

## Effectiveness of Cultural and Biological Management Approaches For Karnal Bunt Disease of Wheat Caused By *Neovossia Indica* (Mitra) Mundkur



### Agriculture

**KEYWORDS :** Karnal Bunt, *Neovossia indica*, *Tilletia indica*, Management

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### ABSTRACT

*Karnal bunt incidence greatly depends upon weather and agronomical practice thus studies were conducted to ensure best environment in field for disease free crop. Studies indicated that early sowing is recommendable as it shifts the panicle stage from 2nd week of Feb (Most susceptible period). 25th of Nov (1.70%) was found most susceptible, however least disease incidence was observed with 5th December (0.78%) followed by 26th October (0.88%). Studies on irrigation schedule shows that judicious use of irrigation manages the spread of the disease. Irrigation at later stages (Flowering) was more prone to disease hence after fourth irrigation only life saving irrigation may be given. Ploughing depths on disease incidence indicated that with the increase in depth of sowing, disease intensity was more. Fungal bio agents like *Trichoderma viride* and *Trichoderma harzianum*, significantly more effective than bacterial bio-agents treatments in karnal bunt disease of wheat management.*

### Introduction

Karnal bunt is so named because it was discovered in 1931 on wheat grown near Karnal, India by Mitra. Since then, it has been found in all major wheat-growing states of India, as well as in Pakistan, Iraq, Mexico, and Afghanistan. Karnal bunt (also known as partial bunt) is a quarantine disease of bread wheat (*Triticum aestivum*) (Mitra, 1931), durum wheat (*T. durum*) and triticale (Agrwal et al., 1976).

Disease is caused by the fungal pathogen *Tilletia indica* (Syn. *Neovossia indica* (Mitra) Mundkur). Karnal bunt has the potential to reduce grain quality and marketability significantly; therefore quality bread-making wheat may become downgraded to feed, resulting in large financial losses for the producer. The loss in quality results from infected grain having an objectionable 'rotting fish' odour and taste, as do products made from the grain. This is due to the presence of trimethylamine. Reports of localised direct losses on yield vary from less than 1% to 20%. During severe epidemics total losses in India has been around 0.3 to 0.5 percent (Joshi et al., 1983). An indirect effect of Karnal bunt is its potential to cause significant damage to export markets.

*Tilletia indica*, a flower-infecting organism that partially infects the seeds of host e.g. wheat. The teliospores *T. indica* may be deposited on the soil at harvesting and threshing, or they may become attached to surface of seed as an external contaminant (Chona et al., 1961). Upon germination at the soil surface, each teliospore gives rise to a promycelium, which bears filiform primary sporidia at its tip (Mundkur, 1940). These primary sporidia and secondary sporidia, which develop subsequently, are carried to wheat spike either by air currents or by splashing water (Mundkur, 1943).

The effectiveness of cultural and biological management approaches evaluated in karnal bunt disease of wheat by teliospores occurrence. In order to experiments were conducted to see effects of modified cultural operations and use of biological control tools on incidence of Karnal bunt.

### Materials and Methods

It has been observed that temperature and humidity plays very important role in disease occurrence. An integrated approach to overcome Karnal bunt needs study of various cultural practices that favours high humidity and cordial temperature, conducive for disease initiation. A study was conducted in order to pin point the best suited cultural practices as well as biological management.

#### (i) Altered Sowing Dates

Date of crop sowing is one of the most important aspects that can lead to development or avoidance of disease (Aujla, et. al., 1977). Thus five different sowing dates viz. 26<sup>th</sup> October, 5<sup>th</sup> November, 15<sup>th</sup> November, 25<sup>th</sup> November and 5<sup>th</sup> of December were selected as different sowing dates with 15<sup>th</sup> of November acting as control i.e. recommended date of sowing for Jammu

division. Total number of replications was four and random block design was adopted for the experiment. The locally grown wheat variety (PBW-343) was taken up for the trials.

#### (ii) Altered Irrigation Schedule

Another important agronomical practice that could lead to disease development was poor irrigation management (Singh et al., 1992). So six irrigation schedules were taken up with four replications for each schedule, experiment was conducted in random block design.

