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Research Article

PATHOGENIC DIVERSITY OF *Rhizoctonia solani* ISOLATES COLLECTED FROM MAIZE AGAINST *RAGI*

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Abstract: Twenty seven *R. solani* isolates collected from maize and one isolate from rice were inoculated on to 55 days old cv. BPT-5204 and 30 days old bajra cv. HHB-67 using sheath inoculation method. The virulence diversity among the isolates revealed that the isolate RS16 from Krishna district recorded maximum PDI and minimum by RS13 isolate from Warangal district on rice, while maximum relative lesion was recorded by the isolate RS28 (rice) and least by RS2 from Medak district. In case of bajra, the isolate RS11 from Khammam district recorded maximum PDI and relative lesion length, whereas the isolate RS21 from Guntur district recorded minimum PDI. The rice isolate (RS28) had 2.6 days latent period in bajra, 2.0 days with respect to original host crop *i.e.*, rice indicating that the isolate is equally virulent to that of maize isolates RS11, RS12 and RS16.

Keywords: Maize, *Rhizoctonia solani*, Virulence diversity, *Ragi*

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Introduction

Banded leaf and sheath blight of maize caused by *Rhizoctonia solani* is gaining economic concern worldwide in recent years. Since the pathogen is highly diversified and had wide host range, currently there is no information available regarding the population genetic structure of *R.solani* AG-1 IA infecting rice and maize in Andhra The information on genetic differences and host specialization studies between *R. solani* AG-I A populations on rice and maize is not clear tiation a Pradesh. Host specialization has been detected within the *R.solani* complex [1] and specifically, for AG-1 IA [2]. Host specialization can lead to divergence between populations of plant pathogens [3]. To infer whether host specialization is the main cause for the divergence, it is necessary to sample sympatric host populations to determine the extent of genetic differentiation. Cross-inoculation tests are also needed to determine the extent of host specialization and also to identify patterns of between-host migration and to reveal recombination, with possible implications for the effectiveness of control strategies on both hosts.

Materials and Methods

Pathogenicity of twenty seven maize isolates and one rice isolate of *R.solani* collected from different geographical areas was tested on *ragi* using leaf sheath inoculation method[4]. The *R. solani* isolates collected from maize were inoculated on *ragi* crop.

Pathogen Inoculation

Thirty days old *ragi* cv Godavari was inoculated with each of the 28 *R. solani* isolates (27 maize + 1 rice) by placing 5mm mycelial disc with sclerotial body in lower leaf sheaths. The inoculated portions of the sheaths were covered with the blotter papers and a high humidity was created by wetting the blotters during morning and evening hours and also by frequent irrigations. The inoculated plants were observed regularly for the appearance of symptoms.

Disease Evaluation

The percent disease severity, virulence index and lesion length, in each sheath inoculated plants were recorded 10 days after inoculation. The per cent disease severity was recorded by using 0-5 scale.

Scale

1. No infection
2. 1-Lesions upto first node
3. Lesions upto second node
4. Lesions upto third node
5. Lesions upto fourth node
6. Lesions on fourth and above fourth node

Results and discussion

Ragi crop

Latent Period

The latent period between the maize isolates on *ragi* crop varied significantly.The isolates RS2, RS5, RS6, RS13, RS21, RS23 isolates from Doulatabad mandal of Medak, Kamareddy and Mortad mandals of Nizamabad, Janagoan mandal of Warangal, Kolipara mandal Guntur, Jangareddygudem mandal of West Godavari recorded maximum latent period of 6.67 days followed by RS15, RS18, RS24, RS26 with 6.33 days. While the isolate RS12 from Illandu mandal of Khammam district recorded minimum latent period of 3.33 days. No significant difference was observed between rice isolate and RS1, RS3, RS4, RS7, RS8, RS9, RS11, RS14, RS19, RS22, RS27 isolates of maize. With regard to rice isolate the latent period was 5.00 days which was similar to the maize isolate RS3 and RS8 which also took 5.00 days to express the symptom but it differed significantly with other maize isolates.

Table-1 Pathogenicity of *R. solani* isolates of maize and rice on *Ragi* cultivar Godavari

