YAQOOB JALAL MINHAS

"AGRONOMIC PRACTICES TO ENHANCE YIELD OF SUGARCANE"

SUGARCANE: Some Facts

- GDP by Agriculture Sector 24.6%
- Sugarcane share in GDP 0.8%
- Value added agriculture 3.6%
- Sugarcane area 1.124 m. ha
- Sugarcane Production 62.47 m tones
- Sugarcane Yield 55.58 t ha^{-1}
- Total (Cropped Area Pak) 22.6 m. ha
- Sugarcane share 4.6%
  - Share in area 2012-13
  - Punjab 69
  - Sindh 21
  - Kyber Pakhtoon Khawa 10

Top 10 Largest Sugar Cane Producers in the World

Rank	Country	Production (Tonnes)
1	Brazil	672,157,000
2	India	285,029,000
3	China	116,251,272
4	Thailand	66,816,400
5	Pakistan	50,045,400
6	Mexico	49,492,700
7	Colombia	38,500,000
8	Philippines	32,500,000
9	Australia	30,284,000
10	Argentina	29,000,000

Cane and Sugar Yield of main Sugarcane Growing Countries of the World

Country	Cane yield (t/ha)	Sugar Recovery (%)	Sugar yield (t/ha)
Australia	100.4	13.8	13.85
Egypt	110.8	11.5	12.74
Brazil	68.4	14.5	9.91
U.S.A	80.2	11.7	9.38
Colombia	80.5	11.5	9.26
Mexico	79.5	11.6	9.22
Indian	66.9	9.9	6.64
Pakistan	50.3	9.2	4.63
World Avg.	64.4	10.6	6.82

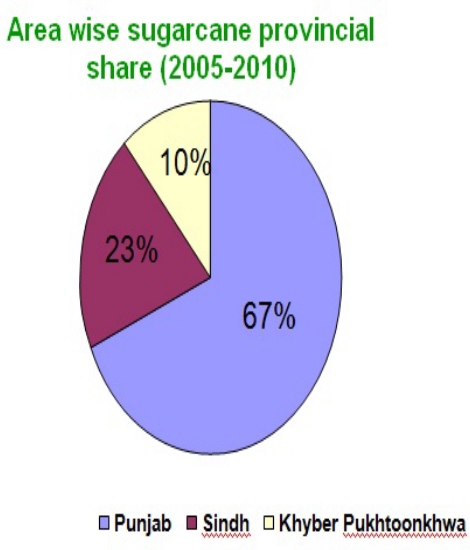
Source: FAO .

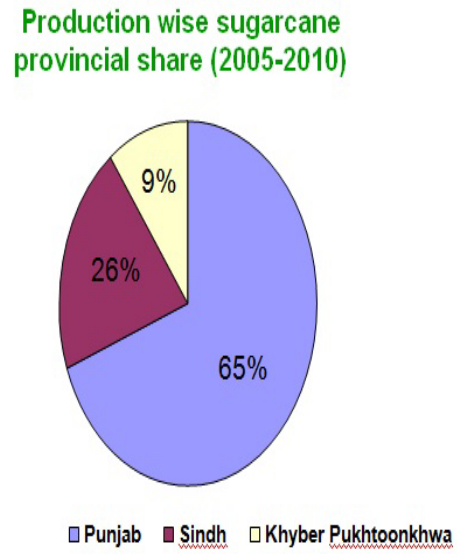
In year 2010 over 166 million of Sugar (raw equivalent) 70% derived from sugarcane 30% " " Sugar beet were produce throughout the world.

