

Development and performance evaluation of tractor operated shredder

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ABSTRACT

Development and performance evaluation of tractor operated shredder was carried out at College of Agricultural Engineering and Technology, Dapoli. A 35 hp, 540±10 PTO rpm Tractor operated shredder with a capacity of 300 Kg/hr was developed and evaluated for horticultural pruned waste viz. Mango, Sapota, Cashew, Nutmeg branches and Harvested Grasses in order to utilize them as organic matter as well as industrial applications. During testing, feeding unit, cutting unit and power transmission system worked satisfactorily for selected horticultural pruned waste and harvested grasses. At the optimum speed of the cutter head i.e. 450 rpm, more than 80 per cent cut pieces were observed in the length group of 20-40 mm and 40-60mm with a capacity for all five-crop waste. The required operation period for 100 kg pruned branches of mango, sapota, cashew, nutmeg and grasses was 0.36,0.40,0.46,0.51 and 0.32 hrs. The total cost of developed machine (excluding tractor cost) was Rs. 33,800.

Key words : Shredder, Pruned branches, Waste, Spices crops, Horticultural crops.

INTRODUCTION

It is seen that the annual production of crop residue (including industrial waste) in India is estimated as 347.2 MT (Anon.1992) and annual production of horticultural pruned waste and harvested grasses in Konkan region of Maharashtra was estimated as 8.789 MT (Anon.1997). The manurial value and the quantity of the plant waste available vary from crop to crop and variety to variety. A major disadvantage of most recyclable waste is its bulk i.e. it requires a large space for accommodation thus such material remains unutilized and there exists an environmental pollution.

It is realized that if waste is treated in such a way that reduces its storage space, then its use for manurial purpose as well as industrial utilization becomes more viable. The shredded waste can be useful for the production of hard boards, particleboards, corrugated boards and boxes, paper pulp and industrial application. It is also a useful source of lignin in animal feeds. Use of organic manure improves the physical, chemical and biological properties of soil by improvement of soil structure, water holding capacity, soil aeration, buffering of the soil surface temperature, reduction of the soil losses due to soil erosion etc. In order to utilize the agricultural waste as an organic manure material, it requires to reduce the volume i.e. to break into small pieces. A tractor operated shredder was developed and its performance was evaluated.

MATERIALS AND METHODS

The horticultural waste under study i.e. mango, sapota, cashew, nutmeg and grasses, were pruned in the month of November-December 2005. At the time of the storage the moisture content, bulk density, length of the pruned branches, top width of branches, weight of branches and diameter of branches were determined. These parameters were considered for development of shredder.

The tractor-operated thresher was developed with shredding capacity 200 kg/hr. The maximum bending stress required for various horticultural pruned branches was 125 Kg/cm² (Cowlick et. al. 1971), which was considered equivalent to dynamic shear stress. The force requirement for cutting pruned branches simultaneously (25-30 mm branch diameter) was calculated by using the Blevins (1954) and Bianer *et al.*(1955) formulae. Considering the power transmission losses, the HP requirement of engine was calculated as:

$$HP = \frac{P_1 \times rps}{75}$$

Where,

P_1 = Total work done requirement, Kg-m

rps = Revolution per second of shredding cylinder

To meet the requirement of shredding cylinder speed and torque, 35 hp and 540 ±10 rpm water cooled diesel engine tractor was selected as a power source.

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