

DIARA CULTIVATION OF CUCURBITS

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Received-05.04.2020, Revised-26.04.2020

Abstracts: In recent years, the agriculture sector is adversely affected by climate change, and the rural poor are becoming more vulnerable to unsustainable livelihoods. River areas are known as “Diara”. Diara land cultivation continues to be carried out with the traditional manner. Riverbed cultivation is a type of vegetables forcing, facilitating off season production of mainly cucurbitaceous vegetables. Incomes generated by river bed vegetable growers were used primarily for meeting their household food security. On riverbed vegetable cultivation is easy with respect to land preparation, water management and other cultural practices. In north India, the cucurbits generally grown together are cucumber, bottle gourd, bitter melon, summer squash, round melon and long melon but ridge gourd in Rajasthan, MP and UP. The major constraints of diara farming are stray animals, strong windstorms and long spell of droughts. Diara farming is a pro-poor focused program for the rural community to increase household income and to improve the food security of landless and land poor households of India.

Keywords: Climate change, Cultivation, Cucurbits, Vegetable

INTRODUCTION

The ancient practice diara cultivation was started during the mughal period predominantly with various cucurbits. It was selected as an entry point to promote inclusive economic growth for the benefit of the landless people. A piece of land created inside a river due to deposition of sand is known as Diara land or river bed. Cultivation in riverbeds facilitates off season production which is a type of vegetable forcing in many cucurbitaceous vegetables which is purely an indigenous and innovation of Indian vegetable grower. The term "Diara" has been extracted from the word 'Diya' meaning earthen lamp. Keeping in conformity with the shape of the 'Diya', the bowl like systems on the surface (depressions) situated between the natural levees on either side of the river appear like small 'Diyas' when rain water gets accumulated in them during the rainy session. In survey it was observed that out of total area under cucurbits cultivation, 60 % area is under riverbed cultivation during the summer season around 75-80 % of total cucurbits production is being produced in river beds or diara land area which is available in market from February – June. Such land is also known as in different areas of India as khaddar lands, char lands, dariayi, kachhar, doab, kochar, nad, riverine area, and nadiari. Diara lands and tal lands.

How it forms

The alluvion and diluvion action of perennial Himalayan Rivers during South- West monsoon lead to the formation of diara lands. During monsoon, the vegetable crops can be grown on these lands due to yearly deposits of fresh silt and clay. After the monsoon season, the water from the riverbeds retreats back to its channel, leaving large areas dry. These areas of land are generally left unused. The subterranean moisture seeped from adjacent river, streams, makes the upper layers of land more suitable for growing early vegetable crops.

Where it works

- The technology works well on marginal lands, in topographically flat areas with river beds that are dry for one crop cycle (approximately 6 months) with arable land silted over and/or washed away due by floods.
- Distance/Adjoining to village: not more than 30 minutes on foot.
- Sand must be fine and small-grained and the groundwater table should be <1 m.
- Riverbeds or riverbanks may be cultivated. Riverbeds have a higher soil moisture content compared to riverbanks.

Main River beds in India

Main river beds which formed by different rivers are found in 9 states (Table 1). State wise, the main river beds in India are:

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Table 1. River beds of India

States	Main river beds
Uttar Pradesh	Jamuna, Hindon, Sarayu, Ganga, Ghaghra, Tank beds, Sharada, Ramganga, Gomati
Bihar	Ganga, Gandak, Sone, Kosi, Burhi Ganga
Madhya Pradesh	Narmada, Tapti, Tawa, Mohana
Rajasthan	MarkhedaGhat, Banas
Gujarat	Sabarmati, Vatrak, Panam-Orusung, Mohi-Banas, Tapti
Maharashtra	Tapti, Burai, Purna, Vagur, Girna, MaisBhuikund, Nirguna, Kanchan
Andhra Pradesh	Tungbhadra, Krishna, Pennar, Papagni, Hundri-Sagileru
Karnataka	Channapatna, Hanganoor, Shimsha
Kerala	Pamba, Manimala

Classification of Diara land on the basis of precise location from the main stream

- 1. Main riverbed (low land) diara-** The actual riverbeds, which have fine sand to coarse deposits on surface, become available during non-monsoon seasons i.e. December/January to May/June until early rains set in. Main crop is Bottle gourd and Bitter gourd.
- 2. Main land (medium land) diara-** These areas are located on the bank of the river and its width varies considerably. They are frequently inundated during rainy season by the swelling of flood water. The depth of the main diara region varies considerably at different locations. Main crop is Watermelon, Cucumber, Luffa, Pointed gourd and Muskmelon.
- 3. Upland diara-** Due to continuous deposition, such areas have been elevated and are relatively less frequently flooded than the main land diara areas. For all operational purposes these areas are not very different from the normal (non- diara) lands. Main crop is pointed gourd.