AREA, PRODUCTION AND YIELD OF SUGARCANE IN PAKISTAN

Year	Cane area (m ha)	Cane prod. (m tons)	Cane yield (t ha^{-1})	Sugar prod. (m tons)	Sugar Recovery (%)
2008-09	1.025	49.050	47.85	3.20	9.46
2009-10	0.943	49.370	52.40	3.10	9.00
2010-11	0.998	53.737	53.90	4.14	9.24
2011-12	1.057	58.39	55.2	4.66	9.64
2012-13	1.124	62.47	55.58	5.03	10.00

Province Wise Area & Production Share





SUGARCANE AND SUGAR PRODUCTION 2012-13

Province	No. of Mills	Cane Production Mill. tonnes	Cane Crushed Mill. Tonnes	Sugar Produced ooo tonnes	Recovery %age
Punjab	44	42.98	31.98	3172	9.92
Sindh	34	15.96	14.75	1547	10.50
KPK	7	4.77	3.35	310	9.23
Balochistan	0	31.00	0.00	0	0.00
Total:	86	63.71	50.08	5030	10.00

Source: Annual Report 2013, PSMA Islamabad.

AGRONOMIC PRACTICES TO ENHANCE YIELD OF SUGAR CANE

- **Sugarcane is the second most important industrial, cash and now a days as bio fuel producing crop of the country and Sindh province as well. Its main product sugar or sucrose is also a commercially important substance owing to its verstile use in food and variety of industrial products.**

- **It is reported that on the world level about 60% of sugar comes from the cane and about 40% from the sugar beet, but in Pakistan 98% sugar is produced from the sugar cane and 2% only from sugar beet from peshawar valley. So far sindh province is concerned, we entirely depend on sugarcane for sugar production.**

- **Though, sindh province possesses all required natural resources for high sugarcane production, but yet not so good to meet the world standard in cane production and recoverable sugar.**

- **Sindh is leading province in Pakistan for cane production and sugar recovery, but still the yield in the province are considered as very low when comparison is made with developed countries of the world of the similar climate and soil conditions, or when consideration is given to the yield potential exists under Sindh conditions.**
- **Because of the lower cane yield per unit area and potential sugar recovery the domestic sugar needs are not being met and still huge amount of foreign exchange is spent on sugar imports, while it is considered that Pakistan has its agriculture based economy.**
- **Due to lower can yield per unit area and resultant less total can production, the cane requirements for 31 sugar mills are not being fulfilled in the province.**
- **During last five years nearly 90%of the total crushing capacity of the mills could be utilized. The cane production can be improved with out increasing the area under sugar cane by adoption of improved production practices in the field.**

SUGAR CAN YIELD AND POTENTIAL

	Can yield (Tons/ha)	sugar recovery (%)	sugar yield (tons/hac)
Average	**55.58**	**10**	**5.03**
Potential	**100**	**11**	**10**

- ✓ **The data in above demonstrated the deteriorating position of the sugar industry.**
- ✓ **Feeling the gravity of the situation, Agriculture Research Institute, Tando Jam analysed the main causal factors for this drawback and their specific contribution.**

AGRONOMICAL OPERATIONS RESPONSILE FOR LOW CAN PRODUCTION AND THEIR CONTRIBUTION IN %

Sr#	Agronomical operation/ problems	Contribution %
1.	Selection of soil and land preparation	10-20
2.	Use of pure, healthy and recommended seed (Age wise)	10-20
3.	Use of recommended variety and seed rate	10-20
4.	Use of diseased free cab seed/ seed treatment	5-10
5.	Proper time and method of swoing	10-20
6.	Use of balanced fertilizer, lack of OM , proper time and method of their application	20-30
7.	Proper time and method of irigation application	5-10
8.	Proper weeding, intercullturing and earthingup	10-15
9.	Proper plant ptotection measures	10-15
10.	Proper time and method of ratooning	05-10
11.	Proper time and method of harvesting	05-10

PROPOSED *AGRONOMICAL PRACTICE IN SUGAR CANE CULTIVATION*

1. SOIL SELECTION

Deep rich loam and clay loam having good drainage and aeration free from water logging and salinity with soil pH ranging from 6.5 to 8.5.

