The uniformity coefficient calculated are given in the Tables 1 and 2. On comparison with the conventional method, the cablegation furrows at both 60° and 90° orientations resulted in fairly well distributed moisture pattern. The uniformity was found to be 20 per cent higher than that of the continuous.

The system's capability to creage "surge" effect caused the moisture storage to be uniform throughout as a result, higher efficiency.

The semi-automated cablegation system designed was only to suit 9 furrows. The overall performance was good comparing to the continuously irrigated furrows.

The variations in discharge in the outlets on the upstream and downstream sides can easily be rectified by modifying the outlet size or by positioning the plug near those outlets till they discharge the required quantities. This would provide still more uniform moisture storage efficiency.

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MODIFICATION AND TESTING OF A POWER-TILLER ROTOVATOR FOR FLAIL MOWING

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ABSTRACT

A power tiller operated rotovator was modified as a flail mower. The speed of rotovator shaft was increased from 255 to 1137 rev/min and the rotary blades were replaced with 6 mm size and 25 mm pitch mild steel chains of 280 mm length having a flat cutting element at the tip. The modified machine was evaluated for lawn mowing and parthenium cutting operations. The cost of conversion was Rs.1060/- . Maximum cutting efficiency of 97 per cent was achieved at 1100 rev/min rotor speed and 1.60 km/h forward speed. Average effective field capacity of the machine was 0.05 ha/h with average field efficiency of 56.3 per cent.

KEY WORDS : Power Tiller, Rotovator, Flailmower, Lawn Mowing, *Parthenium* Cutting

Mild steel chains of different sizes can be used as flails with a peripheral velocity of 2000 m/min for impact cutting of grass, *Desmostachya bipinnata* (Agarwal, 1976). A power tiller operated flail mower having 650 mm width of cut is capable of mowing one ha of grass in 16 h at 1 km/h forward speed with 97.4 to 98.0 percentage of cut (Ghatey, 1977). The flail type mower using chains as flails gives better cutting of plants with less noise and vibrations after attaching knives at the end of chains (Tajuddin, 1980; Tajuddin and Datta, 1983). Flail type mowers have more scope for cutting grasses due to their lower maintenance requirements, greater speed of operation and less damage caused to the cutting elements when used in stoney, stumpy and uneven fields (Tajuddin and Datta, 1984). Hence, a power tiller operated rotovator was modified as a flail mower having mild steel chains with cutting elements at the tip as flails.

METERIALS AND METHODS

Maximum clearance between the rotatovator (Mitshubishi make) cover and the rotovator shaft was 300 mm. Therefore, the length of 6 mm size and 25 mm pitch mild steel chain inculding the horizontal circular cutting element was adopted as 280 mm. The rotary blades were removed and the chains were connected in the place of blades. For obtaining 2000 m/min eri heral velocit with 560 mm diameter of rotation, the required rotational speed of rotovator shaft was calculated to be 1137 rev/min. The existing speed of rotovator shaft (255 rev/min) was increased to 1137 rev/min by extending the rotovator shaft and the rotovator driving shaft for mounting V pulleys of 90 mm and 420 mm diameters respectively. When used for mowing purposes the chain over the rotovator sprockets were removed and the pulleys were connected by a B type V belt (Tajuddin, 1989).

The modified machine was operated to cut a 20m strip of lawn grass at different throttle positions and different gears of the power tiller to study the effect of rotovator speed and forward speed on cutting efficiency of the machine. Time taken by the machine to cover the strip and the rotational speed of rotovator shaft were measured using stop watch and tachometer respectively. After each trial the number of uncut and cut grass stems were counted at random in a plot of size 0.50 m X 0.50 m to calculate the cutting efficiency. The experiment was repeated for cutting parthenium plants also. Centrifugal force (CF) developed at the tip of the flails was determined using the following formula.

$$CF = \frac{w v^2}{g r}$$

where

N = rotational speed of rotor, rev/min

r = radius of rotation = 0.28 m.

w = weight of each flail = 16 N (1.63 kg)

g = acceleration due to gravity = 9.81 m/s^2

v = periphoral velocity of rotor = $\Pi \frac{DN}{60}$ m/s

D = diameter of rotor tip = 0.56 m

The theoritical field capacity of the machine (forward speed x width of rotor) was determined. Actual field capacity of the machine was found by operating the machine in a plot of 30 x 20 m size and noting the time taken to mow the entire plot

