

Original Research Article

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Determination the Role of Weeds Hosts in Spreading of Sheath Blight from Weeds to Rice Crop in Western Plain Zone of Uttar Pradesh, India

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ABSTRACT

Rice is a staple food for human being all over the world and India is the second largest producer and consumer of rice at global level. Production of rice in India is limited by several biotic and abiotic factors. Rice sheath blight (*Rhizoctonia solani* AG1-IA) is one of the most important factor causes significant grain yield and quality losses at worldwide. Yield losses of up to 50% have been reported under most conducive environments in India. Several uncultivated (weeds) and cultivated plant species are known to act as alternate and collateral hosts of *R. solani* in different agro-climatic regions of India. The cv. Pusa Basmati-1 (PB-1) grown in the western plain region of Uttar Pradesh and to screen weed species growing in and around paddy fields to study the carryover of pathogen from rice to weeds and vice-versa. Out of 75 weed species tested for host range of *R. solani*, 73 were found to show high or low degree of symptoms *in vitro*. Whereas, 11 weed species *i.e.* *Launaea procumbens*, *Cynodon dactylon*, *Echinochloa colona*, *Blumea lacera*, *Eragrostis tenella*, *Typha angustata*, *Chloris barbata*, *Xanthium strumarium*, *Cyperus rotundus*, *Paspalum distichum* and *Bidens pilosa* were found to carry infection of *R. solani* as they exhibited characteristic symptoms after artificial inoculation. A total of 22 weed species were evaluated inside rice field using cv. PB-1 to know infection level and how associated in spreading the disease. Out of 22 weed species, 13 weed species *viz.* *Echinochloa colona*, *Brachiaria decumbens*, *Cyperus rotundus*, *Setaria verticillata*, *Paspalum distichum*, *Leptochloa chinensis*, *Brachiaria reptans*, *Imperata cylindrica*, *Saccharum spontaneum*, *Digitaria sanguinalis*, *Cyperus difformis*, *Eclipta alba* and *Cynodon dactylon* showed higher disease incidence and five weed species *i.e.* *Sorghum halepense*, *Echinochloa colona*, *Paspalum distichum*, *Imperata cylindrica* and *Desmostachya bipinnata* were showed higher disease severity as well as a very prominent role in spreading *R. solani* to rice plants during both the years (2011 and 2012). Weed species *Echinochloa colona* and *Brachiaria decumbens* associated with rice were maximum percent disease severity (15.62% & 12.33%) and disease incidence (25.47% & 24.41 %), respectively when planted in between the rows of rice under field condition. These weeds are having played a crucial role in transfer and spread of pathogen from weeds to rice crop. These studies will help in managing the sheath blight disease.

Keywords

Rice, *Rhizoctonia solani*, Sheath blight, Weeds, Host range

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Introduction

Rice (*Oryza sativa* L.) is a major food constituent of human diet, for more than two third population of India. Globally, after China, India ranks second in rice production. It is a major food crop in India, China and most of the other Asian countries, where 92% of the world's rice is cultivated (Rai, 2006). To fulfill the rice requirement globally, it is estimated that about 115 million tons of additional milled rice needs to be produced by 2035, which is equivalent to an overall increase of 26% in the next 25 years. At present, rice productivity has been increased four times from the past five decades that made possible by the adoption of semi-dwarf high-yielding varieties (HYV) with applying modern cultural practices.

Efforts for enhancing the productivity are limited by a number of biotic and abiotic stresses. The rice crop suffers from a number of devastating diseases caused by fungi, bacteria, viruses, nematodes, phytoplasma. Alone fungal diseases are responsible for about 12 to 20% yield losses per year (Rajan, 1987). Among the fungal diseases, sheath blight caused by *Rhizoctonia solani* Kühn [*Thanetophorus cucumeris* (Frank) Donk] is one of the most serious threat for Basmati rice production in India, specially where acreage under Basmati rice is growing exponentially. *R. solani* is a complex of genetically distinct groups of fungi with more than 100 species; having very diverse life histories (Anderson 1982; Adams, 1988; Binder *et al.*, 2005) with a wide host range and infects large number of crop plants, horticulture and weed species (Ou, 1972). Among *R. solani* anastomosis groups (AGs), the subgroup AG1-IA is one of the predominant causal agent of sheath blight from rice growing regions worldwide (Taheri *et al.*, 2007; Bernardes-De-Assis *et al.*, 2009; Gonzalez-Vera *et al.*, 2010).

