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Shifting tillage: Novel tillage methodology to sustain agriculture

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ABSTRACT

Generally frequent tillage result in decline in soil physical chemical and biological quality and studies shows the incident of increasing greenhouse gas emission due to soil organic carbon loss. We proposed shifting tillage to reduce the tillage depth which will be helpful in preserving the soil nutrient from soil erosion. In addition the proposed methodology will utilize the weed prone area soil for cultivation of food grain which is urgent requirement for sustainable agriculture in India. Weed inhabitant land in India can be used for cultivation and reducing the ill effect of tillage for soil sustainable productivity. Amendment of Rhizospheric soil after amending organic amendments will improve soil properties.

Keywords: Shifting Tillage, Weeds, Rhizospheric soil, Organic amendments

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INTRODUCTION

Tillage cracks the soil structure which result in accelerated soil erosion. Long tillage conventional tillage generally results in decline in organic matter in soils [1] and soil productivity [2]. Indian population is rapidly increasing and consequently agriculture has been intensified to sustain life. High pressure on land and soil cause soil quality deterioration, loss of soil biodiversity, salinization, high external input and other environmental degradation process. Due to huge pressure of food security in overpopulated nation like India, conventional tillage is emerging threat. Securing food by intensive green revolution had already made a mark of reducing Indian forest cover by 11 percent. In contrast, no or reduced tillage significantly increase soil organic matter [3] however, non-even distribution of organic matter and critical sensitive procedure are serious concerns. To mitigate and reduce the rapid decomposition of organic matter and to improve soil quality, conservation tillage strategies have been popularized.

Shifting Tillage

In this scenario if the degraded soil may possible used for tillage amendment to reduce the tillage depth, soil can be conserved and sustainable agriculture is possible. This practice of amendment of degraded soil after reclamation to reduce tilled land, we define it as shifting tillage. We hypothesize that this practice has a potential of not only improve our soil use efficiency but also improve soil quality. Rhizosphere initiates many biogeochemical reactions [4] and increase the soil carbon sequestration [5, 6] consequently plant influenced microbial population increase. The augmented microbial densities due to rhizospheric functions regulate soil nutrient exchange and allow different types of associations [7]. Both plant species and soil type have an impact on soil function mediated by accrued specific microbial communities due to rhizodeposition and reported by many studies that both the factors dominate for efficient ecosystem functioning [8].

