

Occurrence of Karnal bunt and black point disease of wheat in Northern part of Haryana

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Agriculture plays a vital role in the economy and stability of India. Wheat (*Triticum aestivum*) is one of the most important food crops of the world. Production of wheat is estimated at 107.59 million tonnes. It is higher by 11.43 million tonnes than the average wheat production of 96.16 million tonnes. Total production of *Kharif* rice during 2020-21 is estimated at 102.36 million tonnes. It is higher by 6.70 million tonnes than the previous five years' average production of 95.66 million tonnes. (Anonymous, 2021). In India, wheat is affected by various diseases such as rusts, powdery mildew, loose smut, leaf blight and Karnal bunt (Juroszek & Tiedemann 2013). Amongst these, Karnal bunt caused by the fungus, *Tilletia indica* (syn *Neovossia indica*) and black point caused by the fungus, *Alternaria* spp, *Helminthosporium* and *Curvularia* etc are the major seed borne disease of wheat. Karnal bunt is the limiting factor in increasing wheat yield (Sharma *et al.*, 2011). Mitra discovered Karnal bunt in an infested experimental field at the Botanical Experimental Station in Karnal, India, in 1931 (Mitra, 1931), and the disease was named after him. Karnal bunt is a limiting factor in wheat export because the pathogen is regulated by most countries as a quarantine pest. As a seed borne pathogen it threatens wheat trade between countries. Therefore, it has significance in seed certification aspects (Kumar *et al.*, 2008 and Tan *et al.*, 2009). Wheat with three per cent bunted grains is unfit for human consumption (Ullah *et al.*, 2012). The seed viability of highly infected grains is significantly reduced. Increased infection grades result in continuous decrease infertile.

The presence of trimethylamine, which is secreted by teliospores, causes the disease's fishy odour. 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 (Tunwar and Singh, 1988). Black point another disease of wheat is common in all wheat growing regions of the world (Lorenz, 1986) and characterized by a dark discoloration of the embryo sides of the wheat and barley grains (Mak *et al.*, 2006). Black point of wheat is a brown or black discoloration at the germ end of the grain and in severe cases extends along the crease of the grains (Williamson, 1997). This is a serious problem and occurs regularly especially in irrigated areas where *T. aestivum* wheat are predominantly grown. When, seed moisture content exceeds 20 per cent, coupled with the relative humidity above 90 per cent, the amount of black point increases dramatically. The environment had a major impact on the incidence of black point. Low temperature and high rainfall during the period of grain filling resulted in severe kernel discoloration (Wang *et al.*, 2002). In Haryana, Karnal bunt infection has ranged from 0.05- 9.90 and 0.05-3.00 per cent during 1995-96 and 1996- 97 crop seasons, respectively (Duhan *et al.*, 2004). The disease was found in almost all the districts of Haryana in cultivated varieties (Jakhar and Punia, 2013; Jakhar and Bhuker, 2014). While, black point Infection range was found maximum in Hisar (0.05-1.50%) during 2014



and it was found maximum in Kurukshetra (0.15-5.00%) during 2015. Lowest infection was found in the samples collected from Jind (34.04%) and Kurukshetra (59.01%) in 2015. Minimum average infection was found in the samples of Jind (0.043%) in 2014 while in 2015, minimum average infection was found in Yamunanagar (0.217%). Infection range of this disease was found minimum in Sirsa (0.05-0.30%) in 2014 while in 2015 it was found minimum in Fatehabad and Ambala (0.20-0.80%) (Jakhar and Bhuker, 2015).

The current study was designed to assess the status of Karnal bunt and black point in the Northern region of Haryana during the *rabi* 2021-22. The seed/grain samples were collected during April, 2022 from grain markets and seed producers of 11 districts *viz.*, Hisar, Fatehabad, Sirsa, Karnal, Kaithal, Kurukshetra, Yamuna Nagar, Panipat, Jind, Sonipat, and Ambala and analysed for Karnal bunt and Black point infection in the seed pathology laboratory of Department of Seed Science & Technology, CCS Haryana Agricultural University, Hisar. Overall 849 samples were collected from 49 grain markets and seed producers comprising. The samples are homogenized by seed divider. The samples were analyzed for Karnal bunt following NaOH seed soak method and black point infection following dry seed examination method. A total of 4,000 seeds were taken in 2 replications of 2000 each. The per cent Karnal bunt and black point infected seeds were calculated by following formula:

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 samples having infection greater than permissible limit /Total sample analyzed) x 100

Karnal bunt infected seeds were detected by NaOH seed soak technique (Agarwal and Verma 1983, Agarwal and Srivastava 1985). 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.

