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Effect of Subsoiler on Soil Physio-Chemical Properties and Root Growth on Various Crops-A Review

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A B S T R A C T

Subsoiler plough is predominantly exclusively primary tillage equipment far and wide. In ideal conditions, subsoiling should break up the soil at depth and produce vertical cracks through the whole soil profile. On overview of effects of subsoiler on soil physio-chemical properties and root growth of various crops. The subsoiler has better performance on improving soil properties such as bulk density, porosity, strength, infiltration rates, chemical properties and root development. The crop yields were seen positive or no correlation on subsoiling.

Introduction

Holistic management of arable soil is the key to dealing with the most complex, dynamic, and interrelated soil properties, thereby, maintaining sustainable agricultural production systems, the lone foundation of human civilization.

Any management practice imposed on soil for altering the heterogeneous body may result in generous or harmful outcomes (Derpsch, *et al.*, 2010). Unsuitable management practices cause degradation in soil health (depletion of organic matter and other nutrients) as well as decline in crop productivity (Ramos *et al.*, 2011). Reducing disturbance of soil by reduced tillage influences several physically (López-Garrido *et al.*, 2012), chemically, and biologically interconnected properties of the natural body.

Subsoiler plough is predominantly exclusively primary tillage equipment far and wide. In ideal conditions, subsoiling should break up the soil at depth and produce vertical cracks through the whole soil profile. The depth of subsoiling can be 25 cm (Burgess *et al.*, 1998; Harrison *et al.*, 1994) to loosen topsoil, or much deeper (50 cm) to loosen dense B horizons (Chapman & Allbrook 1987; Richardson *et al.*, 1990; Harrison *et al.*, 1994).

It is a technique commonly used to alleviate the adverse effects of soil compaction and improve soil physical properties, chemical properties and better root growth. Due to heavy machineries working on field the soil is compacted which in turn affects the infiltration of water from the surface to subsoil. Heavy machineries and tractors are in some measure reason for soil compaction. A form of soil degradation is the phenomenon which occurs when the macro pores are closed and increased bulk density, soil resistance is known as soil compaction. The subsoiling can be called as aerating, chiselling and ripping. It had poles apart outcomes on modified designs, different crops and several other varying parameters. Subsoiling has the paramount advantages of decreasing the bulk density and increased water storage capacity. Current studies progresses for reduced draft and energy requirements of the subsoiler with more soil disturbances.

Effect on Soil physio-chemical properties

When the soil compaction occurs, it affects the soil properties such as soil cone index, total porosity and dry density. There exists a significant negative correlation between soil compaction and water content. Subsoiling increases soil macro porosity, air permeability and unsaturated hydraulic conductivity. And there will be a reduction in soil bulk density, penetration resistance and critical degree-of-compactness. (João Carlos Medeiros *et al.*, 2013).

Also subsoiling has a significant increase on the infiltration of water. Subsoiling increases the water and nutrients uptake (Unger *et al.*, 1981; Bennie & Botha 1986; Harrison *et al.*, 1994; Burgess *et al.*, 1998). The soil resistance on one pass and two pass subsoiling decreased by 13.3 and 26.2% respectively in the first year of study on a cotton field. Also subsoiling can prevent surface soil erosion.

Effects on crops in Punjab, Pakisthan and revealed that different subsoiler designs by draft, crop residue cover, soil physical properties and yield measurements over the subsequent two growing seasons. Air porosity and cone penetrometer measurements showed continuing benefits, from all subsoil operations, two years after tillage in areas not trafficked. However, two passes of a tractor recompacted the soil (Ishaq *et al.,* 2001).

Minimum soil disturbance, residue retention and appropriate crop rotation are basic principles of conservation agriculture (CA) that significantly improve the soil physical and chemical properties. CA practices improve soil aggregation, bulk density and infiltration in long run due 8 to the presence of carbon pool. The higher amount of SOC in surface soil layer in CA is due to higher accumulation of crop residue which also increases nutrient availability. (Marahatta *et al.*, 2014).

