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Effect of date of sowing and fertilizer level on the incidence Karnal bunt of wheat

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Abstract
Karnal bunt caused by *Tilletia indica* Mitra (*Neovossia indica* Mitra (Mundkur) was first recorded in April, 193from Botanical Research Station, Karnal (Haryana) on wheat cultivar, foundation and Punjab A. The disease was prevalent in the sub-continent since long, infecting native wheat grown over North Western India but it never caused serious yield reduction. However, the disease appeared in serious proportions in early 1970s with the introduction of dwarf Mexican Wheat Varieties into India and Pakistan. Till 1974-75 the disease remained restricted to Jammu and Kashmir, Punjab and Tarai region of Uttar Pradesh. The disease in seed,soil and air borne in nature and difficult to manage and different strategies like crop rotation, delayed sowing, avoiding excessive use of nitrogenous fertilizer and irrigation are no more tenable in present day intensive agriculture. Studies indicated that varieties like Raj-3077, HD-2733, NW-1012, K-307, K-9423 and DBW-17 are safer against the disease. Due to very-very low disease incidence the results regarding the suitability of sowing date and fertilizer levels found inconclusive.

Keywords: Karnal bunt, *Neovossia indica*

1. Introduction
Wheat (*Triticum aestivum* L.) continues to be the most dynamic sector in world grain production and India is the second largest producer, preceded only by China and major contributor to the agricultural economy of the country. It is grown under diverse agro-climatic conditions and occupies more than 29902.23 million hectares area with a production of above 93902.56mt. and average productivity of 31.40 tons/ha [2]. There was quantum jump area production and productivity wise as compared to the previous year. Uttar Pradesh ranked first area and production wise during both the years i.e. 2010-2011 and 2011-2012.Simultaneously, from productivity point of view Punjab ranked first during 2010-11 but came down to second place during 2011-12 and Haryana ranked on first place. However, U.P. remained on 4th place during both the years [2].

There are a number of factors responsible for lower productivity of wheat crop as compared to certain developed countries and states within the country. Biotic as well as abiotic factors are also posing serious threats in realizing the full potential. Among the abiotic factors the global warming, consequently the rise in temperature at milking stage of the crop is major threat affecting the productivity adversely. Very late sowing, slow varietal replacement, poor seed bed after rice, low and uncertain water supply, inefficient use and deficiency of nutrients, weeds, problem soils, termites under dry land conditions are also additional factors continue to impair wheat productivity in the country. Regarding diseases, rusts, foliar blight, loose smut and Karnal bunt and off course, the ear-cockle are major concern in wheat growing regions. On the other hand, the disease UG-99 is also of quarantine importance. Karnal bunt, which is caused by *Tilletia indica*, occur sporadically but assumes epidemic proportions in certain years and causes substantial losses to both quality and quantity of wheat. In certain varieties such as HD-2009, the percentage of affected grains was as high as 30-40% and it has been estimated that the Karnal bunt disease of wheat causes the yield losses up to 400metric tons of grain per year. Loss of 42.4% in the variety of WL-711 and 57.5% in the variety HD-2009 in Punjab during the epidemics of 1978-78 [5]. The disease remained endemic for considerable period of time in the Northern area of Pakistan later it spread to south and was reported from Jhang, Khanewal and Muzaffargarh district of Punjab [7].

There is no estimate of exact losses, due to this disease, occurring in Pakistan, however, survey in India conducted during the years of heavy disease revealed a total loss of 0.5 percent, but in some fields where 8 percent of kernels were infected, the yield losses ranged from 20-40

percent in highly susceptible varieties [1]. *Tilletia indica* (Mitra) Mundkur (Synonym *Neovossia indica* Mundkur).The class name is derived from ustulatus meaning burned, in suggestion to the blackened appearance of the infected plants. Cereal infecting species of *Tilletia* that produce teliospores within the ovaries of their losts plants are generally called bunt fungi.Mundkur stated that *T. indica* probably belongs to the genus *Neovossia* based on the large number of non-conjugating basidiospores produced by the fungus. The teliospores of the Karnal bunt fungus can survive in soil for more than 5 years. The teliospores remains viables upto several years in partially or completely converted into black powdery masses enclosed by the pericarp in seeds [9, 10].