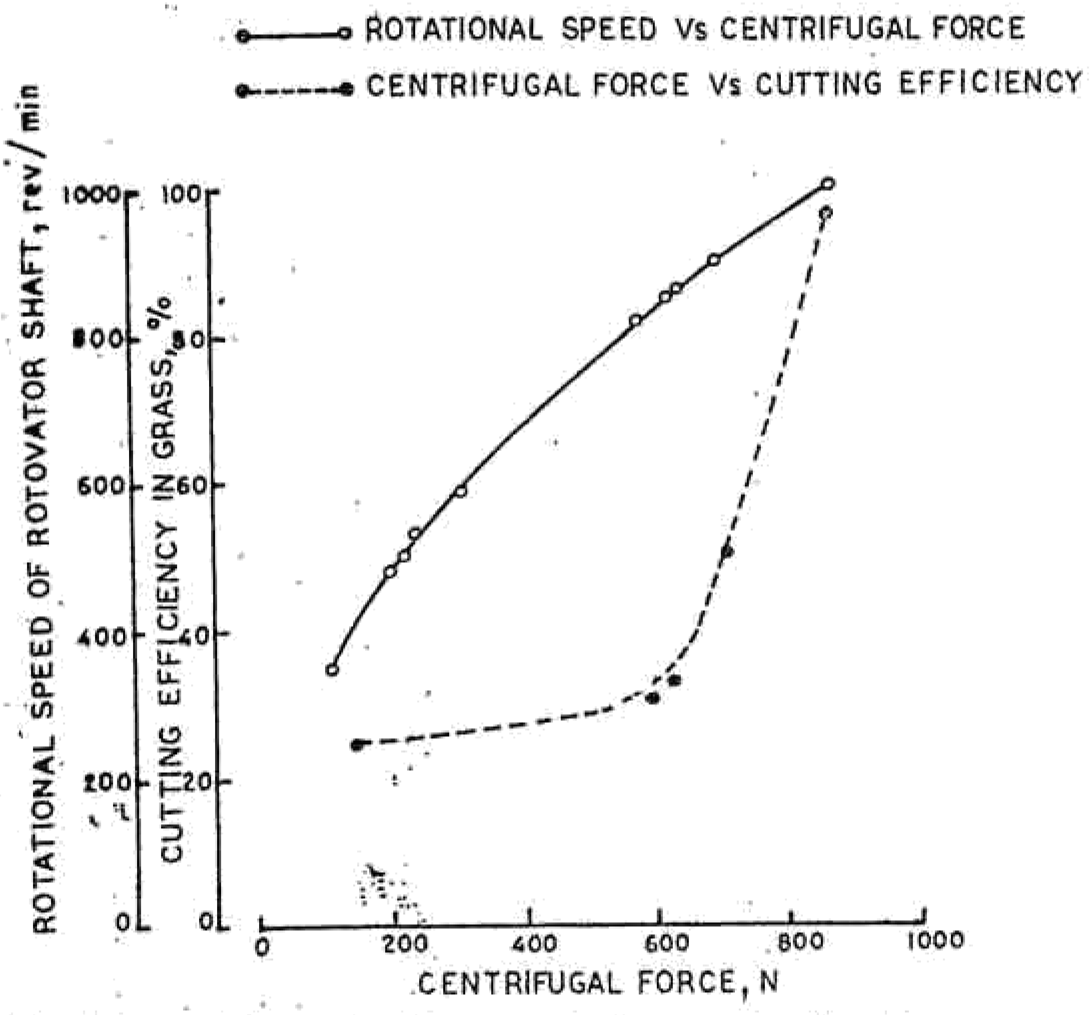

Fig.1 Relationship between flail tip centrifugal force, rotovator shaft speed and cutting efficiency in grass

