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Mini Review

Novel Herbal Hydrogel - Direct Seeded Rice Technology for Water- Resources Conservation

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Abstract

Herbal Hydrogel Technology in agriculture ensure better crops productivity in moisture stress environments by delaying permanent wilting point of the seedling and application of delayed first irrigation and overall less irrigation make the crop nearly weeds free. Thus, Herbal Hydrogel Technology saved significant irrigation water by producing more crops per drop of water, reduced cost of cultivation and used fewer resources (fertilizers, chemicals, water, power, labor) without any plenty on seed yield and environmental gains as well and also make it feasible to grow rice crop successfully in rainfed hill ecology and sandy soils of Semi-Arid Regions of North India and shown potential for its use in other parts of the world having similar ecology.

Keywords: Herbal Hydrogel; Water Conservation; Herbal Hydrogel Seed Coating; DSR

Northern Indian region (Punjab-Haryana States) traditionally did not grow rice due to its semi-arid and arid climate being proximity to the great 'Indian Thar desert' with average annual rainfall 500 mm. But rice cultivation phenomenally increased from 0.4 million ha (1970) to over 5 million ha (2018) by becoming 'Basmati Rice Bowl of India with over Rs 30,000 Crores export)' due to increased irrigation facilities by canal command areas, exploitation of ground water, adoption of 'Green Revolution dwarf high-yielding varieties', favorable policies of assured procurement by the government at MSP-Minimum Support Prices and subsidized electricity, diesel and chemical fertilizers. Prior to Green Revolution, rice like any other summer crops were directly seeded and weeding done manually because area under rice was small and labor availability plentiful and economically cost

Green Revolution though ensured food security but increased the consumption of pesticides, herbicides, ground water and become main causes of environmental degradation. Nitrates and phosphates from fertilizers have leached down into the soil. Earth-warming methane emissions have increased because of the introduction of anaerobic (submergence) wetland rice farming systems or TPR-Transplanted Rice. To counter this, Punjab Agricultural University, Ludhiana and Haryana Agricultural University, Hisar in collaboration with Australian Centre for International Agricultural Research (ACIAR) and PepsiCo have developed improved Direct Seeded Rice (DSR) technology around 1990's with emphasis on weed control with chemicals. But despite the government financial incentive, the farmers have been slow to adopt improved DSR because of the menace of weeds caused by weekly application of irrigations and overdependence on herbicides. Many of those who adopted the DSR have also reverted

The reasons for low crop yield in aerobic agriculture are low-erratic seed germination, poor seedlings-plant growth-survival and low dry matter accumulation as compared to high moisture submerged TPR-Transplanted Rice. The Hydrogels are known to relieve moisture stress in crops. Recent studies by the Indian Council of Agricultural Research (ICAR) and ministry of agriculture have demonstrated that hydrogels can save water, utilize it efficiently and produce more crops per drop of water [1]. But synthetic hydrogels including PUSA HYDROGELS though introduced for agricultural purposes in early 1980's but have not become popular among farmers due to exorbitant cost (Rs 1500-2,000/kg), non-reliable tall claims of their benefits in agriculture and environmental concerns as these contain polyvinyl alcohol or poly- acrylamide which are considered non-biodegradable and

To overcome these concerns, my research team has identified Herbal Hydrogels Goond Katira (Gum Tragacanth EU food label E- 413) and Goond Karaya (Gum Sterculia EU food label E- 416) with water absorption capacity of about 100 times to its dry weight and developed farmer-friendly Herbal Hydrogel- Seed Coating Technology for water conservation for all the crops. It makes agriculture sustainable and resilient to climate change. We also evaluated chemical synthetics Hydrogels (Pusa Hydrogel, Zeba Hydrogel etc) which proved useless because Gypsum, DAP and other fertilizers present in the soil's breakdown synthetic hydrogels into fluids within 24 hour by making these useless for agriculture uses [2,7]. Thus, we used locally-available natural gums (polysaccharides) of various plants as herbal hydrogels which are highly cost effective and environmentally safe as being consumed as human food since ages. The cost of novel herbal hydrogel technology may further be reduced by using organic Xanthan gums (EU food label E- 415) to popularized it for agriculture uses for water and resources conservation.