However, the disease is posing a serious threat to the countries seed production programme during recent years, despite, no outbreak has been reported in recent past. The significance of the disease can be attributed with fact that under Indian Minimum Seed Certification Standards, the maximum permissible limits for the Karnal bunt infected seeds are 0.05% 0.25% in case of foundations and certified seed respectively and any seed lot having more than these limits are rejected, thus causing serious losses to the seed producer and farmers. Control of Karnal bunt has now become a major concern in India due to lack of desired resistance in popular bread wheat cultivars in Northern plain and Central zones coupled with favourable weather conditions at flowering stage favour the high incidence of Karnal bunt. However, there is a urgent need to develop appropriate experimental models to study relative importance of the sub-systems of the integrated management system in terms of their effectiveness and economics. Successful management of a disease like Karnal bunt, which is seed borne, soil-borne and air-borne, would depend on our understanding of the sub-systems mentioned above and their integration into an appropriate package of practices for use by the wheat growers.

The disease has become a major SPS issue in wake of recent Sanitory Phytosanitory Agreement stipulated by World Trade Organization. Affected areas of United States are quarantined to limit spread of disease. Currently, the Karnal bunt regulatory programme allows the U.S. Department of Agriculture to issue Phytosanitory export certificates.

2. Material and Method

2.1 Effect of sowing dates and nitrogen levels on Karnal bunt in wheat varieties

Four wheat varieties namely HD 2733, PBW 343, K 307 and DBW 39 were planted between three different dates i.e. 3 to 11 Nov. 12 to 18 Nov. and 19 to 25 Nov.2012 by the agronomist at CRS Masodha Unit-Ist Faizabad. After the harvesting, samples were obtained and the 1000 grain weight as well as percent KB infection was worked out.

Similarly four genotypes namely HD 3070, C 306, K 8027 and HD 2888 were planted in the plots planted with three nitrogen level i.e. 40, 60 & 80 kg N/ha^{-1}. These fertilizer doses were combined with basal dose of 30 kg P_2O_5 per hectare uniformly. Seed samples were obtained from the individual treatments and 1000 grain weight as well as percent Karnal bunt was worked out as per procedure.

3. Result

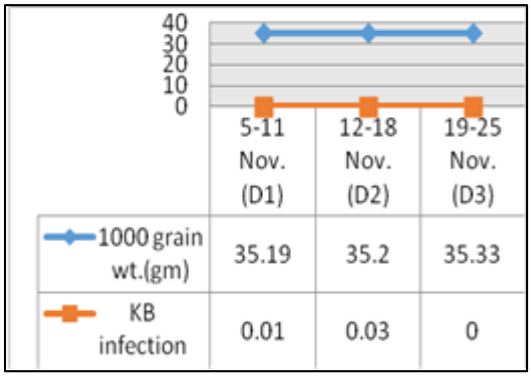
3.1 Effect of sowing date and variety on test weight and incidence of Karnal bunt.

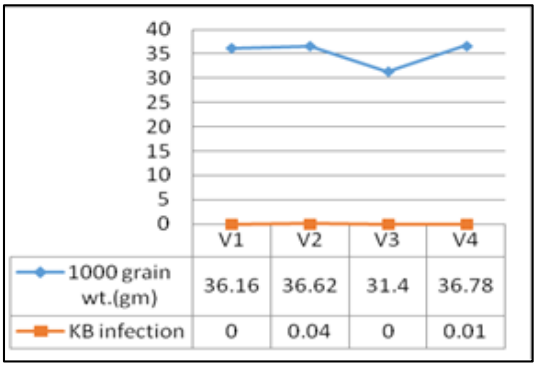
The maximum test weight (35.33gm) was recorded in case of 19 to 25 November sowing followed by D_2 i.e. 12 to 18 November and minimum (35.19gm) in case of D_1 i.e. 5 to 11 November. Variety wise, maximum test weight (36.78gm) was recorded in case of DBW-39 followed by (36.62gm) in case of PBW 343 and (36.16gm) in HD-2733. The minimum test weight (31.40gm) was recorded in case of K-307. Test weight wise V_1, V_2 and V_4 were found significantly inferior (Table-1).

Regarding Karnal bunt the maximum infection was observed in D_2 (0.03%) followed by D_1 whereas in D_3 there was no any Karnal bunt infection because of the very low disease incidence no conclusions, regarding the sowing dates and variety could be possible. Variety wise HD 2733 (V_1) and K-307 (V_3) were found free from Karnal bunt infection whereas in PBW 343 (V_2) the maximum infection (0.04%) was recorded.