2. LAND PREPARATION

For light, medium and loamy soil no deep ploughing is needed, but in heavy clay soil deep ploughing is required, for this purpose chissel plough or sub-soiler may be used after every three years, because sugar cane is deep rooted. Precise levelling and proper planting is also important. It is rightly important to apply 8-10 trolly cart loads or 2-4 trucks loads of well rotted FYM may be applied a month prior to land preparation. Press mud from the sugar mills is also a rich source for nutrients and organic matter to the soil. Green manuring may also serve the purpose if FYM is not available.

Objectives of Land Preparation

- To prepare a seed bed which permits optimal soil water air relations.
- Good physical conditions for early root penetration and proliferation.
- To incorporate preceding crop residues and organic manures.
- To destroy weeds and hibernating pest & disease organisms.
- To facilitate proper soil chemical and microbial activity.

Good Land Preparation

Improper Land Preparation

STEPS IN LAND PREPARATION INVOLVE THE FOLLOWING:

- **Subsoiling or chiseling to a depth of 50 to 75 cm to break hard compact sub soil pan layer.**
- **Ploughing to incorporate previous crops, crop residues and organic manures**
- **Discing to break clods.**
- **Land shaping to provide the required gradient for draining excess water during rainy season.**
- **Field layout - Construct ridges & furrows and shape them. Depth of furrows should be 25 cm. The furrow bottom should be loosened to about 10 cm.**
- **Provide drainage channels, which are deeper than the furrows along the field borders as well as within the field at regular intervals. Drainage channels are particularly important in the high rainfall areas to drain the excess water during rainy season.**

Without Subsoiling

With Subsoiling

PLANTING METHODS

There are two planting methods generally practiced in Sindh province . Recently ring pit method is also tried under experimentation; which shows more profitable then conventional method.

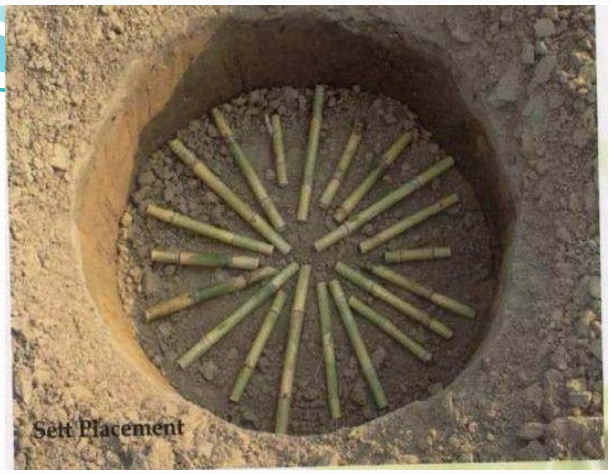
a) Dry Method: In dry method of planting the germination is higher as compared to the wet method.

b) Wet Method: Wet method is used generally under water shortage conditions and in this method the problem of weeds infestation is checked significantly, but germination is relatively less than dry method.

c) Ring-pit Method: Sugarcane is planted in pits of circular shape, so the method is called 'Ring-pit' planting. By this method cane yield can be increased 1.5-2 times more than conventional method, water saving 30-40%, high input use efficiency i.e. water use efficiency 30-40%, nutrient 30-35%, high sugar recovery 0.5%, high profitability, better ratooning, reduced lodging, and insect pest disease.

Ring-pit method

- **Sugarcane crop comprises of mother shoots and tillers. Since tillers start emerging about 45 to 60 days after emergence of the mother shoots, so these are comparatively weak and finally result in millable canes of lesser length, girth and weight.**
- **Therefore, to accommodate more numbers of mother shoots in the same space, tillers of sugarcane need to be suppressed.**
- **To achieve this, more numbers of setts are planted in circular pits at a relatively greater depth.**
- **Thus, mother shoots at larger are allowed to grow with very less or no tillers.**



PLANTING METHODS (continue)

