

## Management of Smut Disease of Pearl Millet through Bio-Control Agents

KAVYA DASHORA AND ARUN KUMAR<sup>1</sup>

National Bureau of Plant Genetic Resources, New Delhi 110 012  
dashorakavyal@gmail.com, arpurster@gmail.com

The pearl millet [*Pennisetum glaucum* (L.) R. Br.] is predominantly a rainfed, salt tolerant crop. It provides a staple cereal diet to the people residing in the rural parts of semi-arid and arid areas of the country. The crop is mainly grown in the states of Rajasthan, Maharashtra, Gujarat, Uttar-Pradesh, Haryana, Karnataka and Tamil Nadu, which cover 90 per cent of the total cultivation of the crop. The crop of pearl millet is well adapted to production systems having high salinity and low pH. It is most tolerant and adapted to drought conditions where most of the grain crops would fail to survive [1].

Smut is one of the major diseases of pearl millet, caused by *Tolyposporium penicillariae* Bref. The disease occurs in almost all the areas where pearl millet is cultivated. The major outbreak of this disease in recent years has proved its economic importance as a serious threat to pearl millet production in northern India, particularly in Rajasthan, Haryana, Punjab and Gujarat due to commercial cultivation of F1 hybrids [2].

Smut has been looked upon as a constant and major threat to the crop of pearl millet mainly in northern India because the occurrence of this disease primarily depends upon climatic factors. The frequent rains during the flowering period favour the occurrence of the disease. Looking to the severity and destructive potential of smut it is very unfortunate that no tangible measures for the management of the disease have been

evolved. It was also seen that chemical fungicides in combination with resistant cultivars provide better control over the disease [3].

Pearl millet is a crop of low economic value and therefore the expensive fungicidal measure for this disease is neither feasible nor economical for the farmers of arid and semi arid areas. A need was therefore felt to find the eco-friendly and sustainable control measure using conventional and unconventional or indigenous technological knowledge.

Farmers generally grow only traditional landraces, which are highly susceptible to the disease. The disease is very difficult to manage because of its seed, soil and air borne nature. To work out effective control measures for the disease the studies were undertaken. A field experiment was conducted at Central Arid Zone Research Institute, Jodhpur during the rainy season in 2005. Nokha local, a smut susceptible pearl millet cultivar was used. The experiment was conducted with seven treatments in randomized block design (RBD) with three replications each. The following treatments were given:

- T<sub>1</sub>. Seed treatment with raw cow milk (RCM) (50% dilution with water for 18h)
- T<sub>2</sub>. Seed treatment with *Gliocladium virens* (6g kg<sup>-1</sup> seed)

<sup>1</sup>Central Arid Zone Research Institute, Jodhpur 342003

- T<sub>3</sub>. Soil treatment with *G. virens* (10g<sup>-</sup>m<sup>2</sup>)  
 T<sub>4</sub>. Combination of all the above treatments (T<sub>1</sub> + T<sub>2</sub> + T<sub>3</sub>)  
 T<sub>5</sub>. Seed treatment with raw goat milk (RGM) (50% dilution with water for 18h)  
 T<sub>6</sub>. Seed treatment with RGM and soil treatment with *G. virens* (10g<sup>-</sup>m<sup>2</sup>)  
 T<sub>7</sub>. Control (No soil or seed treatment)

