (1987). Bacterial and fungal blights of the foliage and heads of wheat. ln: *Wheat and Wheat Improvement* (Eds. Heyne, E. G.), Madison, Wisconsin, U.S.A, pp. 538-539.

Dastur, J. F. (1932). Foot rot and black point disease of wheat in the Central Provinces. *Agric. Live. Stk. India*, **3**: 275-282.

Fernandez, M. R.; Clarke, J. M.; DePauw, R. M.; Irvine, R. B. and Knox, R. E. (2000). Black point reaction of durum and common wheat cultivars grown under irrigation in southern Saskatchewan. *Plant Dis.*, **84**:892–894.

Gaur, A. (1986). Black point of wheat. ln: *Problems and Progress of Wheat Pathology in South Asia*. (Eds. Joshi, L.M.; Singh, D. V. and Srivastava, K.D.), Malhotra Publishing house, New Delhi, pp. 230-241.

Patel, S. I. and Solanki, V. A. (2012). Status of karnal bunt and black point of wheat in North Gujarat. *Environ. Ecol.*, **30** (3): 552-553.

Rees, R. G.; Martin, D. J. and Law. D. P. (1984). Black point in bread wheat: Effects on quality and germination, and fungal associations. *Aust. J. Exp. Agric. Anim. Husb.*, **24**:601–605.

Solanki V. A.; Augustine, N. and Patel, A. A. (2006). Impact of black point on wheat trade and its management. *Indian Phytopath.*, **59**(1): 44-47.

Sulman, M.; Fox, G.; Bell, K.; Young, K. and Inkerman, A. (2001). Field screening using a controlled environment for black point resistance in barley. In: *Proc. of the 10th Australian Barley Technical Symp., Canberra, ACT, Australia. 16–20 Sept. 2001*. Available at www. regional.org.au/ au/abts/1999/sulman.htm, Regional Inst., Gosford, NSW, Australia.

Table 1: Variety-wise and location-wise per cent black point incidence over the years

