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Evaluation and Management Option of Over Aged Sugarcane at Kessem Sugar Project, Southeast Ethiopia

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***Abstract* – A study was conducted at Kessem Sugar factory in Ethiopia to assess evaluation and management option of over aged sugarcane at kessem sugar project. The experiment was laid out in a simple descriptive layout for ease of sampling. The test field was incorporated with age and variety on the standing cane in which different yield parameters were conducted. The result of analysis shows that the sugarcane age has high effect in field yield which is indicator of sugar. Variety was obviously affected by cane age in which Varieties like Co680, Mex54/245 and B41/227 were exhibited a lot of dead stalk, lodged cane and development of side shoots at the age of 36 month while the common sugarcane varieties B52-298 and NCo334 including Co740 showed relatively better performance at the same age. Increased levels of harvest age significantly influenced all quality parameters. On the other hand, improper method of harvesting either under-aged or over-aged cane leads to loss in cane yield, sugar recovery, poor juice quality and problems in milling. Therefore, It is recommended that the cane is harvested at the most suitable time when the economic optimum of recoverable sugar per area is reached and with exception if there were over aged cane it is possible to blend with the recommended ration of one third with normal age cane.**

***Keywords* – Sugarcane Variety, Over Aged Cane, Blending, Field Yield.**

I. INTRODUCTION

Kessem Sugar Factory is on final stage of accomplishing its project phase and start crushing. Beside this the factory and agricultural operation to be succeeded they have to know the quality of sugarcane especially over aged cane in order to take the necessary precaution on time for optimum cane crushing.

Harvesting of sugarcane at a proper time i.e., peak maturity, by adopting right technique is necessary to realize maximum weight of the mill able canes produced with least possible field losses under the given growing environment. Increased levels of harvest age significantly influenced all quality parameters. On the other hand, improper method of harvesting either under-aged or over-aged cane leads to loss in cane yield, sugar recovery, poor juice quality and problems in milling. It is important that the cane is harvested at the most suitable time when the economic optimum of recoverable sugar per area is reached.

Age of harvest is one of the most important factors affecting sugarcane productivity (Sundara, 2000). Varietal differences in growth and maturity rates must be considered when harvesting decisions are made. In addition to the difference of varietal maturity rates, environmental conditions, management practices, and pest pressure also influence the optimal harvest age of sugarcane.

In Ethiopian Sugar Estates usually cane maturity is customarily determined by taking the crop age and appearance as criteria for several years. They have been using a wide range of harvest period which extends from 18-24 and 14 to 17 months for plant cane and ratoon cane respectively for all varieties (Yeshimebet, 2005).

Improper harvest age is recurrent problems of pre-harvest cultural practices, which severely affect quality and yield of sugarcane. Kessem sugar project, around 855.19 hectare was covered with over-stand cane having an age range of 32-45 month old. This will cause a decline both in yield and quality of sugarcane production due to heavy lodging, as the result most of the cane fields were covered by dead stalk and Water shoots which are the late-formed tillers or side shoots, which robust and fast growing. They originate mainly due to plentiful supply of water, inadequate earthing-up and late fertigation. These water shoots, as the name indicates, contain lot of water and less sucrose and more of reducing sugars. Water shoots affects the growth of adjacent stalks. They harbor insect-pests and when they are harvested and sent to mill for crushing, lead to reduced juice quality and affect sugar recoveries. Therefore it is advisable to remove water shoots as and when they arise, remobilization of accumulated sucrose to supply newly growing side shoots. [Hadush *et al.*, 2014].

However due to the late start of the factory some cane fields (855.19 ha) at Kessem Sugar Project become beyond the maximum harvest age (> 24 months) (Table 1). Therefore the fate of these fields should be decided whether it is fit for milling or not. Therefore, the objective of this report is to assess evaluation and management option of over aged cane at kessem for quality of over aged cane fields for crushing.

II. METHODOLOGY

Sampling method

Random sampling method were used in which Predetermined number of cane samples were taken for each cane field at different age group for each variety using (W-Shape). The representatives of the agricultural operation and Planning of Kessem Sugar Project in collaboration with Metahara Research Station conducted the sampling. The laboratory analysis done at Metahara research station. During sampling 18 cane fields three from each and a total 54 samples from different age group (13-36 month) were taken for cane and juice analysis. Out of 855.2 hectare of over matured cane (25-36 month) 123.74 hectare or 14.5% of old cane fields were sampled for cane and juice analysis while all old cane fields also assessed at different age group (25-36) and varieties to observe the current status of the cane.

