

A Study of Paddy Crop Grown in Polluted Irrigated Water

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ABSTRACT

The word "paddy" is derived from the Malay word *padi*, rice plant. Rice is the staple food of Asia and part of the Pacific. Over 90 percent of the world's rice is produced and consumed in the Asia-Pacific Region. With growing prosperity and urbanization, per capita rice consumption has started declining in the middle and high-income Asian countries like the Republic of Korea and Japan. But, nearly one fourth of the Asian population is still poor and has considerable unmet demand for rice. It is in these countries where rice consumption may grow faster. The Asian population is growing at 1.8 percent per year at present, and population may not stabilize before the middle of the next century. This research article is based on the morphological, cytological parameters of paddy crop.

Keywords: paddy, irrigation, land, area, water etc

1 INTRODUCTION

Cereal crops chiefly Wheat, Rice, Maize, Sorghum and pearl millet are the main food source for more than two thirds of the world population. The world cereal has derived from Ceres the Greek goddess of agriculture. Cereal grains have been the staple human diet since prehistoric times. The cultivation of cereals for human consumption began around 10,000 B.C. ranking them as the earliest cultivated staple food plants of many human societies. Their cultivation signified the dawn of the era of stable civilization, which replaced the primitive nomadic way of life. Among common cereals such as wheat, Maize, sorghum, Barley, Oat etc. rice is one of the important cereal food crops of India. It contributes about 43% of the total food grain production and 46% of the total cereal production in the country. Wheat, rice and maize are undoubtedly the most important cereal crops world-wide. Rice is central to the lives of billions of people around the world possibly the oldest domesticated grain (10,000 years) rice is the staple

food for 2.5 billion people. The word rice has Indo-Iranian origin. It came to English from Greek *Oryza* via Latin *Oriza*. The word "rice" *Oryza* and 'ris' are claimed to have their root in the Dravidian term (*arisi*). Rice thrives in areas of considerable warmth and moisture and reaches a height of about 1 m (3ft.), with flowers bearing six stamens and solitary pistil. The fruit grain is produced on a nodding inflorescence of spikelets at the top of the stalk. When the grain is ripe, rice resembles the oat plant. The white endosperm is enclosed by a layer of bran surrounded by brown husk. Rice is grown in states like Punjab, Karnataka, Andhra Pradesh and West Bengal. Rice is the staple food of the states in southern and eastern India. Rice is one of the 19 species of Gramineae family common rice, *Oryza sativa* is the only species of importance to human beings. It is grown in 112 countries but 95% of the crop is grown and consumed in Asia. Rice is the seed of monocot plants *Oryza sativa* or *Oryza glaberrima*. Rice belongs to the genus *Oryza* and has two cultivated and 22 wild species. The cultivated species are *Oryza sativa* and *Oryza glaberrima* has been cultivated in West Africa for the last 3500 years. As a cereal grain it is the most important staple food for a larger part of the world's human population. It is the grain with the second worldwide production, after maize. Rice is normally grown as an annual plant although in tropical areas it can survive as a perennial and can produce a ratoon crop for up to 30 years. The rice plant can grow to 1-1.7 m. (3.3-5.9 ft) tall, occasionally more depending on the variety and soil fertility. It has long slender leaves 50-100 cm. (20-39 in) long and 2-2.5 cm. (0.79-0.98 in) broad. The small wind-pollinated flowers are produced in a branched arching to pendulous inflorescence 30-50 cm. (12-20 in) long. The edible seed is a grain (caryopsis) 5-12 mm. (0.20-0.47 in) thick.

2. Review of Literature

A quantitative analysis of plant growth has been a subject of ecophysiological studies of over a considerable period. A certain number of interactions both within and in between plants and environment result in number of plants processes like growth, differentiation, and other plant responses. Variation in growth, behavior of plant at successive period of growth occurs as a natural phenomenon. Growth analysis studies are since they reveal valuable information about the relative growth of any species different periods. Although it escapes precise definition, we may regard germination as that consecutive member of steps which causes a quiescent seed, with a low water content to show a general rise in metabolic activity which were suspended earlier morphologically germination is transformation of an embryo into a seedling. Physiologically it is the resumption of metabolic and growth earlier suspended. Genetically it is the switching on of the transcription of the genome, and biochemically it is the sequential differentiation of oxidative and synthetic pathway. Mayer and Shain (1974) defined germination as those steps in seed which lead to protrusion of the radical. The success of any plant species in reproduction itself by seeds depends on viability and the seed output. The seed is the potential capacity of a species to reproduce itself. A seed may be defined as a "fertilized" Mature ovule possesses an embryonic plant, stored food material and a protective. The germination of seed depends upon a number of environmental factors. The germination of seed is quite sensitive to toxic materials therefore generally the germination percentage is considered to be the index of toxicity of pollutants. However there are some examples of plants whose seeds and seedlings can tolerate chemicals those ordinarily kill other plants. The tolerant species are able to thrive successfully under adverse conditions particularly in the areas where water pollution is the major problem. All biological reactions occur in water and it is the integrated system of biological metabolic reactions in an aqueous solution that is essential for the maintenance of life. Most human activities involve the use of water in one way or other. It may be noted that man's early habitation and civilization sprang up along the banks of rivers. Although the surface of our planet is nearly 71% water, only 3% of it is fresh of these 3% about 75% tied up in glaciers and polar icebergs, 24% in groundwater and 1% is available in the form of fresh water in rivers, lakes and ponds

