

Selected parameters for production and productivity in dryland agriculture - A review

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Abstract

In India about 60% of total cultivable area comes under dryland agriculture and there is no assured return when rain fails at the right stage of crop. Many a times this leads to heavy losses to farmer. It has also been observed that when the crop is of 40-50 days and at this stage, if rain does not come, the crop is under dry spell conditions and fails. The other parameters such as farm power availability, sowing method, time availability to perform farm operations etc. also affect the return. But all these problems can be solved, if assured irrigation especially when the crop is under dry spell condition is available. The use of solar operated micro irrigation applicator coupled with technology can give assured return to the farmers working in dryland agriculture under rainfed farming system. This technology is pollution free and can be adopted anywhere in remote area, where there is no electricity or diesel engine or gen-sets.

Date of Submission: 27-04-2020

Date of Acceptance: 10-05-2020

I. Introduction

In India about 60% of the cultivable land comes under dryland agriculture. The All India Coordinated Research Project (AICRP) on dryland agriculture was started in 1970 with 23 centres (Anonymous, 2019a) located in different typical agro-climatic conditions with the aim for sustained agriculture in dryland in view of the following constraints:

- i. Rain is the only source of water in dryland agriculture. Therefore optimum time available for carrying out different operations is therefore limited and uncertain.
- ii. Power availability is limited: It is mostly human and animal power, which is used for dryland agriculture. Therefore, more power is required to cover larger areas in limited time. It is thus realized that substantial power will have greater role in dryland agriculture.
- iii. There is lack of precision in seed distribution during sowing. Hand broadcasting results either overgrowing of plants or large gaps in plants.
- iv. Specialized operations like deep ploughing, soil turning, ridging, bunding, ridge/furrow sowing cannot be done easily with the indigenous tools and implements which are normally manually or animal drawn.
- v. Since water is limited, thus under dry land conditions, certain field operations becomes difficult to perform.
- vi. Either fertilizer is not used or problem of its placement with traditional tools is experienced.
- vii. Working capacity of indigenous implements is less. Therefore, it becomes difficult to achieve timeliness of operations.
- viii. Sowing is done, when rain comes. But if rain does not come, at the stage of 40-50 days, the crop is under severe dry spell conditions and many a times the crop fails and the farmer has to incur heavy losses.

Strategies to mitigate the problems in dryland agriculture

- i. Soil moisture conservation and management
- ii. Development of new varieties for dry land agriculture
- iii. Suitable cropping pattern for different agro climatic conditions

- iv. Timely preparation of tillage
- v. Timely seeding operation of land
- vi. Efficient use of fertilizer
- vii. Efficient weed control

Improved practices and agricultural machinery contribution for management in dry land agriculture

Normally, improved implement and practice go hand in hand to achieve full benefits. In rainfed agriculture, where water is the most limiting factor, greater emphasis is laid for soil moisture conservation and utilization. However some practices for better yield are suggested below:

1. **Ridger seeder:** The practice of sowing into the bottom of furrow for *rabi* winter season crops and on the sides of ridges for the monsoon *kharif* crops has been well accepted in desert soil region. The yield increase has been recorded significantly.
2. **Plant population and sowing method:** The effect of plant population and seeding method has significant effect on yield. Optimum plant population and method of seeding calls for use of seeding machinery precise enough to give optimum plant population. For example, ridging with optimum plant stand gives higher yield than flat seeding with high plant population.
3. **Seeding and Interculture:** Weeding of crop within 20 to 30 days after seeding and keeping it free until crop competition surpasses weed growth gives better yield.
4. **Timeliness of farm operations:** Timeliness of seeding and interculture operations are very important especially in dry land agriculture. Seeding beyond specific time span, the yield loss increases heavily. In such cases alternative crops or short duration varieties can be sown, if soil moisture is available. Similarly, timely weeding is very important to get better yield especially in first 20-30 days.
5. **Fertilizer placement:** Fertilizer is frequently recommended to be side dressed and that too in split application if possible. Then placement in top dressing will also be needed. Therefore, suitable machine and techniques be adopted for proper placement of fertilizers.

II. Approaches to solve the problems of dryland agriculture:

1. Pre-rainy season preparations:

Before the commencement of rainy season, deep ploughing of more than 10 cm and bunding of atleast one feet height should be made around the field in order to retain the rain water in the field. Moreover, rain water should be stored in a storage tank of desired capacity for irrigation purposes. Care should be taken to put polythene sheet in the storage tank to avoid seepage losses, if water is stored in underground tank and is not of concrete.

2. Soil Testing:

It is important for the farmer to know that what crop he has to sow based upon the soil testing report or soil health card. Here the role of "Soil health card" comes as aid to farmer. Therefore farmer should have soil health card well in advance to decide the type of crop to be sown in *Kharif* or *Rabi* season.

3. Seed Treatment & Fertilizers Application:

a) Selection of Seed

Selection of seed and variety of seed suitable for that area being important, help in this regard can be taken from the agriculture department. The seed should be well cleaned and graded so that small and broken seeds are removed. It is also suggested that germination percentage of seed should be checked. For this, soak 100 g seed in water for 5-6 hours and then put it in any cotton /jute cloth and leave it for 2-3 days in the shadow. The seed will be sprouted and count the number of seed sprouted. If 90% and more are sprouted then the seed is fit for sowing.

b) Seed Treatment:

i) Seed coating

For one kg seed, Trichoderma powder 5-10 g should be mixed thoroughly for control of fungus etc. Organic fertilizers can also be mixed as per need which is available in the market. Seed can also be coated with 10 g neem oil and 1 g Azitobactor for plant growth. After seed treatment, it should be sown immediately otherwise it will not have desired effect of coating. Some farmers make seed treatment in the evening and sow it

in the morning and vice versa. This practice is not good as the coating of seed becomes ineffective therefore care should be taken to sow the seed immediately after seed treatment.

ii) Seed coating for mitigation of moisture stress conditions

Natural gum, which is easily available in the market at low cost, is versatile natural hydro-gel for agriculture use against sub-optimal moisture stress conditions under rainfed farming system. Hydro-gels are known to minimize moisture stress conditions. One kg gum (*GOND*) is sufficient to coat/treat 10 kg seed.

