

Evaluation of Foliar Applications at Different Growth Stages and Soil Amendment for Management of Karnal Bunt Disease in Wheat

ANUJA GUPTA*, ASHWANI KUMAR, RAVINDRA KUMAR AND KUMKUM VERMA

ICAR-Indian Agricultural Research Institute, Regional Station, Karnal, Haryana, India

*anujag2005@gmail.com

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ABSTRACT: In a field trial, foliar application of 0.1% propiconazole at different growth stages and soil amendment with *Trichoderma viride* were evaluated for management of Karnal bunt disease in wheat cv. HD 2967. Foliar application of propiconazole at different growth stages from 5% ear emergence to anthesis initiation and completion had significant effect on the disease incidence. Two foliar application of 0.1% propiconazole 95% EC at anthesis initiation and completion were effective in reducing the incidence of KB disease (0.027%) significantly as against control (0.135%) i.e. by 80.0%. Soil amendment with *Trichoderma viride* @ 2Kg/acre twice at 45 and 75 DAS reduced the disease incidence by 46.2% but these treatments had insignificant effect on test weight.

Keywords: Karnal Bunt disease, Wheat, Propiconazole, *Trichoderma viride*, Foliar spray, Soil amendment, Growth stages

Karnal Bunt (KB) disease of wheat also known as partial bunt is caused by *Tilletia indica* Mitra, Syn. *Neovossia indica* (Mitra) Mundkur. It adversely affects wheat trade as most of the countries consider this pathogen a quarantine pest. The pathogen is primarily seed, soil and air borne and has long been considered to be an important quarantine pest. Earlier, the disease occurred sporadically restricted to some area, but with the changing climatic conditions, cropping systems and enhanced inputs, it appears in almost all the wheat growing areas at present. It is difficult to detect KB disease in the field as only few kernels on a spike are randomly infected and moreover no symptoms are visible in the infected seed until near maturity. The infection varies from small points of infection to completely bunted kernels. The bunted kernels develop black spore masses with a smell of decaying fish due to the presence of trimethylamine compound which becomes quite apparent when 3% or more of seed is affected [1]. Karnal Bunt (KB) disease is highly erratic in occurrence and depends very much on the weather conditions for its appearance. The disease may result in low yield losses but has major effect on the seed quality which is of paramount importance in any seed production programme. Minimum tolerance levels have been fixed by number of bunted seed for KB disease both in the foundation (0.05%) and certified seed (0.25%) by the Central Seed Certification Board, New Delhi. KB is becoming a burning issue and we have to find ways

and means for its management, since KB is known to be a quarantine disease and strict quarantine measures are needed to contain the spread of the disease. Hence, this study was undertaken to assess appropriate time of foliar application of fungicide along with soil amendment to contain this disease in the field.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* seasons of 2015-16 to 2019-20 at ICAR-IARI, Regional Station, Karnal to assess the efficacy of various management options viz., foliar spray at different growth stages and soil amendments against KB disease.

Experiment was conducted in wheat cultivar 'HD 2967' grown in the field. Foliar spray with Propiconazole 95% EC fungicide @ 0.1% was conducted at three growth stages of wheat crop i.e. 5% ear emergence (T1), anthesis initiation (T2) and completion (T3), along with their different combinations. The plots without any spray served as control. Soil was amended with *Trichoderma viride* @ 2.0 Kg/acre twice at 45 and 75 DAS and the un-amended plot served as control. The experiment was conducted under split plot design with three replications. The crop was raised following recommended agronomic practices and harvested at maturity. The seed was threshed, cleaned and assessed for KB infection by number and test weight for each treatment. Karnal bunt

infection was detected by sodium hydroxide seed soak technique [2]. The pooled data were analyzed statistically using Split plot design.

