Maximizing Production of

Sugarcane and Sugar Yield
through Modern Agricultura Practices

By

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Introduction

- Next to cotton, the sugar industry is the 2nd largest agro-based industry of Pakistan.
- During 2013-14 crop season, the pak sugar industry attained the ever highest production level of 5.50 M. tons, but this marked achievement put the industry in a serious crises of over production with the un-economic sugar price.
- God forbid some units of sugar industry have gone sick.
- Only the units crushing cane at relatively higher sugar recoveries may save their skin.
- Similarly, with day to day increasing input costs, growers are not satisfied with their cash returns due to low yields.
- In fact cane yields while affect the economy of the growing cane, the sugar recoveries affect the manufacture cost of sugar.
- Both cane yield and sugar mills recoveries determine the economic viability of growing cane and producing sugar.
- And the far reaching benefits are achieved when cane and sugar production is stabilized over a period of time.
- This calls for an unhindered work in maximizing the production of cane and sugar yields.

Topic of the day is to discuss:

Prospects of Maximizing Production of

- Sugarcane and Sugar
- Through Modern Agricultural Practices
- Cane yields affect the economics of cane growers
- Sugar recoveries affect the manufacture cost of a sugar factory
- Each of the yield contributing factor shall be discussed separately

Sugarcane Yields

Sugar Cane Yields (TCH) Trends for 1951-60 to 2010-13

Years	Sindh	Punjab	KPK
1951-60	40.70	28.05	29.01
1961-70	40.16	35.15	37.26
1971-80	35.38	36.13	38.80
1981-90	43.80	36.20	40.28
1991-95	54.50	39.20	44.14
1995-00	58.48	42.80	45.40
2001-05	50.18	47.30	46.19
2005-10	57.67	49.63	44.78
2010-13	60.81	56.03	45.37

Cane Yield Potential

- Average cane yield : 60.8 TCH
- Average potential : 75 TCH
  Most often : 80-120 TCH

Increase in Yield is quite possible

- All through Research & Development activities
- Through an organized programme of sugar mills staff and growers.
- On farm development activities have to be accelerated

Cane yield is measured by:

- No. of canes grown per unit area (Cane population)
- Per cane weight of the crop harvested and
- The multiple factor of cane count x cane weight make up the yield

Cane Population

Cane population per unit area is established by:

- Seed rate: 30,000 setts (2 budded) /acre
  20,000 setts (3 budded)/acre
- Fresh or stale seed cane
- Planting time: timely planting or late planting

Facts ignored

- Consider the environments favorable for germination
- Soil conditions: clay, loam, sandy, saline
- Well pulverized or coarse
- Soil moisture
- Soil temperature
- Soil cover on seed

Main controlling factors

- Planting time
- Seed bed preparation

Time of Planting

A long duration crop always gives higher cane and sugar recovery than a short duration crop.

Cane and sugar yields from September and March planting compared

Planting season	Cane yield t ha^{-1}	CCS% cane	CCS t ha^{-1}
September.	106.25	12.30	13.07
March.	77.64	11.22	8.71
Difference % over March	36.85	9.63	50.00

Effect of different sowing dates on the yield and quality of sugarcane

Date of sowing	Cane yield t ha^{-1}	CCS % cane	CCS/t ha^{-1}
15 Sept.	90.00	10.59	9.53
15 Oct	88.11	10.41	9.17
15 Nov	75.54	10.24	7.73
15 Dec	72.27	10’07	7.28
15 Jan	66.79	9’90	6.61
15 Feb	78.08	9.73	7.6o
15 Mar	77.14	9.56	7.37
15 Apr	66.00	9.38	6.19
15 May	52.98	9.22	4.88
15 June	23.97	9.04	2.17

Growth of October (upper) and March planting (lower) Compared

Per cane weight to be enhanced by accelerated growth and vigor

Such a crop is obtained by

- Proper land development
- Improved planting method
- Fertilizer management
- Irrigation management
- Plant protection measures for: Control of Pests, Diseases and Weeds