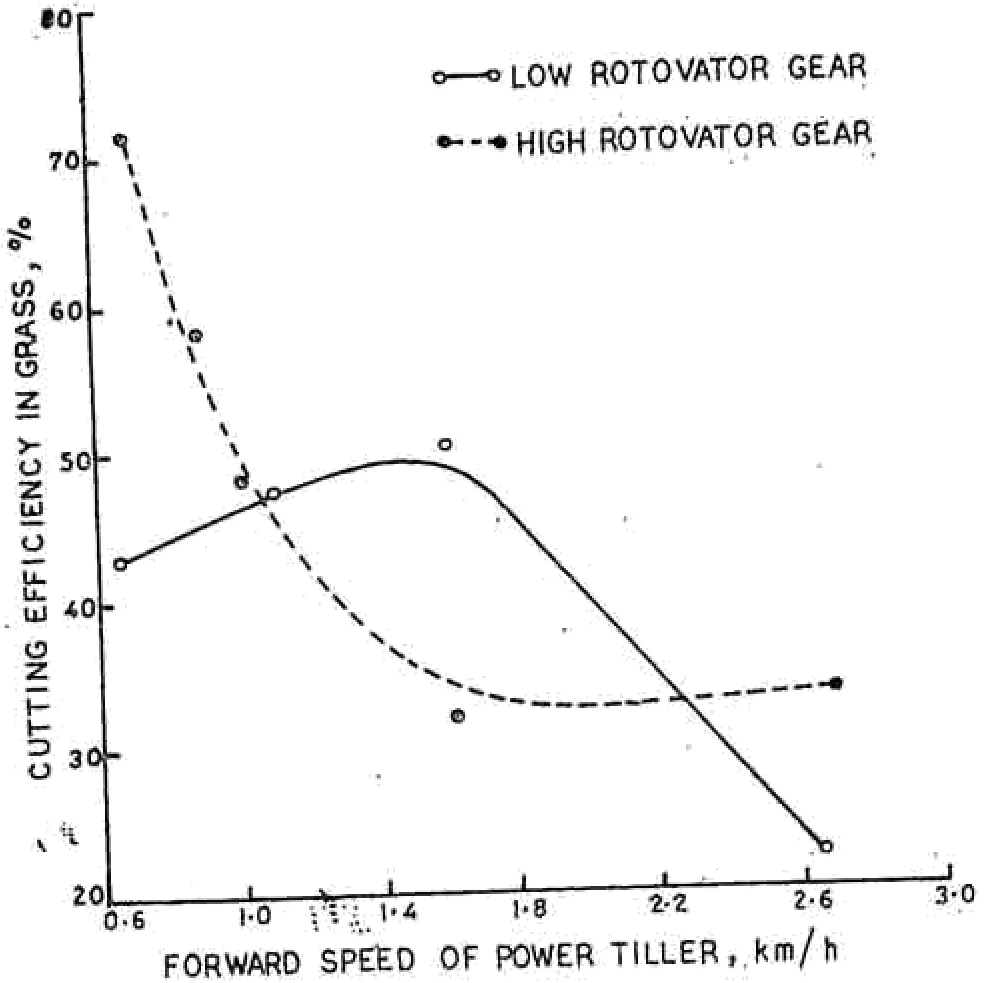

Fig.2 Effect of forward speed on cutting efficiency in grass

and the field efficiency (effective field capacity/ theoritical field capacity) of the machine was also determined (Chandrasekaran *et al.*, 1987).

RESULTS AND DISCUSSION

When the centrifugal force developed at the tip of flails was increased from 140 to 580 N by increasing the rotor speed from 230 to 800 rev/min cutting efficiency of the modified machine in lawn grass remained within the range of 25 to 30 per cent (Fig.1). Beyond a centrifugal force of 580 N, the cutting efficiency increased almost linearly up to 96 per cent at 860 N centrifugal force (1000 rev/min rotor speed). By extrapolating the Fig.1 it was found that complete cutting of lawn grass could be achieved at 870 N centrifugal force. The rotational speed of rotovator shaft required to obtain this centrifugal force was 1010 rev/min. By finding thus the centrifugal force required for maximum cutting of plants the chain size (mass) or the rotational speed of the chains could be determined if one of the above two parameters is assumed for a known radius of rotation of the chains.

Cutting efficiency of the machine increased at a decreasing rate up to 1.6 km/h foward speed of the power tiller at low rotovator gear. Beyond this speed cutting efficiency dropped down (Fig.2). At high rotovator gear the cutting efficiency decreased at an decreasing rate with the increase in forward speed. This might be due to the insufficient time available to the chains to cut the plants at higher forward speeds of the power tiller.