- **Cane is normally planted either as two- or three-budded setts in furrows, or as whole stalks cut into 30 cm lengths and covered with soil.**
- **Most cane is planted manually, but machine planting is also practiced. Row and plant spacings are 1.0-1.3 m x 0.5 m for manual planting.**
- **The row spacing is 1.4-1.6 m for machine planting.**
- **In the case of double row planting, there is 30 cm spacing between double rows and 1.3 m (1.00-1.40 m) between rows.**
- **It is recommended that a variety with high tillering should be planted at the wider row spacing and vice versa.**
- **After planting, farmers should take care of their crops by watering and fertilizing gradually.**
- **Watering of plants during the first 11 months is essential. Every single sett can produce up to seven crops.**

PLANTING SEASON

- Sugar cane is usually planted in two seasons i.e
  I. Autumn Season (15 August To 15 October)
  II. Spring Season (10 February To 15 March).

- Best temperature for good germination and growth vary from 30-37 Ċ. Delay in planting after 15th October gives poor germination with 30% lower yields. The yield of autumn planted crop is 25-30 % and 10-15% sugar recovery is higher than spring planted crop due to longer growing season (growing degree days).

- **Around 26 per cent of the growers plant sugarcane in October, 45 per cent in November, 2 per cent in December and 7 per cent in February.**

SEED BED PREPARATION:

- Sugar cane is a deep-rooted crop, it requires a well-worked and fully pulverised seed bed.
- Fine seed bed can be prepared by ploughing with a furrow-turning plough to a depth of about 20-25 cm particularly when soil is clayey.
- Six to eight subsequent ploughings followed by planking are enough to achieve a good pulverised seedbed free of clods and weeds.

SEED NURSERY

About 8-10 month old nursery seed be used for planting to obtain 30-40 percent higher germination as conmpaired to the seed obtained from 12 months old fresh plant or ratoon crop.

In case the nursery seed is not available 2/3 rd upper portion of plant crop is recommended.

SEED RATE:

- **30,000 to 40,000 two double setts per acer with end to end arrangement (80-100 mds/ac) of planting are recommended.**
- **In case of double row planting system, seed rate should be increased and adjusted according to row to row spacing.**
- **Optimum plant population depends on appropriate seed rate and spacing but the growers often ignored them, which is the key factor in lowering production.**
- **The seed rate and spacing between rows differ with variety.**
- **Eight to nine tones of stripped cane per hectare for thick varieties, and six to seven tones for medium to thin varieties is sufficient to produce a desired plant population of about 0.15 million canes/ha.**
- **The growers use local seed of previous crop, it does not add to cost of production.**
- **When seed of new cultivar is sown, cost of production increases.**

SEED TRATMENT

Objective:

- To protect the crop from soil borne and seed borne diseases causing pathogens, which usually gain entry into the setts through the cut ends following planting and cause sett rotting and damage to buds, thus affecting germination.
- Most farmers don't treat the setts before planting which results low plant population per unit area consequently reducing the yield.
- Seed setts should be applied in any one of the recommended fungicide against the attack of the seed borne sugar cane diseases including whipsumit.

Name Of Fungicides	Duration Of Dipping	Fungicide And Water Ratio
1. Vitavax	5 minute	200 g / 100 lit water
2. Benlate WP	1-2 minute	100 g / 100 lit water
3. Bayletone	05 minute	100 g / 100 lit water
4. Topson	05 minute	100 g / 100 lit water

VARIETIES

Lower Sindh

Early maturing:	BL–4, Thatta-10, SPGS- 26, NIA-2004, Larkana-2001, Larkana-2004 NIA-2011, CP-72-2086, CP43/33, CPF-233, HSF-240, HSF-242, HSF-243
Mid season:	PR –1000, Gulabi-95, NIA-2010, SPF-213, SPF-245, CPF-246, CPF-247, SPF-234

