ABSTRACT

LISYANTO. Evaluation of design parameters of rotated disk tiller for stubble shaving operation on upland sugar cane cultivation. Advisored by EDUARD NAMAKENSEMBIRING, I NENGHASUASTAWA, RADITE PRAEKO AGUS SETIAWAN, and H. M.H. BINTORO DJOEFRIE.

Cutting of sugar cane stubble is one of the important activities in sugar cane ratoon production system. Manual cutting applied until now requires a lot of labour and the result is not always uniform. The existing stubble shaver using impact type of cutting does not produce a good result such as broken sugar cane stubble. Impact cutting mechanism causes the knife edge dull easily, thus requires higher cutting force. Broken surface of sugar cane stubble surface and higher cutting force in mechanical cutting system can be solved by changing the principle of cutting mechanism from impact cutting to sawing.

The objectives of this study were to analyze the cutting mechanism of sugar cane stubble using rotating disk plow and disk harrow, to determine specific cutting force ($\sigma$) for single sugar cane stem of four sugar cane varieties (PA 198, PA 183, PA 022, and Triton), to develop a mathematical model in order to determine the cutting force of sugar cane stubble (more than one stem), and to identify the quality of cutting and quality of sugar cane shoot. Method of analyzing the relative movement of point on edge of disk plow was used to describe a cycloid pattern curve edge of disk movement. Specific cutting force was calculated by means of least squares method describing the relationship between instantaneous area and instantaneous length of cutting and measured total force. The cutting area formed by the moving curved edge on circular cross section of cane stem was calculated using Simpson integration method. Whereas the length of cutting was determined graphically using computer aided design (CAD) software. The mathematical model was then used to predict the cutting force of one stem was also suitable for cane stubble. Compared with disk plow, the cutting by scalloped disk (disk harrow) required lower torque and force and produced smoother cutting surface.

Motion equation of a point on the edge was used to simulate the movement of the disk with tilt angle and disk angle, radius of the disk, rotating speed, forward speed, and the number of edges as the variables. Sugar cane variety of PA 198 had higher specific cutting force (1.15 N mm$^{-2}$ or 2.94 N mm$^{-1}$) compared to the other three varieties. The mathematical model to predict the cutting force of one stem was also suitable for cane stubble. Compared with disk plow, the cutting by scalloped disk (disk harrow) required lower torque and force and produced smoother cutting surface.

Keywords: sugar cane, ratoon, torque, cutting, disk plow, disk harrow