Other Classification

- 1. Riverbed Diara-** The land available for cultivation on both sides of the flowing portion of the riverbed during non-monsoon season.
- 2. Riverbank Diara-** Strips of land available for cultivation in between riverbeds and natural levees or existing embankments.
- 3. Flood Affected Diara-** The lands available for cultivation adjacent to unprotected reaches.
- 4. Flood Prone Diara-** The area on both sides beyond the levees or embankments of the river.

Advantages of riverbed cultivation

The advantages of river bed cultivation are

- High net returns per unit land area

- Early and high yield
- Ease in irrigation
- Low cost of cultivation, highly fertile lands reduces the external mineral requirements
- Limited weed growth
- Pest and disease are controlled by cultural practices, cost effective labour facilities
- No land ownership required
- Income and food security of landless and marginal farmers
- Local adaptation to climate change.

Characteristics of Riverbed soils

The soil in river beds contains mostly sand and moisture is seeped from the adjacent river. Well-drained loamy soils are preferred for cucurbit cultivation. Soil moisture is also important for rapid growth and it should be at least 10% to 15% above the wilting point. For early yields lighter soils and for getting late crop heavier soils are usually used. Subterranean moisture of river streams and alluvial substrate in sandy river-beds support the growth of cucurbits. The soils should not crack and should not be water-logged in summer and rainy season respectively. It should be provided with adequate organic matter. pH below 5.5 is not suitable for cucurbits cultivation and most of the cucurbits prefer a neutral soil pH i.e. between 6.0 and 7.0 is optimum for cucurbits. Water melon is the only cucurbit which is slightly salt tolerant and Musk melon is slightly tolerant to acidic soils. (Patel *et al.*, 2016). For proper growth and development the optimum temperature range should be around 18-22°C. For good soil management firstly level the lands and secondly for alkali soil application of gypsum and for acid soil there is application of lime in diara lands.

Cultivation

Land Preparation: Riverbed plots are chosen by

farmers, with plots perpendicular to the river's flow. After recession of flood during October- November and the cessation of the south-west monsoon pits or trenches or channels are prepared.

Systems of planting

Majority of farmers choose the following system of planting depending on personal preferences and availability of labour. They are –

- i. Pit system of planting
- ii. Ditch system of planting

Pit system of Planting - For the pit system, pits of 0.5 m diameter are dug 1 m deep and 1 to 3 meters apart depending on the crops, and planted with numerous seeds, the feeble of which are thinned out. Sometimes circular pits with diameter of about 35-45cm and a depth of 90 cm are prepared.

Ditch system of planting - To manage the availability of moisture and higher temperature the trenches are dug in North-West direction. To use the ditch system, a trench 1 m deep is dug along the row, with 1 to 2 m (cucumber, bitter gourd) or 3 m (watermelon, bottle gourd, pumpkin) space between rows. Seeds are planted/spaced 1 m (watermelon, bottle gourd, and pumpkin) and 0.5 m (cucumber, bitter gourd) apart in the ditch. The pits/trenches are filled with organic decomposed waste or oil cakes or FYM or any other which is mix in the soil.

Seed rate, seed treatment and sowing/transplanting time

Seed rate varies according crops to be grown. Sowing is usually done for early crop in 1st fortnight of November and 1st week of December. 1st week of January is the best time for late sowing. The seeds are sown in trench at a distance of 45-60 cm and at a depth of 3 to 4 cm. Two seeds are usually sown at one place. Pre sprouted seeds are sown for smooth germination when the temperature is very low. For this, pre-soak the seeds for 24 hours and place the moist seeds on a gunny bag and cover them with a cotton cloth and keep them in a warm place for about a week for sprouting to start.

Sometimes the moistened seeds are wrapped in gunny bags are left near the fire for quick germination and in this way sprouting start after 5-6 days. As soon as sprouts emerged outside the seed coat they are planted. Generally, 3-4 pre-germinated seeds/hill area sown in pits.