Middle Sindh

Early maturing:	BL–4, Thatta-10, SPGS- 26, NIA-2004,Larkana-2001, Larkana-2004 NIA-2011, CP-72-2086, CP43/33, CPF-233, HSF-240, HSF-242, HSF-243, SPSG-26, L-116, L-113
Mid season:	PR–1000, Gulabi-95, NIA-2010, SSPF-213, SPF-245, CPF-246, CPF-247, SPF-234, 2004

Upper Sindh

Early maturing:	BL–4, Thatta-10, SPGS- 26, NIA-2004,Larkana-2001, Larkana-2004 NIA-2011, CP-72-2086, CP43/33, CPF-233, HSF-240, HSF-242, HSF-243, SPSG-26, L-116, L-113
Mid season:	PR–1000, Gulabi-95, NIA-2010, SSPF-213, SPF-245, CPF-246, CPF-247, SPF-234, 2004

Fertilizer Application

- The very important job getting the soil tested before the use of any particular fertilizer is not practiced in our country.
- As mentioned earlier fertilizer use in Pakistan is imbalanced, inadequate and improper.
- Most of the cane growers in the country use only nitrogenous fertilizers while others use an imbalanced combination of N and P.
- Use of K is almost neglected in cane crop.
- It is very important to use proper doses of balanced fertilizers to exploit the maximum yield potential of cane crop.
- Fertilizer recommendations for sugarcane for various ecological zones are given on next slide.

LOWER SINDH	***MIDDLE SINDH***	***LOWER SINDH***
116-58-70 Kg	***92-46-40 kg***	***70-35-50 kg NPK/ac***

20-25% more NPK fertilizer is to be applied in case of ratoon crop.

All P & K +1/3rd of N be applied at planting time and remaining in two equal doses at first earthing up (3-1/2 month after planting) and 1-1/2 month after first earthing up respectively, but it should be necessary to completed upto the month of June.

Nutrient Deficiency Symptoms

NITROGEN

- Die back of older leaves.
- Leaf baldes turn light green to yellow.
- Short and slender stalks
- Tips and margins of older leaves become necrotic.

PHOSPHORUS

- Red and purple discolouration of tips and margins
- Slender leaves
- Short sand slender stalks
- Poor or no tillering

POTASSIUM

- Yellow-orange chlorosis of leaf borders & tips
- Stalks slender
- Older leaves brown or "fired"
- Spindles distorted producing "bunched top" or "fan' appearance

IRRIGATION METHODS

Conventional (Total Losses 17%)

- Furrow Irrigation
- Border Irrigation System
- Basin Irrigation System

Modern (No Losses of Water)

- Sprinkler
- Drip irrigation system

Furrow Irrigation

- In furrow irrigation, only a part of the land surface (the furrow) is wetted thus minimizing evaporation loss.

Furrow Irrigation

- Furrow irrigation is adapted for row crops like sugarcane, corn, banana, tobacco, onion and cabbage. It is also good for grains.
- Irrigation can be by corrugation using small irrigation streams.
- Furrow irrigation is adapted for irrigating on various slopes except on steep ones because of erosion and bank overflow.

Furrow Irrigation Contd.

There are different ways of applying water to the furrow.

- Siphons are used to divert water from the head ditch to the furrows.
- Direct gravity flow whereby water is diverted from the head ditch to the furrows by cutting the ridge or levee separating the head ditch and the furrows.