The actual evapotranspiration rate was 1.82 mm d-1 that declined by 31 % with mulch. The variation of evapotranspiration among different mulch became more prominent under maximum water stressed condition. Among the different treatment maximum water use efficiency obtained by black polythene mulch followed by white polythene mulch, rice straw mulch and lowest in no mulch (Mukherjee *et al.*, 2010).

Soil from adjoining forest, at depths of between 0 and 15 cm; moisture content, bulk density, porosity (Nta *et al.*, 2017). Improvement in structural stability, total porosity and macro-porosity, decrease of surface crusting and by improving the overall soil drainage (Bandyopadhyay *et al.*, 2009).

Residue retention with minimum tillage practices improved soil properties and yield of upland crops but with deeper tillage practices consistently maintained wetland rice production. Bulk density (BD) and porosity responded positively to minimum tillage (MT) and increased residue retention of all crops ($p > 0.05$).

Minimum tillage practice performed better in upland crops ($p < 0.05$; wheat & mungbean yields) and CT outperformed MT in wetland rice crop ($p < 0.05$). The grain and straw yields of wheat and rice were also influenced by previous crop residue retentions ($p < 0.05$) (Salahin *et al.*, 2017).

Effects of Subsoiler Root Growth

There was an improved root parameters such as density, depth, and length on subsoiling. Using Paraplow (type of subsoiler with slanted legs on 45 degree), the root density of spring barley was increased significantly within the horizon (Hipps *et al.,* 1987). Subsoiling increases the depth of roots and in turn helps to withstand conditions of short term droughts. (Meredith *et al.,* 1961; Raper *et al.,* 2007). Length of the roots may increase by 13% on effect of subsoiling.

There is no direct effects on root development of soil compaction. But there exists an indirect effect on soil physical properties which includes porosity, volumetric water content, gaseous diffusion and hydraulic conductivity of the soil. Even the root development altered by changes in soil compactness exists, the growth of plants above the ground may be normal under the conditions of sufficient water and nutrients available to plants. Under artificial soil compaction studies on laboratory, the root penetration decreased (Meredith *et al.,* 1961).

Studies found that productive moisture accumulated in the soil loosened deeply is higher; especially in the subsoil. But the bulk density of subsoil decreased only when grown crops are long-rooted after subsoiling. During a dry summer period following subsoiling, pasture dry matter production was reduced significantly. This was due to the root disturbances and moisture stress (Drewry *et al.,* 2010).

References

Bandyopadhyay, K. K., Prakash, A. H., Sankaranaryanan, K., Gopalakrishnan, N. and Dharajothi, B. (2009). Effect of irrigation and nitrogen on soil water dynamics, productivity and input- use efficiency of Bt cotton in a Vertic Ustropept. *Ind. J. of Agric.sci.* 79(6): 448-453.

Bennie, A. T. P.; Botha, F. J. P. 1986: Effect of deep tillage and controlled traffic on root growth, water-use efficiency and yield of irrigated maize and wheat. *Soil and Tillage Research 7:* 85-95.

Burgess, C. P.; Chapman, R.; Singleton, P. L.; Thorn, E. R. 1998: Effects of livestock treading and mechanical loosening of soil. Proceedings of the New Zealand Society of Soil Science, Gisborne. Pp. 99-100

Chapman, R.; Allbrook, R. F. 1987: The effects of subsoiling compacted soils under grass - a progress report. *Proceedings of the Agronomy Society of New Zealand 17:* 55-58.

Derpsch, R., Friedrich, T., Kassam, A., and Hongwen, L. (2010). Current status of adoption of no till farming in the world and some of its main benefits. *Int J. Agric. Biol. Eng.*3 (1):16-22.

Drewry, J. J. *et al.,* (2000) Effect of subsoiling on soil physical properties and pasture production on a Pallic Soil in Southland, New Zealand, New Zealand Journal of Agricultural Research, 43:2, 269-277, DOI: 10.1080/00288233.2000.9513427

Feng, X, *et al.,* 2018. Effects of Subsoiling Tillage on Soil Properties, Maize Root Distribution, and Grain Yield on Mollisols of Northeastern China, Agronomy Journal. Volume 110, Issue 4 2018 Agron. J. 110:1607–1615 (2018) doi:10.2134/agronj2018.01.0027

López-Garrido, L., Deurer, M., Madejón, E., Murillo, J. M. and Moreno, F. (2012). Tillage influence on biophysical soil properties: the example of a long-term tillage experiment under Mediterranean rainfed conditions in South Spain. *Soil till. Res*. vol. 118: 52–60.

