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Drying of rice crop – a newly progressing entity, its identification, pathogenicity, physiology and developing appropriate control measures

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Abstract

Drying of rice seedlings caused by the entity, (*Dactylella ellipsospora*) is a newly appearing disease in paddy field in Punjab Pakistan. This problem was recorded during 2002 crop season survey for the first time in districts of Jhang and Faisalabad in the suburbs of the river Chenab. In Jhang it damaged (2.5) acre rice crop while in Faisalabad it caused destruction of (½) acre rice crop in village 233 Tikkawala. Studies have been conducted on the aspects of pathogen identification, its pathogenic nature and to develop control measures. The fungus culture was incubated after inoculation on synthetic neutrient agar, PDA medium, it covers 90 mm petri plates in 96 hours period. When kept in NUV light for 24 hours to conidial production, single conidia appeared on conidiophore with six septation having middle cell broader, outer cells tapering at both ends and thin in size, was identified, as *Dactylella elepsospora* Grove. In field studies the pathogen caused 36% pre emergence seed rot and 40% post emergence seedling mortality. *Trichoderma harzianum* treatment showed 70% germination of seeds while the pathogen *Dactylella ellipsospora* showed 64% germination. In control studies, Topsin-M and Rabcide effectively controlled the disease. Both fungicides caused 86.66% to 93.33% reduction in pathogen growth. Physiological studies showed its fast growing nature at 22±1ºC on synthetic medium.

Keywords: Chemical control, *Dactylella ellipsospora* Grove, Paddy Wilt, Incitant, Pathogenicity.

Introduction

Rice or paddy (*Oryza sativa* L.) is the third major field crop in the country. It is grown in all over the four provinces of Pakistan (Anonymous 2004). This newly emerging rice wilt disease affect the fine variety B-385 and Super, right from early stage after transplanting up to maturity. As our national economy depends upon the major export of agricultural commodities. Rice covers about ⅓ agricultural export among agricultural commodities. The country export can be enhanced by improving crop yield through controlling diseases and adopting advanced agronomic practices. The biotic factor of stresses and diseases deteriorate the paddy crop produce affecting the crop in field and produce during storage at temperature ranges from 20-30ºC. The pronounced proponderent effect of the disease appeared in the form of disease causing seed rot, seedling mortality at nursery stage and after transplantation in field up to maturity causing wilting and withering of mature plants (Barnet & Hunter, 1972). Most effective and notorious diseases of rice crop are brown leaf spot, narrow brown leaf spot, stack burn, blast and bakanae. Recently in the country a new pathogenic diseases called wilt/drying of rice caused by *Dactylella ellipsospora* and rice blast (*Pyricularia grisea)* appeared. These affect the paddy crop especially after transplanting at farmers field (Anonymous, 2003; Javed *et al*., 2003). It was contemplated to conduct present studies on the identification, pathogenicity, physiology and appropriate control measures of the pathogen to reduce the disease spread and for better guidance to farmer community. Biological control studies have been conducted but genetic variability will be investigated later on.

Materials and Methods

The disease was observed during 2002 when diseased infected plant samples were brought in by a farmer to the seed pathology laboratory for guidance. Further sampling was done by collecting diseased plant samples from the infected field of Jhang area by visiting the diseased farmer field. The samples were analysed in the laboratory for the identification of the disease. 100 pieces of stem and roots were incubated in petri plates by using blotter method (ISTA 1980) and PDA method. The culture of pathogen was preserved in hot and cool incubator with –20 - 50ºC limit and maintained

on the described medium at 20±1ºC in the incubator. Rice seeds infested with the culture of the pathogen were studied in the laboratory. Growth parameters of the pathogen on radial growth pattern colony appearance and growth characters were studied on PDA fot morphological studies. The growth character of pathogen were compared to know their compatibility with co-relation to time factor and control aspects were also checked. Pathogen identification was made (Barnet & Hunter, 1972; Wang *et al*., 1996). Biological control studies were conducted by using the *Trichoderma harzianum* as biological agent (Anonymous, 2002). Both the fungi i.e., pathogen having white cottony mycelium (later identified as *Dactylella ellipsospora*) and antagonistic fungus was incubated on PDA individually and collectively (in the same dish) to see their affect on each other. In vivo studies naturally infested 200 seeds were sown in pots with four replications having 50 seeds in each case. 100 naturally infested seeds were sown as control. Average germination and mortality data were recorded on 6^{th} day after sowing (Table-4). The same fungus was recorded from Faisalabad district in the next year crop. Funjicides viz; Topsin-M, Rabcide, Score and Copper oxychloride were tested for their toxicity in field conditions against rice wilt causing pathogen (*Dactylella ellipsospora*).

