Kasetsart J. (Nat. Sci. Suppl.) Vol. 22 : 88-90 (1988)

Study on Some Physical Properties of Sugar Cane for Whole Stalk Harvester Design

Banchaw Bhaholyotin[1], Prasarn Kradangna[2], Kazumoto Ichito[3] and Yoshiaki Goto[4]

ABSTRACT

This study was conducted to determine some physical properties of sugar cane which play an important role in harvester design and development. Three varieties of sugar cane F 140, F 156 and U-Thong I were measured in terms of hardness, shearing, compression and tension forces. Twenty regular size and length of stalks were taken as the sample of each variety. The specimens of hardness, shearing and compression force measurement were taken from three portions of cane stalk : bottom, middle and top.

The tension force measurement was done only at the bottom and top portions. It was found that the effective weight and stalk diameter of U-Thong I were more than the other two. The hardness and shearing force of F 140 were more than that of F 156 and U-Thong I while the compression and tension force of F 156 were more than that of F 140 and U-Thong I. U-Thong I had less hardness, shearing compression and tension force.

INTRODUCTION

Harvesting is the part of sugar cane farming where mechanization can be most beneficial. Actually, it is desirable to transport the harvested sugar cane to the factory in 24 hours since the yield decreases by 0.4% per day after cutting. The green cut method has advantage over the burned cut in the sweetness drop and sugar quality as time is taken in transportation and acceptance process of the product at the factory.

The physical properties should be studied because the hardness, shearing, tension, compression and detrashing forces play an important role for harvester design and development. It is a challenge task to design the machine working with the agricultural product which has many factors to deal with, for example the uniformity of the size and shape and also the characteristics of the product both before and after harvesting.

The main functions of cane harvester are to divide and lift the lodged canes in order to facilitate the cutting at the bottom portion of the stalk, cut and delivery the cut stalk in windrow. Detrashing is an additional function to minimize the labor work.

The objective of this study was to determine the shearing, tension, compression and hardness forces of different varieties of sugar cane in order to verify their stalks strength to use as the information in design and development of sugar cane harvester.