Each plot measured 3m x 2m, with 4 rows and each row had 20 plants. The crop was given diammonium phosphate (40 kg ha<sup>-1</sup>) as basal dose. No insecticides or herbicides were applied. Smut incidence was recorded twice, 30 days after sowing (DAS) and at soft dough stage (60 DAS). Protection over control was calculated by following formula:

$$\text{Protection over control} = \frac{C-T}{C} \times 100, \text{ where}$$

C = Per cent disease incidence in control,

T = Per cent disease incidence in treatment

Smut management requires reduction of primary inoculum from seed and soil and secondary infection in plants later during crop growth. *Gliocladium virens* appeared more effective than RCM in reducing the smut incidence (Table 1). In terms of disease incidence and protection over control, seed treatment with RCM seems to be less effective (20.7% protection)

in comparison to soil treatment with *G. virens* (25.2%). However, seed treatment of *G. virens* appeared to be superior (37.8% protection) over these two treatments. As indicated in Table 1 a combination of all the three treatments (i.e. seed treatments with RCM and *G. virens* and soil treatment with *G. virens*) showed considerable reduction of disease (58.9%) when compared with other treatments. Raw goat milk showed better protection and reduced incidence from 53.1 per cent in control to 27.7 per cent providing 47.8 per cent protection over control. Milk is a heterogenous suspension of oil (butter fat), protein (casein), sugar (lactose), minerals, enzymes and vitamins. Several workers have used milk of cow and goat to manage fungal and viral diseases of plants [4, 5, 6]. Studies made to understand the action of milk as biocontrol agent have suggested a number of explanations, which include the anti-fungal action of the fatty acids, the production of free radicals when exposed to UV light, the creation of osmotic imbalance due to salts and other components, and the induction of resistance to host plant [4, 7, 8]. Beside these, an increase in the pH of the leaf surface, establishment of protective barrier, direct induction of systemic resistance and production of biocidal compounds are the other elucidations [6, 9, 10].

Recently, one of the studies related with downy mildew (DM) (*Sclerospora graminicola*)

**Table 1. Effect of biocontrol agents on smut incidence during the rainy season in 2005 at Jodhpur**

| Treatment   | Disease incidence (%) | Protection over control (%) |
|---|-----------------------|-----------------------------|
| T <sub>1</sub> Seed treatment with Raw Cow's Milk (50% dilution with water for 18h)                             | 42.1                  | 20.7                        |
| T <sub>2</sub> Seed treatment with <i>Gliocladium virens</i> (6g kg <sup>-1</sup> seed)                         | 33.0                  | 37.8                        |
| T <sub>3</sub> Soil treatment with <i>G.virens</i> (10g <sup>-</sup> m <sup>2</sup> )                           | 39.7                  | 25.2                        |
| T <sub>4</sub> Combination of the above three treatments (T <sub>1</sub> +T <sub>2</sub> +T <sub>3</sub> )      | 21.8                  | 58.9                        |
| T <sub>5</sub> Seed treatment with Raw Goat's Milk (50% dilution with water for 18h)                            | 27.7                  | 47.8                        |
| T <sub>6</sub> Seed treatment with Raw Goat's Milk (50% dilution with water for 18h) + <i>G. virens</i> in soil | 37.0                  | 30.3                        |
| T <sub>7</sub> Control  | 53.1                  |                             |
| CD at 5 %   | 5.233                 |                             |
| CV (%)  | 32.510                |                             |

management by treating pearl millet seed with amino acids showed that amino acids like Serine, Tryptophan, Leucine and Isoleucine reduced the disease by 57 per cent as a result of amino acid - mediated induced systemic resistance (ISR) in pearl millet [8]. Here it is important to note that cow and goat milks contain all the amino acids with potassium phosphate help boosting plant's immune system through systemic acquired resistance (SAR) [11]. *Trichoderma* (*Gliocladium*) spp. are considered as potential biocontrol agents of plant diseases through various mechanisms including induction of resistance and act in a synergistic manner [12, 13]. It is a well-known fact that major limitations to the chemical control of smut in pearl millet are low monetary value of the crop and scarcity of resources available to the pearl millet growing farmers. For effective and economic control of the disease, a combination of indigenous knowledge and biocontrol agents may be attempted as seed and spray treatments [14]. Since pearl millet is a crop of low economic value grown by resource-poor farmers, seed treatment is a more viable and less expensive option than spraying of fungicides for control of smut. There is a high risk of the pathogen developing resistance that is associated with the use of chemical fungicides unlike biocontrol agents. Therefore, seed treatments with RCM or RGM and *G. virens* along with soil application of the latter can be an important component in an integrated disease management strategy for resource-poor farmers.

