Impact of Vetch Cover Crop on Runoff, Soil Loss, Soil Chemical Properties and Yield of Chickpea in North Gondar, Ethiopia

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Cover crops improve the sustainability and quality of both natural systems and agro ecosystems. In the Gumara-Maksegnit watershed which is located in the Lake Tana basin of Ethiopia, farmers usually use a fallow period during the rainy season after the preceding chickpea crop. This fallow period can lead to soil erosion and nutrient losses. Instead of a fallow period, cover crops can be used as a nutrient reduction strategy and soil erosion protection measure for producers to consider. This is identified as an area where research is lacking, and where studies are needed to better assess impacts of vetch cover crop on soil loss and nutrient management in watersheds.

A field experiment was conducted in 2014 to evaluate the effect of cover crops on runoff, soil loss, soil chemical properties and yield of chickpea in North Gondar, Ethiopia. The plot experiment contained four treatments arranged in a Randomized Complete Block Design with three replications: 1) Control (Farmers' practice: fallow period without cover crop), 2) Chickpea planted with Di-ammonium phosphate (DAP) fertilizer with 46 kg ha^{-1} P_2O_5 and 23 kg ha^{-1} Nitrogen after harvesting vetch cover crop, 3) Chickpea planted with vetch cover crop incorporated with the soil as green manure without fertilizer, 4) Chickpea planted with vetch cover crop and incorporated with the soil as a green manure, plus 23 kg ha^{-1} P_2O_5 and 12.5 kg ha^{-1} nitrogen. Each plot had an area of 36 m^2 and was equipped with a runoff monitoring system (Figure 1). Vetch cover crop was planted in June, just as the rains began, and was plowed under and incorporated before planting chickpea.

Figure 1. Experimental field layout with runoff collection tanks.

The field study results indicated that the percentage of vetch cover crop increased to 92% in the growing period which had a clear impact on runoff volume and sediment loss. Vetch

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cover crop reduced the average runoff by 65%, and reduced the average annual soil loss from 15.7 to 8.0 t ha^{-1} per year. The results of the experiment showed statistically significant ($P < 0.05$) differences on the number of pods per plant, above ground biomass, and grain yield of chickpea. The minimum chickpea grain yield was observed in the bare plot (T1), which was 8.5 t ha^{-1}, while in plots with the cover crop (T2, T3 and T4) the grain yield ranged from 16.7 to 19.7 t ha^{-1}. In this study the average soil loss (15.7 t ha^{-1} yr^{-1}) from the bare soil (T1) was more than the tolerance level. Gomez et al. (2009) reported that cover crops have a significant impact on reducing the amount of runoff and soil loss. Therefore adoption of cover crops, especially vetch, can be used to improve chickpea grain yield in addition to reducing soil erosion in this watershed.

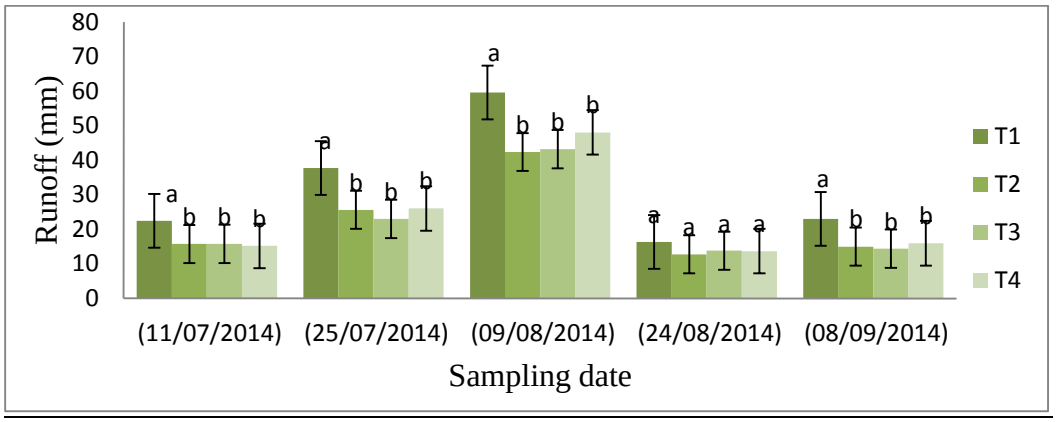

Figure 2. Effect of investigated treatments on runoff (T1: Farmers' practice (fallowing), T2: Chickpea planted with Di-ammonium phosphate (DAP) after harvesting vetch cover crop, T3: Chickpea planted with vetch cover crop used as green manure without fertilizer, T4: Chickpea planted with vetch cover crop used as green manure and with half the recommended fertilizer).

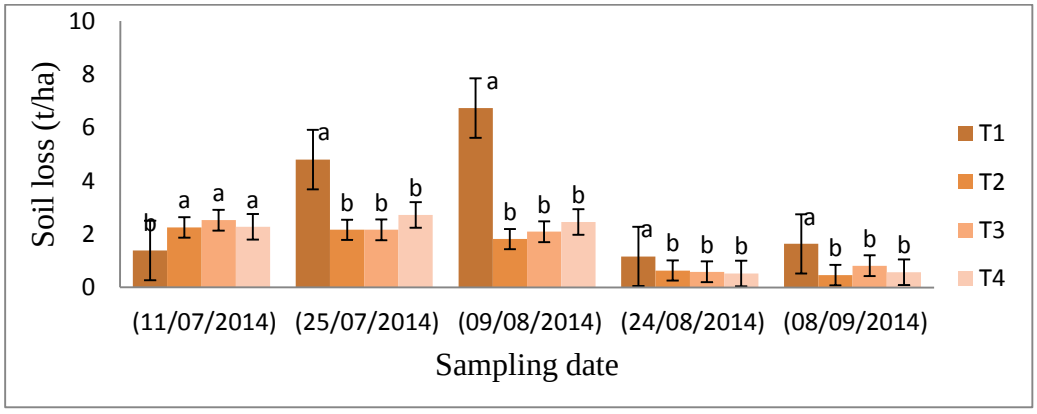

Figure 3. Effect of investigated treatments on soil loss (T1: Farmers' practice (fallowing), T2: Chickpea planted with Di-ammonium phosphate (DAP) after harvesting vetch cover crop, T3: Chickpea planted with vetch cover crop used as green manure without fertilizer, T4: Chickpea planted with vetch cover crop used as green manure and with half the recommended fertilizer).

References

Gomez J.A., M.G. Guzman, J.V. Giraldez, and E. Fereres. 2009. The influence of cover crops and tillage on water and sediment yield, and on nutrient, and organic matter losses in an olive orchard on a sandy loam soil. Soil & Till. Res. 106: 137–144.