suitable for human consumption (Dugan, 1972). Due to increasing industrialization on one hand and exploding population on the other, the demands of water supply have been increasing tremendously. Moreover considerable part of this limited quality of water is polluted by sewage, industrial waste and a wide range of synthetic chemicals. Fresh water which is a precious and limited vital resource needs to be protected, conserved and used wisely by man. But unfortunately such has not been case, as the polluted lakes, rivers and stream throughout the world testify. According to the scientists of National Environmental Engineering Research Institute, Nagpur, India, about 70% of the available water in India is polluted (Pani, 1986). Water quality criteria of various ground water has been studied from different sources e.g. Tube well, Dug well water near the mac- Hia waste disposal site has been evaluated by Karnchanawong et al. (1993). It has been reported that well water in the study area was not suitable for drinking due to high contamination of total and fecal coliforms and moderate contamination by nitrate and manganese. Nitrate pollution of groundwater in 14 cities of Northern China due to nitrogen fertilizer has been reported by Zhang et. al. (1996). The potential impacts of mine wastes on ground and surface water has been studied by Herzog (1996). Groundwater contamination due to storm water infiltration has been reported by Mikkelsen et.al. (1998). Similarly the impact of agriculture on groundwater quality in Slovenia has been assessed by Maticic (1999). It has been reported that among 12 main groundwater aquifers in Slovenia, the amount of nitrate exceeds the allowable level (50 mg./l) for drinking water. Shamruck et. al. (2001) studied the effect of chemical fertilizers on groundwater quality in the Nile valley aquifer, Egypt and found the major ion concentration of Nitrate (20 to 340 mg./l), Sulfate (96 to 630 mg/l). Phosphate (7 to 34 mg/1) and potassium (7 to 28 mg/1). Ammann et.al. (2003) reported about the groundwater pollution by runoff. Almasri et.al. (2004) evaluated regional long-term trends and occurrence of Nitrate in the groundwater of agricultural watersheds in Whatcom Country, Washington.

In India, pioneering studies on limnology of river and lake ecosystems were carried out by David (1963) on river Gandak, Ray et.al. (1996) on river Ganga and Yamuna, Pahwa and Mehrotra (1996) on river Ganga, Vyas (1968) on Pichhola lake, Udaipur and David et. al. (1969) on Tungabhadra reservoir, Raina et.al. (1984) on river Jhelum, Tiwari et. al. (1986) on river

Jhelum Qadri et.al (1993) on river Ganga, Das et.al (1994) on river Ganga, Hosetti et.al, (1994) on Jayanthi nalla river Panchaganga at Kolhapur, Rao et. al. (1994) on Ooty lake, Murugesan et. al (1994) on river Tampraparani (1994) on river Mondakini, Mishra et.al (1995) on river Tawa, Desai (1995) on river Dulhsagar and khandepar river, Kataria et. al. (1995) on river Kubza, Chandra et. al.(1996) on river Ramaganga.Lal (1996) on Pushkar sarovar, Benjee et.al. (1999) on river tikara and Brahmani Gambhi (1999) on Mainthon Research, Jain (1999) on Khnop Reservoir, koshy et.al. (1999)and(2000) on river Pamba, Bhuvaneshwaran et. al. (1999) on river adyar, Patel (1999) on Pitamahal Dam, Sharma et. al. (1999) on river Yamuna, Singh et. al. (1999) on River Damodar, Gyannath et. al. (2000) on river Godavari, Chatterjee et. al. (2001) on river Nunia in Asansol, West Bengal, Kaur et. al. (2001) on river Satluj, Garg et.al. (2002) on western Yamuna canal from Tajewala (Haryana) to Haiderpur Treatment plant (Delhi). Abbasi et. all (2002) on Buckingham canal, Martin et.al. (2003) on river Ram Ganga, Singh et. al. (2004) on river Yumana.