## REFERENCES

1. DASHORA, KAVYA (2005). Biology, epidemiology and control of smut (*Tolyposporium penicillariae*) on pearl millet in Rajasthan Ph. D. Thesis submitted to Jai Narain Vyas University, Jodhpur-342001, Rajasthan India.
2. THAKUR, R.P. & S.B. KING (1988). Smut disease of pearl millet. Information Bulletin no. 25, ICRISAT, Patancheru, India, pp. 17.
3. WILLIAMS, R.J. (1984). Disease Resistance in pearl millet: Today and Tomorrow's Printers and Publishers, New Delhi. Pp. 245-296.
4. BETTOIL, W. (1999). Effectiveness of cow's milk against zucchini squash powdery mildew (*Sphaerotheca fiiliginea*) in greenhouse conditions. *Crop Protection*, **18**(8): 489-92.
5. ARUN-KUMAR & S.K. VERMA (2006). Milk in the Management of Plant Diseases. In: *Proceedings of National Conference on Bridging Gap Between Ancient and Modern Technologies to Increase Agricultural Productivity*, held at CAZRI, Jodhpur, India, (6-18 December 2005). Eds: S. L. Choudhary, R. C. Saxena & Y. L. Nene, Asian Agri-History Foundation, Choudhary Offset Pvt. Ltd., Udaipur, India, 67-73 pp.
6. FERRANDINO, F.J. & V.L. SMITH (2007). The effect of milk-based foliar sprays on yield components of field pumpkins with powdery mildew. *Crop Protection*, **26**: 657-663.
7. KORYCHA-DAHL, M. & T. RICHARDSON (1978). Photogeneration of superoxide anion in serum of bovine milk and in model systems containing riboflavin and amino acids. *J. Dairy Sci.*, **61**: 400-407.
8. SHETTY, R., H.G. PUSHPALATHA, N.P. GEETHA & H. S. SHETTY (2005). Comparative studies on pearl millet seed treatment with amino acid and associated difference in activation of phenyl propanoid pathway in induced systemic resistance (Abstract). Proc. Global Conference II 'Plant Health-Global Wealth', (25-29 November, 2005) ISMPP, MPUAT, Udaipur, India, 73 p.
9. REUVENI, M., V. AGAPOV & R. REUVENI (1993). Induction of systemic resistance to powdery mildew and growth increase in cucumber by phosphates. *Biol Agric. Hort.* **9**: 305-315.
10. MCGRATH, M.T. & N. SHISHKOFF (1999). Evaluation of biocompatible products for managing cucurbit powdery mildew. *Crop Protection* **18**: 471-478.
11. ARUN KUMAR, R. RAJBHANSALI & P.C. MALI (2002). Response of bio control agents in relation to acquired resistance against leaf curl virus in chili (abstract), In: *Proceedings of Asian Congress of Mycology & Plant Pathology*, October, 2002), Mysore, India, 167 pp.
12. HOWELL, C.R. (2003). Mechanisms employed by *Trichoderma* species in the biological control of plant diseases: The history and evolution of current concepts. *Plant Disease*, **8**: 4-10.
13. HOITINK, H.A.J., L.V. MADDEN & A.E. DORRANCE (2006). Systemic resistance induced by *Trichoderma* spp.: interactions between the host, the pathogen, the biocontrol agent and soil organic matter quality. *Phytopathology*, **96**: 186-189.
14. DASHORA, KAVYA, ARUN KUMAR & R. RAJBHANSALI (2008). Smut Disease of Pearl Millet: Biology and Control. In: P. Parihar & L. Parihar (eds), *Advances in Applied Microbiology*, Agrobios, Jodhpur, India, pp: 227-237.