

Prevalence and Incidence of *Neovossia indica* in Wheat Seeds/Grains Produced in Northern Region of Haryana

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Wheat has been staple food of the major civilisations in Europe, Western Asia, and North Africa for 8,000 years. During the past four decades the crop has undergone historic changes. Asia experienced benefits from the “Green Revolution”, started in the mid 1960s. Half of the developing world’s wheat growing area comprises large irrigated tracts, mostly found in India, Pakistan and China. Bread wheat (*Triticum aestivum* L.) is planted on 93 per cent of the global wheat growing area. A number of factors are responsible for lower productivity in wheat as compared to certain developed countries and states within the country. Regarding diseases, rusts, loose smut, Karnal bunt and off course, the ear-cockle is a major concern in growing regions. The smut fungus *Tilletia indica* Mitra (syn. *Neovossia indica* (Mitra) Mundkur), causing Karnal bunt (KB) was first reported by Mitra (1931) from botanical station, IARI, Karnal [1]. The disease shortens the length of ears as well as number of spikelets in the infected heads. Karnal bunt pathogen is seed and soil borne. The disease reduces seed quality, changes the chemical composition of infected grains and makes seed inedible. Wheat containing three per cent bunted grains is unfit for human consumption [2].

The disease now occurs generally in all the states except Maharashtra, Gujarat, Orissa, Assam, Meghalaya, Karnataka, Andhra Pradesh, Tamil Nadu and Kerala [3,4,5]. Haryana is the major contributing state in wheat production. Seed certification agencies reject a large quantity of wheat due to infection of Karnal bunt in case of 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 objectionable Karnal bunt disease has prescribed standards of 0.05 and 0.25 per cent for foundation and certified seeds, respectively [6]. Therefore, roving surveys were conducted to assess the present status of

Karnal bunt in the *Rabi* season of 2020-21 in Northern region of Haryana. The seed/grain samples were collected in April 2021 from grain markets and seed producers comprising of 11 districts (Ambala, Sonapat, Jind, Panipat, Yamunanagar, Kurukshetra, Kaithal, Karnal, Sirsa, Fatehabad and Hisar) and were analyzed for Karnal bunt infection in Seed Pathology Laboratory of Department of Seed Science & Technology. The samples were homogenized by seed divider. A total of 4,000 seeds/grains were taken in two replications of 2000 each.

The per cent Karnal bunt infected seeds/grains 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/grains were detected by NaOH seed soak technique [6,7]. Wheat seeds/grains 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/ grains were thoroughly washed in tap water and were examined visually, aided with light. The seeds/grains exhibiting jet black shiny appearance with hallow or without hollowness were separated. The infected seeds/ grains were counted and the percentage was calculated as per formula mentioned above. District wise observations were recorded on average infection as suggested by Beniwal *et al.*, [9].

Table 1. District wise seeds/grains samples report on Karnal bunt in northern Haryana

Districts	Total samples	Infected Samples		Range of Infection	Infected Seed	Average Infection	Rejected samples	
	No.	No.	%	%	No.	%	No.	%
Ambala	16	11	68.75	0.05-0.50	45	0.140	2	12.50
Sonipat	36	31	86.11	0.05-0.40	117	0.162	9	25.00
Jind	92	63	68.47	0.05-0.50	202	0.109	12	13.04
Panipat	78	54	69.23	0.05-0.60	252	0.161	20	25.64
Yamuna Nagar	47	34	72.34	0.05-0.60	172	0.182	15	31.91
Kurukshetra	127	92	72.44	0.05-0.65	398	0.156	31	24.40
Kaithal	69	56	81.15	0.05-0.65	254	0.184	17	24.63
Karnal	55	41	74.54	0.05-0.60	130	0.154	11	20.00
Sirsa	118	74	62.71	0.05-0.40	147	0.062	4	3.38
Fatehabad	119	74	62.18	0.05-0.55	296	0.124	21	17.64
Hisar	124	79	63.70	0.05-0.50	112	0.045	9	7.25
Total/Average	881	609	69.12	0.05-0.65	2125	0.120	151	17.13

