Impact of Modern Machines used for Plant modification like Sugarcane in Environmental Climate Change

Abstract

In the present research paper analysis on the performance of tractor operated sugarcane leaf stripper is performed. Sugarcane is the most prominent cash crop of India, India is second largest producer of sugarcane. Sugarcane harvesting process is labor intensive takes around 850-1000 man working hours per hectare when sugarcane is harvested manually and de-trashing alone takes 400 man-h in manual harvesting procedures for removal of tops. To prevent the labor mechanized leaf stripper is developed and fabricated and the performance of the machine is evaluated on MCO-238, K-269, and R-94184 variety of the sugarcane. The data regarding de-topping time and stripping rate is taken and effect of parameter's namely Length of, Girth and No. of Buds of stalk is evaluated. The machine was operated at roller speed of rpm. The results showed that length and no. of buds affects the stripping time significantly and length of stalk and girth of stalk has significant impact on the stripping rate.

Keywords: Sugarcane, Mechanical,Tractor PTO Operated and Leaf stripper

Introduction

Sugarcane is the main source of Sugar and is considered among prominent cash crops. India is second largest producer of sugarcane after Brazil. As of the 2018 data the global production of sugarcane stands 1.91 billion tonnes, with Brazil having major contribution of 39% and followed by India with 20%. It has significant contribution in the GDP of the nation. (FAOSTAT, 2019)

Sugarcane belongs to the species of tall perennial true grass; the family of sugarcane is Graminease, class monocotyledons, sub family panicoidae, genus *Saccharum* and tribe *Andropogoneae*. In India,the specie *Saccharumofficinarum*is most common among the different species of sugarcane due to its high sucrose content. Sugarcane is a labor intensive crop, in terms of statistics in India alone 5.0 M ha of area is under sugarcane production which contributes to 19.07% of world's share and out which around 355 MT of sugarcane is produced which is equivalent to 18% of the world's production.The productivity of sugarcane in India stands at 78.25 metric tons per hectare which is above the global average productivity of 70.77 metric tons per hectare. (Statista Research Department, 2020)

Comment [A S1]:

In harvesting of sugarcane the requirement of huge labor force is of major concern, in India mechanized harvesting of sugarcane crop still no much common practice. Use of harvesting knife is among the most common manual harvesting techniques being followed in India, manual harvesting is very time consuming and costly as it takes around 850-1000 man working hours per hectare when sugarcane is harvested manually (KISHORE, et al., 2017). Due to more employment opportunities in other sectors the cultivators of sugarcane feel the brunt of labor shortage which in turn increases the sufferings and losses in the peak season. Any delay in harvesting has direct impact on quality of sugarcane in terms of yield, sugar recovery and juice quality. Therefore, keeping in view of mentioned shortcoming and hardship in sugarcane harvesting there is need to introduce and promote economic mechanized sugarcane harvesting solution in India.

Background

Harvesting of sugarcane at proper time i.e. at peak time of maturity by using appropriate technique is crucial to realize the maximum malleable cane weight. Therefore keeping in view the negative consequences of manual harvesting of sugarcane there is need to adopt mechanized solution to the various stages of sugarcane harvesting.

De-trashing/ Leaf stripping

De-trashing is the process of removal of tops and stripping of leaves. In traditional methods the dried leaves of sugarcane was burnt in the standing crop and then the stalk is cut manually (Dawson & Boopathy, 2007). Generally, at the time of harvesting the sugarcane stalk comprises of 70% stalk for milling, 15% green leaves, 8% cane tops and 7% dry leaves and there is need to remove leaves and tops before milling.

Manual De-trashing

In the conventional method the labor uses sickle to manually remove the trash and by pick sugarcane stalks one after another. Manual process of trash removal is time consuming and labor demanding.

Fig.1: Hand tool developed by TNAU

Fig.2: Hand tool developed by IISR

Mechanized method

In mechanized method de-trashing can be achieved by following process:

a. Removal of leaves by use of compressed air

b. Removal of leaved by centrifugal method

c. Removal of leaves by use of series of rubber belts with groove cuts

In India hand tools are most commonly used in removal of tops and green leaves, institution like IISR, OUAT and TNAU has developed some efficient hand tools for the purpose of de-trashing and these tools are available in market, de-trashersand the efficiency of the same de-trashers along with the data on damage done to the stalk is given in the table below: (KISHORE, et al., 2017)

Table 1: Stripping efficiency and damaged caused to stalk of various developed detrashers.

Developed Detrasher	Stripping Efficiency, kg/h	Damaged caused to stalk, %
IISR detrasher	119.75	6.1
TNAU detrasher	123.25	3.5
OUAT detrasher	117.50	4.3
Hand Operated detrashing	110.60	0.0
IISR mechanical sugarcane detrasher	2400	0.0
IIT Kharagpurdetrasher	1210	0.00

Literature review

In an experimental study conducted by SopaCansee with title "A study of Sugarcane Leaf-Removal during Harvest" role of mechanized sugarcane leaf-removing tool is evaluated in speeding the harvesting process and reduction in contamination. In the study LK92-11 variety of sugarcane in used as feed to machinery which has the harvesting period of 12 months with density of 9,387 stems/rai and it can produce sugar cane tops up-to 14.01 tonns/rai, 1675.2 kg/rai leaves and 180 kg/rai sheath. Small engine powered leaf remover is used with 4 different materials namely soft wire, tendon string, sling and medium wire. The efficiency of machine is indicated by the sugarcane leaf removal quantity (by area) and time. It was observed that quantity of leaves and leaf sheath affects the harvesting rate, also the leaf sheath and leaves are source contamination which could bring mud, sand and clay into the final product such as sugar. Using mechanized method for leaf-removing the harvest time can be reduced from 37h/rai to 11.4h/rai. Also, it was highlighted that the material of leaf