Proper Land Development

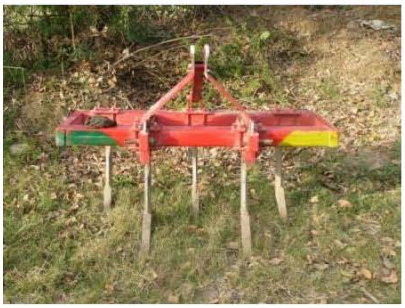
- Land leveling
- Deep ploughing
- Cultivation
- Seed bed preparation to a fine tilth

Deep ploughing and leveling are the most essential operations but are mostly ignored due to ignorance of growers or lack of capital resources.

- Sugar mills may help growers by providing costly farm equipment on loan

Land Preparation Equipment

Deep ploughing



Chissel

Disc plough

Sub-soiler

Land levelling

Land leveler- Blade

Laser leveller

Seed bed Preparation

Disc harrow

Cultivator

Rotavator

Planting method

- Conventional Planting, using Bullocks at 2’ or 2.5’row spaces
- Conventional planting, using tractor:
  - Narrow row spaces at 2.5’ or
  - Wider row spaces at 4’

Inter- row distance for cane planting

Inter-row Spaces Adopted in Various Cane Growing Countries

Country	Row-spaces(m)	Country	Row spaces(m)
USA-Lousiana	1.8	Brazil	1.2 , 1.5
-Florida	1.5	Indonesia	1.2 , 1.5
Argentina	1.6	Philippines	1.2 , 1.5
Cuba	1.65	China	1.2 , 1.5
South Africa	1.5 , 1.8	India	0.9 , 1.2
Mauritius	1.5 , 1.8	Pakistan	0.75, 1.2
Australia	1.6 , 1.8		0.6-1.2-0.6
	0.5-1.3- 0.5		

The Latest Planting Technique

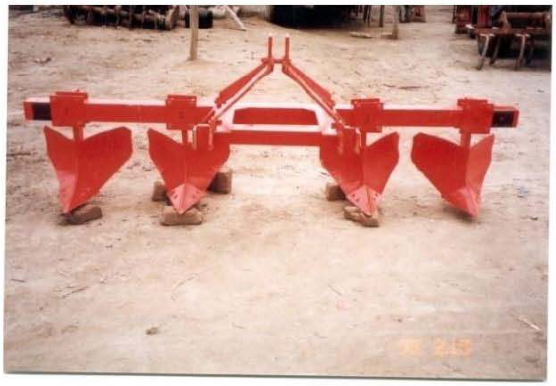
- Dual row planting

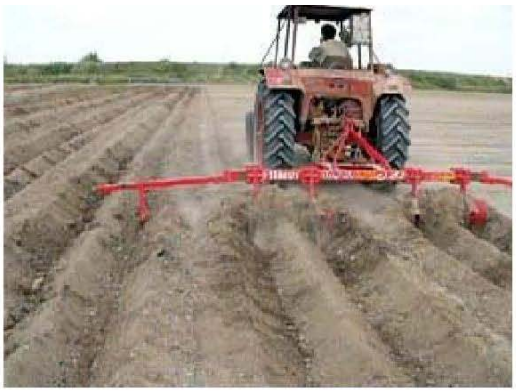
Australia: Inter row spaces = 0.5 – 1.3 - 0.5 meter

