

## Design fabrication and testing of vertical axis rotary tiller

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### ABSTRACT

Vertical Axis Rotary Tiller has been designed with a view to do primary and secondary tillage operation in one pass, particularly in light soils. However this can be used as secondary tillage in heavy soils. This design has only one rotor but in second phase the machine would have rotors in pairs. The design and fabrication of the machine was done in the Agricultural Engineering Department in A.A.I. in the year 92-93. The field capacity of the machine has been observed between 0.085 ha/h to 0.066 ha/h at 100 mm depth. The actual field capacity will increase considerably when the machine will be designed for pair of rotors .

**Key words :** Rotors, Tiller, Vertical, Performance.

### INTRODUCTION

Since the beginning of the civilization man has toiled to till the earth for the production of food and fiber. It was recognized early that stirring of the top crest of the soil enhanced plant growth. Man power and later animal power was utilized to accomplish this task by means of new and improved soil tools. In this endeavour to increase agricultural production the emphasis is now on to replace more advanced equipments and machinery in place of conventional machinery.

Present day tillage tools which even though accomplish the given task are generally not very efficient in energy utilization. The importance of this problem can not be over emphasized when one realized that only one percent increase in ploughing efficiency one of the many tillage operations would result in an annual savings of crores of rupees in India.

The compacting effect due to machine weight alone is increased by the draft forces applied to soil by tractor drive wheels. As tractor power increased so has draft capability as well as the wheel loading required for development of the maximum draft.

Transmission of the power directly to the tillage tool by mechanical means offers opportunity for reducing drawbar pull requirements there by reducing the soil compacting forces of traction wheels. Forced vibration or oscillation of the tillage tool and multipowered rotating tools are the methods of direct power utilization. Multipowered rotating implements are available in western countries in different configuration and arrangement including vertical axis, horizontal axis and transverse axis units. The Vertical axis machine have a series of two tine paths of adjacent rotors overlap. This project is intended only on single powered rotating implement to examine the feasibility of utilization of this type of tillage in Indian farms.

This machine "Vertical Axis Rotary Tiller" has two tine and single rotor mounted on gear shaft but provision is made to convert the machine to two or four unit with the help of chain and sprocket for further development of the machine. The tine paths of adjacent rotor overlap in multipowered units. The machine is driven by P.T.O. with the help of bevel gear arrangement. Power is transmitted from P.T.O. to pinion shaft and then to gear shaft.

This research was undertaken in the year 1992-93 to ascertain the rotary concept of tillage operation on Indian farms and to achieve the following objectives:

1. To design the powered "Vertical Axis Rotary Tiller."
2. To fabricate the designed machine.
3. To test the machine in idle as well as in running and in the field for the functional performance.

### MATERIALS AND METHODS

The design and fabrication of the machine was done in the Agricultural Engineering Department in A.A.I. in the year 92-93. Vertical Axis Rotary machine basically has a series of 2 tine vertical rotors across the width of the machine. The tine paths of adjacent rotors overlap. The machine is powered through P.T.O. of tractor and mounted behind the tractor by means of 3 point linkage. When the tractor is moved forward and the machine is operated by P.T.O. it digs the soil and pulverizes simultaneously. This particular machine has been made with only one rotor in the first phase to see the functional performance and feasibility of operation. The machine can be converted in to a multi power rotating tillage tools in next phase.

#### (i) Detail description of the machine

The Vertical Axis Rotary Tiller consists of following parts:

##### (a) Frame

On which the gear box is mounted and three point linkage is included in the frame.

##### (b) Gear Box

Set of bevel gears and bearings are assembled inside the gear box to transmit the horizontal rotation in to vertical rotation, it is properly sealed to prevent oil leakage.

##### (c) Rotor

Is fitted with gear box output shaft and has arrangement for mounting the blades at both ends.

##### (d) Blades

Two blades of carbon steel are fitted at both the ends of the rotor to dig and pulverize the soil.

#### (ii) Design of gears

Pair of bevel gears has been design for Vertical Axis Rotary Tiller. It was assumed that gear box should be able to transmit 30 hp. safely for pinion rpm. 540 (P.T.O.Speed).

#### (iii) Design of shaft

The material of both gear and pinion shaft is 45C8 steel whose ultimate tensile stress is 7000 kgf/cm and ultimate shear stress is 5000 kgf/cm factor of safety as 5.

#### (iv) Selection of bearings

Selection of bearings have been done on the basis of static and dynamic load acting on the shafts through bevel gear and pinion tooth and speed in rpm. Selected bearings are a pair of taper roller bearings for pinion shaft and gear shaft.