e ISSN–2321–7987 | ●●● Article ●●● |Visit us : *www.researchjournal.co.in*|

Aerobic rice: Worthful in Bihar

Vivek Dubey[1], Md. Saquib Alam[1] **and** Rakesh Kumar[2]
[1]Tirhut College of Agriculture, Dr. Rajendra Prasad Central Agricultural University, Pusa, SAMASTIPUR (BIHAR) INDIA
[2]College of Agricultural Engineering, Dr. Rajendra Prasad Central Agricultural University, Pusa, SAMASTIPUR (BIHAR) INDIA

Abstract

Aerobic rice cultivation provides feasible alternative to traditional rice production in these regions, allowing significant water savings. Field experiments were conducted at the ANGR University Agricultural Research Station, India during 2009–2010 and 2010–2011 to compare crop growth, yield, and water savings under aerobic rice.Aerobic rice is a production system in which rice is direct seeded and grown in non-puddled and non-flooded aerobic soils. Aerobic rice varieties need to be developed to cope with the increasing water scarcity in tropical Asia. Advanced breeding lines were evaluated in 24 yield trials under both non-stressed and stressed aerobic soil conditions in 4 yr (2005–2008) to assess the efficacy of the two-stress-level screening protocol and selection strategies for developing aerobic rice.Cultivation of suitable high yielding rice varieties in direct sown, non-puddle, aerated soils under supplementary irrigation and fertilizers to achieve high yield.Aerobic rice crop does not require continues flooding. It can be irrigated like direct sown crops like maize, jowar and bajra. Irrigation can be provided with interval of 4-5 days and time of irrigation can be adjusted based on the soil type and moisture availability.

Aerobic rice cultivation refers to the high yielding direct sown rice varieties grown in non-flooded and non-puddled aerated soils *i.e.* under supplementary irrigation and fertilizers. The ecology for this type of rice is intermediate between upland and favorable shallow low lands. This type of cultivation practice can be adopted in target areas like tank irrigated area, deep bore well / well irrigated area and the places which are presumed to receive delayed channel / river water *i.e.* in delta region during *Kharif* (June – July) and summer (February).But this is only possible by adoption of efficient herbicide management besides, advanced seed coat technologies.

Reasons to switch on to it :

– A study revealed that its productivity varies from 3.5 to 4.5 t/ha which is double than its present productivity in Bihar of 2.635 t/ha in last triennium average.

– It requires a merely 400-500 mm of water in contrast to 1000-2000 mm in lowland conditions. Moreover, its water use is around 60 per cent lesser than that of lowland rice. It also requires less labour as it can be highly mechanized.

– Field submergence after crop establishment is a must in lowland, consuming on an average 1325mm of water contrary to only 800mm in aerobic condition.

Cultivation of aerobic rice :

– Varieties suitable for aerobic condition should have early seedling vigor, deep root system, erect leaf and early in maturity.

– Cultivation of rice in unpuddled, direct seeded without standing water (need based irrigation as like wheat and maize).

– Combines features of high yielding irrigated lowland and drought tolerant upland cultivars.

Varieties / Hybrid Suitable For Aerobic cultivation in Bihar :

Varieties: Rajendra Neelam, Rasi, Vandana, Jaya, PKM 3, MAS-96

Hybrids: KRH-2, PA 6444, DRRH-3, PA 6201, CORH-3, PHB-71 and Sahyadri

Methods to be adopted for sowing : Prepare land in dry to fine tilth before sowing. At optimum moisture condition, incorporate 10 tons of farm yard manure per hectare and prepare the field to fine tilth for 2-3 times and followed by planking to level the field. Use seed drill in well leveled field for sowing. Deep tillage and fine tilth enhances root growth and higher moisture holding in soil. Direct Sowing is appropriate in aerobic rice cultivation in order to save 50 per cent of water.

CR Dhan 201 (IET 21924) CR 2696-IR 83920 is a preeminent variety in conditions of Bihar.

– The variety is suitable for mid early aerobic cultivation in Bihar and Chhattisgarh.

– Duration of the variety is 110-115 days with semi-dwarf plant type (100 cm).

– It possesses short bold grain and moderately resistant to blast, sheath rot, stem borer (both dead heart and white ear heads), leaf folder, whorl maggot and rice thrips.

– Average yield of the variety is 3.8t/ha, under proper management condition, it can yield up to 6t/ha.

CR Dhan 201(IET 21924)

– A seed rate of 50kg/ha and seeds are to be sown at 20cm between rows and 15cm within rows at 3-5 cm in depth is recommended for Bihar.

Fertilizer dose to be adopted : The recommended dose of fertilizer is 80 kg of nitrogen, 40 kg of phosphorus and 40 kg of potash per hectare. Ten tons of farm yard manure, 100 per cent phosphorus and 50 per cent of potash has to be applied at the time of last ploughing *i.e.* at the time of sowing.The first dose of nitrogenous fertilizer 30 per cent is applied at 10-12 days after germination.During top dressing of fertilizer, sufficient moisture in the soil has to be ensured to make the nutrients available to plants. Nitrogen fertilizer applied in three splits, 30 per cent at 10-12 days after germination, 40 per cent at 30 days after sowing and balance 30 per cent at 50 days after sowing. Potassium fertilizer has to be applied in two splits, 50 per cent at sowing and 50 per cent at 50 days after sowing.Further, zinc sulphate and iron sulphate 20kg and 12 kg per hectare, respectively have to be applied at the time of sowing.