Comment [A S2]:

Comment [A S3]:

removing blade is a crucial element in managing the efficient harvest whereas the poor material on blade can lead to tangling and clogging of rotator dish. (Cansee, 2010)

In a study where large scale sugarcane leaf stripper was introduced with automatic feed, it was found that with advances in harvesting technique where stripper wheels having leaf stripping bars installed in them are used can reduce the labor intensity without compromising the quality and could prove helpful in using the removed leaves from recycling or reuse point of view. (Lin, et al., 2012)

In study by Sing & Solomon, 2014, "Development of a Sugarcane Detrasher" a powered operated detrasher is used which is composed of mechanized feeding mechanism, detrashing unit and delivery system. Detrashing unit consists of two counter rotating rollers, an air blower and comb shaped attachment. Rollers were made of mild steel, cushioned with rubber canvas belt having comb like attachment to increase grip and they have effective diameter of 300 mm. The working mechanism is such that the air blower pushed the green top and leaved of the cane into the detrashing cavity from where the counter revolving rollers pushed down the leaves, meanwhile the forward movement of cane and downward push of leaves through roller separates the leaves from the cane. Five varieties sugarcane namely CoLk 97147, CoPant 97222, CoSe 95422, LG 96115 and CoLk 84184 were used for performance evaluation where three canes at a time are fed through feeding chute at 10° angle and roller rpm was in range of 350-400. It was observed that around 1.5 to 6.6% of trash is left on the de-trashed cane and the average machine output comes out to be 2.4 ton/h. The economic evaluation revealed that cost per ton of cane was INR 83 which is less that the cost of INR 100 per ton in case of manual method of detrashing. Around 17% of cost of operation and 84% of labor requirements are reduced on introduction of mechanized method. (Singh & Solomon, 2014)

Comment [A S4]:

Comment [A S5]:

Comment [A S6]:

In experimental research study by Ashfaq et al., 2014, "Performance Evaluation of Sugarcane Stripper for Trash Recovery" the performance of sugarcane stripper, designed by Agricultural Mechanization Research Institute (AMRI) Wing, Faisalabad was performed using three varieties; V1 (COL1148), V2 (FH-237) and V3 (MO-240). For the experiment the parameters were; NS1 (250 rpm), NS2 (200 rpm) and NS3 (150 rpm) as sprocket speeds and NB1 (750 rpm), NB2 (1000 rpm) and NB3 (1500 rpm) as three blower speeds. The results of experiment showed that maximum sugarcane stripping efficiency was achieved at parameters combination of sprocket speed at NS3 (150 rpm) and blower speed of NB3 (1500 rpm). This indicated that at higher speed of de-trashing drum the stripping efficiency is affected because of quick passage of canes as a result of decreased effect of air thrust of blower and on the other hand higher blower speed has higher air thrust in passing sugarcane which helps in better removal of leaves. The study also highlighted that due to unavailability of labor during harvest duration farmers usually avoid performing de-trashing part which reduces their income by around 10% at sugar industry as the trash can absorb around 30% of the juice during the extraction procedure. Moreover, mechanized method also decreased the cost to INR 17129/ha from INR 19200/ha cost of manual procedure. (Ashfaq, et al., 2014)

In study for regarding "Present Mechanization Status in Sugarcane– A Review" by KISHORE, et al., 2017, it is highlighted that area under sugarcane cultivation is significantly huge and the mechanization in harvesting will be beneficial for the farmers who are still using traditional techniques and tools. The study highlighted that major areas of mechanization in sugarcane cultivation are planting, harvesting and de-trashing. Sugarcane de-trashing alone takes 400 man-h in manual harvesting procedures for removal of tops, dry and green leaves, and INR 7500 as cost of operation per hectare. Use of mechanized solution in de-trashing reduces the harvest time; labor burden and cost of operation, in this way loss of sugar content and contamination in sugarcane harvested crop can be prevented. (KISHORE, et al., 2017)

Chandravanshi et al., 2021, in their study "De-trashing of sugarcane: A review" taken into consideration the losses to sugarcane cultivators due to labor shortage during harvest time. De-trashing and de-topping are crucial procedures in sugarcane cultivation which are labor intensive and accounts for about 65% of labor requirements in the harvesting season. The study favored the use of mechanized de-trashing solution to address the highlighted problems. Manual removal of tops and green leaves can lead to labor fatigue as the manual process exerts excessive stress on joints and muscles. For the adaptability of sugarcane de-trasher it was reported that the rupture rates in mechanized de-trashing units is lower in straight canes than the bending sugarcane therefore the impurities in straight sugarcane were larger than the bending sugarcanes'. Various factors affecting the de-trashing units are the speed of input and output rollers, speed of de-trashing plat, distance between input rollers and de-trashing plate, and between output roller and de-trashing plate, and other important factors are arrangement and material of cleaning element. (Chandravanshi, et al., 2021)

Comment [A S7]:

Methodology

Sugarcane is sturdy and low risk cash crop that has substantial area under cultivation in India, around 50 million farmers are directly or indirectly linked to sugarcane and sugar industry. Uttar Pradesh is among the major sugarcane producing state where the extent of labor consumption in sugarcane cultivation is more but the level of mechanization is still in low. Since, there is regular increase in labor cost along with uncompetitive prices when compared to sugar from mechanized international producers there is need to change the present manual harvesting procedures. The mechanized solution in harvesting stage especially in sugarcane stripping can reduce the drudgery of farmers. Therefore, in an attempt to provide efficient and economical solution to the problems of sugarcane producers design and development of stripper for sugarcane stripping is being done at Division of Farm Machinery and Power Engineering, Vaugh Institute of Agricultural Engineering and Technology, Sam Higginbottom University of Agricultural Technology and Sciences, Prayagraj District of Uttar Pradesh.

