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Aerobic Rice-Global and Indian Scenario

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ABSTRACT

Aerobic rice farming is a novel type of rice cultivation that requires less water than low-land rice. It's grown like an upland crop in non-puddled, non-flooded, and non-saturated soil. Throughout the paddy crop's growing season, the soil is 'aerobic,' or devoid of oxygen. Aerobic rice refers to the cultivation of suitable high yielding rice cultivars in direct planted, non-puddle, aerated soils with supplementary irrigation and nutrients to achieve a high yield. The ecology of this variety of rice is a mix of upland and shallow lowland environments. According to the aforesaid conditions, the crop was planted in target fields such as tank irrigated areas, deep bore well or sufficient well irrigated areas, and regions in the delta region that were expected to receive delayed channel or river water throughout the kharif (June–July) and summer seasons (February). Aerobic rice provides numerous advantages over traditional irrigated lowland rice agriculture. Over the traditional way of paddy cultivation, there is no need for nursery preparation, puddling, or flooding of water in the field, as well as a 50% reduction in water and power use. This method of aerobic rice production is a viable solution for reducing green house gas emissions from paddy fields and thereby protecting the environment.

Keywords: Aerobic Rice, Irrigated Rice, Rainfed Rice, Asia, World Food Security

Introduction

Rice (Oryza sativa L.) is a staple crop for over half of the world's population, and its annual output determines global food security (Dass et al. 2015). Rice is grown on 79 million hectares of irrigated lowland, accounting for around 75% of total production. Due to a lack of fresh water supplies, the viability of irrigated rice systems is jeopardized. By 2025, it is anticipated that 17 million hectares of Asia's irrigated rice will face "physical water scarcity" and 22 million hectares will face "economic water scarcity" (Tuong and Bouman, 2003). The International Rice Research Institute (IRRI) has coined the term "aerobic rice" to describe high-yielding rice grown in non-flooded conditions in non-puddled and unsaturated (aerobic) soil responsive to nutrient supply and cultivated as rainfed or irrigated rice that tolerates (occasional) flooding (Bouman and Tuong 2001).

History

Irrigated rice requires 40% more water than aerobic rice for flooding, and 48% (570 mm) of the applied irrigation water (1,180 mm) is lost by evapotranspiration (Bouman 2009). (ET). Runoff and infiltration account for the remainder of water loss. Rice farmers must pay a significant and essential amount of water as part of their production costs (Brown et al 1978). Under the Asian Development Bank (ADB)-funded project "Developing and disseminating water-saving rice technologies in South Asia," aerobic rice breeding began in 2007 with the use of first-generation aerobic rice germplasm and other exotic materials as donors, which were then hybridized with popular varieties. At CRRI, Cuttack, large variability for aerobic features was generated with different populations, and promising genotypes were selected using pedigree breeding procedures, while aerobic rice cultivation was established and embraced by farmers in Brazil, China, and other Asian countries (Pinheiroet al., 2006).

Varieties

Commercially produced breeding programs for selecting high yielding potential aerobic rice cultivars with a broad spectrum of biotic and abiotic stress tolerance have been developed. Han Dao is a set of temperate aerobic rice cultivars produced by China Agricultural University breeders and has been commercially farmed by farmers in northern China since the early 1990s. In 2001, the International Rice Research Institute (IRRI) began a breeding program to generate tropical aerobic rice cultivars for the Asian tropics, and improved tropical upland rice cultivars (such as Apo) that performed well

in aerobic conditions were identified (Lafitte et al., 2002). CR Dhan 200 or Piyari (suited for Odisha), CR Dhan 201 (appropriate for Chhattisgarh and Bihar), CR Dhan 202 (ideal for Jharkhand and Odisha), and CR Dhan 204 (suitable for Jharkhand and Tamil Nadu) are four aerobic rice types published by the Central Rice Research Institute in Cuttack. ARB 6, MAS 26, and MAS 946-1 for Karnataka have also been provided by the University of Agricultural Sciences, Bangalore. High-yielding aerobic rice varieties of 125 to 135 days length will be suited to replace the existing cultivated varieties in most irrigated areas in Punjab, Haryana, and Andhra Pradesh, as well as the rainfed lowland ecology in eastern India. There was a drop in yield in on-farm trials (KochilaNuagaon, Cuttack district) when compared to on-station yield. However, in aerobic circumstances, three lines (IR70213-10-CPA-4-2-3-2, CR 749-20-2-16-1, and CR 691-475) produced significantly greater yields (> 4.5 t ha1). Among the three tests, Naveen outperformed Shatabdi and IR36 in terms of yield.

Aerobic breeding lines of 110 to 120 days' duration can be grown to replace the currently grown varieties in the upland and midland top sequence of northeastern India, including Assam, which is considered a favorable upland area, as well as the shallow lowland ecosystem of eastern India, where drought is a severe constraint. Under aerobic conditions, the IR78875-131-B-1-4, IR74371-3-1-1, and IR80021-B-86-3-4 generated more than 4.0 t ha1. Anjali outperformed Annada and Naveen in terms of yield among the three checks. The following are some varietal characteristics.