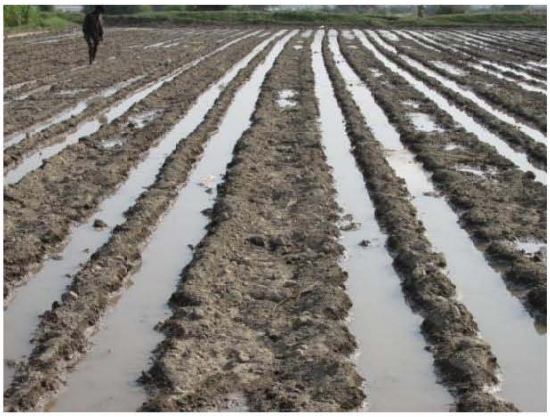
Pakistan : Inter row spaces = 0.6 – 1.2 - 0.6 meter or

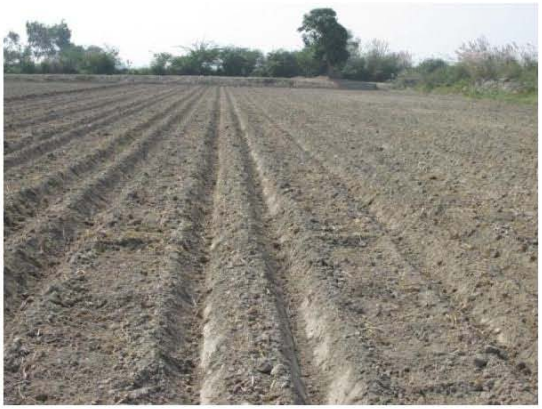
= 0.75 – 1.35 – 0.75 meter

New Device for Dual Row Planting System





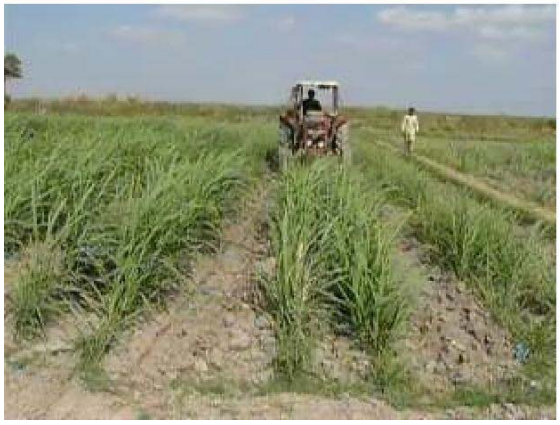


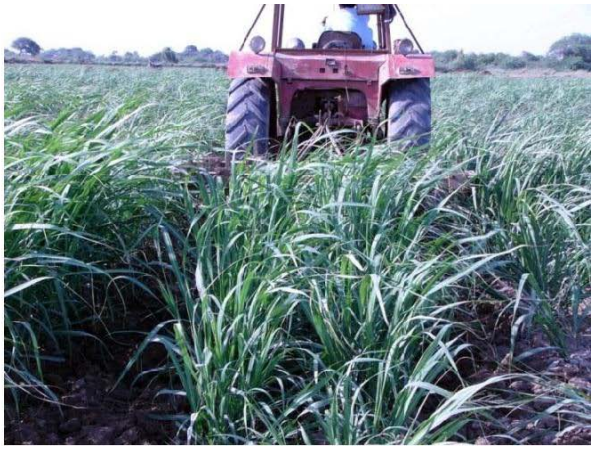


Hoeing and weeding

Manual hoeing

Hoeing by bullock drawn tarphali





Inter-row hoeing in dual row planting – hoeing possible even in a little advance stage of growth

Advantages

This technique is a step towards mechanization and is a labor and time saving device. This system facilitates:

- Inter-row hoeing at early and even later stages of crop growth
- Better crop growth and more tillering
- Convenience in management of ratoon crop
- Wider inter-row spaces
- Better interception of light
- Leaves exposed to more light with higher rate of photosynthesis; hence better sugar recovery

Better management for raising a profitable intercrops

Some inter-crop combinations

Growing wheat in inter-row space spaces of 4ft.

Growing Sarson in inter-row spaces of 4ft

Growing peas in inter-row spaces of 4ft

Growing berseem in inter-row spaces 4ft

Inter-row spaces

Effect of inter row spacing on yield and recovery of sugar cane.