Isolates	Place of collection	District	Percent disease index (%)		Latent Period (days)	Virulence Index	Plant Height (cm)	Lesion Length (cm^2)	Relative Lesion Length (%)
RS1	Pragnyapur	Medak	25.33	(30.19)	5.33	4.80	43.90	14.73	33.70
RS2	Doulatabad	Medak	16.00	(23.46)	6.67	2.43	40.83	8.33	20.40
RS3	Gajwel	Medak	26.67	(31.06)	5.00	5.43	42.33	15.60	36.90
RS4	Armur	Nizamabad	24.00	(29.27)	5.67	4.27	44.00	12.97	29.67
RS5	Kamareddy	Nizamabad	18.00	(25.07)	6.67	2.73	43.27	6.20	14.33
RS6	Mortad	Nizamabad	17.33	(24.56)	6.67	2.63	41.83	8.47	20.17
RS7	Jagityal	Karimnagar	21.33	(27.48)	5.67	3.80	42.17	10.80	25.63
RS8	Metpally	Karimnagar	26.67	(31.06)	5.00	5.33	40.77	14.27	34.97
RS9	Raichal	Karimnagar	24.00	(29.27)	5.67	4.30	44.33	13.17	29.80
RS10	Bonakal	Khammam	28.00	(31.90)	4.67	6.07	42.40	13.63	32.20
RS11	Chintakani	Khammam	26.67	(31.06)	5.33	5.07	42.03	15.93	37.97
RS12	Yellandu	Khammam	32.00	(34.41)	3.33	9.67	41.47	18.30	44.10
RS13	Janagoan	Warangal	17.33	(24.56)	6.67	2.63	43.07	7.10	16.50
RS14	Atmakur	Warangal	24.00	(29.27)	5.67	4.23	42.93	10.07	23.43
RS15	Hasanparthy	Warangal	18.67	(25.56)	6.33	2.97	43.10	8.37	19.41
RS16	Vatsavai	Krishna	28.00	(31.90)	4.67	6.07	40.93	16.73	40.97
RS17	Tiruvur	Krishna	29.33	(32.77)	4.67	6.33	45.87	15.93	34.77
RS18	Nuziveedu	Krishna	22.67	(28.40)	6.33	3.63	41.00	8.67	21.13
RS19	Tenali	Guntur	22.67	(28.40)	5.67	4.00	42.17	12.67	30.47
RS20	Mangalgiri	Guntur	28.00	(31.90)	4.67	6.10	42.83	14.27	33.27
RS21	Kolipara	Guntur	17.33	(24.56)	6.67	3.20	42.37	9.50	22.43
RS22	Eluru	West Godavari	25.33	(30.19)	5.67	4.53	43.23	12.37	28.60
RS23	Jangareddygudem	West Godavari	18.67	(25.49)	6.67	2.87	42.63	7.30	17.17
RS24	Jeelugumilli	West Godavari	20.00	(26.48)	6.33	2.63	43.60	4.63	10.63
RS25	Nandikotkur	Kurnool	28.00	(31.90)	4.67	6.07	41.80	15.53	37.13
RS26	Atmakur	Kurnool	21.33	(27.48)	6.33	3.40	42.57	13.27	31.17
RS27	Thatipadu	Kurnool	22.67	(28.40)	5.33	4.47	41.27	9.50	23.03
RS28(Rice)	ARI	RangaReddy	29.33	(32.77)	5.00	5.87	42.77	14.60	34.10
CD5%			3.35		1.09	1.28	N.S.	1.93	5.15
SE(d)			1.67		0.54	0.64	1.30	0.96	2.56
SE(m)			1.18		0.38	0.45	0.92	0.68	1.81
CV			7.06		1.83	17.37	3.73	9.87	11.18

Per cent Disease Index

From the result it is evident that the isolates of maize and rice were pathogenic on *ragi* crop and among the maize isolates, the PDI varied from 16.00 (RS2 from Medak) to 32.00 (RS12 from Khammam). The PDI recorded by the isolate RS 12 was on par with the isolates RS10, RS16, RS17 RS20 and RS25.Similarly, the PDI among the isolates RS3, RS8, RS11 (26.67), RS17 (29.33); RS1, RS22 (25.33), RS3 (26.67), RS9, RS14 (24.00) were on par. The rice isolate RS28 had recorded 29.33 PDI which was similar to that of maize isolate RS17 (29.33) and did not differ significantly with isolates RS10, RS12, RS16, RS20 and RS 25 (Table).

Virulence Index

Considerable variation in the virulence index values was observed among the *R solani* isolates. Maximum virulence index of 9.67 was observed in RS12 isolate from Illandu mandal of Khammam district and minimum (2.43) by RS2 isolate from Doulatabad mandal of Medak district followed by RS6 from Mortad mandal of Nizamabad, RS13 Janagoan mandal of Warangal, RS24 (2.63) Jeelugumilli mandal, RS5 (2.73) Kamareddy mandal of Nizamabad. The virulence index of the isolates RS3 (5.43), RS8 (5.33), RS10, RS16, RS25 (6.07), RS11 (5.07), RS17 (6.33), RS20 (6.10); RS1 (4.80), RS4 (4.27), RS9 (4.30), RS14 (4.23), RS19 (4.00), RS22 (4.53), RS27 (4.47) were on par with each other. The virulence index on *ragi* by rice isolate was 5.87 and was on par with RS1, RS3, RS8, RS10, RS11, RS16, RS17, RS20 and RS25 isolates of maize

Lesion length

On *ragi*, the lesion length produced by maize isolates of *R.solani* was higher in case of isolate RS12 (18.30 cm2) from Illandu mandal of Khammam district while it was least in isolate RS5 (6.20 cm2) from Kamareddy mandal of Nizamabad. The lesion length among the isolates RS3 (15.60 cm2), RS8 (14.27 cm2), RS11 (15.93 cm2), RS16 (16.73 cm2) and RS17 (15.93 cm2) was on par. Rice isolate RS28 has produced a lesion length of 14.60 cm 2 which was on par with maize isolates RS1, RS3, RS8, RS11, RS17, RS20 and RS25 isolates of maize.