Fields sampled for cane and juice analysis

Sample of mill able cane was collected from each field in three replications; direct cane analysis method was used to determine Brix, Pol, Moisture, Fibr % cane. Reducing sugar was determined on cane juice extracted using hydraulic press (Red.Sug. % Juice) using the original method of Lane & Eynon Recoverable sugar was calculated using the formula practiced in Metahara Sugar Factory, until Kessem generates its own, considering efficiency of the new factory.

III. RESULT AND DISCUSSION

3.1 Effect of cane age on field yield

The analysed data in fig.1 showed that field yield was decreasing with age beyond a certain limit and become constant. This indicates that over aged canes are more prone to deterioration as the plant loss its resistance with age. The constant field yield with acceptable range of old cane at 32-36 months at Kessem condition might be due the continuous supply of water to the plant. But, the constant field yield above 36 months might be due to the influence of sucker plants since mother plant has been died. Therefore, decision should be made based on visual observation above 36 age canes.

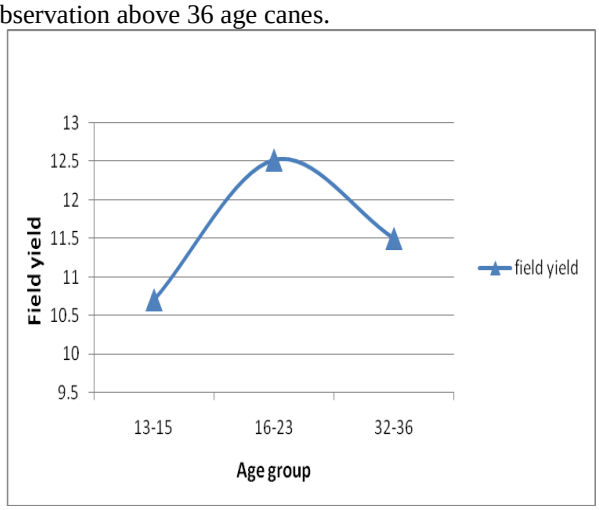

Fig.1. Effect of cane age on field yield

3.2 Effect of over aged sugarcane varieties on field yield

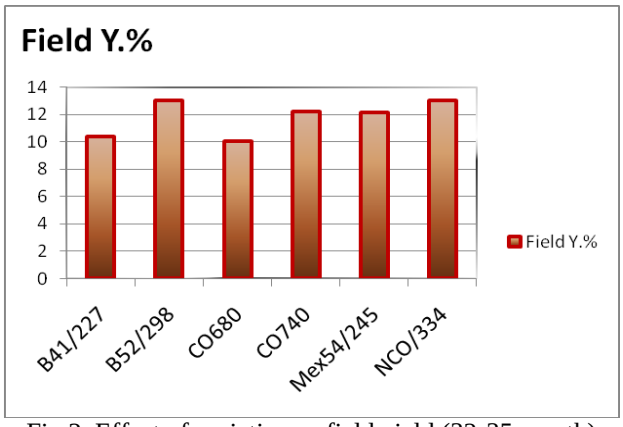

Fig.2. Effect of varieties on field yield (32-35 month)

Variety was noticeably affected by cane age (Fig 2). Varieties like Co680 and B41/227 were found to be inferior cane quality or below the acceptable range (>11%) at the age of 32 month while the common varieties B52-298 and NCo334 recorded the maximum field yield at the same age. This indicated that varieties play a great role in determining cane quality with increasing age. Especially for those new projects in which the factory not yet fitted with the age of the cane, selection of varieties is very crucial during planting. Similarly, Hadush *et al*, 2014 noticed that variety was considerably affected by cane age.

Cane and juice analysis

Based on the result of juice analysis from 24 fields of old cane aged 25-36 month indicated that the recoverable sugar % cane ranged from 10.06 to 13.04 which are quite normal under proper irrigation management.

Purity of cane

The highest purity of cane was 93.08% for Mex 54/245 sugarcane variety at the age of 13 months while the lowest purity was 82.52% for Mex 54/245 at the age of 36 months(Table). The average purity is 87.8 % which is quite alright at the age ranged 13-36 month.