To make efficient use of hydro-gel in agriculture, farmer's friendly herbal hydro-gel coated seed technology by using natural gum which is consumed as human food since ages has been developed for seed treatment. Natural hydro-gel coated seed delays in wilting mortality of seedlings and saves irrigation water and thus making drip irrigation technology more efficient. This also allows delay of first irrigation and therefore seed treated with hydro-gel in combination with pre-emergence application of "herbicide pendimethalin" prove as a "Game Changer Technology" for effective weed control as well. With adoption of natural hydro-gel based seed treatment technology, water and energy consumption is reduced by 50% with significant environmental gains and less incidence of pests and diseases etc. (Mehta, 2005)

c) Fertilizers Application:

Multi nutrient solutions are available in the market which can be sprayed as per requirement after 21 days of crop. These can be given through drip irrigation system, directly to the root zone.

d) Pest Control:

Garlic extract with neem oil is mixed in one litre water and that can be sprayed to control insects and pests in the field.

4. Adoption of suitable micro irrigation machine for irrigation when the crop is under severe dry spell conditions (Fig. 1). The bottle gourd grown using the solar operated drip irrigating machine is given in Fig. 2

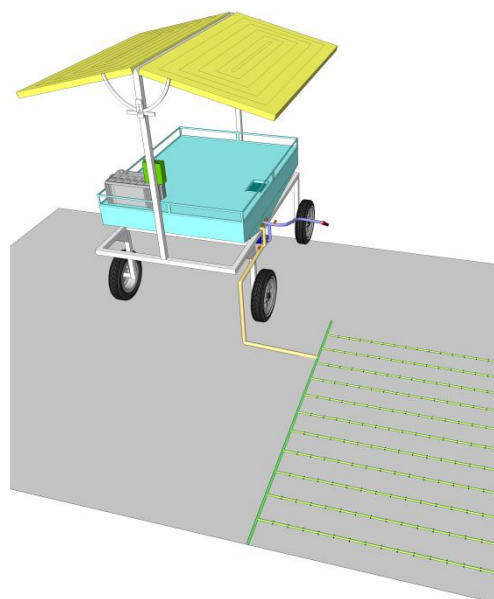


Fig. 1: A sketch of solar operated micro-irrigation applicator



Fig. 2: Bottle gourd grown using solar operated drip irrigation system (Anonymous, 2019b)

5. Product to enhance water utilization efficiency:

While giving drip irrigation through micro irrigation applicator, the following products can be considered to be added in the water tank to increase the water utilization efficiency.

a) ZEBa manufactured by UPL:

ZEBa is a unique hydrating granule. It can absorb water up to 400 times its weight, then forms hydrogel, suspended around the root zone. It reduces water requirement up to 50% and increases productivity up to 30%. It absorbs water and then releases it back to the plants when they need in multiple times to the root zone. It increases water holding capacity, making more efficient use of inputs. It reduces leaching of key nutrients and

maintains moisture level in the root zone. Plants grow healthier with a steady supply of water to the plants. Crops are more uniform and increase the yield. It is fully degradable and is broken down naturally in the soil, leaving no residue at all (Mehta, 2019)

b) APSA-80 manufactured by AMWAY:

APSA-80 is neither a fertilizer nor a pesticide. It is an adjuvant that when added to water, makes the water “wetter” and increases the effectiveness and efficient water usage. APSA-80 should be added in water storage tank, 12 hours before its supply for drip irrigation. It has excellent penetrability and efficient absorbency of pesticides, herbicides etc., when added in water. It reduces water requirement but enhances growth and keeps crops strong during the growth (Mehta, 2019)

III. Recommendations

1. It is advisable to carry out deep tillage of more than 10 cm and boundary wall of at least one foot height around the field before the commencement of rainy season. If the field is sloppy, then terracing should be made to retain rain water and to avoid soil erosion.
2. Rain water harvesting should be opted to store water in storage tank for use on later stage for irrigation purposes as and when needed.
3. Raised bed formation is necessary for sowing or planting of crops. This will facilitate proper moisture in the root zone of the crop and to take away excess water in furrow.
4. The stored water to the plants through drip irrigation system should be applied when sun shine is decreasing i.e. after 3 pm in order to avoid burning of crop.
5. Drip irrigation should be preferred as compared to micro sprinklers under rainfed farming system
6. Drip irrigation system can be installed on ground surface. The farmer can carry drip system after the work is over in order to avoid any theft etc.
7. Selection and variety of crop is very important, which can give high return and needs less water requirement. Besides, demand of the area, accessibility to the market, shelf life of produce, seed availability etc., should also be considered.
8. Concept of multi crop or mixed farming should be considered to maximize the income from the agriculture.
9. Organic farming should be preferred to fetch more value of produce as well as to avoid use of chemical fertilizers and insecticides/pesticides which are hazardous for human beings and environment
10. Farmer should consider selling his produce after proper cleaning and grading in order to fetch more price.
11. Processing and value addition of his produce should also be considered wherever possible in order to generate more income.

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M.L. Mehta, et al. “Selected parameters for production and productivity in dryland agriculture - A review.” *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 13(4), 2020, pp. 36-40.