

## Rainfed vegetable cultivation

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The water scarcity situation is being exacerbated by climate change, especially in the driest areas of the world, which are home to more than 2 billion people and to half of all poor people. To tackle water scarcity even as the demand for food increases, we must support initiatives to produce more food with proportionally less water. Per capita consumption of vegetable is also very less compare to WHO recommendations. There is no way to increasing the cultivable area for vegetable production under irrigated situations, rainfed vegetable production is one way for increased the production to fulfill the needs of consumers. Selection of varieties, tillage operations, seed treatment techniques, application of growth regulators and anti-transpirants are important factors which are influencing rainfed vegetable cultivation. By using above technologies, tomato, brinjal, chilli, bhendi, cucurbits and leguminous vegetables can be cultivated under rainfed situations.

Rain is the only source of water for dry land crops. Dry lands account 67 per cent of the total arable land covering 12 per cent population of the country. In India total cultivable area under rainfed conditions is 92.6m.ha. Per capita consumption of vegetable is very less compare to WHO recommendations. There is no way to increasing the cultivable area for vegetable production, rainfed vegetable production is one way for increasing the production to fulfill the needs of consumers.

Uneven intensity and distribution of rainfall, late onset and early withdrawal of monsoon, prolonged dry spells are the major constraints in rainfed vegetable cultivation. Drought resistance, tolerance and escapisms are the mechanisms to manage the drought under rainfed conditions. The vegetables grown under rainfed ecosystems should have shorter duration to escape drought, faster growth to withstand harsh environments, deep root system and response to fertilizers and high yield potential. Optimum plant density and balanced nutrition are the essential factors for yield increase in vegetables grown under rainfed conditions.

### **Tillage operations:**

Tillage operations like off season fallow tillage, deep tillage (Once in 2-3 years), shallow inter-cultivation, fallowing, mulching, formation of broad beds and furrows, compartmental bunds, dead furrows, small pits on soil surface and providing subsoil barriers (applying the barriers viz., bentonite clay, gel polymers at 60-80 cm depth) are essential for conserving moisture under rainfed vegetable cultivation.

### **Seed treatment:**

In general, the germination of seed is highly influenced by moisture status of the substrate (Datta and Dayal, 1988). In order to get establishment under very low and very high moisture status, film coating technology with fungicides and halogens will be highly useful. Seed coating technology has developed rapidly during the past two decades and provides an economical approach to seed enhancement. An advantage of seed coating is that the seed enhancement material (fungicide, insecticide or micronutrient) is placed directly on the seed without obscuring the seed shape. Film coating is the process of applying a colored polymer film material on the seed surface that completely covers the seed and it has been applied to commercial seeds as an effective delivery system for agrochemicals. In addition to that, the polymers are hydrophilic in nature and they are considered to be prolonging the moisture supply under stress condition. These polymers are having the capacity to absorb water about 100 to 1000 times of their weight from the surrounding rhizosphere. Film coated seed has the benefit of providing uniform and precise pesticide placement, and is dust free and no loss of fungicide during handling, safe to handle, can be highly visible in the soil, has increased flow ability of the seed, bright colour and nice appearance. Thus the use of polymer as a device for seed treatment can control the timing of germination and use of proper coating material favors better conservation of seed quality in storage as well as improves the stand establishment in

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field. Polymers are available in various colors; the suitable polymer colour should be selected for a particular seed to improve its physical appearance as well as the aesthetic values of the seed. The polymer products can be used as such or can be diluted with 1 to 4 parts of water as they contain excellent surfactants and spreaders and have a very quick drying time.

Eckenrode *et al.* (1973) also reported that it is often desirable to coat the seeds with chemicals such as fungicides and insecticides and for which various methods are currently employed such as the use of cellulose derivatives or polymers incorporating the biologically active chemicals as a wet treatment.

#### **Growth regulators and chemicals:**

Exogenous applications of natural plant hormones as well as synthetic plant growth regulators are known to improve the fruit set, yield and accelerate uniform ripening for easy harvest under rainfed conditions. Mepiquat chloride is a bio-regulator which promotes the reproductive phase of vegetable crops. It imparts dark green colour to the leaves and shortens internodal length. Under moisture stress potassium protects the plant by involving in the exchange of cytoplasmic potassium for stomatal hydrogen ions thus raising stomatal pH and facilitating photosynthesis. This spray significantly reduces transpiration rate, this may be due to increased stomatal resistance, which lead to conservation of moisture in the cells by maintaining high relative water content. Proline accumulation was also higher in potassium chloride, which helps to channelise the diversion of protein metabolism for withstanding drought.

Minimizing the transpiration losses by using anti-transpirants (Stomatal opening inhibitors *viz.*, PMA, Alkenyl succinic acids and Atrazine at low concentration, Film forming substances *viz.*, Mobi leaf, Hexadeconal and Silicons, Reflecting types *viz.*, kaoline, celite), growth retardants (application of cycocel reduces lodging and increases the yield) and wind breaks (Increasing the air resistance to water vapor).

#### **Tomato:**

The most sensitive periods of tomato plants to moisture stress are the flowering and fruit enlargement stages. The desirable traits for rainfed varieties (Table 1) are reduced leaf area, production of more assimilates, high level of abscissic acid and increased fruit set. The maximum importance is given for osmotic adjustment and fruit set. Banerjee and Kalloo (1991) found that number of flowers per cluster was highest in *Lycopersicon pimpinellifolium* than other commercial cultivars of

tomato under rainfed conditions.