Planting time	**Cane yield t/Ha**	
	1 meter	1.5 meter
Spring	89.88	82.00
Autumn	107.27	112.29
Cane quality	**Sugar recovery %**	
	10.68	11.55

Mechanized Vs Conventional Planting

Cane yields compared at grower's fields in Habib Sugar Mills area

S.No	PB No.	Grower's Name & Circle	Total acres	Dual rows 2'-4'-2' (acres)	Cane yield t/ha		
					Dual row	Single row	Diff
1	4794	M. BachalJamali, Balochpur	800	550	1000	800	200
2	3009	Abdul Ghafoor,Koree, Liari	18	4	750	550	200
3	3294	Fasihi Ahmad Shah; (manager)Sher Ali Shah	180	40	1000	925	75
4	7243	Ali Raza Jamali,60th mile	50	6	700	550	150
Total / Average			1048	600	995	805	190

FERTILIZER MANAGEMENT

Balanced fertilizer dose

Fertilizer requirements of cane:

	N	P	K
Kg per ton of cane	1.20	0.46	1.49
Recommendations for Sindh Kg ha^{-1}.	200-300	100-12	100-170

Build up Organic Status of Soil

Organic Matter required for good crop production: 1.5 to 2.0 %

Main sources: FYM- Farm yard manure
GM - Green manure
PM - Sugarcane Press mud

Role of sugar mills: Ensure supply of fertilizer on loan and PM for use as organic fertilizer in cane fields

Points ignored:

Efficient use of fertilizer

Time and Method of application

- Be attentive to the timing of P application: in furrows at the time of sowing only; latter application not effectively utilized
- Method of N application: prefer drill application, in furrows after hoeing, fertigation, Never broadcast
- Complete fertilizer by tillering and before cane formation
- Avoid delayed application
  - Crop may lodge
  - Maturity delayed
- All N must be exhausted before harvesting
- Leaf N at the time of harvesting should be reduced from 1.8 - 2.0 to 1.2 - 1.3%
- Leaf color should change form dark green to pale Yellow
- Spray application of potash can help improve sugar recovery

Cane and sugar yield as affected by foliar spray of potassium, 60, 90,120 DAP.

Spray treatment	Cane yield tha^{-1}	Sugar yield tha^{-1}
Potassium choloride @ 2.5%	95.00	6.93
Potassium choloride+ Urea @ 2.5% each	89.30	7.47
No spray	80.70	6.60

Meeting Irrigation Requirements of cane

- Gross water needs 1800 – 2000 mm per crop season.
- Consumptive use requirements of water 1300 mm.
- Irrigation water – main constraint in cane production
- Observe irrigation use efficiency
- Measures to conserve moisture
  - Deep ploughing
  - Incorporate organic matter in soil
  - Proper layout of field and water courses
  - Weed control

Irrigation Water Management

Irrigation scheduling as per actual water needs of the crop.

Observe application efficacy

Excess irrigation: → Affect crop economics
→ Cause leaching of nutrients
→ Cause lodging

Water shortage : Stress on crop growth

Severe shortage : Increase fiber and reduce sugar extraction

Manage irrigation before harvesting

- Irrigation interval to be increased
- Reduce vegetative growth
- No of leaves per plant must be reduced from 12-15 to 6 - 8 leaves.
- Low moisture status in plant help improve sugar recovery
- Leaf sheaths moisture to be reduced from 82 - 85 to 72 - 73%

Adoption of Plant Protection Measures

- For raising a healthy crop, free of diseases, pests and weeds
- Role of Sugar Mills
  - Establish healthy seed nurseries by seed treatment
  - Supply herbicides for effective weed control
  - Establish biological pest control laboratories

Cane Varieties

Cane variety is the single most dominant factor in improving sugar mills recoveries.

A number of high sugar varieties have been released by Sugarcane Research Institutes, during the past decades.

