Disease free seed production of wheat in Punjab: Achievements

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Abstract

Punjab Agricultural University (PAU), Ludhiana produces and supplies about 3,000 tonnes of wheat seed (nucleus/ breeder/foundation/certified/TL), annually, to various public and private seed production agencies including farmers. Up to 1990s, the wheat continued to suffer heavy qualitative and quantitative losses due to severe incidence of seed borne diseases viz., loose smut (*Ustilago segetum* var. *tritici*), Karnal bunt (*Tilletia indica*) and ear cockle nematode (*Anguina tritici*). Keeping in view the destructive nature, these diseases were designated as objectionable under the Indian Seed Act, 1968 and minimum tolerance levels were fixed for them in foundation and certified seed. The present study highlights the impact of various management strategies on the status of these diseases in Punjab vis-à-vis seed health. Nearly complete control of loose smut and ear cockle nematode has been achieved at seed production farms and farmer's fields through chemical and mechanical seed treatments and seed replacement through introduction of new varieties and organization of farmer's awareness and participatory programmes. Carboxin, carbendazim and triazole compounds have proved highly effective against loose smut. The nematode galls are easily separated by the seed processing machines or floating on brine solution. However, in the past, Karnal bunt has been an elusive problem where complete control could not be achieved. Nevertheless, a single foliar spray of propiconazole or tebuconazole or hexaconazole at heading stage provided a considerable control of the disease in seed plots. The concerted efforts have resulted into the identification of resistant stocks against Karnal bunt are being used for incorporating resistance in high yielding wheat which will probably be a long lasting solution for this problem.

Introduction

Wheat occupies a premier place among cereals in India. Intensive cultivation and monoculture has lead to the occurrence of seed borne diseases like loose smut, flag smut Karnal bunt, black point and ear cockle nematode. Loose smut (*Ustilago segetum* var. *tritici*), Karnal bunt (*Tilletia indica*) and Ear cockle nematode (*Anguina tritici*) diseases were designated as high risk diseases and minimum tolerance levels were fixed for them in foundation and certified seed. Up to 1990s, the wheat continued to suffer heavy qualitative and quantitative losses due to severe incidence of these diseases. Systemic fungicides are better protectants and can be applied before hand (Rowell 1976, 1985). Tilt (Propiconizole), a triazole fungicide is effective against rusts and other diseases in wheat and the application timing depends on the initiation of the disease (Watkins, 2004). Impact of various management strategies on the status of the diseases; loose smut (*Ustilago segetum* var. *tritici*), Karnal bunt (*Tilletia indica*) and Ear cockle nematode (*Anguina tritici*) on wheat crop in Punjab vis-à-vis seed health has been studied.

Materials and Methods

Assessment of disease incidence

Extensive surveys were conducted from 1991-92 to 2011-12 in the Punjab State. For loose smut, observations at heading stage of the crop were recorded at every 20-25 km at farmers fields and data on % incidence on tiller basis was recorded.

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For KB and ECN samples from different grain markets and seed production farms were collected every year and the % incidence was worked out.

Chemical Control

Milstein (Carbendazim) Profit (tricyclazole) and controll (hexaconazole) were compared with the recommended fungicides *viz*., Vitavax (Carboxin) Bavistin (Carbendazim), Tilt (Propiconazole) and Raxil (Tebuconazole).

Loose smut

Experiment was conducted on variety PBW 343. The inoculated seed was prepared in the previous year as per recommended method. The seed was dressed dry with WP formulations. In EC formulatios, a detergent lisapol @10ml/ kg seed was mixed with the chemical to enable uniform coating of the fungicide. Data on disease incidence (%tiller infected) were recorded.

Karnal Bunt

Artificial inoculations were made at boot leaf stage as per recommended method. To find out the most effective time of spray, post inoculation foliar sprays of the fungicides were made after 2,8 and 15 days. After maturity inoculated ears were harvested, threshed and % KB Infection was calculated.

Varietal Resistance: Wheat lines were screened for Karnal bunt through artificial inoculations.

Results and Discussion

The present study was conducted in the Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana during the period 1991-2012