The impact of weed competition on rice yield has been well documented (Antralina *et al.*, 2015; Sureshkumar *et al.*, 2016; Hosoya and Sugiyama, 2017). Weeds have also been identified as hosts for a variety of rice pathogens including *Ustilagoideia virens* (Shetty and Shetty, 1987; Deng *et al.*, 2015), *Fusarium fujikuroi* (Carter *et al.*, 2008), *Xanthomonas oryzae* pv. *oryzae* (Brar and Thind, 1994), and *Bipolaris oryzae* (Biswas and Mohanty, 1995). As alternative hosts for pytopathogens, weeds contribute to increased inoculums density, allow carryover of pathogens in crop rotation, and provide a base for pathogenic variation (Hartman *et al.*, 1986). Several uncultivated (weeds) and cultivated plant species are also known to act as alternate and collateral hosts of *R. solani* in different agro-climatic regions of India (Singh *et al.*, 2012). Various weeds like *Cyperus rotundus*, *Cyperus difformis*, *Cynodon dactylon*, *Echinochloa colonum*, *Commelina obliqua* and *Amaranthus viridis* were reported as collateral hosts and the pathogen survives in these hosts in absence of rice plants (Acharya and Sengupta, 1998).

The host range studies of *R. solani* indicated that it was successfully infected 14 different plant species belonging to three families. This indicates that weeds and plants species serve as collateral hosts and responsible for spreading the disease in next crop season (Srinivas *et al.*, 2014). As a consequence, the increasing importance of the disease and lack of information on weed hosts of *R. solani* in the Uttar Pradesh, there is a need to gather information on the off season survival of *R. solani* in rice ecosystem on different weeds and plant species. The present investigation is carried out to record host range of *R. solani* on different weeds, the infection level of sheath blight in different weeds grown in and around paddy fields to study their carryover of pathogen from rice to weeds and *vice-versa* in the Uttar Pradesh.

Materials and Methods

Evaluation of host range of *R. solani* on different weed species

Seventy five weed species belonging to different families were selected for the host range study. The leaves of different weed species were collected in polythene bags, labeled and stored. Leaves were cut with sterilized scissor (90.0% alcohol) and placed on sterilized and moist Whatman filter paper Grade 1 in the sterilized petriplates. Mycelial bits of 5 mm dia. were cut from the actively growing colony of *R. solani* and placed on the detached weed leaves in the petriplates containing moist and sterilized Whatman filter paper (Kumar *et al.*, 2013).

Three replications were maintained for each treatment. Inoculated leaves were incubated in BOD at 28±2°C. Three leaves were inoculated in each petriplates. After inoculation, infection or no infection were observed at 24 hours intervals for one week. Development of lesions on the detached leaves was considered to be the host for *R. solani*.

Determination of role of different weed species in spread of sheath blight in rice

To determine the role of various weed species in spread of sheath blight disease, a field experiment was conducted at Chirori Farm, S. V Patel Agriculture University, Meerut UP, for two crop season *i.e.* Kharif 2011 to Kharif 2012.

A total of 22 weed species were evaluated inside rice field. Weed species were planted in between the two rows of rice and inoculated with *R. solani* inoculum grown on rice bran. Observations on sheath blight disease incidence and severity were recorded after every 25 days following Standard Evaluation System for Rice (IRRI, 1996).