A maximum cutting efficiency of 97 per cent was achieved by the machine with parthenium plants (plant density = 83 plants/m^2) at 1100 rev/min rotational speed of rotovator shaft and at 1.15 km/h forward speed of the power tiller (Fig. 3). Below and beyond the 1.15 km/h forward speed the cutting efficiency decreased. The mower could cover 0.056 ha/h with 60.4 per cent field efficiency in lawn mowing and 0.047 ha/h with 52.2 per cent field efficiency in parthenium cutting operations. Operational costs of the mower for the above two operations were Rs.540/ha and Rs.430/ha respectively. Therefore, lawn mowing and

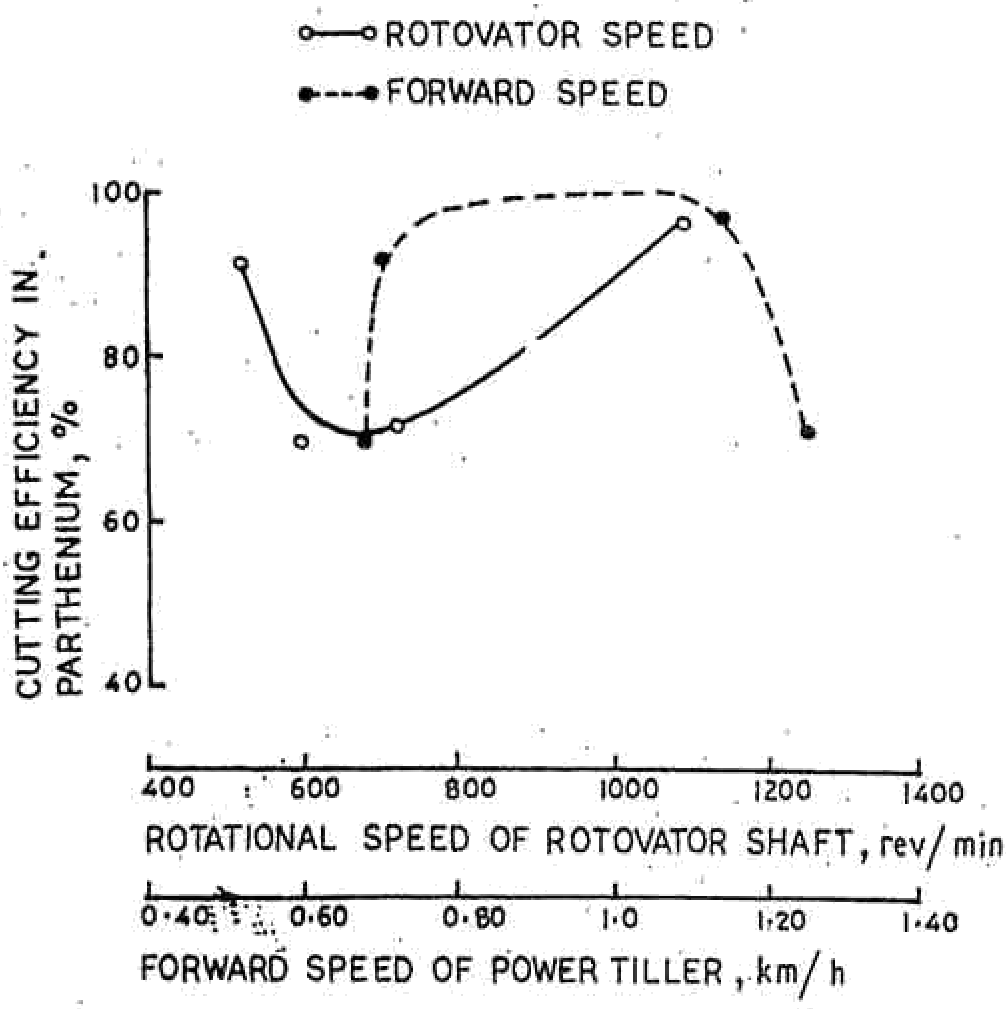

Fig.3 Effect of forward speed and Rotovator Shaft speed on cutting efficiency in Parthenium

parthenium cutting operations could be effectively carried out by the power tiller operated rotovator modified flail mower at 1100 rev/min rotational speed of rotovator shaft and at 1.6 km/h forward speed of power tiller. The cost of converting the power tiller rotovator to a flail mower was Rs.1060. The total investment cost of the modified machine which includes the cost of power tiller was Rs.42, 420.

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