Middle-East Journal of Scientific Research 4 (1): 44-47, 2009
ISSN 1990-9233

Exploration of Untapped Potentiality of Coastal Paddy Fields of Kerala (India) - A Case Study

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Abstract: The coastal belt of Kerala (South India) has a unique system of rice cultivation in the saline soils known as *pokkali/ kaipad/ kaikandam* cultivation. In the present study the authors tries to unveil the fertility factor of these coastal paddy fields. A total of 32 species of higher filamentous marine fungi comprising 20 Ascomycota, 2 Basidiomycota and 10 Mitosporic fungi were isolated from these fields. The study support 4% of global estimate of marine fungi from coastal paddy fields. Hence, they are also an ideal environment for the growth and reproduction of marine fungi. Due to the high degrading capacity of marine fungi these costal paddy fields are fertile. Today these paddy fields are under serious anthropogenic threat which appears remarkably similar to other wetland ecosystem across the country. If these fertile areas are utilized properly for paddy cultivation, the problem of rice shortage of the state can be solved to certain extend

Key words: Costal paddy fields · Marine fungi · Degrading capacity · Fertile

INTRODUCTION

Rice is grown in 114 countries across the world, occupying a total area of 150 million ha. More than 90% of the world's rice is grown and consumed in Asia, which is a home for 60% of the earth's population. India stands first in rice area (44. 6 million hectares) and second in production which almost tripled from 30. 4 million tones in 1966 to a record production of 93. 3 million tones in 2001-02 [1].

Though there was steady increase in area and production of the rice in the country, reverse was the case in Kerala. Since mid seventies, area under paddy cultivation is declining at the rate of 4. 3% per annum. At present, area under rice in Kerala is 2. 8 lakh ha and production is only 6. 8 lakh tones. In spite of huge amount of investment in major irrigation projects in past, particularly after sixties gross area under paddy in Kerala reduced to 40%. Productivity of rice was increasing at a very low average rate of 1. 3% per annum. Today the annual requirement of rice in Kerala works out to 40 lakh tones, while our internal production is only less than 8 lakh tones giving a defict of more than 80% [1]. The decline in farmer's productivity and profitability are discouraging many farmers from pursuing rice farming.

Kerala state has a coastline of 560km. This coastal belt has a unique system of rice cultivation in the saline soils known as *pokkali/ kaipad/ kaikandam* cultivation. This area is the confluence of limnic and saline waters. Salinity varies from 0-31 ppt or more. Its salient features are that modern farming technologies are alien to these areas. The waterlogged swampy fields do not require the use of labour-saving heavy equipment and addition of manure. The seedling just grows the natural way. In order to survive in the water logged field, the rice plants grow up to 2m. But as they mature, they bend over and collapse with only the panicles standing upright. While harvesting, only the panicles are cut and the rest of the stalks are left to decay in the water, which in time become feed for the prawns. Also, the use of fertile bottom mud of this field as manure for the coconut plantation is also a common practice in North Malabar.

The waterlogged condition of this region through out the year facilitates the easy degradation of dead remains of plants and animals. During and after the heavy down pour months of monsoon all the dead remains of plants and animals are brought by the innumerable rivulets and rivers and are dumped in the costal water bodies of Kerala. These dead remains are harbored in and around the vicinity of *pokkali* or *kaipad* fields. Thus trapped dead remains are thoroughly degraded by the innumerable array of microorganisms present in these water bodies. Among these microorganisms, the dominant and the most prominent are the marine mycoflora.

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Marine fungi are physiologically, ecologically and morphologically a fascinating group that are quantitatively important in the breakdown of organic matter in such an environment. They have been shown to degrade the wood materials in two ways: Softrot attack by ascomycontina and mitosporic fungi [2] and white rot mainly by Basidomycotina [3]. Examination of wood decay in marine habitats has shown that while bacteria can cause extensive decay of the wood they are unable to penetrate deeply in to the wood. However fungi by their ability to penetrate through cell wall can decay wood to a depth of more than 40mm. [4].