Main components ofPTO operated sugarcane stripper

I. **Frame:** Frame of the machine is designed by keeping in mind the space and required strength. Frame not only support the other compiled components but also reduces the vibration during loading of machine.

II. **Feeding chute:** The feed chute is ergonomically designed and fabricated on the machine at 10° angle from horizontal to facilitate easy feeding.

III. **Intake roller unit:** Combination of two rollers placed one above another makes the intake roller unit. Roller is made up of Mild Steel (MS).

   a) Supporting roller: Function of the supporting roller is to support sugarcane stalk and slide the stalk in to the stripping unit.

   b) Stripping roller. Stripping roller is spring loaded having covered with nylon rubber.

IV. **PTO attachment:** PTO attached is provided on the back side of the machine to power the machine through tractor.

V. **Air Blower:** Air blower is placed above the stripping unit. It function is toblowaway the leaves removed by stripping roller.

Comment [A S8]:

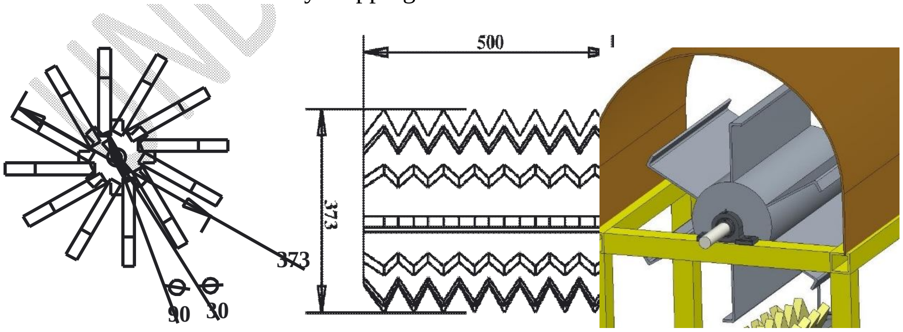
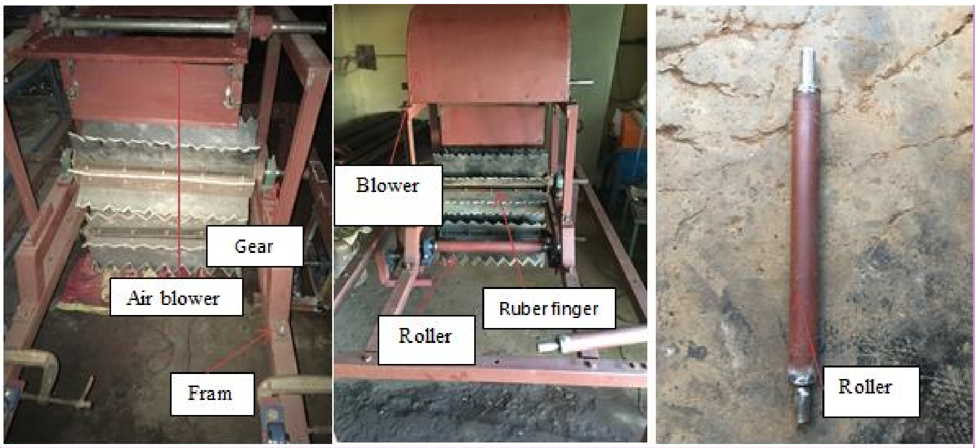


Fig.3: Leaf stripping rollers, blades and blower assembly



Comment [A S9]:

Fig.4: Various parts of developed sugarcane leaf stripper machine

Design of experiment

Robust designing of engineering machines is vital for producing highly efficient product with economical cost. In designing the effect of parameters involved in functioning of machine must be known so that effective machine design can be developed. Taguchi's parameter design is considered among most effective tool in obtaining a robust design. It provides a systematic approach to optimize the parameters.

Orthogonal arrays in Taguchi's technique are used to reduce large no of experiments into less number of effective experiments to obtain accurate result for analysis and also save time, money and labor. In the given experiment 3 parameters with 3 levels are selected therefore L9 orthogonal array is used for this investigation.

Analysis of variance (ANOVA)

The analysis of variance (ANOVA) is performed to evaluate the significance each selected factors involved in the stripping process. ANOVA results provide the accurate idea about how far a particular process parameter has its influences on the output of experiments and the level of significance of each parameter.

