



## Effect of sea weed extracts on sesame leaf spot incidence of rice

Sumathra S, Jaiganesh V

Department of Plant Pathology, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Cuddalore DT, Tamil Nadu, India

### Abstract

The present studies were undertaken to investigate the effect of sea weed extracts for the management of Brown spot in rice caused by *Bipolaris oryzae*. Among the sea weed extracts, seed treatment with *Sargassum wightii* recorded maximum seed germination, shoot and root length and maximum vigour index followed by *S.muticum* when compared to control. Whereas, the five sea weed extracts tested as foliar spray, *S. wightii* at 20 % concentration was the most effective over the other extracts followed by *S. muticum* at 20 % in reducing disease incidence as compared to control and increases the grain yield. Also, the data indicated that the disease incidence was minimum and the maximum yield was recorded in plots sprayed thrice with *S. wightii* @ 10 % conc. at 15, 30 and 45 DAT, followed by plots receiving two sprays at 15 DAT and 30 DAT which were statistically at par.

**Keywords:** brown algae, sea weed, brown spot, rice

### Introduction

Rice crop is affected by a number of various diseases caused by biotic, abiotic and mesobiotic pathogens which results in considerable crop yield losses (Ou, 1985) [20]. Among the various biotic fungal diseases of rice, brown spot or sesame leaf spot etiological agent is *Helminthosporium oryzae* (Breda de Haan) Subram. and Jain (Syn: *Bipolaris oryzae* (Breda de Haan) Shoemaker) is found to occur in most rice growing areas. The disease is also called as fungal blight or Helminthosporiose. Also, this pathogen is major responsible factor for the grain discolouration in rice (Savary *et al.*, 2000) [21]. The current possible management practices of brown spot disease of rice are the use of fungicides, growing resistant varieties, biological agents and resistance inducing chemicals. Normally fungicides are primary means of managing plant diseases. But the use of Agrochemicals is under special scrutiny for posing potential eco-friendly threat as the indiscriminate use of chemical fungicides resulted in environmental pollution and ill-health to biotic community as a whole.

Hence, much attention is being focused on the alternative techniques of pathogen management. Therefore, it has become necessary to adopt eco-friendly approaches for enhancing crop yield and crop health. Marine sea weed algae represent a great source of a vast variety of complex natural products and could be a promising source of novel wide range of bioactive compounds that can help plant survival by offering protection against stress imposed by pathogens (Jayaraj *et al.*, 2011) [15].

Marine algae may have several applications in agriculture. It has been reported that seaweeds *viz.*, green, brown, and red algae possess compounds exhibiting antimicrobial potential against the pathogenic organisms of medical, agricultural, and environmental importance (Wally *et al.*, 2009). Therefore, the present studies were undertaken to investigate the effect of sea weed extracts for the management of rice brown leaf spot.

### Materials and Methods

#### Collection and preparation of seaweed extracts (Flora *et al.*, 2012) [11]

Seaweeds were collected from Gulf of Mannar in Mandapam coast, Tamil Nadu. Samples of brown algae *viz.*, *Sargassum muticum*, *Sargassum wightii*, *Sargassum fusiforme* *Sargassum polycystrum* and *Sargassum siliquastrum* were collected manually. After hand picking, the seaweed samples were washed initially with seawater. The epiphytes and other extraneous matters were removed and washed with fresh water (nearly 4-5 times). The seaweeds were dried under shade conditions for seven days. 100g of powdered seaweed was mixed with distilled water in the ratio of 1:10 ratio and autoclaved at 150lb pressure for 1hour. The extracts were filtered immediately through a muslin cloth. All the extracts were measured, labeled and stored in bottles which were kept in a refrigerator. The extracts thus obtained were taken as 100 % sea weed extracts (SWE). SWE of different concentration was prepared with distilled water and used for the present study.

#### Crop, Variety and Source

Crop: Rice (*Oryza sativa* L.)

Variety : ADT 36

Source: Tamil Nadu Rice Research Institute (TRRI), Tamil Nadu Agricultural University (TNAU), Aduthurai, Tamil Nadu.

#### Effect of seed treatment with seaweed extracts on seed germination, growth and vigour of rice seedlings

##### a. Seed germination

Taking the emergence of radical as criteria for recording the seed germination (IRST, 1966) [13], and the data was recorded on the seventh day.

