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Promising Techniques for Management of Dryland farming

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Introduction:

Arid land ecosystems account for eighty percent of global agriculture and play a key role in achieving global food security. However, the world's growing population, water scarcity and climate change threaten rainfed agriculture due to increased vulnerability to various abiotic stresses, such as droughts and other extreme weather events. Drought, salinity, temperature, radiation and heavy metal stress are among the main stressors that negatively affect plant growth and productivity. Different forms of abiotic stress limits agricultural production on most of the 1.4 billion hectares cultivated worldwide. Irrigation will not be a practical solution because water becomes scarce and irrigation will instead lead to soil salinization (Richards, 1996). High and low temperatures, acidic soils and rich in metal ions reduce crop productivity in large areas of land and will remain a major challenge for the foreseeable future. The solutions to the problem will be as complex as the problem itself. Abiotic stresses generally do not occur in isolation and many stresses occur simultaneously, severely affecting crop productivity. In response to these signs of stress, nature has developed different ways to combat and tolerate them. Thus, the different technological capsules developed to solve the problems of arid zone ecosystems.

Problems affecting agriculture in dryland area

1. Heat stress

Heat stress is often defined as when temperatures are high enough to cause irreversible damage to plant performance or development (Hall 2000). Extremely positive deviations from the maximum normal temperature cause heat waves in different parts of India. Peak heat waves occur in eastern Uttar Pradesh, followed by Punjab, eastern Madhya Pradesh and Kutch in Gujarat (Raghavan, 1967).

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2. Salinity

In India, the total degraded area is estimated at 120.7 million hectares, of which 104.2 million hectares (86.3 percent) are arable land and 16.5 million hectares (13.7 percent) open forests. Of the total area of degraded land, 73.3 Mha (60.7%) are caused by water erosion, 12.4 Mha (10.3%) by wind erosion, 5.4 Mha (4.5%) by salinization and 5.1 M ha (4.2%) due to soil acidification. Some areas are affected by multiple degradation processes (Maji 2007).

Crop improvement technologies regarding breeding and biotechnologies

The production of genes that express transgenic plants or crops that are functionally active to induce stress-relieving action in plants, in addition to other desirable agronomic characteristics, as detailed in the discussion above, is the goal of biotechnology in the field. Simply put, the steps involved are to identify candidate genes, clone them and incorporate them into varieties that are already processing high-quality agronomic traits.

1) Importance of the characteristics of the plant

One of the important characteristics to consider when increasing tolerance to abiotic stress by conventional and molecular methods are the characteristics of the plant that promote productivity and also have a direct effect on the tolerance mechanism. Physiological changes are interpreted here broadly as any change in the growth, development, morphology, anatomy or physiology of a culture. However, physiological changes, such as flowering time and plant height have been important for production progression and molecular genetics routinely selects the desirable expression of these characteristics to maintain optimal adaptation and performance. The characteristics associated with stress tolerance and higher yield will generally not be the same in most crops. Thus, the molecular creator is faced with a paradox of choice options, resulting in the forced exclusion of certain mutually exclusive characteristics (Bohnert *et al*., 2006).

2) Water use efficiency

In plants adapted to dry environments, anatomical and morphological changes in leaves and plants prevent metabolic imbalances and help to improve relations with water. Therefore, greater water use efficiency (WUE) and better water status in the tissue and potentially greater growth and / or yield without additional water consumption penalty are

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essential to obtain a disease resistant strain (Beale *et al.*, 1999). The transpiration efficiency (ET) depends on the plant and the environmental attributes related to the resistance to CO_2 absorption by the leaves. In certain circumstances, the environment can have a significant influence on ET.

3) Osmotic adjustment

Osmotic adjustment is a biochemical mechanism that helps plants to cope with dry and salty conditions. Many drought-tolerant plants can regulate their solute potential to compensate for transient or prolonged periods of water stress by making osmotic adjustments, resulting in a marked increase in the number of solute particles present in the plant cell (Buitink, 2006). Osmotic adjustment reduces the impact of stress on crop growth and production.

