Compactability behaviour of soils under different cropping sequences

There is growing realization that intensive cropping and increased mechanization used for higher production have led to a gradual densification of soils. The present investigation was, therefore, aimed at studying the compactability behavior of soils of Haryana where after green revolution, there has been a substantial increase in the cropping intensity, and number of tractors and other tillage implements. Adoption of zero tillage technology for wheat in rice-wheat cropping system has also increased in the recent past. The surface samples of sand soil from Regional Research Station (RRS), Balsamand and clay loam soil from RRS, Kaul of CCS HAU, Hisar, were collected and mixed in different ratios to have soils of different textures for establishing the relationship between texture, organic matter and soil water content with compactability of soils. Different levels of organic carbon (0, 0.21, 0.43, 1.1, and 2.2%) in each texturally different soil were obtained by adding a known amount of well decomposed farm yard manure of known organic carbon content (21.5%). The maximum bulk density (MBD) of soils was determined from their soil moisture and bulk density relationships using the Standard Proctor Test. The water content at which MBD was achieved was also noted and designated as critical moisture content (CWC). Susceptibility of soils to compaction (SC) was determined as the slope of the ascending regression line between moisture content and bulk density of soils. To identify readily measured soil properties which relate to the compactability indices (MBD, CWC and SC) under different cropping systems, a total of 60 surface (0-15cm) soil samples were collected from five different locations from each of rice-wheat, cotton-wheat, bajra-wheat/mustard, and fallow-gram/mustard cropping systems in the state during January 2005. The physical properties measured were: sand, silt, clay, particle density, organic carbon, liquid and plastic limit, plasticity index, field capacity moisture content. Data were subjected to simple correlation, multiple and step wise regression analysis to assess the influence of different soil properties and their interactions on MBD, CWC and SC. The samples were also grouped according to the cropping systems and their textures. The differences in soil properties between each group were compared with the mean differences analysis test. The relative bulk density was used to assess the existing level of soil compaction under different cropping systems. The soil core samples from various depths from 20 different locations covering all the four cropping systems were collected for their field bulk density and MBD measurements. The compactability indices were found to be increased with increase in the fineness of the texture of the soils. Sandy (sand and loamy sand) soils achieved maximum compaction at relatively low moisture content as compared to loamy (sandy loam, loam and clay loam) soils. The critical moisture content for maximum bulk density of loamy soils was found to be less than the moisture contents at their field capacities. The swelling soil (clay loam) was found to be severely compacted upon compaction and subsequent drying (shrinkage) but the Proctor test used for compactability did not identify such a high level of compaction due to swelling. The degree of compactness of clay loam soil after correction for swelling was found to be least suggesting that clay loam soil may be compacted to a greater extent upon application of pressure/load and subsequent drying as compared to other textured soils studied. An increase in soil organic matter reduces the risk of compactability in different textured soils at given moisture content. The large variation between soils, however, suggested that soil specific tests (due to variation in texture) would be required to determine the correct organic matter level to achieve a target bulk density for avoiding the problem of compaction. The best prediction of maximum compaction may be obtained on the basis of soil organic carbon content while susceptibility of soil to compaction may be estimated using silt content of the soil. Due to very low amount of organic matter in soils, soil compactability in different cropping systems was not found to be related to organic carbon contents of soils. The susceptibility of soil to compaction was related to silt content of soils of rice-wheat and cotton-wheat.
cropping sequences. The existing level of compaction was highest in soils of rice-wheat system followed by cotton-wheat, bajra-wheat/mustard and fallow-gram/mustard. The variation in the level of compaction was, however, quite large in each cropping system. The study suggested that the soil moisture content is very important to measure, particularly in loamy soil, before carrying out any tillage and other farm operations to avoid excessive compaction. The presence of organic matter tends to lower the risk of compactability, therefore, a part of the compaction threat to soils can be countered by increased emphasis on achieving higher organic matter levels in soils of the state which are very poor in their organic carbon contents. The results of the study is also helpful in deciding the level of organic matter to be applied in different textured soils so as to keep their bulk densities to a level which would not be a restricting one to the root growth.