Selected input parameters are:

1. Length of Stalk, mm,
2. Girth of Stalk, mm, and
3. No.of buds.

The performance of machine measured over the output:

1. De-topping time, s.
2. Stripping rate, kg/h

Experimental procedure for performance evaluation

In the experiment to evaluate the performance of the leaf stripper in terms of de-topping time, stripping rate and damage done to stalk, there varieties of sugarcane are selected; a. MCO-238, b. K-269, c. R-94184. The rpm of the machine roller was set at400-450RPM and blower RPM was set at 520 with air velocity of 24.3 m/s. all three varieties were fed into the stripping machine and data was collected for de-topping time, stripping rate and damage to stalk as shown in Table 2, 3, 4 below:

Table 2: MCO-238 output results

Length, mm	Girth, mm	No. of buds	De-topping time, s	Stripping Rate, kg/h
3005.90	51	24	2.50	1825
3005.90	53	25	2.52	1860
3005.90	54	27	2.55	1870
3009.50	51	25	2.56	1865
3009.50	53	27	2.58	1875
3009.50	54	24	2.55	1885
3048.00	51	27	2.61	1880
3048.00	53	24	2.58	1900
3048.00	54	25	2.60	1920

Table 3: K-269 output results

Length, mm	Girth, mm	No. of buds	De-topping time, s	Stripping rate, kg/h
2623.60	47	22	2.42	1835
2623.60	49	24	2.49	1855
2623.60	51	27	2.53	1865
2743.20	47	24	2.53	1866
2743.20	49	27	2.57	1876
2743.20	51	22	2.51	1883
2876.30	47	27	2.6	1885
2876.30	49	22	2.54	1897
2876.30	51	24	2.57	1905

Table 4: R-94184 output results

Length, mm	Girth, mm	No. of buds	De-topping time, s	Stripping rate, kg/h
2935.20	49	23	2.47	1855
2935.20	50	24	2.50	1870
2935.20	52	27	2.54	1882
3267.30	49	24	2.62	1875
3267.30	50	27	2.67	1890
3267.30	52	23	2.57	1895
3392.70	49	27	2.71	1887
3392.70	50	23	2.67	1905
3392.70	52	24	2.66	1925

Analysis of MCO-238

ANOVA for De-toppingtime (95% confidence level)

Table 5: Analysis for de-topping time (MCO-238)

Source	DF	Seq SS	Adj SS	Adj MS	F	P	% Contribute
Length, mm	2	0.008089	0.008089	0.004044	364.00	0.003	78.6179
Girth, mm	2	0.000156	0.000156	0.000078	7.00	0.125	1.5161
No. of buds	2	0.002022	0.002022	0.001011	91.00	0.011	19.6520
Residual Error	2	0.000022	0.000022	0.000011			
Total	8	0.010289					

Table 6: De-topping time (95% confidence level)

Level	Length, mm	Girth, mm	No. of buds
1	2.523	2.557	2.543
2	2.563	2.560	2.560
3	2.597	2.567	2.580
Delta	0.073	0.010	0.037
Rank	1	3	2

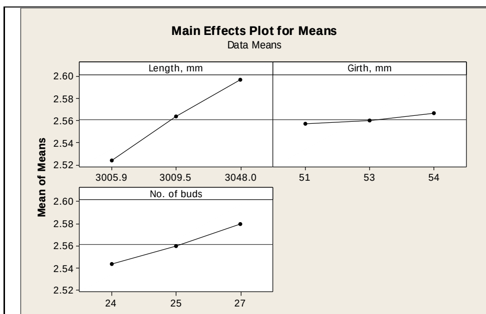


Fig. 5: Main effectsplot for means of length, girth and no. of buds on de-topping time

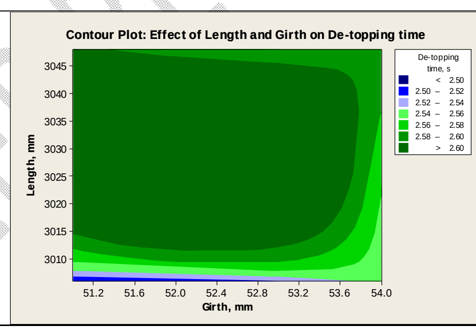


Fig. 6: Effect of length and girth on de-topping time

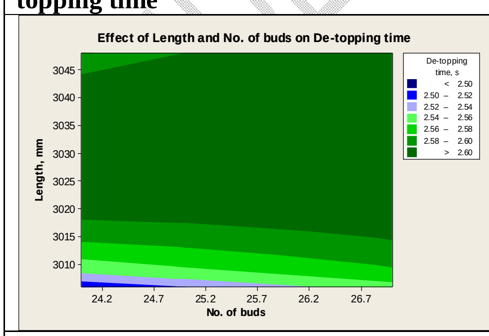


Fig. 7: Effect of length and no. of buds on de-topping time

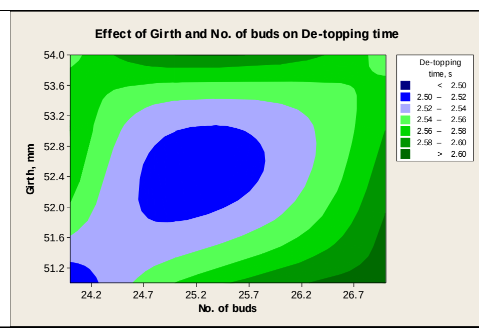


Fig. 8: Effect of girth and no. of buds on de-topping time

Results of ANOVA:

ANOVA test was performed using MINITAB software, the relative importance of sugarcane stalk physical parameter is shown in Table 5. As per the ANOVA table the Length of Stalk is most dominant parameter with 78.62 % contribution in affecting the de-topping time, followed by No. of buds with 19.65 % contribution. Contribution of Girth of stalk has no significance in test as per the "P" value (.125>.05). Mean effect plots for means in Figure 9 for each factor shows how the de-topping time changes with factor, length and no. of buds have dominant effect and same trend has been shown by Response Table for Mean given in Table 6.

The contour plots in Figure 6 to 8 also provide the same picture.