##### b. Roll towel method- (ISTA, 1976) [14]

The seed germination paper used was soaked in water for nearly 2-4 h to moist it evenly and to remove any water

soluble toxic substances if present. The 25 rice (ADT 36) seeds are treated with different seaweed extracts at 5 per cent concentration were placed in equal distance between the two sheets of paper towel (27 x 20 cm), rolled carefully ensuring no pressure on the seed, wrapped with polythene paper to reduce the surface evaporation and kept in germination chamber in an upright condition and incubated at room temperature ( $28 \pm 2^\circ\text{C}$ ) for nearly fifteen days. Each treatment was replicated thrice. Observations were made on the germination percentage, shoot length and root length using the standard procedures after the incubation period is over. The germination percentage was calculated by using the formula,

### c. Seedling growth and Vigour

Ten normal seedlings were collected at random from each replication and the shoot length from collar region to the tip of the plant shoot and root length from the collar to the root tip of the primary root portion was measured and the respective mean values were recorded. The vigour index (VI) was calculated by using the formula suggested by Abdul Baki and Anderson (1973)<sup>[1]</sup>.

### Pot culture studies

Pot culture study was conducted to test the efficacy of brown algae species for assessing their influence on the incidence of brown spot of rice. The sesame leaf spot susceptible variety ADT 36 grown in pots with rectangular shape of 30x45 cm size, was used for the study. The plants were given artificial pathogen inoculation by spraying the spore suspensions with adequate spore load (50,000 spores/ml) at 15 DAT (Days After Transplanting) in the evening hours. The crop was maintained in a poly house with frequent spraying of water to provide adequate moisture and relative humidity to enable successful infection by the *Bipolaris oryzae*. The experiment was conducted in a randomized block design (RBD) with four replications for each treatment and a suitable control was also maintained. The fungicide Mancozeb 75 WP @ 0.2 per cent was used for comparison and the standard agronomic practices as recommended by the Tamil Nadu State Agricultural Department were followed.

### Evaluation of Brown sea weed extracts for the management of *B.oryzae*

Five Brown SWE's viz., *Sargassum muticum*, *Sargassum wightii*, *Sargassum fusiforme* *Sargassum polycystrum* and *Sargassum siliquastrum* were sprayed @ 5.0, 10.0 and 20.0 % conc. individually at disease initiation and repeated once at fifteen days interval.

In each field, five plots of one square meter area were selected randomly and brown spot incidence was assessed from 20 randomly selected plants. The disease incidence was assessed by adopting 0-9 scale according to "Phytopathometry" by Mayee and Datar (1986)<sup>[17]</sup> and the per cent disease incidence /index was calculated based on the formula suggested by Vidhyasekaran *et al.* (1989)<sup>[23]</sup>.

Table 1

Disease Severity	Description of Disease index
0	No lesions
1	Affected leaf area less than 1 %
3	1-10 % affected leaf area
5	11-25 % affected leaf area
7	26 -50 % affected leaf area
9	> 50 % leaf area affected

### Field experiment

The field study was conducted to test the efficacy of Brown algae (At their respective MIC's after screening tests i.e. @ 10 %) for assessing their influence on the incidence of brown spot of rice. The brown spot highly susceptible variety ADT 36 was used for the study. The experiments were conducted in a randomized block design (RBD) with four replications for each treatment and a suitable control. Also, the suitable fertilizer application was done following the blanket schedule of 120:38:38 of Nitrogen: Phosphorus: K (Potassium) recommended by the Tamil Nadu State Agricultural department. A plot size of 5X4 m was maintained for each treatment schedule and the rice crop was raised with the proper spacing of 12.5 X 10 cm and all the standard agronomic rice crop cultivation practices as recommended by the Tamil Nadu State Agricultural Department were followed. The fungicide Mancozeb 75 WP @ 0.2 per cent was used for comparison. The crop was harvested at maturity, thrashed, winnowed and cleaned plot wise, dried and the yields of grain and straw were recorded.

### Effect of spraying *Sargassum wightii* (10 %) at different crop growth stages on brown spot incidence and yield of rice var. ADT 36 (Field experiment)

A field experiment was conducted during December, 2020 - March, 2021 at the brown spot endemic area with ADT 36 as test cultivar. The efficacy of *Sargassum wightii* (10%) as foliar spray was worked out by spraying it once, twice and thrice at different crop growth stages viz., 15, 30 and 45 DAT. In the field trial, the observations on disease incidence was assessed on a randomly selected set of 25 hills per plot at the time of crop maturity. Also, the grain and straw yield of rice was recorded and expressed as t/ha.

