Red pepper coverage effect on soil erosion by different transplanting dates

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Abstract

The study was carried out to evaluate the crop coverage effect on soil erosion as affected by different transplanting times under heavy rainfall. It was conducted at lysimeters having slopes of 15%, and length of 5 m, width of 2 m with three soil textural types, which were transplanted red peppers (*Capsicum annum* L.) on May 4(RPI), 15(RPII), and 25(RPIII). Crop coverage for the plot was calculated by NDVI and crop heights measured at interval of 7 days. After the rainfall event, the runoff volume and soil erosion from the each plot was measured. Under heavy rainfall over 100mm, crop coverage of red pepper and soil erosion ratio were related (p<0.05), depending on textural types. The coverage effect of red pepper transplanting time on runoff was different according to EI_{30}, rainfall with under 100 MJ mm /ha/h EI_{30}, affected runoff, but over 100 MJ mm /ha/h EI_{30}, it was not effective. Red pepper coverage effects on soil erosion partly depend on soil texture, and red pepper coverage effects on runoff depend on rainfall types.

Key Words

Soil erosion, crop coverage, soil texture, rainfall, red pepper.

Introduction

Upland in Korea is mainly slope land, and there is much heavy rainfall in summer, causing soil erosion. The surface coverage effect by crops is effective in protecting soil erosion. It could be that soil surface cover by vegetation increases infiltration of rainfall by increasing porosity, decreasing the striking power of falling raindrop and velocity of flowing water and consequently diminishes runoff and soil loss (Wainwright *et al.* 2000). In this study, our aim was to investigate the effect of red pepper transplanting time and coverage on soil erosion under lysimeters.

Materials and methods

The study was conducted at the lysimeter of the National Academy of Agricultural Science (NAAS) from May to August, 2009, which had 15% slope with length of 5m, width of 2m, having three textural type, clay loam, loam and sandy loam. Red pepper(*Capsicum annuum* L.) were transplanted on May 4, 15and 25, indicated 'RPI', 'RPII', 'RPIII' respectively. After each rainfall event, runoff volume and soil erosion of each plot were measured. Rainfall data were obtained from meteorological information portal service system. EI_{30} was calculated using RUSLE (Renard *et al.*1997). The procedure was:

$$EI_{30}= \Sigma(KE \times R) \times I30 \ (MJ \ mm \ /ha/h)$$

$$KE=0.119+0.0873 \log I$$

Where KE is the kinetic energy (MJ/ha/mm), R is rainfall amount(mm) and I is rainfall intensity(mm/h). Canopy cover which is a RUSLE subfactor was calculated by using Normalized Difference Vegetation Index and canopy height estimated at intervals of 7 days from the lysimeter plot. As crops grow, the value of NDVI is higher and canopy cover is lower. Relationships between canopy cover, soil erosion ratio and runoff ratio were analyzed by using SAS statistics.

Results and discussion

Rainfall Events were classified as two types on the basis of EI_{30}. There were 2 events of type one (I) rainfall for which EI_{30} was lower than 100 MJ mm /ha/h, 131 mm in rainfall, 79.43 MJ mm /ha/h for EI_{30} and 145 mm in rainfall, 67.01 MJ mm /ha/h for EI_{30}, respectively. Type(II) rainfall was higher than 100 MJ mm /ha/h EI_{30}, i.e., 273.5 mm rainfall, 303.34 MJ mm /ha/h for EI_{30} and 101.3 mm in rainfall, 139.88 MJ mm /ha/h for EI_{30}. For this time crop coverage range was 16.8-58.3% on the plot with clay loam soil, 13.3-58.3 on the plot with loam soil and 17.9-59.6% on the plot with sandy loam soil. Canopy cover was calculated using crop coverage and crop height. Soil erosion ratio and canopy cover were correlated, but not having high R-Squared, but when sorted by texture, they were correlated having higher R^2. Soil erosion ratio to plot with

bare soil was higher with canopy cover for the plot with clay loam soil. Soil texture had an influence on crop coverage effect on soil erosion under heavy rainfall over 100 mm. Runoff ratio for a plot with bare soil and canopy cover were not correlated, but on being sorted by rainfall type, they had relationship for rainfall type (I). Under the rainfall type(II), they had no relationship. It was anticipated that crop coverage by red pepper was not effective in reducing runoff under heavy rainfall, higher than 100 MJ mm /ha/h EI_{30}.

Table 1. Regression of soil erosion ratio(Y) with canopy cover(X) and runoff ratio(Y) with canopy cover(X) according to different textures and rainfall types. Soil erosion ratio means that eroded soil mass of RPI, RPII, RPIII divided by that of bare soil. 'Rainfall type I' is under 100 MJ mm /ha/h EI_{30}, and 'rainfall typeII' is over 100 MJ mm /ha/h EI_{30}.

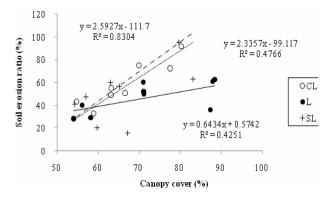|		Regression	R^2
Soil erosion		Y=1.47368x-44.85533	0.3543 **
Texture	Clay loam	Y=2.59205x-111.64204	0.8307**
	Loam	Y=0.64448x+0.49345	0.4264 (ns)
	Sandy loam	Y=2.33658x-99.18761	0.4770*
Rainfall	I	Y=0.97209x-27.64524	0.1148 (ns)
	II	Y=1.29047x-35.04603	0.3132*
Runoff		Y= 0.56479x+ 47.60506	0.0849(ns)
Texture	Clay loam	Y= 0.76025x+ 42.52626	0.2116(ns)
	Loam	Y=0.30103x+55.67837	0.0454 (ns)
	Sandy loam	Y=1.10190x+13.18546	0.1451 (ns)
Rainfall type	I	Y= 1.35040x -13.73805	0.3356*
	II	Y= -0.14044x+ 102.00995	0.0114 (ns)

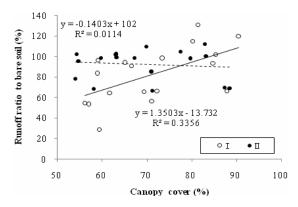**Figure 1. The effect of canopy cover on soil erosion ratio in plots with clay loam, loam and sandy loam soil.**

Figure 2. The effect of canopy cover on soil erosion ratio for rainfall types. Rainfall type II has the higher EI_{30}.

Conclusion

Coverage of red pepper with different transplanting times and soil erosion was related (p<0.01), depending on soil texture. Particularly the trend was higher for the plot with the loam soil than for other plots when under heavy rainfall. The coverage effect on runoff was different according to rainfall type. For rainfall under 100 MJ mm /ha/h EI_{30}, crop coverage by transplanting date was effective on runoff. For rainfall over 100 MJ mm /ha/h EI_{30}, it was not. Consequently, the crop coverage effect on runoff was related to rainfall, but more experimental data would be needed to set the critical point of EI_{30} provide to cover effect.

References

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