Nutrient management

Earlier manures/fertilizers were not used in diara land cultivation but nowadays farmers are slightly using fertilizers and manures for proper growth of the crop. Since this cultivation practice is taken only for one season, so inorganic fertilizers and organic manures are used in a limited quantity with extra caution. Well decomposed FYM or compost, caster cake or groundnut is applied first. To enhance retentively of moisture in the feeding zone River silt is generally used. Germinating seeds or growing transplants are provided with warmth from the

organic manure. At the time of thinning 30-60 g urea per pit will be useful. After 25-30 days of sowing, depending on weather conditions and growth, chemical fertilizers are top dressed in two split doses, especially fertilizer mixtures or nitrogenous fertilizers like urea. This top dressing is applied in shallow trenches away from the plants.

Water management

The deep root system in cucurbits, enables the plant to survive in diara land. Pitcher irrigation is given in the initial stages of germination and growth till the roots of the plants touch the water regime below the sand or left as such. Trickle or sprinkler irrigation system is quite advantageous to avoid leaching losses of the nutrients in sandy soils.

Weed management

Major weeds in diara land areas are *Euphorbia hirta*, *Polygonum sp.*, *Eclipta prostrata*, *Fimbristylis dichotoma*, *Sida sp.* etc. These weeds can be eradicated manually by pulling, since soil is quite loosened due to excess sands. Herbicides should be avoided completely as it may prove to be hazardous to human, animal and fishes when mixed with running river water.

Thatch preparation

In north-west India, when the winter goes down 1-2^o C in Dec-Jan, young plants should be protected from low temperature and frost in their early stages. The thatch screen made of locally available material like paddy straw, Saccharam grass or sugarcane leaves provides protection for the young seedlings.

Grass is spread in the month of February over the sand as a bedding and mulch, to protect the tender and young plants and fruits from scorching of heat sand during summer and also stops the vines to drift during strong winds. Polyethylene cover as a method for frost protection is still to be developed. This will be affordable and will be available easily for ordinary growers.

Cropping pattern

Mixed cropping is usually practiced in riverbeds. Water melon and Musk melon generally go together. Other cucurbits mainly grown together are summer squash, bottle gourd, round melon, cucumber, sponge gourd, bitter gourd, long melon in north India, ridge gourd in Rajasthan, MP, and UP and pointed gourd in Bihar.

Harvesting and yield

Harvesting should be done when fruits are quite tender and edible. Fruits which attain edible maturity should be harvested at 2-3 days interval, or else, the quality deteriorates and fruits are hardened due to seed maturity. By the end of June to end of October harvesting at regular interval can be done. Table 2 contains the Potential yield of various vegetables. Harvesting of fruits starts in Feb-March (off-season) and gives early yield and higher return (Selvakumar, 2014). After harvest, crops are transported to local market centers for sale.

Table 2. Crop duration and yield of cucurbitaceous vegetables in diara lands

S.No.	Vegetables	Seed rate (kg/ha)	Planting Time	Harvesting Time	Average Yield (q/ha)
1	Bottle gourd	3-4	Nov-Dec	March-July	200-350
2	Bitter gourd	4-5.5	Feb-March	May-July	100-150
3	Pointed gourd	-	Nov-Dec	March-July	350-400
4	Ridge gourd	3.5-5	Apr-May	June-July	100-200
5	Sponge gourd	2.5-3.5	Jan-Feb	April-May	100-200
6	Cucumber	2.5-3.5	Jan-Feb	March-June	225-250

Table 3. Important considerations for Cucurbits harvesting/marketing

Sl. No	Crops	Harvesting	Test method	Stage of fruit	Remark
1	Cucumber	60-70 days after sowing	Anthesis duration	Tender green fruit	Optimum length 20-25 cm (depending upon variety/consumers demand)
2	Bitter gourd	55-100 days after sowing (depending upon variety)	Anthesis duration	Tender green fruit	Optimum length 20-25 cm
3	Pointed gourd	80-90 days after transplanting	Anthesis duration	Green fruits having tender seeds	Optimum length 20-25 cm
4	Ivy gourd	Tender immature fruits	Anthesis duration	Green fruits having tender seeds	Optimum length 20-25 cm
5	Ash gourd	75-125 days after sowing	Anthesis duration	Full mature stage	White wax deposition on skin
6	Bottle gourd	60-100 days after sowing, 12-15 days after fruit setting	Pressing the skin and little pubescence persisting on the skin Nail test	Light green colour	Seed should be soft, if examined in transverse section
7	Luffa species	55-60 days after sowing, 6-7 days after anthesis	Anthesis duration	Fruit should not turn fibrous and picking should be done earlier	Picking at 4-5 days interval