Results and Discussion

Determination of host range of *R. solani* on different weed species *in vitro*

Host range studies revealed that *R. solani* successfully colonized all the tested weed species except *Datura metel* and *Commelina benghalensis* and produced typical symptoms of sheath blight under artificial *in vitro* inoculation (Table 1). The sheath blight symptoms were started appearing 7 days post inoculation. The weed species *Launaea procumbens*, *Cynodon dactylon*, *Echinochloa colona*, and *Blumea lacera* recorded highest disease severity (range 81.43% to 86.95%), followed by *Eragrostis tenella*, *Typha angustata*, *Chloris barbata*, *Xanthium strumarium*, *Cyperus rotundus*, *Paspalum distichum* and *Bidens pilosa* (range 70.48%-77.90%) and produced typical symptoms of sheath blight. However, six weed species *viz.*, *Tridax procumbens*, *Eleusine indica*, *Leptochloa chinensis*, *Setaria verticillata*, *Ipomoea cairica* and *Dactyloctenium aegyptium* showed moderately high disease severity (range 60.24%-67.33%) and 26 weed species namely *Alternanthera sessilis*, *Rhynchosia minima*, *Desmostachya bipinnata*, *Cassia tora*, *Lantana camara*, *Euphorbia hirta*, *Vitis carnosa*, *Peristrophe paniculata*, *Croton bonplandianum*, *Alternanthera pungens*, *Echinochloa glabrescens*, *Eclipta alba*, *Coccinia grandis*, *Anisomeles indica*, *Ocimum basilicum*, *Setaria verticillata*, *Brachiaria reptans*, *Triumfetta rhomboide*, *Malvastrum coromandelianum*, *Mecardonia procumbens*, *Polygonum hydropiper*, *Erianthus munja*, *Leucas cephalotes*, *Sorghum halepense*, *Sida acuta*, and *Kirganelia reticulate* showed moderately low disease severity (range 30.57%-57.62%). The remaining 30 weed species *Solanum nigrum*, *Celosia argentea*, *Scoparia dulcis*, *Trianthema monogyna*, *Withania somnifera*, *Brachiaria decumbens*, *Tribulus terrestris*, *Parthenium*

hysterophorus, *Mukia maderaspatana*, *Cyperus difformis*, *Oxalis corniculata*, *Cannabis sativa*, *Cissampelos hirsute*, *Ziziphus mauritiana*, *Anisomeles malabarica*, *Lindernia crustacean*, *Calotropis procera*, *Ageratum houstonianum*, *Digera muricata*, *Chenopodium album*, *Alysicarpus vaginalis*, *Saccharum spontaneum*, *Phyllanthus niruri*, *Physalis minima*, *Urena lobata*, *Cuscuta reflexa*, *Sida rhombifolia*, *Achyranthes aspera*, *Cassia occidentalis* and *Amaranthus viridis* showed lower disease severity (range 0.95%-28.38%). The pathogen was re-isolated from all the infected weed species which produced typical characteristics of *R. solani* on potato dextrose agar (PDA). The results indicate that weed species serve as subsidiary hosts (alternate/collateral host) of *R. solani* and helped in the disease incidence in the next cropping season. Similar observations were reported by Tsai (1974) and found that 20 species of weeds from 11 families infected with *R. solani* and that the sclerotia obtained from the diseased tissues of weeds produce typical symptoms of sheath blight of rice. The occurrence of fungus *R. solani* on several weeds in nature was also observed by several other workers (Roy, 1973; Sharma and Mukherjee, 1978). Srinivas *et al.* (2014) reported that rice isolates of *R. solani* infected 14 species belonging to three different families *i.e.* Amaranthaceae, Graminaceae and Leguminaceae.

Determination of role of different weed species in spread of sheath blight in rice

Effect on percent disease severity

To find out the role of different weed species in spreading the sheath blight of rice. An experiment was conducted under field condition using 22 different weed species. Out of 22 weed species, six weed species *i.e.* *Echinochloa colona*, *Brachiaria decumbens*, *Imperata cylindrica*, *Leptochloa chinensis*,

Brachiaria reptans, and *Eleusine indica* were found to have a very prominent role in spreading the pathogen *i.e.* *R. solani* to rice plants, as there was considerable level of disease severity (range 10.23%-15.62%) of sheath blight in rice during both the years (2011 and 2012) planted in association with these five weeds (Table 2).