Literature survey [Becker and Kohlmeyer [5], Borse [6, 7], Borse *et al.*, [8], Sarma and Vittal [9, 10], Ravikumar and Vittal [11], Maria and Sridhar [12], Prasannarai and Sridhar [13, 14], Raveendran and Manimohan [15], Gayatri and Raveendran [16, 17] conveys that in India most of the marine fungal studies were carried out from beaches, estuaries, deltas and mangrove ecosystem. Here an attempt to explore and elucidate the marine fungi of coastal paddy field of Kerala was undertaken so as to unveil the fertility factor of these paddy fields.

MATERIALS AND METHODS

Collections of the wood samples were confined to the *pokkali fields* of North Malabar region of Kerala namely Vellikeel, Katampally, Pazhayangadi, Valapattanam, Kuppam, Telichery, Mahe and Meloor. Collected samples were intertidal wood including dead remains of paddy, decaying mangrove substrate and other woody substrates. Collections were made during May 2007 to September 2008. Each wood samples was screened for the presence of fungal structures within a week of sampling. Later, each wood was incubated separately in sterile polythene bags at room temperature. These wood samples were periodically screened for six months. Identifications of marine fungi were done using taxonomic keys by Kohlmeyer and Kohlmeyer, [18] Kohlmeyer and Volkmann Kohlmeyer, [19]; Hyde and Sarma, [20] and Raveendran and Manimohan [15]. The fungi isolated were recorded and listed (Table 1)

Presentation of Data: Percent frequency of occurrence (FO) = Number of isolates of a particular species divided by total number of wood samples supporting marine fungi X 100.

Table 1: List of marine fungi isolated from coastal paddy fields

Name of fungi	No: of isolates	FO	RA
Ascomycetes			
Aigialus grandis Kohlm and Schatz	1	1.3	0.8
Aigialus mangrovei Borse	3	3.95	2.43
Aniptodera chesapeakensis Shearer and Miller	5	6.32	4.07
Aniptodera longispora Hyde	1	1.3	0.8
Aniptodera mangrovei Hyde	2	2.63	1.62
Aniptodera haispora Vrijmoed, Hyde and Jones	4	5.26	4.07
Dactylospora haliotrepha (Kohlm and Kohlm) Hafellner	7	9.21	5.69
Halosarpheia abonnis Kohlm	2	2.63	1.62
Halosarpheia marina (Cribb and Cribb) Kohlm	4	5.26	4.07
Halosarpheia minuta Leong, Tan, Hyde and Jones	2	2.63	1.62
Halosarpheia viscosa (1.Shmidt) Shearer and Crane ex Kohlm and Volkm-Kohlm	1	1.3	0.8
Halorosellinia oceanica (Schatz) Whally, Jones, Hyde and Leassoe	3	3.95	2.43
Lignincola laevis Hohnk	2	2.63	1.62
Lignincola longirostris (Cribb and Cribb) Kohlm	5	6.58	4.07
Lulworthia grandispora Meyers	1	18.42	11.38
Marinosphaera mangrovei Hyde	2	2.63	1.62
Pleospora pelagica Johnson	1	1.3	0.8
Savoryella lignicola Jones and Eaton	6	7.69	5.98
Savoryella paucispora (Cribb and Cribb) Koch	8	10.53	6.5
Salsuginea ramicola Hyde	4	5.26	4.07
Verruculina enalia (Kohlm) and Volkm Kohlm	5	6.58	4.07

