

RESEARCH ARTICLE :

Utilization and identification of rice genetic stock against false smut disease under agro conditions of Jabalpur (M.P.)

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SUMMARY : Rice (*Oryza sativa* L.) is the most important cereal food crop and the primary source of livelihood for about half of the global population. With the changing climatic variations the proneness of the crop is also experienced. One time considered as minor problem, are being observed as a severe and wide spread threats. False smut (*Ustilaginoidea virens*) has emerged as an alarming malady primarily due to change in weather conditions, increased applications of nitrogenous fertilizers and large scale cultivation of the crop. Disease appears at grain filling stage and in a panicle few grains turned into smut balls of the fungus. Later at pre harvest and threshing stage, smut balls are ruptured and spores are spread out and sticks to the new grains, that helps in seed associated dissemination. Spore balls also fall down and contaminate the soil that serves as secondary source of inoculum. Considering the crop improvement as an effective and cheaper means to combat the problem, evaluation of genetic pool was under taken in naturally infected soil conditions at JNKVV, Jabalpur (M.P.). It was observed that among 40 rice varieties, seven exhibited no incidence of false smut, while only three rice hybrids were free from infection out of 19 hybrids. Out of 120 JNPT lines 82 were free and had no disease whereas 15 land races were identified no incidence out of 25 land races tested. Among 15 A lines, four lines did not exhibit the association of false smut. At JNKVV, Jabalpur these identified lines are being used for crop improvement and as a result Jawahar Hybrid Rice 76, JRH 85 have been developed for release.

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BACKGROUND AND OBJECTIVES

Rice (*Oryza sativa* L.) is the most important cereal food crop and the primary source of livelihood for about half of the global population. Among various diseases affecting rice crop, false smut caused by

Ustilaginoidea virens (Cooke) Takahashi, (Teleomorphe: *Villosiclava virens* Tanaka) has emerged as an alarming malady primarily due to change in weather conditions, increased application of nitrogen fertilizers and large-scale planting of hybrid rice (Zhou *et al.*, 2008 and Haiyong, 2012). The disease appeared in

epidemic form in 2001 and 2002 on cultivar PR 116 and has become endemic causing losses ranging from 2 to 85 per cent in different regions of India (Pannu *et al.*, 2010 and Ladhalakshmi *et al.*, 2012). In certain varieties, losses up to 44 per cent have been reported. The fungus produces toxins *viz.*, Ustilotoxin A causing rumination stopping in cows, suppression of tubulin of mammals and necroses of liver, kidney and bladder tissues (Ji, 2000 and Sinha *et al.*, 2003). It is also dangerous to the health of human (Ladhalakshmi *et al.*, 2012). The fungus produces ustilotoxin, a phytotoxin and a mycotoxin thus contaminating rice products (Koiso *et al.*, 1992 and Li *et al.*, 1995).

RESOURCES AND METHODS

In the present investigation, 40 varieties, 19 hybrids, 120 JNPT lines, 24 rice land race and 13 Alines of Rice were evaluated under natural field conditions at Rice Research Experimental Area, Adhartal Tank Farm, Department of Plant Breeding and Genetics, JNKVV, Jabalpur, during *Kharif* 2015 and 2016. The experimental site lies between 22°49' and 20°80' North latitude and 78°21' and 80°58' East longitude at an altitude 411.78 meter above the mean sea level. Observations on incidence of grain diseases were recorded on pre randomly selected 100 rice plants. Disease incidence was calculated as per the formula (Datar and Mayee, 1991). The disease was identified on the basis of typical field symptoms.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

False smut (*Ustilagoidea virens*) : Identification of disease :

False smut (*Ustilagoidea virens*) was observed during Oct II and III week and that coincided with average temperature 27.42° C, relative humidity of 83 per cent and rainfall of 12.1 mm. Usually the symptoms of false smut were confined to the panicles. As a result of infection the individual seed in rice was transformed and developed into the greenish velvety spore ball. Later on, the yellow greenish spore mass turned into black mass. At early stage of infection, the spore ball was covered with a transparent membrane that ruptured due to the pressure of spores and liberated. The disease could be identified from a distance on the basis of the presence of spore balls attached with the panicles. The status of rice false smut as an emerging fungal disease (anamorph: *Ustilagoidea virens* (Cooke) Takah.; teleomorph *Villosiclava virens* (Nakata) E. Tanaka and C. Tanaka) of rice (*Oryza sativa* L.) has been recognized worldwide (Atia, 2004; Brooks *et al.*, 2009; Ashizawa *et al.*, 2010; Li *et al.*, 2013; Singh *et al.*, 2014 and Nessa *et al.*, 2015).

