International Journal of Agricultural Engineering, Vol. 3 No. 2 (October, 2010) : 192 -198

Research Paper :

Effect of tool shape and operating parameters on soil disruption of cultivator sweeps in sandy loam soil

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Accepted : *May, 2010*

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ABSTRACT

Both soil condition and soil physical characteristics like structure and texture demand different shapes of soil working tools as well as operating conditions. Hence, soil-tool-tillage complex need to be studied for a given location and tool geometry and is to be optimized for better tool performance and energy. Furrow parameters such as furrow bottom, soil throw, soil disturbance in vicinity of tool in relation to speed and depth of operation are affected by tool parameters like shape, size. In this paper effect of tool shape and depth and speed of operation on soil disruption of sweeps for tractor drawn cultivator is discussed. The experiments were conducted in sandy loam soil using two commonly used sweeps at four forward speeds (0.97, 1.25, 1.53 and 1.81 m/s) and depths (0.04, 0.08, 0.12 and 0.16 m) at soil moisture content of about 10.5 per cent (db) under controlled soil bin conditions.

Key words : Sweeps, Soil disruption, Soil profile

Tillage is an energy intensive farm operation consuming about 40 per cent of the total energy input required for crop production (Yadav *et al.,* 2006). It is a basic operation in farming and is generally performed to breakup and pulverize the soil and allow the free movement of air and water in order to promote plant growth. Field soils loosened by tillage tend to become compact as the crops grow. The weeds destroyed by tillage grow once again and land tends to return to the state that existed before tillage therefore it becomes necessary to do tillage before growing every crops.

Cultivator is one of the most important tillage tools used by Indian farmer (Yadav *et al.,* 2006). Even many organic farmers say that a pass with the cultivator has the same effect on the crop in dry weather as a half inch of rain (Klaas and Martens, 2005). It is primarily the type of tillage implement which is used for opening the land, preparing the seedbed for sowing of the seeds as well as after the crop has come up a few cms above the ground (Jain and Grace Philip, 2003). The field cultivators are often used as secondary tillage tools for seedbed preparation. Reversible shovel, sweep, half sweep, furrower etc. are the different types of tool that can be attached to a cultivator shank for different applications. Soil disruption, which is a measure of effectiveness of tillage implement is affected by type of tillage tool, speed and depth of operation. Soil profile or soil redistribution after tillage operation is important in several aspects such as seed placement and covering, incorporating manure and crop residues, protecting soil from wind and water erosion etc. (Liu and Kushwaha, 2006). The study of soil profile and soil redistribution by tillage has progressed slowly due to its complexity which involves many factors, such as soil types and properties, types of tillage tools and their operational parameters. Furrow parameters such as furrow bottom, soil throw, soil disturbance in vicinity of tool in relation to speed and depth of operation are affected by tool parameters like shape, size and spacing, operating parameters such as speed and depth of operation and soil parameters like soil type, moisture content, compaction etc. and are studied by various researchers (Dowell *et al.*, 1988; Raper and Sharma, 2004; Raper, 2005; Darmora and Pandey, 2006, Godwin and O'Dogherty, 2006; Liu and Kushwaha, 2006). Keeping these points in view the study was conducted with the objective to study the influence of shape of sweeps, speed and depth of operation on soil disruption.

METHODOLOGY

The experiments using RBD design were conducted in indoor circular soil bin filled with locally available sandy loam soil at College of Technology and Engineering, Udaipur, Rajasthan, India during year 2008. It had an outer diameter of 5520 mm, inner diameter of 3490 mm and a depth of 900 mm. Thus annular width of 1010 mm was available for operating the tool frame. A DC variable shunt wound motor of 20 hp was coupled to worm gear for speed reduction in the ratio of 5:1. The vertical powered shaft was clamped to the horizontal beam of 3150 mm length and 65 mm diameter. A pneumatic wheel was