When weed species *Echinochloa colona* was grown in between two rows of PB-1, it was observed that this resulted in highest disease severity of 20.83% on PB-1. The rice associated with weed *Echinochloa colona* also showed higher infection of sheath blight of rice, except *Leptochloa chinensis* which was free from the disease but rice row associated with this weed also showed some minimum level of disease severity (13.89%) as compared to above mentioned other weeds. During 2012 the disease severity was comparatively lower than previous years as, out of 22 weed species, 8 weed species *viz.*, *Echinochloa colona* (10.42%) and *Paspalum distichum* (7.64%) showed comparatively lower severity of sheath blight among these weeds. The higher average severity of sheath blight of rice on variety PB-1 in association with weed species *Echinochloa colona*, *Brachiaria decumbens*, *Brachiaria reptans*, *Paspalum distichum*, *Saccharum spontaneum*, *Imperata cylindrica*, *Eleusine indica*, *Cyperus difformis* and *Cynodon dactylon*, clearly indicate that these weeds are having greater role in spreading sheath blight disease to rice plants. Kannaiyan and Prasad (1980) have listed 30 monocot weed species as host of *Thanatephorus cucumeris* (*Rhizoctonia solani*). Kozaka (1965) and Tsai (1974) observed that rice fungus infected 20 species which are from 11 families and observed that the sclerotia from diseased tissue of weed hosts produced typical symptoms of sheath blight on paddy. Kozaka (1961) from Japan recorded 188 species of plants from 32 families that can be infected by this fungus.

Two virulent isolates of *Thanatephorus cucumeris* could infect and survive on several weed hosts which are commonly found in rice fields namely *Echinochloa crusgalli*, *E. colonum*, *Fimbristylis littoralis*, *Cyperus rotundus*. Kannaiyan and Prasad (1980) have listed 30 monocot weed species as host of *Thanatephorus cucumeris*.

Table.1 Evaluation of host range of *R. solani* on different weed species *in-vitro* in Uttar Pradesh

S. No.	Botanical name	Family	Total weed leaves height (cm)	Per-cent disease severity
1	<i>Datura metel</i>	Solanaceae	5	0.00
2	<i>Commelina benghalensis</i>	Commelinaceae	5	0.00
3	<i>Solanum nigrum</i>	Solanaceae	5	0.95
4	<i>Celosia argentea</i>	Amaranthaceae	5	1.76
5	<i>Scoparia dulcis</i>	Scrophulariaceae	5	3.38
6	<i>Trianthema monogyna</i>	Aizoaceae	5	5.71
7	<i>Withania somnifera</i>	Solanaceae	5	5.71
8	<i>Brachiaria decumbens</i>	Poaceae	5	6.00
9	<i>Tribulus terrestris</i>	Zygophyllaceae	5	6.86
10	<i>Parthenium hysterophorus</i>	Asteraceae	5	7.43
11	<i>Mukia maderaspatana</i>	Cucurbitaceae	5	7.57
12	<i>Cyperus difformis</i>	Cyperaceae	5	7.62
13	<i>Oxalis corniculata</i>	Oxalidaceae	5	7.67
14	<i>Cannabis sativa</i>	Cannabaceae	5	8.10
15	<i>Cissampelos hirsute</i>	Menispermaceae	5	10.56
16	<i>Ziziphus mauritiana</i>	Rhamnaceae	5	10.57
17	<i>Anisomeles malabarica</i>	Lamiaceae	5	11.24
18	<i>Lindernia crustacean</i>	Scrophulariaceae	5	11.90
19	<i>Calotropis procera</i>	Asclepiadaceae	5	15.90
20	<i>Ageratum houstonianum</i>	Asteraceae	5	16.43
21	<i>Digera muricata</i>	Amaranthaceae	5	17.14
22	<i>Chenopodium album</i>	Chenopodiaceae	5	17.33
23	<i>Alysicarpus vaginalis</i>	Fabaceae	5	17.90
24	<i>Saccharum spontaneum</i>	Poaceae	5	20.24
25	<i>Phyllanthus niruri</i>	Euphorbiaceae	5	23.52
26	<i>Physalis minima</i>	Solanaceae	5	23.52
27	<i>Urena lobata</i>	Malvaceae	5	25.38
28	<i>Cuscuta reflexa</i>	Cuscutaceae	5	25.62
29	<i>Sida rhombifolia</i>	Malvaceae	5	26.05
30	<i>Achyranthes aspera</i>	Amaranthaceae	5	26.95
31	<i>Cassia occidentalis</i>	Fabaceae	5	27.19
32	<i>Amaranthus viridis</i>	Amaranthaceae	5	28.38
33	<i>Alternanthera sessilis</i>	Amaranthaceae	5	30.57
34	<i>Rhynchosia minima</i>	Fabaceae	5	33.43