Relative lesion length

The isolates significantly varied in producing relative lesion length on *ragi* crop. Maximum relative lesion length of 44.10 was recorded by RS12 isolate from Yellandu mandal followed by the RS16 (40.97) and minimum of 10.63 by RS 24 isolate from Jeelugumilli mandal of West Godavari district. No significant difference was observed among isolates RS1 (33.70), RS3 (36.90), RS8 (34.97), RS11 (37.97), RS17 (34.77), RS25 (37.13). Rice isolate RS28 had recorded 34.10 relative lesion length and was on par with isolates RS1, RS3 (Pragnyapur and Gajwel mandals of Medak), RS4 (Armur mandal of Nizamabad), RS8 (Metpally mandal of Karimnagar), RS10, RS11 (Bonakal and Chintakani mandals of Khammam), RS17 (Tiruvur mandal of Krishna), RS20 (Mangalgiri mandal of Guntur) and RS25 (Nandikotkur mandal of Kurnool) of maize. The rice isolate RS28 had 2.3 days latent period in maize crop, 2.6 days in bajra, 3.0 days with respect to original host crop i.e rice indicating that the isolate is equally virulent to that of maize isolates RS11,RS12 and RS16. The rice and the maize derived isolates of *R.solani* AG-1 IA were pathogenic to *ragi*. However, isolates were more aggressive on their host of origin. The cross inoculation/ host range studies of the present investigation is in accordance with the findings of the host range studies done by[5] using artificial inoculation of *R.solani* isolates from rice which developed blight symptoms on all the weeds / crops (*Zea mays, Pennisetum americanum, Vigna radiata, V. mungo, Solanum tuberosum, Cynodon dactylon, Digitaria adscendus, Echinochola crusgalli, Panicum crusgalli* and *Cyperus rotundus* with some variations in colour and shape of lesions on leaves / sheaths. [6] confirmed by inoculation that *R.solani* AG1 – IA and *R. cerealis* isolates could also infect rice, wheat or maize under favourable conditions. This may be related to temperature and nutrition during the growth and development periods of each crop. Isolates from rice plants infected with sheath blight have been assigned to AG-1[7], [8]. Both leaf and sheath blight diseases already have a worldwide importance but BLSB is considered to be an emerging disease problem in Asia (Bhutan, India, Indonesia, Nepal, Philippines, Southern China, Vietnam), Africa and Latin America [9], where warm and humid environmental conditions are favourable for the pathogen [10].

The findings were in accordance with [11] who stated that the *Rhizoctonia solani* anastomosis group -1 IA (AG-1 IA) represents a single species with a broad host range. Host range studies of *R. solani* has indicated that the pathogen has produced typical sheath blight symptoms on *ragi*, maize, bajra, and wheat [12,13]. The fungal pathogen *R. solani* infects fabaceous and graminea members and cause sheath blight in maize, aerial blight in soybean[14,15]. In general, *Poaceae* infecting *R.solani* AG-1 IA is considered predominantly asexual and is thought to survive as mycelium and sclerotia in soil and on seeds [16]. Ogoshi (1987) [17] stated that isolates of AG-1 are mainly from *Graminae* and *Leguminosae*. This pathogen has an extremely broad host range of over 500 host species [18] and is a species complex composed of different genetic or anastomosis groups (AGs) with a distinct degree of host specificity [19,20]. The host range studies indicated that the pathogen *Rhizoctonia solani* f. sp.sasakii successfully infected *Cynodon dactylon* L., *Oryza sativa* L., *Saccharum officinarum* L., *Sorghum bicolor* L., members of family *Poaceae. Arachis hypogea* L., *Glycine max* L., *Pisum sativum* L., *Vigna radiata* L., *Vigna mungo* L., Happer of *Leguminaceae, Lycopersicum esculentum* L. *and Solanum tuberosum* L., of family *Solanaceae* which were in accordance with the findings of Baruah and Lal, (1981) [21]. Trivedi and Rathore, (2006) [22] reported that *R.solani* f.sp. sasakii from maize could infect different grass hosts *viz. Heteropogon contortus, H. melanocarpus. Panicum maximum, Bothriochloa ishaemum and Brachiaria racemosa*. Maize and rice derived isolates of *R.solani* AG-1 IA were pathogenic to *ragi*, but more aggressive on their original host. This differential response in aggressive observes for the host populations of *R.solani* AG-1 IA isolates could be explained by ecological adaptation.

Application of research: Pathological identification of *Rhizoctonia solani* isolates infecting maize and *ragi* and understanding of their ecological adaptive capacities.

Research Category: Genetic Diversity of plant pathogens.

Abbreviations: RS: *Rhizoctonia solani*

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