Water management : Aerobic rice crop does not require continuous flooding. It can be irrigated like direct sown crops like maize, jowar and bajra. Irrigation can be provided with interval of 10 days and time of irrigation can be adjusted based on the soil type and moisture availability. Rice crop under aerobic situation could be successfully raised with 700 to 900 mm of total water in summer and during monsoon season the water utilization can be further reduced.Since the water resource is effectively utilized, 1 kg of rice is produced with 3000 to 3500 litre of water in contrary to 4500 to 5000 litre in transplanted rice system.After sowing in dry condition in fine tilth soil, surface irrigation should be done immediately. Surface irrigation should be given upto 50 days after sowing at the interval of 5 days.Irrigation should be given once in 3 days, in the critical stages like active tillering, panicle initiation, flowering and grain filling. Water must be withheld one week before harvest of the crop to facilitate uniform ripening of grains. By adopting aerobic rice cultivation method, the water can be saved to the tune of 45 to 65 per cent.

How can be weed managed? : Weeds are the major concern in aerobic rice cultivation, which reduces crop yield. Therefore, weed management should be done by both chemical and manual means for effective control. Spraying of pre-emergence herbicides like 40 per cent Bispyribac- sodium @ 15-45g/ha as spray. After 20-25 days of seeding, one hand weeding or post emergence herbicides should be applied for effective management of weeds.Hand weeding or inter cultural operation with hand hoe or weeder will control weeds effectively and increases aeration for better root growth and also increases tiller numbers.

Transplanted rice, not a good wisdom! : Although, it is true that rice grows more abundantly in standing water than it does in upland condition, but this does not make continuous flooding the best option. Little attention has been paid until recently to an optimizing middle range of water management in which soil is kept moist but mostly aerobic through controlled water application or alternate wetting and drying in paddy field. Several observable physiological features of rice grown under continuously flooded conditions suggest that these are not ideal situation

for best rice performance. The reasons are:

Root development: After 1 month of transplanting in flooded condition, about 75 per cent of rice roots growing in saturated soil are concentrated in upper 6cm of soil. As it remains nearer to surface of soil, it obtains oxygen only from the irrigated water. Such truncated root systems can access nutrients from only a limited volume of soil, having to rely mostly on nutrients provided through fertilizers. Conversely, when rice is grown with intermittent flooding, roots extend downward 30 to 50 cm and can access nutrients from deeper layers of soil.

Aerenchyma formation: When rice plants are grown under continuously flooded conditions, much of root cortex disintegrates to form aerenchyma. This process occur both in varieties bred for irrigated cultivation and upland cultivation. However, neither irrigated nor upland varieties form aerenchyma when they are grown in well-drained soil. The difference between these two categories of rice is that the former are able to create larger and more regular aerenchyma that enables roots to continue functioning and to survive longer in flooded soil. Formation of aerenchyma appears to be asub optimizing rather than an ideal adaptation to hypoxic conditions.

Prolonged root activity : By the time of flowering when grain production begins, about 75 per cent of roots of rice plants that are growing in continuously saturated soil are degenerated, whereas there is little or no degeneration of roots in well drained condition.

Aerobic rice: A great advantage : Aerobic rice has many advantages over conventional lowland irrigated type of cultivation. Since, direct seeding is recommended, nursery preparation, puddling and transplanting cost can be avoided.

Further, rational use of water for field preparation and irrigation helps in 35-45 per cent of water saving. On the other hand, reduction in number of irrigations will help in cost cut and savings in power consumption. In flooded rice the frequency of irrigation is 12 to 15 compared to only 4 to 5 in aerobic condition. This saves more than 1100 mm of water in aerobic rice over puddle rice. In conventional lowland irrigated rice cultivation, green house gas like methane emission is elevated than the aerobic situation.

Under aerobic rice cultivation, researchers proved that methane emission has been reduced. Maintenance of soil structure is beneficial to non-rice crops in the rotation and timely sowing of succeeding crop after rice. Increased mycorrhizal association is an important consequence of growing paddy in aerobic condition which is not possible under puddled condition. Mycorrhizal fungi that infect roots help to maintain a balance in the supply of nutrients to the plant as well as provide protective services. They can increase the soil volume accessed by as much as 100 times compared with the uninfected root. Plants with mycorrhizal fungi can grow well with just a fraction of phosphorus required for unassisted plants. Since fungi cannot survive under hypoxic condition, continuously irrigated rice has to forego the benefits of their associations for a long time.

Moreover, latest research states increased rhizobia that grows as entophytein and on roots (without nodulation), contribute to increased paddy production even though rice plant is not a legume. Besides, increased uptake of N, P, K, Ca, Mg, Zn, Mo, etc. is also reported along with reduced loss of nitrogen in form of leaching and de-nitrification to nitrite form.

Practices to be incorporated in aerobic rice cultivation:

– Dry sowing with minimum tillage in non-flooded soil.

– Efficient seed coating with phosphobacterium and or rhizobia culture is important.

– Optimum planting depth and maintenance of moist but aerated soil is an important consideration.

– Allowing a thin film of water (1-2 cm) is to be maintained after panicle initiation stage.

Conclusion : The large savings in water used for rice production are possible in agro-climatic regions of Bihar through the use of aerobic production system. But still we have to go a long way in this research as we need to develop new cultivar types combining moderate drought tolerance, high rates of tillering, high harvest index, and lodging resistance. Some cultivars of this type have already been developed in China and now underway by Asian upland rice breeding programmes in IRRI and our country too.

References :

Anandan, A. (2016). Question and doubts concerning Aerobic Rice

Shanmuganathan, M. (2006). Aerobic Rice. *Agric. Update,* **1** (2)

Statistics from Government of Bihar and Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar.

Viraktamath, B.C. Powerpoint presentation at Directorate of Rice research.

Received : *01.09.2016* ***Revised :*** *01.11.2016* ***Accepted :*** *17.11.2016*