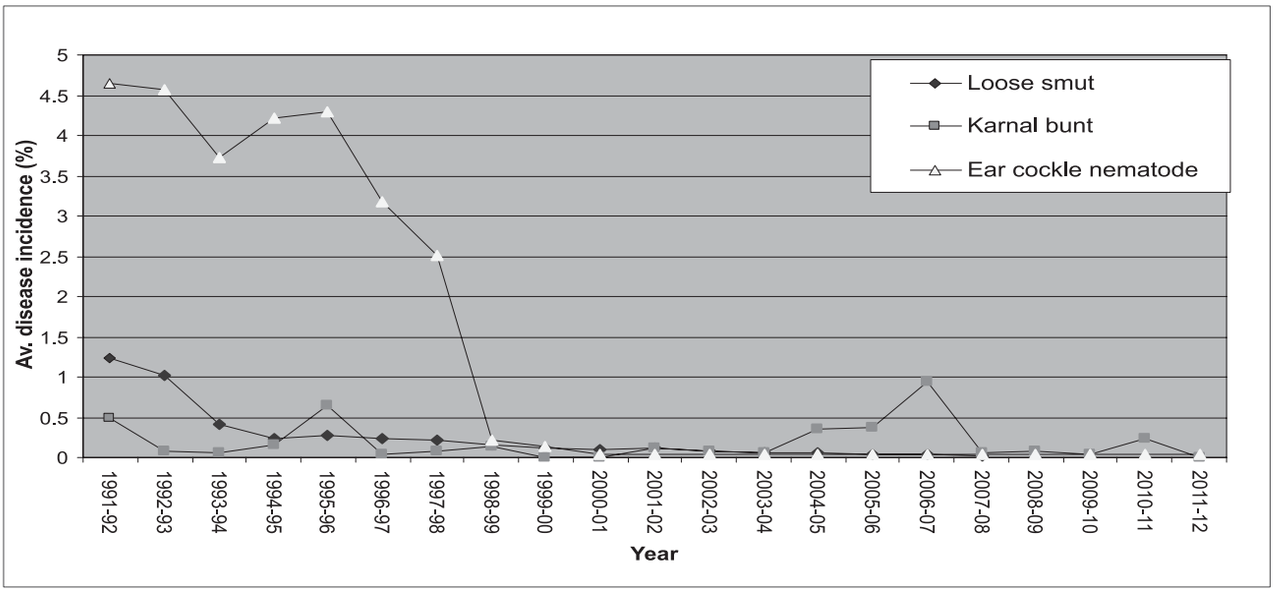

Fig. 1. Disease situation of seed borne diseases in Punjab

Loose smut

The data collected from 1991-92 to 2007-08 showed consistent decrease in disease from 1.24 percent average infection to 0.02 per cent (Fig 1). This was due to the chemical control of the disease by various chemicals. The Tilt showed maximum disease control of 99.96 per cent followed by (99.87%) control (Table 2).

Karnal bunt

There is varying degree of Karnal bunt infection in different districts of Punjab over the years. In the year 2006-07, maximum average KB infection (0.95 %) was observed. The highest infection i.e. 3.2 per cent was recorded from district Hoshiarpur during the year 2006-07 (Table 1, Fig 1) .Variations in disease development in the disease endemic areas have been attributed to varietal susceptibility and favourable environmental conditions for pathogen multiplication and infection in different years at vulnerable stage of wheat growth (Bedi and Dhiman 1982; Aujla *et al* 1986; Singh *et al* 1996; Sharma *et al* 1998).

Karnal bunt has been an elusive problem as its control could not be achieved. Nevertheless, a single foliar spray of triazole compounds at heading stage provided a considerable control of the disease in seed plots (Table 2). Further single spray on 15th Feb. was quite promising to control rusts and Karnal bunt (Sharma *et al* 2009). The concerted efforts have resulted into the identification of resistant stocks against Karnal bunt which are being used for incorporating resistance in high yielding wheat which will probably be a long lasting solution for this problem.

Table 1. Status of various seed borne diseases in Punjab (per cent average incidence)

Year	Loose smut* (Farmer fields)	Ear cockle* (Farmer fields)	Karnal Bunt	
			Farmer fields	Seed Farm
1991-92	1.24	4.65	0.49 (998)**	0.22
1992-93	1.01	4.57	0.08 (1043)	0.05
1993-94	0.42	3.72	0.05 (1929)	0.01
1994-95	0.24	4.21	0.16 (1477)	0.10
1995-96	0.28	4.29	0.64 (2337)	0.28
1996-97	0.24	3.17	0.04 (1993)	0.01
1997-98	0.22	2.51	0.07 (2319)	0.02
1998-99	0.16	0.22	0.14 (1913)	0.04
1999-2000	0.12	0.14	0.004 (2952)	Traces
2000-01	0.10	0.04	0.008 (2367)	Traces
2001-02	0.12	0.00	0.12 (2059)	0.05
2002-03	0.07	0.00	0.08 (1702)	0.04
2003-04	0.05	0.00	0.06 (2850)	-
2004-05	0.05	0.00	0.36 (1274)	-
2005-06	0.04	0.00	0.37 (2128)	-
2006-07	0.04	0.00	0.95 (1774)	-
2007-08	0.02	0.00	0.065 (1340)	-
2008-09	-	0.00	0.073 (1325)	-
2009-10	-	0.00	0.033 (1562)	-
2010-11	-	0.00	0.23 (1455)	-
2011-12	-	0.00	0.0028 (1903).	-

* Seed farms were free from loose smut and ear cockle nematode

** Figures in parentheses are the number of samples collected on which the observations are based for KB and ear cockle nematode.

Table 2. Chemical control of loose smut (seed treatment) and Karnal bunt (foliar spray) in wheat

Fungicides	Dose (%)	Loose smut incidence (%)	Disease control (%)	Percent Disease incidence (DI) / Disease control (DC) of KB after post inoculation sprays (Days)							
				2		8		15		Pooled average	
				DI	DC	DI	DC	DI	DC	DI	DC
Vitavax (Carboxin)	0.2	0.15	99.36	18.2	57.5	24.5	42.8	25.1	41.4	22.6	47.2
Bavistin (Carbendazim)	0.2	4.10	82.55	16.2	62.1	24.7	42.3	23.3	45.6	21.4	50.0
Milstein (Carbendazim)	0.2	5.18	77.96	-	-	-	-	-	-	-	-
Raxil (Tebuconazole)	0.1	1.04	95.57	16.5	61.5	19.2	55.1	22.2	48.1	19.3	54.9
Tilt (Propiconazole)	0.1	0.01	99.96	6.0	86.0	0.6	98.6	0.28	99.6	2.3	94.7
Control (Hexaconazole)	0.1	0.03	99.87	9.5	77.8	2.1	95.1	3.8	91.0	5.1	88.0
Check (No treatment)	-	23.50	-	42.8	-	-	-	-	-	42.8	-
CD (5%)	-	1.25	-	-	-	-	-	-	-	2.4	-

Ear Cockle

The data analyzed over a period of two decades showed100 per cent control of ear cockle nematode (Table 1, Fig 1). This was due to seed replacement, introduction of new varieties and organization of farmer's awareness & participatory programmes. The nematode galls are easily separated by the seed processing machines or floating on brine solution

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