### Results and discussion

The effect of seaweed extracts on the seed germination and vigour index of paddy was studied in roll towel method. The data furnished in table 1, clearly showed that seed treatment with *S. wightii* recorded maximum seed germination (93.46 %), shoot and root length (18.3 and 8.1 cm) respectively and maximum vigour index (2467.34) followed by *S.muticum* with a seed germination 90.31 %, shoot and root length of 15.1 and 7.2 respectively and vigour index of 2013.91 compared to control which recorded the minimum seed germination (80 %) shoot and root length (9.2 & 4.2) and vigour index (1104). Numerous reports have revealed a broad range of beneficial effects of seaweed extract applications on plants, such as early seed germination and establishment, improved crop performance and yield, resistance to biotic and abiotic crop stress, and enhanced resistance against postharvest pathogens (Beckett and Van Staden, 1989; Hankins and Hockey, 1990; Blunden, 1991; Norrie and Keathley, 2006; Agarwal *et al.*, 2021)<sup>[4, 12, 5, 19, 2]</sup>. Beneficial effects recorded in various plant growth bioassays have led to speculation that sea weed extract contain plant growth promoting substances (Williams *et al.*, 1981; Tay *et al.*, 1985; Mooney and Van Staden, 1986)<sup>[26, 22, 18]</sup>. Furthermore, the wide range of crop growth responses induced by seaweed extracts implies the presence of more than one group of plant growth-promoting hormones (Crouch and Van Staden 1993)<sup>[8]</sup>. Seaweed extracts improve nutrient uptake by crop roots (Crouch *et al.*, 1990)<sup>[9]</sup>, resulting in crop root systems with improved water and nutrient efficiency, thereby causing enhanced general plant growth and vigour.

The results of pot culture experiment showed that all the Sea weed extracts tested reduced the disease incidence when compared to control. Among the five sea weed extracts tested, *Sargassum wightii* at 20 % concentration was the most effective (22.46 %) over the other extracts followed by *Sargassum muticum* at 20 % in reducing disease incidence (25.77 %) as compared to 63.72 % observed in control and increases the grain yield. *Sargassum siliquastrum* at five per cent was least effective (Table 2). However, the test fungicide was the most effective when compared to other sea weed extracts for reducing the disease incidence. In general, grain yield and straw yield were significantly higher in sea weed extract treated plots when compared to comparison fungicide treated and control plots.

The data indicated that the disease incidence was minimum (16.71 %) in plots sprayed thrice with Sea weed extract at 15, 30 and 45 DAT, followed by plots receiving two sprays at 15 DAT and 30 DAT (17.60 %) which were statistically at par (Table 3). The grain yield and straw yield were also higher in plots sprayed thrice (15, 30 and 45 DAT) followed by plots receiving two sprays at 15 and 30 DAT. Among the

various treatments the plots receiving single spray ( $T_3$ ) was the least effective. The control plots recorded 40.76 per cent disease incidence, 4.16 t/ha of grain yield and 5.72 t/ha of straw yield.

The present findings on the efficacy of sea weed extracts are also in line with these earlier reports. Marine sea weed algae can serve as an important source of plant defense elicitors (Cluzet *et al.*, 2004, Antonios Zambounis *et al.*, 2012, Agarwal *et al.*, 2021) [6, 3, 2]. A variety of polysaccharide compounds *viz.*, carrageenans, alginates and phenols elicit multiple defense responses in various plants (Craigie, 2011, Agarwal *et al.*, 2021) [7, 2]. Foliar sprays of *Ascophyllum nodosum* extract reduced Late blight infection in capsicum and downy mildew in grape (Lizzi *et al.*, 1998) [16]. Soil application of SWC inhibits damping-off disease of seedlings (Dixon and Walsh 2002) [10]. A red seaweed *Solieria robusta* used as soil amendment showed better suppressive effect on root rotting fungus *Fusarium solani* than Topsin-M, a fungicide in soya bean (Viqar *et al.*, 2011) [24]. These earlier reports lend support to the present findings.