Table 7: Analysis for stripping rate(MCO-238)

Source	DF	Seq SS	Adj SS	Adj MS	F	P	% Contribute
Length, mm	2	3505.56	3505.56	1752.78	90.14	0.011	62.3518
Girth, mm	2	1872.22	1872.22	936.11	48.14	0.020	33.3003
No. of buds	2	205.56	205.56	102.78	5.29	0.159	03.6562
Residual Error	2	38.89	38.89	19.44			
Total	8	5622.22					

Table 8: Stripping rate (95% confidence level)

Level	Length, mm	Girth, mm	No. of buds
1	1852	1875	1870
2	1875	1878	1882
3	1900	1892	1875
Delta	48	35	12
Rank	1	2	3

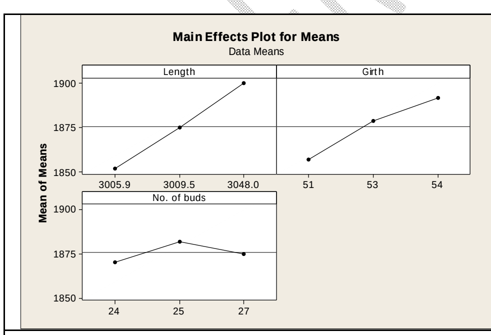


Fig. 9: Main effectsplot for means of length, girth and no. of buds on stripping rate

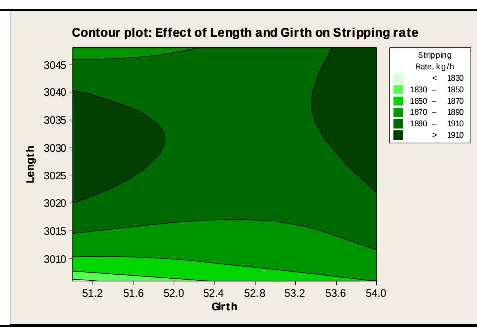


Fig. 10: Effect of length and girth on stripping rate

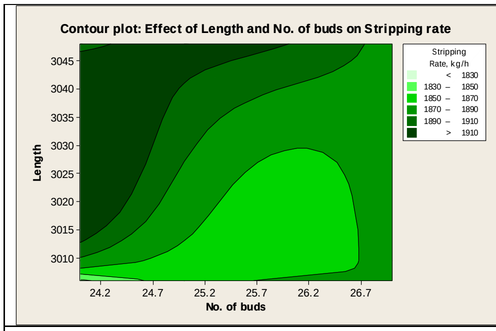


Fig. 11: Effect of length and no. of buds on stripping rate

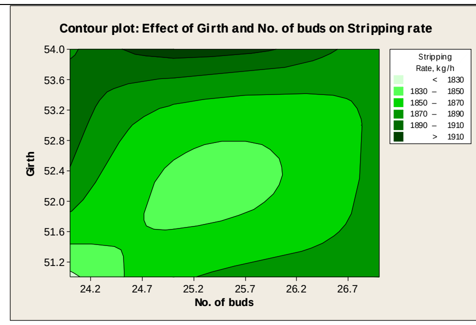


Fig. 12: Effect of girth and no. of buds on stripping rate

As per the ANOVA Table 7, the Length of Stalk is most significant (P value: 011<.05) and dominant parameter with 62.35 % contribution in affecting the Stripping rate, followed by Girth with 33.30 % contribution. Contribution of No. of buds has no significance in test as per the "P" value (.159>.05). Mean effect plot for mean in Figure 9 showed that length of stalk and girth has dominant effect on the stripping rate and same trend has been shown by Response Table for Meanin Table 8. The contour plots in Figure 10-12 also provide the same picture.

Analysis of K-269

Table 9: Analysis for de-topping time (K-269)

Source	DF	Seq SS	Adj SS	Adj MS	F	P	% Contribute
Length, mm	2	0.012422	0.012422	0.006211	34.94	0.028	55.7315
Girth, mm	2	0.000689	0.000689	0.000344	1.94	0.340	03.0912
No. of buds	2	0.008822	0.008822	0.004411	24.81	0.039	39.5800
Residual Error	2	0.000356	0.000356	0.000178			
Total	8	0.022289					

Table 10:De-topping time (95% confidence level)

Level	Length, mm	Girth, mm	No. of buds
1	2.480	2.517	2.490
2	2.537	2.533	2.530
3	2.570	2.537	2.567
Delta	0.090	0.020	0.077
Rank	1	3	2

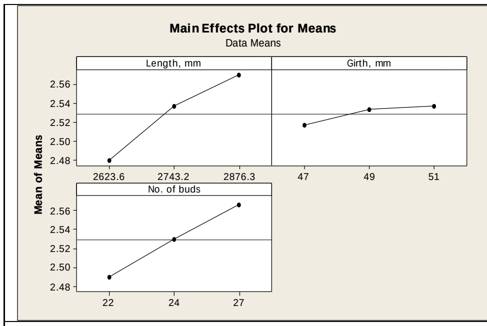
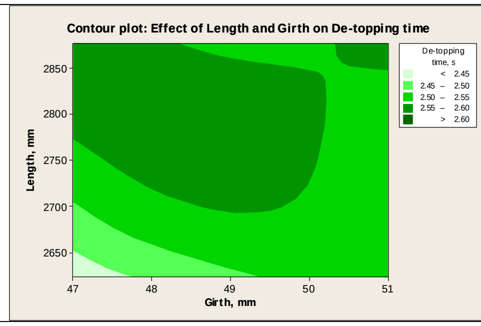
	

