Alternate Wetting and Drying (AWD) Technique for water management in Irrigated Lowland Rice Cultivation

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Introduction

Alternate wetting and drying (AWD) technique is a water-saving option in irrigated lowland paddy which generally requires high amount of water for production. It is known as controlled irrigation or intermittent irrigation. The aim of AWD is to reduce irrigation number without yield reduction. This method is gaining attention now in parts of Asia like Japan, China and India where competitions for water among crops are rapidly increasing and supply of water is less than the demand. In AWD, irrigation water is applied to flood the field after a gap of certain time period (1 day to >10 days depending on soil type) in which soil is exposed to sun for drying (without stressing the plants) resulting in alternate flooding and non-flooding situations. This method not only reduces irrigation water requirement for production of paddy, but also helps in curtailing greenhouse gas emissions. The system of rice intensification (SRI) technique also adopts AWD where farmers grow young rice seedlings singly at wider and squared spacing using intermittent irrigation. SRI keeps the soil moist but not wet and reduces irrigation water by 25-50% leading to profitable crop production (Chapagain and Yamaji, 2011).

Implementation and operation

AWD is suitable for lowland rice growing areas where soils can be drained in 5-day intervals. The field will be unable to dry during rice season if rainfall exceeds evapotranspiration and seepage. Therefore, AWD is suitable for dry season rice cultivation.

Implementation method

A water tube/pipe made of PVC is usually used to practice AWD method. The main purpose of the tube is to monitor the water depth. The tube allows measuring water availability in the field below the soil surface. The usual practice is to use a pipe of 7–10 cm diameter and 30 cm long, with perforations in bottom 20 cm. The pipe is installed in such a way that the bottom 20 cm of perforated portion remains below the soil surface and the non-perforated 10 cm above the surface. The perforations permit the water to come inside the tube from the soil, where a scale is used to measure water depth below the soil surface. However, there are variations in preparing the tube/pipe for the implementation of AWD. Some farmers use a bamboo pipe instead of PVC pipe. Some farmers use a 30 cm tube with 15 cm perforated at the bottom.

Location for installation of Water tube

Identify representative spots in the paddy field where AWD tubes will be installed. Typically, 2-3 tubes are required per hectare for effective monitoring of the water levels in the fields.

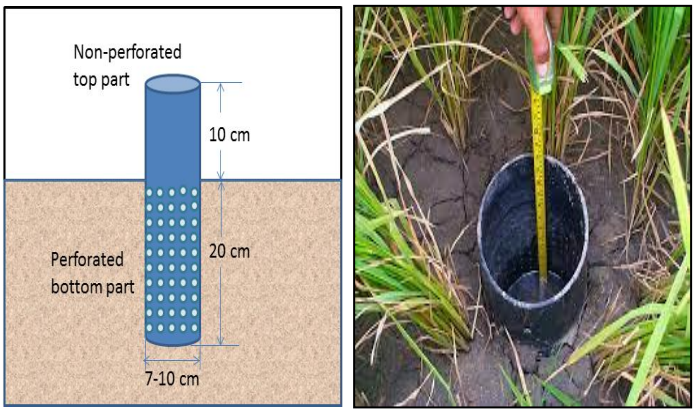

Fig. 1. Installation of Water Tube/Perforated PVC Pipe

Operation technique

After the irrigation in the crop field, the water depth gradually decreases because of evapotranspiration, seepage, and percolation. Because of the installed tubes in the field, it is possible to monitor the water depth below the soil surface up to 15–20 cm. When the water level drops 15 cm below the soil surface, irrigation should be applied in the field to re-flood to a depth of 5 cm. During the flowering stage of the rice, the field should be kept flooded. After flowering, during the mid-season and late season (grain filling and ripening stages), the water level is allowed to drop below the soil surface to 15 cm before re-irrigation. To suppress the growth of weeds in the rice field, AWD method should be followed 1–2 weeks after the transplantation. In the case of many weeds in the field, AWD needs to be started after three weeks of transplantation. Usually, the fertilizer recommendations are as same as continuous flooding method. Application of nitrogen fertilizer is preferable on dry soil just before re-irrigation. To ensure a similar dry or wet condition throughout the crop field, which is essential to maintain good yield, it is important to level the rice field properly.

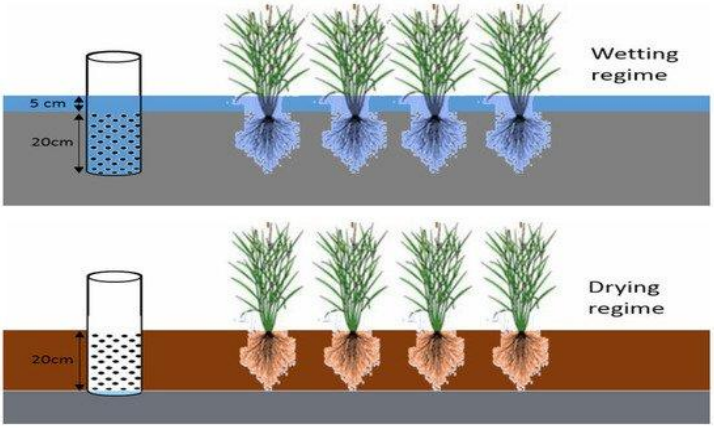

Fig. 2. Wetting and Drying Regime under AWD technique

Advantages of Alternate wetting and drying (AWD) technique

i. It saves water by 25-30% without any adverse effect on paddy yield and increases water productivity by 15-25% over continuously flood irrigation.

ii. It provides adequate aeration required for root respiration and enhances availability of nutrients like zinc for plant's uptake.

iii. It promotes root anchorage, resulting in sturdy crop growth and less lodging issue.

iv. This method can increase grain yield through improving grain-filling rate, root growth and remobilization of carbon reserves from vegetative tissues to grains.

v. AWD saves time, labour and cost involved in irrigating paddy field continuously through minimizing irrigation numbers.

vi. It reduces fuel consumption and saves pumping costs to an extent.

vii. AWD allows mechanical harvest through firming the soil condition suitable to operate machines.

viii. It reduces greenhouse gas emissions by 30-85% (methane by 48%) occurred through anaerobic decomposition of organic materials in flooded rice field.

ix. Alternate wetting and moderate soil drying reduces heavy metals like cadmium, arsenic, lead accumulations in rice grains.

x. Periodic irrigation and drying reduces insect pest and fungal disease infestations and transmissions.

Limitations of Alternate wetting and drying (AWD) technique

i. The major disadvantage of AWD method is the increased N2O emissions.

ii. High weed growth under un-flooded condition may be an issue which urges for proper weed management.

iii. It may create soil salinity or accumulation of salts on soil surface or in crop root zone.

iv. Rice productivity can reduce by following AWD for non-trained farmers.

v. It requires drainage for disposal of water intermittently.

Conclusion

AWD is a promising water management technique that can contribute to sustainable rice production by reducing water use and greenhouse gas emissions, while also potentially improving soil health and crop yields. The AWD technology has also been proven to effectively mitigate greenhouse gas (GHG) emissions, specifically methane (CH4), from rice production by 30-70%, without causing a yield reduction. During the dry phases, the methane-producing bacteria are inhibited, thus, setting a condition to reduce GHG emission.

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