35	<i>Desmostachya bipinnata</i>	Poaceae	5	33.48
36	<i>Cassia tora</i>	Fabaceae	5	33.86
37	<i>Lantana camara</i>	Verbenaceae	5	34.05
38	<i>Euphorbia hirta</i>	Euphorbiaceae	5	35.10
39	<i>Vitis carnosa</i>	Vitaceae	5	36.29
40	<i>Peristrophe paniculata</i>	Acanthaceae	5	39.10
41	<i>Croton bonplandianum</i>	Euphorbiaceae	5	39.24
42	<i>Alternanthera pungens</i>	Amaranthaceae	5	42.71
43	<i>Echinochloa glabrescens</i>	Poaceae	5	43.00
44	<i>Eclipta alba</i>	Asteraceae	5	43.00
45	<i>Coccinia grandis</i>	Cucurbitaceae	5	44.29
46	<i>Anisomeles indica</i>	Lamiaceae	5	44.76
47	<i>Ocimum basilicum</i>	Lamiaceae	5	44.81
48	<i>Setaria verticillata</i>	Poaceae	5	45.24
49	<i>Brachiaria reptans</i>	Poaceae	5	45.57
50	<i>Triumfetta rhomboidea</i>	Tiliaceae	5	47.29
51	<i>Malvastrum coromandelianum</i>	Malvaceae	5	49.05
52	<i>Mecardonia procumbens</i>	Scrophulariaceae	5	50.00
53	<i>Polygonum hydropiper</i>	Polygonaceae	5	52.38
54	<i>Erianthus munja</i>	Poaceae	5	52.76
55	<i>Leucas cephalotes</i>	Lamiaceae	5	55.33
56	<i>Sorghum halepense</i>	Poaceae	5	55.48
57	<i>Sida acuta</i>	Malvaceae	5	56.10
58	<i>Kirganelia reticulate</i>	Euphorbiaceae	5	57.62
59	<i>Tridax procumbens</i>	Asteraceae	5	60.24
60	<i>Eleusine indica</i>	Poaceae	5	61.43
61	<i>Leptochloa chinensis</i>	Poaceae	5	62.29
62	<i>Setaria verticillata</i>	Poaceae	5	63.05
63	<i>Ipomoea cairica</i>	Convolvulaceae	5	64.52
64	<i>Dactyloctenium aegyptium</i>	Poaceae	5	67.33
65	<i>Eragrostis tenella</i>	Poaceae	5	70.48
66	<i>Typha angustata</i>	Typhaceae	5	70.86
67	<i>Chloris barbata</i>	Poaceae	5	71.14
68	<i>Xanthium strumarium</i>	Asteraceae	5	75.14
69	<i>Cyperus rotundus</i>	Cyperaceae	5	75.33
70	<i>Paspalum distichum</i>	Poaceae	5	76.00
71	<i>Bidens pilosa</i>	Asteraceae	5	77.90
72	<i>Launaea procumbens</i>	Asteraceae	5	81.43
73	<i>Cynodon dactylon</i>	Poaceae	5	81.57
74	<i>Echinochloa colona</i>	Poaceae	5	84.02
75	<i>Blumea lacera</i>	Asteraceae	5	86.95
	CD(p=0.05)			9.772

Table.2 Assessment of role of different weed species in spreading of sheath blight in rice cv. PB -1