#### **Brinjal:**

Brinjal seeds pelleted with arappu and pungam leaf powders maintained its superiority in germinability than the untreated control even after eight months of storage (Viswanatha Reddy, 1995). In brinjal, application of potassium chloride at one per cent reduced the effect of drought by maintains high leaf number and leaf area leading to higher dry matter production through the better photosynthetic activity. Use of anti-transpirants increases the tolerance to moisture stress situations of brinjal. Prakash (1990) found that the diffusive resistance, relative water content and soluble protein were increased by spraying of cycocel @ 500 ppm in brinjal.

#### **Chilli:**

Chilli is one of the most important crops cultivated mainly under black soils of rainfed conditions. The states like Andhra Pradesh, Karnataka are major chilli growing areas under rainfed conditions. The *gundu* types are generally more pungent than *samba* types and they are adapted to rainfed culture than *samba* types. In chillies, the initial germination and subsequent seedling establishment and also the high mortality rate of the seedlings in the nursery are posing a great problem and seed pelleting as a pre-sowing treatment can enhance the seedlings and thus enhanced the yield can be obtained. Jerlin *et al.* (2008) reported that, Chillies cv.K1 has registered highest seed quality characters by using aluminium foil as a storage material and this was followed by 400 gauge polythene bag and cloth bag. Natarajan (1990) found that application of 75 kg nitrogen through soil and foliar sprays recorded the highest dry pod yield in chilli cv. Ramanathapuram Local under semidry conditions.

#### **Bhendi:**

In bhendi, polythene mulch has recorded highest yield than control and grass mulch under moisture stress situations (Gupta and Gupta, 1985). Application of exfoliated vermiculite @ 20 t ha<sup>-1</sup> increases the moisture retention capacity at 0.1 bar tension, decreases the bulk density and saturates the hydraulic conductivity of the soil and increases the yield of bhendi (Gupta and Gupta, 1982).

#### **Cucurbits:**

Most of the cucurbits are planted in rainfed situation. In arid regions, cucurbit like xerophytic plants can absorb moisture from the atmosphere. Under lesser moisture

**Table 1 : List of vegetable varieties suitable for rainfed cultivation**

Sr. No.	Crop	Varieties suitable for rainfed cultivation
1.	Tomato	Pusa Early Dwarf, Pusa Ruby, Arka Meghali, Paiyur-1, CO3, PKM 1, J-10-21 and KT-1
2.	Brinjal	PKM1 and APAU Bagmathi
3.	Chillies	K-1, K-2, G-3, G-4, G-5 (Andhra Jyoti), Sindhur (CA-960), CA-1068 (Aparna), Arka Lokit and PMK1
4.	Pumpkin	CM-14
5.	Water melon	Durgapura Meetha and Durgapura Kesar
6.	Dolichos beans	Konkan Bhusan
7.	Faba bean	BR1 (black seeded), BR2 (yellow seeded), Jawahar Vicia
8.	Cluster bean	Pusa Sadabahar, Pusa Mausami and Pusa Naubahar
9.	Elephant foot yam	Gajendra

conditions seed germination is very difficult process and affects the plant population. In case of musk melon the seeds are soaked in water over night and then kept in moist cloth or gunny bags in a warmer place and germination commences within 3-4 days. Also, the seed water content declines rapidly 10 days after anthesis and 25 days later, the seed becomes tolerant to rapid desiccation.

Singh *et al.* (1975) found that incorporation of bentonite alone or in combination with farm yard manure significantly increases the yield over other treatments in Cucumber. Pitcher irrigation is recommended for getting higher yield in bitter melon grown under rainfed cultivation (Reddy and Rao, 1983).

#### **Leguminous vegetables:**

Faba bean is grown as *rabi* crop in India under rainfed conditions. Cluster bean (*Cyamopsis tetragonoloba*) popularly known as guar is a drought hardy, deep rooted, summer annual legume, grown as vegetable. This crop is susceptible to water stagnation and as well as severe drought condition and hence the seed germination, emergence and establishment are very difficult under these conditions. In cluster bean cv. PUSJI NAVBHAGAR, seeds coated with polykote @3g kg<sup>-1</sup> along with bavistin @2g kg<sup>-1</sup> maintained the seed germination and seedling vigour both initially and after accelerated ageing (Renugadevi *et al.*, 2008). Application of 20 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 10 kg ZnSO<sub>4</sub> recorded the highest number of pods per plant (Maliwal *et al.*, 1987) in cluster beans.

#### **Agro horticulture:**

Drumstick comes up well in all soils and can be grown even in waste lands. It is predominant crop of dry and arid tracts. Most fruit trees grown in dryland take 5-8 years to cover the interspaces. Further, in dry land fruit trees like ber, pruning is done every year, so, the interspace is available. In such cases, intercrops can be grown

successfully and profitably between the fruit plants in a system of agro-horticulture. The crops grown in the interspaces should be normally low stature and of short duration, so that, they do not compete with the fruit trees for light, moisture and nutrients. At Hyderabad, agro-horticulture system involving ber and vegetables resulted in higher returns than ber alone (Somani, 1992).

#### **Conclusion:**

Vegetable cultivation under rainfed condition is not much popular while comparing to other systems of cultivation. However, it solves the problem of rural poverty and malnutrition. Therefore, much concentration should be given for rainfed vegetable farming by efficient adoption of techniques *viz.*, selection of varieties, seed treatment practices, use of growth regulating substances and crop husbandry practices.

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