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 0.05–0.40 per cent in the surveyed districts. The infected samples were 281 (33.09%) and rejected samples were four (0.47%) having infection more than 0.25 percent (maximum limit of Indian Minimum Seed Certification Standards). The average infection in districts was maximum in Yamuna Nagar district (0.051%) followed by Sonipat (0.042%), Fatehabad (0.037%), Jind (0.033%), Hisar (0.026%), Kaithal (0.025%), Karnal (0.024%), Panipat (0.022%), Kurukshetra (0.017%), Ambala (0.014%) and minimum was recorded in Sirsa (0.011%). The range of infection was highest in Sonipat (0.05-0.40%), Fatehabad (0.05-0.40%) followed by Kaithal (0.05-0.35%) and lowest was observed in Sirsa (0.05–0.10%) and Kurukshetra (0.05 – 0.10%). The similar trend of infection was observed in 2016-17, 2017-18 and 2020-21 in surveyed districts of Haryana (Jakhar *et al.*, 2018, Gill *et al.*, 1993, Jakhar and Bhuker 2014 & Jakhar and Punia 2013). The reason behind occurrence is suitable temperature, high relative humidity, cloudy and rainy weather which promoted the Karnal bunt development (Nagarajan *et al.*, 1997). Table 2 shows that infected samples were lowest in Sirsa district (19.65%) and infection was in ascending order in following grain markets *viz.*, Kaithal (26.78%), Ambala (28.75%), Kurukshetra (29.41%), Panipat (30.90%), Jind (31.06%), Fatehabad (33.33%), Karnal (39.43%), Hisar (39.85%), Yamuna Nagar (48.83%) and Sonipat district (48.88%). In case of rejected samples, some of the grain markets found rejected samples *viz.*, Tohana (2), Lakhna Majra (1) and Kalayat (1). No rejection of infected samples was found except Fatehabad, Sonipat and Kaithal. The highest numbers of rejected samples were found in Tohana 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. The perusal of data of Table 3 indicates the range of black point was between 0.05-2.25 per cent in the surveyed districts. The infected samples were 740 (87.16%). The severity of black point was highest in Sonipat district with average infection of 0.218 per cent followed by Fatehabad (0.189%), Yamuna Nagar (0.180%), Sirsa (0.179%), Kaithal (0.165%), Jind (0.147%), Hisar (0.127%),



Panipat (0.112%), Karnal (0.105%), Kurukshetra (0.082%) and Ambala (0.042%) The incidence of the disease was lowest in Ambala (0.042%) followed by Kurukshetra (0.082%). During *rabi* 2021-22, Fatehabad district recorded high infection/incidence of black point (range of infection 0.05-2.25%) followed by Sonipat (0.05-1.60%) whereas, it was lowest in Ambala (0.05-0.10%). Table 4 shows that infected samples of black point were lowest in Ambala (57.14%) and infection was in ascending order in following grain markets *viz.*, Kurukshetra (75.49%), Panipat (81.81%), Karnal (84.50%), Yamuna Nagar (86.04%), Sirsa (88.03%), Fatehabad (88.40%), Jind (92.42%), Kaithal (92.85%), Sonipat (93.33%) and Hisar district (93.47%). None of the district surveyed was found free from black point. There was 100 per cent infected samples found in following grain markets/seed producers *viz.*, Kathura, Narwana, Dhamtan sahib, Nagura, Safidon, Israna, Partap Nagar (Khizrabad), Kaithal, Gumthala, Mundhal and Uklana. The similar trend of infection was observed in 2014-15 in surveyed districts of Haryana (Jakhar and Bhuker, 2015). Environmental conditions of cultivated area play a great role in disease incidence (Beniwal *et al.*, 2005 and Jain *et al.*, 2012). 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 (Wei and Gui 2010 & Singh and Robin 2011) in wheat seed production programmes and also spray the required dose of chemicals during susceptibility stage (Goates and Jackson 2006). Karnal bunt and black point diseases are difficult to control due to their intermittent nature. The prevalence changes considerably from year to year depending on availability of favorable conditions during the heading stage. So, roving surveys were planned to know the present status of the disease in eleven districts of northern Haryana. A total of 849 seeds/grains sample were collected among them 281 samples were found infected with Karnal bunt and 740 with Black point. It is noticed that none of the districts was found free from Karnal bunt and Black point. Hence, to reduce the Karnal bunt and Black point infection, the seed must be treated prior to sowing. The seed production programme should be taken in less disease prone areas, which need to be identified. The recommended measures should be taken at appropriate stage *i.e.* spray of propiconazole (tilt 25 EC) at heading stage and soil fumigation with methyl bromide.