S. No.	Weed botanical name	Weed family	Percentage of disease severity on rice			Percentage of disease incidence on rice		
			2011	2012	Average	2011	2012	Average
1	<i>Sorghum halepense</i>	Poaceae	3.12 (9.30)*	1.74 (7.34)	2.43 (8.32)	10.40 (16.60)	7.90 (15.14)	9.15 (15.87)
2	<i>Commelina benghalensis</i>	Commelinaceae	3.82 (10.55)	0.35 (4.73)	2.08 (7.64)	12.40 (18.40)	3.98 (10.17)	8.19 (14.29)
3	<i>Dactyloctenium aegyptium</i>	Poaceae	10.27 (17.12)	0.35 (4.73)	5.21 (10.93)	19.11 (23.67)	2.61 (7.75)	10.86 (15.71)
4	<i>Brachiaria reptans</i>	Poaceae	17.36 (22.53)	3.13 (9.47)	10.24 (16.00)	23.62 (26.60)	7.23 (14.50)	15.42 (20.55)
5	<i>Echinochloa colona</i>	Poaceae	20.83 (26.51)	10.42 (18.26)	15.62 (22.38)	32.59 (34.44)	18.36 (25.17)	25.47 (29.81)
6	<i>Brachiaria decumbens</i>	Poaceae	14.58 (22.10)	10.07 (18.13)	12.33 (20.12)	31.07 (33.49)	17.75 (24.71)	24.41 (29.10)
7	<i>Cynodon dactylon</i>	Poaceae	5.55 (12.81)	7.29 (14.46)	6.42 (13.64)	20.41 (24.34)	10.25 (17.25)	15.33 (20.80)
8	<i>Setaria verticillata</i>	Poaceae	7.27 (14.60)	8.68 (15.89)	7.98 (15.25)	25.30 (29.83)	15.07 (22.58)	20.18 (26.21)
9	<i>Paspalum distichum</i>	Poaceae	10.06 (18.24)	7.64 (16.00)	8.85 (17.12)	24.69 (29.37)	15.60 (23.01)	20.14 (26.19)
10	<i>Saccharum spontaneum</i>	Poaceae	9.03 (16.60)	7.98 (16.29)	8.51 (16.45)	21.44 (25.03)	18.51 (25.29)	19.98 (25.16)
11	<i>Cyperus rotundus</i>	Cyperaceae	8.33 (16.69)	6.59 (13.89)	7.46 (15.29)	26.81 (30.76)	21.70 (26.89)	24.26 (28.82)
12	<i>Digitaria sanguinalis</i>	Poaceae	10.42 (18.14)	5.54 (12.77)	7.98 (15.45)	21.08 (27.06)	18.18 (23.10)	19.63 (25.08)
13	<i>Eleusine indica</i>	Poaceae	13.54 (21.33)	6.93 (15.14)	10.23 (18.23)	15.28 (22.27)	16.63 (22.95)	15.95 (22.61)
14	<i>Imperata cylindrica</i>	Poaceae	15.63 (23.25)	8.68 (16.86)	12.15 (20.05)	22.87 (28.53)	17.30 (24.28)	20.08 (26.40)
15	<i>Leptochloa chinensis</i>	Poaceae	13.89	7.29	10.59	23.84	20.53	22.18

			(21.79)	(15.21)	(18.50)	(28.91)	(25.42)	(27.16)
16	<i>Phyllanthus niruri</i>	Euphorbiaceae	6.60 (14.58)	11.81 (20.06)	9.20 (17.32)	14.61 (21.71)	20.52 (26.13)	17.57 (23.92)
17	<i>Cyperus difformis</i>	Cyperaceae	5.21 (12.37)	11.11 (19.25)	8.16 (15.81)	14.04 (21.74)	11.63 (19.62)	12.83 (20.68)
18	<i>Eclipta alba</i>	Asteraceae	6.60 (13.04)	5.90 (12.70)	6.25 (12.87)	12.97 (19.01)	6.04 (11.92)	9.51 (15.46)
19	<i>Launea nudicaulis</i>	Asteraceae	4.51 (11.56)	7.97 (14.67)	6.24 (13.12)	4.67 (10.81)	13.80 (19.49)	9.24 (15.15)
20	<i>Desmostachya bipinnata</i>	Poaceae	2.08 (7.23)	7.96 (16.30)	5.02 (11.77)	2.40 (7.56)	18.72 (25.34)	10.56 (16.45)
21	<i>Chloris</i> sp.	Poaceae	0.00 (4.05)	8.32 (16.53)	4.16 (10.29)	2.40 (7.56)	13.09 (21.00)	7.74 (14.28)
22	<i>Vernonia gigantean</i>	Asteraceae	0.00 (4.05)	4.16 (10.72)	2.08 (7.39)	0.00 (4.05)	3.81 (9.95)	1.91 (7.00)
	Mean		8.57 (15.38)	6.81 (14.06)		17.36 (22.35)	13.60 (20.08)	
	CD (p= 0.05)		8.36	6.92		13.42	11.24	