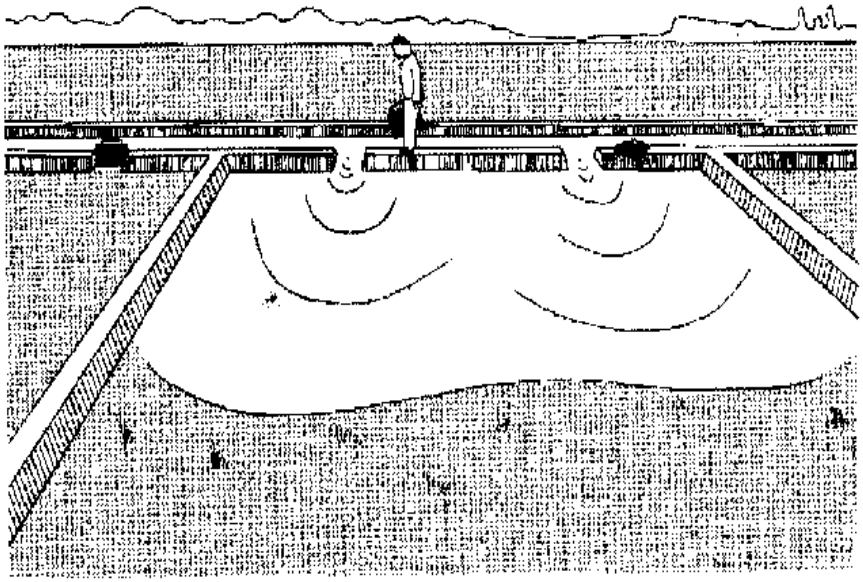
Furrow Irrigation Contd.

- Gated pipes can also be used. Large portable pipe (up to 450 mm) with gate openings can be used to deliver water to the furrows.
- Water is pumped from the water source in closed conduits.
- The openings of the gated pipe can be regulated to control the discharge rate into the furrows.

Border Irrigation System

- **In a border irrigation, controlled surface flooding is practiced whereby the field is divided up into strips by parallel ridges or dykes and each strip is irrigated separately by introducing water upstream and it progressively covers the entire strip.**

Border Irrigation System



Border Irrigation System

Suitability:

- For crops that can withstand flooding for a short period e.g. wheat.
- It can be used for all crops provided that the system is designed to provide the needed water control for irrigation of crops.
- It is suited to soils between extremely high and very low infiltration rates.

Border Irrigation Contd.

- In border irrigation, water is applied slowly.
- The root zone is applied water gradually down the field.
- At a time, the application flow is cut-off to reduce water losses.
- Ideally, there is no runoff .
- Possibility of deep percolation losses.
- The problem is that the time to cut off the inflow is difficult to determine.

Basin Irrigation System

In basin irrigation, water is flooded in wider areas. It is ideal for irrigating rice.

- The area is normally flat.
- In basin irrigation, a very high stream size is introduced into the basin so that rapid movement of water is obtained.
- Water does not infiltrate a lot initially.
- At the end, a bond is put and water can pond the field.

Basin Irrigation Diagram

SPRINKLER IRRIGATION

Introduction: **The sprinkler system is ideal in areas where water is scarce.**

- **The sprinkler system conveys water through pipes and applies it with a minimum amount of losses.**
- **Water is applied in the shape of sprays sometimes simulating natural rainfall.**
- **The difference is that this rainfall can be controlled in duration and intensity.**
- **If well planned, designed and operated, it can be used in sloping land to reduce erosion where other systems are not possible.**

Raingun Irrigation System

DRIP OR TRICKLE IRRIGATION

Introduction: In this irrigation system:

a) **Water is applied directly to the crop i.e. entire field is not wetted.**
b) **Water is conserved**
c) **Weeds are controlled largely**
d) **Low pressure system – saves energy**
e) **Slow rate of water application somewhat matching to the consumptive use. Application rate can be as low as 1 - 12 lit/hr**
f) **Less evaporation losses, only potential transpiration is considered**
g) **No need for a drainage system**

IRRIGATION

- **Sugar cane contains 73-76% water, so it is life of the plant of sugar cane.**
- **Roughly one tone of water is required for production of ½ kg of sugar.**
- **It needs 20-25 irrigations from planting to harvesting for all zones of sindh.**
- **In general water containing 250-700 parts of soluble salts/ million is good.**
- **If the TSS are 700-1000 ppm mixing with tube well water and canal water is recommended 1:1 ratio.**
- **It is very important to take care of the irrigation requirements of sugarcane, particularly in summer months.**
- **Farmers must plan their acreage to be planted under cane crop according to the available water at their farm.**
- **Keep in mind that each field should get at least 22 to 25 irrigations during the crop year adjusting the irrigation schedule according to rainfall.**