Location	Year	Lok 1	GW 496	GW 366	GW 322	GW 273	GW 1139	MEAN
Vijapur	2008-09	2.20	2.70	3.80	0.00	2.00	0.00	2.14
	2009-10	3.90	3.30	4.60	0.00	0.00	0.00	2.36
	2010-11	1.50	0.85	2.25	0.00	0.00	0.00	0.92
	2011-12	0.80	0.40	1.20	0.00	0.00	0.00	0.48
	2012-13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2013-14	0.75	0.30	1.40	0.40	0.30	0.00	0.63
	2014-15	4.40	4.70	5.30	0.40	0.10	0.00	2.98
	MEAN	**1.94**	**1.75**	**2.65**	**0.11**	**0.34**	**0.00**	**1.36**
Dehgam	2008-09	4.80	4.60	7.50	5.20	4.80	0.00	5.38
	2009-10	1.70	1.10	2.90	0.00	0.00	0.00	1.14
	2010-11	1.30	1.20	2.30	0.00	0.00	0.00	0.96
	2011-12	1.00	0.40	2.30	0.00	0.00	0.00	0.74
	2012-13	0.80	0.60	1.60	0.20	0.30	0.00	0.70
	2013-14	1.00	0.50	1.40	0.30	0.40	0.00	0.72
	2014-15	4.20	4.90	6.90	0.90	0.40	0.00	3.46
	MEAN	**2.11**	**1.90**	**3.56**	**0.94**	**0.84**	**0.00**	**1.87**
Sardarkrushinagar	2008-09	24.90	3.80	30.20	1.90	3.40	0.00	12.84
	2009-10	1.20	1.10	2.60	0.00	0.00	0.00	0.98
	2010-11	11.95	7.20	15.95	1.60	0.40	1.10	7.42
	2011-12	0.20	0.30	0.50	0.00	0.00	0.00	0.20
	2012-13	0.30	0.50	0.80	0.00	0.20	0.00	0.36
	2013-14	0.50	0.40	1.20	0.20	0.30	0.00	0.52
	2014-15	4.70	4.20	5.90	1.40	0.60	0.00	3.36
	MEAN	**6.25**	**2.50**	**8.16**	**0.73**	**0.70**	**0.16**	**3.67**
Talod	2008-09	2.00	0.70	2.90	0.00	0.70	0.00	1.26
	2009-10	0.10	0.00	0.00	0.00	0.00	0.00	0.02
	2010-11	2.65	0.15	1.30	0.00	0.00	0.00	0.82
	2011-12	0.30	0.20	0.70	0.00	0.00	0.00	0.24
	2012-13	0.20	0.40	1.30	0.30	0.30	0.00	0.50
	2013-14	0.60	0.20	0.60	0.00	0.10	0.00	0.30
	2014-15	2.30	4.90	3.80	1.20	0.80	0.00	2.17
	MEAN	**1.16**	**0.94**	**1.51**	**0.21**	**0.27**	**0.00**	**0.82**
Kothara	2009-10	1.80	1.20	3.20	0.00	0.00	0.00	1.24
	2010-11	3.75	3.40	4.25	0.70	0.90	0.00	2.60
	2011-12	0.90	0.50	1.10	0.20	0.10	0.00	0.56
	2012-13	0.60	0.20	0.80	0.00	0.30	0.00	0.38
	2014-15	1.20	1.40	1.80	0.60	0.40	0.00	1.08
	MEAN	**1.65**	**1.34**	**2.23**	**0.30**	**0.34**	**0.00**	**1.17**
Mundra	2008-09	2.60	2.40	3.90	1.60	0.00	0.00	2.10
	2009-10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2010-11	2.00	1.90	3.50	0.80	0.70	0.00	1.78
	2013-14	0.20	0.20	0.60	0.50	0.30	0.00	0.36
	2014-15	0.50	0.20	1.30	0.00	0.00	0.00	0.40
	MEAN	**1.06**	**0.94**	**1.86**	**0.58**	**0.20**	**0.00**	**0.93**

Table 2: Mean black point incidence: Variety x Location over the years

	Vijapur	Sardarkrushinagar	Dehgam	Talod	Mean
Lok 1	1.94 (8.50)	6.25 (12.46)	2.11 (8.95)	1.16 (7.05)	2.87 (9.24)
GW 496	1.75 (8.00)	2.50 (9.17)	1.90 (8.35)	0.94 (6.20)	1.77 (7.93)
GW 366	2.65 (9.71)	8.16 (14.59)	3.56 (11.19)	1.51 (7.77)	3.97 (10.81)
GW 322	0.11 (4.45)	0.73 (6.02)	0.94 (6.10)	0.21 (4.70)	0.50 (5.32)
GW 273	0.34 (4.98)	0.70 (5.84)	0.84 (5.93)	0.27 (4.94)	0.54 (5.42)
GW 1139	0.00 (4.05)	0.16 (4.51)	0.00 (4.05)	0.00 (4.05)	0.04 (4.17)
MEAN	1.13 (6.62)	3.08 (8.76)	1.56 (7.43)	0.68 (5.78)	
	S. Em. ±	**C.D.**	**C.V. (%)**		
Variety (V)	**0.60**	**1.65**	**44.18**		
Location (L)	**0.49**	**1.35**			
V X L	**1.19**	**NS**			

Figures in parentheses are arc-sin transformed values

Table 3: Correlation co-efficient values for different weather parameters - Vijapur

S.N.	Period	Min. T	Max. T	Mean T	RH I	RH II	Mean RH
1	10 d after EDS	NS	NS	NS	0.73	0.83	0.80
2	15 d after HDS	NS	NS	NS	0.74	0.90	0.88
3	Flowering to EDS	NS	-0.57	-0.50	0.83	0.78	0.88
4	Flowering to maturity	NS	NS	NS	0.74	0.81	0.79
5	EDS to maturity	NS	NS	NS	0.77	0.89	0.85
6	Flowering to HDS	NS	NS	-0.53	0.79	0.85	0.87
Critical value : ± 0.50*							