1 Department of Agricultural Engineering, Faculty of Engineering, Kasetsart University, Bangkok.

2 National Agricultural Machinery Center, KURDI, Kasetsart University. Kampaengsaen campus, Nakorn Pathom.

3 Short term expert, National Grassland Research Institute, Ministry of Agriculture, Forestry and Fishery, JAPAN.

4 Long term expert, JAPAN

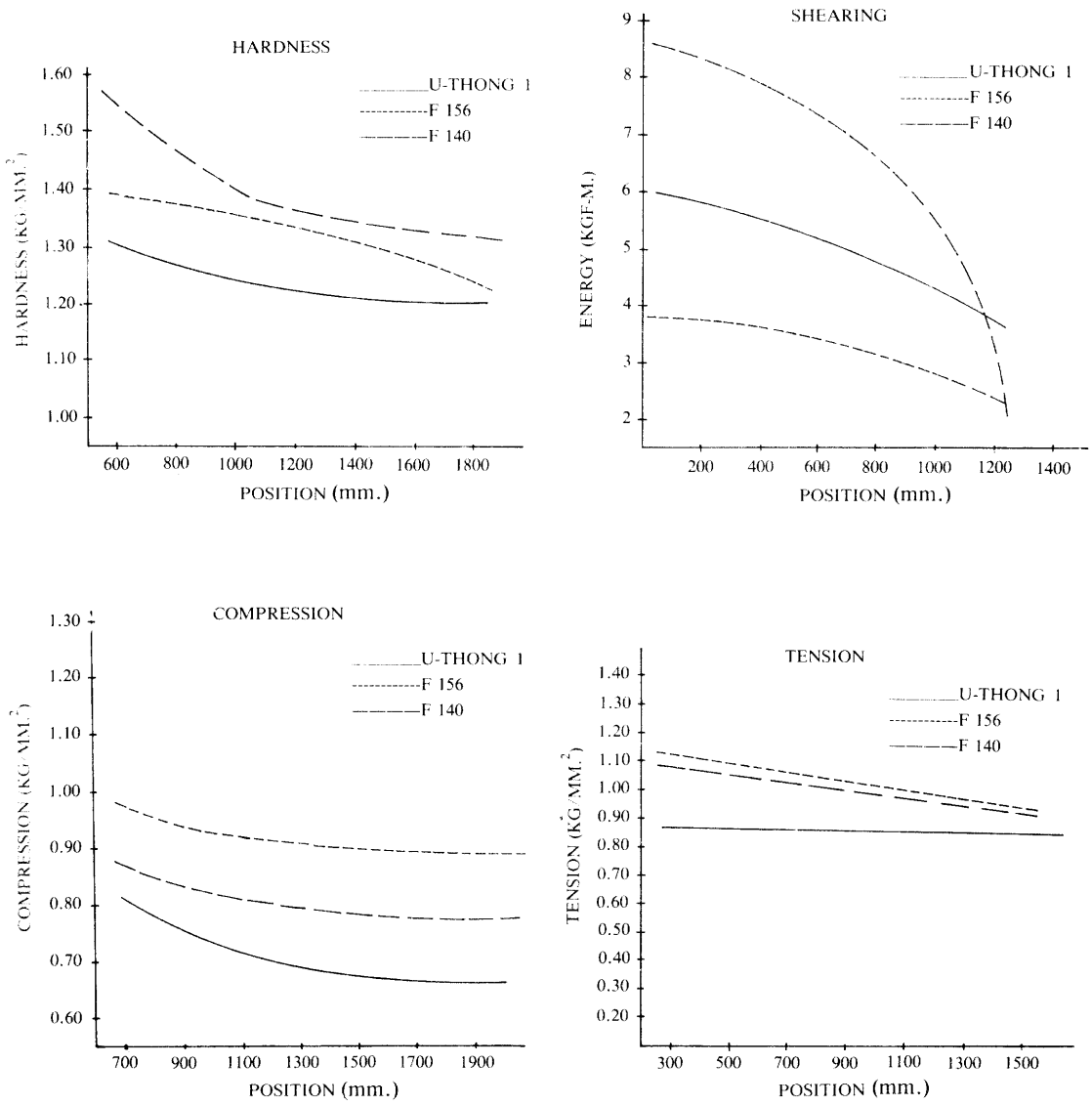

Figure I Shows the hardness, shearing, compression and tension forces of three varieties of sugar cane

MATERIALS AND METHODS

Three sugar cane varieties, F 156, F 140 and U-Thong I, were used as samples in this study. Twenty regular size and length of stalks were taken from each variety. They were cut close to the ground level, the total length and total weight were recorded. After cutting the top off, the top length and effective length were measured as well as the top and effective weight. Number of nodes were also noted. The stalk of each sample were divided into three portions, bottom, middle and top, the average of stalk diameter at each portion was collected.

The shearing sample of 100 mm., compression sample of 60 mm., and hardness sample of 150 mm. were prepared for each portion of the stalk and tension sample of 500 mm. was prepared only for bottom and top portion. The shearing and hardness sample had nodes at each of its end

while the tension sample had the sectional width of about 7 mm.

The sharpy testing machine was used to find the shearing force as well as the universal testing machine was used to determine the compression and tension forces. For the hardness test, the displacement transducer, the load cell and recorder were used along with the universal testing machine.

The length of the samples sometimes varied as the length of internode in order to facilitate the operation of testing machine.

RESULTS AND DISCUSSION

In general, the total length and top length of F 156 were more than those of U-Thong I and F 140 but the effective weight of U-Thong I was more than those of F 156 and F 140. The stalk diameter of F 156 was rather smaller than F 140 and U-Thong I.

It was found that F 140 had more hardness than F 156 by 8% and U-Thong I by 16% F 156 had more compression force than F 140 by 13.6% and U-Thong I by 24.3%, F 140 had more shearing force than U-Thong I by 93.5% and F 156 by 22.5% and F 156 had more tension force than F 140 by 2.9% and U-Thong I by 17.5% respectively.

The hardness as well as the shearing force of F 140 varied much from bottom to top of the stalk. The compression force of U-Thong I varied much between the bottom and top portion. The variation of tension force between bottom and top portion of F 156 and F 140 were almost the same.

CONCLUSION

It showed that the stalk strength of F 140 was much more than F 156 and U-Thong I and the strength concentration was at the bottom portion. Even the total length of F 156 was longer than F 140 but the effective length of F 140 is longer than F 156. U-Thong I had almost the same effective length as F 156 but U-Thong I had almost twice effective weight of F 156. In comparision of the three varieties, U-Thong I had more effective weight than the other two. And it was noticed that the stalk strength depends upon the characteristic of variety and the age of the sugar cane.

In this study, it was realized that not only the power and method of cutting should be considered in the sugar cane harvester design but also the traditional type of planting and the number of year of planting which the ridge and row condition including number of stalks in the row will be taken into consideration.

In addition, cane leaf is another function to deal with as the green cane harvester concerned.

LITERATURE CITED

Mohsenin, N.N. 1970. Physical Properties of Plant and Animal Materials. Vol. I. Gorden and Breach Science Publishers, New York.

Suzuki, M. 1986. Report of Survey on Sugar Cane Cultivation in Thailand, JICA, 24 pp.

Zoerb, G.C. 1967. Instrumentation and Measurement Techniques for Determination of Physical Properties of Agricultural Products. Trans. of the ASAE 10(1): 100-109 p.