Recoverable sugar % cane

The highest recoverable sugar % cane was 13.04% for NCO 334 at the age of 32 months while the lowest was 9.53 % for CO 680 at the age of 14 months. The average recoverable sugar is 11.57 % on cane which is quite normal.

Fiber % cane

The highest fiber % cane was 16.89 % for B41/227 while the lowest was 11.43% for Mex 54/245 sugarcane variety at the age of 32 months. Though the highest and the lowest fiber content of cane are out of the required range, the average is closer to the optimum level (13.59%)

Moisture % cane

The highest moisture % cane was 73.20 % for D41 /227 at the age of 14 months. The low moisture content of cane was 68.55 for CO 740 at the age of 15.

Table 1. Analytical result for cane and juice analysis at different age (13-36 month)

Variety	Age (month)	Brix% cane	Pol% cane	Purity % cane	Moisture %cane	Red. Sugar %juice	Fiber% cane	Recoverable sugar % cane
Mex 54/245	13	14.58	13.55	93.08	71.43	0.173	13.99	11.95
CO680	14	13.65	11.64	84.89	73.3	0.426	13.05	9.53
B41/227	14	14.84	12.6	84.97	73.2	1.172	11.96	10.36
B52/298	15	15.69	13.82	88.1	72	0.467	12.3	11.73
NCO/334	15	15	12.51	83.46	73.05	0.376	11.94	10.08
CO740	15	15.26	13.37	87.47	68.55	1.671	16.18	11
Mex54/245	17	17.13	15.03	87.73	70.92	0.135	11.95	12.74
CO740	17	16.46	14.46	87.93	70.65	0.112	12.89	12.21
B52/298	21	17.79	15.52	87.21	70.3	0.206	11.91	13.08
NCO/334	21	17.06	14.13	82.94	70.13	0.204	12.48	12.43
NCO/334	23	16.56	14.56	87.96	68.45	0.181	14.99	12.14
NCO/334	32	17.63	15.47	87.69	69.45	0.265	12.91	13.04
NCO/334	32	15.69	13.06	83.45	71.57	0.445	12.75	10.47
B52/298	32	17.48	15.44	88.33	68.55	0.308	13.97	13.01
Mex54/245	32	17.09	14.62	85.39	71.48	0.25	11.43	12.14
CO740	32	15.85	14.27	89.9	70.15	0.411	13.99	12.25
B41/227	33	14.8	12.68	85.43	71.98	0.394	13.22	10.41
CO680	33	14.71	12.49	84.71	70.23	0.335	15.05	10.06
Mex54/245	36	16.41	13.6	82.52	70.12	0.209	13.47	10.8

Reducing sugar % juice

The highest reducing sugar content of juice was 1.67 for CO 740 at the age of 15 months while the lowest was 0.112 for CO740 at the age of 36 and 17 months respectively. From the 24 samples only two samples of cane show 1.67 % and 1.72 % reducing sugar content for CO 740 and B41 /227 respectively and the rest 22 samples show less than 1% of reducing with average of 0.35% since the required reducing sugar content of cane is less than 1, most of the cane samples are under the required range.

Table 2: Percentage of over aged cane varieties by area and cane tonnage at Kessem

Varieties	Area	Est. cane (Qt)	% area	%cane tonnage
NCo334	275.49	165265.16	32.2	30.24
Mex54/245	174.76	119016.07	20.43	21.80
B52/298	202.47	123,642.98	23.70	22.62
Mixed	80.27	53,287.47	9.43	9.75
CO740	64.12	44845.31	7.50	8.2
CO680	34.99	24,960.69	4.01	4.56
B41227	20.29	13751.64	2.40	2.52
NCo376	2.8	1738	0.33	0.32
Tobe blended	**823.23**	**521,523**	95.4	95.4
discarded	**39.96**	**24,984**	4.6	4.6
Total	**855.19**	**546,508.12**	100	100

Variety was obviously affected by cane age (Fig.2). Varieties like Co680, Mex54/245 and B41/227 were exhibited a lot of dead stalk, lodged cane and development of side shoots at the age of 36 month while the common sugarcane varieties B52-298 and NCo334 including Co740 showed relatively better performance at the same age. These indicate that varieties play a great role in determining cane quality with increasing age.