Table 1: Districtwise report on Karnal bunt in northern Haryana (May, 2022)

Districts	Total seed Sampled	Infected Samples		Range of Infection (%)	Infected Seed (No.)	Average Infection (%)	Rejected samples	
		No.	%				No.	%
Ambala	21	06	28.75	0.05	06	0.014	0	0.00
Sonipat	45	22	48.88	0.05-0.40	38	0.042	1	2.22
Jind	132	41	31.06	0.05-0.20	88	0.033	0	0.00
Panipat	55	17	30.90	0.05-0.15	25	0.022	0	0.00
Yamuna Nagar	43	21	48.83	0.05-0.20	44	0.051	0	0.00
Kurukshetra	102	30	29.41	0.05-0.10	35	0.017	0	0.00
Kaithal	56	15	26.78	0.05-0.35	25	0.025	1	1.78
Karnal	71	28	39.43	0.05-0.15	34	0.024	0	0.00
Sirsa	117	23	19.65	0.05-0.10	26	0.011	0	0.00
Fatehabad	69	23	33.33	0.05-0.40	52	0.037	2	2.89
Hisar	138	55	39.85	0.05-0.20	74	0.026	0	0.00
Total	849	281	33.09	0.05-0.40	447	0.026	4	0.47

Table 2: Grain Marketwise report on Karnal bunt in northern Haryana (May, 2022)



Districts	Grain market	Total seed Sampled	Infected Samples		Range of Infection (%)	Infected Seed (No.)	Average Infection (%)	Rejected samples	
			No.	% age				No.	%
Ambala (1)	Mullana	21	06	28.75	0.05	06	0.014	0	0.00
	Total	21	06	28.75	0.05	06	0.014	0	0.00
Sonipat (3)	Gohana	30	14	46.66	0.05-0.10	20	0.033	0	0.00
	Lakhan Majra	7	4	57.14	0.05-0.40	12	0.085	1	14.28
	Kathura	8	4	50.00	0.05-0.10	6	0.037	0	0.00
	Total	45	22	48.88	0.05-0.40	38	0.042	1	2.22
Jind (7)	Narwana	17	05	29.41	0.05-0.10	06	0.017	0	0.00
	Dhamtan sahib	08	01	12.50	0.05	01	0.006	0	0.00
	Julana	34	15	44.10	0.05-0.15	24	0.035	0	0.00
	Uchana	16	06	37.50	0.05-0.20	10	0.031	0	0.00
	Jind	26	09	34.61	0.05-0.20	15	0.028	0	0.00
	Nagura	11	07	63.33	0.05-0.15	11	0.034	0	0.00
	Safidon	20	09	45.00	0.05-0.20	21	0.052	0	0.00
	Total	132	41	31.06	0.05-0.20	88	0.033	0	0.00
Panipat (3)	Madlauda	17	05	29.41	0.05-0.15	13	0.038	0	0.00
	Panipat	22	08	36.36	0.05	08	0.018	0	0.00
	Israna	16	04	25.00	0.05	04	0.012	0	0.00
	Total	55	17	30.90	0.05-0.15	25	0.022	0	0.00
Yamuna Nagar (3)	Radaur	18	08	44.44	0.05-0.10	11	0.030	0	0.00
	Partap Nagar (Khizrabad)	09	05	55.55	0.05-0.15	13	0.072	0	0.00
	Jagadhari	16	08	50.00	0.05-0.20	20	0.062	0	0.00
	Total	43	21	48.83	0.05-0.20	44	0.051	0	0.00
Kurukshetra (8)	Pipli	10	04	40.00	0.05	04	0.020	0	0.00
	Ladwa	13	05	38.46	0.05-0.10	09	0.034	0	0.00
	Shahbad	16	04	25.00	0.05	04	0.012	0	0.00
	Nissing	18	03	16.66	0.05	03	0.008	0	0.00
	Thol	10	03	30.00	0.05	03	0.015	0	0.00
	Ismailabad	10	03	30.00	0.05-0.10	04	0.020	0	0.00
	Pehowa	09	04	44.44	0.05	04	0.022	0	0.00
	Barara	16	04	25.00	0.05	04	0.012	0	0.00
	Total	102	30	29.41	0.05-0.10	35	0.017	0	0.00
Kaithal (4)	Kalayath	15	05	33.33	0.05-0.35	12	0.040	1	6.66
	Kaithal	20	04	20.00	0.05	04	0.010	0	0.00
	Pundri	15	04	26.66	0.05-0.10	05	0.016	0	0.00
	Gumthala	06	02	33.33	0.10	04	0.033	0	0.00