Irrigation Schedule

- **March-April** **12-14 days**
- **May-June** **8-10 days**
- **July-August** **10-15 days (if there is no rainfall, irrigation interval should be 8-10 days)**
- **September-October** **15-20 days**
- **November-December** **25-30 days**

WEEDS CONTROL

- **In sugarcane weeds have been estimated to cause 12 to 72 % reduction in cane yield depending upon the severity of infestation.**
- **The nature of weed problem in sugarcane cultivation is quite different from other field crops because of the following reasons.**
- **Sugarcane is planted with a relatively wider row spacing.**
- **The sugarcane growth is very slow in the initial stages.**
- **It takes about 30-45 days to complete germination and another 60-75 days for developing full canopy cover.**
- **The crop is grown under abundant water and nutrient supply conditions.**

- **Weeds flora in sugarcane field besides competing for moisture and light also remove about 4 times N and P and 2.5 times of K as compared to crop during the first 50-days period. Weeds also harbour certain diseases and pests that attack sugarcane and thus lead to indirect losses.**

- **Doob grass (Cynodon dactylon), the cogan grass (Imperata cylindrica) are known to play as alternate hosts to ratoon stunting disease of sugarcane. Thus weeds essentially harm young sugarcane sprouts by depriving them of moisture, nutrients and sunlight. Poor growth of cane resulting from weed infestation also affects quality.**

- **Weeds that are present in the furrows i.e., along the cane rows cause more harm than those present in the inter-row spaces during early crop growth sub-periods. Thus the initial 90-120 days period of crop growth is considered as most critical period of weed competition.**

- **Therefore the weed management practice adopted should ensure a weed-free field condition for the first 3-4 months period.**

EARTHING UP

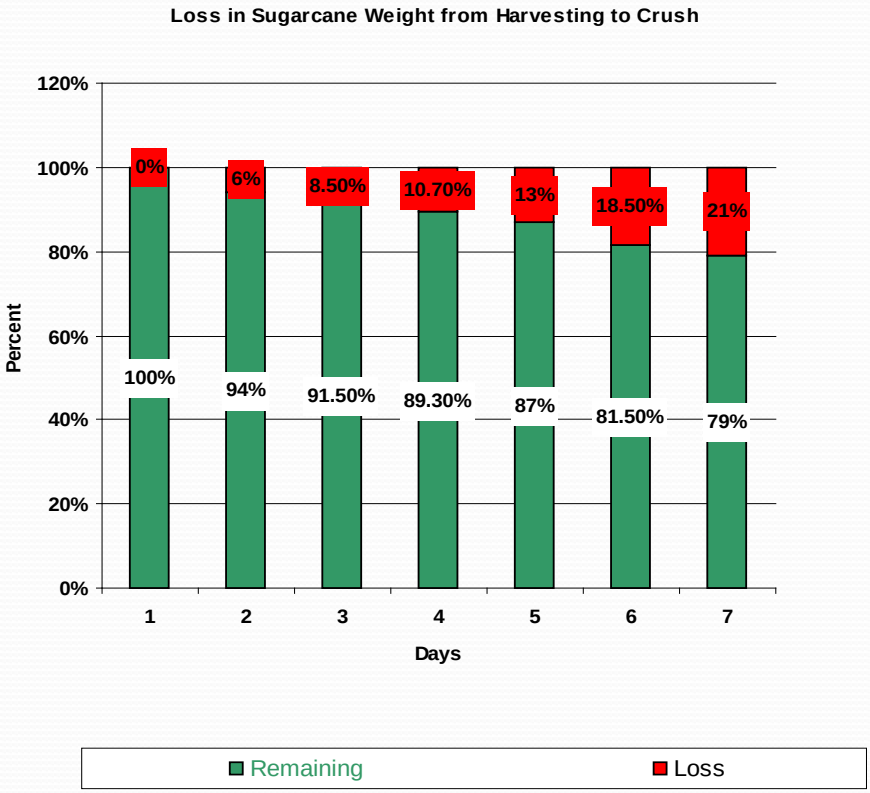
- **Earthing-up operation is also known as "hilling-up". This operation is carried out in two or three stages. The first earthing-up operation is known partial earthing-up and the second/third operation is known as "full earthing-up".**