3.3. Old cane field observation

Based on visual observation on old cane fields, most of the fields are exhibit dead stalk, lodged cane, high open spot, watery shoot (side shoot) and cane damage . In general, among the observed old cane fields were poorly managed as the result cane yield may not be obtained as estimated earlier. The total cane composition in table 1 shows that varieties B52/298, NCo-334 and

Mex54/245 have higher proportion respectively. Totally they account for about 83.6 % of the total cane supply during crashing time of the factory, Furthermore, out of the total over aged cane of above 32 months, B52/298, NCo-334 and Mex54/245 varieties accounts for about 74.66 % of the total over aged cane (Table 1).

Based on Metahara experience, the blending of over aged cane with normal age cane is effectively working without affecting the processing quality and daily crushing capacity of the factory.

Moreover, no significant difference in sugar production was recorded between the separately crushed normal age

cane and the blending of over aged cane with normal age cane. During the blending of over aged cane and normal aged cane, it is realized that varieties of NCo-334 and B52/298 could maintain their optimum sucrose content if they are managed well during their old age.

Out of the total old cane fields only 4.6 percent has been discarded totally. Among the discarded field 88.5 percent of the area is covered by CO680 variety which is very sensitive to ageing. During visual observation the technical committee decided to discard the above mentioned fields because of 75 percent of the fields is totally dried, dead stalk and open. Since, the fields were full of dead stalk and dry, it will be easy to burn and collect the remaining debris so as to clean the field and ready for uprooting.

3.4 Economic return of milling over aged cane

The economic return was directly adopted from Metahara condition from old cane blending. even though some of the over aged cane do have low sucrose content (field yield), it is possible to process economically acceptable amounts of sugar. For instance if we assume at minimum field yield value of 5% , 97% recovery, 639qt/ha average estimated old cane yield, 1400 unit price (birr/qt) and 200 birr/qt cost of processing, the factory can get **25,293,800** birr net return (Table 2). On the other hand, extra expense could be incurred to load, unload and transport the cane during da mping. To damp the cane, the conventional trailers cannot be easily used as usual. Rather the estate should rent Dam trucks for this purpose which is qui te expensive. Additionally these types of vehicles may cause soil compaction on those area expected to discarded.

Table 2: Net Earnings from processing of over aged cane

Area (ha)	Est. cane (Qt/ha)	Est. Total cane(Qt)	Milling cable	Field Yield	PWS (Qt)	Price (birr/qt)	Total Revenue (birr)	Cost of processing (birr/q)	Total Cost of production	Gross Net Earning (birr)
823.2	639	521,523	0.97	5%	25,293.8	1200	30,352,560	200	5,058,760	25,293,800

IV. Conclusion and Recommendations

Based on the result obtained the following recommendation was suggested for kessem sugar factory; blend the old cane at the ratio of one third with normal cane which can give at least appropriate field yield under the factory's sampling conditions, above 11% is taken because of the readings of juice analysis result from the sampled cane which is a little bit exturated as it is cut while the cane is green, with no extraneous matter and with almost no kill to mill time period.

- It is recommended to process the cane by taking most care during harvesting. Canes with higher age and varieties like, B41/227 and CO 680 should be given priority during harvesting;
- It is preferable to use B52298 and NCo334 having a good stand for blending as these varieties do have better process ability. These canes will be obtained from fields with age of 14-24 months,

Moreover during harvesting of over aged cane attention should be given for :

- To avoid deterioration burnt cane field at each cutting site should be all in all cut and stalked as well as transported on that day as the resistance of aged cane for deterioration is very low
- The cane should be carefully graded or selected properly to eliminate dead or infected canes, as well as late season tiller (bull shoots),
- The cane should ideally exclude the white immature cane top, green leaves, trash, and any other extraneous material (stones, soil etc.),
- Before harvesting soil moisture should be maintained through irrigation till the onset of drying off period.
- Drying off period should be shorter (as long as the field is convenient for machineries)
- Correction measure should be done accordingly at the time of blending of normal aged cane with over aged cane during crushing.

In general the current sugarcane quality parameters sampled show quite process ability. However care should be taken by the agricultural operations in order to keep up such quality until crushing starts.

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