A total of 881 wheat seeds/grains samples were collected from 48 places of northern Haryana located in eleven districts *viz.*, Hisar, Jind, Fatehabad, Yamunanagar, Panipat, Kurukshetra, Karnal, Sirsa, Ambala, Kaithal and Sonipat (Table 1). The results indicated that out of 881 samples examined, 609 were found infected (69.12%) while the range of infection was between 0.05–0.65 per cent among the districts. A total of 151 seeds/grains samples were rejected having infection more than 0.25 per cent (maximum limit of IMSCS). Among the districts maximum average infection was recorded in Kaithal district (0.184%), Yamuna Nagar (0.182%), Sonipat (0.162%) and Panipat (0.161%) while minimum was recorded in Hisar (0.045%) and Sirsa (0.062%) districts. The highest range of infection was recorded in both Kaithal (0.05-0.65%) and Kurukshetra (0.05-0.65%)

districts. The results were corroborated with the earlier findings [10,11].

The table 2 showed the samples collected from grain markets in different districts. The highest number of samples was collected from eight places in Kurukshetra (127) followed by seven places in Hisar (124) and seven places in Fatehabad (119). The lowest number of samples was collected from one place in Ambala (16) and Sonipat (36). The infected samples were recorded highest in Sonipat (86.11%) and lowest in Fatehabad (62.18%). Among districts, maximum number of rejected samples were recorded in Yamunanagar (31.91%) followed by Panipat (25.64%) and minimum was in Sirsa (3.38%). The results are in accordance with the similar findings [12].

Table 2. Places wise report in different districts on Karnal bunt in northern Haryana

Districts	Places	Total samples	Infected Samples		Range of Infection	Infected Seed	Average Infection	Rejected samples	
		No.	No.	%	%	No.	%	No.	%
Ambala (1)	Mullana	16	11	68.75	0.05-0.50	45	0.140	2	12.50
	Total	16	11	68.75	0.05-0.50	45	0.140	2	12.50
Sonipat (1)	Gohana	36	31	86.11	0.05-0.40	117	0.162	9	25.00
	Total	36	31	86.11	0.05-0.40	117	0.162	9	25.00
Jind (5)	Narwana	21	17	80.95	0.05-0.40	52	0.124	2	09.52
	Julana	19	15	78.94	0.05-0.50	51	0.134	4	21.05
	Uchana	19	13	68.42	0.05-0.50	50	0.131	3	15.78
	Pillu-Khera	15	08	53.33	0.05-0.35	19	0.063	1	06.66
	Jind	18	10	55.55	0.05-0.35	30	0.083	2	11.11
	Total	92	63	68.47	0.05-0.50	202	0.109	12	13.04

Contd.