- **The partial earthing-up is done at 45 days after planting. In partial earthing-up, little amount of soil from either side of the furrow is taken and placed around the base of the shoots. While doing partial earthing-up, the furrow in which the cane row is present gets partially filled-up.**

- **Full earthing-up is done after 120 days after planting coinciding with the peak tiller population stage. During full earthing-up the soil from the ridge in between is fully removed and placed near the cane on either side. This operation converts the furrows into ridges and ridges into furrows. This operation could be done either manually or by using a bullock-drawn/tractor drawn furrower depending upon the spacing adopted.**
- **Full earthing-up at the end of formative phase (i.e., 120 DAP) checks further tillering, provides sufficient soil volume for root proliferation, promotes better soil aeration and provides a sound anchorage or support to the crop and thus preventing lodging.**
- **One more earthing-up after cane population is stabilized at 180 DAP may be helpful in preventing lodging and water shoots formation. It also improves aeration and helps to control weeds**

HARVESTING AND TRANSPORTATION

- **Stop irrigation 25 to 30 days before the harvest of crop and do not leave the harvested crop for long in the field.**
- **In case it has to be kept for a prolonged period, it should be covered with trash. Different varieties planted may be harvested according to their maturity. Harvesting of early maturing varieties may be started during November, mid season varieties during December and the late maturing varieties during January.**
- **Harvesting is done when the crop has fully matured and ripened.**
- **Early varieties and ratoon crops are the first to be harvested.**
- **When the stem is close to the surface, great vigilance is required in order to cut the maximum portion of the stem, which is valuable both for its weight and sugar content.**
- **The harvested cane should be immediately hauled to the mill otherwise weight and sucrose losses may occur.**
- **For this purpose, transport should be arranged in advance.**
- **The harvested should reached the mill gate for processing, no latter than 24 hours after harvest.**



Ratoon Crop Management

- If the ratoon crop is properly managed, it could give higher returns than the plant crop because of savings in certain field operations and inputs. It is important to remember that ratoon crop requires 30 to 40 per cent higher fertilizers than the plant crop. The month of October and November in Sindh and the end of January to beginning of March in Punjab is the best time to keep the crop for ratooning Cane from the fields to be kept for ratoon should be cut at ground level.

- The sugar recovery in ratoon crop is also better and it matures earlier than the plant crop. However, remember that it has to be managed with extra efforts and care. Apply all the phosphorus and potash fertilizer plus one third of N during March. Plough the land in between the furrows to mix the fertilizer well in the soil and then irrigate the crop. Fill the gaps, control the weeds, insect pests and diseases properly. Rest of the nitrogenous fertilizer should be applied in two equal splits during February and March in Sindh where as April and May in Punjab.

CONCLUSION

- **What is the need of the day, it is the big gap and Sindh province has the potential to improve the cane yield and recovery to a significant level.**
- **The government and the researchers, millers and growers can only play a positive role by consolidating their efforts to increase the can yield per unit area within the existing resources.**
- **The ultimate doer for increasing the yield per unit area is grower's community and the government, researchers and millers can play their positive role by helping the growers in terms of training/education for adopting modern cultivation techniques and other relevant guidelines (researchers); making some regular policies regarding support price of cane and advancing short term loan with no interest well before each crop season for their land preparation and inputs (government and millers).**


Thank You