	Total	56	15	26.78	0.05-0.35	25	0.025	1	1.78
Karnal (3)	Jundla	15	05	33.33	0.05-0.10	06	0.020	0	0.00
	Karnal	30	10	33.33	0.05-0.15	13	0.021	0	0.00
	Assand	26	13	50.00	0.05-0.10	15	0.028	0	0.00
	Total	71	28	39.43	0.05-0.15	34	0.024	0	0.00
Sirsa (6)	Dabwali	18	05	27.77	0.05-0.10	08	0.022	0	0.00
	Odhan	20	04	20.00	0.05-0.10	04	0.010	0	0.00
	Kalawali	15	02	43.33	0.05	02	0.006	0	0.00
	Sirsa	11	02	18.18	0.05	02	0.009	0	0.00
	Ding	28	05	17.85	0.05-0.10	05	0.008	0	0.00
	Nathusuri Chaupta	25	05	20.00	0.05	05	0.010	0	0.00
	Total	117	23	19.65	0.05-0.10	26	0.011	0	0.00
Fatehabad (4)	Bhattu	22	03	13.63	0.05	03	0.006	0	0.00
	Fatehabad	19	07	36.84	0.05-0.10	09	0.023	0	0.00
	Bhuna	16	03	18.75	0.05-0.10	05	0.015	0	0.00
	Tohana	12	10	83.33	0.05-0.40	35	0.145	2	16.66
	Total	69	23	33.33	0.05-0.40	52	0.037	2	2.89
Hisar (7)	Hansi	24	07	29.16	0.05-0.10	09	0.018	0	0.00
	Mundhal	08	04	50.00	0.05-0.20	08	0.050	0	0.00
	Bass	20	12	60.00	0.05-0.20	16	0.040	0	0.00
	Uklana	10	03	30.00	0.05	03	0.015	0	0.000
	Barwala	33	16	48.48	0.05-0.10	21	0.031	0	0.00
	Narnaund	25	07	28.00	0.05-0.10	10	0.020	0	0.00
	Mandi Adampur	18	06	33.33	0.05-0.10	07	0.019	0	0.00
	Total	138	55	39.85	0.05-0.20	74	0.026	0	0.00
Grand Total	49	849	281	33.09	0.05-0.40	447	0.026	4	0.47

Table 3: Districtwise report on black point in northern Haryana (May, 2022)

Districts	Total seed Sampled	Infected Samples		Range of Infection (%)	Infected Seed (No.)	Average Infection (%)
		No.	%			
Ambala	21	12	57.14	0.05-0.10	18	0.042
Sonipat	45	42	93.33	0.05-1.60	197	0.218
Jind	132	122	92.42	0.05-1.10	390	0.147
Panipat	55	45	81.81	0.05-0.90	123	0.112
Yamuna Nagar	43	37	86.04	0.05-0.60	155	0.180
Kurukshetra	102	77	75.49	0.05-0.50	169	0.082
Kaithal	56	52	92.85	0.05-1.10	185	0.165
Karnal	71	60	84.50	0.05-0.15	150	0.105



Sirsa	117	103	88.03	0.05-1.55	419	0.179
Fatehabad	69	61	88.40	0.05-2.25	262	0.189
Hisar	138	129	93.47	0.05-0.45	352	0.127
Total	849	740	87.16	0.05-2.25	2420	0.142

Table 4: Grain marketwise report on black point in northern Haryana (May, 2022)