#### Total Number of treatments (T<sup>1</sup>-T<sup>6</sup>): 06

#### Total Number of replications: 04

T<sup>1</sup> - Irrigation was withheld at crown root initiation

T<sup>2</sup> - Irrigation was withheld at tillering stage

T<sup>3</sup> - Irrigation was withheld at jointing stage

T<sup>4</sup> - Irrigation was withheld at flowering stage

T<sup>5</sup> - Irrigation was withheld at milk stage

T<sup>6</sup> - Irrigation was withheld at dough stage

**Control-** All recommended irrigations

**Design adopted** - Random Block Design

#### (iii) Altered Ploughing Depths

As the viability of teliospores of *Tilletia indica* varies with the depth of inoculum, effects of ploughing depths on disease development was studied (Singh and Singh 1985). Seed was dibbled with the help of graduated stick. Normal ploughing depth served as control in this experiment whereas other four treatments were as under:

#### Total Number of treatments (T<sup>1</sup>-T<sup>4</sup>): 04

#### Total Number of replications: 05

T<sup>1</sup>- Zero tillage

T<sup>2</sup>- 3 cms

T<sup>3</sup>- 9 cms

T<sup>4</sup>- 15 cms

**Control** - Recommended ploughing depth

#### (iii) Management of Karnal Bunt by biological control agents:

##### (a) In vitro studies

To determine growth of *Tilletia indica* in culture filtrates of biological control agent's viz. Fungi and Bacteria, filtrates were inoculated with the freshly grown 20 days old sporidial bits of *Tilletia indica* and dry mycelia weight was observed after 25 days of

incubation at 25±2°C. Four replications per treatment were kept and the experiment was laid in CRD (Elad,*et al.*,1981).

### (b) In vivo studies

The experiment was conducted by randomised block design following normal agronomic operations during the course of entire experiment. The crop was raised as per recommended package of practices. Fungal biological control agents *Trichoderma harzianum* and *Trichoderma viride* were used for seed treatment (Singh, *et al.*, 1991). The bio-control agent for seed treatment was grown on PDA (Potato Dextrose Agar). Spore suspension of bio-control agent was prepared from 7 days old culture. Concentration of 10<sup>8</sup> spore ml<sup>-1</sup> was made by further dilutions with distilled water and monitored using haemocytometer. Seed were soaked in spore suspension in sterile water for 15 min and then air dried in shade before sowing.

Fresh spore suspension obtained as processed earlier for seed treatment is further used for foliar applications too (Singh, *et al.*, 1991). For control, distilled water sprays were used. Spray schedule as recommended for Karnal bunt management was followed.

Bacterial biocontrol agents (*Pseudomonas fluorescence*) to be used for field sprays were multiplied in Nutrient agar broth. A healthy population of bacteria is obtained after 72 hours. Bacterial broth thus obtained was filtered through muslin cloth and collected in a separate beaker. Concentration of 10<sup>8</sup> cfu ml<sup>-1</sup> was made by further dilutions. Seed were soaked in broth for 15 min and then air dried in shade before sowing.

Fresh bacterial suspension was obtained as processed earlier for seed treatment and the similar methodology was adopted for foliar applications too. For control distilled water sprays were used. Spray schedule as recommended for Karnal bunt management was followed. Four replications per treatment were kept and the experiment was laid in RBD.

## Results & discussions

### Effects of different sowing dates on incidence of karnal bunt disease of wheat

Five sowing dates were chosen in the study. During 2006-07 (Fig 1.) least disease incidence was recorded with 15<sup>th</sup> November (0.85) followed by 5<sup>th</sup> of December (0.90). Maximum disease incidence was recorded with 5<sup>th</sup> of November (1.62) as sowing date. Disease incidence of 1.27 and 1.60 was recorded with 26<sup>th</sup> of October and 25<sup>th</sup> of November respectively. During 2007-08 least disease incidence was recorded with 26<sup>th</sup> of October (0.27) followed by 5<sup>th</sup> of December (0.67). Maximum disease incidence was recorded with 5<sup>th</sup> of November (1.40) as sowing date. Disease incidence of 1.35 and 1.12 was recorded with 15<sup>th</sup> of November and 25<sup>th</sup> of November respectively.

Observations recorded from both the crop years 2006-07 and 2007-08 (Fig 1.) revealed least disease incidence (0.77) with 26<sup>th</sup> of October as sowing date followed by 5<sup>th</sup> of December (0.79). Maximum disease incidence was recorded with 5<sup>th</sup> of November (1.51). 25<sup>th</sup> of November recorded a disease incidence of 1.37 and 1.10 with 15<sup>th</sup> of November as sowing dates.

From experiment (Fig 1.) it is evidence that early sowing is recommendable because we shift the panicle stage from 2<sup>nd</sup> week of Feb. which is the most susceptible period for the disease. An alternate is late sowing but it may cause low yield. 5<sup>th</sup> Nov. has been found to be most susceptible for disease, however least disease incidence was observed with 26<sup>th</sup> October followed by 5<sup>th</sup> of December.

