Journal of Agricultural Machinery
Vol. 5, No. 2, Fall - Winter 2015, p. 368-380

نشریه ماشین‌های کشاورزی
جلد ۵، شماره ۲، نیمسال دوم ۱۳۹۴، ص ۳۸۰-۳۶۸

The effects of forward speed and depth of conservation tillage on soil bulk density

A. Mahmoudi[1*]- A. Jalali [2]- M. Valizadeh[3]- I. Skandari[4]

Received: 23-11-2013
Accepted: 02-02-2014

Introduction: In recent years, production techniques and equipment have been developed for conservation of tillage systems that have been adopted by many farmers. With proper management, overall yield averages for conventional and reduced tillage systems are nearly identical. Sometimes, field operations can be combined by connecting two or more implements. Combined operations reduce both fuel consumption, and time and labor requirements by eliminating at least one individual trip over the field. Light tillage, spraying, or fertilizing operations can be combined with either primary or secondary tillage or planting operations. Tillage helps seed growth and germination through providing appropriate conditions for soil to absorb sufficient temperature and humidity. Moreover, it helps easier development of root through reducing soil penetration resistance. Tillage is a time-consuming and expensive procedure. With the application of agricultural operations, we can save substantial amounts of fuel, time and energy consumption. Conservation tillage loosens the soil without turning, but by remaining the plant left overs, stems and roots. Bulk density reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. Bulk densities above thresholds indicate impaired function. Bulk density is also used to convert between weight and volume of soil. It is used to express soil physical, chemical and biological measurements on a volumetric basis for soil quality assessment and comparisons between management systems. This increases the validity of comparisons by removing the error associated with differences in soil density at the time of sampling. The aim of conservation tillage is to fix the soil structure. This investigation was carried out considering the advantages of conservation tillage and less scientific research works on imported conservation tillage devices and those which are made inside the country, besides the importance of tillage depth and speed in different tiller performance.

Materials and methods: This investigation was carried out based on random blocks in the form of split plot experimental design. The main factor, tillage depth, (was 10 and 20cm at both levels) and the second factor, tillage speed, (was 6, 8, 10, 12 km h^{-1} in four levels for Bostan-Abad and 8,10,12,14 km h^{-1} for Hashtrood) with four repetitions. It was carried out using complex tillage made in Sazeh Keshte Bukan Company, which is mostly used in Eastern Azerbaijanand using Massey Ferguson 285 and 399 tractors in Bostab-Abad and Hashtrood, respectively. In this investigation, the characteristics of soil bulk density were studied in two sampling depths of 7 and 17 centimeters. Bulk density is an indicator of soil compaction. It is calculated as the dry weight of soil divided by its volume. This volume includes the volume of soil particles and the volume of pores among soil particles. Bulk density is typically expressed in g cm^{-3}.

Results and Discussion: In this study, the effect of both factors on the feature of the soil bulk density at the sampling depth of 5-10 and 15-20 cm was examined. In Bostan-Abad, regarding tillage speed effect for studies characteristics at 1% probability level ($p<0.01$) on soil bulk density was effective. The effect of tillage depth on the soil bulk density was significant at 5% probability level ($p<0.05$). The interaction effect of tillage speed and depth on soil bulk density was significant at probability level of 1% ($p<0.01$). Regarding sampling depth effect, the soil bulk density was significant at 5% ($p<0.05$) probability level, respectively. In Hashtrood, the effect of tillage speed on soil bulk density at probability level of 1% ($p<0.01$), and also tillage depth effect on soil bulk density was significant at 5% level of probability ($p<0.05$). The interaction effect of tillage speed and depth on soil bulk density was significant at 5% level of probability ($p<0.05$). Regarding the depth of sampling it was significant on soil bulk density at probability level of 1% ($p<0.01$). Through an increase in tillage speed, soil bulk density reduces at unit level.

Conclusions: In this study, the effect of both factors on the feature of the soil bulk density in the sampling depth of 5-10 and 15-20 cm was examined. In Bostan-Abad and Hashtroud, on the whole, the results indicated that the increase in

1- Associate Professor, Department of Biosystem Engineering, University of Tabriz, Iran
2- PhD Student, Department of Biosystem Engineering, University of Tabriz, Iran
3- Professor, Department of Agronomy and Plant Breeding, University of Tabriz, Iran
4- Faculty member, Dry land Agriculture Research Institute, Maragheh, Iran
(*- Corresponding Author Email: a_mahmoudi@tabrizu.ac.ir)

the speed of tillage, soil bulk density, was reduced and the speed of 10 kilometers per hour was the best for this to implement work. Also, with an increasing depth of tillage, the bulk density increased. Through an increase in tillage speed, soil bulk density reduced at unit level. Moreover, the optimum speed was concluded 10km per hour. Through an increase in tillage depth, bulk density and soil humidity increase accordingly. The best tillage depth using this machine is 10cm.

Keywords: Bulk density, Conservation tillage, Depth, Soil, Speed