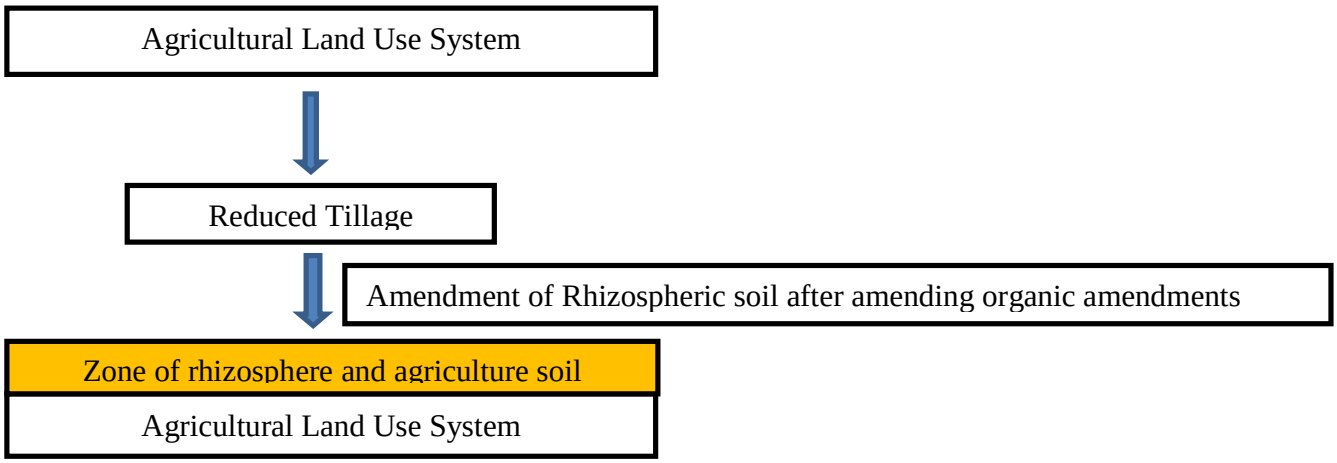

Fig 1: Concept of Shifting Tillage

Rhizospheric effect and soil microbes

The rhizospheric effect i.e. the interaction and then dominance of rhizospheric influenced microbial communities generally determine the microbial functions in rhizospheric as well as bulk soil [9]. In addition as reported by Nannipieri et al [10], rhizosphere is the zone of increase biological activity and if the weed dominated rhizospheric soil can be used as amendment to proximity agriculture soil, depth of tillage can be reduced.

Higher microbial diversity generally increase the functional stability of soil [11] and in a degraded land as compared to bulk soil, higher microbial diversity is expected in weed rhizospheric soil. Studies shows that functional redundancy in microbial communities were high [12] and so it may be possible that degraded land use system soil can be incorporated with proximity agricultural land use system for better soil use efficiency.

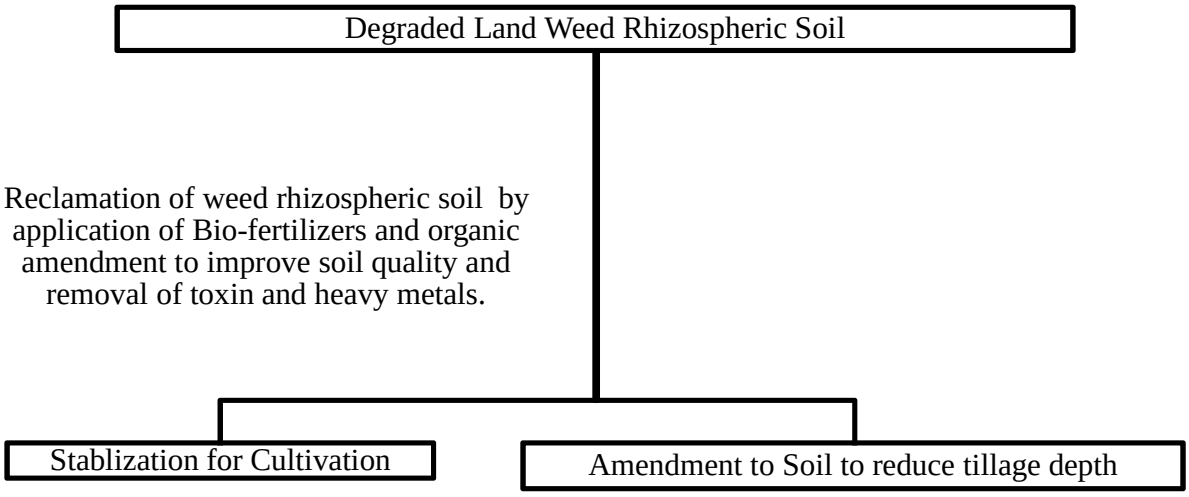

Figure 2: Schematic representation of the main steps involved for using degraded soil to increase soil use efficiency

Figure 3: Photograph of fertile wheat plot near Lovely Professional University (31.2536° N, 75.7037° E) taken in spring 2015. Fertile wheat plot is surrounded by long-time ignored degraded land inhabiting weeds. Photo by J Jayanthi

CONCLUSION

Till date there are no study reported in which the degraded soil were reclaimed and amended in agricultural land to reduce tillage depth and we wish to introduce the term "Shifting Tillage" which might have the potential to conserve and may possibly improve the present soil quality. We define Shifting Tillage as amending the rhizospheric soil of the agricultural proximal land in reducibly tilled agricultural land. According to Ministry of Rural Development, Government of India nearly 68.35 million hectare area were classified as wasteland [13] and being a population rich country with very limited land resources, soil use efficiency is highly crucial for food production and security. How longer Indian soil sustain green revolution would be a foremost query and need to be answer very swiftly for securing Indian population. The initial reclamation of degraded soil and further organic amendments may have economical cost high but in context of conserving our natural resource, this shifting tillage approach will beefficient element in sustaining agriculture.

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