Fig. 13: Main effects plot for means of length, girth and no. of buds on de-topping time	**Fig. 14: Effect of length and girth on de-topping time**

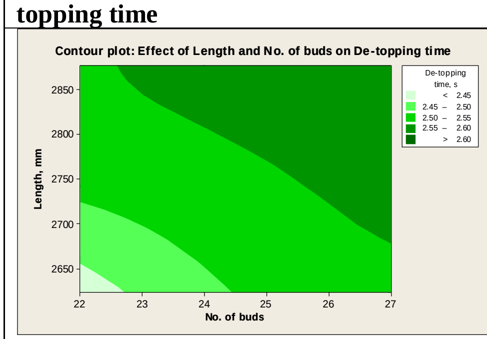
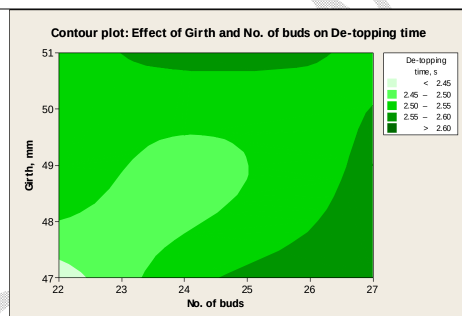

	

Fig. 15: Effect of length and no. of buds on de-topping time	**Fig. 16: Effect of girth and no. of buds on de-topping time**

As per the ANOVA Table 9, the Length of stalk is most significant (P value: 005<.05) and dominant parameter with 55.73% contribution in affecting the De-topping time for K-269 variety, followed by Number of buds with 39.58 % contribution. Contribution of Girth has no significance in test as per the "P" value (.34>.05). As per mean effect plots for means in Figure 13, Length and No. of Buds have more dominant effect on the De-topping time and same trend has been shown by Response Table for Mean in Table 10. The contour plots in Figure 14 to 16also provide the same picture.

Table 11:Analysis for stripping rate(K-269)

Source	DF	Seq SS	Adj SS	Adj MS	F	P	% Contribute
Length, mm	2	2907.56	2907.56	1453.78	120.04	0.008	78.0995
Girth, mm	2	764.22	764.22	382.11	31.55	0.031	20.5276
No. of buds	2	26.89	26.89	13.44	1.11	0.474	0.7222
Residual Error	2	24.22	24.22	12.11			
Total	8	3722.89					

Table 12:Stripping rate (95% confidence level)

Level	Length, mm	Girth, mm	No. of buds
1	1852	1862	1872
2	1875	1876	1875
3	1896	1884	1875
Delta	44	22	4

Comment [A S10]:

Comment [A S11]:

Rank	1	2	3

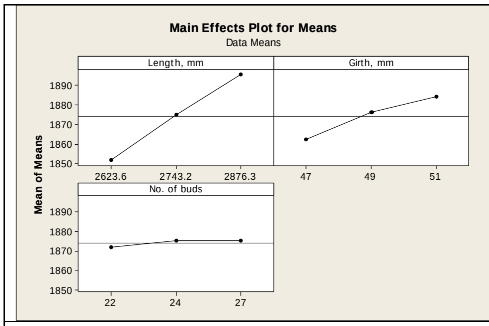


Fig.17: Main effects plot for means of length, girth and no. of buds on Stripping rate

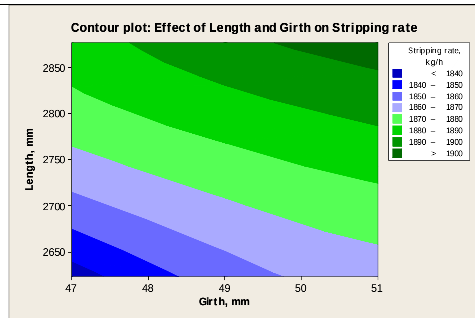


Fig.18: Effect of length and girth on stripping rate

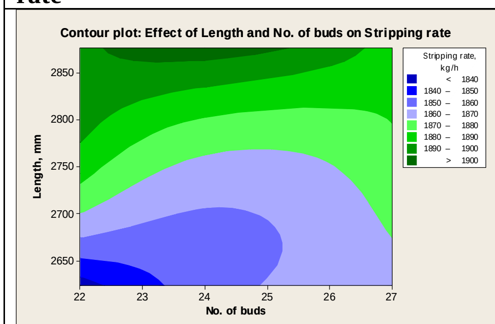


Fig. 19: Effect of length and no. of buds on stripping rate

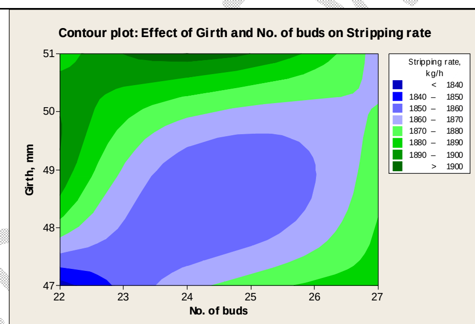


Fig. 20: Effect of girth and no. of buds on stripping rate

As per the ANOVA Table 11, the Length of Stalk is most significant (P value: 008<.05) and dominant parameter with 78.1 % contribution in affecting the Stripping rate, followed by Girth with 20.5 % contribution. Contribution of No. of buds has no significance in test as per the "P" value (.474>.05). Mean effect plot for means in Figure 17, showed that length of stalk and girth has dominant effect on the stripping rate and same trend has been shown by Response Table for Mean in Table 12. The contour plots in Figure 18-20 also provide the same picture.