The Herbal hydrogel technology showed seedling's wilting and mortality delayed in rice, wheat, barley, pulses, oilseeds, vegetable and other crops under farmer's field trials and in large-scale field experiments conducted during 2014 -2018.

The results showed that herbal hydrogel Goond Katira coated seed proved as GAME CHANGER TECHNOLOGY which needed less irrigation and first irrigation could be delayed by 2-3 weeks in the summer crops and 4-6 weeks in winter crops depending on soil types and with application of Pendimethalin as pre-emergent herbicides, weeds are effectively controlled. In novel herbal hydrogel technology, the water and energy consumption is reduced significantly and there is a reduction in cost of cultivation, use of chemicals and environmental gains as well. The incidence of pests-diseases is also less. The farmers in Northern Indian region shown keen interest during 2016-18 seasons by planted herbal hydrogel-DSR on large scales by proving that if technology useful and farmers friendly, there is no need for Govt. support for its adoption.

Novel Herbal Hydrogel-DSR Technology is successfully adopted in the rainfed hill ecology of Uttrakhnad-India [6] and even arid zone with sandy soils on large scale with significant benefits of weeds free DSR (Figure 1), saving of nearly half of irrigation water, nitrogenous fertilizers, cost of cultivation without any penalty on seed yield in comparison to the water guzzling and high cost and high inputs TPR- Transplanted Rice.

Figure 1: Herbal Hydrogel – DSR Water Conservation Technology.

The farmers adopted following 'Packages and Practices for Herbal Hydrogel-DSR' developed by my research team which make novel herbal hydrogel technology as the "GAME CHANGER TECHNOLOGY " and "Success Story of Herbal Hydrogel -DSR

The rice seed are artificially coated (Figure 1) with powder of herbal hydrogel Gum Tragacanth (Goond Katira) at rate of 10% to the seed rate of the crops, first by making the seed sticky by using locally prepared adhesive made from sugarcane jiggery plus gum Acacia and then pouring- mixing of powder gum Tragacanth on sticky seed for developing good seed coating which may also be fortified by symbiotic microorganisms, micronutrients, soil adjuvants, germination promoters, growth regulators, and dry fungicides etc. Then dry these hydrogel coated seed under the shade for 6-8 hours before sowing by seed drill or broadcasting

Figure 2: Hydrogel coated crop seed.

Then, DSR sowing done on the field prepared after pre-sown irrigation on the dates recommended for sowing of TPR-nursery in a particular zone i.e. Second half of month of 'May' in Northern India, about a month earlier than the onset of regular monsoon rainy season to avoid heavy competition of DSR with weeds at germinating and early stages of rice crop.

The DSR sowing done by using herbal hydrogel coated seed and additional application of 10-12 kg/ha herbal hydrogel to the soil by mixing with DAP fertilizers or organic manure which help in delaying the first irrigation by 2-3 weeks DAS which in combination with application of pre-emergence herbicide pendimethalin make the crops nearly weeds free up to 30-40DAS.

The Irrigations schedule followed at 15 days intervals depending on rainfall by adopting 'Alternate Wetting and Drying Irrigation Cycle'.

Further emergence of weeds, if any, takes care by spray of NOMINEE GOLD + Pyrazosulfuron Ethyl 10% WP after second irrigation at 30-40 DAS.

IPM and INM followed as per the recommendation for rice crops except for reduced doses of nitrogenous fertilizers by half doses which generally goes waste in standing water of TPR by its depletion to lower layers of the soil which become main cause of ground water pollution [3-5].

Conclusions

Novel Herbal Hydrogel Technology help in water and resources conservation in agriculture with need of less irrigation particularly at initial stages of seed germination and seedling growth by delayed permanent wilting point of the seedling and application of delayed first irrigation and overall less irrigation make the crop nearly weeds free. The Novel Herbal Hydrogel technology saved significant amount of irrigation water, reduced cost of cultivation and use of fertilizers without any plenty on seed yield with environmental gains as well. It make it feasible to grow rice crop successfully in rainfed hill ecology and sandy soils of Semi Arid Regions and has potential for its global use in other parts of the world having similar ecology for producing more crops per drop of water.

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