Harrison, D. F.; Cameron, K. C; McLaren, R. G. 1994: Effects of subsoil loosening on soil physical properties, plant root growth and pasture yield. *New Zealand Journal of Agricultural Research 37:* 559-567.

Hipps, N A, *et al.,* 1988. Residual effects of a slant-legged subsoiler on some soil physical conditions and the root growth of spring barley, *J. agric. Set.*, Camb. (1988), 110, 481-489.

Ishaq, M., Ibrahim, M., Hassan, M., Saeed and Lal, R. (2001). Subsoil compaction effects on crops in Punjab, Pakisthan. *Soil.Till. Res.* 60(3-4):153-161.

Marahatta, S., Sah, S. R., MacDonald, A., Timilnisa J. and Devkota K.P. (2014). Influence of conservation agriculture practices on physical and chemical properties of soil. *Int. J. of Advanced Res.* 2(12):43-52.

Medeiros, J C, 2013. Deep subsoiling of a subsurface-compacted typical hapludult under citrus orchard, R. Bras. Ci. Solo, 37:911-919, 2013.

Meredith, H. L., and W. H. Patrick. 1961. Effects of Soil Compaction on Subsoil Root Penetration and Physical Properties of Three Soils in Louisiana1. *Agron. J.* 53:163-167. doi:10.2134/agronj1961.00021962005300030011x

Mukherjee, A., Kundu, M. and Sarkar, S. (2010). Effect of different mulhing material on water use efficiency and evapotranspiration in tomato. *Agric.Water.Manag.* 98(1):182-189.

Nta, S. A.; Lucas, E. B. and Ogunjimi, L. A. O (2017). Effect of Tillage on Soil Physico-Chemical Properties in South-Western Nigeria. *Int. J. Res. Agric. Forestry*. 4 (7): 20-24.

Ramos, M. E., Robles A. B., Sánchez-Navarro A. and González-Rebollar J. L (2011). ―Soil responses to different management practices in rainfed orchards in semiarid environments‖ *Soil till. Res.* 112(1):85–91, 201

Raper, R.L *et al.,* 2007. In-row subsoiling: a review and suggestions for reducing cost of this conservation tillage operation, *Applied Engineering in Agriculture*, Vol. 23(4): 463-471, 2007, American Society of Agricultural and Biological Engineers ISSN 0883−8542.

Richardson, M. A.; Haynes, D. A.; Edwards, J. A. 1990: Subsoiling for drainage in Northland. *In:* Home, D. J.; Furkert, 1. F. H. *ed.* Proceedings of the Fifth National Land Drainage Seminar. Massey University. *Occasional Report 10:* 60-70.

Salahin, N., Islam M., Alam, K. M., Rashid, M. H. and Hoque, A. I. (2017). Effect of Tillage and Residue Retention on Soil Properties and Yields in wheat –mungbean – rice Crop Rotation under Sub Tropical Humid Climate. *Open J of Soil Sci*.7:1-17

Soltanabadi, M H, *et al.,* 2008. Effect of subsoiling in condition of strip tillage on soil physical properties and sunflower yield, *Journal of Agricultural Technology*, 2008, V. 4(2): 11-19.

Soltanabadi, M H, *et al.,* 2008. Effect of subsoiling on soil physical properties and sunflower yield under conditions of conventional tillage, Int. Agrophysics, 2008, 22, 313-317.

Unger, P. W.; Eck, H. V.; Musick, J. T. 1981: Alleviating plant water stress. *In:* Arkin, G. F.; Taylor, H. M. *ed.* Modifying the foot environment to reduce crop stress. *American Society of Agricultural. Engineers Monograph 4:* 61-96.

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