CHAPTER I

INTRODUCTION

1.1 General

The mechanics of soil vehicle system is a complex one. It may be defined as the detailed analytical study of the relation between traction performance, vehicle dimensions and soil properties. The problem of vehicle mobility has been solved to a great extent by the construction of roads. However, it offers a problem in sandy, muddy or snowy terrains.

1.2 Problem and Justification

The ever increasing demands of food and fibre has resulted in the increased use of power on the farm and the problem of mobility of these machines is very important. In India, paddy is the main staple crop and increased paddy production is possible by adopting the multiple cropping system. This can be achieved only if the cultivation is mechanized. In Japan power tillers have been successfully employed in paddy cultivation and they offer greater potentiality if introduced in Indian agriculture. The Indian farmer has become conscious of the advantages of using the mechanical power in agriculture. On the basis of the current trends, the yearly estimated demand reported by the government sources are in the range of 50,000 tractors and 30,000 power tillers (56)*. The power tillers which are now

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* The number in parenthesis refers to the numbered reference in the references.

available in the market are either manufactured in India or imported from abroad. The same trend will continue in future also. Hence the responsibility of the people in trade is very great as far as the success of mechanization of the farms with power tillers is concerned. The Indian farmer though illiterate responds eagerly to new systems or practices if he is confident about their success. The machines are meant to reduce the drudgery and their operation on the farm should prove economical. Though at present the Indian farmer is mostly using animal (bullocks) power on wet soft ground as well as in sandy area, there is enough scope for employing power tillers.

The experience indicates that in wet, soft ground conditions, the development of pull power and speed is a great problem and it becomes extremely low in puddled and sandy soil conditions. The success of mechanized cultivation with power tillers would depend upon how efficiently these machines can be operated in the fields. The performance studies on the power tillers with special reference to their traction devices are quite timely because of the following reasons:

a) The studies would indicate the efficiency at which engine power is converted into useful power, thus helping in assessing tractor power requirements.

b) It would help in designing better traction wheels resulting in better performance efficiencies.

c) This would result in large savings in fuel, materials and power, on national level.

d) It would reveal the suitability of power tillers in carrying out different farm operations in wet soil conditions.

A traction wheel is one which when supplied with rotational power develops thrust due to interaction between wheel and soil and also develops motion at the expected speed and loading conditions. The criterion for the good traction wheel is that it should be able to attain the best desired performance or in other words be able to develop the power closest to the power supplied to it. This means that the wheel should function at the best possible efficiency. Tests indicate that the power efficiencies achieved in soft wet ground conditions are around 40-50 per cent and it goes down further in difficult terrain conditions (21). When a driven wheel moves on a soil surface, the energy supplied to it is consumed in different ways. A part of the energy is consumed in developing power, the other part is utilized in compressing and deforming the soil. This process continues till the wheel is able to develop sufficient traction to overcome the rolling resistance. As soon as the soil strength is destroyed, the wheel is immobilized.

The problem of low tractive efficiency is well recognized and the research is now-a-days directed towards increasing the tractive efficiency. One of the reasons for low tractive

efficiency is the tendency of the manufacturer to increase the drawbar power by increasing the engine horse power, without trying to increase the tractive performance. The increase in tractive efficiency is also maintained by increasing the weight acting on the driving wheels by means of additional ballast or utilizing the weight transfer or both. This works well if the terrain is quite firm to support the additional weights. Sometimes the size of a wheel is increased to accommodate the additional weight and the torque, thereby higher efficiency is achieved.

There are number of ways to increase the tractive performance in soft soil conditions in case of a powertiller . The use of pneumatic track, dual wheels, combination of pneumatic wheel with a cage wheel, four wheel drive system or modified wheels, are possible solutions. However, another important factor will be the economic factor, i.e. the system used should be economical so that the cost of power tiller should not become prohibitive.

1.3 Research Work Proposed and Objectives

Available knowledge indicates that the pull developed by a wheel is dependent upon soil properties, wheel parameters, weight on wheel and slip (21). The power output is a function of some of these variables. Unfortunately there is no unique

relationship between them. Also it is very difficult to express in mathematical form the traction phenomenon and factors affecting it. A traction wheel carrying a fixed weight and operating on a uniform soil develops a unique pull for each value of slip. Therefore, by controlling the weight on the wheel and the wheel parameters, other variables can be optimized to achieve the best traction performance. Hence the tractive performance of a device might be considered to be influenced by soil and wheel characteristics. It is not possible to manipulate the soil properties to a greater extent. However, during the experiments the soil properties are measured to control the soil variability under different tests. Under such a controlled condition, any change in the performance, therefore, could be attributed to the wheel design mainly.

The proposed research work was undertaken to study the performance of small traction wheels in wet soils. In order to conduct the tests, it was felt necessary to develop the test facilities also. Finally with following major objectives, the research work was undertaken:

1) To develop the laboratory facilities for conducting traction studies to measure various dependent and independent variables associated with it.

2) To conduct and compare the performance tests on both the pneumatic and steel wheels of the sizes commonly used on

power tillers at different moisture levels upto puddled conditions.

3) To develop simple and efficient power tiller wheels suitable for puddled soil conditions.

4) To conduct wheel performance tests in laboratory on pneumatic and steel wheels on dry sand and evaluate their performances.