RESULTS AND DISCUSSION

Statistical analysis of the pooled data revealed that the time of foliar spraying with Propiconazole @ 0.1% was important in management of KB disease in the field. The results revealed that the incidence of KB in wheat seeds harvested from plots with one spraying at 5% ear emergence was 0.587 and 0.334%, at anthesis initiation it was 0.178 and 0.101% and at anthesis completion stages it was 0.13 and 0.075% in unamended and amended plots, respectively (Table 1). However, there was reduction in the incidence of KB in the seed obtained from plots which were subjected to two or three consecutive sprayings. The results showed that two consecutive foliar sprays at anthesis initiation and anthesis completion stages (0.046 and 0.027%) were effective in reducing the KB disease incidence significantly as against control (0.241 and 0.135%) in unamended and amended plots, respectively *i.e.* by 80.0%. Two consecutive sprayings undertaken at 5% ear emergence and anthesis initiation gave 0.123 and 0.063% KB infection, whereas KB infection at 5% ear emergence and anthesis completion stages was 0.224 and 0.133% in unamended and amended plots, respectively. Three sprayings at 5% ear emergence, anthesis initiation and anthesis completion stages gave 0.139 and 0.032% disease as against control in unamended and amended plots, respectively. The first spraying done at 5% ear emergence stage was found ineffective in reducing the disease rather it enhanced the disease. However, KB infection in plots with one spray at anthesis initiation stage (0.178 and 0.101%) and anthesis completion stage (0.13 and 0.075%) were found to reduce the disease as against control in unamended and amended plots, respectively.

Increase in the disease incidence at 5% ear emergence stage was probably because the efficacy of the fungicide got reduced by the peak time of infection *i.e.*, at anthesis stage which appears to be the most susceptible crop growth stage when the sporidial population was also assumed to be high. But second and third fungicidal sprayings at initiation and completion of anthesis effectively inhibited the infective sporidia thereby minimizing the infection. However, the plots with only first spraying had become vulnerable to infection by then.

Thus, anthesis initiation to completion appears to be the most susceptible (critical) growth stages and spraying at these stages reduced the disease incidence substantially as at this time the load of the pathogen and its aggressiveness may be maximum because of the prevailing conducive environment.

It has been reported in various studies that yield losses due to KB disease are insignificant [3]. This may be attributed to the erratic behaviour of the pathogen which highly depends on the conducive environment for development and spread of the disease [4]. Further, it is not only the environment but susceptibility of the growth stage of the crop and infectivity or aggressiveness of the pathogen which are also important for successful infection to occur. Various studies have proposed different growth stages which are most susceptible. According to Bedi et al [5] heading stage is the most susceptible stage but Bains [6] concluded boot emergence stage to be the most susceptible stage. Growth stage 49, when the first awns are visible, has been reported to be most sensitive stage [7]. However, most studies indicate that the infection initiates at boot stage which can then continue up to anthesis stage [7-9]. Some studies have reported the late infection even at dough stage [10, 11]. Kaur et al [12] did not observe any disease when boot inoculations were conducted 24 hours before spraying with the fungicide at GS 47, but there was increase in the disease incidence with increase in the gap. It has been observed over the years at our station that when the winters are exceptionally wet, a high incidence of KB disease was recorded especially when rains in February coincided with the flowering stage of wheat crop in the fields. A continuous wet condition, especially at the time of heading is highly conducive and favourable for disease development. Spraying window is very narrow and critical as it very much depends on the environment. This is the time when weather plays a crucial role and there may be incessant rains when the spraying cannot be undertaken at appropriate time, but even one spraying at this growth stage can minimize the disease incidence effectively.