Table 1: Effect of sowing dates and variety on test wt. and Karnal bunt of wheat. Date of sowing 100grain wt.(gm) KB infection

Date of sowing	1000 grain wt.(gm)	KB infection
5-11 Nov. (D_1)	35.19	0.01
12-18 Nov. (D_2)	35.20	0.03
19-25 Nov. (D_3)	35.33	0.00
SEm±	0.257	0.006
CD 5%	0.753	0.017
Variety		
HD-2733 (V_1)	36.16	0.00
PBW-343 (V_2)	36.62	0.04
K-307 (V_3)	31.40	0.00
DBW 39(V_4)	36.78	0.01
SEm±	0.296	0.007
CD5%	0.513	0.020





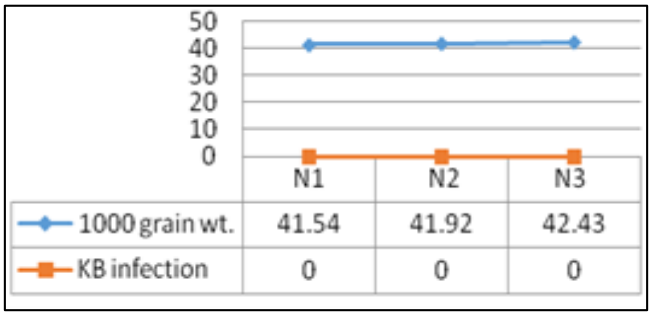
3.2 Effect of fertilizer doses and variety on test weight and incidence of Karnal bunt

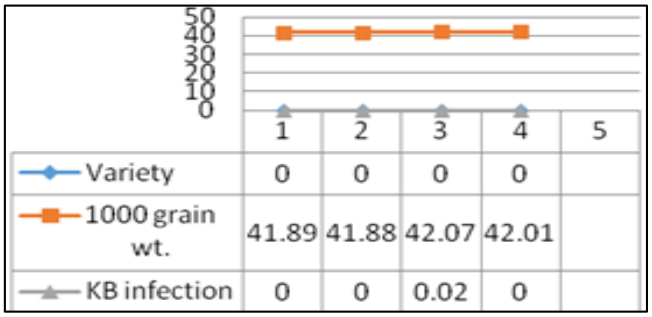
The maximum test weight (42.43gm) was recorded in case of N_3 (80kg Nitrogen alongwith basal dose of P_2O_5@30 kg/ha^{-1}. Variety wise, maximum test weight (42.07gm) was recorded in case of K-8027 followed by 42.01 gm in case of HD-2888

and 41.89gm in HD-3070. The minimum test weight 41.88gm was recorded in case of C-306. Test weight wise V_1, V_3 and V_4 were found significantly at par whereas V_2 was significantly inferior (Table-2).

Table 2: Effect of fertilizer doses and varieties on incidence of Karnal bunt of wheat.

Fertilizer doses	1000 grain wt.	KB infection
40 kg N(N_1)	41.54	0.00
60 kg N (N_2)	41.92	0.00
80 kg N (N_3) along with basal dose of P_2O_5 @ 30 kg/ha^{-1}	42.43	0.00
SEm±	0.202	0.002
CD 5%	0.594	NS
Variety		
HD-3070	41.89	0.00
C-306	41.88	0.00
K-8027	42.07	0.02
HD-2888	42.01	0.00
SEm±	0.234	0.003
CD5%	0.686	0.008





Regarding the effect of fertilizer doses on Karnal bunt infection it was recorded that at the level of all the three fertilizer doses (all the three nitrogen levels) i.e. 40,60 and 80 kg N along with basal dose of P_2O_5@ 30 kg/ha^{-1} there was no any Karnal bunt infection in any of the treatment.

Likewise, among the four varieties tested at three N levels variety HD-3070, C-306 and HD-2888 were found free from Karnal bunt infection and only the trace level infection (0.02%) was recorded in case of K-8027. Accordingly, the results remained inconclusive because of the very -very low incidence of Karnal bunt may be due to unconducive weather conditions for the development of Karnal bunt (Appendix-I).

Table3: AppendixI Meteorological data (Weekly average) during investigation period (2011-12).

Month	Standard weeks	Temperature		Average Relative Humidity (%)	Wind Speed (km/ha)	Sunshine (Hrs.)	Rainfall (mm)
		Min.	Max.				
January	3	7.9	21.0	77.2	3.2	3.3	001.4
	4	5.5	22.2	71.5	3.7	7.0	000.0
February	5	5.0	23.0	72.3	3.5	7.3	000.0
	6	6.6	22.9	74.7	4.1	5.9	015.2
	7	8.6	24.3	67.7	3.1	5.0	000.0
	8	11.0	27.5	64.8	3.5	8.3	000.0

4. Discussion

4.1 Effect of sowing dates and varieties on test weight and incidence of Karnal bunt

The maximum test wt. was recorded in case of 19 to 25 November sowing followed by 12 to 18 November and the minimum in case of 5 to 11 November whereas variety-wise maximum test weight in DBW-39 by PBW-343, HD-2733 and the minimum was in K-307.