In India there are many water resources such as ground water, rivers, ponds and lakes which are located adjacent to the city carry the effluents released from industrial concerns. Studies in relation to water pollution of river have attracted the attention of several workers in India and abroad. Studies have been made on ground water pollution, river water pollution of different India rivers viz. Ganga (Agarwal et al., 1976; Bharti et al. 1978; Bigrami & Siddiqui 1980;) Jamuna (Bulvser & Sharma 1966; Dakshini and Soni 1979;) Gomti (Prasad & singh, 1982), Cauvery (Somashekar and Ramaswamy 1982) Chambal (Olaniya et al., 1976 Das & Agarwal, 1982; Rao et al., 1978) (Rao & Saxena 1983) Kashipra (Rao et al., 1982 Bandi (Rana & Palria, 1982).

3. Varieties of rice (Paddy crop):

According to Dr. Richaria, one of the most eminent rice scientists of the world, 4,00,000 varieties of rice existed in India during the vedic period. He estimated that even today 2,00,000 varieties of rice exist in India which is indeed an exceptionally high number. Every variety has specific purpose and utility. The harvesting area of rice in India in the world's largest. Rice cultivation is found in all the states of India, but West Bengal, Uttar Pradesh, Madhya Pradesh, Punjab, Orrisa and Bihar are the major rice producing states.

There are many varieties of rice which are grown all over the world. The most famous variety of rice is Basmati. It means the "queen of fragrance" or the perfumed one. This type of rice has been grown in the foothills of the Himalayas for thousands of years. In India, Basmati Rice is characterized by extra long, superfine slender grains having a length to breadth ratio of more than 3.5, sweet taste, soft texture, delicate curvature, linear Kernel and extra elongation. The highly aromatic rice. India's gift to the whole world. It is long grain rice famous for its fragrance and delicate flavor. The grains of basmati rice are longer than non-basmati rice varieties. Cooked basmati rice can be uniquely identified by its fragrance. The name basmati is a combination of two words 'Bas'and 'Mati', Bas Means in hindi 'aroma' and mati means "a full of", hence the word Basmati is full of aroma. Basmati rice has a typical flavor caused by the aroma compound *2-acetyl-1-pyrroline*.

A number of basmati rice exist. Traditional ones include Basmati-370, Basmti-385, Basmati-R.S. Pusa, while hybrid basmati varieties include Pusa Basmati I. Basmati Rice has been cultivated at the foot hills of the Himalayan mountain range in India for thousands of years. The river Yamuna and sutly irrigate the basmati paddy fields in Haryana and Punjab respectively. To obtain the correct aroma and flavor of Basmati rice, Proper ageing is required to reduce its moisture content. The best quality Basmati rice comes from the old karnal District, known as the 'rice bowl of India'. Basmati is now grown in kernel, Panipat, Kaithal, Kurukshetra and Ambala District of Haryana. It is also grown in Punjab, Degradun Region of Utrakhand and Jammu region of Jammu and Kashmir. There are other varieties of wild rice which is altogether a different species (*Zizania aquatic*). This species is grown in western nation such as the United States and has become a delicacy in markets. Rice come in different colours, lengths and is grown in different conditions. The harvested rice, which still has the husk around the grain come in server different colour including white, brown amber, red or black. Some of these varieties are long and slender, while others are short and thick. Another type of rice has been created in China by experts at the National Rice Institute. It has been referred to as "super Rice". It is immune to the toxic effects of herbicides. It was described as "resilient and tasty."

The main characteristic features of India Basmati Rice are as follows:-

3.1 Origin: Authentic Basmati rice is sourced from northern India at the foothills of the Himalayas. Whilst Basmati Rice can be sourced from India and Pakistan, India Basmati is traditionally considered premium.

3.2 Colour: The colour of Basmati is translucent, Creamy white. Brown Basmati Rice is also available but the most commonly used is white Basmati.

3.3 Grain: Long Grain, The grain is long (6.61-7.5 mm.) or very long (more than 7.50 mm and 2mm Breadth).

3.4 Shape: Shape or length –to–width ratio is another criteria to identify basmati rice.

3.5 Texture: Dry, firm, separate grains, Upon cooking, the texture is firm and tender without splitting and it is non-sticky.

3.6 Elongation: The rice elongates almost twice upon cooking but does not father much. When cooked the grains elongate (70-120% over the pre-cooked grains) more than other varieties.