* Data in the parentheses are angular transformed values

Effect on percent disease incidence

Out of 22 weed species, tested 13 weed species viz. *Echinochloa colona*, *Brachiaria decumbens*, *Cyperus rotundus*, *Leptochloa chinensis*, *Setaria verticillata*, *Paspalum distichum*, *Imperata cylindrica*, *Saccharum spontaneum*, *Digitaria sanguinalis*, *Phyllanthus niruri*, *Eleusine indica*, *Brachiaria reptans* and *Cynodon dactylon* showed higher disease incidence (range 25.47%-15.33%) in association with rice during both the years (2011 and 2012) (Table 2). Other weed species i.e. *Sorghum halepense*, *Launea nudicaulis*, *Desmostachya bipinnata*, *Chloris* sp. and *Vernonia gigantea* were found to harbor lower incidence of sheath blight disease under field condition. The rice variety PB-1 showed highest disease incidence of 32.59 % in the rows between *Echinochloa colona* and *Chloris* sp. and *Desmostachya bipinnata* showed very less disease incidence (2.40%) of sheath blight during 2011.

The weed species *Cyperus rotundus* (21.70%) showed highest disease incidence and *Dactyloctenium aegyptium* (2.61%) showed very less disease incidence of sheath blight during 2012. Thus there was higher average incidence of sheath blight in association with weed species *Echinochloa colona*, *Brachiaria decumbens*, *Cyperus rotundus*, *Paspalum distichum*, *Leptochloa chinensis*, *Brachiaria reptans*, *Imperata cylindrica*, *Saccharum spontaneum*, *Digitaria sanguinalis* and *Cynodon dactylon*. Singh *et al.* (2012) determined the status of sheath blight in various rice cultivars and hybrids at maximum tillering to dough stage. The disease was particularly devastating on PR 114, PAU 201, Pusa Basmati-1121, Pusa Basmati-1, PA 6444 (Arize 6444), PA 6129 (Arize 6129) and CSR 30. The disease appeared in severe form particularly in PR 114, CSR 30 and Pusa Basmati-1121 due to

build up of inoculum during last few years and prevalence of highly favorable environmental conditions for the disease development. They also reported that out of 28 weed species tested to determine the weed hosts of *R. solani*, a varied degree of disease development was recorded on 24 weeds following inoculation of the rice isolate while 4 weeds were not infected. All the *R. solani* isolates of weed hosts were cross-pathogenic on rice cultivar HKR 127. *Euphorbia microphylla*, *E. hirta*, *Cassia obtusifolia*, *Dichanthium annulatum*, *Caesulia axillaris*, *Sida* sp., *Xanthium strumarium*, *Parthenium hysterophorus*, *Chenopodium album* and *Trianthema portulacastrum* are being reported as hosts of *R. solani*. The highest disease incidences of *R. solani* on weed species i.e. *Echinochloa crusgalli* and *E. colonum* have also been advocated by Kozaka (1965).

The present study identified 73 weed species that are potential hosts for *R. solani* AG1-IA. The ability of weeds to serve as hosts for the pathogen in the absence of rice may explain why epidemics can occur in fields where rice has not been cultivated previously. Wu *et al.* (2015) suggested that rational use of N rate and increased row spacing reduced the severity of sheath blight by promoting air movement through rice canopy. Wu *et al.* (2013) concluded that differences in canopy structure resulting from planting density and N rates influences sheath blight epidemics. High infestation of weed species may affect sheath blight development and incidence by increasing total plant density and reducing air movement within the rice canopy as well as serving as bridge hosts for pathogen. The role of weeds as hosts for the pathogens involved in the sheath blight may play an important role in disease epidemiology by providing another source of spread through the canopy other than rice to rice contact. Therefore, it is recommended that weeding at time intervals

during cropping season and rotation of non-host crop helps in minimizing the disease incidence in the next cropping season. The present study highlight the importance of weed control, not only for reducing plant competition and increasing production, but also for the potential impact on sheath blight development.

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