Mini Review

Aerobic rice cultivation on adoption of water saving technologies and improving agronomic practices during summer season in India

Abstract

Application of irrigation at IW/CPE ratio of 2.0 along with sprouted seeds recorded significantly maximum water use efficiency (3.84 kg ha^{-1} mm) than rest of the irrigation regimes. With regard to the production economics in pooled data, highest gross return, net return and consequently highest B:C ratio was obtained in the treatment combination IW/CPE of 2.0 coupled with sprouted seeds (IRs 61000, Rs 2574 and 1.73 respectively). On the basis of results it could be concluded that, scheduling of irrigation at IW/CPE=2 irrigation regime coupled with sprouted rice seeds soaked for 48 hrs was found suitable as upland aerobic summer rice for maximum growth, yield and monetary benefit. And that saved up to 40% of irrigation requirement for rice cultivation during summer season under aerobic situation.

Keywords: aerobic rice, summer season, water saving and agro-technique

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Introduction

In particular, increasing physical water scarcity is a main constraint for irrigated rice (*Oryza sativa)* production.[1] By 2025, the per capita available water resources in Asia are expected to decline by 15–54 percent compared with 1990.[2] The supply of water for irrigation is endangered by declining water quality, declining resource availability, increased competition from other users, and increasing costs.

At the farm level, water inputs can be reduced by decreasing the relatively large and unproductive losses from seepage, percolation, and evaporation. Water-saving irrigation technologies such as saturated soil culture and alternate wetting and drying can drastically diminish these losses. In Asia, upland rice is aerobically grown with minimal inputs and it is usually planted as a low yielding subsistence crop in the adverse upland conditions.[3] With predictions suggesting that many Asian countries will have severe water problems by 2025, aerobic rice under conservation agriculture gives hope to farmers who do not have access to enough water to grow flooded lowland rice. A new concept of growing rice using less water is aerobic rice: high-yielding rice grown in non-puddled aerobic soil using supplementary irrigation just like upland crops. Aerobic rice is crop grown in well-drained, non-puddled & non-saturated soils without ponded water.[4] Growing rice in conservation agriculture, with the use of external inputs such as supplementary irrigation, fertilizers and aiming at high yields[4] has been established. Main driving force behind aerobic rice is economic water use. Farmers in Brazil, China, and India are pioneering this system where water is scarce or costly. Preliminary studies in Italian climatic environments have shown promising results when rice was grown under dry land conditions, using sprinkler or flushing irrigation rather than flooding, indicating that rice does not necessary require flooded conditions for high yield and good grain quality.[5,6] However, new aerobic rice varieties and specially designed management strategies are needed if this system is going to be successful. Through the adoption of water-saving irrigation technologies, rice land will shift away from being continuously anaerobic to being partly or even completely aerobic.

Materials and methods

A field experiment on growth and yield of aerobic rice in summer season under various moisture regimes and planting techniques in upland condition was carried out at the Regional Research Station of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (India) during summer seasons of 2011 and 2012. The station located in a sub-tropical region at 23°N latitude, 89°E longitude and at an elevation of 9.75m above sea level. The soil of the experimental field is sandy clay loam in texture and the depth of the soil is shallow to medium with total nitrogen (0.072%), moderate in phosphorus (15.70 kg ha^{-1}) and potassium (193.58 kg ha^{-1}) content. The soil was moderately alkaline in reaction (pH 6.8). Organic carbon content of soil was 0.67 percent, respectively. The bulk density of soil was 1.47 g cc^{-1}, respectively. The experiment was laid out in a split plot design and replicated three times. The treatment consist of three irrigation regimes *viz.*, IW/CPE=1, IW/CPE=1.5 and IW/CPE=2 and four treatments on planting techniques *viz.,* P_1: Sprouted seeds, P_2: Non-sprouted seed, P_3: Soaking seeds overnight (12hrs), P_4: Soaking seeds overnight (12 hrs) followed by shade drying.

Result and discussion

The results revealed that scheduling of irrigation at IW/CPE=2 registered significantly maximum growth attributes in *viz.*, plant height (85.98cm), tiller number (374.17m^{-2}), leaf area index (3.26), dry matter accumulation (974.97 g m^{-2}), crop growth rate (8.22 g $m^{-2}d^{-1}$). Root characters *viz.*, root length (24cm), root volume (12.72 cc $hill^{-1}$) and root weight (121.95 g $hill^{-1}$) also registered maximum when irrigation was scheduled at IW/CPE=2. The yield attributes panicle length (21.29cm), filled grains per panicle (84.46) test weight (16.80g), and also grain yield (4.13 t ha^{-1}) and straw yield (5.84 t ha^{-1}) were significantly higher with scheduling of irrigation at IW/CPE=2 irrigation regime. Amongst planting technique, sprouted seeds showed maximum growth attributes *viz*., plant height (85.98 cm), tiller number (376.89 m^{-2}), leaf area index (3.26), dry matter accumulation (1018 g m^{-2}) crop growth rate (8.18 g $m^{-2}d^{-1}$). Root characters *viz*., root length (24.24cm), root volume (12.59 g hill^{-1}) and root weight (124.05 g hill^{-1}) was significantly higher when sprouted seeds were used. The same trend was followed in yield attributes *viz*., panicle length (21.38cm), filled grains per panicle (88.11) test weight (17.12g), grain yield (4.16 t ha^{-2}) (Table 1) and straw yield (5.84 t ha^{-1}). Application of irrigation at IW/CPE ratio of 2.0 along with sprouted seeds recorded significantly maximum water use efficiency (3.84 kg ha^{-1}mm) than rest of the irrigation regimes. With regard to the production economics in pooled data, highest gross return, net return and consequently highest B:C ratio was obtained in the treatment combination IW/CPE of 2.0 coupled with sprouted seeds (IRs 61000, Rs 2574 and 1.73 respectively). On the basis of results it could be concluded that, scheduling of irrigation at IW/CPE=2 irrigation regime coupled with sprouted rice seeds soaked for 48hrs was found suitable as upland aerobic summer rice for maximum growth, yield and monetary benefit. And that saved up to 40% of irrigation requirement for rice cultivation during summer season under aerobic situation.

Table 1 Effect of moisture regimes and planting techniques on grain yield of rice under aerobic condition in conservation agriculture

Grain Yield (t ha^{-1})			
Treatment	**2011**	**2012**	**Pooled**
Moisture regimes			
I_1	2.93	3.08	3.00
I_2	3.46	3.61	3.54
I_3	4.00	4.26	4.13
SEM(±)	0.06	0.04	0.04
CD at 5%	0.25	0.14	0.12
Planting techniques			
P_1	4.07	4.25	4.16
P_2	3.03	3.24	3.14
P_3	3.30	3.34	3.32
P_4	3.45	3.76	3.60
SEM(±)	0.08	0.08	0.06
CD at 5%	0.23	0.24	0.16

I_1, Irrigation when IW/CPE=1; I_2, Irrigation when IW/CPE=1.5; I_3, Irrigation when IW/CPE=2; P_1, Sprouted seeds; P_2, Non-sprouted dry seeds (control); P_3, Soaking seeds (12hrs); P_4, Soaking seeds overnight (12hrs) followed by shade drying.

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Conflict of interest

There is no conflict of interest on publishing the article.

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