Soil amendment treatment was found necessary because teliospores of the pathogen, the primary source of inoculum, survive in the soil and germinate to produce primary sporidia with the onset of conducive environmental conditions which then cause infections in wheat crop [13, 14]. Soil amendment with *Trichoderma viride* @ 2.0 Kg/acre twice at 45 and 75 DAS was found

Table 1. Effect of number and time of foliar sprayings on incidence of Karnal bunt disease

Stage of spraying	No of spraying	% KB infection		Mean
		No soil amendment	Tv soil amendment	
90 DAS (T1)	1	0.587	0.334	0.461
102DAS (T2)	1	0.178	0.101	0.139
114DAS (T3)	1	0.13	0.075	0.103
T1+T2 (T4)	2	0.123	0.063	0.093
T1+T3 (T5)	2	0.224	0.133	0.179
T2+ T3 (T6)	2	0.046	0.027	0.037
T1+T2+T3 (T7)	3	0.139	0.032	0.086
Control (T8)	-	0.241	0.135	0.188
Mean		0.208	0.112	
	Factor (A) Soil amendment	Factor (B) Foliar spray	Factor(B) at same level of A	Factor(A) at same level of B
CD 0.01	0.038	0.065	0.097	0.092

Tv = *Trichoderma viride*

Table 2. Effect of Karnal bunt disease on test weight of wheat seed

Stage of spraying	No of spraying	% KB infection		Mean
		No soil amendment	Tv soil amendment	
90 DAS (T1)	1	36.024	36.704	36.364
102DAS (T2)	1	37.725	37.683	37.704
114DAS (T3)	1	37.971	37.3	37.635
T1+T2 (T4)	2	38.737	37.515	38.126
T1+T3 (T5)	2	37.884	38.532	38.208
T2+ T3 (T6)	2	38.335	38.903	38.619
T1+T2+T3 (T7)	3	38.02	38.653	38.337
Control (T8)	-	37.607	37.032	37.319
Mean		37.788	37.790	
	Factor (A) Soil amendment	Factor (B) Foliar spray	Factor (B) at same level of A	Factor (A) at same level of B
CD 0.01	NS	1.291	0.973	NS

to reduce the disease incidence significantly by 46.15% (Table 1). In certain areas a 2-year period free from wheat reduces, but did not eliminate the inoculum. It is difficult to eradicate the fungus from the soil as the teliospores can remain viable in the soil for up to 4-5 years. Also, no seed treatment is recommended for the control of Karnal bunt disease. Warham et al [15] reported that both seed and soil treatment were only partially successful in the control of Karnal bunt disease. Also, soil treatment with fungicides at seeding was reported as ineffective in reducing the disease probably due to the infections caused by airborne sporidia which germinated from teliospores present in untreated fields [16].

Many studies have shown that Karnal bunt disease does not cause substantial loss in the yield but does affect quality of wheat seeds. This study also showed that the disease did not affect the test weight in different

treatments (Table 2). The loss in test weight depends very much on the different grades of infection as tip infection, partial infection or full infection. Beniwal *et al* [17] and Bansal *et al* [18] reported reduction in 1000-grain weight ranging from 4.5 to 52.3 per cent depending on severity of infection. Karwasra *et al* [19] observed 56.9 to 65.9% reduction in 1000-grain weight, whereas Rattan and Aujla [20] showed that germination, shoot length, root length, fresh and dry weight of wheat seedlings were severely affected only when >75% of the grain was converted into a spore mass. Kumar and Gupta [21] also reported loss in test weight depended on different grades of infection in the seed. They reported 38.13, 9.89 and 0.27% loss in test weight in full, partial and tip infections, respectively. Thus, with increase in the disease severity there was proportional decrease in seed weight, germination and vigour.

Since it is impossible to completely control the disease through seed, soil or foliar treatments, it is essential to manage the disease through different ways and means. The disease being seed borne, use of disease free seed is important for its proper management. It is imperative to strictly follow recommended seed standards especially in a seed crop. Movement of KB infected seeds should be restricted. It is much easier to prevent a disease than to control it completely. Foliar application at the right time, coinciding with the most susceptible growth stage can be a cost-effective and comprehensive (judicious) way to manage the disease as it reduces the spread of the infection and the population level. Hence, spraying with 0.1% propiconazole 95% EC fungicide at initiation to completion of anthesis stage is effective in management of Karnal bunt disease in wheat.

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