Results and Discussion

Studies have been conducted on pathogen previously directly isolated fungus for isolation, identification, pathogenicity, physiology and biological control aspects.

Isolation

Isolations of the pathogen were made in the laboratory from five infected rice plant samples each on blotter paper and PDA medium at 22±1ºC. The white cottony mycelium was isolated from the diseased plants infected portions (stem and root pieces) after incubation at 22±1ºC in the growth chamber. It was the same fungus that was recorded in the direct isolation (Table.1). The pathogen was later identified as *Dactylella ellipsospora* fungus (Barnet & Hunter, 1972; Wang *et al*., 1996). The culture was purely isolated from diseased plants. The pathogen destroyed 2.5 acre rice crop in the Jhang area by retrenching 10-65% plant population that was surveyed during field visit assessment studies in 2002.

Table. 1: Isolations of the new rice wilt pathogen from diseased plant samples

Sample S. No.	Isolations of *Dactylella ellipsospora* pathogen			
	Stem		Root	
	PDA	Blotter	PDA	Blotter
RDPS 1	+	+	+	+
RDPS 2	+	+	+	+
RDPS 3	+	+	+	+
RDPS 4	+	+	+	+
RDPS 5	+	+	+	+

Disease Symptoms

After nursery transplantation in field the disease caused drying/ wilting/ withering of paddy crop. The pathogen attacked the plant at soil level, resulting in the spread of the entity *Dactylella ellipsospora* by irrigation water. The infected plants showed withering and drying of plants with profused growth of the pathogen at hypocotyls region. The fungal growth had pure white cottony appearance of fungal propagules that infect the whole tillers in the diseased plants that dried quickly and showed white cottony growth of fungal mycelial mat. At maturity stage infected plants appeared Bakanae like dried plants. Panicles remained unfilled and reduced the yield. During the year 2003 in Faisalabad this diseased caused 1.00% mortality in farmer field.

Identification

The fungus culture was incubated in the NUV light for 24 hours for conidial production. When observed morphologically conidia appeared singly on conidial heads , conidiophore was erect, strait and single with white cottony mycelium on PDA. In stereo-microscope it was identified as *Dactylella ellipsospora* Grove by following literature (Barnet & Hunter, 1972). Single conidia appeared on conidiophore with six septation having middle cell broader while, outer cells at both ends are tapering and thin in size (Fig.1). Finally the pathogen was identified as *Dactylella ellipsospora* Grove based upon colony and form of the conidial production singly (Wang *et al*., 1996).

Physiological Studies

In physiological studies it was found that the *Dactylella ellipsospora* is the faster grower than that of *Trichoderma harzianum* and its white cottony mycelial growth covered 2.49, 5.37, 8.09 and 9.00 cm diameter in 9.0 cm Pyrex glass dishes in 24, 48, 72 and 96 hours but in 96 hours all the 10 dishes the colony growth covered up to

9.0 cm area (Table.2). At 22+1^{0}C temperature in the incubator, it could not produce conidia even after the period of 5 years & 3 months under laboratory conditions in present studies. Conidia production in one week old culture initiated with in 24hrsof exposure to NUV light.

Table. 2: Physiological studies on *Dactylella ellipsospora* the rice wilt pathogen.

Hours	**Radial growth (cm) of *Dactylella ellipsospora* isolated from infected rice plant**										
	Dishes										**Mean**
	1	2	3	4	5	6	7	8	9	10	
24	2.5	2.4	2.1	2.5	2.3	2.5	2.4	2.4	2.5	3.3	**2.49**
48	5.0	5.3	5.1	5.8	6.4	5.2	3.4	4.8	5.4	7.3	**5.37**
72	8.5	7.9	8.2	8.4	7.8	8.4	7.2	8.0	8.6	7.9	**8.09**
96	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**9.0**

Pathogenicity

Two hundred infested seeds sown in pots in such a way that 50 seeds represent each treatment and 100 seeds were sown with *Trichoderma harzianum* infestation for bio-control studies. *Trichoderma harzianum* treatment showed 70% germination of seeds while the pathogen *Dactylella ellipsospora* showed 64% germination. Both the treatmeats exhibit 30 and 36% pre-emergence seedling mortality in artificially infested seeds (Table.3). 40% pre-emergence seed rot was recorded in pathogen *Dactylella ellipsospora* amended treatments.