Table 1: Continued

Basidiomycetes			
Halocyphina villosa Kohlm and Kohlm	6	7.69	5.98
Nia vibrissa Moore and Meyers	1	1.3	0.8
Mitosporic fungi			
Cirrenalia macrocephala (Kohlm) Meyers and Moore	1	1.3	0.8
Cirrenalia pygmea Kohlm.	8	10.53	6.5
*Clavatospora bulbosa (*Anast.) Nakagiri and Tubaki	7	9.21	5.69
Cumulospora marina Schmidt	1	1.3	0.8
Epicoccum sp	1	1.3	0.8
Periconia prolifica Anastasiou	12	15.79	9.76
Trichocladium alopallonellum (Meyers and Moore) Kohlm and Volk Kohlm	10	13.16	8.13
Trichocladium sp	2	2.63	1.62
Zalarion maritimum (Linder) Anastasiou	7	9.21	5.60
Zalarion varium Anastasiou	1	1.3	0.8

FO is percent frequency of occurrence and RA is percent relative abundance

On the basis of percentage occurrence, the marine fungi were classified as most frequent (occurring in > 10% samples), frequent (in 5-10%), occasional (in 3-5% samples) and rare (in < 3%).

Percent relative abundance (RA) = Number of isolates of a particular species obtained divided by total number of fungal isolates obtained from all the location X 100.

RESULTS AND DISCUSSION

Altogether 32 species of higher filamentous marine fungi belonging to 21 genera were recorded. The fungi comprised 20 Ascomycota, 2 Basidiomycota and 10 Mitosporic fungi. Based on the percentage frequency of occurrence, *Lulworthia grandispora* (18. 42%) *Aniptodera chesapeakensis* (13. 16%), *Trichocladium alopallonellum* (13. 16%), *Savoryella paucispora* (10. 53%) and *Cirrenalia pygmea* (10. 53%) were the most frequent species. Nine species were frequently encountered. *Aigialus mangrovei* and *Halorosellina oceanica* were found occasionally. Fifteen species were obtained in less than 3% of the samples collected. In terms of percent relative abundance, *Lulworthia grandispora* emerged as the most abundant species (11. 38%) from the coastal paddy fields of North Malabar.

Present study reveals that the occurrence of marine fungi from coastal paddy fields is very much similar to that of other coastal wetlands. However the common species obtained in the present study is distinct from other coastal wetlands along Indian coast. *Antennospora quadricornuta, Clavatospora bulbosa, Crinigera maritima, Periconia prolifica* and *Torpedospora radiata* were reported more frequently from beach ecosystem [13], *Corollospora filiformis* and *Periconia prolifica* from estuarine habitat [16]. *Ascocratera manglicola*, *Biatriospora marina*, *Dactylospora haliotrepha, Halorosellina oceanicum, Halocyphina villosa and Trichocladium achrasporum* were the common fungi from mangrove ecosystem of Andaman and Nicobar Island [21]. Factors like temperature, salinity, p^H, availability and nature of host appears to have an effect of species diversity [22].

The study support 4% of global estimate of marine fungi from coastal paddy fields. Hence, they are also an ideal environment for the growth and reproduction of marine fungi. Due to the high degrading capacity of marine fungi these costal paddy fields are fertile.

Inspite of such vital roles being played by the paddy fields, they are under serious anthropogenic threat which appears remarkably similar to other wetland ecosystem across the country. Most of these ecosystems are converted for other purposes like roads, bridge, residential or commercial activities. Invasion of weed such as *Acanthus ilicifolius*, over exploitation of fish and prawn are some of the major reasons for the decline in *pokkali/ kaipad* lands. Also, these areas appear to be one of the most preferred landfills for dumping solid water and an ultimate point for discharging untreated industrial and domestic effluents. Lack of labours for harvesting is another major problem. Increased land price value forces the farmers to sell their plot to private company/construction agencies to overcome their loss making fields.

Kerala boosted with a number of perennial water bodies parallel to coastal ecosystem share almost similar environmental conditions. Moreover in the coastal plains apart from paddy other crops may not thrive. Hence, if these fertile areas are utilized properly for paddy cultivation, the problem of rice shortage of the state can be solved to certain extend.

ACKNOWLEDGEMENTS

The authors are grateful to the Principal and Management of Sir Syed College, Taliparamba, Kannur for their timely help.

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