**Table 2:** Effect of seaweed extracts on the seed germination and growth of seedlings of paddy

S. No.	Sources	Conc. (%)	Seed germination (%)	Shoot length (cm)	Root length (cm)	Vigour index
1.	<i>Sargassum muticum</i>	10	90.31	15.1	7.2	2013.91
2.	<i>Sargassum wightii</i>	10	93.46	18.3	8.1	2467.34
3.	<i>Sargassum fusiforme</i>	10	89.25	14.3	6.4	1847.47
4.	<i>Sargassum polycystrum</i>	10	87.19	13.2	4.5	1543.26
5.	<i>Sargassum siliquastrum</i>	10	86.25	10.0	3.9	1198.87
6.	Mancozeb	0.2	91.71	16.6	4.5	1935.08
	Control		80.00	9.6	4.2	1104.00
	Sed		0.24	0.48	0.17	6.54
	Cd(0.05)		0.55	1.06	0.45	14.36

**Table 3:** Effect of foliar application of certain sea weed extracts on brown spot incidence and grain yield of rice var. ADT 36 (pot culture experiment)

Sl.No.	Sea weed extracts		Disease index (%)	Yield (g/pot)
	Sea weeds	Concentration		
1.	<i>Sargassum muticum</i>	5 %	35.68	32.50
		10 %	31.40	33.42
		20 %	27.24	35.72
2.	<i>Sargassum wightii</i>	5 %	34.60	34.13
		10 %	27.38	35.58
		20 %	24.66	36.42
3.	<i>Sargassum fusiforme</i>	5 %	39.02	31.14
		10 %	33.74	32.66
		20 %	31.56	32.98
4.	<i>Sargassum polycystrum</i>	5 %	44.32	30.75
		10 %	40.35	32.28
		20 %	37.58	32.69
5.	<i>Sargassum siliquastrum</i>	5 %	46.02	30.48
		10 %	41.58	31.96
		20 %	39.80	32.28
6.	Mancozeb (0.2 %)		16.95	33.82
7.	Control		66.80	26.94
	C.D. (p=0.05)		1.12	0.48

**Table 4:** Effect of spraying *Sargassum wightii* (10 %) at different crop growth stages on brown spot incidence and yield of rice var. ADT 36 (Field experiment)

Treatment	Stages of spraying	Disease incidence (%)	Grain yield (t/ha)	Straw yield (t/ha)
T <sub>1</sub>	15 DAT	20.68	4.88	6.73
T <sub>2</sub>	30 DAT	23.84	4.63	6.54
T <sub>3</sub>	45 DAT	25.07	4.44	6.32
T <sub>4</sub>	T <sub>1</sub> + T <sub>2</sub>	18.86	6.00	7.24
T <sub>5</sub>	T <sub>1</sub> + T <sub>3</sub>	17.60	5.08	7.59

T <sub>6</sub>	T <sub>2</sub> + T <sub>3</sub>	19.89	5.06	6.81
T <sub>7</sub>	T <sub>1</sub> + T <sub>2</sub> + T <sub>3</sub>	16.71	6.79	8.24
T <sub>8</sub>	Mancozeb 0.2 %	15.71	4.72	6.00
T <sub>9</sub>	Control	40.76	4.16	5.72
	C.D. (p=0.05)	4.53	0.11	0.14