CR Dhan 200 or Piyari (IET 21214) CR 2624-IR 55423-01

The cultivar is ideal for Odisha's water-scarce locations, with a period of 120-125 days and a semi-dwarf plant type (95 – 100 cm). It has a short, bold grain and is fairly resistant to rice diseases such as leaf blast, neck blast, and brown spot, as well as stem borer (dead heart and white ear head) damage, whorl maggot, gall midge, and leaf folder assault. It's a non-lodging plant with a thick culm, easy threshability, and a strong fertilizer response.

CR Dhan 201 (IET 21924) CR 2696-IR 83920

With a period of 110-115 days and a semi-dwarf plant type, the variety is appropriate for mid-early aerobic cultivation in Chhattisgarh and Bihar (100 cm).Blast, sheath rot, stem borer (both dead heart and white ear heads), leaf folder, whorl maggot, and rice thrips are fairly resistant to this variety. Under ideal conditions, the variety can yield up to 6 t ha^{-1}, with a yield of 3.8 t ha^{-1}.

CR Dhan 202 (IET 21917) CR 2715-13-IR 84887-B-154

The semi-dwarf plant kind is appropriate for growing in Jharkhand and Odisha states for a mid-early aerobic situation with a 115-day length (100 cm). With short bold grain, medium and dense panicle, and moderate test weight, it takes 85 days to reach 50% blooming. Blast, brown spot, sheath rot, stem borer (both dead heart and white ear heads), leaf folder, whorl maggot, and rice thrips resistance is moderate. The variety's average production is 3.7 t ha^{-1}, but with good management, it can yield up to 6 t ha^{-1}.

Technology

Aerobic rice refers to the procedures for growing suitable high yielding rice varieties on direct planted, non-puddle, aerated soils with supplementary irrigation and nutrients to produce high yield.

This rice's ecology is a cross between upland and advantageous shallow lowland environments. This form of agricultural method can be used in target locations such as tank irrigated areas, deep bore well / well irrigated areas, and sites where delayed channel / river water is expected, such as the delta region during kharif (June – July) (February).

Fertilizer usage

Farmers created, recommended, demonstrated, and implemented a horticulture program that included

• High yielding drought tolerant short duration cultivars such as DRRDhan42, DRRDhan44, and DRRDhan46 @20-30 kg/ha seed rate are necessary, as are no or very few clods/clumps in the field, as are any dry land crops.

• Sowing by dibbling or drilling at a depth of 2-3 cm, at a spacing of 20-25 X 5 cm for HYVs and 25-30 X10 cm for Hybrids, at a depth of 2-3 cm.

• Apply Glyphophate @2.5 to 5 L ha^{-1} in the main field 15 days before field preparation as a pre-sowing herbicide. Within 3 days of sowing, use pendimethalin, and at 20-30 DAS, apply penoxsulam+cyhalotofop butyl @2.5 L ha^{-1} (2-4 leaf stage of weeds) It is recommended to apply 50 percent nitrogen at 10-12 days after rice emergence, 25 percent at maximum vegetative stage (45 DAS), and 25 percent N, 25 percent K at 50 percent flowering stage. Spray ferrous sulphate @2.0 percent ferrous sulphate 3 to 4 times at weekly intervals if iron deficiency is detected.

• If apparent indications of hairline cracks on the soil surface are noticed, irrigation is required to keep the soil at field capacity. It's crucial to keep the soil wet during the critical periods of Active Tillering, Panicle Initiation, Flowering, and Grain Filling.

• Use of plant protection chemicals based on need

Outcomes

Aerobic rice used around 51% less total water than flooded rice and had 32–88% higher water productivity, defined as gram of grain per kilogram of water, by minimizing water usage during land preparation and controlling seepage, percolation, and evaporation (Bouman et al., 2005). Aerobic rice

also saves labor because flooded rice requires more labor for land preparation such as puddling, transplanting, and irrigation activities (Wang et al., 2002).

Food security

In aerobicrice systems with high-yielding rice cultivars, grain yields of 5–6 tha1 have been reported (Bouman et al., 2006). Brazil has created anaerobic rice varieties with high grain yields of 5–7tha1 (Castaneda et al., 2002). Using high-yielding aerobicrice varieties and proper management approaches, grain yields of 8 tha1 and even higher have been reached in northern China. In India, the interaction of genotypes with soil water conditions revealed that in aerobic conditions, CR Dhan 200 (4.0 t ha–1) and IR74371-3-1-1 (3.80 t ha–1) showed better performance with less yield decline (7.0 to 9.5 percent); in semi-aerobic conditions, supplementary irrigation increased grain yield (4.3 to 4.4 t ha–1). As a result, a negative impact of physical and biochemical root characteristics leading to a yield decline in aerobic rice might be mitigated under semi-aerobic conditions with extra watering at critical growth stages without compromising water productivity (Ghosh et al., 2012).

Conclusion

CRRI, Cuttack's study on aerobic rice has found numerous promising aerobic rice lines. Farmers can now grow two aerobic rice types, CR Dhan 200 and Anagha, and numerous other aerobic rice lines are in the works. Although aerobic rice gives the highest yield per unit of water consumed of all water-saving rice technologies, yield under aerobic circumstances is still lower than output under flooded irrigated settings.

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