

AEROBIC RICE: RESPONDING TO WATER SCARCITY

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Aerobic rice is a new concept of growing rice in non-puddled and non-flooded aerobic soil. It is a new way of growing rice that needs less water than lowland rice. It entails the growing of rice in aerobic soil with the use of external inputs such as supplementary irrigation and fertilizers and aiming at high yields. This way of growing rice saves water by eliminating continuous seepage and percolation, reducing evaporation and eliminating wet land preparation. This rice commercially grown in Brazil. In India, the innovative farmers of Hariyana, Punjab and UP have begun to grow. Aerobic rice is one of the best approaches, which can address the problems of drought and limited water. Aerobic rice varieties combining high yield potential with tolerance for aerobic soil conditions have usually been derived from breeding programs in which varieties are developed and evaluated under aerobic soil conditions and with fertilizer applications sufficient for a 4 to 6 t/ha yield target.

What is aerobic rice? :

Aerobic rice cultivation is a production system, which involves the growing of specially developed, input-responsive rice varieties in well-drained, nonpuddled, and nonsaturated soils without ponded water. A nonsaturated soil is also called an "aerobic soil".

What is the difference between aerobic rice and upland rice?: Aerobic rice varieties are high-yield upland varieties distinguished from traditional upland rices adapted to low-input, subsistence-oriented management by their improved lodging resistance and higher harvest index.

Upland rice is grown in rainfed, naturally well-drained soils with banded or unbanded fields without surface water accumulation. Upland rice varieties are mostly grown as a low-yielding subsistence crop to give stable yields under the adverse environmental conditions of the uplands. Upland rice varieties are drought-tolerant but have a low yield potential and a tendency to lodge under high levels of external inputs such as fertilizer and supplemental irrigation.

Aerobic rice is targeted at more favorable

environments where farmers can afford to buy external inputs such as fertilizers and can have access to supplementary irrigation if rainfall is not sufficient. Achieving high yields under relatively favorable aerobic soil conditions requires new varieties of "aerobic rice" that combine the drought-resistant characteristics of upland varieties with the high-yielding characteristics of lowland varieties.

Why aerobic rice?:

Higher water requirements and increasing labour costs are the major problems of the traditional rice

production system, to overcome these problems, aerobic rice culture is an attractive alternate.

Advantages of Aerobic rice:

- The water use efficiencies of aerobic varieties are higher than lowland variety.
- water inputs in aerobic rice is more than 50% lower (only 470-650mm)
- Water productiveness 64-88% higher.
- Gross returns 28-44 % lowers.
- Labour use 55% lower, because of absence of puddling and transplanting as well as here possibilities of mechanized sowing and harvesting.
- Increased mycorrhizal association.
- Reduced nitrogen loss: Loss of nitrogen in the form of leaching and also denitrification of nitrate form of nitrogen to nitrite form occur tremendously and hence the use of inorganic source is very frequent in wet land rice. But in aerobic soil the loss must be minimized.
- Reduced irrigation efficiency: In flooded rice the frequency of irrigation is 12 to 15 as compared only 4 to 5 in aerobic conditions.
- Mineralization of organic nitrogen into ammonical form and subsequent nitrification to nitrate form is possible with aerobic microbes in aerobic rice. This improves the Nitrogen use efficiency of rice grown under aerobic conditions.
- Reduced methane emission and other green house gases.
- Profuse rooting and high tillering.



Aerobic rice practices:

- Dry direct seeding with minimum land preparation (non-puddled and non-flooded soil).
- Use of pre- or post-emergence herbicides.
- Efficient seed coating technology either with suitable phospho bacterium and/or rhizobial cultures.
- Square sowing with wide spacing to avoid root competition.
- Maintenance of moist soil but aerated soil during vegetative growth period (by flush irrigation, furrow irrigation or by sprinkler irrigation) (keeping the soil wet but not flooded/ saturated).
- Efficient weed management either by use of herbicides or by use of frequent hand weeding specially in the early stages of growth.
- Allowing a thin film of layer (1-2 cm) to be maintained after panicle initiation.

Aerobic rice cultivars: A new type of rice varieties is required to achieve high yields under aerobic conditions. Aerobic rice should be responsive to high inputs and should tolerate flooding. Moreover, it has to combine characteristics of both upland and high yielding lowland varieties. Special aerobic rice varieties called 'Han Dao' (such as HD 297, HD 277, HD 502) have been developed by the China Agricultural University with yield potential of upto 6.5 tons per hectare.

In tropical Asia, IRRI identified that a lowland variety 'Magat' and some upland genotypes like 'APO' and 'CT 6510-24-1-2' perform well better under aerobic conditions. These varieties were mainly derived from crosses between *indica* and tropical *japonica* parents. In Tamilnadu, an upland rice variety 'PMK 3', was performed well under aerobic conditions. SVBPUAT, Meerut released the MAUB-13 rice variety that has been produced by hybridisation technology involving indigenous rice varieties only. This will be followed by the release of the aerobic varieties of rice— IR72862-27-3, IR74371-46-1-1, IR74371-70-1-1 etc. that have been produced by hybridisation technology involving rice varieties from Sri Lanka, Philippines etc.

Problems and prospects of aerobic rice:

- Lower yields under aerobic system (but saving of water 55-60%). There is a need for the development of new rice cultivars combining high yield, drought tolerance and weed competitiveness for aerobic rice cultivation.
- Yield decline and crop failure under continuous aerobic rice culture which is attributed to infestation by soil borne pests and diseases such as nematodes/ fungus/ root aphids, nutrients (P, Fe and other micronutrient) imbalances and impaired nitrogen uptake.
- The crop is also prone to lodging.

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