Districts	Places	Total samples		Infected Samples		Range of Infection		Infected Seed		Average Infection		Rejected samples	
		No.	No.	%	%	No.	%	No.	%	No.	%		
Panipat (3)	Madlauda	32	19	59.37	0.05-0.50	80	0.125	7	21.87				
	Panipat	23	20	86.95	0.05-0.60	142	0.308	13	56.52				
	Israna	23	15	65.21	0.05-0.20	30	0.065	0	0.00				
	Total	78	54	69.23	0.05-0.60	252	0.161	20	25.64				
Yamuna Nagar (3)	Radaur	18	12	66.66	0.10-0.65	62	0.172	5	27.77				
	Ladwa	17	12	70.58	0.05-0.50	53	0.155	5	29.41				
	Jagadhari	12	10	83.33	0.05-0.60	57	0.237	5	41.66				
	Total	47	34	72.34	0.05-0.60	172	0.182	15	31.91				
Kurukshetra (8)	Pipli	15	9	60.00	0.10-0.65	45	0.150	5	33.33				
	Kurukshetra	14	12	85.71	0.05-0.50	54	0.192	6	42.85				
	Brara	19	14	73.68	0.05-0.40	41	0.107	3	15.78				
	Shahbad	15	11	73.33	0.05-0.40	39	0.130	5	33.33				
	Thol	18	12	66.66	0.05-0.40	41	0.113	3	16.66				
	Ismailabad	18	14	77.77	0.05-0.50	56	0.155	4	22.22				
	Pehowa	19	15	78.94	0.05-0.45	57	0.150	4	21.05				
	Malikpur	9	5	55.55	0.05-0.30	15	0.083	1	11.11				
	Total	127	92	72.44	0.05-0.65	398	0.156	31	24.40				
Kaithal (4)	Kalayath	20	15	75.00	0.05-0.60	112	0.280	9	45.00				
	Kaithal	17	15	88.23	0.05-0.50	60	0.176	3	17.64				
	Pundri	15	13	86.66	0.05-0.40	40	0.133	2	13.33				
	Gumthla	17	13	76.47	0.05-0.65	42	0.123	3	17.64				
Total	69	56	81.15	0.05-0.65	254	0.184	17	24.63					
Karnal (3)	Jundla	10	06	60.00	0.10-0.35	23	0.115	1	10.00				
	Indri	23	16	69.56	0.05-0.60	77	0.167	5	21.73				
	Assand	22	19	86.36	0.05-0.50	70	0.154	5	22.72				
	Total	55	41	74.54	0.05-0.60	130	0.154	11	20.00				
Sirsa (6)	Dabawali	18	08	44.44	0.05-0.30	17	0.047	1	5.55				
	Odhan	19	11	57.90	0.05-0.15	19	0.050	0	0.00				
	Kalanwali	20	08	40.00	0.05-0.10	11	0.027	0	0.00				
	Sirsa	21	17	80.95	0.05-0.40	50	0.119	3	14.22				
	Ding	24	16	66.66	0.05-0.25	28	0.058	0	0.00				
	Nathusuri Chaupta	16	14	89.50	0.05-0.25	22	0.068	0	0.00				
Total	118	74	62.71	0.05-0.40	147	0.062	4	3.38					
Fatehabad (7)	Dhand	12	05	41.66	0.05-0.45	24	0.100	3	25.00				
	Bhattu	24	19	79.16	0.05-0.50	111	0.231	8	33.00				
	Fatehabad	23	16	69.56	0.05-0.40	28	0.060	1	4.34				
	Bhuna	14	06	42.85	0.05-0.45	19	0.067	1	7.14				
	Aharwa	10	03	30.00	0.05-0.10	4	0.020	0	0.00				
	Tohana	20	19	95.00	0.05-0.55	99	0.247	8	40.00				
	Ratia	16	06	37.50	0.05-0.20	11	0.550	0	0.00				
Total	119	74	62.18	0.05-0.55	296	0.124	21	17.64					
Hisar (7)	Hansi	20	12	60.00	0.05-0.20	19	0.047	0	0.00				
	Mundhal	17	11	64.70	0.05-0.40	34	0.100	2	11.76				
	Bass	20	10	50.00	0.05-0.50	31	0.095	2	10.00				
	Uklana	22	16	72.72	0.05-0.20	37	0.084	0	0.000				
	Barwala	17	11	64.70	0.05-0.30	34	0.100	1	5.88				
	Narnaund	13	06	46.15	0.05-0.45	16	0.061	1	7.69				
	Mandi Adampur	15	13	86.66	0.05-0.30	21	0.070	1	6.66				
Total	124	79	63.70	0.05-0.50	112	0.045	9	7.25					
Grand Total	48	881	609	69.12	0.05-0.65	2125	0.120	151	17.13				

Karnal bunt disease is difficult to control due to its 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 881 seeds/grains samples were collected among them 609 were found infected. The highest range of infection was observed in Kurukshetra and Kaithal. The safest district having least percentage of rejected seeds/grains samples was Sirsa and Hisar which were to be undertaken for seed production purposes. 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.

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