Soil & Tillage Research 180 (2018) 204–209

Contents lists available at ScienceDirect

Soil & Tillage Research

journal homepage: www.elsevier.com/locate/still

Short communication

Celery harvesting causes losses of soil: A case study in Turkey

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ARTICLE INFO

Keywords:
Soil erosion
Soil loss due to crop harvesting
Soil degradation
Celery
Soil nutrient losses

ABSTRACT

Soil loss due to crop harvesting (SLCH) could contribute to the total soil loss, but the extent of such losses could vary among root crops. While many have studied SLCH with different crops, studies on SLHC for celery are unavailable. Thus, we quantified SLCH of celery (*Apium graveolens* L.) in northwest Turkey, a region with 19% of celery production in Turkey. We also studied the factors influencing SLCH and the cost of nutrients lost with soil due to celery harvesting. Soil loss due to manual celery harvest ranged from 1.41 to 8.52Mg ha^{-1} harvest^{-1} with an average value of 4.00 Mg ha^{-1} harvest^{-1}. Clay, lime, organic matter, and soil moisture content explained about 35% of the variation of SLCH. The estimated annual cost of nutrient lost with soil was US$ 6.18 per hectare. The significant soil loss due to celery harvesting should be taken into account when estimating total soil erosion.

1. Introduction

Soils provide numerous services including food production, regulation of water and air quality, C and nutrient cycling, and maintenance of biodiversity, among many others (Keesstra et al., 2016). Soil erosion is one of the factors that can negatively affect the critical role of soils in sustainable agriculture. Intensive agriculture is the leading anthropogenic process that causes soil erosion. Soil loss due to harvesting of potato (*Solanum tuberosum* L.), sugar beet (*Beta vulgaris* L.), carrot (*Daucus carota* L.), radish (*Raphanus sativus* L.) and celery can be important components of total soil erosion. During the harvesting of tuber and root crops, soil adhering to the roots along loose soil or clods is exported. Soil loss due to crop harvesting (SLCH) is far from negligible (Ruysschaert et al., 2004; Parlak et al., 2016; Poesen, 2018). The SLCH rates vary significantly in space and time depending on a range of factors (i.e. soil properties, crop type and characteristics, agronomic practices, harvesting techniques, and post-harvest treatments (Ruysschaert et al., 2004)).

While many have studied SLCH with different crops, information on SLCH for celery is limited. Celery roots and leaf stalks are consumed as vegetable. Celery is poor in carbohydrate and portion with protein but it is rich in vitamin A, B, C, and minerals, which are essential to human nutrition and health (Vural et al., 2000). In 2016, 18,981 Mg of celery were produced in Turkey from 8,828 ha of land area (TUIK, 2017). This present study was conducted to determine: 1) soil loss due to the harvest of celery, 2) factors affecting soil loss with celery harvest, and 3) cost of nutrients lost with soil due to celery harvesting.

2. Materials and methods

2.1. Description of the study area

This study was conducted in Geyve town, which is located on south of Sakarya province on east of Marmara Region (northern west Turkey; Fig. 1). The study site is located between 40° 30′- 40° 45′ north latitudes and 30° 13′–30° 29′ east longitudes. According to the Geyve meteorological station (1950-2005), the mean annual precipition is 640.3 mm and mean annual temperature is 13.9 °C (DMI, 2005). Agricultural practices in the study region mostly include viticulture, fruit culture (*Malus communis* L., *Cydonia oblonga* L., *Prunus persica* L., and *Prunus avium* L.), vegetable culture (mostly celery) and cereals (Aktas, 2011). In 2016, about 19% of root celery production of the country was in Geyve town of Sakarya (TUIK, 2017). Celery seedlings are planted between April and July. Row spacing is 50–60 cm and on-row plant spacing is 30-40 cm. Harvest is performed between November and February either through manual pull-out or with knives to cut the plants. Tinny roots and unmarketable old leaves are removed from the harvested plants. According to the World Reference Base for Soil Resources, soils in the study region were classified as Calcaric Fluvisol (Jones et al., 2005) with various textural classes including silty clay, silty clay loam, clay loam, and silty loam.

2.2. Sampling methodology

Soil and celery plants were sampled manually from the

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https://doi.org/10.1016/j.still.2018.03.011
Received 11 January 2018; Received in revised form 6 March 2018; Accepted 14 March 2018

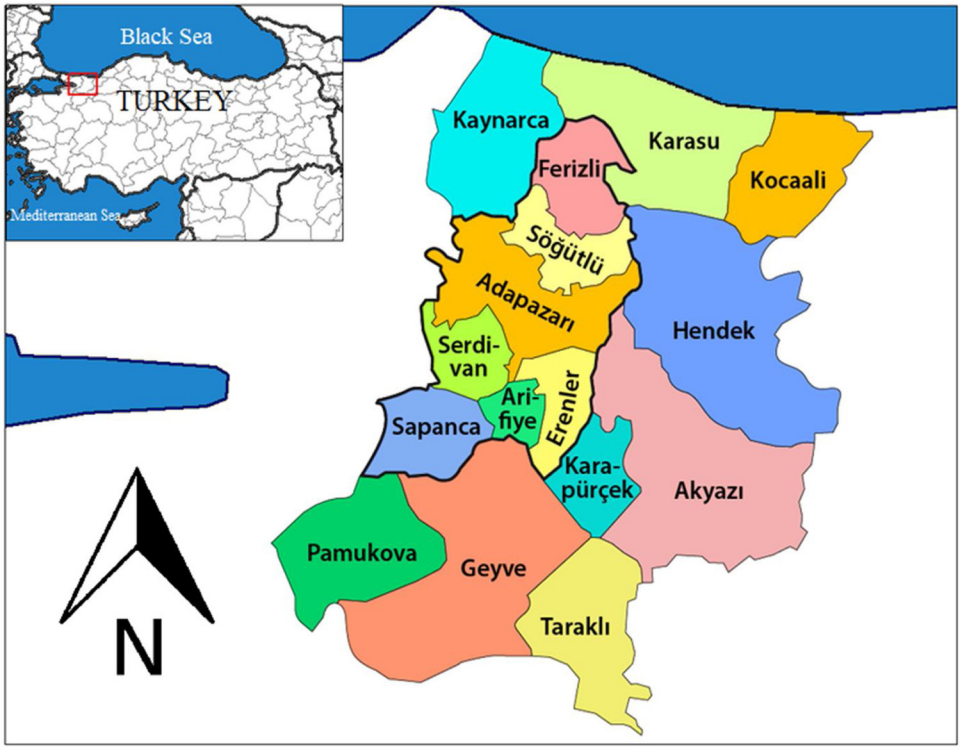

Fig. 1. Map showing the study area located in northwest Turkey.

Fig. 2. A. Manual celery harvest **B**. Celery wash up **C**. Celeries waiting for wash up in trailer **D**. Soils left and accumulated in washing facility after manual celery harvest.