Major agronomic techniques for dryland farming management

1) Contour Bunding

On this earth, the bunds are built on contours on gentle slopes which vary from 0.5 to 6 percent with an average annual rainfall that does not exceed 750-1000 mm (Fig. 1). It is adopted on all types of relatively permeable soils, except calayey or deep black cotton soils, where it can cause water stagnation and reduce upstream yields. Processing of blunt contours recorded soil loss as low as 0.3 t/ha compared to 18.92 t/ha in the control plots. (Kale *et al.*, 1993).

Fig.1 Contour bunding

2) Mulching

The padding extends from any material on the floor surface (Fig. 2). Mulch is an important agronomic measure that not only dissipates the kinetic energy of raindrops and prevents soil erosion, but also facilitates infiltration and reduces runoff and evaporation losses (Krishnappa *et al*., 1999).

Fig.2 Mulching

3) Use drip irrigation facilities

Using the drip irrigation method, vegetables can be grown with very little water and liquid fertilizers can be effectively added to the irrigation water (Fig 3). In the tomato, Dhake *et al.* (2009) reported that the parameters that contribute to yield were significantly higher with liquid fertilizers by drip irrigation than with solid fertilizers applied by drip or surface irrigation.

Fig. 3 Drip irrigation

4) Intercropping

Plant diversity improves the stability of biomass in natural ecosystems through overload or buffer effects that decrease the temporal variation of biomass (Figure 1). It is important to note that the consortium combinations, such as cereals and legumes also play an important stabilizing role in global agricultural lands (Raseduzzaman and Jensen, 2017).

Fig. 4 Intercropping

5) Integration of livestock in dry farming systems

The impact of livestock activity on the environment is direct, like grazing (in extensive livestock systems) or indirect, through the production of forage to feed confined cattle. Animal production currently represents 70% of all agricultural land in the world and 30% of the land area. With regard to ecological conditions and environmental changes, the increased demand for products of animal origin will affect pastures more intensely in arid, semi-arid and tropical regions (Follett and Schuman, 2005).

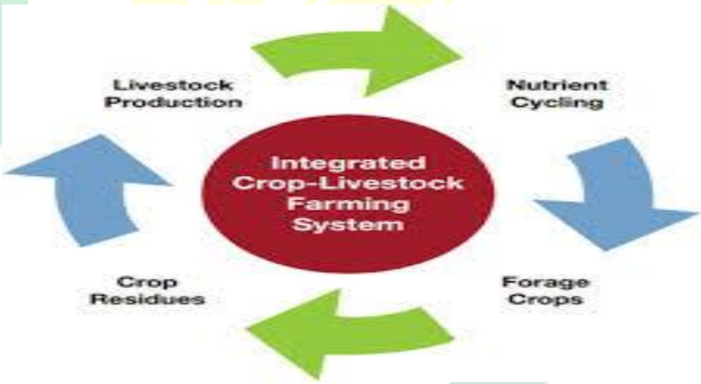

Fig. 5 Integrated farming system

Physiological approaches towards dryland farming

Antiperspirants are used to conserve water that is otherwise lost through perspiration.

Antiperspirants can be effective in two ways.

- Through films covering the surface of the sheet, and
- Chemicals that close the stomata.

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Antiperspirants such as phenyl mercury acetate and certain alkenyl succinic acids work by inhibiting the opening of the stoma. They are also used as chemical antiperspirants such as triadimefon, calcium chloride, fulvic acid and succinic acid. Film-forming antiperspirants (waxy or plastic emulsions) produce an external physical barrier to delay the escape of water vapour from plants (Gale, 1961).

Weeds compete not only for nutrients in the soil but also for water, making their control critical. Crop selection is also important. Dwarf varieties have less area and lose less water. Some plants close their stomata in hot weather, which reduces their water loss. Crops like corn roll up their leaves in the hot afternoon and open them at night, effectively changing their surface depending on conditions.

Conclusion

To feed the world for the next 50 to 100 years, concerted efforts are needed, involving sound agricultural policies, well-planned research strategies and efficient distribution systems. Water is an essential natural resource, local rainwater management or the collection and recycling of rainwater runoff is essential to mitigate the effects of water stress (drought) on plantations. The risk associated with weather insurance is not only inherent in the location of the reference weather station, but is also a function of the product design of the Weather Based Crop Insurance Plan (WBCIS). The evolution of several abiotic stress-tolerant traits is still in its early stages. It would be desirable for future work to take advantage of synergies at the interface between physiological and molecular / genetic research.

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