The problems observed are:

- Rate of new varieties adaptation is very slow.
- There is a great time lag between a variety release and its spread at growers end.
- Quite a few sugar mills make a desired investment in seed propagation.
- Sugar mills are least concerned for research on new variety evaluation.
- All the sugar mills don't have seed farms for variety multiplication.
- And
- Research Institutes don't have enough germ plasm for new variety evolution.

Cane Varieties – Yield

- Cane variety yield is reflected by its adoptability in the region.
- SPF 234 got adopted largely in Bahawalpur Div.
- BL4 was confined in Lower Sindh.
- Cane varieties yield better when are evolved for site specific objectives – .
- HS 12 very good for average and poor fertility areas
- Should have varieties for saline and low lying areas.

Sugar recovery trends in cane growing provinces of Pakistan

Period	Sindh	Punjab	KPK
1951-60	0.0	7.6	7.8
1961-70	8.5	8.2	8.3
1970-80	9.1	8.5	7.8
1980-90	9.1	8.3	8.6
1991-95	9.4	8.2	8.6
1995-00	9.6	7.9	8.0
2001-05	9.4	8.6	8.1
2005-10	9.5	8.8	8.1
2010-13	9.9	9.6	9.3

Sugar Mills Recovery Potential in Sindh

- Average mills recoveries: 9.9 %
- Average potential : 11.0 %
  - Most often : 9.5 -10.5 %

Sugar Yields

Besides the cultural practices already discussed , sugar recoveries are increased by:

- Grow high sugar varieties
- Harvesting according to crop maturity / variety
- Reduce sugar losses

– Adopt proper harvesting method
– post harvest staling losses
– Tops and trash-the extraneous matter in cane

– For a profitable crushing season sugar mills should start operating with 10 % sugar mills recovery in November and terminate the season at 12.5 % sugar recovery. The sugar recovery pattern of our sugar mills indicates the level of required improvements.

Periodic Sugar Recoveries of Different Sugar Mills in Sindh, During 2010-11

Sugar Mills	Season 2010-2011					
	Nov.	Dec.	Jan.	Feb.	Mar.	Season Avg.
Mirpur Khas	7.2	9.6	10.1	10.8	11.4	10.4
Al-Abbas	7.4	9.3	10.1	10.8	10.7	10.2
Habib	7. 7	9.2	9.6	10.3	10.9	9.9
Army Welfare	0	8.2	8.7	9.3	0	8.7
Khoski	0	8.4	8.7	8.7	8.7	8.6

Sugar Recovery Level of Cane Varieties

We do have cane varieties to harvest better sugar in early and late crushing period. The sugar mills have to manage cane planting with definite objectives in view.

Periodic Sugar Recoveries of Cane Varieties at Sugar Cane Research Institute, Faisalabad.

Varieties	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Average Nov. - Mar
HSF-240	8.5	9.2	10.7	11.4	11.6	12.1	11.0
CPF-246	9.9	11.0	11.5	11.8	12.0	12.2	11.7
CPF-247	10.0	10.5	10.8	11.1	11.7	12.4	11.3
CP 77-400	9.3	10.0	10.9	11.3	11.4	12.2	11.1
CPF-237	9.4	10.4	10.9	11.4	11.9	12.3	11.4

Reducing Sugar Losses – Tops and Trash

- A detrimental feature of our sugar industry, cane is purchased with tops and trash.
- Causing tremendous loss to the sugar industry.
- Un trashed cane
  - Tops 10 -15 % of mature cane
  - Trash 5 -7 % of mature cane
- Truck/Troley loads received
  - Clean cane , partial clean
  - Completely un-trashed with tops.
- And, we accept all types – a little resentment

Extraneous Matter

Trash, tops, roots, dirt & dried stalks.

- The volume and mass varies with consignment from 0 to 20% or even more in extreme cases.