### Effects of irrigation schedule on incidence of Karnal Bunt

During the crop year 2006-07 minimum disease incidence was recorded (0.55) (Fig 2.) when irrigation was withheld at crown root initiation stage. A maximum of 3.47 per cent of disease incidence was recorded when irrigation was withheld at dough stage. However with all the six irrigations, as recommended for wheat crop a disease incidence of 3.27 per cent was recorded. When irrigation was withheld at tillering stage a disease inci-

dence of 0.70 per cent was recorded. Disease incidence of 1.20 and 1.90 per cent was recorded when irrigation was withheld at jointing and flowering stages respectively.

During the crop year 2007-08, data revealed that during the crop year minimum disease incidence was recorded (0.15) when irrigation was withheld at crown root initiation stage. A maximum of 1.22 per cent of disease incidence was recorded when irrigation was withheld at dough stage. However with all the six irrigations, as recommended for wheat crop a disease incidence of 1.25 per cent was recorded. When irrigation was withheld at tillering stage a disease incidence of 0.60 per cent was recorded. Disease incidence of 0.73 and 1.18 per cent was recorded when irrigation was withheld at jointing and flowering stages respectively.

Observations recorded from both the crop years (Fig 2.) revealed that least disease incidence (0.35) was recorded when irrigation was withheld at crown root initiation stage. Irrigation till dough stage gave maximum disease incidence (2.35). Six irrigation schedule gave a disease incidence of 2.26 per cent. Disease incidence of 2.20 per cent was recorded when irrigation was withheld at milk stage. Disease incidence of 1.53, 0.96 and 0.65 per cent was recorded when irrigation was withheld at flowering, jointing and tillering stages respectively.

Studies on irrigation schedule reveals that minimum/judicious use of irrigation may control the spread of the disease. Also at later stage, irrigation is more prone to disease hence after fourth irrigation only life saving irrigation may be given.

### Effects of ploughing depths on incidence of Karnal Bunt

Studies on effects of ploughing depths on incidence of Karnal bunt of wheat was conducted during crop years 2006-07 and 2007-08 (Fig 3.). During 2006-07 crop year it was observed that least disease incidence (0.93) was recorded with Zero tillage followed by plough depth of 9cm (1.06). Maximum disease incidence was recorded with plough depth of 15 cm (1.50) and 1.08 per cent with a ploughing depth of 3 cm. Control treatment i.e. 4cm of ploughing depth recorded a disease incidence of 3.36 per cent.

During the crop year 2007-08 minimum disease incidence was recorded with Zero tillage practice (0.20) and a maximum of 1.06 per cent with 15 cms of ploughing depth. Disease percentage of 0.64 per cent was recorded with 3 cms and 0.56 per cent with 9 cms of ploughing depth. Disease incidence per cent of 1.04 was recorded with control i.e. 4 cms of ploughing depth.

Two years study on effects of ploughing depths on Karnal bunt (Fig 3.) incidence revealed that Zero tillage recorded minimum disease incidence per cent (0.57) due to least disturbance to inoculum buried in soil. Maximum disease incidence per cent was recorded with 15 cms of ploughing depth (1.28). Disease incidence of 0.86 and 0.81 per cent was recorded with 3 and 9 cms of ploughing depths respectively.

Data provide evidence that ploughing depths had significant impact on disease intensity. With the increase in depth of sowing, disease intensity was more. Maximum disease intensity was observed with 15 cm (1.28%) and minimum with zero tillage. Thus zero tillage is highly recommended in areas prone to Karnal bunt of wheat.

### Management of Karnal bunt disease of wheat

#### (a) In vitro -using fungal and bacterial biocontrol agents

Studies on In vitro management of Karnal bunt of wheat using fungal biocontrol agents revealed that *Trichoderma viride* fully checked the growth of *Telletia indica*. No mycelial growth was recorded in fungal extract of the bio-agent. Another fungal bioagent used in the study was *Trichoderma harzianum*; fungal extracts of this bioagent too checked pathogen growth *In vitro* (0.17 gms). Control (Potato dextrose broth) recorded mycelial growth of 1.34 gms after 20 days.

Another study was conducted with bacterial bioagents for the

management of Karnal bunt pathogen *In vitro*. Two bacterial bioagents, *Pseudomonas flourescence* (PDBC) and *Pseudomonas flourescence* (Resident) were used in this study. *Pseudomonas flourescence* (PDBC) gave fungal mat weighing 1.06 gms whereas *Pseudomonas flourescence* (Resident) yielded an average of 1.10 gms of mycelial mat. Nutrient agar broth acting as control yielded an average of 1.45 gm of mycelial mat.