Table. 3: Effect of Bio-control agent and pathogen to disease development.

Sr. #	Parameters	*Dactylella ellipsospora* + *Trichoderma harzianum*	Pathogen *ellipsospora*	*Dactylella*
1	Germination %age	70.0		64.0
2	Pre-emergence seed rot %age	30.0		36.0
3	Post-emergence mortality %age	0.0		40.0

Field Studies To Develop Control Stratigies:

Effective control strategy was developed in field conditions against the pathogen *Dactylella ellipsospora* by evaluating different fungitoxicants. The tested chemicals showed a diversity of effectiveness. Among fungicides tested for control of pathogen Rabcide and Topsin-M proved effective at recommended doses when applied as two fortnightly foliar sprays. Both the fungicides caused 93.33 and 86.66% reduction in pathogen growth when infected panicles incubated at 22+1^{0}C temperature in incubation room on blotter paper, while Score and Copper oxychloride did not exhibit any reduction in growth of the pathogen (Table. 4).

Table. 4: Disease incidence by *Dactylella ellipsospora* in paddy field and its control

Treatment	Recommended Dose gm/acre or ml/acre	% age infected panicles	% age reduction in fungal growth
Control	Distilled water	100	0.00
Score	125 ml	100	0.00
Rabcide	250 gm	6.66	93.33
Topsin-M	600 gm	13.32	86.66
Copper oxychloride	1.0 kg	100	0.00

Discussion

Rabcide 50 WP is widely used to control the blast incidence in rice recently (Mogi, 1979). Topsin-M + Thiram was found very effective against rice blast diseases (Agarwal *et al*., 1989). The described entity *Dactylella ellipsospora* is blast like pathogen. Both the pathogenic fungi produce same neck blast symptom in the panicles and block the food supply, consequently the panicles remain empty. The pathogen is also isolated from the infected portion producing neck blast like symptoms from the samples collected from blast infected fields. The fungicides Rabcide and Topsin-M found

effective the disease. Seed treatment with Rabcide and Topsin-M could effectively reduced the disease from seed surface. These were found effective against blast disease in Japan (Mogi, 1979 and Agarwal *et al*., 1989).

Trichoderma harzianum treatment showed 70% germination of seeds while the pathogen *Dactylella ellipsospora* showed 64% germination. Both the treatmeats exhibit 30 and 36% pre-emergence seedling mortality in artificially infested seeds. Biological control by the fungus *Trichoderma harzianum* can enhance the germination by5%. However *Trichoderma harzianum* was unable to engulf the pathogen when grown mixed in the synthetic medium. The disease is newly emerging in the country so it should be strongly recommended that the seed treatment practices should be strictly adopted to reduce the spread of the disease in the disease free areas. In all these studies the pathogenic fungus *Dactylella ellipsospora* found associated in one or the other way with rice crop failure. Neither *Trichoderma* fungus nor any temperature fluctuation could effect the fast growing character of the pathogenic fungus kept in hot (50^0C) and cool (-20^0C) incubator for period of two years at laboratory conditions however it failed to produce conidia. The appearance of this fungus in Faisalabad region indicates the spreading nature of the entity. Chemicals tested for blast proved effective against this fungus. This pathogen caused bakanae like drying plant symptoms at maturity stage of the crop. Wholly dried plant showed unfilled empty grains in the panicle spike. Chaffyness of grains found profuselyin such dried plants. The best control is the use of disease free seed certified by the Seed Certification Department. This pathogen is newly recorded in Pakistan that badly retrenched rice crop produce.

Recently, this pathogen was isolated from groundnut dried plants collected from Chakwal areas during 2004 (Anonymous 2004). The pathogen has been recorded on different crops Lupin, Lavendar, Mango and Shesham (Barnet & Hunter, 1972; Arshad *et al*., 2005; Javaid *et al*., 2004). Mogi, 1979 and Agarwal *et al*., 1989 also recorded this pathogen from rice crop in seed health studies and during developing its control in rice by chemotherapeutic means in Japan. The farmers failed to control the disease without technical help of the Research Institutes. Even if effective, the use of kerosine oil could enhance the complications such as deterioration of soil texture and change the soil pH drastically. So these studies conducted to illuminate the effect of pathogen and chemicals to restrict the disease spread in disease free areas and to disseminate the results purely and properly to farmer's community, which results to enhance the paddy yield. This endeavour may prove effective to increase per acre yield that provide and remunerated renaissance to farmers.

Fig 1: Conidia of *Dactylella ellipsospora*

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