Regarding incidence of Karnal bunt was maximum in 12 to 18 Nov. followed by 5 to 11 Nov. whereas in case of 19 to 25 Nov. date of sowing, then, there was no any Karnal bunt infection because of the very low disease incidence no conclusions. Variety-wise HD-2733 and K-307 were found free from Karnal bunt infection whereas PBW-343 showed

the maximum level of infection.

The effect of three different sowing dates on Karnal bunt development was studied and find the coefficient of infection was greater for crops sown on 16 November than for crops sown in 16 and 31 December. The varieties C-306 (31.96%), WH-147 (31.16%), HD-2009(26.93%) and UP-232(20.93%) had a greater mean coefficient of infection compared to WH-283, HD-2285 and WH-896.Weather parameters from the date of inoculation to harvesting for crops sown on 16 November made them more susceptible to infection than those sown in 31 December [6]. Similarly, Karnal bunt incidence increase sharply with delay in sowing, did not consider adjustment of sowing dates a good practical solution, since North West India has certain years well short weather fluctuation at anthesis [3].

4.2 Effect of fertilizer doses and variety on test weight and incidence of Karnal bunt

The maximum test weight was recorded in 80 kg Nitrogen along with basal dose of P_2O_5@30 kg/ha^{-1}.Variety-wise maximum test weight was recorded in K-8027 followed by HD-2888 and HD-3070, whereas the minimum test weight was recorded in C-306.

Regarding the effect of three nitrogen doses (40, 60 and 80 kg) along with basal doses of P_2O_5@30 kg/ha^{-1}, there was no any Karnal bunt infection in any treatment.

Likewise, among the four varieties tested at three nitrogen level variety HD-3070, C-306 and HD-2888 were found free from Karnal bunt only trace level of infection was recorded in K-8027.

The disease incidence was as high as 30% in heavily manured, irrigated clay soils where the crop lodged, compared with only 2% in unirrigated fields with little or no manure or no crop lodging [5]. Nitrogen doses greater than 80 kg/ha have been sown to increase the disease [3].

Several cultural practices such as intercropping, reducing plant density, irrigation, nitrogen fertilizers, crop rotation/non cultivation of wheat for two consecutive year minimize the disease. Karnal bunt infection is generally less in early planted wheat resulting in escape due to either non availability/less sporidia inoculums during the incidence of vulnerable growth stage. Amendment of soil with FYM and biological mulches like chick pea and sugarcane refuse reduce the Karnal bunt incidence. Less disease was recorded under zero tillage. In addition various mechanical methods of sorting the infected grain and reduction in seed borne inoculums have also been recommended [8, 11].

5. Conclusion

Regarding the effect of sowing dates and varieties it was recorded that PBW-343 when sown between 19 to 25 November exhibited maximum 100grain weight side by side there was no Karnal bunt infection recorded also in case of HD-2733 and K-307 when sown in these dates. Because of very low disease pressure the result remained inconclusive.

Regarding the effect of fertilizer doses and varieties the maximum test weight indicative of good harvest was also recorded in case of K-8027 when provided 80 kg Nitrogen along with basal dose of P_2O_5@30 kg/ha^{-1}.Because of the very-very low seed infection the results remained inconclusive and only in case of K-8027 the disease was recorded in trace.

On the basis of results obtained and the pertaining discussion summarized above following major conclusions were drawn.

Varieties like HD-2733, Raj-3077, K-307, K-9423 and DBW-17 should be preferred in the areas where the history of regular Karnal bunt incidence is reported.

Varieties like PBW-502, PBW-550, PBW-7903, PBW-343 and UP-262 may be avoided in the areas where the disease is reported all the time. Although these varieties having superior yield and yield contributing factors and because of that the farmers are fond off for their cultivation may be taken with prophylactic measures recommended for disease free healthy seed/grain production.

Early sown crop escape the Karnal bunt infection if it is not coincides with the conductive environmental conditions. The weather conditions during the year of study were not favourable for disease appearance.

Regarding the fertilizer doses studies indicated that higher doses of nitrogenous fertilizers favours the disease development and in case of K-8027 there was the disease of trace level also but due to very-very low disease intensity the results were inconclusive and no solid conclusion could be drawn.

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