## References

- Abdul Baki AA, Anderson JD. Vigour determination in soyabean seed by multiple criteria. *Crop Science*,1973;13:630-633.
- Agarwal PK, Dangariya M, Agarwal P Dixon GR. Seaweed extracts: Potential biodegradable, environmentally friendly resources for regulating plant defence - Review. *Algal Research*,2021;58 :102363.
- Antonios Zambounis, Emmanuel Gaquerel, Martina Strittmatter, Jean-Pierre alaun, Philippe Potin, and Frithjof C Kupper, Prostaglandin A2 triggers a strong oxidative burst in *Laminaria*: a novel defense inducer in brown algae. *Algae*,2012;27(1):21-32.
- Beckett RP, Van Staden J. The effect of seaweed concentrate on the growth and yield of potassium stressed wheat. *Plant Soil*,1989;116:29–36.
- Blunden G MD. Agricultural uses of seaweeds and seaweed extracts. In (eds) Seaweed resources in Europe uses and potential. Wiley, Chicester, 1991, 65–81.
- Cluzet S, Torregrosa C, Jacquet C, Lafitte C, Fournier J, Mercier L *et al.* Gene expression profiling and protection of *Medicago truncatula* against a fungal infection in response to an elicitor from the green algae *Ulva* spp. *Plant cell Environ.*,2004;27:917-928.
- Craigie JS. Seaweed extract stimuli in plant science and agriculture. *J. Appl. Phycol.*,2011;23:371–393.
- Crouch IJ, Van Staden J. Effect of seaweed concentrate from *Ecklonia maxima* (Osbeck) Papenfuss on *Meloidogyne incognita* infestation on tomato. *J. Appl. Phycol.*,1993;5:37–43.
- Crouch IJ, Beckett RP, Van Staden J. Effect of seaweed concentrate on the growth and mineral nutrition of nutrient stressed lettuce. *J Appl Phycol.*,1990;2:269–272.
- Dixon GR, Walsh UF. Suppressing *Pythium ultimum* induced damping– off in cabbage seedlings by bio stimulation with propriety liquid seaweed extracts managing soil- borne pathogens a sound rhizosphere to improve productivity in intensive horticultural systems. Proceedings of the 26<sup>th</sup> International Horticultural congress, Toronto, Canada, 2002, 11-17.
- Flora G, Maria Victorial Rani S. An approach towards control of blast by foliar application of seaweed concentrates. *Science Research Reporte*,2012;2(3):213-217.
- Hankins SD, Hockey HP. The effect of a liquid seaweed extract from *Ascophyllum nodosum* (Fucales, Phaeophyta) on the two spotted red spider mite *Tetranychus urticae*. *Hydrobiologi.*, 1990;204:555–559.
- IRST- International rules for seed testing. Proceedings of Int. Seed Test Ass.,1966;9(31):1-152.
- ISTA. International rules for seed testing. *Seed Sci. Technol.*,1976;4:3-49.
- Jayaraj R, Chandramohan M. Martin Deva prasath, khan TH. Malachite Green dye removal using sea weed *Enteromorpha*. *J. Chen*,2011;8(2):649–656.
- Lizzi Y, Coulomb C, Polian C, Coulomb PJ, Coulomb PO. Seaweed and mildew: what does the future hold. Laboratory tests have produced encouraging results [L'algue face au mildiou: quel avenir. Des resultats de laboratoire tres encourageants]. *Phytoma.*,1998;508:29–30.
- Mayee CD, Datar VV. “*Phytopathometry*” – Technical bulletin-I (Special Bulletin 3). Marathwada Agricultural University, Parbhani, 1986, 218.
- Mooney PA, Van Staden J. Algae and cytokinins. *J Plant Physiol*,1986:123:1–21.
- Norrie J, Keathley JP. Benefits of *Ascophyllum nodosum* marine-plant extract applications to ‘Thompson seedless’ grape production. (Proceedings of the 10<sup>th</sup> International Symposium on Plant Bioregulators in Fruit Production, 2005). *Acta Horti*, 2006:727:243–247.
- Ou SH. Rice Diseases, 2<sup>nd</sup> Edition, Common Wealth Mycological Institute, U.K, 1985, 380.
- Savary S, Wilocquet L, Elazegui FA, Castilla NP, Teng PS. Rice pest constraint in Tropical Asia; Quantification of yield losses due to rice pest in a range of production situation. *Plant Dis.*,2000;84:357-369.
- Tay SA, Macleod JK, Palni LM, Letham, DS. Detection of cytokinins in a seaweed extract. *Phytochemistry*,1985;24:2611–2614.
- Vidhyasekaran P, Umapathy G, Gopalan M, Ramakrishnan G, Sivaprakasam K. Pest and Disease Surveillance, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore-3, 1989, 237.
- Viqar S, Baloch GN, Ambreen Ara J, Tariq MR, Ehteshamul-Haque S. Comparative efficacy of a red alga *Solieria robusta*, chemical fertilizers and pesticides in managing the root diseases and growth of soybean. *Pak. J. Bot.*,2011;43(1):1-6.
- Wally O, Jayaraj J, Punja ZK. Comparative resistance to foliar fungal pathogens in transgenic carrot plants expressing genes encoding for chitinase,  $\beta$ -glucanase and peroxidase, *European Journal of Plant Pathology*,2009;123:331-342.
- Williams DC, Brain KR, Blunden G, Wildgoose PB, Jewers K. Plant growth regulatory substances in commercial seaweed extracts. *Proc. Int. Seaweed. Symp.*,1981;8:760–763.