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Status of Karnal Bunt in Major Wheat Growing Regions of Northern Haryana

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Authors' contributions

This work was carried out in collaboration among all authors. Author SSJ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SK and AKM managed the analyses of the study and literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Karnal bunt is a major problem in reducing the quality of wheat seed during seed production programmes in Haryana. A survey was conducted to access the status of Karnal bunt in major wheat growing regions of Haryana during *Rabi* season of 2018-19. During the survey 11 districts of northern Haryana *viz.,* Hisar, Yamunanagar, Sirsa, Fatehabad, Ambala, Jind, Kurukshetra, Kaithal, Karnal, Panipat and Sonipat were covered. Under the survey a total of 785 samples of wheat grains were collected from 34 grain markets. Samples revealed the range of Karnal bunt was between 0.05 – 4.70 per cent in these districts which was exceeding the permissible limit of Indian Minimum Seed Certification Standards (0.25%) for quality wheat seed production. The infected samples were 395 (50.31%) and rejected samples were 155 (19.74%) having infection more than 0.25 per cent. Maximum average infection was found in Karnal district (0.413%), Hisar (0.278%) and Kurukshetra (0.273%) and the minimum was recorded in Sirsa (0.012%), Ambala (0.077%)

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and Fatehabad (0.104%). The range of infection was highest in Karnal (0.05 - 4.70%), then Hisar (0.05 - 4.50%) followed by Kurukshetra (0.05 - 3.40%) and lowest was observed in Sirsa (0.05 - 0.10).

Keywords: Karnal bunt; Neovossia indica; wheat; Triticum aestivum; infection.

1. INTRODUCTION

Agriculture is the primary source of livelihood for about 58 per cent of India's population. Gross Value Added by agriculture, forestry and fishing is estimated at Rs 18.53 trillion (US$ 271.00 billion) in 2018 [1]. Wheat (*Triticum aestivum* L.) is one of the most important strategic cereal crops for the majority of world's population. The decreased production of wheat in the major wheat growing countries may be attributed to prevalence of Karnal bunt disease. The major impact of Karnal bunt is reduction of yield and quality of grains by imparting a fishy odour and taste which is due to the presence of trimethylamine secreted by teliospores. The disease shortens the length of ears as well as number of spikelets in the infected earheads. Also, the viability of infected seeds is decreased. The disease is also named as partial bunt because only part of the kernel is affected during infection. This pathogen is soil and seed borne which poses a serious quarantine problem and thus restricts the international trade of wheat. Therefore, quarantine restriction is applied by approximately 70 countries on wheat trade where Karnal bunt is known to occur [2,3]. Several Indian wheat varieties have been reported to be resistant against Karnal bunt but most of the cultivars are susceptible [4,5].

Karnal bunt of wheat, caused by *Tilletia indica* [6] Mundkur, was first reported in 1931 from botanical research station, IARI, Karnal (Haryana) on wheat cultivar, foundation and Punjab A. It was a minor disease for many years and the pathogen is found only in Northwestern regions of India. During the 1969–70 crop season it was unusually widespread in another parts of India. The disease is now established in many countries *viz.,* Afghanistan, Iraq, Pakistan and Mexico. The increased geographic distribution of disease may be due to the development and wide distribution of cultivars of wheat that were more susceptible than the older ones. In India, it is present in most wheat growing states except from Maharashtra, Gujarat, Orissa, Assam, Meghalaya, Karnataka, Andhra Pradesh, Tamil Nadu and Kerala [7,8,9]. Haryana is among the major contributors in production of wheat grains in India. A large quantity of wheat seed produced is rejected by seed certification agencies due to infection of Karnal bunt in case of both foundation and certified seeds. To limit the entry of the pathogen to disease free areas within India, stringent seed health standards have been established. The seed certification programme allows a maximum level of 0.05 and 0.25 per cent of disease infection for foundation and certified seeds, respectively [10]. Therefore the present study was planned to assess the status of Karnal bunt in wheat produced during Rabi season of 2018-19 in northern region of Haryana.

2. MATERIALS AND METHODS

Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana has a well equipped Seed Testing Laboratory under the Department of Seed Science & Technology. Surveyed samples are collected and analyzed for Karnal bunt infection. Overall 785 samples were collected from 34 grain market comprising of 11 districts from the produce of Rabi 2018-19. The samples are homogenized by seed divider. A total of 4,000 seeds were taken in 2 replications of 2000 each. The per cent Karnal bunt infected seeds were calculated by following formula:

Karnal Bunt Infected Sample (%): (Number of infected sample / Total sample analyzed) x 100

Average Infection (%): (Total number of infected seed/grain in a sample/ Number of seed/grain tested (2000) x 100

Total Rejected Sample (%): (Number of sample having infection greater than permissible limit / Total sample analyzed) x 100

Karnal bunt infected seeds were detected by NaOH Seed soak technique [11,12]. Wheat seeds were soaked in a beaker containing 250 ml of 0.2 per cent NaOH solution (2 g NaOH/1000 ml water) for 24 h at 25°C. After 24 h the solution was decanted. Seeds were

thoroughly washed in tap water and were examined visually, aided with light. The seeds exhibiting jet black shiny appearance with hallow or without hollowness were separated. The infected seeds were counted and percentage was calculated as per formula mentioned above. District wise observations were recorded on average infection as suggested by Beniwal et al. [13].