Table 4. Important Diseases and pests in diara land

Diseases				
Sl. No	Name of the Disease	Causal organism	Symptoms	Control
1	Powdery mildew	<i>Sphaerotheca fuliginea</i>	White fluffy, circular patches on the under surface of leaves. At later stages brown surface with shrivelled leaves appear and lastly defoliation occurs.	Spray diathane M-45 an early stage and repeated 2 to 3 times.
2	Fusarium wilt	<i>Fusarium oxysporium</i> s.sp. <i>nivarum</i>	In young seedlings, cotyledons droop and wither. In older plants, leaves wilt suddenly.	Soil dressing by captan or hexocaptan or thiride 0.2 to 0.3% solution.

3	Anthraco nose	<i>Colletotrichum spp.</i>	Reddish brown dry leaf spots are formed which often coalesce and cause shriveling and death of leaf. Water soaked and yellowish lesions on petiole and stems.	Repeated spraying at 5 to 7 days interval with dithane M-45 0.2% or diathane Z-78 0.2% solutions.
4	Viral disease	Cucumber mosaic virus, Water melon mosaic virus, Tobacco mosaic virus, Kakari mosaic virus and Luffa mosaic virus	The leaves show a molting, mosaic, crinkling and twisting and stunted internodes and flowering in adversely affected.	Take precaution in case of mechanical transmission. Use of insecticide. Avoid seeds from the virus affected plants.

Insects

The pests like aphids and red pumpkin beetle are usually noted in early stages of crops. The fruit-fly incidence is more in pointed gourd and bitter gourd and mite infestation increases in arid situations, as the day temperature rises above 40°C.

Mineral deficiencies

Non-pathogenic diseases mostly caused by mineral deficiencies are also prevalent in some situations. This is a special problem in river-beds. Absence of rich sub-soil, silt or alluvium beneath the sandy layer and leaching of nutrients due to sandy substrate sometimes cause deficiencies of macro and micro nutrients.

Constraints

- Non availability of quality seed
 - Most of these fruits are produced by cross pollination before selection of the fruit for seed extraction. That is the reason why the fruits coming from river-beds are of undependable quality, especially in sweetness and flesh color of which urban consumers often complains.
 - It has enabled the perpetuation of natural variability and there has been a continuous process of recombination and selection involuntarily promoted by the farmers.
- Non availability of land
- Sometime the river-bed remains underwater for a longer period.
- The vegetable growers are not the owner of available land.
- Due to heavy leaching of the soils, fertility is very low.
- River-bed cultivation practice does not fit in any of the crop rotation, and cucurbits are especially adopted for such type of cultivation.
- The major share of benefit is usually taken by the business man and middle man who purchase the cucurbits vegetables in summer and sale it in market. Thus, the small and marginal farmers who raised a good crop on river-bed or practically on sand, is deprived of his major share of profits.

CONCLUSION

Riverbed farming may increase farmers' vulnerability environmental shocks because riverbed cultivation is low-environmental-impact, easy-to-learn, cost effective technology allowing landless households to produce unused marginal lands. This type of cultivation is best suited for the small farmers and marginal farmers who can work themselves along with their families in the fields, producing a large number of cucurbits and other vegetables economically. By utilizing an under exploited resources and enhancing small holders productive skills on marginal soils, it increases marginal farmers' options for sustainable coping with the effects of environmental shocks like floods. For this the Indian Institute of Vegetable Research, Varanasi has taken the responsibility and initiated a multi-institutional project "Evaluation of high yielding varieties/hybrids of cucurbitaceous vegetables for river bed (diara land) cultivation and standardization of their agro-techniques" involving "Institute of Agriculture, SHIATS, Allahabad" and "C. S. Azad Univ. of Agriculture & Technology, Kalyanpur, Kanpur".

Future Thrust

- There is urgent need for screening of the existing varieties and advanced lines of cucurbitaceous vegetables under riverbed condition.
- The Multiplication and distribution of seed of such landraces are should be done by Horticultural Research Institute/SAUs /Local agricultural, horticultural departments in nearby experiment station.
- Standardization of riverbed technologies for cucurbits so that scientific information regarding varietal suitability and other input parameters of river bed technology can be refined, and documented.

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