Immense losses by way of

- Reduction in actual cane weight, with extra payment on weight of E.M
- Increased fiber and poor juice extraction
- High sugar losses in bagasse
- Increased turbidity in cane juice
- Poor clarification with additional time and expenses
- Trash reduces grinding capacity of mills, affecting efficiency.
- Additional impurities and suspended material make clarification difficult, with reduced boiler efficiency.

Reducing Sugar Losses – Tops and Trash in cane should be discouraged at all cost.
1% increase in trash reduce sugar recovery by 0.12% (Shakarganj research)

With just 5% trash & tops in a truck load of 400 maunds: cane trash weight 20 maunds = it amounts to Rs. 3600; It is additional payment over and above the cane wheat.

Sugar Rec. loss 0.6% : Loosing 9.6 kg sugar per truck load

Are we aware of this tremendous loss?

Post Harvest Staling Losses

Two fold losses loss in cane weight:

Due to moisture loss and drying

Loss in sugar recovery: due to biochemical changes in cane juice

Post harvest staling losses in sugar cane

% losses in cane weight			
Day	Nov.	Jan.	Mar.
1.	0	0	0
2.	1.11	0.54	0.67
3.	2.14	1.40	3.03
4.	2.74	1.74	4.14
5.	3.23	2.32	6.02
6.	4.21	3.44	6.60
7.	5.59	3.88	7.00
8.	7.19	5.22	8.60

% losses in CCS % cane			
Day	Nov.	Jan.	Mar.
1.Actual Rec.%	11.43	12.40	13.67
2.	0.00	+ 1.61	1.75
3.	0.87	+ 2.18	3.44
4.	2.62	+ 2.18	6.14
5.	5.25	- 0.56	9.07
6.	8.75	- 0.81	12.65
7.	21.52	- 4.84	16.09
8.	38.76	- 8.87	20.04

Measures to avoid staling losses

- Use vigilance in cane supply permit.
- Cane harvesting and supply to correspond with crushing capacity of mills.
- Harvesting program of growers to be watched.
- Proper education to growers on cane harvesting
- Cane supply permit = for within 24 hours crushing
- Sugar mills to have prompt cane transport system.
- Cane varieties show varying behavior of post harvest staling losses
- Sugar cane Research Institute to release tolerant varieties.

Cane Harvesting Schedule

Bases of cane harvesting schedule

- Maturity of the crop
- Recovery pattern of cane varieties.
- Crop condition

Crop maturity to be prioritized as under:

- Ratoon crop
- Autumn planted crop
- Spring planted crop

In each set of the condition variety factor to be prioritized as

- Early maturity varieties
- Mid maturity varieties
- Late maturity varieties
- Harvesting Schedule of Cane Varieties with Reference to their Maturity Period

Conclusion

- Low cane yields and low sugar recoveries with unplanned marketing system in cane procurement are attributed to affect the economic viability of sugar industry.
- Economic viability of the industry can be enhanced by the increase in yield pre unit area, increase in sugar recoveries and reducing the sugar losses in cane.
- The cane yields are enhanced by adopting full package of cane production technologies with organized efforts of sugar mills staff and growers and floating incentives by the industry.
- The sugar recoveries are improved by propagation of high sugar varieties.
- The role of sugar industry in its cane procurement program is of paramount importance with respect to liaison with grower, cane development services, provision of farm input resources, and prompt cane payment.
- Cane price competition and transportation charges on purchase of cane from far of distance become great economic liability on sugar industry. This could be avoided by development of cane within sugar mills jurisdiction and getting rid of middlemen.
- Industry is suffering great quality and monitory losses by purchase of cane with tops and trash and crushing stale cane. These losses if reduced would greatly enhance economic viability.
- In cane supply and procurement program induction of middlemen has proved a menace to the industry by increasing purchase price and supply of poor quality cane. To curb the situation the mill owners have to pay attention to this problem.