3. RESULTS AND DISCUSSION

Karnal bunt was present in all the northern districts of Haryana. However, the incidence was varied in different districts of state. The perusal of data of Table 1 indicates the range of Karnal bunt was between 0.05 – 4.70 per cent in the surveyed districts. The infected samples were 395 (50.31%) and rejected samples were 155 (19.74%) having infection more than 0.25 per cent (maximum limit of Indian Minimum Seed Certification Standards). The average infection in districts was maximum in Karnal district (0.413%) followed by Hisar (0.278%), Kurukshetra (0.273%), Panipat (0.260%), Yamuna Nagar (0.186%), Jind (0.157%), Sonipat (0.142%), Kaithal (0.119%), Fatehabad (0.104%), Ambala (0.077%) and minimum was recorded in Sirsa (0.012). The range of infection was highest in Karnal (0.05-4.70%), Hisar (0.05-4.50%) followed by Kurukshetra (0.05-3.40%) and lowest was observed in Sirsa (0.05 – 0.010). The similar trend of infection was observed in 2016-17 and 2017-18 in surveyed districts of Haryana [14,15, 16,17]. The reason behind occurrence is suitable temperature, high relative humidity, cloudy and rainy weather which promoted the Karnal bunt development [18].

Table 2 shows that infected samples were lowest in Sirsa district (16.66%) and infection was in ascending order in following grain markets *viz.,* Ambala (27.94%), Jind (43.67%), Karnal (44.92%), Fatehabad (46.57%), Hisar (51.40%), Sonipat (52.00%), Yamuna Nagar (54.68%), Kaithal (59.57%), Panipat(75.00%), Kurukshetra district (79.80%). In case of rejected samples, some of the grain markets showed disease free samples *viz.,* Hansi, Hisar, Bhatto, Fatehabad, Sirsa, Ding, Nathusari Chopta, Kalayat. Whereas, in Sirsa district grain markets, there was no rejection of infected samples and highest number were found in Karnal grain market. The variation observed in districts over the range of infection is due to their weather parameters which makes the crop susceptible to Karnal bunt disease.

Hence, Haryana state should be cautious and due consideration is given to weather parameters during susceptibility period, i.e. from earhead emergence to anthesis stage [19,20] in wheat seed production programmes and also spray the required dose of chemicals during susceptibility stage [21].

Table 1. District wise report on Karnal bunt in northern Haryana (April, 2019)

Districts	Grain market	Samples collected	Infected samples		Infected seeds	Average infection	Range of infection	Rejected sample	
	No.	No.	No.	%	No.	%	%	No.	%
Hisar	7	142	73	51.40	792	0.278	0.05-4.50	33	23.23
Jind	4	87	38	43.67	278	0.157	0.05-1.15	22	25.28
Fatehabad	3	73	34	46.57	152	0.104	0.05-3.00	3	4.47
Yamuna Nagar	2	64	35	54.68	239	0.186	0.05-3.00	16	25.00
Panipat	2	40	30	75.00	208	0.260	0.05-2.90	15	37.50
Kurukshetra	5	104	83	79.80	569	0.273	0.05-3.40	23	22.11
Karnal	3	69	31	44.92	571	0.413	0.05-4.70	23	33.33
Sirsa	3	66	11	16.66	16	0.012	0.05-0.10	0	0.00
Ambala	2	68	19	27.94	105	0.077	0.05-1.75	5	7.35
Kaithal	2	47	28	59.57	112	0.119	0.05-0.55	10	21.27
Sonipat	1	25	13	52.00	71	0.142	0.05-0.75	5	20.00
Total	34	785	395	50.31	3113	0.198	0.05-4.70	155	19.74

Table 2. Grain marketwise report on Karnal bunt in northern Haryana (April, 2019)