Comment [A S12]:

Comment [A S13]:

Analysis of R-94184

Table 13:Analysis of De-topping time (R-94184)

Source	**DF**	**Seq SS**	**Adj SS**	**Adj MS**	**F**	**P**	**% Contribute**
Length, mm	2	0.048422	0.048422	0.024211	114.68	0.009	84.5223
Girth, mm	2	0.000822	0.000822	0.000411	1.95	0.339	01.4348
No. of buds	2	0.007622	0.007622	0.003811	18.05	0.052	13.3044
Residual Error	2	0.000422	0.000422	0.000211			
Total	8	0.057289					

Table 14:De-topping time (95% confidence level)

Level	**Length, mm**	**Girth, mm**	**No. of buds**
1	2.503	2.600	2.570

2	2.620	2.613	2.593
3	2.680	2.590	2.640
Delta	0.177	0.023	0.070
Rank	1	3	2

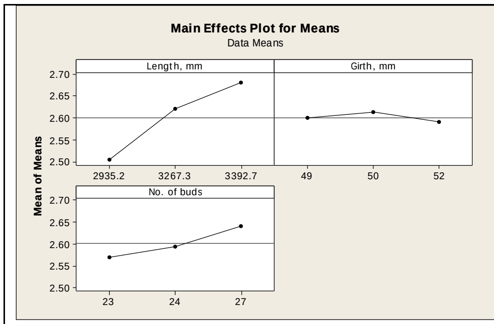


Fig. 21: Main effects plot for means of length, girth and no. of buds on de-topping time

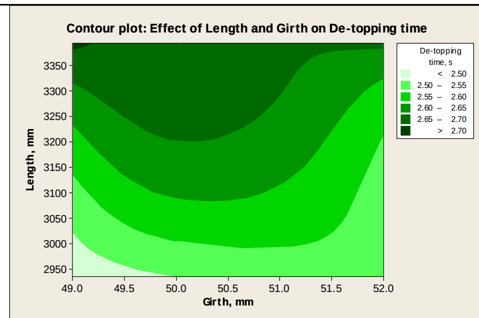


Fig. 22: Effect of length and girth on de-topping time

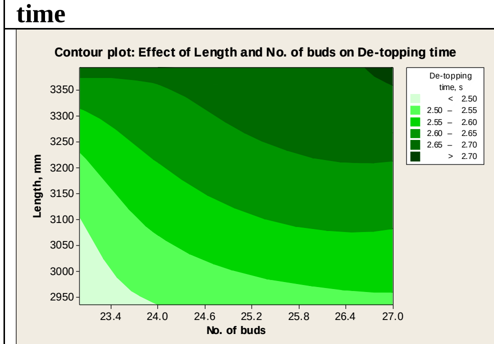


Fig. 23: Effect of length and no. of buds on de-topping time

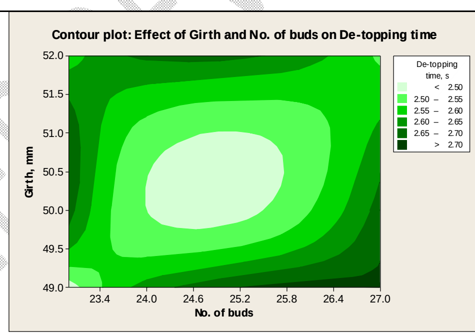


Fig. 24: Effect of girth and no. of buds on de-topping time

As per the ANOVA Table13, the Length of stalk is most significant (P value: 009<.05) and dominant parameter with 84.52% contribution in affecting the De-topping time for R-94184 variety, followed by Number of buds with 13.30 % contribution. Contribution of Girth has no significance in test as per the "P" value (.339>.05). As per mean effect plots for means in Figure 21, Length and No. of Buds have more dominant effect on the De-topping time and same trend has been shown by Response Table for Mean in Table 14. The contour plots in Figure 22 to 24also provide the same picture.

Comment [A S14]:

Table 15:Analysis for stripping rate(R-94184)

Source	DF	Seq SS	Adj SS	Adj MS	F	P	% Contribute
Length, mm	2	2017.56	2017.56	1008.78	37.21	0.026	60.7170
Girth, mm	2	1210.89	1210.89	605.44	22.33	0.043	36.4408
No. of buds	2	40.22	40.22	20.11	0.74	0.574	01.2103
Residual Error	2	54.22	54.22	27.11			

Total	8	3322.89					

Table 16:Stripping rate (95% confidence level)

Level	Length, mm	Girth, mm	No. of buds
1	1869	1872	1885
2	1887	1888	1890
3	1906	1901	1886
Delta	37	28	5
Rank	1	2	3

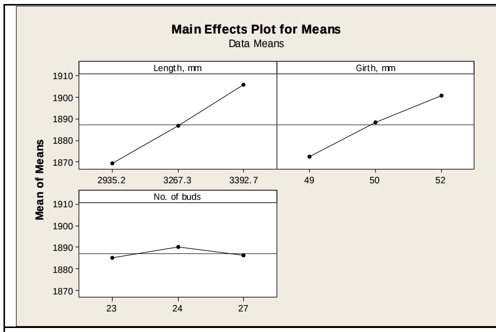


Fig. 25: Main effects plot for means of length, girth and no. of buds on stripping rate