Districts	Grain market	Total seed Sampled	Infected Samples		Range of Infection (%)	Infected Seed (No.)	Average Infection (%)
			No.	%age			
Ambala (1)	Mullana	21	12	57.14	0.05-0.10	18	0.042
	Total	21	12	57.14	0.05-0.10	18	0.042
Sonipat (3)	Gohana	30	28	93.33	0.05-0.55	81	0.135
	Lakhan Majra	07	06	85.71	0.05-1.60	70	0.500
	Kathura	08	08	100.00	0.05-0.55	46	0.287
	Total	45	42	93.33	0.05-1.60	197	0.218
Jind (7)	Narwana	17	17	100.00	0.10-0.30	47	0.138
	Dhamtan sahib	08	08	100.00	0.05-0.20	20	0.125
	Julana	34	31	91.17	0.05-0.50	94	0.138
	Uchana	16	16	100.00	0.10-0.45	45	0.140
	Jind	26	19	73.07	0.05-0.75	71	0.136
	Nagura	11	11	100.00	0.05-0.35	37	0.168
	Safidon	20	20	100.00	0.05-1.10	76	0.190
	Total	132	122	92.42	0.05-1.10	390	0.147
Panipat (3)	Madlauda	17	15	88.23	0.05-0.90	53	0.155
	Panipat	22	14	63.33	0.05-0.15	32	0.072
	Israna	16	16	100.00	0.05-0.20	38	0.118
	Total	55	45	81.81	0.05-0.90	123	0.112
Yamuna Nagar (3)	Radaur	18	16	88.88	0.05-0.20	37	0.102
	Partap Nagar (Khizrabad)	09	09	100.00	0.10-0.60	70	0.388
	Jagadhari	16	12	75.00	0.05-0.30	48	0.150
	Total	43	37	86.04	0.05-0.60	155	0.180
Kurukshetra (8)	Pipli	10	8	80.00	0.05-0.50	34	0.170
	Ladwa	13	8	61.53	0.05-0.20	19	0.073
	Shahbad	16	12	75.00	0.05-0.10	20	0.062
	Nissing	18	15	83.33	0.10-0.25	33	0.091
	Thol	10	8	80.00	0.05-0.15	12	0.060
	Ismailabad	10	8	80.00	0.05-0.35	18	0.090
	Pehowa	09	8	88.88	0.05-0.20	13	0.072
	Barara	16	10	62.50	0.05-0.30	20	0.062
	Total	102	77	75.49	0.05-0.50	169	0.082
Kaithal (4)	Kalayath	15	14	93.33	0.05-1.10	46	0.153
	Kaithal	20	20	100.00	0.10-0.35	104	0.260
	Pundri	15	12	80.00	0.10-0.15	26	0.086
	Gumthala	06	06	100.00	0.05-0.10	09	0.075



	Total	56	52	92.85	0.05-1.10	185	0.165
Karnal (3)	Jundla	15	13	86.66	0.05-0.25	26	0.086
	Karnal	30	24	80.00	0.05-0.45	60	0.100
	Assand	26	23	88.46	0.05-0.10	64	0.123
	Total	71	60	84.50	0.05-0.15	150	0.105
Sirsa (6)	Dabwali	18	16	88.88	0.05-0.30	38	0.105
	Odhan	20	17	85.00	0.05-0.95	55	0.137
	Kalawali	15	13	86.66	0.05-0.20	21	0.070
	Sirsa	11	10	90.90	0.05-0.50	35	0.159
	Ding	28	26	92.85	0.05-1.55	126	0.225
	Nathusuri Chaupta	25	21	84.00	0.05-1.35	144	0.288
	Total	117	103	88.03	0.05-1.55	419	0.179
Fatehabad (4)	Bhattu	22	21	95.45	0.05-0.20	33	0.075
	Fatehabad	19	13	68.42	0.05-0.25	32	0.084
	Bhuna	16	15	93.75	0.05-0.90	70	0.218
	Tohana	12	12	100.00	0.15-2.25	127	0.529
	Total	69	61	88.40	0.05-2.25	262	0.189
Hisar (7)	Hansi	24	20	83.33	0.05-0.25	44	0.091
	Mundhal	08	08	100.00	0.05-0.45	27	0.168
	Bass	20	19	95.00	0.05-0.25	55	0.137
	Uklana	10	10	100.00	0.05-0.35	31	0.155
	Barwala	33	32	96.66	0.05-0.35	86	0.130
	Narnaund	25	24	96.00	0.05-0.30	63	0.126
	Mandi Adampur	18	16	88.88	0.05-0.40	46	0.127
	Total	138	129	93.47	0.05-0.45	352	0.127
Grand Total	49	849	740	87.16	0.05-2.25	2420	0.142

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Author's Contribution

S.S. Jakhar: Designing and execution of experiments

Axay Bhuker: Analysis of data and interpretation

Bittu Ram: Preparation of the manuscript

Declaration of interest statement

The authors declare no conflict of interest.

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