Districts	Grain market	Samples collected	Infected samples		Infected seeds	Average infection	Range of infection	Rejected sample	
		No.	No.	%	No.	%	%	No.	%
Hisar	Narnaund	12	5	41.66	11	0.045	0.05-0.35	1	8.33
	Mandi Adampur	25	11	44.00	54	0.108	0.05-1.15	3	12.00
	Hansi	21	8	38.09	13	0.030	0.05-0.15	0	0.00
	Bass	24	17	70.83	176	0.366	0.05-2.90	10	41.66
	Uklana	21	11	52.38	189	0.450	0.10-3.50	8	38.09
	Hisar	21	5	23.80	5	0.012	0.05	0	0.00
	Mundhal	18	16	88.88	344	0.955	0.10-4.50	11	61.11
	Total	142	73	51.40	792	0.278	0.05-4.50	33	23.23
Jind	Pillukhera	22	19	86.36	157	0.356	0.05-1.15	12	54.54
	Uchana	22	13	59.05	64	0.145	0.05-0.75	4	18.18
	Julana	20	6	30.00	57	0.142	0.05-0.65	4	20.00
	Damtan Sahib	23	10	43.47	35	0.076	0.05-0.45	2	8.69
	Total	87	38	43.67	278	0.157	0.05-1.15	22	25.28
Fatehabad	Bhatto	24	6	25.00	11	0.022	0.05-0.20	0	0.00
	Tohana	25	23	92.00	132	0.264	0.05-3.00	3	15.78
	Fatehabad	24	5	20.83	9	0.018	0.05-0.25	0	0.00
	Total	73	34	46.57	152	0.104	0.05-3.00	3	4.47
Yamuna Nagar	Radaur	36	20	55.55	124	0.172	0.05-0.75	8	22.22
	Jagadhari	28	15	53.57	115	0.167	0.05-3.00	8	28.57
	Total	64	35	54.68	239	0.186	0.05-3.00	16	25.00
Panipat	Israna	22	18	81.82	114	0.259	0.05-2.90	8	36.36
	Gharonda	18	12	66.66	94	0.261	0.05-2.00	7	38.88
	Total	40	30	75.00	208	0.260	0.05-2.90	15	37.50
Kurukshetra	Shahabad	21	15	71.42	56	0.133	0.10-0.45	3	14.28
	Pehowa	20	17	85.00	173	0.432	0.10-1.55	8	40.00
	Pipli	23	16	69.56	138	0.380	0.05-3.40	3	13.04
	Thol	12	12	100.00	53	0.220	0.10-0.45	3	25.00
	Ismailabad	28	23	82.14	149	0.266	0.05-2.20	6	24.00
	Total	104	83	79.80	569	0.273	0.05-3.40	23	22.11

Districts	Grain market	Samples collected	Infected samples		Infected seeds	Average infection	Range of infection	Rejected sample	
		No.	No.	%	No.	%	%	No.	%
Karnal	Indri	25	11	44.00	129	0.258	0.05-3.50	8	32.00
	Karnal	14	11	78.57	322	1.150	0.05-4.70	9	64.28
	Assand	30	9	30.00	120	0.200	0.05-3.50	6	20.00
	Total	69	31	44.92	571	0.413	0.05-4.70	23	33.33
Sirsa	Sirsa	25	4	16.00	6	0.012	0.05-0.10	0	0.00
	Ding	22	3	13.63	5	0.011	0.05-0.10	0	0.00
	Nathusari Chopta	19	4	21.05	5	0.013	0.05-0.10	0	0.00
	Total	66	11	16.66	16	0.012	0.05-0.10	0	0.00
Ambala	Mullana	23	10	43.47	60	0.130	0.05-1.75	2	8.69
	Barara	45	9	20.00	45	0.050	0.05-0.50	3	6.66
	Total	68	19	27.94	105	0.077	0.05-1.75	5	7.35
Kaithal	Kaithal	24	21	87.50	98	0.204	0.10-0.55	10	41.66
	Kalayat	23	7	30.43	14	0.030	0.05-0.15	0	0.00
	Total	47	28	59.57	112	0.119	0.05-0.55	10	21.27
Sonipat	Total Gohana	25	13	52.00	71	0.142	0.05-0.75	5	20.00
	Grand Total	785	395	50.31	3113	0.198	0.05-4.70	155	19.74

4. SUMMARY AND CONCLUSION

Karnal bunt is a major problem in reducing the quality of wheat seed during seed production programmes in Haryana. A survey was conducted to access the status of Karnal bunt in major wheat growing regions of Haryana during *Rabi* season of 2018-19. During the survey 11 districts of northern Haryana *viz.,* Hisar, Yamunanagar, Sirsa, Fatehabad, Ambala, Jind, Kurukshetra, Kaithal, Karnal, Panipat and Sonipat were covered. Under the survey a total of 785 samples of wheat grains were collected from 34 grain markets. Samples revealed the range of Karnal bunt was between 0.05 – 4.70 per cent in these districts which was exceeding the permissible limit of Indian Minimum Seed Certification Standards (0.25%) for quality wheat seed production. The infected samples were 395 (50.31%) and rejected samples were 155 (19.74%) having infection more than 0.25 per cent. Maximum average infection was found in Karnal district (0.413%), Hisar (0.278%) and Kurukshetra (0.273%) and the minimum was recorded in Sirsa (0.012%), Ambala (0.077%) and Fatehabad (0.104%). The range of infection was highest in Karnal (0.05 - 4.70%), then Hisar (0.05 - 4.50%) followed by Kurukshetra (0.05 - 3.40%) and lowest was observed in Sirsa (0.05 - 0.10). So it is proved that all the districts show the considerable infection of disease which is related to favourable weather parameters in this year (2018-19). Therefore a careful management is needed by crop rotation, soil solarization, seed treatment and prophylactic sprays of chemicals at needed intervals.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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