3.7 Flowers: Distinct fragrance. The most important characteristic of them all is the aroma. Incidentally the aroma in Basmati arises from a cocktail of 100 compounds-hydrocarbons, alcohols, aldehydes and esters.

4. Conditions and production systems of rice:

The variety of rice that should be planted in a particular region depend upon the altitude of the region, whether it is an upland or lowland area. There are two seasons for sowing and transplanting. There are Rabi and Kharif seasons. The kharif crop is planted in early summer and depends on the summer monsoons for irrigation. Ploughing is done between the months of March and May. Nurseries are prepared between April and June and plants are transplanted to the fields a month later. Rice is harvested in October-November. The Rabi crop is sown or transplanted to the fields in the winter months of November-December in the southern states of Andhra Pradesh, Kerala and Tamil Nadu. It is harvested in May-June. Rice is grown under many different conditions and

production systems, But submerged in water is the most common method used worldwide.



Fig1. Irrigated paddy fields in India

Rice is the only cereal crop that can grow for long periods of time in standing water. 57% of rice is grown on irrigated land, 25% on rainfed lowland, 10% tidal wetlands. Just as rice can be grown in different environments it has many characteristics, making one variety more popular in one region of the world than another. Although the germination of seed and entire growth of a plant depends upon availabilities of soil water but paddy in particular is a crop which is regarded as a water dependent crop as it requires at least three or four times more water than wheat. The sowing of paddy plantlets is carried out only in water submerged fields; therefore the physical and chemical composition of water influences the paddy growth significantly. In India and all over the world the main source of irrigation water is ground water. Ground water is a source of drinking water for million rural and urban families. It accounts for nearly 80% of the rural domestic water needs and 50% of the urban water needs in India. In India the ground water is used intensively for irrigation and industrial purposes, a variety of land and water-based human activities and is causing pollution of this precious resource. Water contained in the pores of the soil or in aquifers is called ground water. About 40% of municipal water comes from ground water and additional forty million, including most of the rural population draw drinking water from domestic wells. Water is one of the critical inputs for the sustenance of mankind. The major uses of water are for irrigation 30%, thermal power plants 50% while other uses are domestic 7% and industrial consumption 12%. Now a day's urbanization has given rise to a number of environmental problems such as water supply, waste water generation and its collection, treatment and disposal in urban areas. This waste water percolates into the ground and in turn contaminates the groundwater or is discharged into the natural drainage system, causing pollution in downstream areas. Similarly there are many other sources of ground water pollution in India. In our

country garbage, domestic wastes in directly dumped into water bodies or roadsides, which is often be washed into streams and lakes. The municipalities dispose off their treated or partly treated or untreated waste water into natural drains joining rivers or lakes. Toxic chemicals from sewage water transfer to the plants and entire food chain and affect public health. Generally municipal waste water is made up of domestic waste water, industrial waste water, etc. Domestic waste water considers of effluent discharge from household, institutions and commercial buildings. Industrial waste water is the effluent discharged by manufacturing units and food processing by manufacturing units and food processing plants. Pandey S.N. (2004) reported that effluent from electroplating industry has inhibit the seed germination and seedling growth and produced 80% mortality in zea maize and 60% in *Oryza sativa*. Generally sewage water contains organic matter Nutrients (Nitrogen, Phosphorus, potassium). Inorganic matter (dissolved minerals), toxic chemicals (heavy metals and pesticides) and pathogens. Due to the presence of nutrient content it can be used extensively for irrigation and other ecosystem services. In some cases its use has shown positive benefits to the farming community, society and municipalities. In the same way Hassan et al. (2005) explained that addition of Zn in Cd medium has significantly increased the plant height, biomass, chlorophyll concentration and photosynthetic rate. Similarly Kumar et al. (1975) reported improved plant growth, chlorophyll content, enzymatic activity and grain yield of rice plants. Waste water (treated and untreated) is extensively used in agriculture because it is a rich source of nutrients and provides all the moisture necessary for crop growth. Most crops give higher than potential yields with waste water irrigation, reduce the need for chemical fertilizers, resulting in net cost savings to farmers. Ground water plays crucial role as decentralized source of drinking water for millions rural and urban families. Human activities can alter the natural composition of ground water. In the present scenario water pollution is a major problem in the global context. It is a leading worldwide cause of death and diseases and that it accounts for the death of more than 14000 people daily. Pollution of ground water due to industrial effluents and municipal waste in water bodies is another major concern in many cities and industrial clusters in India.

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