**In vivo- using fungal and bacterial bio-control agents**

During the crop year 2006-07, *Trichoderma viridiae* recorded a disease incidence of 0.92 per cent and that of *Trichoderma harzianum* was 1.12 per cent. Bacterial biocontrol agents *Pseudomonas flourescence* (Resident) and *Pseudomonas flourescence* (PDBC) recorded a disease incidence of 1.17 and 1.42 per cent. Distilled water used for control recorded a disease incidence of 2.08 per cent.

During the crop year 2007-08, *Trichoderma viride* recorded a disease incidence of 0.35 per cent and that of *Trichoderma harzianum* was 0.77 per cent. Bacterial biocontrol agents *Pseudomonas flourescence* (Resident) and *Pseudomonas flourescence* (PDBC) recorded a disease incidence of 0.80 and 0.90 per cent. Distilled water used for control recorded a disease incidence of 1.07 per cent.

Average of data recorded from two years field trials revealed that *Trichoderma viride* recorded a disease incidence of 0.64 per cent and that of *Trichoderma harzianum* was 0.95 per cent. Bacterial biocontrol agents *Pseudomonas flourescence* (Resident) and *Pseudomonas flourescence* (PDBC) recorded a disease incidence of 0.99 and 1.16 per cent. Distilled water used as control recorded a disease incidence of 1.92 per cent. *In vitro* management with bio-agents suggests that *Trichoderma viride* and *Trichoderma harzianum* are not significantly different but *Trichoderma viride* is found to be most effective for management of Karnal bunt of wheat in field conditions. For disease management in field conditions, fungal treatment was significantly more effective than bacterial treatments.

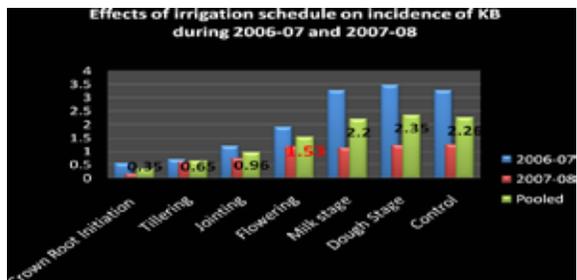


Fig. 2. Effects of irrigation schedule on incidence of KB during 2006-07 and 2007-08

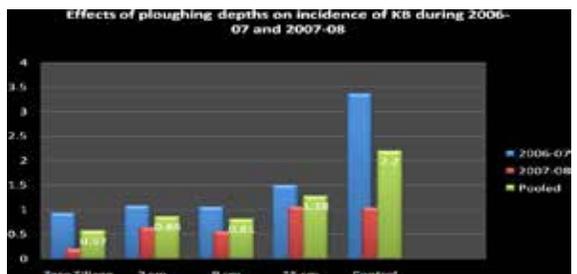


Fig. 3. Effects of ploughing depths on incidence of KB

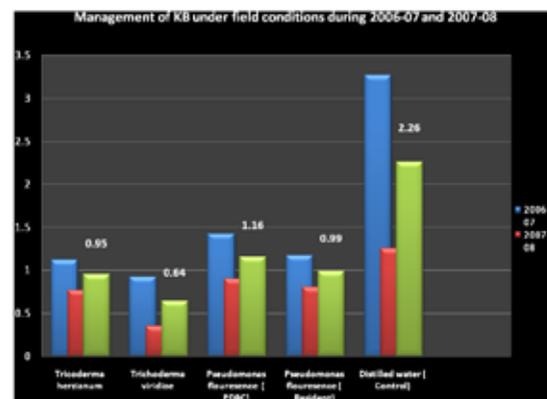


Fig. 4. Management of KB using Bio agents

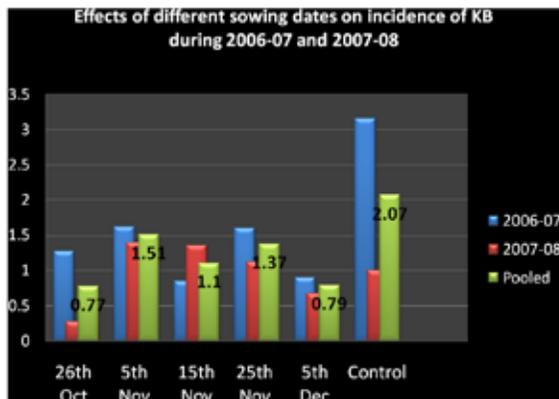


Fig. 1. Effects of different sowing dates on incidence of KB during

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