EDS : Early Dough Stage ; HDS : Hard Dough Stage

Table 4: Correlation co-efficient values for different weather parameters - Sardarkrushinagar

S.N.	Period	Min. T	Max. T	Mean T	RH I	RH II	Mean RH
1	10 d after EDS	-0.67	NS	-0.63	NS	NS	NS
2	15 d after HDS	-0.51	-0.54	-0.59	NS	NS	NS
3	Flowering to EDS	0.65	NS	NS	NS	NS	NS
4	Flowering to maturity	NS	NS	NS	NS	NS	NS
5	EDS to maturity	-0.60	-0.53	-0.64	NS	NS	NS
6	Flowering to HDS	0.59	NS	0.55	NS	NS	NS
Critical value : ± 0.50*							

Table 5: Correlation co-efficient values for different weather parameters - Dehgam

S.N.	Period	Min. T	Max. T	Mean T	RH I	RH II	Mean RH
1	10 d after EDS	NS	NS	NS	0.54	0.56	0.57
2	15 d after HDS	0.71	NS	NS	0.68	0.73	0.73
3	Flowering to EDS	0.64	NS	0.74	NS	NS	0.50
4	Flowering to maturity	0.78	-0.57	0.61	0.58	NS	0.55
5	EDS to maturity	0.67	NS	NS	0.78	NS	0.68
6	Flowering to HDS	0.69	-0.59	NS	0.67	0.63	0.70
Critical value : ± 0.50*							

Table 6: Mean Correlation co-efficient values for different weather parameters

S.N.	Period	Min. T	Max. T	Mean T	RH I	RH II	Mean RH
1	10 d after EDS	NS	NS	NS	0.39	NS	NS
2	15 d after HDS	NS	NS	NS	NS	-0.30	NS
3	Flowering to EDS	NS	NS	NS	0.40	NS	NS
4	Flowering to maturity	NS	NS	NS	0.29	-0.34	NS
5	EDS to maturity	-0.34	NS	NS	0.34	-0.39	NS
6	Flowering to HDS	NS	NS	NS	0.35	-0.28	NS
		Critical value : ± 0.28*					
OVERALL		NS	NS	NS	0.33	-0.29	NS
		Critical value : ± 0.11*					

Table 7: Correlation co-efficient values for grain diameter with per cent black point incidence

(Critical value :+ 0.50)

Variety	Year	Vijapur		Sardarkrushinagar		Dehgam		Correlation Co-efficient
		PDI	Seed Diameter	PDI	Seed Diameter	PDI	Seed Diameter	
Lok 1	2008-09	2.20	2.84	24.90	3.24	4.80	3.10	0.74**
	2009-10	3.90	2.89	1.20	2.76	1.70	2.84	
	2010-11	1.50	2.72	11.95	3.11	1.30	2.73	
	2014-15	4.40	3.05	4.70	3.09	4.20	3.08	
GW 496	2008-09	2.70	2.82	3.80	2.97	4.60	3.01	0.90**
	2009-10	3.30	2.88	1.10	2.88	1.10	2.80	
	2010-11	0.85	2.72	7.20	3.20	1.20	2.80	
	2014-15	4.70	3.02	4.20	3.15	4.90	3.01	
GW 366	2008-09	3.80	2.98	30.2	3.27	7.50	3.14	0.63**
	2009-10	4.60	3.12	2.60	2.95	2.90	2.84	
	2010-11	2.25	2.81	15.95	3.24	2.30	2.80	
	2014-15	5.30	3.26	5.90	3.21	6.90	3.12	
Correlation Co-efficient		0.93**		0.71**		0.93**		

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