Evaluation of genetic stock :

Incidence in rice varieties:

The incidence of false smut ranged from 0.0-50.0 %. Out of 40 varieties tested, seven varieties were free from infection of false smut pathogen, No incidence of false smut was noticed, in Erra Malallu, JR 201, JGL 3828, Kavya, Kudrat, Varalu and WGL 32183. In 21 varieties Ajay, BPT 2391, BPT 5204, Falguni, GAR 13, IGKVR 2, Improved Chinnor, Jagityal Sanalu, JGL 3844, JRB 1, JR 81, MR 220, OR 199-5, OR 1912-24, Pratikshya, PUSA 1121, PUSA 1401, Surekha, Rajlaxmi, WGL 14 and WGL 23985, incidence ranged from 1.0-5.0 %, while in ten varieties, Danteshewari, IR 36, Improved Jeerashakar, MR 219, MTU 1010, MTU 1081, Naveen, PUSA 1460, Satya Krishna and WGL 32100, infection ranged from 6.0 - 20.0 %. Incidence of false smut with 21.0-50.0 % was observed in two varieties, IR 64 and Kranti (Table 1).

Table 1 : Incidence of false smut in rice varieties

Range of Incidence	Number of varieties	Varieties
No incidence	7	Erra Malallu, JR 201, JGL 3828, Kavya, Kudrat, Varalu and WGL 32183.
- 5.0 %	21	Ajay, BPT 2391, BPT 5204, Falguni, GAR 13, IGKVR 2, Improved Chinnor, Jagityal Sanalu, JGL 3844, JRB 1, JR 81, MR 220, OR 199-5, OR 1912-24, Pratiksha, PUSA 1121, PUSA 1401, Surekha, Rajlaxmi, WGL 14 and WGL 23985
6.0 - 20.0 %	10	Danteshewari, IR 36, Improved jeerashar, MR 219, MTU 1010, MTU 1081, Naveen, PUSA 1460, Satya Krishna and WGL 32100.
21.0 -50.0 %	2	IR 64 and Kranti.
More than 50.0 %	-	Nil

Incidence in hybrid rice :

The incidence of false smut ranged from 0.0-5.0 per cent. Out of 19 rice hybrid tested, three rice hybrids was free from infection of false smut pathogen, No incidence of false smut was noticed, in JRH 76, JRH 85 and PA6444. In 16 rice hybrids, JRH 5, JRH 8, JRH 65,

JRH 66, JRH 67, JRH 68, JRH 69, JRH 70, JRH 72, JRH 73, JRH 75, JRH 79 JRH 86 and PA 129 incidence ranged from 1.0-5.0 % (Table 2)

Incidence in JNPT Lines :

Among from 120 JNPT lines, 34 JNPT lines 6AX

Table 2 : Incidence of false smut in hybrid rice

Range of Incidence	Number of varieties	Varieties
No incidence	3	JRH 76, JRH 85 and PA6444.
1.0 - 5.0 %	16	JRH 5, JRH 8, JRH 65, JRH 66, JRH 67, JRH 68, JRH 69, JRH 70, JRH 72, JRH 73, JRH 75, JRH 79 JRH 86 and PA 129.
6.0 - 20.0 %	-	Nil
21.0 – 50.0 %	-	Nil
More than 50.0 %	-	Nil