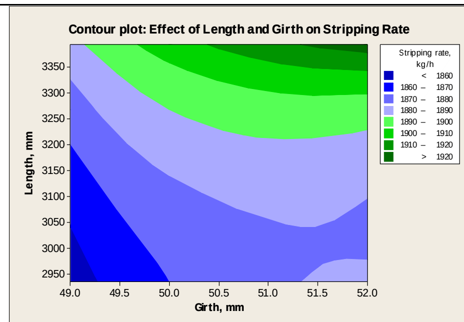


Fig.26: Effect of length and girth on stripping rate

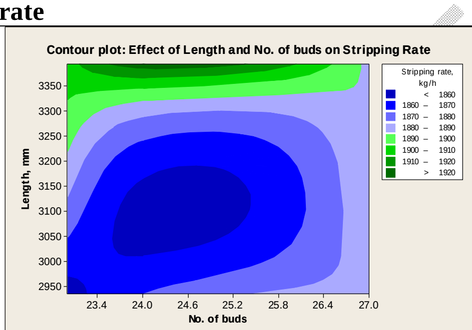


Fig. 27: Effect of length and no. of buds on stripping rate

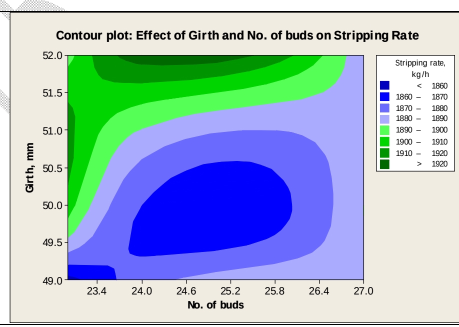


Fig. 28: Effect of girth and no. of buds on stripping rate

As per the ANOVA Table 15, the Length of Stalk is most significant (P value: 008<.05) and dominant parameter with 60.72 % contribution in affecting the Stripping rate, followed by Girth with 36.44 % contribution. Contribution of No. of buds has no significance in test as per the "P" value (.574>.05). Mean effect plot for means in Figure 25, showed that length of stalk and girth has dominant effect on the stripping rate and same trend has been shown by Response Table for Mean in Table 16. The contour plots in Figure 26-28also provide the same picture.

Comment [A S15]:

Comment [A S16]:

Discussion:

In the experiment to evaluate the performance of the leaf stripper in terms of de-topping time, stripping rate and damage done to stalk, on varieties: a. MCO-238, b. K-269, c. R-94184. Following were the outcomes:

i. For De-topping time in case of all three varieties (MCO-238, K-269, and R-94184), Length is the most significant factor with contribution of 78.62%, 55.73 % and 84.52% respectively. The second significant dominant factors was No. of buds with 19.65%, 39.58% and 13.30 % contribution. In all three cases Girth has no significant contribution and effect.

ii. For stripping rate the most dominant and significant factors was Length of the Stalk: in MOC-238 has 62.35 % contribution, in K-269 has 78.10% contribution and in case of R-94184 has 60.72% contribution. The second significant factors were Girth with contribution of 33.30%, 20.53% and 36.44% contribution in MCO-238, K-269 and R-94184 varieties respectively. The factor, No. of Buds remained insignificant.

Conclusion:

From the results of the experiment and then analysis through Taguchi's technique it has been concluded that while using PTO operated sugarcane leaf stripping machine; length and No. of buds affects the stripping time significantly, Length of stalk and Girth of stalk has significant impact on the stripping rate and lastly the damage on the stalk is connected with Girth and No. of Buds. These factors have significant role in performance of the machine and hence can help in efficient designing and fabricating.

Comment [A S17]:

Comment [A S18]:

References:

Ashfaq, S., Ghafoor, A., Ahmad, M. & Yaqub, Q., 2014. Performance Evaluation of Sugarcane Stripper for Trash Recovery. *INTERNATIONAL JOURNAL of RENEWABLE ENERGY RESEARCH*, 4(4), pp. 992-997.

Cansee, S., 2010. A Study of Sugarcane Leaf-Removal Machinery during Harvest. *American J. of Engineering and Applied Sciences*, 3(1), pp. 186-188.

Chandravanshi, A., Verma, A. & Roy, D., 2021. De-trashing of sugarcane: A review. *The Pharma Innovation Journal*, 10(2), pp. 01-10.

Clemenson, C. L. & Hansen, A., 2008. Pilot study of manual sugarcane harvesting using biomechanical analysis. *J Agric Saf Health*, 14(3), pp. 309-320.

Dawson, L. & Boopathy, R., 2007. Use of post-harvest sugarcane residue for ethanol production. *Bioresource Technology*, 98(9), pp. 1695-1699.

FAOSTAT, 2019. *Sugarcane production in 2018, Crops/Regions/World list/Production Quantity (pick lists).* [Online] Available at: https://www.fao.org/faostat/en/#data/QC [Accessed 02 February 2022].

KISHORE, N. et al., 2017. PRESENT MECHANIZATION STATUS IN SUGARCANE – A REVIEW. *International Journal of Agriculture Sciences,* 9(22), pp. 4247-4253.

Lin, J., Yan, W. & Lin, J., 2012. The Large-Scale Sugarcane Stripper with Automatic Feeding. *Research Journal of Applied Sciences, Engineering and Technology*, 4(14), pp. 2183-2185.

Singh, A. & Solomon, S., 2014. Development of a Sugarcane Detrasher. *Sugar Tech. 17. 10.1007/s12355-014-0306-5.* , 17(2), pp. 189-194.

Statista Research Department, 2020. *Annual yield of sugarcane in India from financial year 2014 to 2020, with an estimate for 2021,.* [Online] Available at: https://www.statista.com/statistics/764345/india-yield-of-sugarcane/ [Accessed 02 April 2022].