Table 3 : Incidence of false smut in JNPT lines

Range of incidence	Number of JNPT lines	Lines
No incidence	82	6A X NPT-32-01 -4R, 6AXNPT-79-01, 6AXNPT-79-01, 6AXNPT-79-01, NPT37-01, 6AXNPT-79-01, 6AXNPT-79-01, NPT25-01, NPT78-01, NPT24-01, NPT79-01, NPT80-01, NPT61-01, 6A X SPS 71, SPS71X NPT80, NPT (S)23-1, NPT (S)4-1, NPT (S)7-1, NPT (S) 7-1-2 NPT (S) 6-2, NPT (S)10-1-1, NPT (S)10-1, NPT29 X R1045-1-2, NPT89 X IR 36, NPT101 X IR64, NPT121X IR 64, NPT100X HMT, NPT100 XHMT, NPT100 XHMT, NPT100 XHMT, NPT100 XHMT, NPT100 XHMT, NPT100 XHMT, NPT100 XHMT, NPT100XHMT, NPT 100XHMT, NPT 100XHMT, NPT 100XHMT, NPT 100XHMT, 25AXNPT70 32, 25AXNPT7035, 25A X NPT 70-28, 25A X NPT 70-30, 25A X NPT 70-82, 25B X NPT 100, 2A X IR 42342, 2A X IR 42342, 2A X IR 42342, 2A X IR 42342, 2A X IR 42342, 2A X IR 42342, 2A X IR 42342, IR – 64, 10 A X IR 42342, NPT(S) 35-2, NPT(S) 6-6, 25 A X NPT 70(26-2), NPT(S) 23-1, 25B X NPT 101, 88A X NPT 29, NPT29 X Pusa Basmati, SPS71 X IR42342, SPS71 X IR42342, SPS71 X IR42342, NPT-1, 57K -65-61, H- 56, H- 4, NPT-70, NPT-7, NPT-10, NPT-17, NPT-29, NPT35-1, NPT41, NPT39-01, NPT40-01, NPT35-01, , NPT37-01, NPT37-01, NPT38-01, NPT-01, NPT13-01, NPT23-01, NPT63-01 and NPT63-01.
1.0 – 5.0 %	38	6AX NPT-32 01, SPS71XNPT 80, NPT27-01, SPS71XNPT 80, SPS71XNPT 80, NPT32-01, NPT41-01, 25A X NPT 70-36, 25A X NPT 70-34, 25A X NPT 70-28, NPT (S)4-1-2, NPT (S)6-6, NPT (S)6-42, NPT (S)7-1, NPT (S)8-1, SAHABHAGI , NPT 100XHMT, 25A X NPT 70-30, 25A X NPT 70- 15-10, NPT (S) 7-1, 10 A X IR 42342, NPT-23 NPT-24, NPT(S) 10- 1, NPT- 65, NPT-25, NPT35-2, NPT37, NPT47, NPT49, NPT52-01, NPT56-01, NPT69-01, NPT71-01, NPT57-01, NPT61-01 and NPT 40-01 X HMT.
6.0 – 20 %	-	Nil
21- 50 %	-	Nil
More than 50 %	-	Nil

Table 4 : Incidence of false smut in rice A lines

Range of incidence	Number of A lines	A lines
No incidence	4	22 A, 25 A, 69 A, 97 A
1.0- 5.0%	8	17 A, 29 A, 31 A, 32 A, 3 A, 56 A, 99 A, 6A
6.0– 20.0%	1	36 A
21.0 – 50.0%	-	Nil
More than 50.0%	-	Nil

Table 5 : Incidence of false smut in rice land races

Range of incidence	Number of land races	Land races
No incidence	15	Chinnor, Chinnor desi, Dhubraj, Kapoorsar, Karhani, Khudy, <i>Tulsi</i> , Jeera Shankar, Luchai, Luchandichoti, Madhuri, Peerikhanak, Raikera, Sukraphool, Vishnubhoog
1.0-5.0%	5	Badalphool, Basmatiya, Chatariya, Makram, Sairam
6.0-20.0%	4	Chotaluchai, Jeera phool, Khandajal, Laxshmibhoog
21.0-50.0%	-	Nil
More than 50.0%	-	Nil

NPT-32 01, SPS71XNPT 80, SPS71XNPT 80, SPS71XNPT 80, 25A X NPT 70-36, 25A X NPT 70-34, 25A X NPT 70-28, NPT (S)4-1-2, NPT (S)6-6, NPT (S)6-42, NPT (S)7-1, NPT (S)8-1, SAHABHAGI, NPT 100XHMT, 25A X NPT 70-30, 25A X NPT 70- 15-10, NPT (S) 7-1, 10 A X IR 42342, NPT-23 NPT-24, NPT(S) 10- 1, NPT- 65, NPT-25, NPT35-2, NPT37, NPT47, NPT49, NPT27-01, NPT32-01, NPT41-01, NPT52-01, NPT56-01, NPT69-01, NPT71-01, NPT57-01, NPT61-01 and NPT 40-01 X HMT, and exhibited the infection due to the false smut pathogen, the incidence ranged in 01- 5.0 per cent. 82 JNPT lines did not show any infection of false smut under natural field conditions during at Jabalpur (Table 3).

Incidence in rice A lines :

The false smut disease was not recorded in four, A lines namely 22 A, 25 A, 69 A, 97 A, whereas 8 lines had the incidence upto 5 per cent (Table 4).

Incidence in rice land races :

False smut was not recorded in 15 land races namely Chinnor, Chinnor desi, Dhubraj, Kapoorsar, Karhani, Khudy, Kodokapour, Luchai, Luchandichoti, Madhuri, Peerikhanak, Raikera, Sukraphool, *Tulsi*, Vishnubhoog, data collected from 11 agro climatic zones of Madhya Pradesh (Table 5).

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